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Vol. 48 / No. 286

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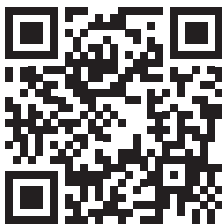
from the editor

Sawdust

The deeper you get into woodworking the more metalworking you do it seems. The drill press in my shop is about the same age as me. Recently, I replaced the bearings to give it a service life-extension program. It runs smooth, quiet, and more accurate. Disassembling the machine taught me a few lessons about machine construction, battling rust, maintenance, and why vintage tools are so durable. The task also revealed a few holes in my tool kit.

My ongoing desk project features a drop-front and a pair of glass doors. The hinges for these require some modifications and a change in the finish to get the look I'm after. None of these are complicated processes. The ingredients to success are patience and care. All pretty familiar to woodworkers.

NEW COURSES. As you've noticed, there's a lot more to Woodsmith than this magazine. One of the other projects we do is elearning courses. I had a new Advanced Router Table Techniques course launch a couple months ago. Our newest class on finishing is set for release any day now. To find out more, click 'Courses' over at Woodsmith.com or use the QR link below.



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Watch out. This one may get "borrowed" for inside use. Best to make a few of them.

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Library Chest on Stand 40

There's an illuminating story behind this bookcase. A bonus table works as a stand or small desk.

designer project

Bent Lamination Chair 48

You'll turn thin pieces of wood into curved shapes while you make this comfortable chair.

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Lidded Box 56

Take your box-making skills to another level. Applied details add interest and depth to the design.

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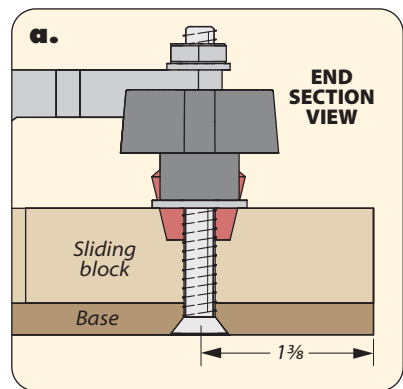
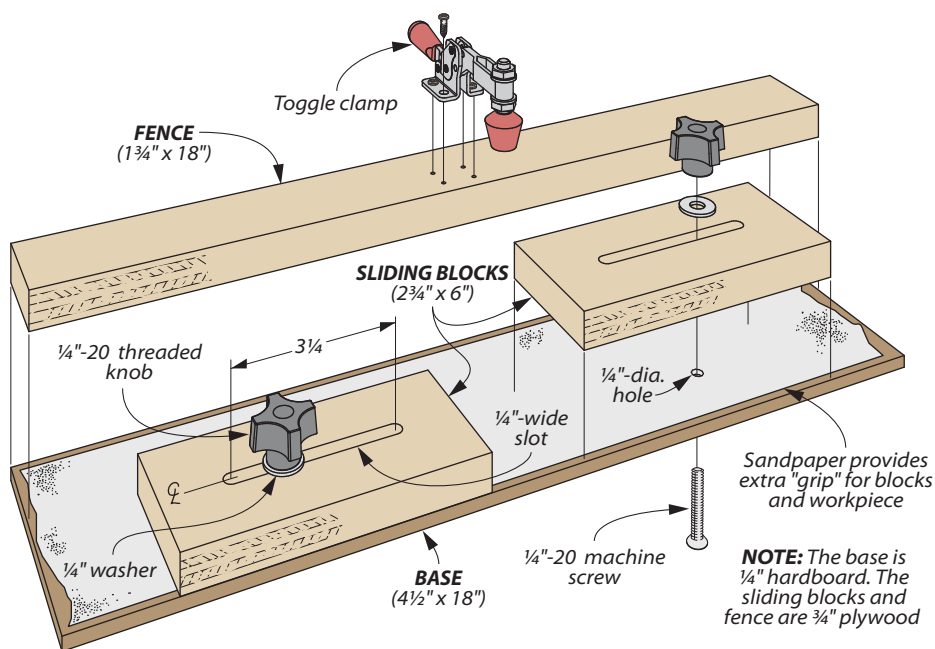
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READER'S Tips



▲ A pair of sliding blocks adjust to the width or length of the workpiece. A toggle clamp then secures it.



Small Part Routing Sled

Routing small parts always presents a bit of a tricky situation. There's rarely a good way to hold the workpiece for the cut that doesn't leave your fingers uncomfortably close to the bit. But, that doesn't mean the router is any less useful on small parts than big ones — which is where this sled comes in.

The sled starts with a hardboard base. A fence is glued along the back edge and a toggle clamp is attached to it, allowing me to quickly and easily secure the part for a cut. Sliding blocks are attached to the base by threaded knobs which run through slots, allowing them to be adjusted to the size of your workpiece.

The sled can be used with bearing bits (like the slot cutter you see above) or with the fence in place to register the workpiece. In either case, the added size of the sled will keep your fingers well away from the action, and allow you greater control over your cut.

*Phil Huber
Urbandale, Iowa*



Adding Dividers

Great ideas happen all the time in the shop. Unfortunately, sometimes those ideas come after I've already glued a project up. After I put together a new cart for my shop (pictured here), I suddenly realized I would rather have dividers to section off one of the cubbies. Rather than attempting to rout dadoes for the dividers into an already-assembled project, I decided to create them with some 1/4" plywood. After sizing them, I used spacers of the same material my dividers would be to locate the plywood, then pin nailed the pieces in place. The gaps between formed faux dadoes, and the dividers slid neatly in.

Quintin Long
Green Mountain, Iowa

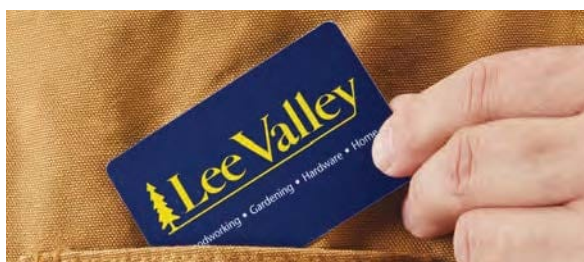
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▲ The cleats of the shelf fit around the lower stretchers of these sawhorses. The platform offers easy access to small tools while your workpieces rest above.

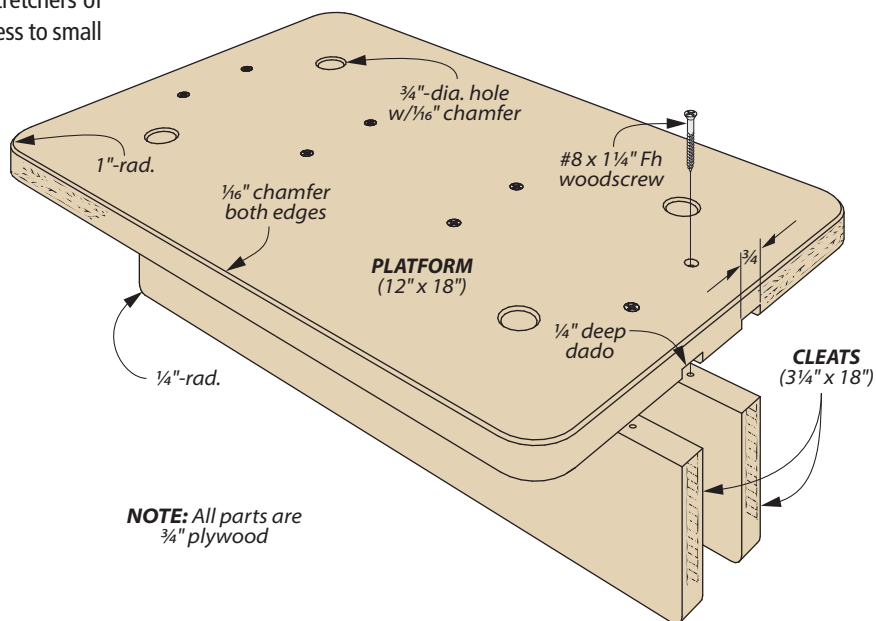
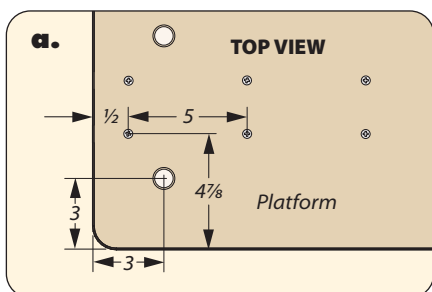
Sawhorse Shelf

A set of sawhorses I made from a design in *ShopNotes* 108 has been sitting around my shop for some time. I recently decided to make an addition to them.

The unique parts of these sawhorses are their thick stretchers. These provide some extra rigidity to the frames, but also served

as a place to saddle the shelf you see here. The shelf is a platform with two cleats beneath, meant to store a pencil, tape measure, or whatever else I might want on hand. I also added holes to let me hang the shelf on the wall.

*Jerry Christian
Clayton, North Carolina*



QUICK TIP



Panel Glueup Spacers. *James Stein of Muskegon, MI* uses rare earth magnets to keep the bars of his bar clamps off of the squeezeout during panel glueups. The thin magnets lift the bar just enough to still allow for solid clamping pressure, plus they stick right to the bar when it's time to take the clamps off.

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QUICK TIP



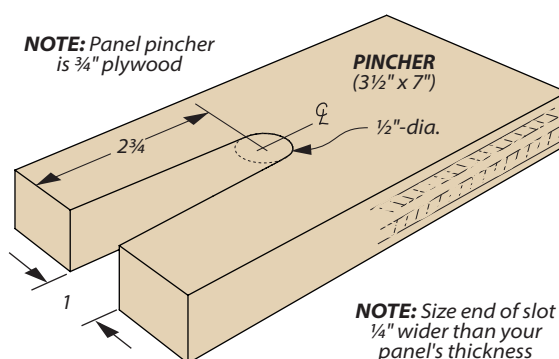
Magnet Board. Chris Hennessey of Des Moines, IA had a unique idea for sticking often-used items in an easy-to-access place. He screwed a thin sheet of steel to a piece of plywood attached to his shop wall, then attached the items using magnets. Nitrile gloves, small bags of hardware, and even his keys all fit the bill.

Panel Pinchers

During a panel glueup, you not only need to finagle bar clamps across the width, but you also have to attach F-clamps and cauls to keep the ends of the boards aligned. It can be stressful to make sure all the clamps are positioned right before the glue sets, so I made an easier solution.

These little "pinchers" fit around the joining ends of the boards. They have tapered slots, which pull the ends together as they're tapped on. Make sure to add a layer of paste wax beforehand though so your pinchers don't end up joining the panel.

Eric Dixon
Glendale, Arizona



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Comments & Questions



CHESSBOARD FINISH

Hi Woodsmith,

I am completing the chessboard from Issue 83. I built some in the past, but do not remember the finish I used on them.

I used cherry for the base and frame that holds the chessboard. Hope you are able to advise me what finish would work to protect the board and look good.

Thanks!
Allen Arcand

Hi Allen,

Thank you for writing in. The issue 83 chessboard is a beauty. I don't know the exact finish used on the project in the article, but I do know that wipe-on oil-based finish was popular here at Woodsmith when I started back in 2000. At that time, and now, we used General Finishes Seal-a-Cell. I do think

that oil-based finishes, be it a wipe-on finish or a brush-on varnish offer the best protection for a surface from dirt, skin oils, and accidental spills.

I have become a fan of water-based finishes for my remodeling projects around the house, but water-based finishes don't impart any depth to hardwoods like cherry and walnut, and can be rather thick. The chessboard floats in its frame to allow for wood movement, so a thick finish can "glue" things in place and prevent free movement. An advantage of a wipe-on finish is that the film build-up is thin, so the finish will not cause difficulties with the close tolerance fit of hinges and hasps or prevent wood movement. So, all that said, I'd use 3 to 4 coats of wipe-on oil-based finish for a durable, thin, and easy-to-apply coating.

All the best,
Chris Fitch
Creative Director/Woodsmith

of a safety stop. That's just a guess on my part because I have seen flats on the back of rocking chair rockers, and they do put a bit of a stop to the rocking motion if you get a bit over-enthusiastic with your rocking.

All the best,
Chris Fitch
Creative Director/Woodsmith

COMBI-CORE PLYWOOD

In the "Stacking Sawhorse for a Small Shop" video, Phil is using a "combination-core plywood" there at Woodsmith.

What would this be called, in order for me to find it?

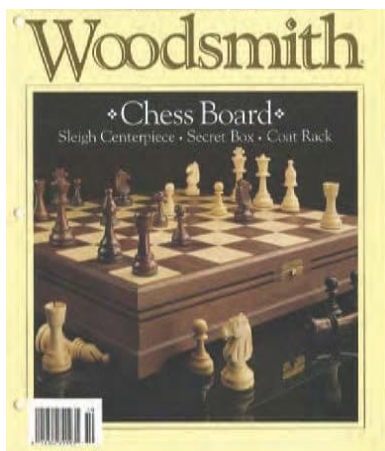
I would like to try this for a "proof-of-concept" speaker cabinet design I'm working on. Phil says it's much lighter in weight.

Regards,
Kevin

Hi Kevin,

Thank you for writing in with your question. The product that Phil used commonly goes by the name "combi-core plywood." It is available unfaced (MDF) or with a face of wood veneer.

Combi-core plywood has several advantages over MDF and all veneer-core plywood. Combi-core plywood is lighter than MDF-core plywood. While MDF-core plywood offers excellent surface quality and is uniform in thickness, it is



WHOA HORSEY

Gentlemen,

Why are ends of rockers on rocking horses flat?

Jack Jones

Hi Jack,

Thank you for writing to Woodsmith. Well, that's an interesting observation. I can only think that the flat on the ends of the rockers make it more difficult to rock too far and flip the horse back — kind



darn heavy and makes furniture projects difficult to handle. Also, MDF-core plywood suffers from long term “sag” issues and must be well supported.

Combi-core plywood is less expensive than all veneer-core plywood and is more readily available.

Combi-core plywood offers better surface quality than all veneer-core plywood. Voids and variance in veneer thickness can telegraph through to the surface — having a uniform core of MDF

helps minimize these issues.

Combi-core plywood has better screw holding and strength qualities than MDF-core plywood.

Here is a link to Columbia Forest Products for a description of their combi-core products.

You might be able to have a local lumber yard special order combi-core plywood but the best



approach would be to call a lumber/sheet goods distributor — they will know exactly what you are talking about. We use www.LibertyHardwoods here in the Des Moines area.

All the best,
Chris Fitch
Creative Director/Woodsmith

DOWEL CENTERS

I just read “How to find the center of a dowel.” I use what I think is a much easier and faster way to find the centers of a number of dowels, especially if you’ve already drilled the correct-sized hole in a piece of scrap wood. (I generally use a cutoff piece of a 2x4).

Since any drill bit has to be centered around its point, simply put the dowel part way into the hole, the drill bit into the other side, and tap the drill bit lightly with a mallet to mark the centerpoint of the dowel — quick, simple, and easy.

John Dean

Hi John,

Thank you for writing in and sharing your method of finding the center of a dowel. It sounds like a winner to me — easy and foolproof.

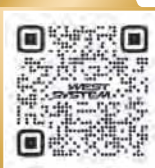
All the best,
Chris Fitch
Creative Director/Woodsmith



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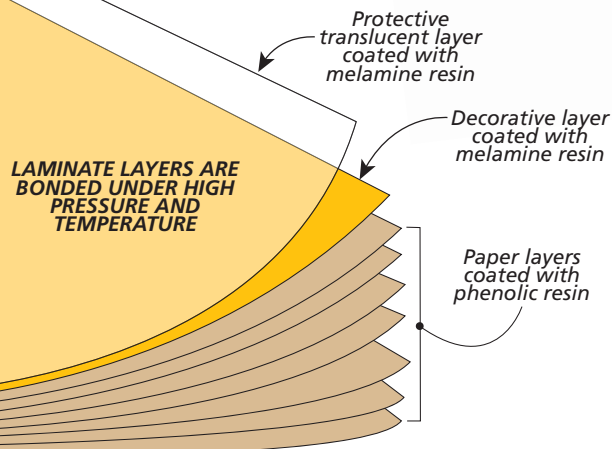
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STABLE SUBSTRATES

Working with laminate starts with selecting the right substrate — that means one that doesn't move with seasonal humidity, is flat, and has a smooth surface that promotes a strong adhesive bond. MDF is the clear winner as it has each of these three qualities, and it comes at a good price. When strength and resistance to long-term deflection are issues, use high-quality plywood such as Baltic birch.

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▲ **Step 1.** With an auxiliary rip fence fit tight to the saw's table, use a push pad to help feed the thin laminate and keep it flat.



▲ **Step 2.** You don't need to be fast but you need to be thorough. It's a good idea to double-coat porous materials like MDF.

CUTTING THINGS DOWN TO SIZE

The easiest way to cut laminate is at your table saw — with some preparation. Plastic laminate is brittle; to prevent a ragged cut use a fine-toothed blade, such as a crosscut blade, and a zero clearance insert.

When sawing, laminate can “climb the blade.” Setting the blade at a height of about 1½” will help prevent this.

Plastic laminate is thin and can slip under the fence, binding as it is fed through the saw. Prevent this by clamping an auxiliary fence, held tight to the table, to your fence for a gap-free fit as in Step 1.

Large and floppy, laminate sheets are awkward to handle, so clear the deck around your saw, set up supports and recruit a helper before powering up.

When sizing the plastic laminate, give yourself some extra room, allowing an inch extra on all sides. Edging can be cut ½” wider. This extra room means you don't have to be perfect when gluing the laminate in place.

ADHESIVES FOR LAMINATE

Most glues will adhere to laminate, but the best choice for ease of use and production efficiency is contact cement. Solvent-based contact cement is a time-proven choice for laminate work, but it must be used with excellent ventilation as the fumes are both flammable and toxic. At the *Woodsmith* production shop, we use water-based contact cement to avoid the fire hazard and fumes, but ventilation is still required. If you are building a small project and want convenience, consider contact cements

that come in aerosol cans.

Before you apply the adhesive take this advice — Keep Things Clean! A bit of sawdust or a laminate chip on any of the surfaces will prevent the laminate from laying down — and with laminate work, there really isn't any fixes for mistakes, you just have to start over.

STICKING IT DOWN

Contact cement is applied to both the laminate and substrate (see Step 2). A foam brush works for small areas; a foam roller is best for larger projects. Let the adhesive dry until it is no longer tacky. Small pieces of laminate and edging can be positioned on the substrate by eye. For larger pieces, we need some help to get the laminate in the correct position and not stuck down until you are ready. Wood dowels spaced evenly over the



▲ Safe, water-based contact cement and convenient aerosol adhesives are good choices for the shop.



▲ **Step 3.** With the laminate aligned over the substrate, start at one end, removing the strips in order and pressing down on the laminate with your hand.

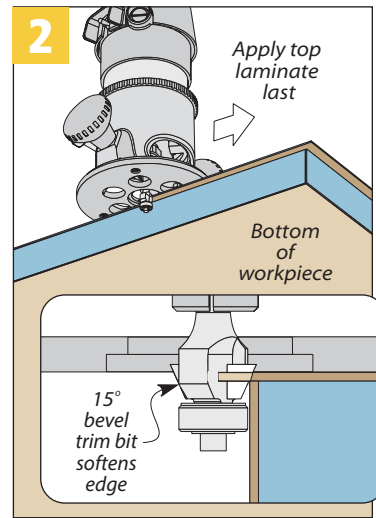
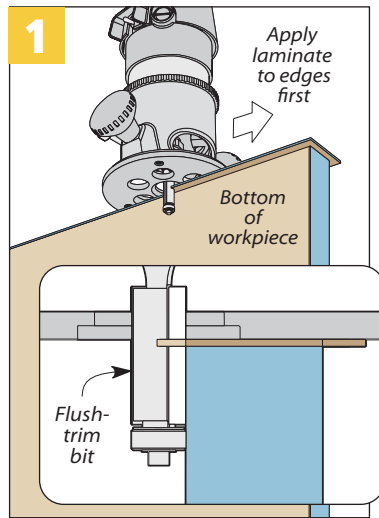


Step 4. Before flush trimming the laminate (inset photo), use a roller to make sure it's well adhered.



▲ **Step 5.** A palm router is the tool for trimming laminate. Use a flush-trim bit for edging and a 15° bevel-trim bit for edges that overhang.

substrate keep things separated and allow for accurate positioning of the laminate. Once the laminate is in position, pull out the first dowel starting at one end, or the center for large projects, as shown in Step 3. Press the laminate down gently with your hand. Now work towards the other end, removing one dowel at a time and pushing the laminate down and towards the far end to make sure there is no buckling of the laminate.



▲ Downward and outward strokes of a flat mill file make smooth edges.

As shown in Step 4, use a roller and firmly apply pressure to the entire surface to completely bond the contact cement. If you don't have roller, tap down the surface with a smooth block of wood and hammer.

ROUTING & FILING

The final step is to trim and smooth the overhanging laminate. Edging can be trimmed to

size with a flush-trim bit while face sheets should be trimmed with a bevel bit to ease the edge and prevent chipping. Finally, use a smooth cut mill file to smooth any overhanging material and soften the edges.

Plastic laminates are easy to apply and readily available. So if you haven't worked with them yet, give them a try and expand your workshop's capabilities. **W**



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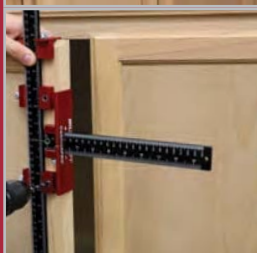
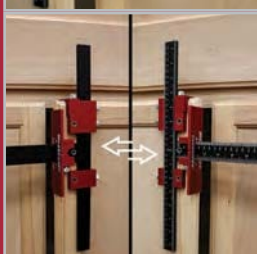
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Oliver's New 10080 8-in. Benchtop Jointer

The new 10080 benchtop jointer includes features typically found on Oliver's floor-standing jointers—features like an HCX helical cutterhead, cast-iron fence and tables, a 2-hp universal motor, and a built-in chip-evacuation blower. These features, in addition to Oliver's well-known build quality and long service life, make the new 10080 a standout in the benchtop jointer space that really has no competition.



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Jointer, Jig & Clamps



Getting to review tools offers a nice opportunity to try new things, even when I might not normally be inclined to. A benchtop jointer sounded like an odd idea — then I got to try out the one you see here. On the following pages, I'll discuss a neat drawer jig and a unique set of clamps. I'm often one to "make do" with what I

have, and my usual suspects of clamps could do the jobs of these tools fine. But, after giving them a chance, I have to admit they impressed me. I encourage you to take a look — you might just find them worth your time, too.

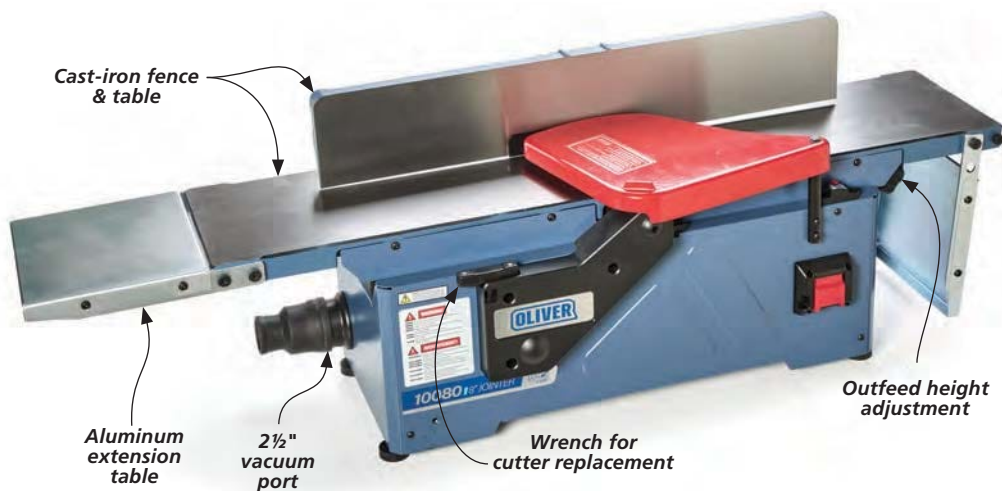
OLIVER BENCHTOP JOINTER

Our first product for the issue is the jointer shown on this page

and the next. This comes from the *Oliver Machinery Company*. Oliver is an old brand, started by its eponymous founder, Joseph Oliver, in 1890. Their claim to fame came in 1908 with the introduction of the cylindrical cutterhead, which offered a significant reduction in both tearout and workplace amputations over the former square cutterheads.

Today, *Oliver* still produces large-scale tools and machines, but they've expanded into making products for home woodshops as well. This brings us to the subject of this page and the next: their "benchtop" jointer.

FUNCTION & PERFORMANCE. The jointer you see here offers 8" of table width and 56" of length (with the extension wings) to support longer workpieces. A two-horsepower motor runs a helical cutterhead. Each of the carbide cutters has four-edges, and can be rotated as they dull.





▲ Aluminum extension wings can be flipped out to support longer workpieces. With the wings out, the jointer offers 56" of table length.



▲ The helical cutterhead of this jointer contains four-edged blades, which can be rotated as they dull. The dots in the corner indicate which sides have been used.

In practice, I find this machine covers a good deal of my workpieces. The length is sufficient for most boards, and 8" covers most material until you start getting into glued-up panels. Helical cutterheads seem to have become the standard option for jointers, as well, and it's a welcome feature. It's nice to simply rotate cutters as they dull, and I find the helical heads are less prone to sniping and tearing out. Of course, the real selling point of this jointer is its size.

A BENCHTOP OPTION. What precisely constitutes a benchtop tool? To me, it's one that can be used while sitting on top of your bench. Seems simple enough, right? You may already see where an issue arises. On a standing jointer, the table tends to be around 32" off the floor — which is also where most workbenches stand. On this jointer, the table is about

12" tall, which means that on a workbench the table will end up being about chest height. Instead, an ideal stand for this tool would be around two feet tall, and *Oliver* offers a rolling companion stand at that height for \$250.

ASSESSMENT. Now, none of this is meant to detract from the tool itself. The "benchtop" discussion here is largely semantic. Admittedly, "benchtop jointer" sounds better than just "short jointer," even if it is a bit of a misnomer.

The important sizes to consider on this machine are the table and the motor. I've discussed the table, but you should consider the motor as well. You aren't likely to notice much difference between this model and a 3HP jointer when you're edge-jointing, but

you may when face-jointing. If you're taking off $\frac{1}{16}$ " of material on a 7" or more board, the motor may start to bog. However, I never had any issues when the depth stayed at $\frac{1}{32}$ ".

The small model has its advantages. It can be mounted on a rolling cart and plugged into a 120V outlet. The big one, though, is the price, at half that of a standing option. And that might just make the smaller model worth it.



▲ The benchtop jointer offers up to 8" of width, which allows me to face-joint most pieces I work with. The 2HP motor can limit your depth of cut on workpieces that approach the max width.

