

**DON'T BRUSH STAINS! WHY WIPING IS BETTER**

I Can Do That:  
Easy Knife Block



# POPULAR Woodworking

Learn How. Discover Why. Build Better.

AUGUST 2009 #177

## Pennsylvania BLANKET CHESTS

**A Dovetailed Beauty  
With A Secret**

**Marc Adams' Ultimate Guide to  
CHOOSING THE  
RIGHT GLUE**

**We Test The  
USA-made  
UNISAW**

**Why Bevel-up  
Planes Are  
SIMPLY BETTER**



— ■ AUGUST 2009 ■ —

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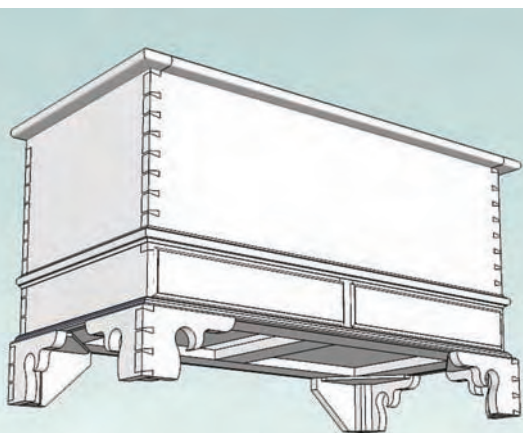
## ON THE AUGUST COVER



Blanket chests come in all sizes – build one, and it's simple to scale it up (or down). Senior Editor Glen D. Huey shares his plans for the smaller version on page 32.

COVER PHOTO BY AL PARRISH





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Video



Video

## New This Month:

### Blanket Chest Drawing

On page 32, Senior Editor Glen D. Huey shows you, start to finish, how to build a Pennsylvania blanket chest. But download the free SketchUp drawing and you can turn it around, take it apart and examine the joinery before ever cutting a piece of wood. Plus, you can customize the drawing and make your chest truly your own masterpiece.

[popularwoodworking.com/aug09](http://popularwoodworking.com/aug09)

## Video Gallery

### Bodger Vision

Don Weber began his woodworking career as a bodger in his native Wales (a bodger is an itinerant chairmaker and fixer of all things turned). Years later, he's also a blacksmith, and makes everything from Viking tool boxes to dining tables. In this video, Don shows us how to split wood the traditional way – and tells us why it's important to start a woodworking project with a log.

[popularwoodworking.com/video](http://popularwoodworking.com/video)

## Contest



### Enter to Win a SawStop Saw

You could win a SawStop 10" professional cabinet saw (complete with 52"-fence system) just by answering a few questions. One lucky winner will be chosen at random from all the correct entries. Visit [popularwoodworking.com/sawstop](http://popularwoodworking.com/sawstop) and enter now – but hurry – the contest ends at midnight on July 31, 2009.

[popularwoodworking.com/sawstop](http://popularwoodworking.com/sawstop)

## And More!

Visit [popularwoodworking.com/aug09](http://popularwoodworking.com/aug09) to find a complete list of all the online resources for this issue – including videos, additional drawings and photos.

### Cuff Banding

Bellflowers and stringing inlay are just two eye-catching features of fine Federal furniture (which you can learn about on page 49). Add cuff banding and you'll draw attention to the ankles, too. Rob Millard shows you how in this new video.

[popularwoodworking.com/video](http://popularwoodworking.com/video)

### Ebony Pegs

Marc Spagnuolo (a.k.a. The Wood Whisperer) walks you through the process of pillowing the ends of ebony pegs for Greene & Greene pieces.

[popularwoodworking.com/video](http://popularwoodworking.com/video)

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**Lonnie Bird** is a tool designer and prolific author who has been working wood for nearly three decades. He's written for many major woodworking magazines, and has six woodworking books to his credit. Lonnie is also the founder of Lonnie Bird's School of Fine Woodworking ([lonniebird.com](http://lonniebird.com)) in Dandridge, Tenn.