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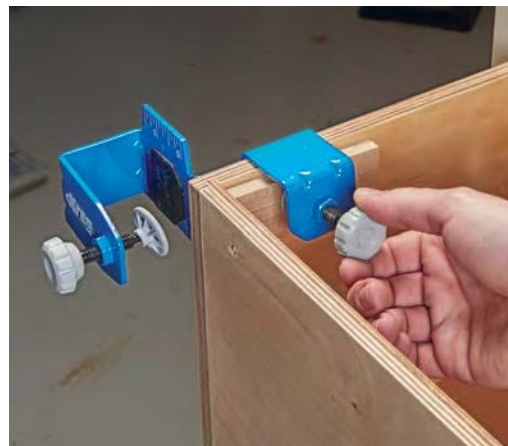
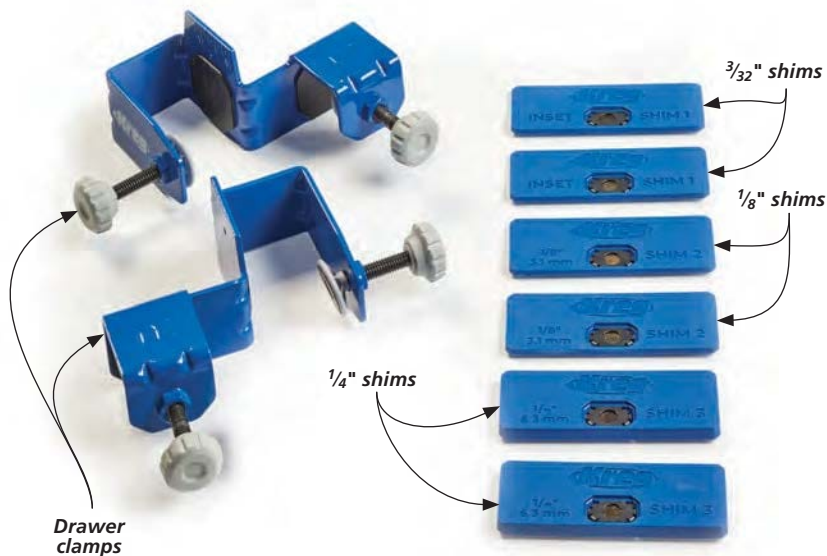


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▲ The inner clamp of the jig secures to the side of the drawer. After you place the false front, the outer clamp tightens down to hold it.

KREG DRAWER JIG

An omnipresent annoyance with false fronts is ensuring they stay square to the drawers they're being attached to and evenly spaced from the other false fronts of the project. The job on its own isn't too hard, but minor shifts are easy to have happen when you tighten the clamps down, which means realigning the front and retightening the clamp. This is where our second piece of gear in this issue comes in.

I first encountered this jig (made by Kreg) when our shop manager, Marc Hopkins, was adding false fronts to the drawers on some cabinets. He'd come across the jig the previous week and decided to give it a try. Turns out, it's pretty slick.

There are essentially three parts to the jig. The jig comes in when you've installed your drawers in their case, but before you've attached the false fronts. The inner clamps first tighten onto the sides of the drawers.

Next, a set of shims comes in. These are placed on either side of the false front to support it, either on your workbench (for the lowest false front) or on the top edge of the front below the one you're installing. There are seven shims in total: two at $\frac{3}{32}$ ", two at $\frac{1}{8}$ ", two at $\frac{1}{4}$ ", and a large $\frac{3}{4}$ "-thick shim. This means your front spacing can be anywhere from $\frac{3}{32}$ " to $\frac{27}{32}$ ".

The last step is to set the false front on the shims and clamp it down with the outer portion of the jig. There's a ruler on this outer portion that indicates how far the edge of the false front is from the edge of the real front, allowing you to ensure both sides are set evenly. Once these outer clamps are tight, you can screw your false front in place. All in all, this jig offers an easy solution to a common challenge, and the set that includes both the jig and the shims is a good use of \$50.

WOODPECKERS PANEL CLAMPS

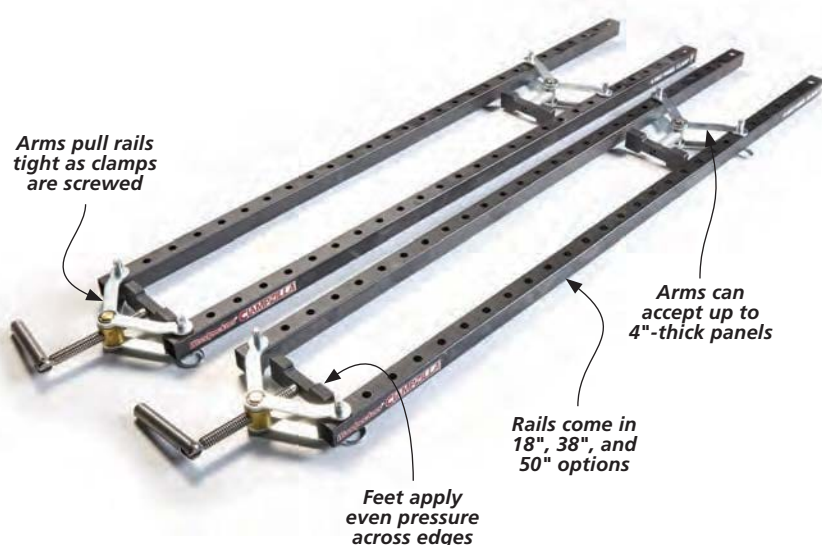
If you make any projects of a medium to large size, then chances are your process begins

- ◀ To use the jig, select the shim (or combination of shims) for the spacing between your false fronts. Set the front on top and clamp it in place, then pull the drawer out to screw the false front on.





▲ Screws on the clamps tighten them around the panel. The feet of the clamps provide pressure to the edges, while the rails sandwich the boards along their faces.



with panel glueups. Gluing up panels isn't a difficult task, but it can be a tedious one.

Our final product here seeks to solve that issue. These panel clamps are from *Woodpeckers*, and the idea is that as the screw is tightened, the foot applies pressure evenly along the edge (replacing bar clamps) while

the arms pull the rails across the faces (replacing F-style clamps to keep the boards aligned).

The initial setup takes some time. Boards need to be slid between the rails and feet, and the arms need to be positioned on the rails so the screws are near enough to be tightened down. Nonetheless, they work great

from there. Glue can be applied after everything's in place, and tightening the clamps is a cinch. The clamps can be purchased in sets of four or individually, and come in three lengths. The price on these can be a bit steep, but if panel glueups are common in your shop, these clamps are worth your consideration. **W**

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Playful Kitchen Hutch

Combine plentiful storage options, angles, and a sunny paint scheme and you end up with a neo-retro take on a classic furniture form.

Hutch, cupboard, press, standing dresser, Hoo-sier cabinet — whatever you call it, this type of storage piece has been around for hundreds of years and shows up in many different countries. Each era and region adds a unique twist that's fun to explore. Creative Director Chris Fitch scooped up inspiration from a not so distant time and place for his version.

Post World War II southern California was changing dramatically. There was a need to outfit homes with good-quality furniture and avoid high-priced materials. There was also a move away from previous dark and heavy looking furniture styles. Plywood, paint, and plastic laminate gave folks a change of pace.

History doesn't always repeat, but sometimes it rhymes. Plywood (along with MDF) is still a great way to build pieces quickly with an eye on your budget. Chris selected alder plywood (and solid wood) because it offers a warm color without being too dark ... or as costly as cherry. A blue and yellow paint scheme complements the wood tones. However, this offers you a chance to personalize the look to suit your tastes.

From a workshop perspective, there's plenty to hold your interest. The joinery is a master-class in grooves, dadoes, and rabbets. Throw in some template routing, drawer building, and a clever solution to the sliding doors and you have a lot to look forward to.

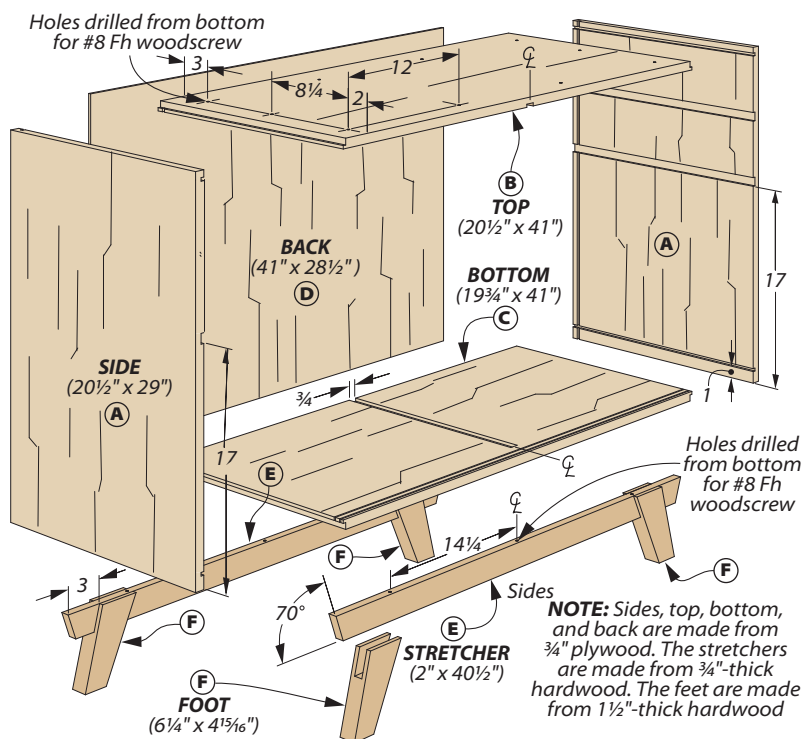
- ◀ Angled feet and stretchers lift the hutch off the floor and add to the modernist appeal. The warm, not-too-dark alder provides a calm backdrop to the painted surfaces.



▲ Full-extension drawer slides not only keep items from getting lost. They also operate smoothly even when heavily loaded. The drawer fronts overlap to conceal gaps.



▲ Painted, sliding doors conceal large storage spaces in the case above and down here at the bottom. A clever solution keeps them running smoothly.



Simple Joinery, PLYWOOD CASE

The drawing above shows the starting point, the shell of the lower case and the stand it sits on. There's a lot going on (just take a peek at the next page), so we need to get cracking.

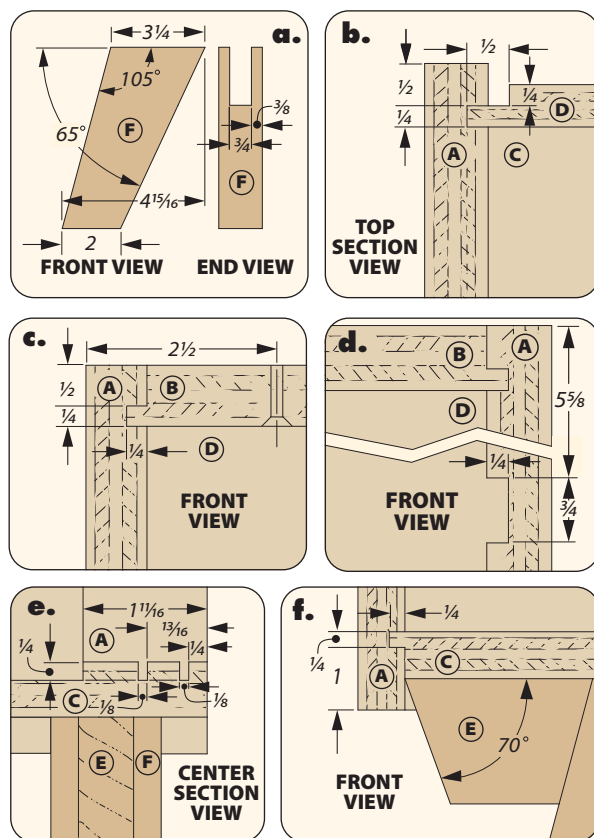
ESSENTIAL JOINERY. This case is proof positive that joinery details like dados, rabbets, and grooves take you far in your woodworking. The sides begin

with a narrow dado at each end for the top and bottom, as shown in details 'c' and 'f.'

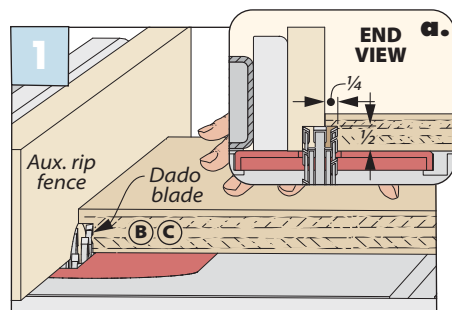
Full-width dados allow dividers to slide into place after the main case is glued up (main drawing and detail 'd'). Take note that the dados aren't the same in each side. The case back is housed in a groove cut along the back edge, as in detail 'b.'

TOP & BOTTOM. The top and bottom have a tongue formed on each end to fit (snugly) into the dados in the sides, as in Figure 1. Then they go their own way. The top has a centered dado and a groove to hold the back. Pause the joinery to drill some pilot holes for woodscrews.

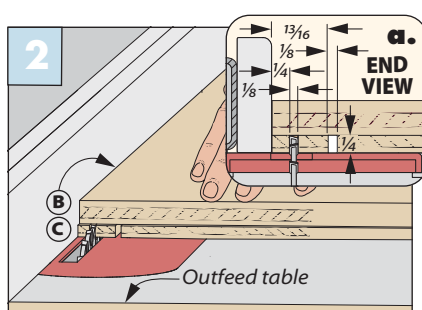
The bottom is narrower than the top, which allows the back



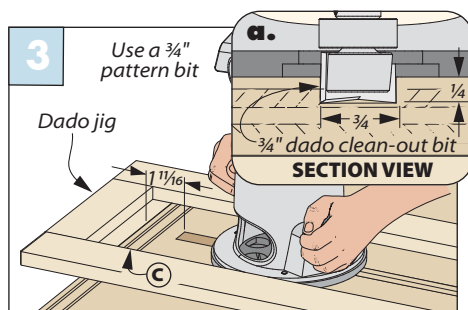
RABBETS & GROOVES



Tongue & Dado. A short tongue on each end of the top and bottom fits into a dado in the case sides.



Door Grooves. A regular blade forms a narrow groove for the sliding doors.



Stopped Dado. Make a frame that matches the width of your router base for a versatile dado jig.

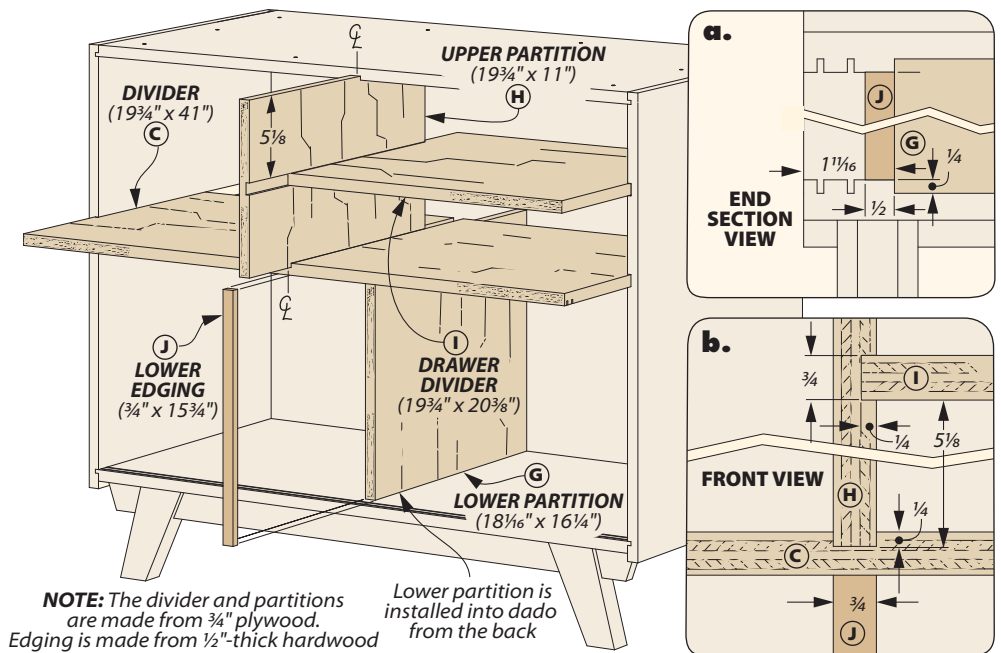
panel to slide into place from below. A pair of grooves run along the front edge (detail 'e'). These are for the lower set of sliding doors. Cut these at the table saw, as shown in Figure 2.

The bottom does have a centered dado to match the one in the top. However this dado stops short of the grooves. This calls for a change in tooling. Figure 3 shows a simple frame that guides a hand-held router to make the cut and stop it right where you want. Then glue up the sides, top, and bottom.

Take a look at Figure 4 to see the setup for cutting the rabbets on the back panel. The resulting tongue should slide easily in the grooves in the case sides. We need to leave it out of the case for the time being.

FEET. The case stands on a set of feet and stretchers. The ends of the stretchers are angled (detail 'f'). The stretchers are sized to slip into the recess at the bottom of the case.

The feet receive a notch to slip over the stretchers before they're cut to size, as in Figure 5. The grain on the feet runs side to side to match the stretcher. I cut the angled sides of the feet at the band saw. Detail 'a' on the previous page has the dimensions and angles. Remove the blade marks



and smooth the edges with a block plane or edge sander.

Glue the feet to the stretchers. The location is shown in the main drawing on the previous page. Then attach the assembled pairs to the case with long woodscrews.

INTERIOR DETAILS

The inside of the case is divided to organize the space and provide for the different storage solutions. Dadoes do all the work. The pieces slide into place one at a time. I aim for the parts to slide with a firm push.

The first piece to make is the large horizontal divider. It features a set of narrow grooves for doors on the underside that align with those in the bottom.

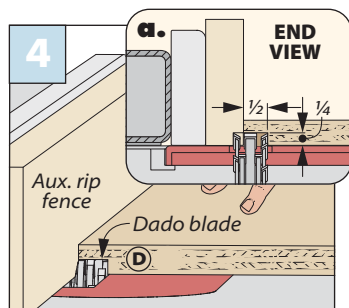
Each face of the divider has a centered dado. The top dado runs through. The one on the bottom face stops before it gets to the grooves, as in detail 'a.' Glue this piece into place.

PARTITIONS. The installed divider allows you to determine the size of the lower partition. It's cut to size based on the depth of the dadoes in the bottom and divider. Because of the stopped dadoes, this one slides into place from the back.

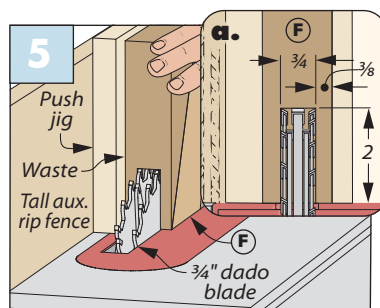
You'll notice that the parts get simpler as we go along. The upper partition has just one dado. It aligns with the dado in the right side of the case, as shown in the drawing above and in detail 'b.'

A drawer divider comes last for the panels. All you need to do here is cut it to size. At this point, you can slide the back into place, securing it with glue and screws into the various dividers and partitions. Finally, cover the front edge of the recessed lower partition with edging.

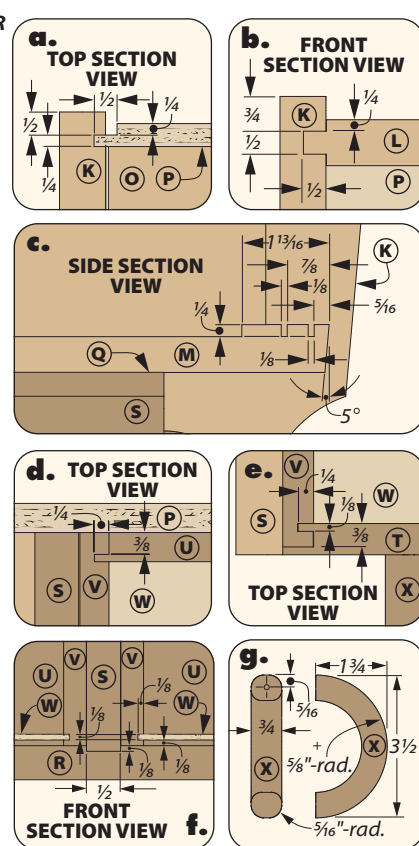
MORE JOINERY



Rabbets. A wide dado blade and an auxiliary fence allow you to dial in the exact width.



Foot Slot. While each foot is still a square blank, cut a deep slot across the top edge.



Onto the HARDWOOD

THE SIDES. The sides define the look of the upper unit. Joinery comes first though. The upper

The sides' profile involves a three-step process. First, I made a hardboard template to guide me.

FAMILIAR TERRITORY. The work on the cap, shelf, and divider repeats the steps you've already taken: more dadoes, rabbits,

a. SIDE SECTION VIEW

Start line

Waste

$\frac{1}{4}$ "

$\frac{3}{4}$ "

$\frac{1}{4}$ " straight bit

Align end of workpiece with layout line

2

$\frac{1}{2}$ " flush-trim bit

A Tongue. A rabbet cut on each face of a workpiece forms a tongue to fit into a dado.

and grooves (details 'a,' 'b,' and 'c'). The cap needs to be trimmed as in Figure 4 in order to join with the sides.

Wrap up your work with holes for adjustable shelves and making the back panel, as in detail 'a.' The case can now be glued up.

SET OF BINS. Tucked under the shelf sits a bank of bins. These fit into a case of cubbies joined with rabbets and dadoes, as shown in details 'd' and 'f.'

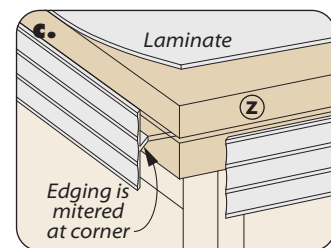
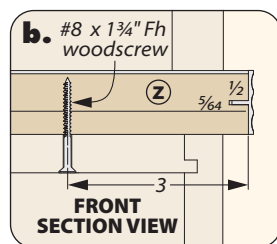
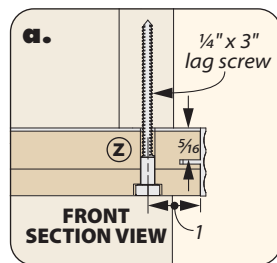
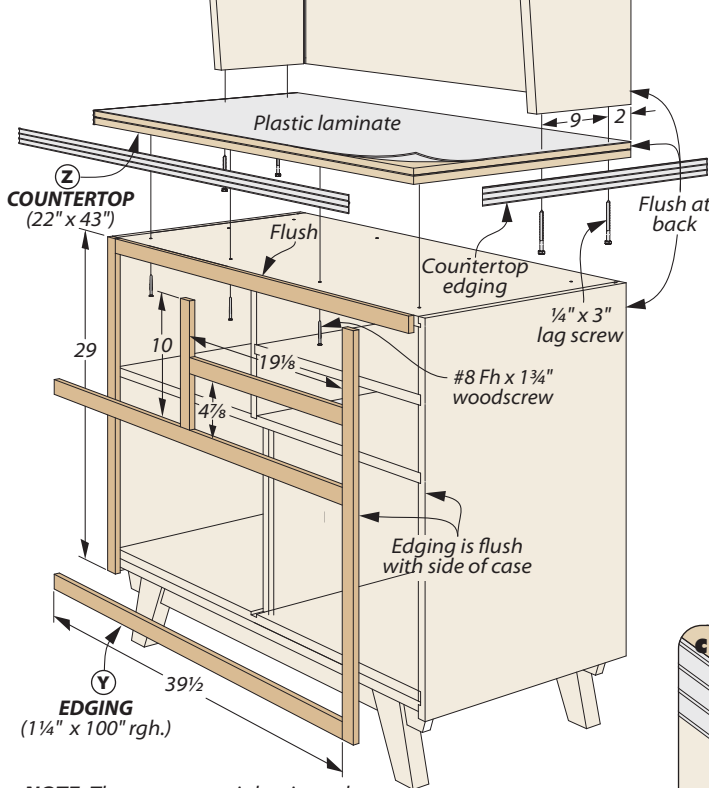
The bins are assembled with a locking rabbet at the front and a tongue and dado at the back (details 'd' and 'e'). Figure 5 below has the table saw setup for the front.

Instead of using a purchased pull, which you could do, I made a semi-circle pull from MDF. I drew the shape on an oversize blank. I cut the outer profile, sanded it smooth, and rounded the edges. From here, the inside is cut and shaped, as you can see in Figure 6.

TRIM & COUNTER

A few intermediate steps are necessary before the two sections can be joined. The drawing at right shows the parts that you need to make.

EDGING. To blend the plywood of the base with the solid wood of the top, conceal the front edges



NOTE: The countertop is laminated from one layer of 3/4" MDF and one layer of 1/2" MDF. The edging is cut from 1/2"-thick hardwood

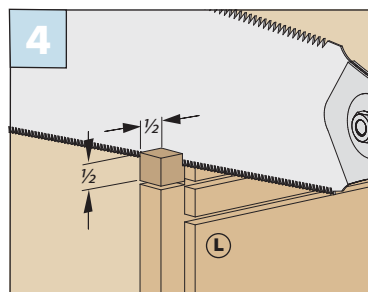
with thin strips of hardwood. The pattern of these strips is arranged how a typical face frame would look. The process works from the outside vertical pieces towards the middle.

COUNTER. A laminate covered countertop serves as the transition between sections. To match the look, the edge of the counter features a retro-style metal edging. The width of the edging dictates the thickness of the countertop (including the

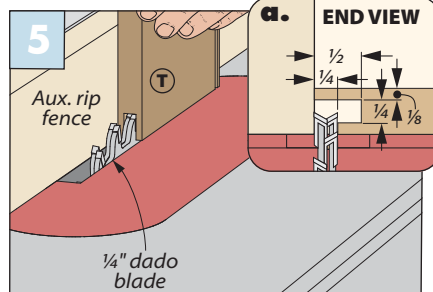
laminate). I found that a layer of 3/4" MDF plus a 1/2" layer solved the issue for me.

The edging fits into a narrow slot routed into the edge of the countertop, as in details 'a' and 'b.' I purchased a slot cutter sized for the task. The edging is mitered at the corners, as in detail 'c.' Lag screws and washers join the counter to the upper case. Screws attach this assembly to the lower case, as you can see in details 'a' and 'b.'

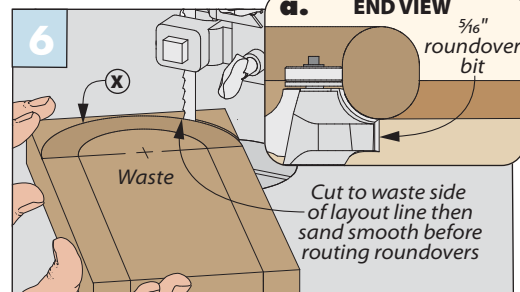
MORE JOINERY & CUSTOM PULLS



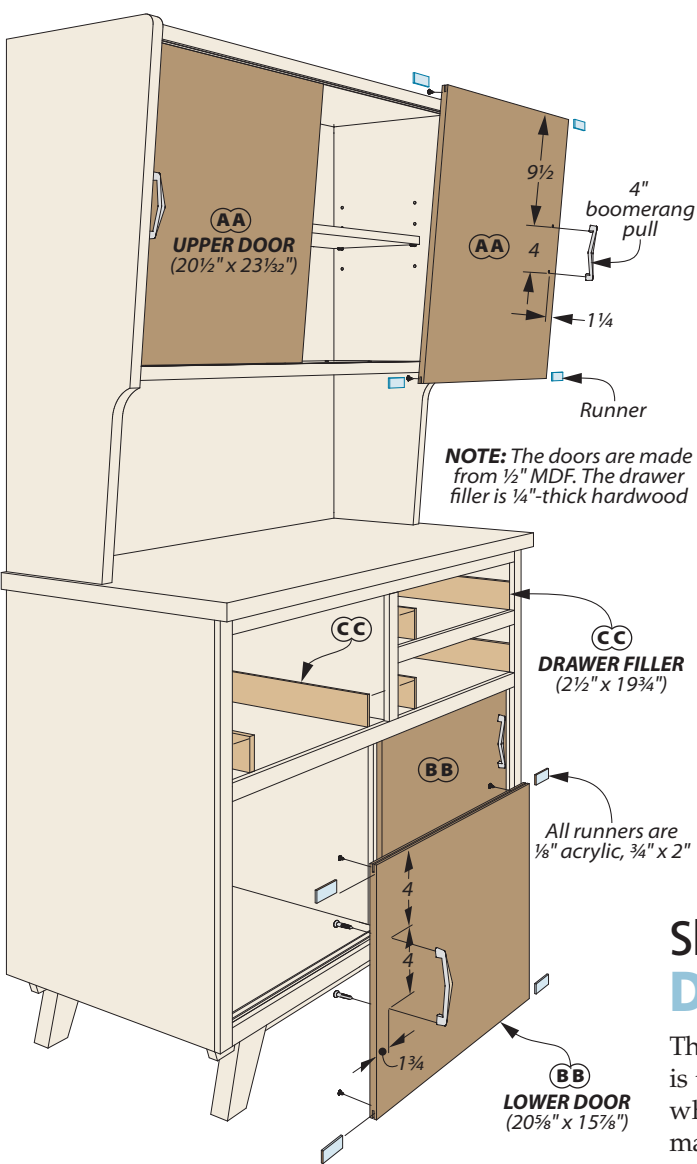
Trim The Cap. In order to fit into its stopped dado, cut away a small notch on the tongue.



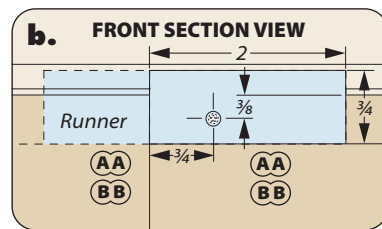
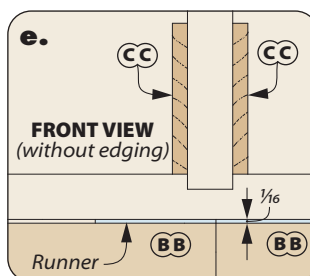
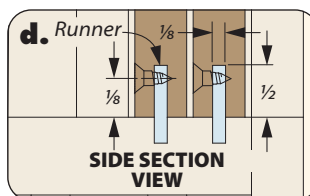
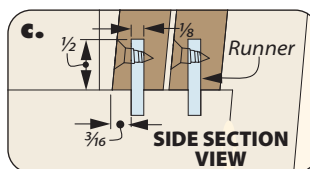
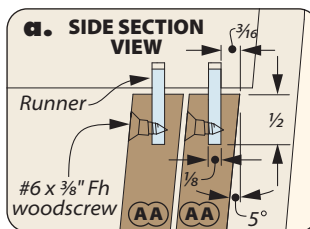
Locking Rabbet. Cut a slot in each end of the front. Then trim the inner flange to accept the drawer side.



Bin Pull. Since the pulls get painted, I used MDF. Establish the shape at the band saw. Round the edges at the router table.



NOTE: The doors are made from 1/2" MDF. The drawer filler is 1/4"-thick hardwood



so that they slide smoothly. We have you covered there.

DOOR DETAILS. Since the doors will be painted, Chris chose MDF (Baltic birch plywood would also work). It's smooth and stable, ideal for both sliding doors and for accepting paint.

The door panels are sized about 1/8" shorter than the openings. The forward lean of the upper case means that those panels need to be beveled, as shown in Figure 1 below.

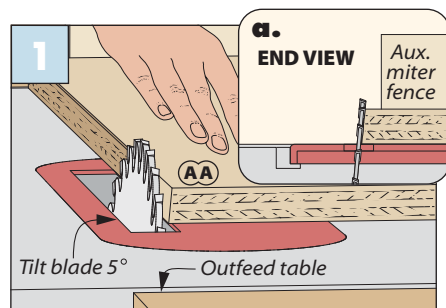
For motion, the doors ride on acrylic (*Plexiglas*) runners, as in detail 'b.' The runners form a low-friction surface that minimizes wear in the grooves.

These fit into grooves cut in the ends of the door panels, as you can see in 'a,' 'c,' and 'd.' Figure 2 shows the accommodation you need to make for the angled upper doors. The lower doors are easier (Figure 3). The runners are secured with a screw from the inside. Drill the pilot hole before you install the doors. Fit a door into place and slip the runners into the groove.

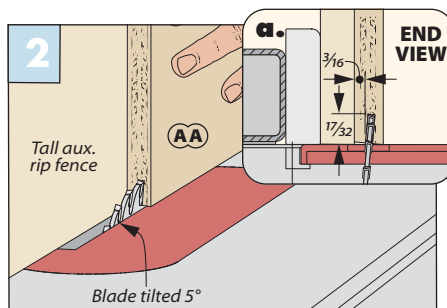
Slip Sliding DOORS

The advantage of sliding doors is that they don't take up space when you open them. That makes a big difference in a small or crowded space. The trick is fitting and installing the doors

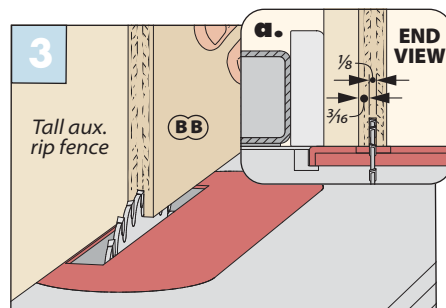
DOORS THAT MOVE



Bevel Upper Doors. The top and bottom edges of the doors have a slight bevel to match the case profile.



An Angled Groove. Keep the blade tilted to cut a groove for the door runners that's square to the ends.



Lower Doors. The grooves in the lower doors are cut with the blade perpendicular to the saw table.

Then reach inside to drive the screw to lock it in place. A retro pull completes the look.

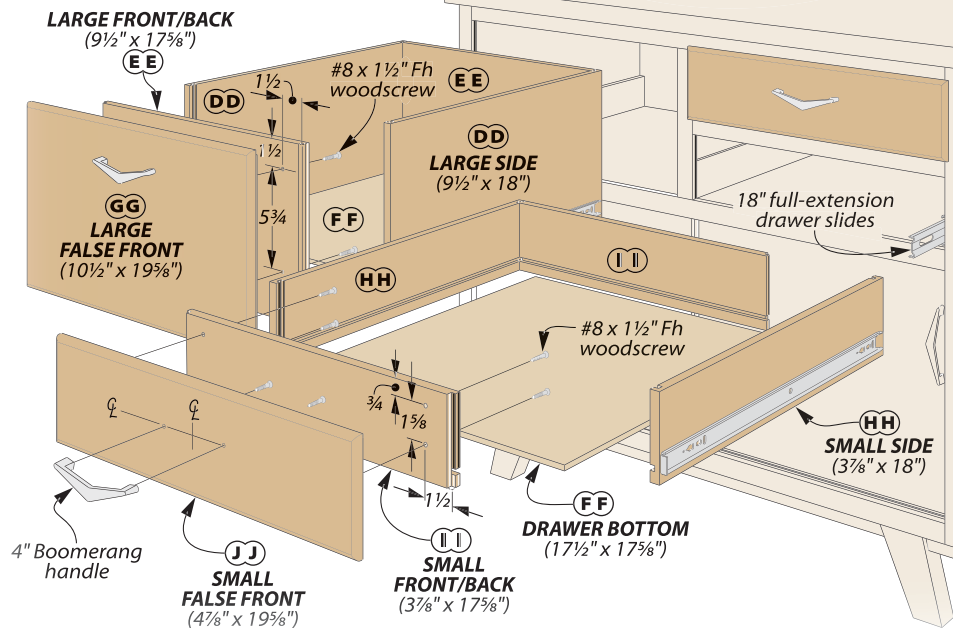
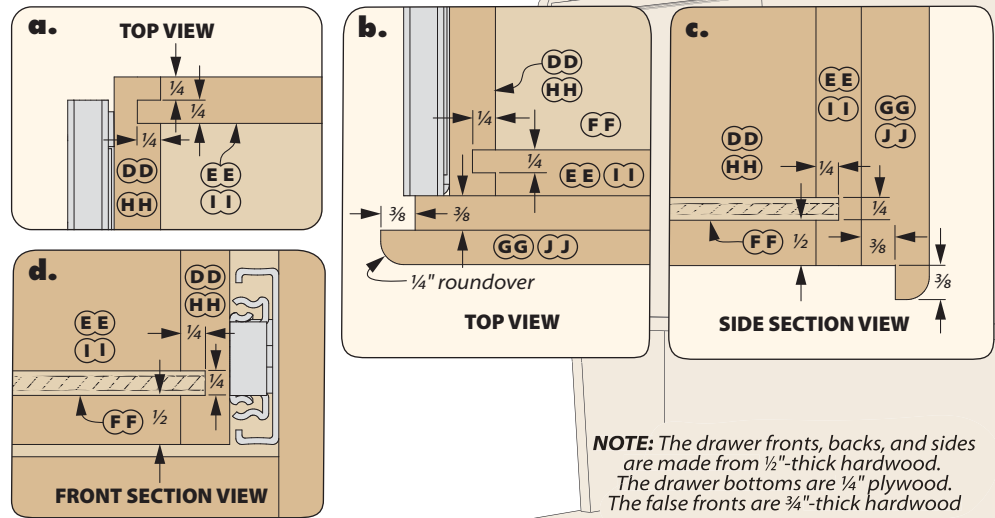
DRAWERS

A set of drawers fills the remaining compartments in the lower case. In the drawing at right, you can see the three drawers. There's a large drawer and a pair of half-size drawers. Feel free to change up this arrangement to suit your needs.

The drawers ride on full-extension slides. For this to work, you need to install filler pieces to create a flush surface. This is shown in the drawing and detail 'e' on the previous page.

SIMPLE JOINERY. Tongue and dado joinery connects the drawer sides, fronts, and backs. Details 'a' and 'b' contain the dimensions you need to set up your table saw or router table. The grooves shown in details 'c' and 'd' hold the drawer bottom.

FALSE FRONTS. Each drawer has a false front to hide the slides and create a clean look. The fronts overlap the opening slightly, as you can see in details 'b' and 'c.' They're attached with screws and use the same pulls as the doors. It's a groovy way to wrap up this project. [W](#)



Materials & Supplies

A Sides (2)	3/4 ply. - 20 1/2 x 29	Q Cubby Sides (2)	3/4 mdf - 8 x 6	GG Large False Front (1)	3/4 x 10 1/2 - 19 5/8
B Top (1)	3/4 ply. - 20 1/2 x 41	R Cubby Top/Bottom (2)	3/4 mdf - 8 x 19	HH Small Sides (2)	1/2 x 3 7/8 - 18
C Bottom/Divider (2)	3/4 ply. - 19 3/4 x 41	S Cubby Dividers (3)	3/4 mdf - 8 x 4 3/4	II Sm. Front/Back (2)	1/2 x 3 7/8 - 17 5/8
D Back (1)	1/2 ply. - 41 x 28 1/2	T Bin Fronts (4)	1/2 mdf - 4 1/2 x 4	JJ Small False Front (1)	3/4 x 4 7/8 - 19 5/8
E Stretchers (2)	3/4 x 2 - 40 1/2	U Bin Backs (4)	1/2 mdf - 4 1/2 x 3 9/16		
F Feet (4)	1 1/2 x 6 1/4 - 4 15/16	V Bin Sides (8)	1/2 mdf - 4 1/2 x 7 7/8		
G Lower Partition (1)	3/4 ply. - 18 1/16 x 16 1/4	W Bin Bottoms (4)	1/4 ply. - 35 1/16 x 7 1/4		
H Upper Partition (1)	3/4 ply. - 19 3/4 x 11	X Bin Pulls (4)	3/4 mdf - 1 3/4 x 3 1/2		
I Drawer Divider (1)	3/4 ply. - 19 3/4 x 20 3/8	Y Edging (1)	1/2 x 1 1/4 - 100 rgh.		
J Lower Edging (1)	1/2 x 3/4 - 15 3/4	Z Countertop (1)	1 1/4 mdf - 22 x 43		
K Upper Sides (2)	1 x 14 15/16 - 40	AA Upper Doors (2)	1/2 mdf - 20 1/2 x 23 1/32		
L Cap (1)	1 x 14 1/2 - 41	BB Lower Doors (2)	1/2 mdf - 20 5/8 x 15 7/8		
M Upper Shelf (1)	1 x 11 7/16 - 41	CC Drawer Fillers (6)	1/4 x 2 1/2 - 19 3/4		
N Upper Divider (1)	1 x 10 1/8 - 23 1/2	DD Large Sides (2)	1/2 x 9 1/2 - 18		
O Adjustable Shelves (2)	3/4 x 10 - 19 3/8	EE Large Front/Back (2)	1/2 x 9 1/2 - 17 5/8		
P Upper Back (1)	1/2 ply. - 40 1/2 x 38 3/4	FF Drawer Bottoms (3)	1/4 ply. - 17 1/2 x 17 5/8		

- (4) #8 x 1 1/2" Fh Woodscrews
- (4) #8 x 1 1/4" Fh Woodscrews
- (6) #8 x 2 1/2" Fh Woodscrews
- (8) 1/4"-dia. Shelf Pins
- (1) 24" x 48" Plastic Laminate
- (1) 1 1/4" x 144" Metal Edging
- (10) #8 x 1 3/4" Fh Woodscrews
- (4) 1/4" x 3" Lag Screws & Washers
- (16) 3/4" x 2" - 1/8" Acrylic
- (16) #6 x 3/8" Fh Woodscrews
- (7) 4" Boomerang Pulls w/Screws
- (3 pr.) 18" Drawer Slides w/Screws

simple, elegant Shop Stool

Ten pieces of wood are all it takes to make this sturdy piece of shop furniture.

As fun as it is to while away the hours in the shop, it's a good idea to take a break now and then. And although my partner loves the projects that come out of the shop, she'll give me the stink-eye if I show up in the house covered in dust and sweat. I don't blame her.

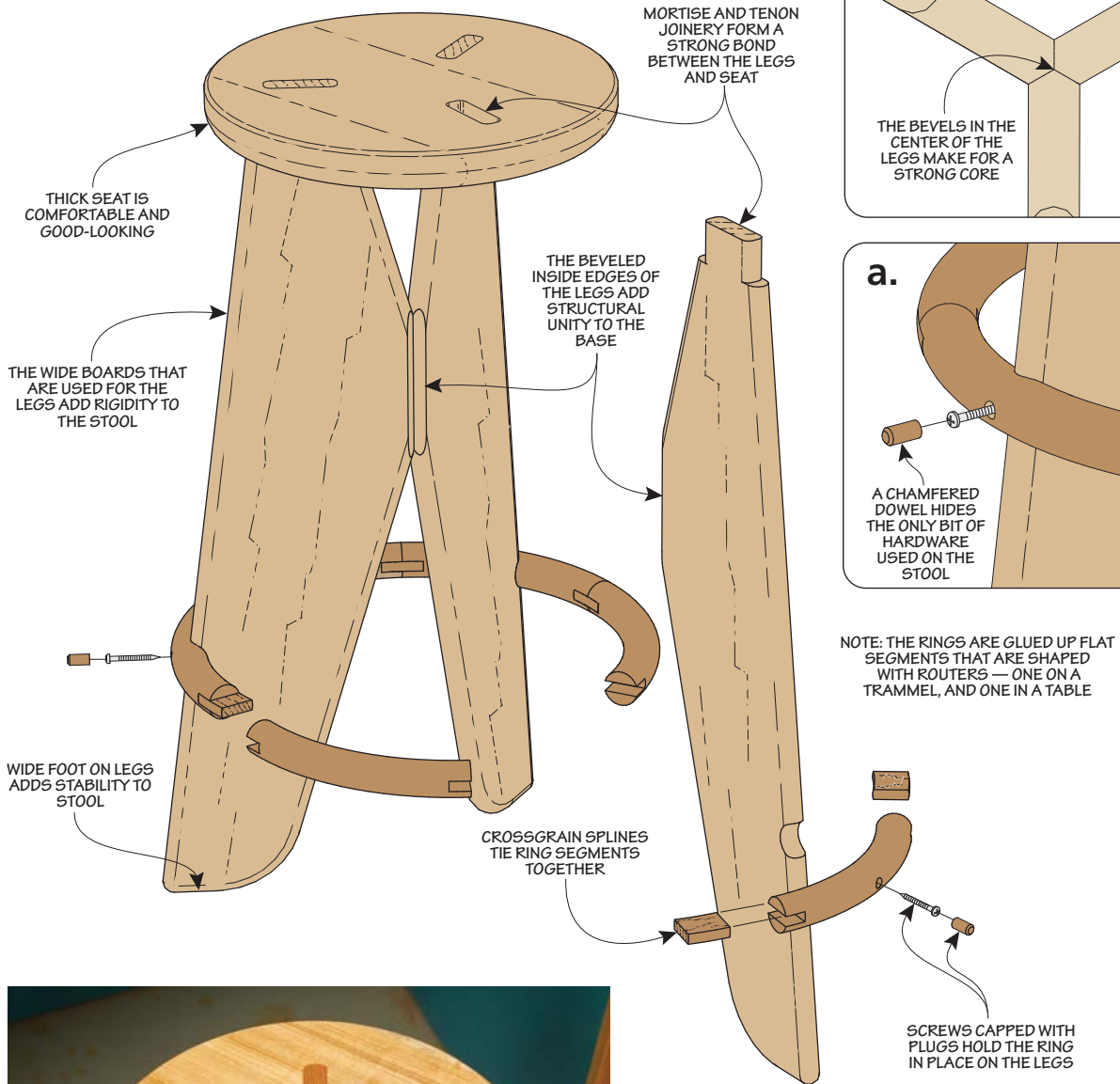
So one way to bridge the divide was to come up with a resting spot in the shop that's comfortable (but not so much that I'd end up looking for a remote and a libation) and doesn't take up much space. The stool you see here rings the bell in all categories. It's tall enough that you can work comfortably at the bench and stretch your legs at the same time, yet sturdy enough to take the occasional unintended abuse.

And really — who are we kidding — this stool is nice enough to take up residence in just about any place in your home as well as the shop. So look out, this project might end up in the house and you'll be back in a lawn chair.



Exploded View Details

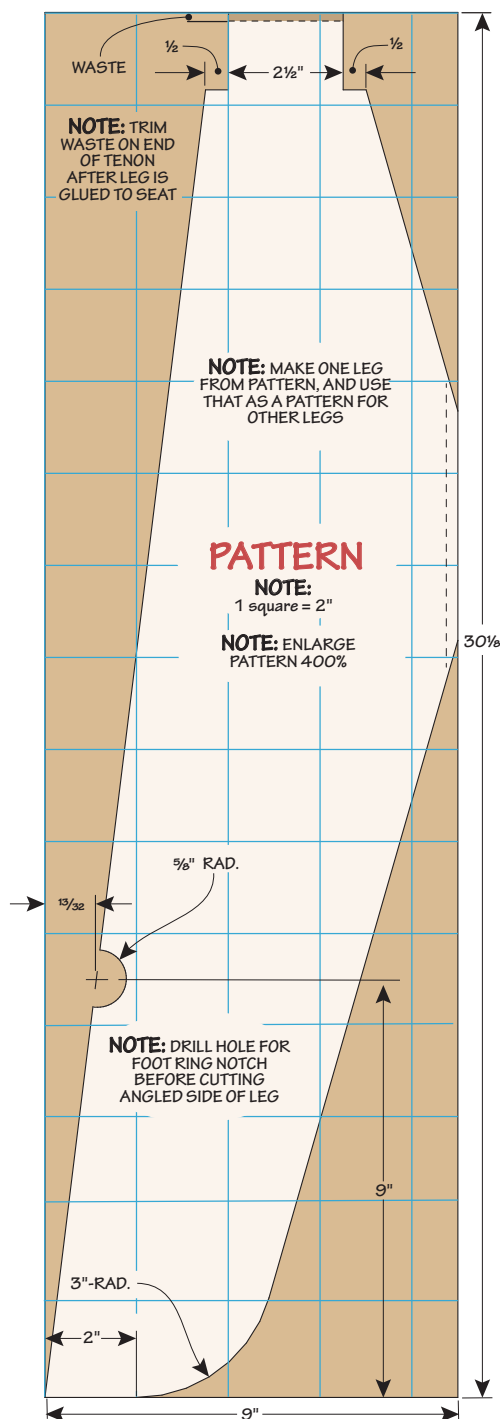
OVERALL DIMENSIONS:
24¹/₄"D x 24¹/₄"W x 30"H



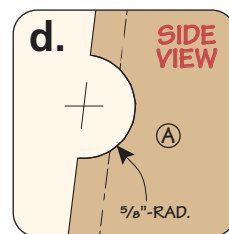
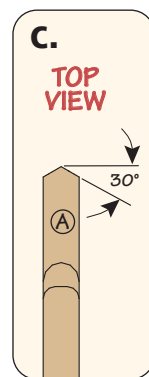
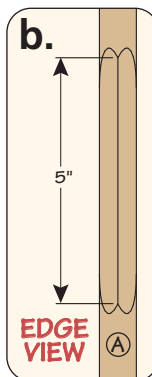
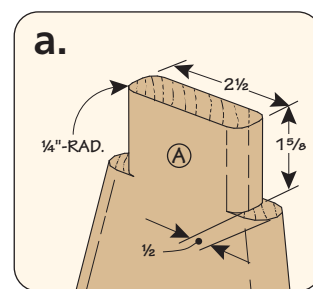
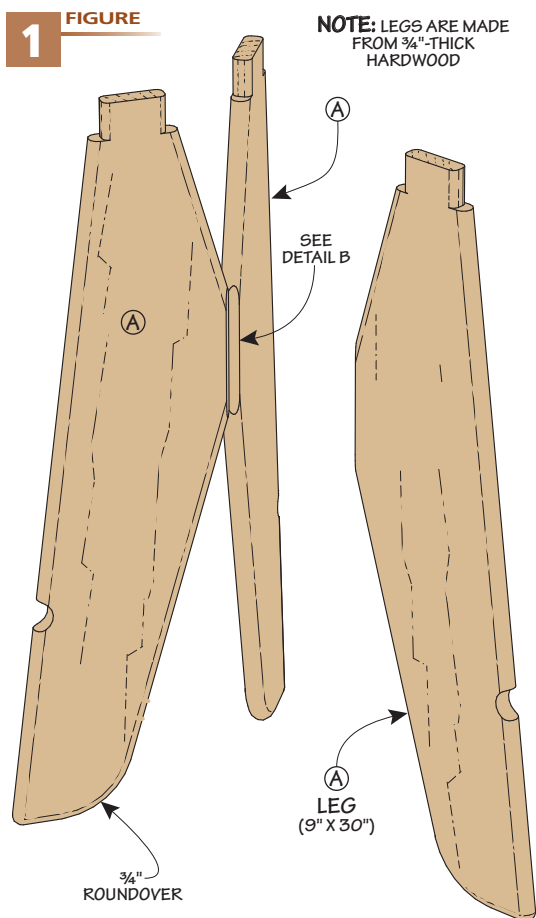
▲ The warm tones of the hickory works well for the seat and legs. The contrast of the end grain showing through the mortises are a visual delight.

materials & hardware

A	Legs (3)	¾ x 9 - 30 ¹ / ₈
B	Seat (1)	1½ x 14 - 14
C	Foot Ring Segments (6)	¾ x 3 - 10 ³ / ₈
D	Splines (6)	¾ x 4½ - 1½
	• (3) #8 x 1¾" Ph Woodscrews	
	• (3) ⅜"-dia. - ¾" Dowel	



1 **FIGURE**



Start with a stable Tripod

You might find material wide enough for each of the legs. If not, you'll need to spend some time gluing up three blanks to create the width you see in the drawing above. When the clamps are packed away, cut the three blanks to their final size. The game plan is to complete the

profile of one of the legs following the pattern shown to the left, then use it as a template on the remaining two. That being said, there are two operations you can do to all three blanks beforehand — the bevel on the inside edge (Figure 1a and b), and the body of the tenon on the top (Figure 1a).

BEVEL FIRST. Cut the bevel at the table saw using the rip fence. Sneak up on the center of the bevel (Figure 1c).

Normally you would make the mortises first and fit the tenons to them. Here, since the tenons are a unit that's joined in the center with the bevels, it proved easier to reverse the process. You'll cut the tenons first and use the clamped up leg assembly to lay out the location of the mortises.

TENONS. Stand the legs on end to cut the edges of the tenons. Support the legs with an auxiliary fence attached to your miter gauge. As for defining the shoulders, a hand saw at the bench does the job nicely. Wait on shaping the corners of the tenons until the mortises in the seat are done.

There's one more thing to mention about the tenons: if you want them to be perfectly flush with the seat, you'll need to leave them a little longer, like we're showing in Figure 1a. Then you can shave and sand them flush to the seat.

Now you can focus on the profile of the leg with one of the partially finished blanks. After laying out or tracing the angles on the blank, the first thing to do is drill the hole for the foot ring at the drill press (Figure 1d). Using a Forstner bit and a sacrificial board underneath the blank will make for a clean hole.

ANGLED CUTS. The band saw is the tool of choice for the angled cuts — along with the radius on the inside corner of the legs. Remove the blade marks and smooth the edges with whatever method works for you.

Now you can trace the profile of the finished leg onto the remaining leg blanks. Then repeat the shaping process, starting with the foot ring holes.

The roundover on the edges of the legs that you see in Figure 1 and details above are next on the to-do list.

The smaller radius on the tenons will be done after the template for the seat is made, let's head that way now.

THE SEAT

The seat, like the legs, is made of hickory blanks (thicker than the legs though) that are glued up to the width needed. A hardboard template (Figure 2) will help you shape the contour of the seat. It will also guide you in making the mortises for the leg tenons. Let's look at the mortises for a moment.