In this issue, he writes about how bevel-up planes can help improve your woodworking, especially when wrangling with gnarly grain (page 44).



**Marc Adams** has been a professional woodworker for almost 30 years, during which he's won numerous awards, worked with the U.S. government on woodworking-related issues, and been featured in many books and magazines. He is also the founder of the world's largest woodworking school, the Marc Adams School of Woodworking ([marcadams.com](http://marcadams.com)).

In this issue, Marc writes about the characteristics and properties of the seven types of glue (page 54).



**Joseph Ilardo** After 30 years as a college teacher, Joe became a student again when he joined a community woodshop. With the tutelage of fellow members, Joe's skills and ambition have grown in the years since he started woodworking. Ever the teacher, however, Joe couldn't pass up the opportunity to create woodworking kits for his 8-year-old twin grandchildren, in hopes they too would get hooked on the craft. He writes about the experience on page 80.



**Rob Millard** builds Federal-style reproductions in a one-car-garage shop (that also holds a car). He has contributed to a number of magazines and has written for the *Journal of the Society of Period Furniture Makers*. You can see more of his incredible work at [americanfederalperiod.com](http://americanfederalperiod.com).

In this issue, Rob writes about bellflowers and stringing inlay – two of the hallmarks of furniture from the Federal period (page 49).

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# The Best Teacher Might be a Rodent

I had three hours in my Saturday to do about eight hours of work in the shop. So I pulled on my shop apron, crammed my hearing protection into my ears and reached for the table saw's switch.

But before I could depress that blessed green button, my 13-year-old daughter Maddy and her friend Sierra walked into the shop. They announced that they wanted to build a house for Sierra's hamster.

My hand dropped away from the saw's switch and my head shifted gears. Instead of a day of careful stock preparation and even more careful dovetailing, I was going to help slap together a rodent shack.

During the last 13 years I've found that when you build things with children, you have to use an entirely different set of skills than when you build something for yourself.

You need to build quickly. If the process takes more than a couple hours, many kids will lose interest. You need to allow them to do as much of the planning and assembly as possible. And yet the final result also needs to look somewhat presentable.

Accomplishing all that is harder for me than building a dovetailed carcass. Luckily, nails and pocket screws usually make this a do-able task.

I began by gathering scraps from the offcut bin and sending the two girls into the other room to design their hamster bungalow. I told them I needed a drawing with measurements (here's a tape measure). I needed to see what the house looked like from the front and the side.

They came back with their project plans drawn in ink on a Kleenex. (To be fair, I've seen worse construction drawings from adults.) I gave them a combination square and made them mark out all the cuts on the bits of scraps I had gathered for them. To save time, I made the cuts on the band saw. I let them make measurement mistakes and figure out how to fix them. I told them to do a dry-fit of their parts to make sure everything would go together.

And then, with an 18-gauge brad nailer and a lot of glue, we nailed the little cottage together.

They were thrilled, but I wasn't. I've always wondered how to get my daughters to build something more ambitious than these little projects. So I was delighted to read Joseph Ilardo's solution: ready-made kits. (See the "Out of the Woodwork"

column at the end of this issue for the full story.)

These approaches share something in common: They focus on the result and not the process. Most people get into the craft because they need some shelves, a cupboard or a barn for some plastic horsies. Only after they complete that project do they think: Wow. I really liked building that. What should I build next?

Those are the first steps to learning the most difficult skill in woodworking: patience. **PW**



*Christopher Schwarz*

PHOTO BY THE AUTHOR

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## Safety Note

Safety is your responsibility. Manufacturers place safety devices on their equipment for a reason. In many photos you see in *Popular Woodworking*, these have been removed to provide clarity. In some cases we'll use an awkward body position so you can better see what's being demonstrated. Don't copy us. Think about each procedure you're going to perform beforehand.