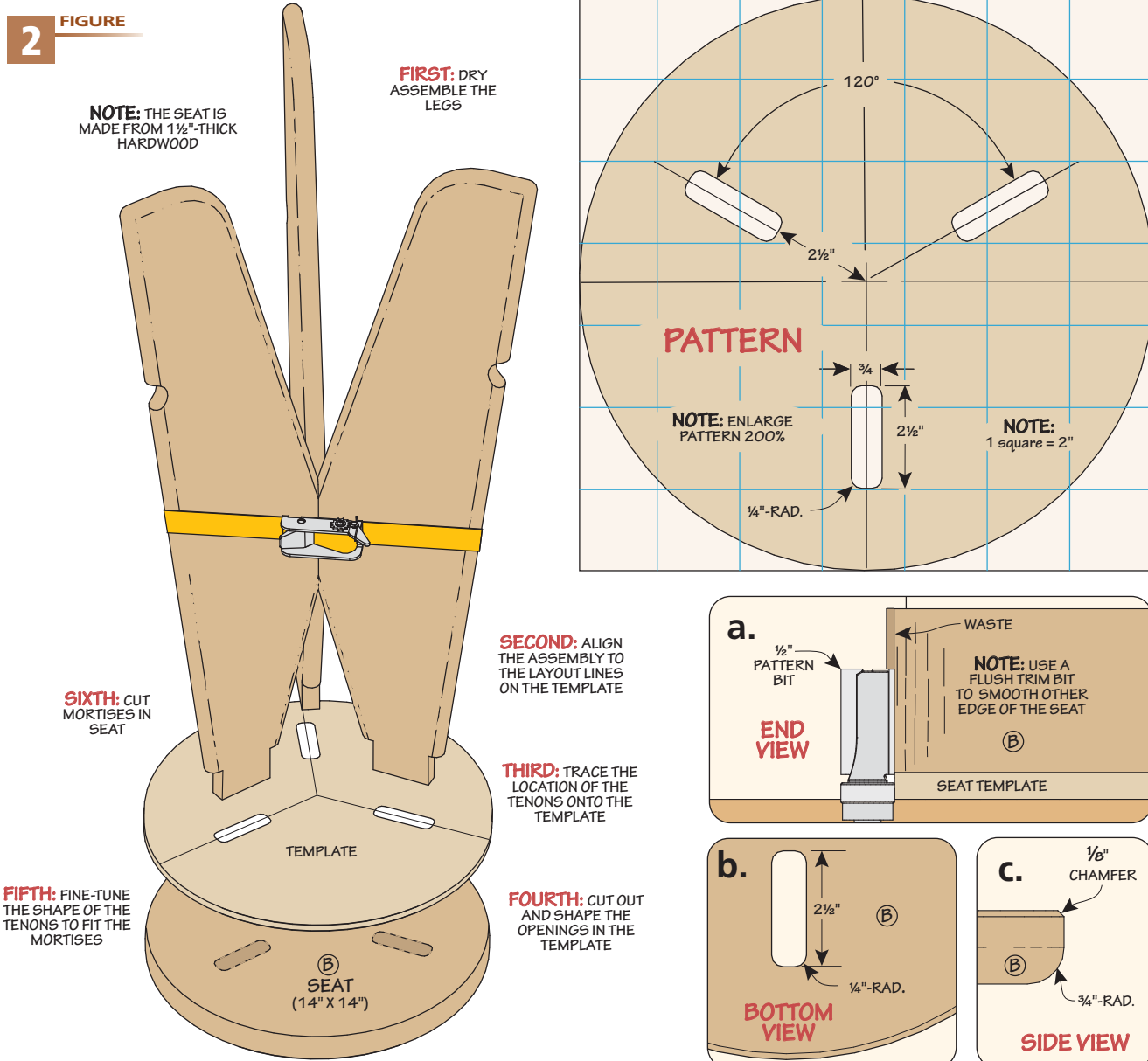
In a perfect world the mortise locations you see in the pattern detail will line up exactly with the tenons on the leg assembly. While we're waiting for

that perfect world, you might want to consider locating the mortises in the template using the legs dry assembled as a guide. Figure 2 below walks you through the steps.

A band clamp is the ideal tool to hold the legs together for this task. Next, line the legs up to the mortise center lines on the template. Trace the tenon locations on the template with a sharp pencil. Then you can cut out the mortise openings in the template, shaping the corners at the same time. Now set the template on top of the legs and trace the mortise profile on the ends of the tenons. Rasps and files are the tools of choice to round over the tenons.

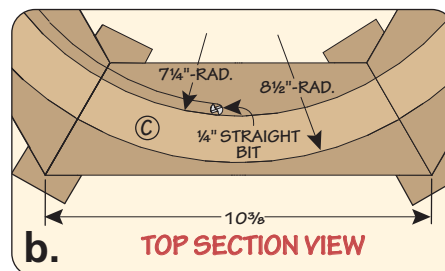
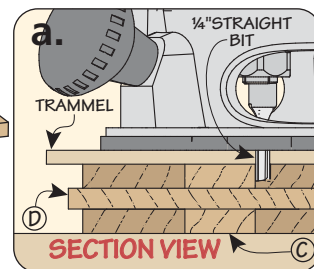
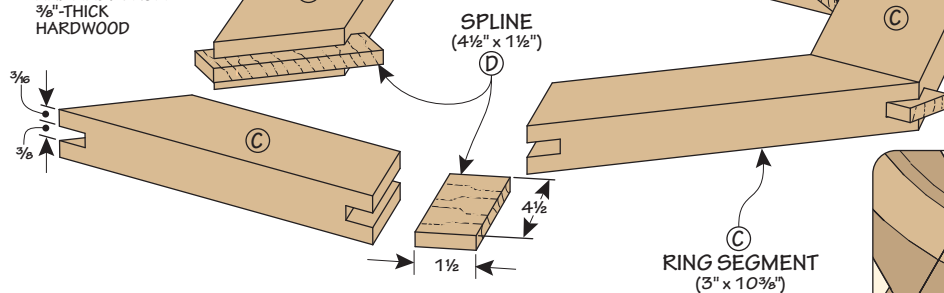
SHAPE THE SEAT. First, trace the template profile and mortise openings on the seat blank and rough out the shape to the waste side of the line at the band saw. Drill out most of the waste in the mortises as well. Attach the template to the seat with double-sided tape. Use a pattern bit at the router table to make the final seat shape (Figure 2a).

There's a little cosmetic work needed to finish out the top. Start by routing the large roundover on the underside of the seat. Also, ease the top edge with a chamfer bit (Figure 2c). Before we glue the legs and seat together there's a segmented ring that needs to be made, that's next on the agenda.



3 FIGURE

NOTE: SEGMENTS ARE MADE FROM $\frac{3}{4}$ "-THICK HARDWOOD. SPLINES ARE MADE FROM $\frac{3}{8}$ "-THICK HARDWOOD



crafting the Foot Ring

The foot ring is the last piece to make before assembling the stool. Figure 3 above shows you the raw anatomy of the ring and the two parts it's comprised of — a ring segment that is beveled and slotted on the ends, and splines that join the segments.

Both parts are made of strong and durable ash (the same material that's used for baseball bats) so it won't take the abuse that comes its way personally. But it's the grain direction of the two parts that puts the ring's strength over the top. The long-grain strength of the beveled segments combined with the cross-grain structure of the splines all but eliminates the weak short-grain sections at the tips of the segments. You'll spend a little time at the table saw making these parts.

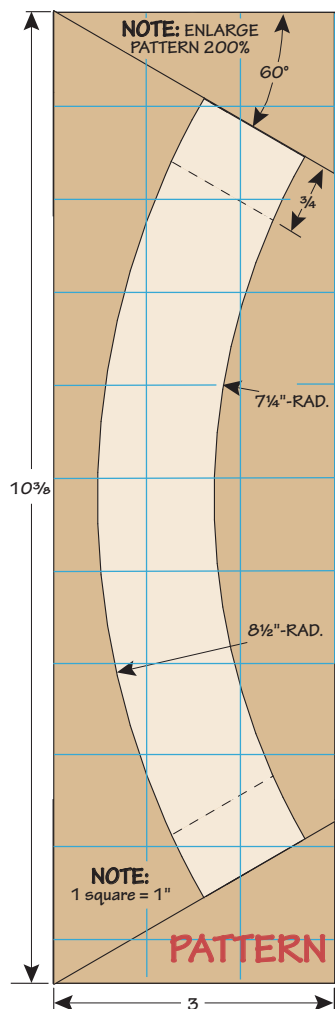
SEGMENTS FIRST. After ripping the segments to width cut each piece extra-long. Adjust your miter gauge to 30° and attach an auxiliary fence to it with screws. You want all the segments to be identical in length. To do this, lay out and cut the angles on one of the segments. Hold the segment to the gauge and against the blade, then clamp a stop block on the other end of the auxiliary fence. With that you're set up to cut the other five segments.

Next is the slots for the splines. The set

up for this is fairly simple — a $\frac{3}{8}$ " dado set in your table saw, along with your rip fence. The angled sides of the segments are long enough that they don't need any support when cutting the slots. But if you're not comfortable with that, you can use a backer board to support the piece while making the cut.

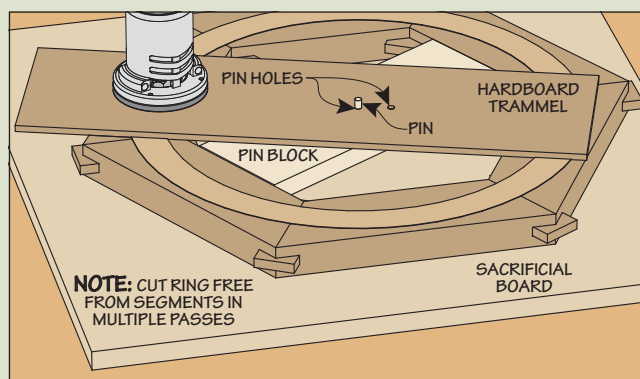
CROSSGRAIN SPLINES. As I mentioned earlier, you're going to make the splines with the grain running perpendicular to the slots. This is a much stronger than a long grain spline.

Start with a blank that's wider than the length of the slots and long enough to safely cut a spline out of each end of the board (5"-6" should be fine, three blanks will yield all the splines you need). Using a zero-clearance insert in your saw, set the rip fence so it leaves you with a spline that's the proper thickness ($\frac{3}{8}$ " in this case), and raise the blade high enough to match the length of the slots. Adjust the rip fence and lay the board



The Ring

Cutting out the shape of the ring is done in multiple passes. The process requires a little patience but you'll have a perfect ring when all is done. Double-sided tape holds the ring in place as you cut through and into the sacrificial board.



flat with the splines to the outside of the blade to cut them free. The spline should fit snugly in the slot — since you'll see the ends between the ring segments you don't want a loose fit.

To glue up the foot ring, use epoxy and a band clamp. After the assembly has cured, you can turn your attention to bringing the ring to its final shape. A trammel is in order for this step.

TRAMMEL TIME. A piece of hardboard for the trammel is all that you need for this jig. Drill mounting holes for your router and attach it to the base. Drill the holes at the opposite end that will define the inner and outer edges of the foot ring (Figure 3b). Stick the ring down with double-sided tape to a sacrificial board that has a center block and pin to guide the trammel. It's best to make multiple $\frac{1}{4}$ "-deep passes on the ring. When the ring is free of the blank, head over to the router table and round over the edges (Figure 5b). Since the ring is finished with *Old Masters Carbon Black* (and lacquered) to create a nice contrast at the base of the stool, do that now. Then you can assemble the stool.

ASSEMBLY

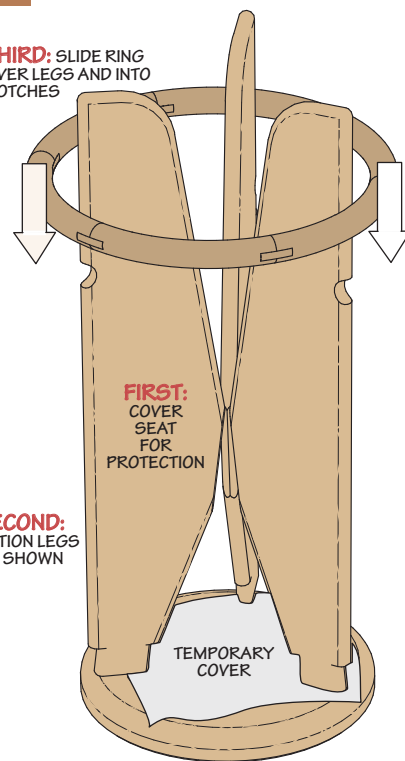
On this page the three figures and their details walks you through assembling the stool. Here I'll expand on the process a little more. First, it would be wise to call in a friend to help maneuver the legs and foot ring during this stage. The temporary cover you see in Figure 4 protects the seat while you're maneuvering and gluing the legs.

Apply epoxy to the beveled surfaces of the three legs. With the help of said friend, turn the legs together and lower the tenons into the mortises (dry for now) while holding the foot ring in the grooves. Clamp the center with a band clamp and let cure (Figure 5). Once cured, drill countersunk pilot holes. A chamfered dowel that's left proud of the surface of the foot ring adds a nice visual contrast. (Figure 5a and b).

Finally, flip the stool upright and remove the seat. Apply epoxy to the seat and the tenons, then clamp the two together. After the joints have cured, cut the tenons flush and sand smooth (Figure 6a). Two coats of lacquer are all that's needed to protect the stool. 🛠️

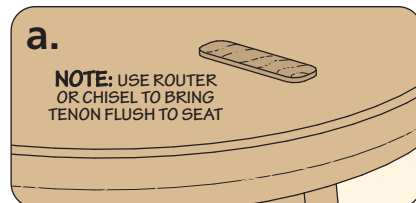
4 FIGURE

THIRD: SLIDE RING OVER LEGS AND INTO NOTCHES



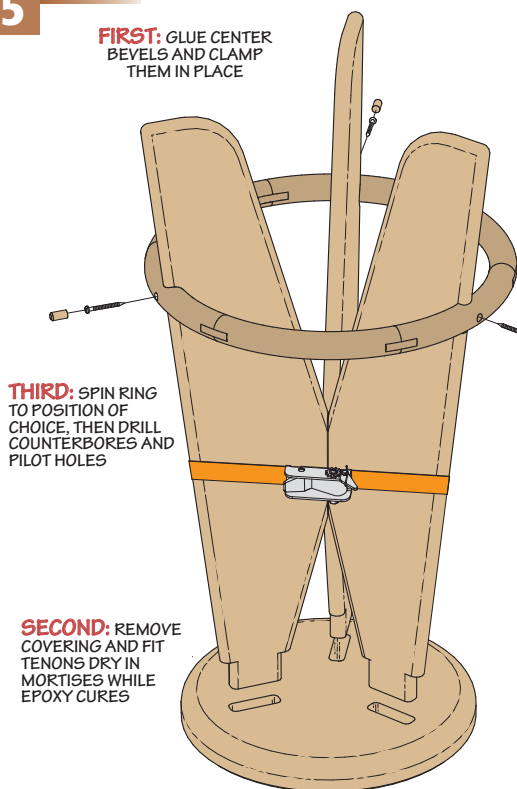
a.

NOTE: USE ROUTER OR CHISEL TO BRING TENON FLUSH TO SEAT

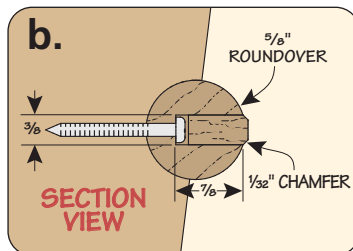
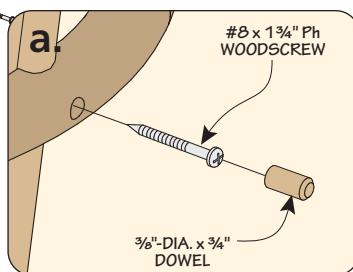


5 FIGURE

FIRST: GLUE CENTER BEVELS AND CLAMP THEM IN PLACE

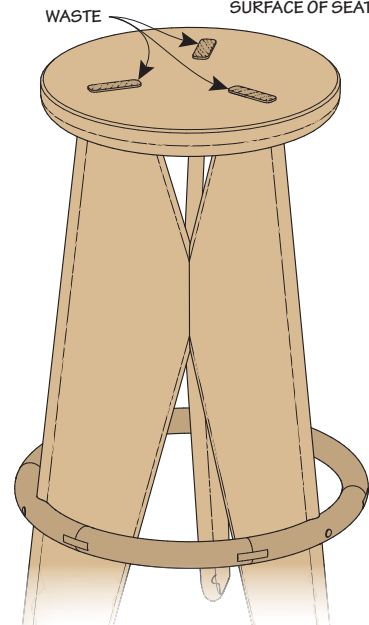


FIFTH: INSTALL SCREWS AND DOWEL CAP



6 FIGURE

NOTE: TRIM AWAY MOST OF WASTE, THEN SAND SMOOTH WITH SURFACE OF SEAT





Traveling Library Chest

Antique inspiration combines with Craftsman details to create a fascinating method of book storage.

As society has progressed, we've left many designs by the wayside. Consider the wardrobe. Once a standard furnishing in any home, they fell out of fashion as modern house designs incorporated built-in wardrobes — or, as we know them today, closets. Nonetheless, antique wardrobes present impressive designs and craftsmanship.

The project you see here was inspired by a similar (if less prolific) piece of furniture: the portable library chest. Around the turn of the 20th Century, the United States Lighthouse Service commissioned and circulated these chests to lighthouse keepers and their families. Many lighthouses were (and are) in remote locales, and while they were often well-stocked in necessities, keepers were frequently left wanting for any form of entertainment. These chests were issued to lighthouses, filled with books of all kind, and periodically exchanged between them.

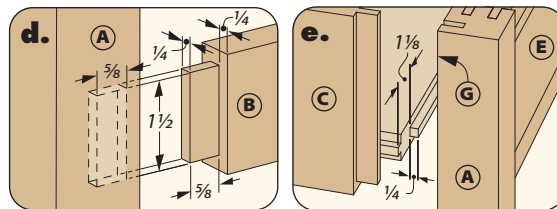
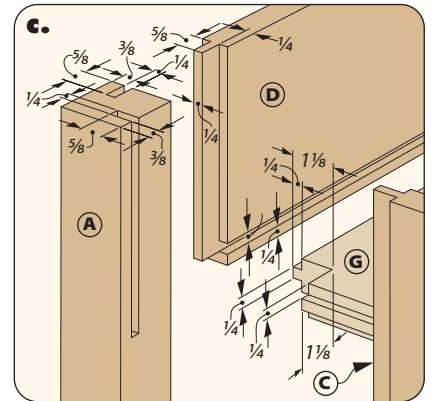
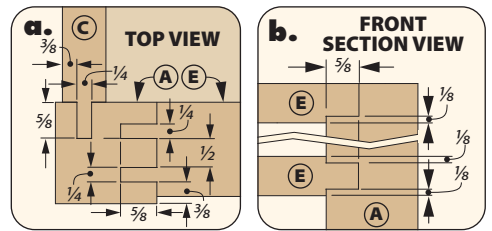
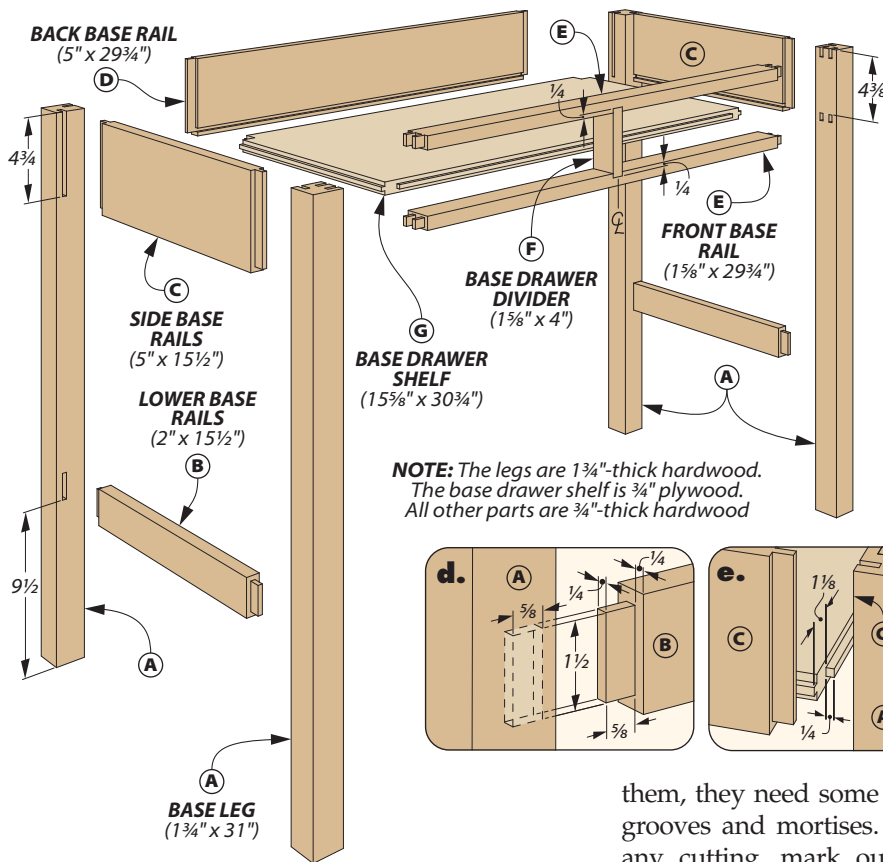
Today, lighthouses are automated, and any book you might want to read can likely be downloaded or ordered with same-day shipping. The need for a traveling library may no longer exist, but it remains an interesting bit of history, and an attractive piece of furniture in its own right. To address the project here, the chest is included with a sideboard as a base for it to rest upon. White oak was the chosen material. Yellow pine would've been more historically accurate, but we've no need to move this chest across the nation, so a heavier hardwood seemed like an appropriate modern adaptation. Along with its sturdy joinery, this project presents both a fun build and a long-lasting piece of furniture.



▲ This chest provides a plethora of storage options. The main enclosure is well-suited for books of course, but the quartet of drawers is also convenient for small items.



▲ The "dovetailed" rabbets are a recurring motif throughout the project and come from the original piece that inspired this chest.



Kick off with LEGS & RAILS

This project begins at the base. The stand you see above isn't just a place to put the chest. It offers storage of its own, with a pair of drawers and a shelf.

LEGS. The legs started out as 8/4 lumber, and, after sizing

them, they need some stopped grooves and mortises. Prior to any cutting, mark out where each leg will be positioned. The joinery on these legs differs slightly depending on which rails they're mating with.

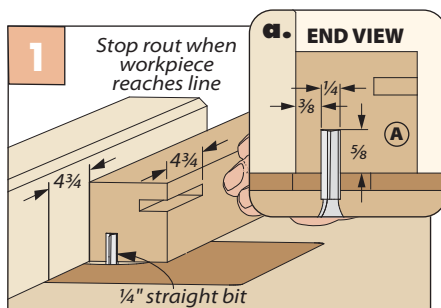
STOPPED GROOVES. I began with the stopped grooves. Details 'a' and 'b' above show these on the front legs. Detail 'c' shows the grooves on the back legs. I cut these at the router table (as in Figure 1). Note that there

are two lengths of grooves: long ones for the side and back rails, and short grooves on the front legs for the double tenons.

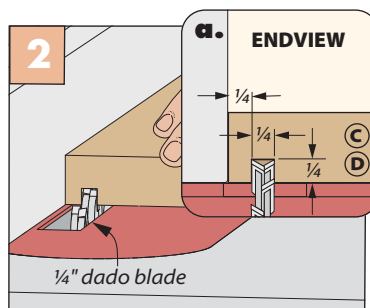
ROUTING MORTISES. Long mortises in the legs accept tenons in the lower rails (detail 'd') and short ones in the front legs fit the lower front rail (detail 'b'). I cut these using a plunge router.

RAIL TENONS. With mortises made, it's time for some tenons. For now, we have two lower rails, two side rails, and a back rail. Despite their different dimensions, making these parts is largely the same.

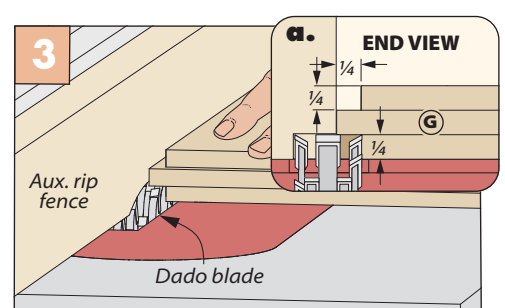
CUTTING GROOVES & RABBETS



Stopped Grooves. Rout the stopped grooves for the upper rails using a straight bit at the router table.



Rail Grooves. Cut the grooves in the upper rails at the table saw using a dado blade.



Rabbeted Tongues. To create the tongues around the drawer shelf, cut a rabbet on both sides of each edge.

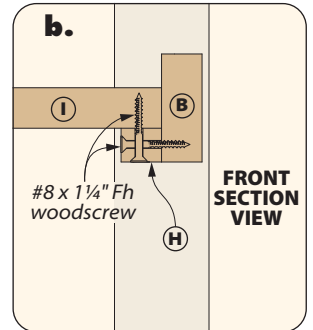
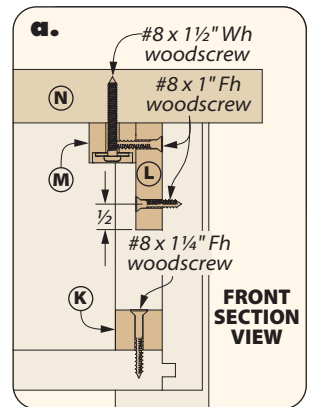
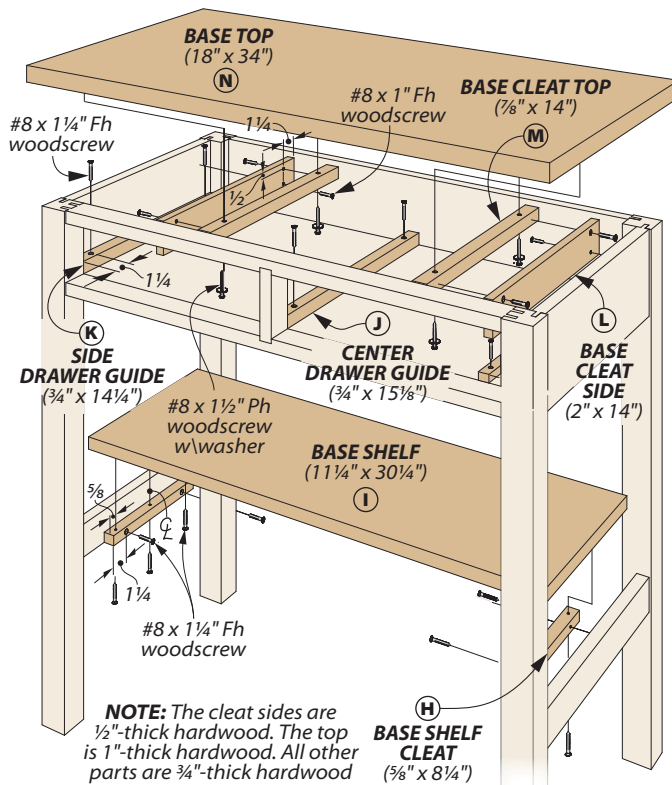
After sizing them, cut the tenons to match the leg mortises. I did this by rabbeting both faces at the table saw. Next, I added a groove along their bottom edges to accept the tongues of the drawer shelf (Figure 2).

FRONT RAILS. The top of this base has a pair of drawers. To make room for those, we used an I-shaped assembly for the front rails. These have double-tenoned ends, and the box below shows how to cut those.

You'll also need the drawer divider. This part simply needs cut to size, but you'll also need to cut a dado in the center of each front rail for it.

DRAWER SHELF. The drawer shelf supports the drawers and provides a place to secure their guides. Rabbets along its perimeter create tongues to fit into the grooves in the rails (Figure 3). Notches in the corners fit the legs, which I cut at the band saw.

BASE ASSEMBLY. Gluing up these parts begins with the side assemblies, joining the legs with the lower and side rails. I also glued up the front rails around the drawer divider to make the I-shaped assembly. Next, glue up the parts and back rail around the drawer shelf, slotting tongues into grooves and tenons into mortises.



DRAWER GUIDES & SHELF

The body of the base is made, and now there are a few more things to add on top, beginning with a shelf.

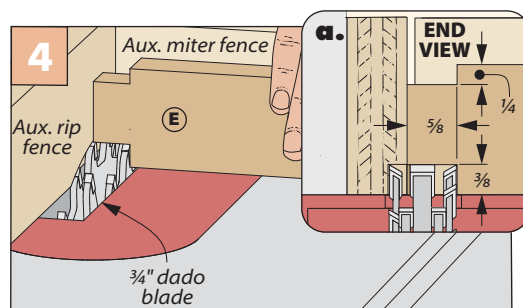
BASE SHELF. The shelf spans the stretchers and is supported by cleats (detail 'b'). Screws do the work here, so after cutting the shelf to fit and cleats to size, just screw everything in place.

DRAWER GUIDES. The drawers of this project are kept on track by

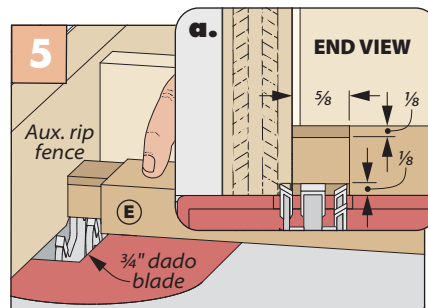
hardwood guides. The side guides fit between the legs, while the center guide is located behind the drawer divider. Once these are cut, screw them in.

ADDING A TOP. The top of this base is attached by a pair of cleats. You can see how these come together in detail 'a' above. To allow for wood movement, the screws in the top are given wider clearance holes in the cleat tops and secured with washers.

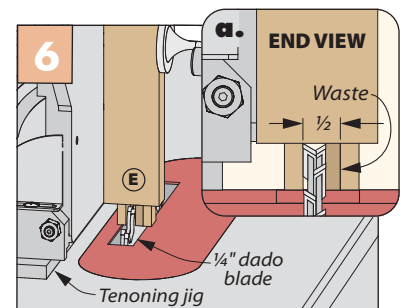
MAKING A DOUBLE TENON



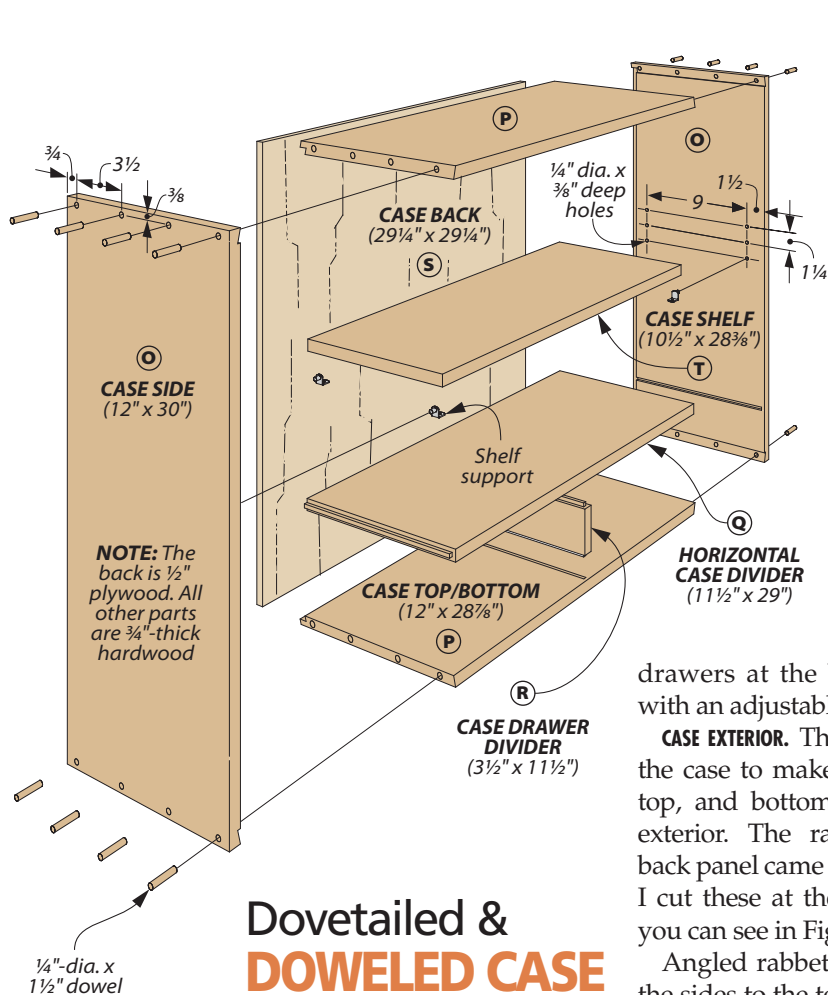
Shoulder Cuts. Begin making the double tenons by first cutting the edges, using a dado blade buried in an auxiliary fence.



Face Cuts. Leave the fence in position to cut the faces. This completes the "big tenon" that we'll separate next.



Split It Up. Remove the waste between the two tenons. Use an undersized stack to dial in the fit.



Dovetailed & DOWELED CASE

Now that the base is done (excluding the drawers — we'll get to those), it's time to work on the case of this library chest. This consists of sides, a top and bottom, and a back, but it also contains a compartment for two

drawers at the bottom, along with an adjustable shelf.

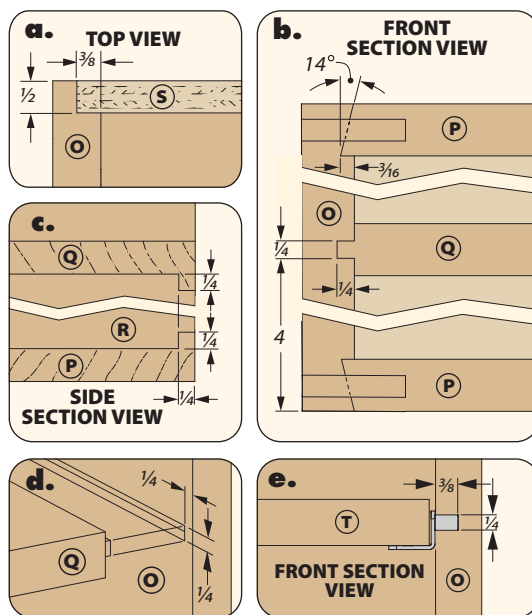
CASE EXTERIOR. The first parts of the case to make are the sides, top, and bottom that form its exterior. The rabbets for the back panel came first (detail 'a'). I cut these at the table saw, as you can see in Figure 1 below.

Angled rabbet joints connect the sides to the top and bottom. The rabbeted portion was cut at the router table using a dovetail bit (Figure 2), while the ends of the top and bottom were beveled at the table saw.

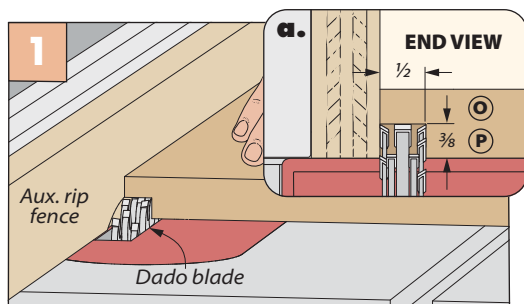
The last tasks on these parts address the interior. First, that

means a few holes in the sides for the shelf supports, which you can see in the main illustration. After that, the sides and bottom need stopped dados. In the sides, these accept the case divider, while the bottom one is for a tongue in the drawer divider. I cut these using my plunge router and a guide for its base, as in Figure 3 below.

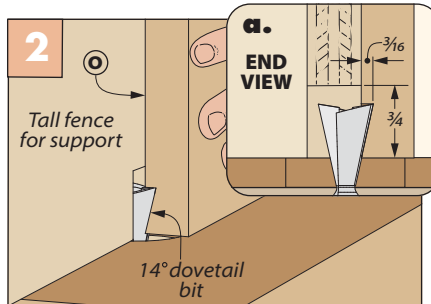
DIVIDERS. Two dividers segment the compartments of the case. The horizontal divider separates the main enclosure of the case from the drawers. The drawer divider separates the drawers in their section.



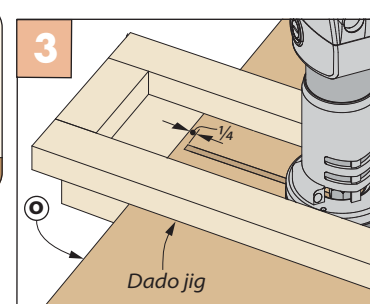
CUTTING CASE JOINERY



Back Rabbets. To accept the back panel, cut rabbets in the sides, top, and bottom of the case with a dado blade at the table saw.



Dovetailed Rabbets. Angled rabbets in the sides hold the top and bottom, and are cut at the router table.



Stopped Dados. Use a plunge router and guide to cut the stopped dados in the case.

After cutting these to size, the first thing I did was repeat the routing from the bottom panel to create the dado for the drawer divider in the horizontal divider. After that, I rabbeted the ends of the horizontal divider and the edges of the drawer divider to create the tenons and tongues.

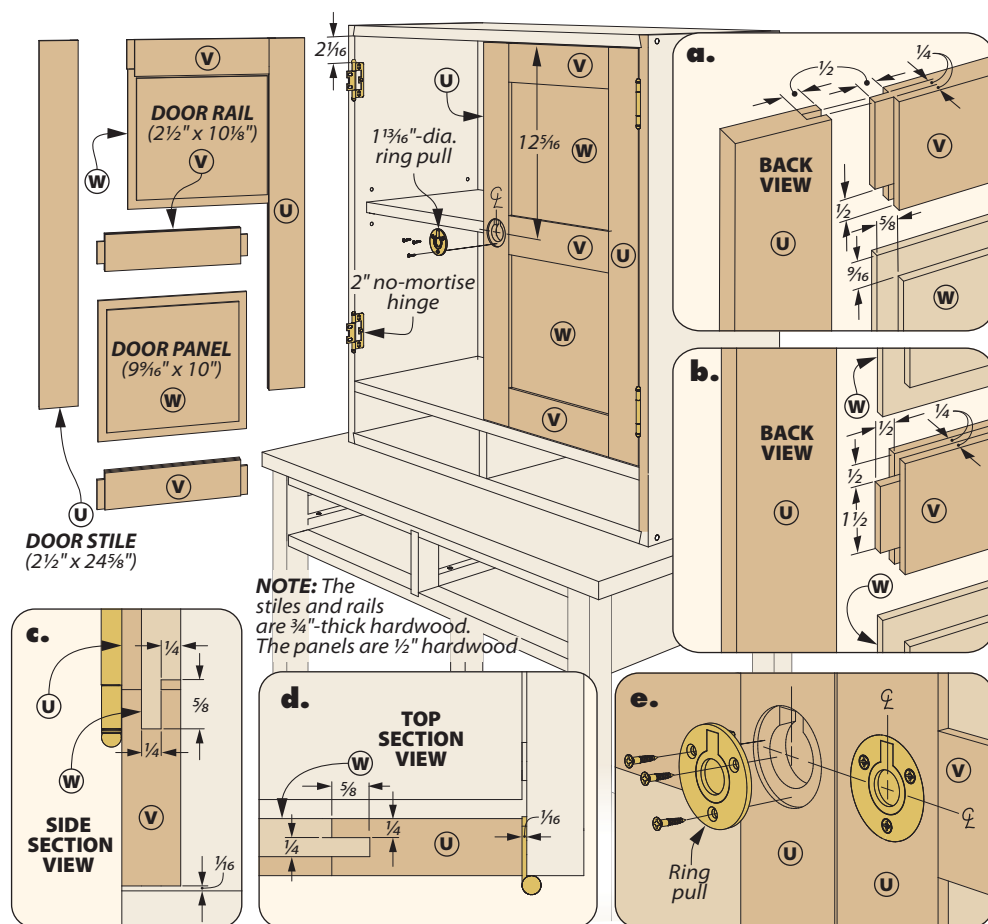
ASSEMBLY. Now we're ready to assemble the case. Note the dowels shown on the previous page. After gluing up the case, drill the holes for these, tap them in, and trim them flush.

At this point, there are two more parts to make for the case itself. Cut the back to fit within the rabbets behind the case and glue it on. Next, cut a shelf to fit between the sides, then insert the shelf supports and set it in place.

A PAIR OF DOORS

The main compartment of the case is enclosed by a pair of framed doors. There are three parts to the doors, and I began with the stiles.

FRAME & PANEL JOINERY. After sizing the stiles, cut a groove down the center of their inner edges (details 'a' and 'd'). While you're at it, the rails need similar grooves on their inner edges (detail 'c'). Then, cut the tongues and tenons for those grooves. These are made by rabbeting the



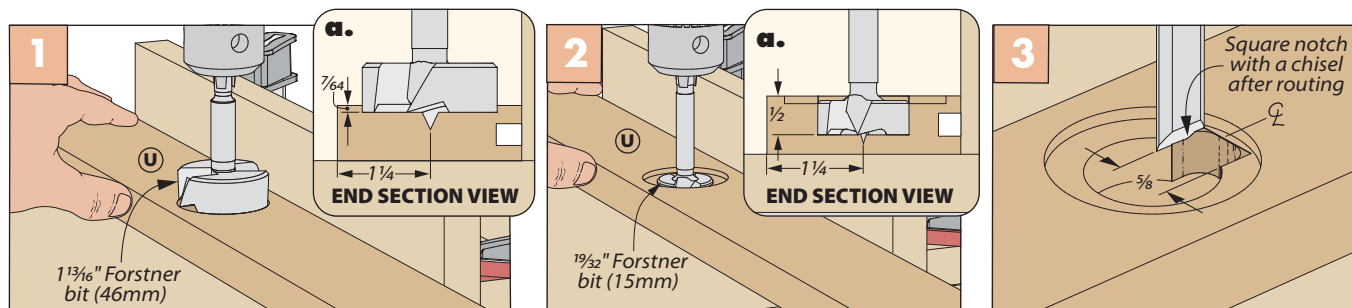
NOTE: The stiles and rails are 3/4"-thick hardwood. The panels are 1/2" hardwood.

back edges of the panels and the ends of the rails.

RING PULLS. Before putting the doors together, make the mortises for the ring pulls. These sit flush to the stiles' faces, and you can see how to make them below. Once you've cut the mortises, screw the pulls in place.

DOOR ASSEMBLY. To assemble the doors, the tongues on the door panels are slotted in the grooves in the stiles and the rails, and the tenons of the rails are glued into the stiles' grooves. We used no-mortise hinges to hang the doors, which makes these pretty quick and easy to install.

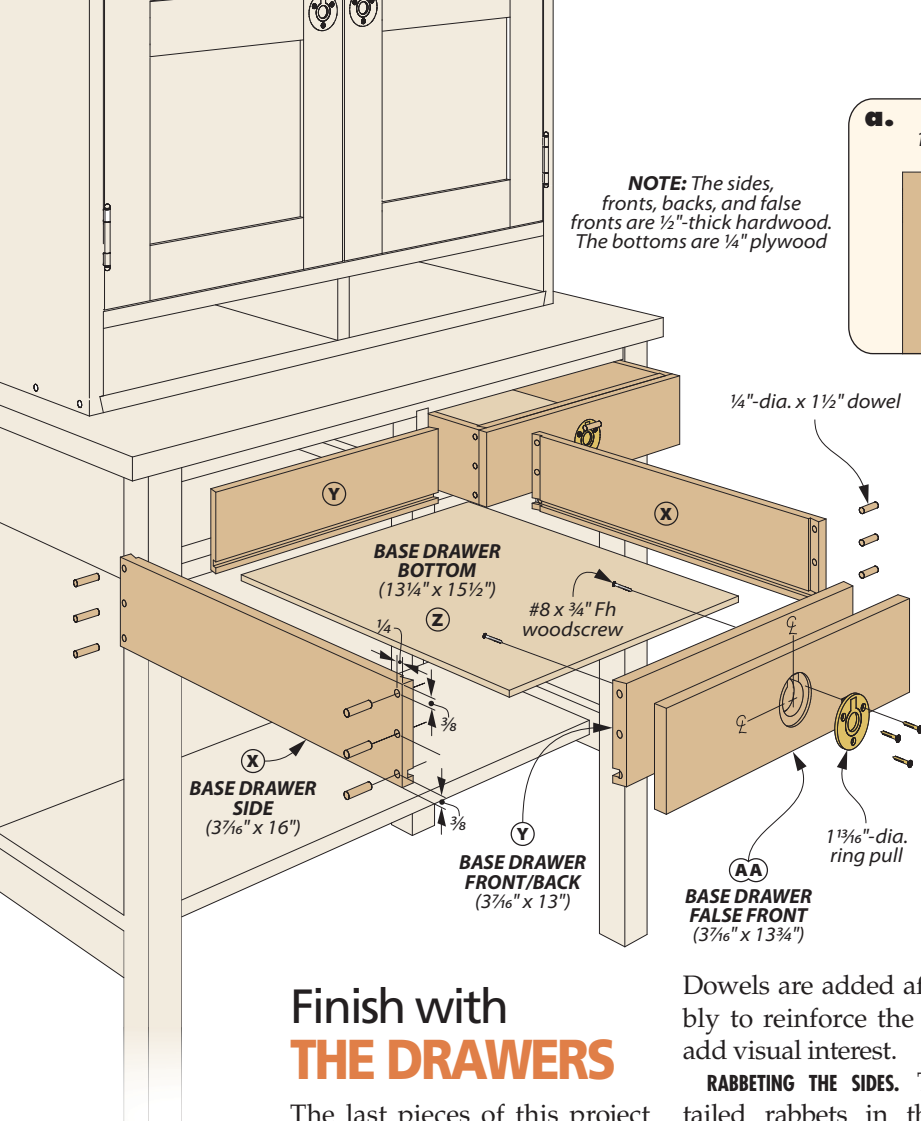
FLUSHED RING PULLS



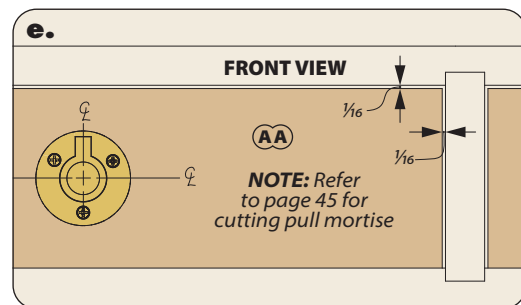
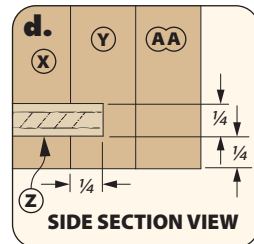
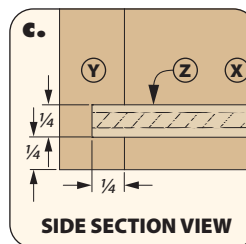
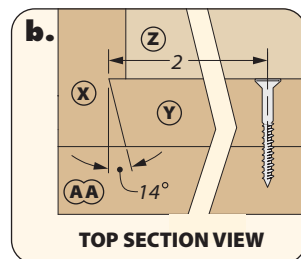
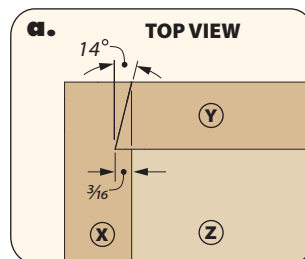
Big Hole First. Create the hole for the flange of the pull first with a Forstner bit. The point provides a target for the next drilling task.

Bore Out the Middle. A deeper hole in the center of the last one will fit the inner portion of the pull.

Hinge Notch. The ring's hinge requires a notch to be chiseled out in the top of the mortise.



NOTE: The sides, fronts, backs, and false fronts are 1/2"-thick hardwood. The bottoms are 1/4" plywood



Finish with THE DRAWERS

The last pieces of this project are the drawers for the base and case. The construction of these drawers is somewhat reminiscent of the case. Angled rabbets in the sides accept the beveled ends of the fronts and backs.

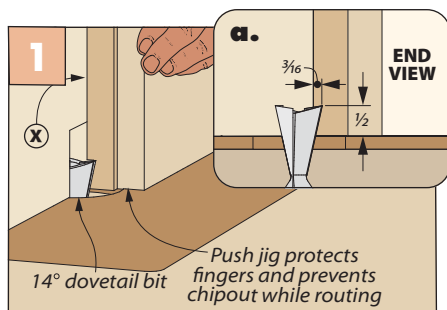
Dowels are added after assembly to reinforce the joints and add visual interest.

RABBETING THE SIDES. The dovetailed rabbets in the drawer sides are made at the router table, much like the ones in the case sides. However, a little extra consideration is required to cut these. Due to the width of these parts (or lack thereof)

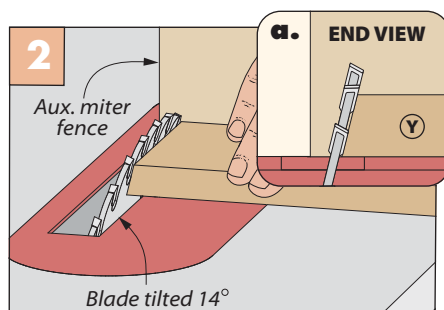
supporting them during the cut with just your hand leaves your fingers uncomfortably close to the bit. It also leaves a chance of the piece tipping if the throat if your insert is too wide. Neither of these are ideal.

To avoid mishaps, I made the cutting jig you see in Figure 1 below. This is simply three pieces of plywood: one to serve as a

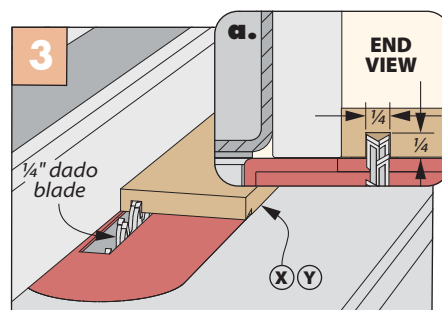
DRAWER JOINERY



Router Table Jig. To cut the rabbets on the drawer sides, I constructed a simple jig to hold the piece vertically.



Beveled Ends. Just like the top and bottom of the case, the drawer fronts and backs have beveled ends.



Bottom Grooves. Grooves along the bottom edges of the sides, fronts, and backs accept the drawer bottoms.

backer and two to sandwich the workpiece in place. Pin nails or even just double-sided tape work fine to assemble this cutting jig. Conveniently, this jig will also help eliminate any chipout on the back edges. Once you have the jig made, slide the workpiece into it and make the cut.

FRONT, BACK, & BOTTOM. The remaining drawer work is fairly straightforward. After cutting the fronts and backs to size, trim a bevel on their ends to match the dovetailed rabbets in the sides (as in Figure 2). To accept the bottom panel, cut a groove along the inner, lower edges of the sides, fronts, and backs (Figure 3). After you cut the bottom panels to size, you're now ready to glue up the drawers.

FINISHING TOUCHES. Like the angled rabbets on the case, we added dowels to the joints after the fact. Once the clamps come off the drawers, drill out the holes for those dowels, mallet them in, then trim them flush.

A false front for each drawer masks the end grain of the drawer sides and completes these drawers. After cutting these to size, you'll need to cut the mortises for the ring pulls. Refer to the bottom of page 45 for guidance on this. After screwing the ring pulls onto the false

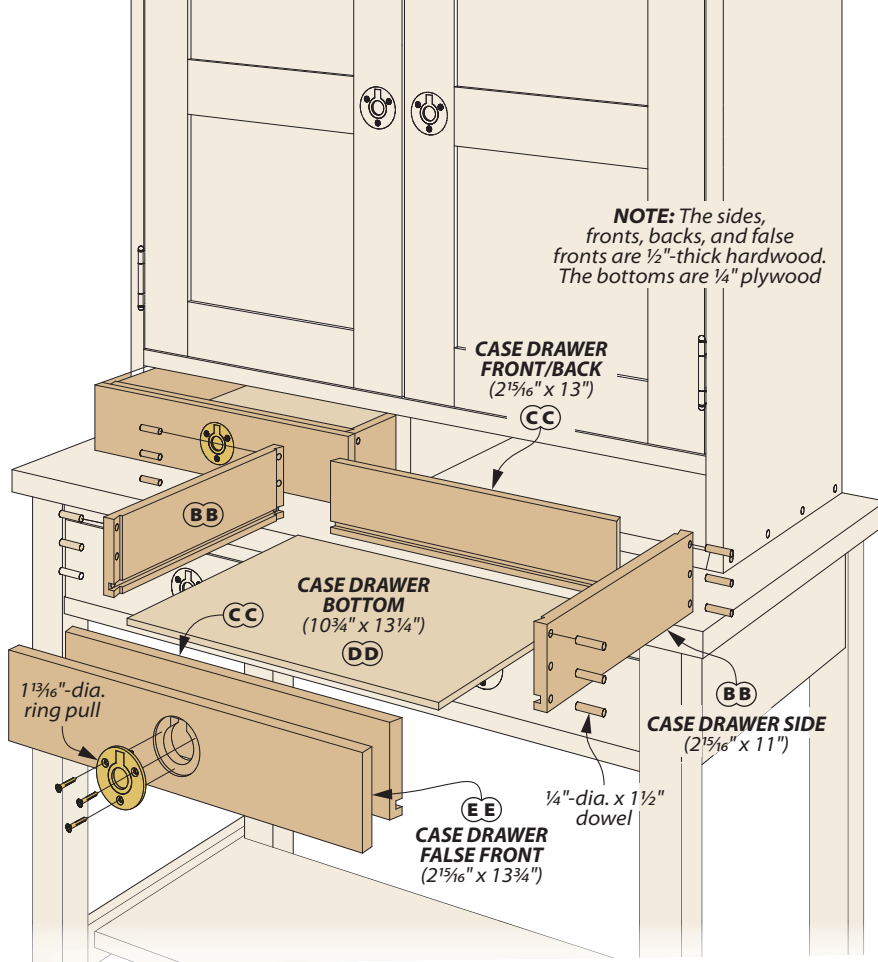
fronts, they can be screwed to the drawer fronts in turn.