# Huntboard Mortises: How Much Glue is Enough?

I thoroughly read through Glen's article on the huntboard, and while his methods aren't mine (I wouldn't use power tools to build a piece like that – it's too early for power tools), there's a detail that perhaps Glen meant to put in that was edited out, and it's critical to the construction. I didn't see any comments as to whether a reader should glue all three mortises on the case sides, or glue the bottom and let the top two float, or glue the top mortise, pin the bottom one (and elongate the hole in the tenon for the pin), and let the middle one float (this last option would be my choice).

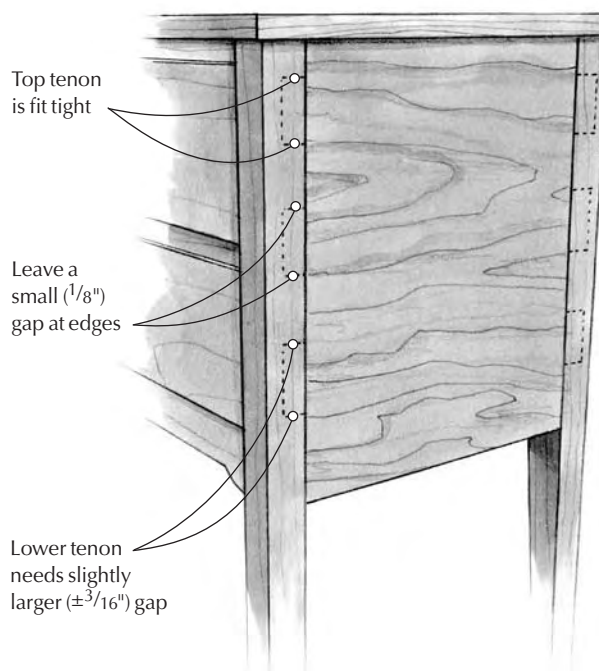
Obviously, this affects how the piece will age – if all three mortises are glued, it's likely that the case sides will crack. While historically accurate, that result might greatly disturb some readers, especially beginners.

David Keller  
Raleigh, North Carolina

*I've built many pieces of furniture (from huntboards to highboys and lowboys) that have case sides mortised into legs. As a novice woodworker, I glued the sides securely into the legs without any thought of wood movement. You would think the case sides would or could crack given that arrangement. However, I have yet to see this happen to any of the pieces. Today I practice the same method – I fully glue the tenons and do not worry about wood movement issues and the possibility of cracks.*

*If you calculate the total movement of the sides of the huntboard, you'll arrive at a maximum potential movement of around  $1/8"$ . It is my contention that the glues we use and the "give" of the woods are forgiving enough to counteract any movement. Add in the idea that most homes do not experience extreme changes in humidity and I don't see this as an issue.*

*I think a bigger problem, and possibly the cause of case side cracks over and above the glue question, is how those side tenons are fit. If there is not enough room for expansion and contraction built in – if the tenons*



*are fit too tight from top to bottom – your work is much more prone to problems such as cracks.*

*As the wood moves and the glue creeps, if tenons are fit too tightly and if there is no allowance or space to move, stresses build – something has to give.*

*Of course, this is my opinion. And like pins versus tails, I expect this topic will never fully be resolved.*

— Glen D. Huey, senior editor

*Editor's Note: To read more about Keller's approach to this joint, see [popularwoodworking.com/aug09](http://popularwoodworking.com/aug09).*

## Grinder Tool Rest Jig Flaw

The April 2009 issue (#175) featured an article on a grinder tool rest setting jig by Bruce D. Wedlock. This jig has a serious flaw if the intent is to "accurately set the grinder's tool rest to achieve the desired angle." This jig sets the angle for the top of the tool rest but

because one grinds a tool basically upside-down it has only a marginal relationship to the angle at which the tool is ground.

Grinding is done on the grinding wheel's tangent and to be accurate, a bench grinder angle jig has to take into account the thickness of the tool being ground. A  $1/8"$ -thick

tool and a  $3/16"$  tool will be ground at different angles with the same tool rest setting.