CASE DRAWERS

The last task to complete this library chest is to make the set of drawers for the case. These are nearly identical to the ones in the base, save for being a bit narrower, which means you'll

need a narrower jig for cutting the rabbets in the sides. Aside from that, the same process will lead you to success.

With the last drawers complete, it's time for the finish. We found tung oil to be a great choice. After that, you'll just need to decide where this library will be spending its days. **W**



Materials & Supplies

A Legs (4)	1 3/4 x 1 3/4 - 31	N Base Top (1)	1 x 18 - 34	AA Bs. Drwr. False Fronts (2)	1/2 x 3 7/16 - 13 3/4
B Lower Base Rails (2)	3/4 x 2 - 15 1/2	O Case Sides (2)	3/4 x 12 - 30	BB Case Drawer Sides (4)	1/2 x 2 15/16 - 11
C Base Side Rails (2)	3/4 x 5 - 15 1/2	P Case Top/Bottom (2)	3/4 x 12 - 28 7/8	CC Case Drawer Front/Back (4)	1/2 x 2 15/16 - 13
D Base Back Rail (1)	3/4 x 5 - 29 3/4	Q Horizontal Case Divider (1)	3/4 x 11 1/2 - 29	DD Cs. Drwr. Bottoms (2)	1/4 ply. - 10 3/4 x 13 1/4
E Base Front Rails (2)	3/4 x 1 5/8 - 29 3/4	R Case Drawer Divider (1)	3/4 x 3 1/2 - 11 1/2	EE Cs. Drwr. False Fronts (2)	1/2 x 2 15/16 - 13 3/4
F Base Drawer Divider (1)	3/4 x 1 5/8 - 4	S Case Back (1)	1/2 ply. - 29 1/4 x 29 1/4	• (16) #8 x 1 1/4" Fh Woodscrews • (8) #8 x 1" Fh Woodscrews • (4) #8 x 1 1/2" Wh Woodscrews • (64) 1/4"-dia. x 1 1/2" Dowels • (6) 1 3/16"-dia. Ring Pulls • (2 pr.) 2" No-Mortise Hinges • (2) Magnetic Door Catches • (8) #8 x 3/4" Fh Woodscrews	
G Base Drawer Shelf (1)	3/4 ply. - 15 5/8 x 30 3/4	T Case Shelf (1)	3/4 x 10 1/2 - 28 3/8		
H Base Shelf Cleats (2)	3/4 x 5/8 - 8 1/4	U Door Stiles (4)	3/4 x 2 1/2 - 24 5/8		
I Base Shelf (1)	3/4 x 11 1/4 - 30 1/4	V Door Rails (6)	3/4 x 2 1/2 - 10 1/8		
J Center Drawer Guide (1)	3/4 x 3/4 - 15 1/8	W Door Panels (4)	1/2 x 9 9/16 - 10		
K Side Drawer Guides (2)	3/4 x 7/8 x 14 1/4	X Base Drawer Sides (4)	1/2 x 3 7/16 - 16		
L Base Cleat Sides (2)	1/2 x 2 - 14	Y Base Drawer Front/Back (4)	1/2 x 3 7/16 - 13		
M Base Cleat Tops (2)	3/4 x 7/8 - 14	Z Bs. Drwr. Bottoms (2)	1/4 ply. - 13 1/4 x 15 1/2		



Curved-Leg Lounge Chair

Graceful curves invite relaxation in this streamlined chair. A classic bending technique lies behind it all.

There are projects where a technique is the driving force. Think dovetails in a case piece. Two things occur when this happens: first, as a woodworker, you have the chance to build your skills with a technique. The second is that you end up with a project to show for it. This chair is a great example of this.

Dillon has sort of become our resident chair guy. For his latest project, he wanted to design a chair that featured flowing curves and a contemporary vibe. To achieve those curves, he turned to bent lamination. Thin, flexible pieces of wood (and plywood) are glued together around a form that matches the curve you want to create. Once the glue dries, the shape is set. The front legs are the most obvious use of this technique. However, the seat and back rest are shaped this way as well.

MATERIAL MATTERS. One issue with bent lamination is that the individual strips may stand out on the edges. To minimize that, Dillon selected straight-grain walnut for the legs, as you can see in the detail photos. On the seat and back rest, he chose riftsawn oak plywood. The result is an even curve with quiet lines. By the way, the plywood edges are covered with veneer edgebanding. With an oil finish, the two materials go well together.

◀ The curved seat and back rest are formed with a lamination technique as well. In this case, plywood pieces are glued up.



▶ Large rubber bumpers cushion the seat and back rest, adding to the comfort provided by the curved pieces. Also note the complementary screw plug.



▶ Straight-grain walnut disguises the strips and gluelines that make up the curved front legs. The technique is described on page 62.



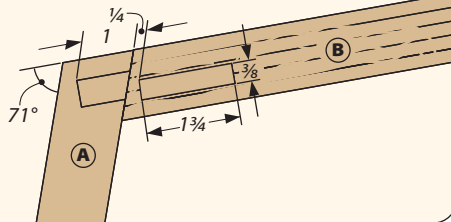
NOTE: Back legs are cut from 1¼"-thick hardwood. The front legs are laminated from ¼"-thick strips

NOTE: The bent lamination technique is detailed in the article beginning on page 62

BACK LEG
(2½" x 24¾")

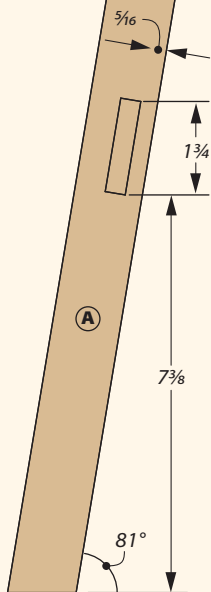
FRONT LEG
(2½" x 60" rgh.)

a. SIDE SECTION VIEW

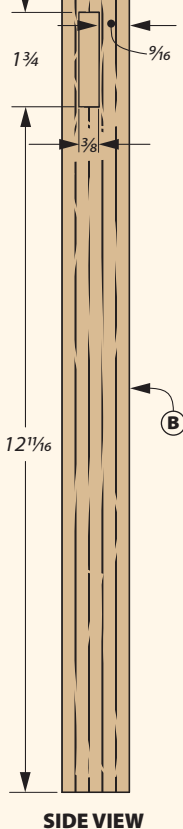


b.

SIDE VIEW



c.



You only notice the CURVED LEGS

The four legs of the chair form the primary structure. They also carry a lot of weight in the chair's appearance. That's due to the front legs. These reach up from the floor and flow back to form the arm rests.

BACK LEGS. I began with the back legs since they're easier to make than the front legs. I'll rationalize that by also saying they're a warm-up exercise for what's ahead. The back legs lean forward in order to meet the front legs. This requires you to cut an angle on each end, as shown details 'a' and 'b.'

Once you establish the final size of the legs, it's time to focus on the joinery that connects the legs to the other components of the chair. For the most part, mortise and tenon joinery assumes this role.

Detail 'b' shows the location of the mortise on the inside face of the leg that houses a stretcher. Take a look at Figure 1 on the next page to see how I tackled the mortise at the top of the leg. I cut a wedge to match the angle to support the workpiece. Some chisel work is needed to square the corners and smooth the edges of the mortise.

FRONT LEGS

All right. The easy stuff is over, it's time to tackle the front legs. These signature elements are made up of a series of thin strips glued into a curved shape. The article on page 62 has more details. Here I'll hit the major points of the process.

You need five strips for each leg. I cut these from a long blank at the band saw. Between each

cut, I planed the face smooth. The strips take a trip through the planer to clean the opposite face.

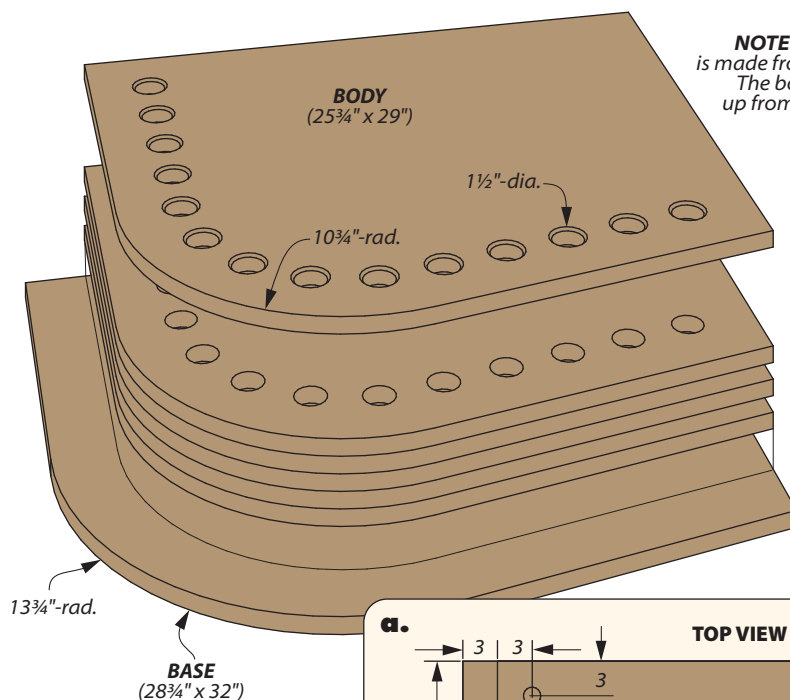
BENDING FORM. The legs get their shape from the bending form shown in the drawing at right. The body consists of four layers of MDF. I shaped one layer to use as a template. Glue on a slightly oversized piece and trim it flush with a router and a flush-trim bit. Packing tape covers the edges so the strips won't get glued to the form.

A series of holes along the curved edge holds the heads of clamps for the laminating process. A wide base allows you to secure the form to the bench.

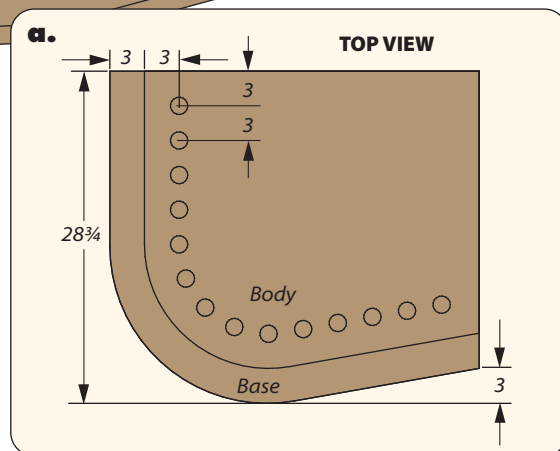
MORE JOINERY. Once the legs come out of the forms, you need to address some joinery. Figure 2 below details the process for a mortise on the inside of the leg to hold the front stretcher. Cut another one near the back, as shown in detail 'a' on the previous page. The back end of the leg has a tenon to fit into the back leg. Due to the shape of the workpiece, I used the band saw to cut the wide faces of the tenon.

Guide the leg with the rip fence. The sides of the tenon can be cut the same way with the leg curling up from the saw table. Trim the angled shoulders of the tenon with a back saw.

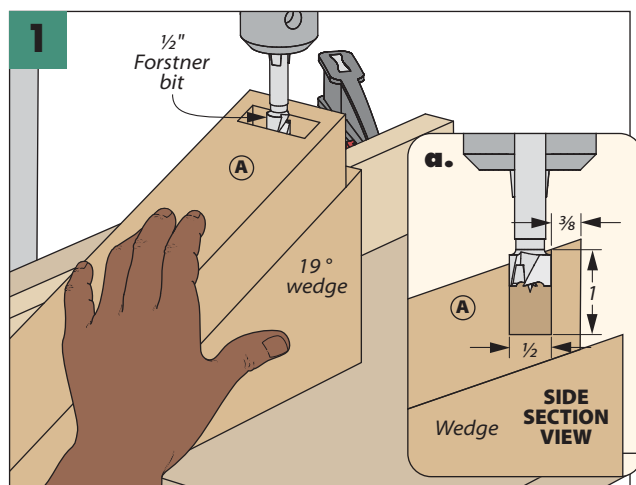
ASSEMBLY. Glue up the legs. I secured a handscrew clamp to the front leg, serving as a clamp block, and pull the parts together.



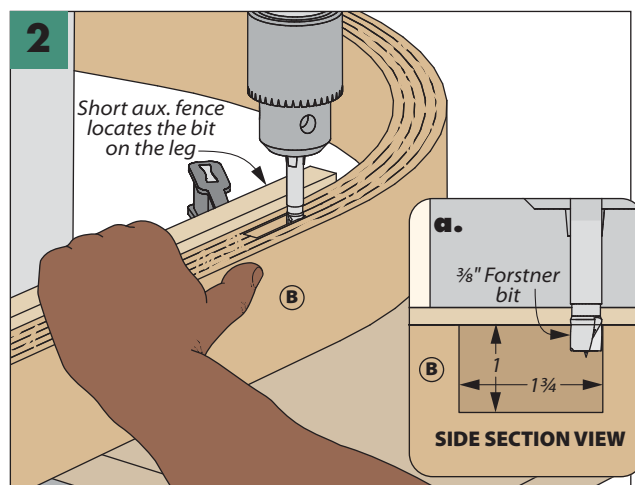
NOTE: Form base is made from 3/4" MDF. The body is glued up from four layers of 3/4" MDF



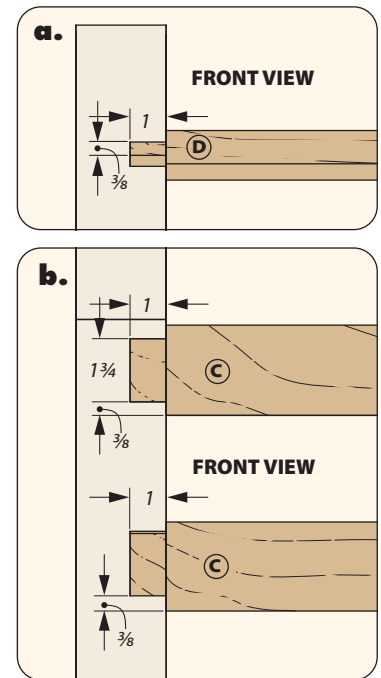
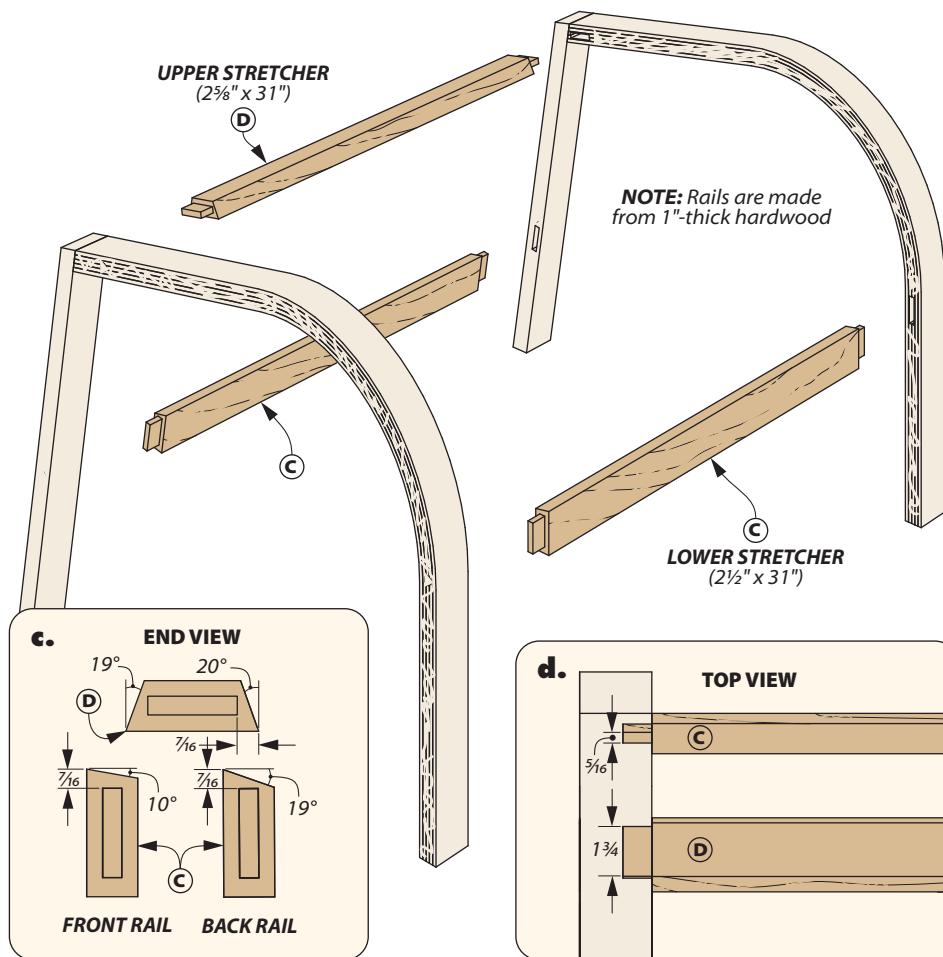
MORTISES IN MINUTES



Angled Mortise. Cut a wedge to match the angle of the leg. Use a Forstner bit to clear out most of the waste between the layout lines.



Front Leg Mortises. Attach a short fence to the drill press table to locate the workpiece without the curve of the leg getting in the way.



Bring it **ALL TOGETHER**

The middle part of this chair project almost feels like cabinetmaking. The parts here are all straight and square and the

joinery is traditional. Only a few bevels to shake things up.

STRETCHERS. The drawing above picks up the story. A trio of stretchers join the leg pairs into a single unit. These aren't identical parts, though. Take note that the upper stretcher is slightly wider than the lower two.

Cut a tenon on each end of the stretchers, as you can see in details 'a,' 'b,' and 'd.' Figure 1 at left shows a table saw method that provides good results.

From a drawing point of view, the tenons are the same. In practice, it's a good idea to base the tenon sizes off the actual mortises in the legs.

For me, this means cutting the tenons a bit oversized. Then I use a shoulder plane to trim each tenon for a snug fit into a specific mortise. I'm not talking about a lot of waste material to remove, though. Ideally, a few swipes

should be all that's needed to achieve a snug fit.

BEVELS. The upper edges of the lower stretchers have a bevel to account for the tilt of the seat and their relative position to each other. Detail 'c' shows the angle. These kinds of angles are fun to form with a hand plane. Double check your work. Install the stretchers into the legs and use a straightedge to see if the surfaces align. Fine-tune any inconsistencies.

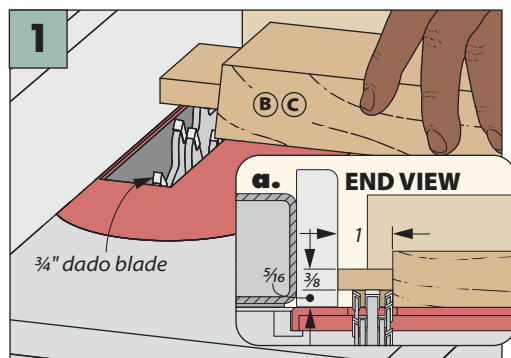
The upper stretcher has a bevel along each edge. The back edge matches the slope of the legs. The front accounts for the lean in the back rest. Again refer to detail 'c.' With that complete, glue the stretchers into their mortises.

SEAT & BACK FRAMES

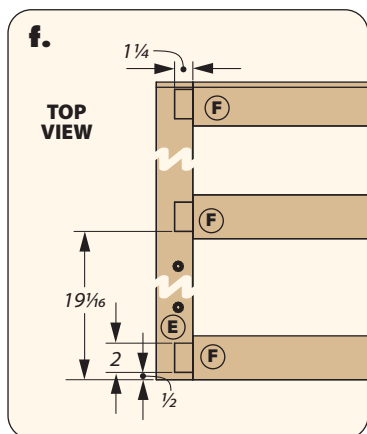
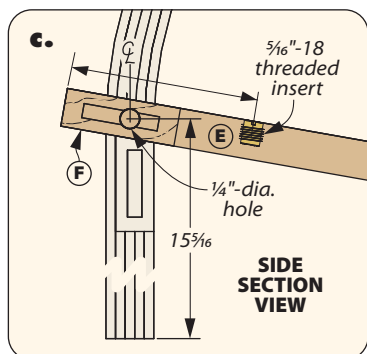
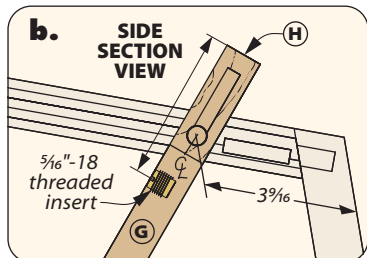
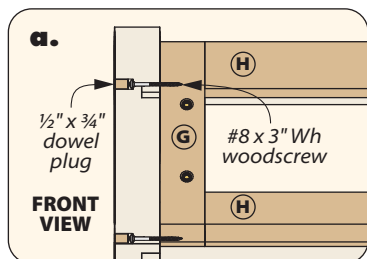
The next stage is to make a pair of frames. These will hold the seat and back rest. The drawing on the next page shows what's all involved. These frames rest on the stretchers.

SEAT FRAME. The seat frame comes first. A pair of stiles is joined by three rails. Cut the mortises in the stiles first, then form the tenons on the rails.

TABLE SAW TENONS

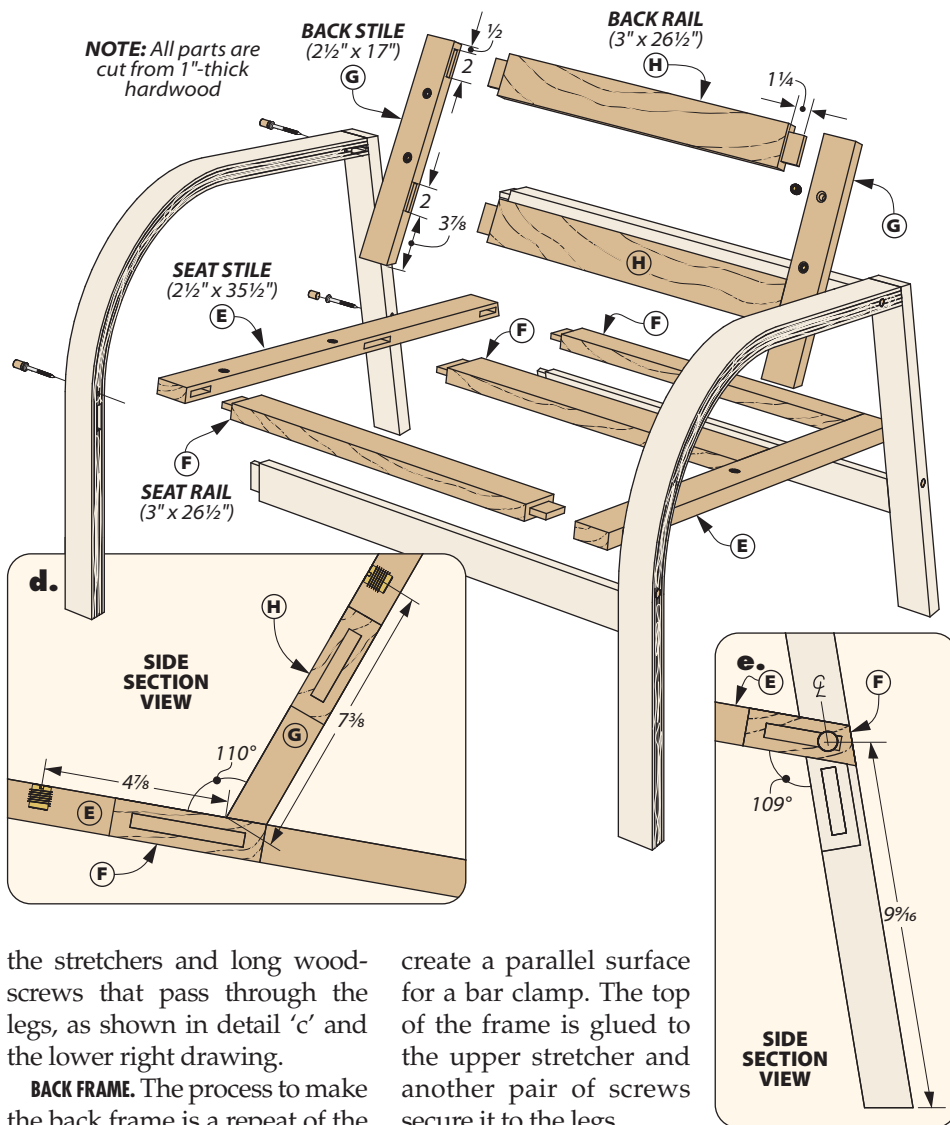


Smooth Cheeks. A dado blade makes clean tenon faces. Use the rip fence as an end stop so that the tenons are consistent in length.



These's one other detail, and that's to drill holes and install a set of threaded inserts, as shown in details 'c' and 'd.' These are used to support the seat.

ASSEMBLY BEGINS. It's time to glue up and install the seat frame. Once the clamps come off, set the frame in place. It should be flush with the back legs, as shown in detail 'e.' I marked and planed the waste away. The frame is held by glue on



the stretchers and long wood-screws that pass through the legs, as shown in detail 'c' and the lower right drawing.

BACK FRAME. The process to make the back frame is a repeat of the seat frame, more or less. The notable exception is that there are only two rails.

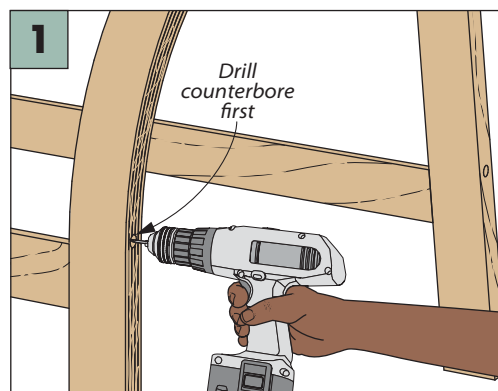
In detail 'd' notice that the bottom ends of the stiles are mitered to meet the seat frame when the stiles lie against the upper stretcher (detail 'b').

When you've assembled the back frame, you're left with a tricky situation. How do you clamp the back frame to the seat frame? My solution was to make a pair of clamping blocks.

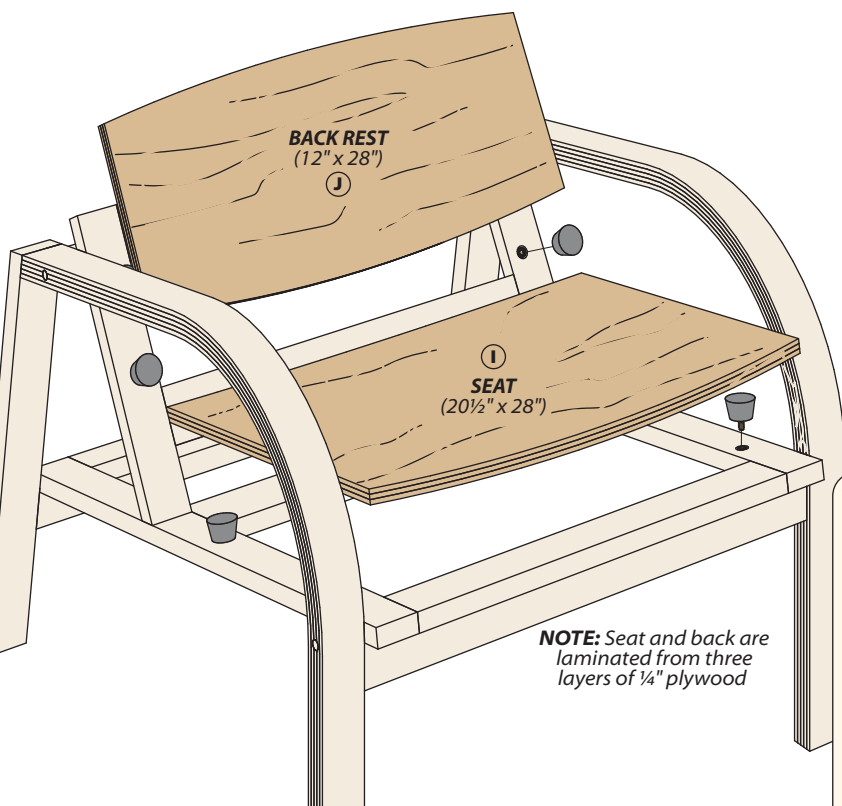
One block is angled to match the tilt of the frame. It's clamped to the rear of the back frame. Think of it as a clamping square, just with one angled leg. The other block goes below the seat frame. It has an angled edge to

create a parallel surface for a bar clamp. The top of the frame is glued to the upper stretcher and another pair of screws secure it to the legs.

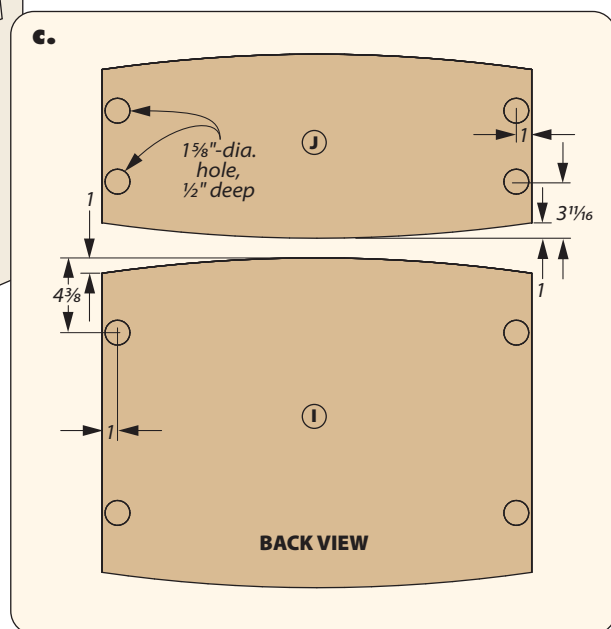
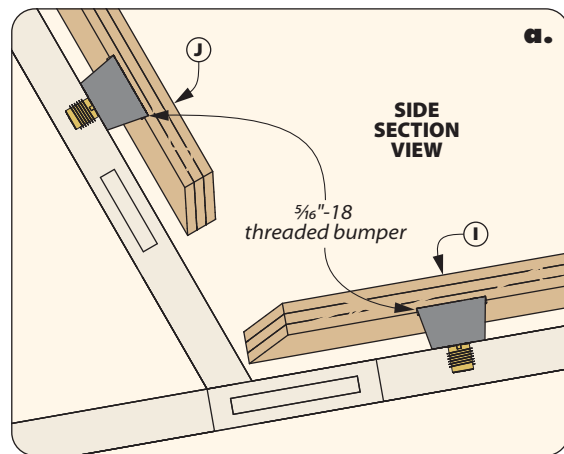
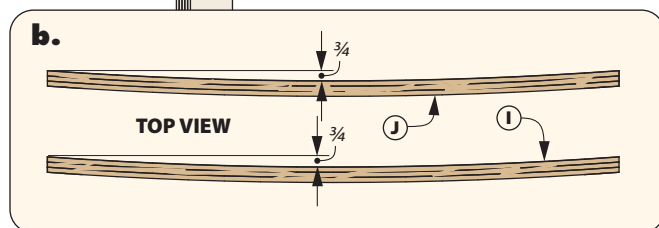
ANCHOR WITH SCREWS



Two-Step. The dimple left by drilling the counterbore positions the smaller pilot bit to drill the through hole in the leg.



NOTE: Seat and back are laminated from three layers of 1/4" plywood



Curvy, Comfy **SEAT & BACK**

The chair's structure is complete. What's left is to make the parts of the chair that meet our bodies: the seat and back rest. The previous parts emphasized sturdy construction. Here our main concern is comfort. Dillon's design for this chair separates those two functions so that you can focus on one goal at a time.

Surprisingly, a comfortable chair doesn't require upholstery or deep cushions. All it takes is a gentle curve in the seat and back that cradles the sitter and distributes weight.

LAMINATED PANELS. To pick up an earlier theme, the way to do that is with bent lamination. While the front legs were glued up from narrow, thin strips, the seat

and back rest are glued up from wide, thin sheets or panels.

For the version we made Dillon selected thin plywood. It's flexible enough to conform to the shape he wanted.

You could certainly use thin solid wood here as well. The width of the layers means that you will have to glue up narrow pieces. I would aim for riftsawn or quartersawn material to minimize wood movement.

TWO-PART FORM. One of the differences with this type of lamination is that the surface area is much larger. You need a way to spread out the clamping pressure. The solution is a two-part form, as you can see on the next page. The forms are

mirror-images of each other. This creates a clamp sandwich.

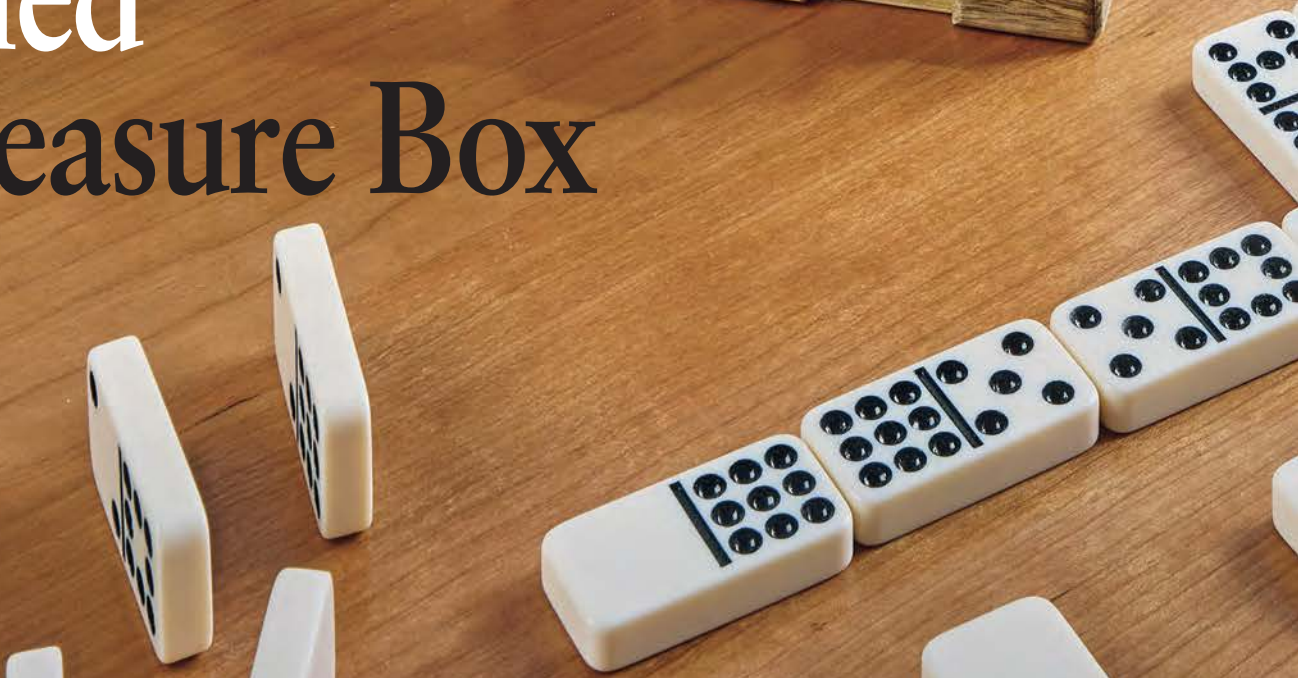
I made the convex form first. This starts with the ribs. Like the form for the legs, I made one rib first and used that as a template for the rest (detail 'a' on the next page). The ribs are glued to a base, as in detail 'b.'

The final step is to add a thin layer of plywood across the ribs. This creates a smooth surface for the workpieces and prevents the ribs from leaving dents in the project parts. Apply a layer of packing tape across the surface to avoid laminating your parts to the form.

The second form has a concave profile. Otherwise the construction process is identical.



Tiled Treasure Box



The striking, tiled exterior and exotic hardwood aren't the only unique things about this keepsake box. A few well-placed cuts make a seamless, lipped lid easily achievable.

Many projects stem from a single concept or idea, which then informs all of the numerous decisions our designers make as they work out what a particular piece will be. The project you see here is one such case. When first working on this design, Chris Fitch knew he wanted a box emphasizing applied details, which eventually led him to the tiled pattern shown on these pages.

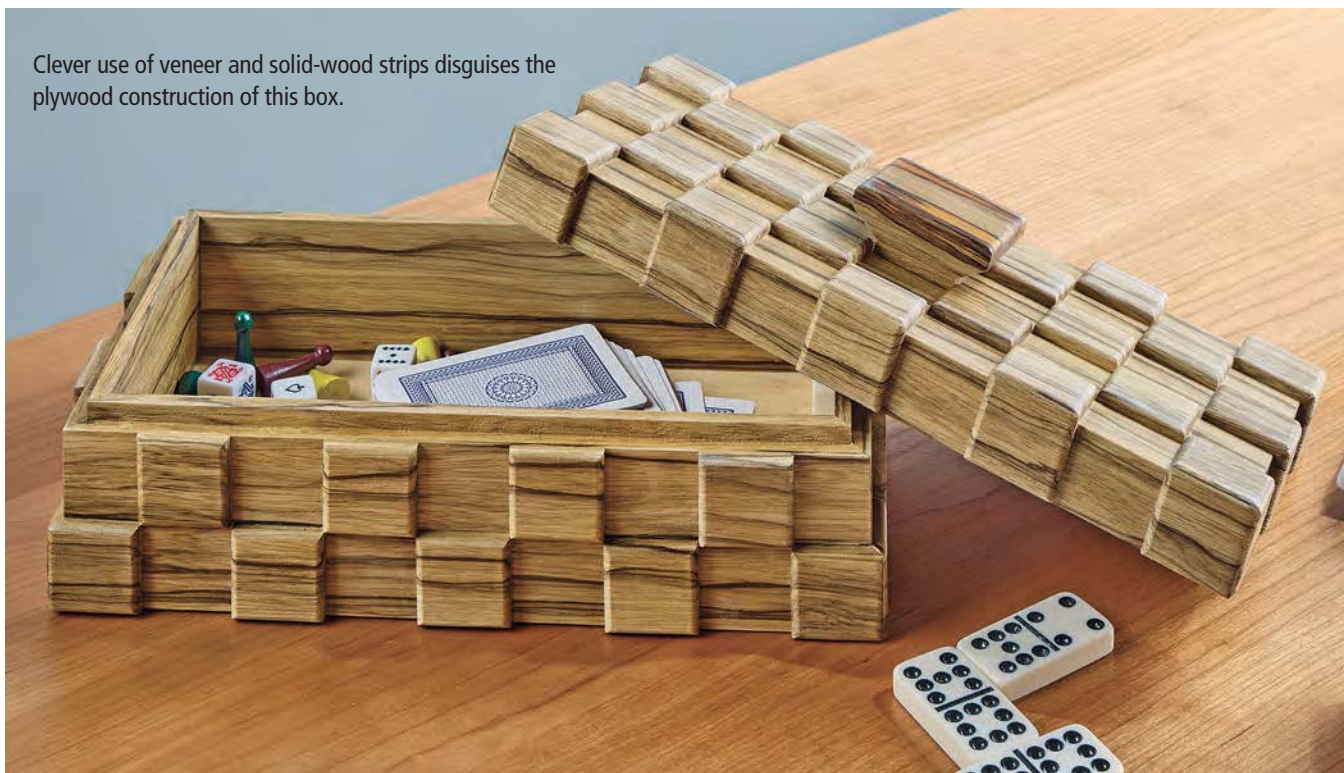
That tiling informed much of what this box is. The first concern was to create a stable base for the tiles. Despite its appearance, the meat of this box is actually plywood. A seamless look complemented the tiling best, which led to the process you'll find on the next page.

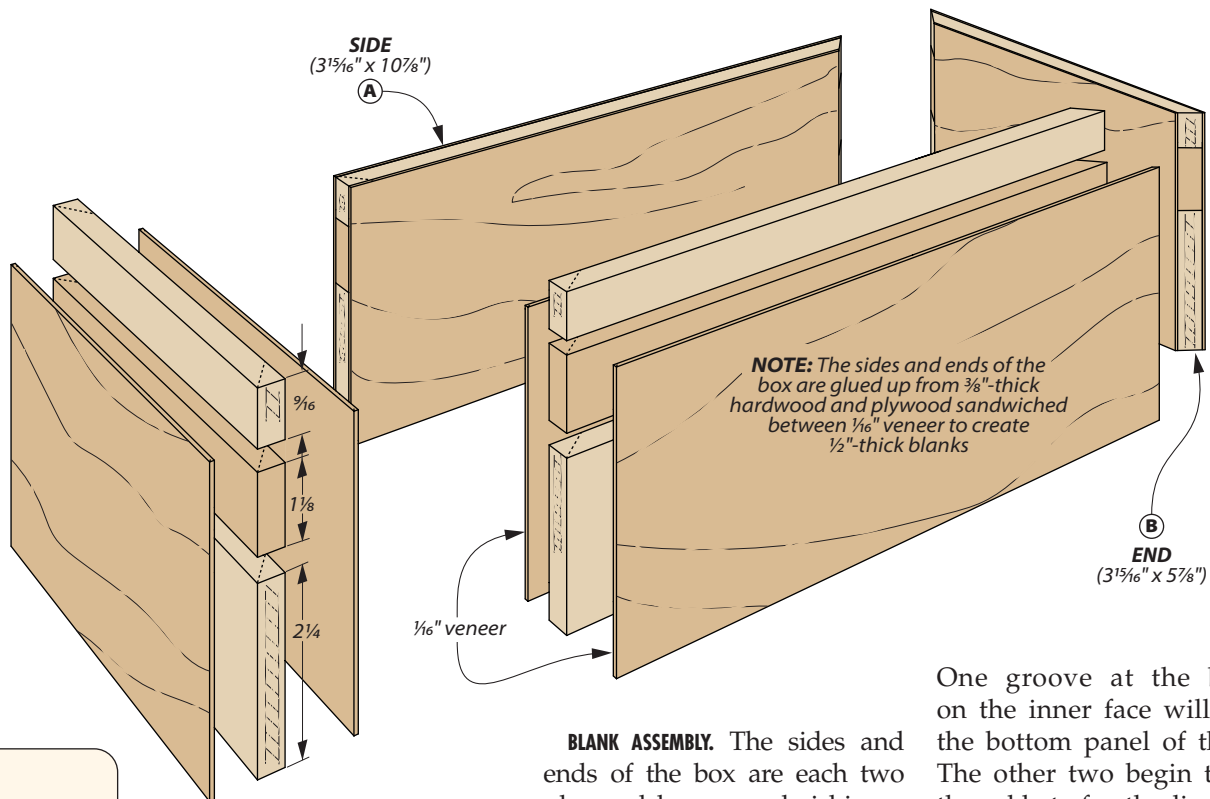
The hardwood that seems to dominate the project is black limba. The bold streaks in the figure worked quite well with the tiles, and black limba is pretty easy wood to work with, so the small parts weren't too much of a challenge. That said, any well-figured wood could work great as well, and there's even something to be said for picking two contrasting woods. Altogether, this project offers a distinct and eye-catching aesthetic with a build much simpler than it may seem.



▲ Mitered joinery begins the box, but that's just the start of the story on this lid design.

Clever use of veneer and solid-wood strips disguises the plywood construction of this box.





A Layered & MITERED BOX

The first half of this tiled box project is making the box itself. And, as you can see above, this isn't your typical box design.

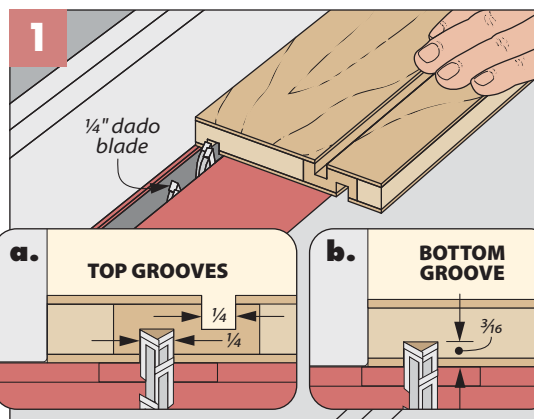
BLANK ASSEMBLY. The sides and ends of the box are each two plywood layers sandwiching a layer of solid wood, with veneer on both faces. The purpose of this is to give ourselves a stable base for the tiles while still appearing as solid wood.

Begin by gluing the strips into a blank about four feet long. It's best to make the joinery on these blanks before they're separated.

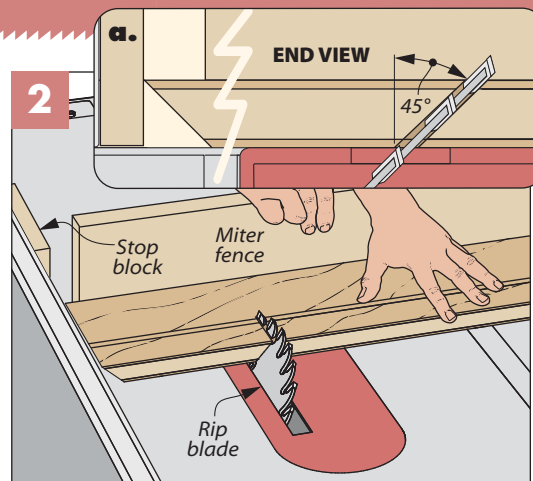
One groove at the bottom on the inner face will accept the bottom panel of the box. The other two begin to form the rabbets for the lipped lid. I made these at the table saw using a dado blade, as in Figure 1. A miter also needs to be cut along the inner face of the upper edge to accept the top.

Now, the parts can be separated from the blank. Miter their ends while cutting them to length (Figure 2). The rip fence

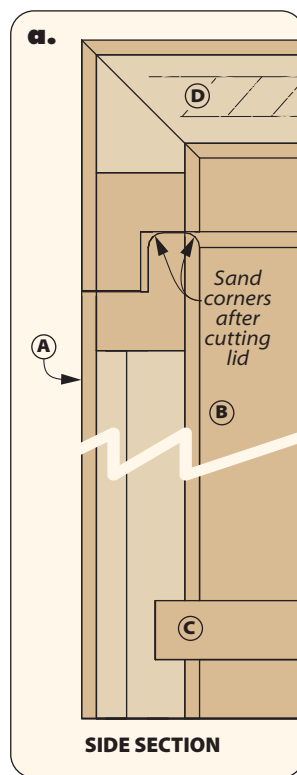
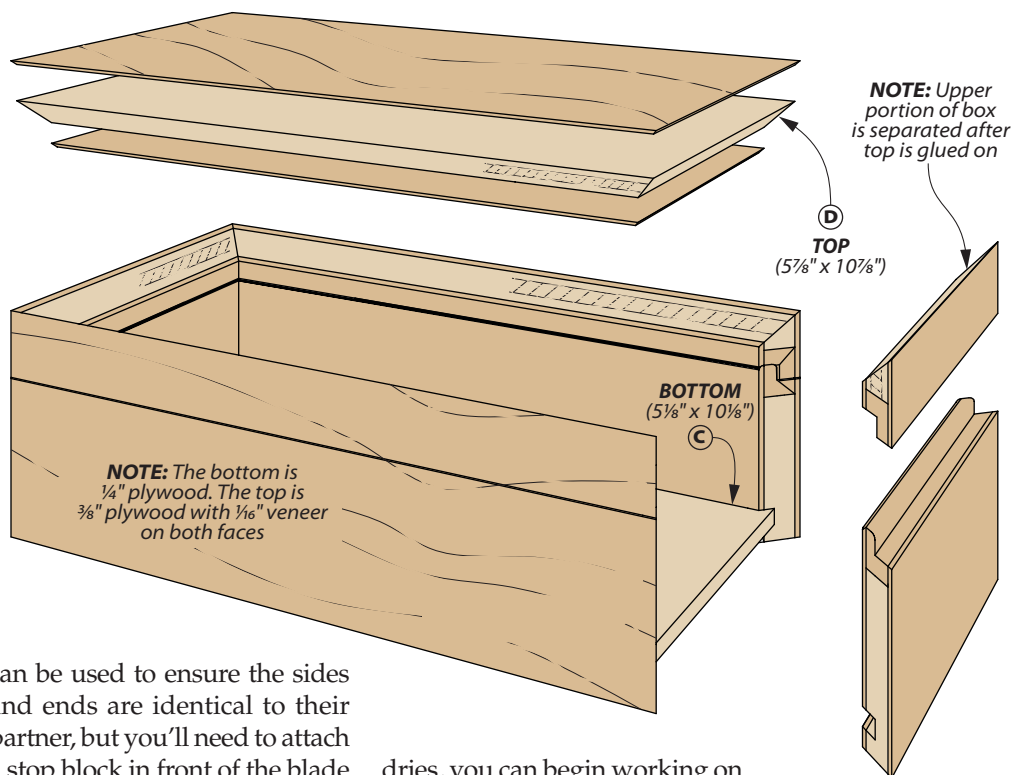
MAKING GROOVED BLANKS



Three Grooves. After gluing up the blank for the sides and ends, cut two grooves along the inner face of the blank and one on the outer face.



Miter Cuts. Once the grooves are in place, cut the blank apart into the sides and ends. These pieces join with miters, so miter them now.



can be used to ensure the sides and ends are identical to their partner, but you'll need to attach a stop block in front of the blade so the cutoff piece won't get trapped by the fence.

ASSEMBLING THE BOX

We'll need to bring the box together before we separate it into its final form. First, cut the bottom panel to size. Then, glue up the sides and ends of the box around it. While the glue the

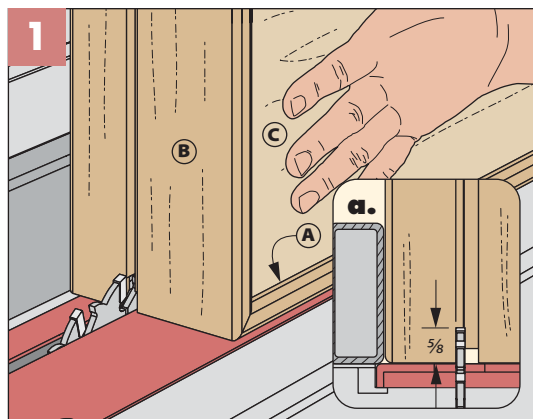
dries, you can begin working on the multi-layered top.

THE TOP. The top panel is a veneered piece of plywood. After it's been veneered and cut to size, miter its perimeter to fit the miters of the box. Test the fit with the other parts and, once you're happy, glue it on top.

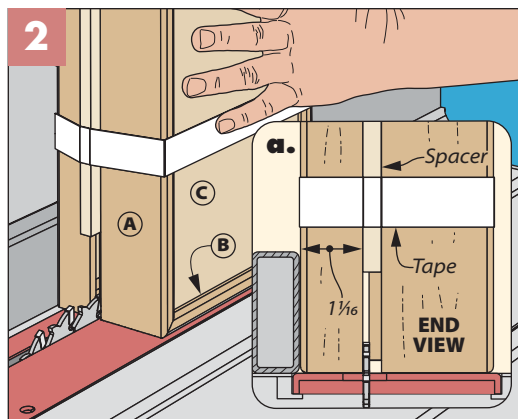
SEPARATE THE LID. After the top is glued on and the clamps come

off, it's time to separate the lid. The box below shows how. You'll remove the thin strip of waste shown in detail 'a' on the previous page, leaving you with rabbets, as in detail 'a' on this page. After you've separated the parts, sand the corners on the box so the lid slides on easily.

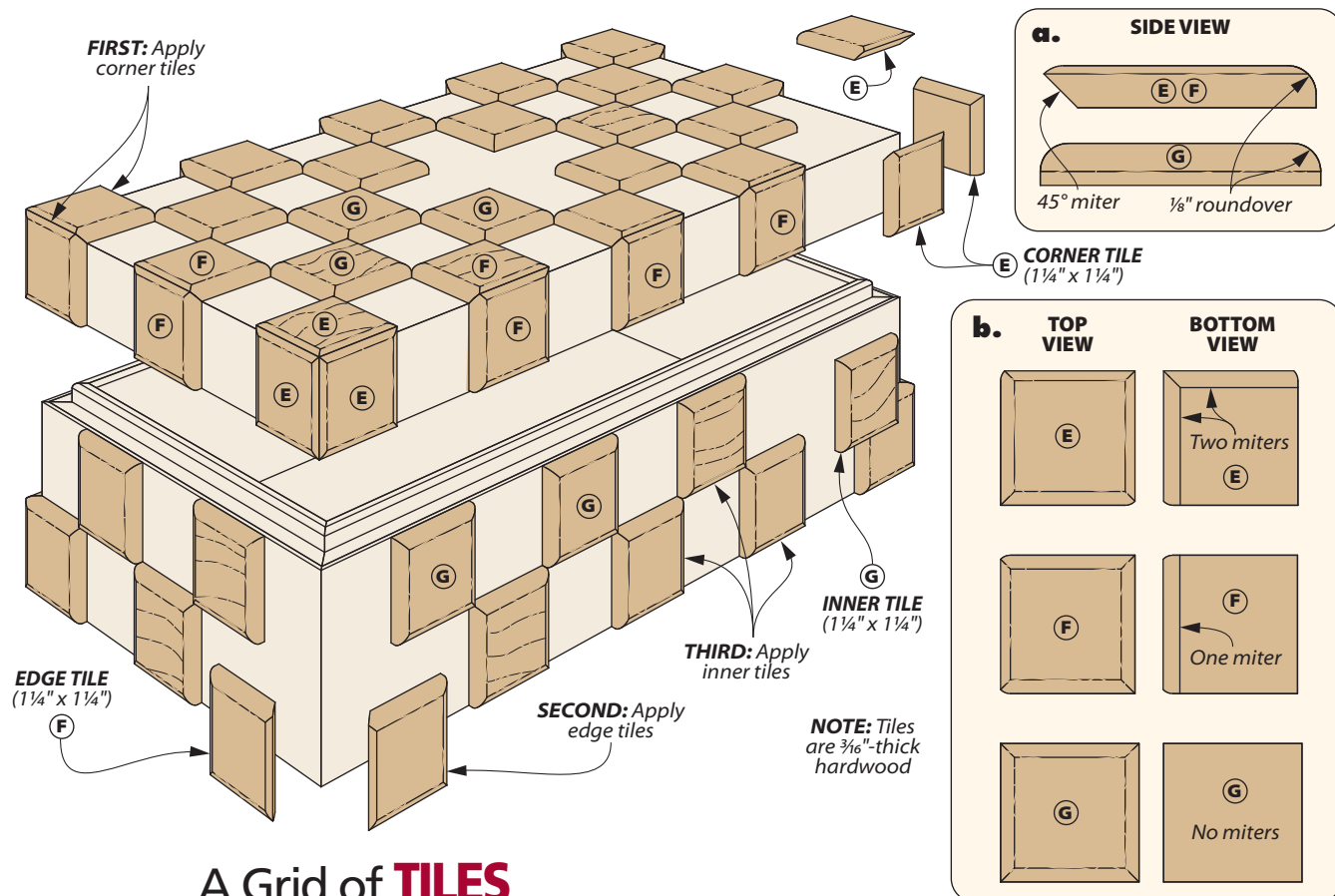
PERFECT-FIT LID



First Cuts. Begin separating the lid by cutting along the side pieces. Position the blade on the upper side of the outer groove.