We use just simple sticks of wood to set the angle of the tool rest. We cut sticks about  $3/4"$  wide and 7" long that are the same thickness as the tools we need to grind. We bevel one end at 25° and the other at 30° and use

these to set the tool rest. The stick's bevel is only eye-balled to match the surface of the grinding wheel so there is probably a little error each time the rest is set, but we find this is much more accurate than the jig the author describes. Our little stick references are also much easier to make.

— Larry Williams  
Clark & Williams,  
Eureka Springs, Arkansas

## Providence Desk Bead

In the April 2009 issue (#175) the "Providence Writing Desk" article gives little information about making the bead that goes around the apron and legs. Could you elaborate on the bead detail?

— Vince Cappiello  
via e-mail



*This delicate, but very visible detail is critical to the success of the desk. So, it was important to proceed carefully. The first step was to select clean, sound material (straight grain, no imperfections) and mill several pieces about 1½" square and 40" long. These stout pieces remained flat and straight and did not flex or twist as they were passed over the router table.*

*I used a ¼" quirk-and-bead bit on the router table for the moulding profile. After a quick test cut, I ran all four corners of each piece on the router table.*

*Note: The two mouldings require slightly different setups. For the bracelet moulding, I set the bead flush with the edge of the moulding blank (and the surface of the router table). For the apron moulding (just under the drawers), I raised the bit to cut a quirk on each side of the ¼" bead.*

*After milling the beads on the router table, I cut them free on the table saw with two cuts. The hefty 1½"-square lengths of material made the table saw operation easier and safer too. I always make about 25 percent extra, then select the best of the batch.*

*The key to a safe operation (that yields great results) is to rout the profiles on large, straight pieces, then cut the moulding free.*

— Mario Rodriguez, author

## Plane Review Disappoints

The comparison of Wood River and Börg handplanes to Lie-Nielsen and Clifton products was disappointing.

Your approach to the piece makes it appear that you have a strong bias toward the Lie-Nielsen planes. Comparing the products is like comparing a \$20,000 car to a \$60,000 car; it isn't an apples-to-apples comparison. Both are indeed handplanes, but the expectation at the Lie-Nielsen price point should be much different than at the Wood River or Börg price.

The Wood River and Börg planes were purchased new, but you didn't mention the age or method used to acquire the Lie-Nielsen tool. From your disclosure statement at the end of the story I am suspicious that you used a plane already in your possession that was possibly a demo or gift from Lie-Nielsen.

Reviewing the planes then doing a short sidebar on how they match up to their more expensive rivals would have been a dramatically better representation.

The online video of breaking the plane

bodies goes on to cement the idea of a bias in my mind. (To watch the video, go to [popularwoodworking.com/aug09](http://popularwoodworking.com/aug09).) The language at the beginning of the video clearly indicates the idea that the imported plane would not perform as well as the Lie-Nielsen.

Jason Lueder  
Mandan, North Dakota

*I should have mentioned in the review that I don't take gifts. Ever. Just like I have never taken a dime from any toolmaker.*

*In fact, all the planes were purchased at retail. I have many years of experience fixing up old planes and setting up every new plane that has been made by every major manufacturer, from Groz to Grizzly to Clifton to Karl Holtey.*

*The Wood River and Börg planes are obviously aimed at competing with the Western Bed Rock-style planes, so that is what I compared them to. It is no different than when I have compared the Grizzly 1023S cabinet saw to the Delta Unisaw (and liked the Grizzly – look it up).*

*Like any human, I have my biases. And like any reader, you have yours. I tried to look at the Börg and Wood River planes as working tools and evaluate what it took to get them functioning to a high level – an expectation that is touted by the company's catalog language.*

*I'm sorry to disappoint, but I feel comfortable with my evaluation of the tools and have no regrets. PW*

— Christopher Schwarz, editor

## Question? Comment? We want to hear from you.

*Popular Woodworking welcomes comments from readers about the magazine or woodworking in general, as well as questions on all areas of woodworking. We are more than happy to share our woodworking experience with you by answering your questions or adding some clarity to whatever aspect of the craft you are unsure about, and if you have a complaint, we want to address it whenever possible.*

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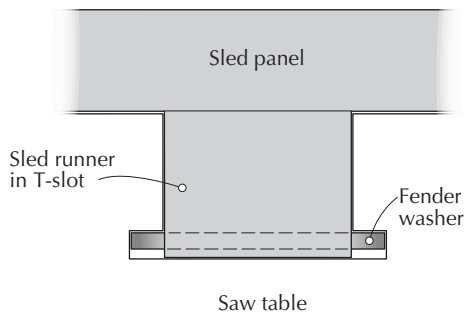
THE WINNER:

# Sled Runner Restraints

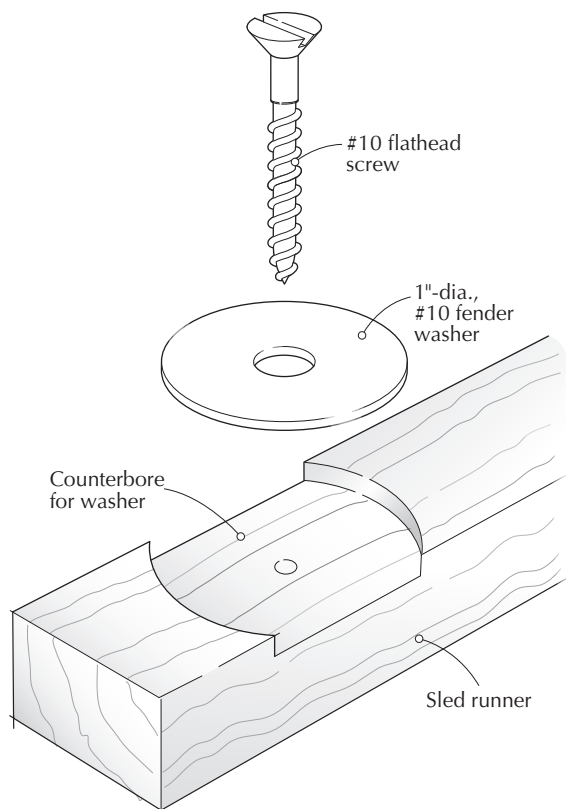
I recently made a crosscut sled for my table saw. The saw table has typical inverted T-slots, so I decided to add fender washers to the leading ends of the sled runners. Acting like the washer on the end of many a miter gauge bar, the washers on the sled runners prevent the sled from tipping when cantilevered off the front of the saw.

I find that #10 fender washers work great for the job, being 1" in diameter with a 1/4"-diameter hole. They fit well in the wide section of the table slot and accept the head of a #10 flathead screw nicely. Depending on the thickness of your sled runners, you'll probably need to counterbore a shallow recess to accept each washer. I used a 1 1/8" Forstner bit to do the job, drilling just deeply enough to align the washer with the wide section of the slot. For maximum strength, attach each washer with as long a screw as possible.

— Rich Flynn, Huntington Beach, California



END VIEW



## Cash and prizes for your tricks and tips!

Each issue we publish useful woodworking tips from our readers. Next issue's winner receives a \$250 gift certificate from Lee Valley Tools, good for any item in the catalog or on the web site ([leevalley.com](http://leevalley.com)). (The tools pictured at right are for illustration only, and are not part of the prize.)

Runners-up each receive a check for \$50 to \$100. When submitting a trick (either by mail or e-mail) you must include your complete mailing address and a daytime phone number. If your trick is selected for publication, an editor will need to contact you. All entries become the property of *Popular Woodworking*. You can send your trick by e-mail to [popwoodtricks@fwmedia.com](mailto:popwoodtricks@fwmedia.com), or mail it to Tricks of the Trade, *Popular Woodworking*, 4700 E. Galbraith Road, Cincinnati, OH 45236.