Second Cuts. Finish removing the lid by cutting along the ends. Before cutting, tape spacers in the grooves to keep from pinching the blade.



A Grid of **TILES**

With our box made, it's time to tile it. You can see on this page how they're applied, but before getting there, we'll need to make three kinds of tiles.

CUTTING SMALL PARTS. You can see the tiles we'll be working with in details 'a' and 'b' above. The three kinds of tiles are all the same size, and they all feature roundovers on their upper edges. Where they differ is in the miters on their bottoms.

Begin by cutting the tiles to size. First, I planed the stock down and cut several strips

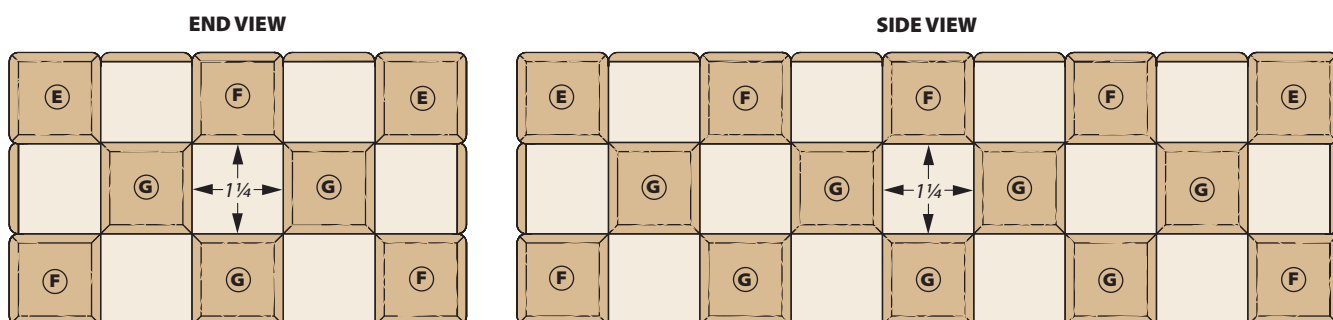
to width. Make sure you have enough material to cut a few spares. Spare parts are always handy to have in case of tearout or other mishaps, but we'll also be using them as spacers shortly.

To cut the tiles to length, I used a small parts sled for the table saw, as you can see in Figure 1 on the next page. This consists of plywood base with a front and back fence. Underneath, hardwood runners slide in the miter slots to keep the sled on track.

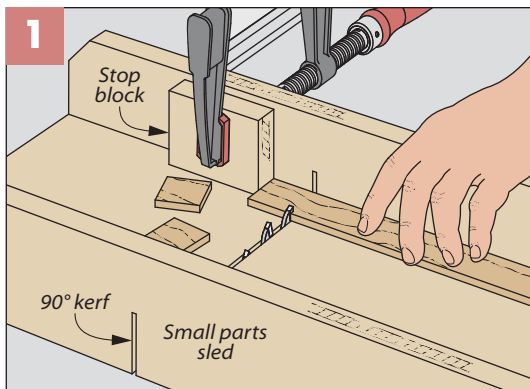
Once all the tiles are cut, it's time to round them over. I did

this at the router table using a roundover bit. Due to their small size, I held the tiles in a wood handscrew clamp.

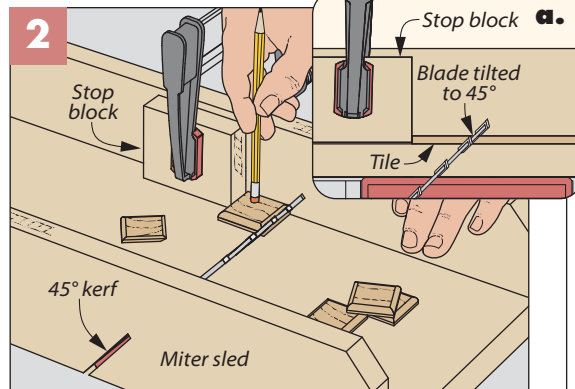
Before adding the miters, sort the tiles into three piles: corner tiles, edge tiles, and inner tiles. The inner tiles are done; set them aside. As for the others, the corner tiles need two miters (as they're adjacent to two other tiles) and the edge tiles need one miter (since they're adjacent to one other tile). I used another sled for the table saw, but this time with a 45° kerf (Figure 2).



CUTTING SMALL PARTS



Small Parts Sled. The safest and most accurate way to cut the tiles is to use a table saw sled. A stop block ensures each tile is identical.



Miter Sled. Use a sled with a kerf at 45° to cut the miters on the corner and edge tiles. Use a stop block to ensure the miters are consistent.

APPLYING THE TILES. To attach the tiles, use a quick-set glue, like *Titebond's Speed Set*. Begin at the corners. Apply a dot of glue to the bottom of a tile and hold it in place until the glue sets.

Next, the corners can be used as a reference for the edge tiles. Use a ruler as a straightedge and a spare tile as a spacer, then glue

the edge tiles in place, working towards the center. Finally, the inner tiles can be glued on. As before, a ruler used as a straightedge and a spare tile spacer should get you through.

ADDING THE HANDLE

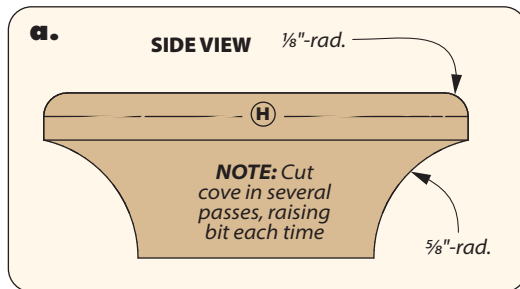
To finish up this box, we'll need a handle to complement our lid.

This begins as a small hardwood block. After sizing it, there are two tasks. First off, rout roundovers along the upper edges (detail 'a'). Next, we'll need to cut the coves

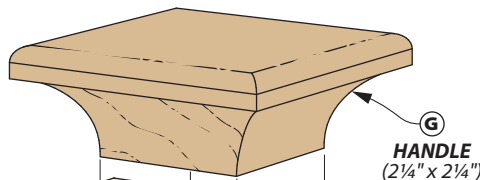
beneath to give your fingertips somewhere to grip.

This was done at the router table with a cove bit. As with the tiles, I used a handscrew clamp to hold the workpiece and keep my fingers away from the bit. The cove bit takes off a good amount of material, so it's smart to make these cuts in multiple passes. I also find it best to make the two cuts across the grain first, that way chipout will be removed by the lengthwise cuts.

With that, the handle is complete. Quick set glue attaches it to the box just as well as it does the tiles, so place a dollop on the bottom and press it down until it sets. Once it's dry, your box is finished, and all that remains is to figure out what to store in this striking new piece. **W**



NOTE: The handle is 5/8"-thick hardwood



Materials & Supplies

A Sides (2)	$\frac{1}{2} \times 3\frac{15}{16} - 10\frac{7}{8}$
B Ends (2)	$\frac{1}{2} \times 3\frac{15}{16} - 5\frac{7}{8}$
C Bottom (1)	$\frac{1}{4}$ ply. - $5\frac{1}{8} \times 10\frac{1}{8}$
D Top (1)	$\frac{1}{2}$ ply. - $5\frac{7}{8} \times 10\frac{7}{8}$
E Corner Tiles (12)	$\frac{3}{16} \times 1\frac{1}{4} - 1\frac{1}{4}$
F Edge Tiles (24)	$\frac{3}{16} \times 1\frac{1}{4} - 1\frac{1}{4}$
G Inner Tiles (30)	$\frac{3}{16} \times 1\frac{1}{4} - 1\frac{1}{4}$
H Handle (1)	$\frac{7}{8} \times 2\frac{1}{4} - 2\frac{1}{4}$

Bent Lamination

How do you get a straight, rigid piece of wood to bend in a smooth, flowing curve? One way is with a technique called bent lamination.

▼ **Strong Grain.**

The key to the strength of a curved form that's made by gluing up thin strips of wood is simple — the grain

Basically, it involves ripping a bunch of thin, flexible strips of wood and applying glue to each one. Then, after stacking the strips in layers like a sandwich, they're bent around a form and squeezed together with clamps. This is the most challenging part of the whole process — and also

the messiest. As you wrestle the slippery strips around the jig, they slide up and down (and forward and back) against each other. And while you're trying to corral the strips, glue is oozing out everywhere.

But when the glue dries and you remove the clamps, the reward is worth it — a piece of wood that's bent to the shape of your form. Granted, it's now speckled with a crust of dried glue. But with a little cleanup

work (scraping, jointing, planing, and sanding), a beautiful bent lamination of your making begins to emerge.

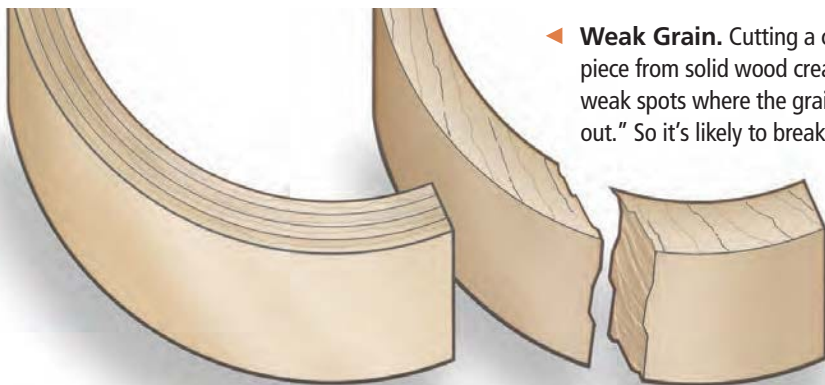
SIMPLE CURVES

Depending on the design of the project, you can bend wood into either a simple (one plane) or a compound curve (multiple planes). This affects both the strips of wood you cut and the kind of form that you need.

For the purposes of this article, I want keep the focus on simple curves. After you've experimented with this technique in several projects, you can begin to branch out in to more complex bent shapes.

SIMPLE. To create a simple curve, the wood strips that are bent around the form remain in a single, flat plane. And, while a simple curve from a single species is attractive all by itself, you can combine species to add contrast and visual appeal.

◀ **Weak Grain.** Cutting a curved piece from solid wood creates weak spots where the grain "runs out." So it's likely to break.



STRENGTH

Now you might think that a bent wood form would be extremely fragile. But that's not the case. In fact, it's considerably stronger than a curved piece that's cut from solid stock.

GRAIN DIRECTION. The reason has to do with grain direction. Take a look at the drawings on the previous page to see what I mean. When you glue up thin strips of wood into a curved form, the grain runs around the bend. So the grain acts like a continuous thread that reinforces the piece — even when it's bent in a tight curve.

But if you cut a solid piece of wood into the same curved shape, there's a weak spot where the grain "runs off" the edge. And even a small amount of pressure can cause it to break.

THIN STRIPS

Grain direction also plays a big part in how easy it is to bend the thin strips around the form. Here are some other characteristics to consider.

STRAIGHT GRAIN. To prevent the strips from breaking, the goal is to end up with straight grain on the edge of the strips. This way, the wood fibers will lay nice and flat when you bend the strip — almost like you're smoothing the fur on a cat. This is shown in detail 'b' in drawing at right. So if the straightest grain is on the face of the board, all you need to do is rip the strips to the desired thickness.

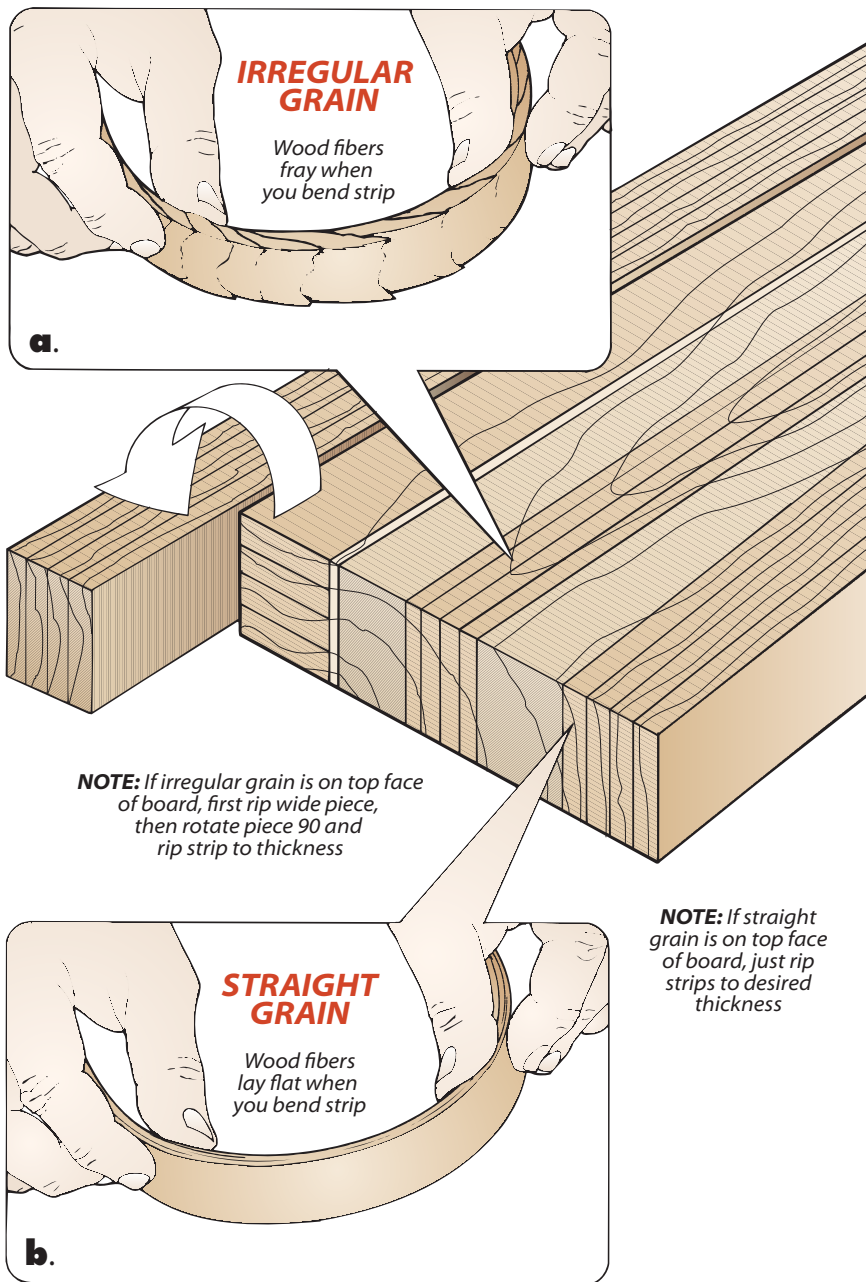
IRREGULAR GRAIN. But if the grain on the edge runs in an irregular pattern, the wood fibers will start to fray as you bend the strip, as shown in detail 'a.' Almost as if you're stroking the fur in the wrong direction. That's a good indicator that the strip will fracture, and ultimately fail.

RIP & FLIP. What if the straight grain is on the edge of the board (not the face)? Just rip a piece to the width of the finished strips (plus $\frac{1}{16}$ " to allow for clean-up), as shown in the drawing at right. Then flip that piece on edge and rip the strips with the straight grain up.

While a table saw works for cutting the strips, I prefer to use the band saw. The thin blade removes less material. Between each cut, I use a hand plane to smooth the edge of the workpiece.

THICKNESS. In addition to the grain, another consideration is the thickness of the strips. As a rule, I use the thickest strip that I can bend around the jig without breaking. Depending on how tight the bend is, that's anywhere between $\frac{1}{16}$ " and maxing out at $\frac{1}{4}$ " thick.

To find out for sure, you'll need to bend a test strip. If it starts to break, try another one that's $\frac{1}{32}$ " thinner. This doesn't sound like much but it can make all the difference between a successful bend and disappointing break.



TIPS ON RIPPING THIN STRIPS

- 1 Select Clear Wood. Wood with straight, clear grain bends best. So avoid using wood with knots or highly figured grain.
- 2 Rip for Straight Grain. To reduce the chance of breaking a strip, rip each one so the straight grain is on the edge.
- 3 Cut Strips Oversize. To allow for final trimming and clean-up, cut strips about 2" longer and $\frac{1}{16}$ " wider than final size.
- 4 Arrange Strips. By arranging strips in order as they're cut off the board, the bent lamination will look like a piece of solid stock.
- 5 Make Extra Strips. Just in case a strip does break during the glue-up, it's a good idea to rip a few extra strips.

BENDING FORMS

Let's take a moment to talk about the other part of the bent lamination formula: the form. The form defines the final shape and distributes the clamping pressure along the strips so you don't end up with any gaps. A bending form can be as simple as a single piece or a two-part setup that consists of an inner form and one or more outer forms. Take a look at the forms used in the chair project on page 48 for some examples of two-part forms.

SHEET GOODS. Your form can be made from either plywood or MDF. I like using $\frac{3}{4}$ " MDF. It's much easier to shape than plywood and it's usually less expensive, too.

You want the forms to be approximately as thick as the wood strips you're going to bend. This way, the clamping pressure is distributed evenly across the thickness of the stock, and you're less likely to end up with gaps on the outside edges.

You also have to figure out how to clamp the strips to the form. I drill a series of holes parallel to the curved edge after the forms are cut out. Size the holes large enough to hold the head of your clamps. You're going to need a barrier between the forms and the strips so they're



▲ A makeshift trough is constructed to pre-soak the laminations. I just used some scrap wood from the shop — it doesn't have to be pretty. The trough should be just a bit larger than your strips so you don't need a lot of water.

not glued together permanently. To do this, I apply strips of packing tape to cover the edges.

SOAKING & PRE-BENDING STRIPS

When making the legs on the chair, I found that some of the strips felt too stiff to bend around the form. To make the strips even more flexible, you can soak them

in water and pre-bend them. The process is shown in the photos on these pages.

The strips on small projects can be placed in a tub or even a length of PVC pipe fitted with end caps. For the long strips of the chair, I ended up making a long, plywood trough and lining it with plastic.



▲ I lined the trough with a couple of 50-gallon garbage bags taped at the seam. A high-density painter's plastic will work as well.



▲ Place the laminations into the trough. Lay them on their sides and space them to ensure maximum moisture absorption.



▲ Once the laminations have been placed, add water and allow them to soak for 30 minutes to an hour.



▲ **Epoxy.** West System's 105 epoxy is a great choice for bent laminations, especially when pre-soaking the laminations.



PRE-BEND. After an hour, bend a strip around the form. If it still resists bending, you need to soak the strips longer. When the strip bends easily, gather them up and clamp them in place on the form, as shown in the lower left photo.

As you do this, you want the parts to be in as close to their final position as possible. As you tighten the clamps tap the strips into alignment with a hammer and block of wood.

Leave the strips in the form to dry. This will take a day or two. It all depends on the thickness of the strips and how long you had to soak them.

FINAL GLUEUP. The pre-bending process is a good practice run for the glueup. You can use regular wood glue for this. On this project, I used epoxy for the longer open time, as shown above.

Coat the mating surface of each strip with a layer of glue. Admittedly, this is a messy

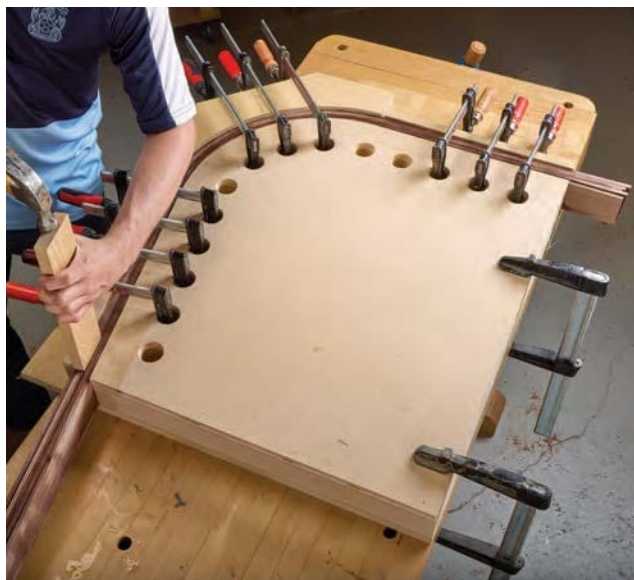
process. Wear gloves and have a few rags and the appropriate solvent on hand. (Use denatured alcohol for epoxy.)

At this point, the assembly isn't a pretty sight. There's glue caked everywhere. I use a carbide scraper to remove the excess. A block plane works well to clean up the edges. Any glue on the face can be sanded away. From there, trim the piece to final size, then it's ready to be put to use in your project. **W**

▲ Here, a lamination's pliancy is tested before committing to the final glueup.



▲ Combine the strips and begin to clamp them around the form as you would if you were gluing them up. Start on one end and work your way around the form.



▲ Once the laminations are clamped, I like to go back over and tap them down to the form with a block of wood and hammer. This ensures a flat side for milling.

Sources

Most of the materials and supplies you'll need to build the projects are available at hardware stores or home centers. For specific products or hard-to-find items, take a look at the sources listed here. You'll find each part number listed by the company name. See the left margin for contact information.

MAIL ORDER SOURCES

Project supplies may be ordered from the following companies:

Cabinetmaker Warehouse
cabinetmakerwarehouse.com

Destaco
888-337-8226
destaco.com

Heffrons
315-363-7726
heffrons.com

Kreg
800-447-8638
kregtool.com

McMaster-Carr
630-833-0300
mcmaster.com

Old Masters
800-747-3436
myoldmasters.com

Oliver Machinery
Company
800-559-5065
olivermachinery.net

Rejuvenation Hardware
800-279-4441
rejuvenation.com

Rockler
800-279-4441
rockler.com

West System
866-937-8797
westsystem.com

Woodpeckers
800-752-0725
woodpeck.com

TIPS & TECHNIQUES (p.6)

- **Destaco**
Toggle Clamp 213-U

PLASTIC LAMINATE (p.14)

While plastic laminate seems like an "Unobtainium" material, the reality is you can find it online from several sources. We get ours from *Cabinetmaker Warehouse*. The contact adhesive and other tools are readily available at hardware stores and home centers.

GREAT GEAR (p.22)

The three products featured in this issue's Great Gear can be purchased from the manufacturers' websites (see margin). Product SKUs are shown below.

- **Oliver Machinery Company**
Benchtop Jointer 10080.201
Jointer Stand. A-ADJSTAND.001
- **Kreg Tool**
Drawer Jig KCS-DFMT-PRO
- **Woodpeckers**
50" Panel Clamps CLPZ-50-4-22
38" Panel Clamps CLPZ-38-4-22
18" Panel Clamps CLPZ-18-4-22

STORAGE HUTCH (p.26)

We used our standard pre-catalyzed lacquer to finish the alder solid wood and plywood. For the painted parts, we selected *Benjamin Moore* colors in the Regal Select (semi-gloss) line: Blue Flower, Pure Joy, Mountain Peak White.

- **Rejuvenation Hardware**
Boomerang Pulls 3019003
- **Rockler**
18" Drawer Slides 43888
- **Cabinetmaker Warehouse**
Plas. Lam. Specter White . . . 15055
- **Heffrons**
Metal Edging EAM-900-BD

LIBRARY CHEST (p.40)

Shellac would be a historically accurate finish for this library chest. However, we chose to finish the library chest with tung oil, which did a nice job of accentuating the grain giving the white oak a deeper color.

- **Lee Valley**
Campaign Ring Pulls . . . 00A1824
No-Mortise Hinges 00H5122
- **Amazon**
Door Catches B0BKGN85RF

LOUNGE CHAIR (p.56)

Outside of the glue used to create the laminated parts and a few screws, the chair requires no other hardware. The finish is a couple coats of *Old Masters'* tung oil. I thinned the tung oil with mineral spirits in a 50/50 ratio to make it easier to apply. Apply a coat of wax after the oil dries for a couple days.

TILED TREASURE BOX (p.56)

No hardware is required to build the tiled treasure box. As for finish, we found the black limba we used for the box was best complemented by a satin spray lacquer. Shellac or was would work here, too. Just avoid using oil on the inside of the box — it can leave a lingering smell.

BENT LAMINATION (p.62)

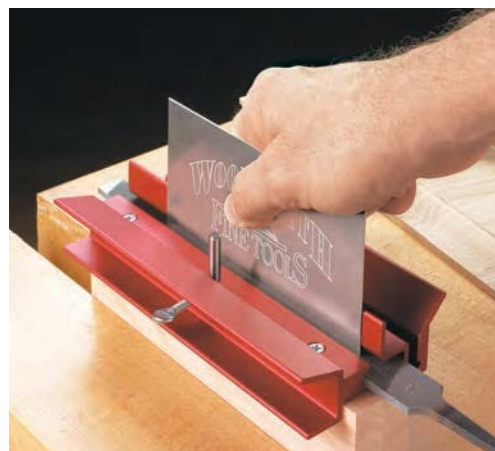
You can use your regular wood glue (such as Titebonds Original and II versions) for bent lamination projects. For the lounge chair, Dillon used epoxy for the long open time. He used the 105 series epoxy from *West Systems*.

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