## Multi-purpose Micro-adjuster

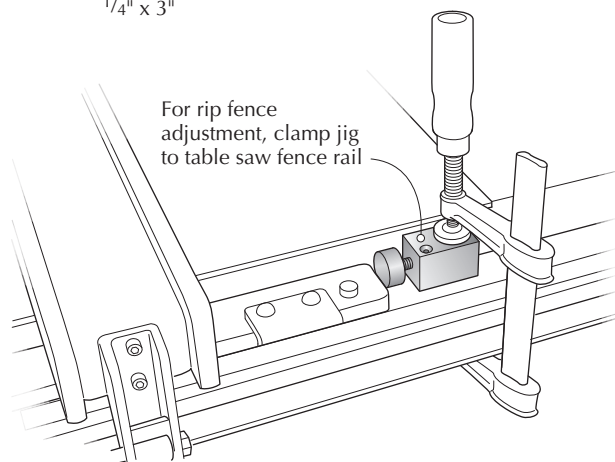
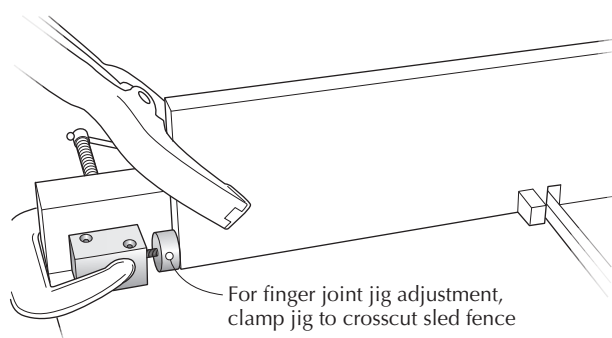
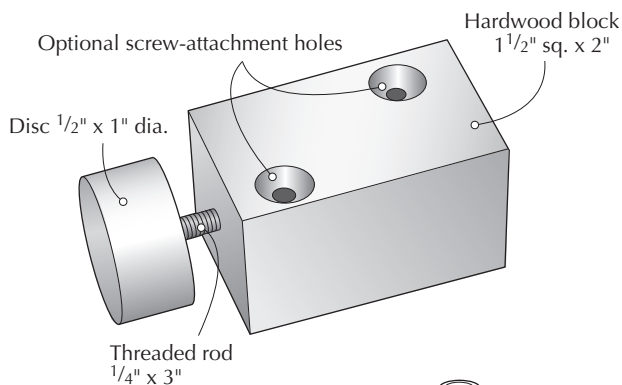
I use this little micro-adjuster to make minute adjustments on my table saw and router table fences, as well as a number of jigs. It is nothing more than a small block of wood outfitted with a threaded rod that has a wooden disk attached to one end. In use, the block is clamped or screwed to a tool's table with the disc pressed against the fence to register its location. After making a test cut on your workpiece, check the accuracy of the fence setting. If it needs adjustment, simply unlock the fence and dial the disc in or out a bit to re-register the fence location. The jig allows for very precise, controlled adjustments.

Make the jig from a  $1\frac{1}{2}$ " square x 2"-long block of cherry, walnut or other moderately dense hardwood. At the drill press, bore a  $\frac{13}{64}$ "-diameter hole through the axis of the block. Slice a  $\frac{1}{2}$ "-thick disc from a 1"-diameter dowel, and drill a  $\frac{7}{32}$ "-diameter hole through its center. Epoxy a 3" length of  $\frac{1}{4}$ "-diameter threaded rod into the hole.

For accurate operation, it's important that the outer face of the disc is perpendicular to the axis of the rod. To ensure this, chuck the rod in the drill press and lower the spinning disc against sandpaper

resting on the table. Finish by screwing the threaded rod into the block. Filing a V-notch into the leading threads will help them cut their way into the wood.

— Philip Houck, Boston, Massachusetts



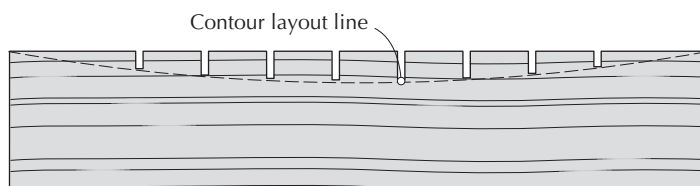
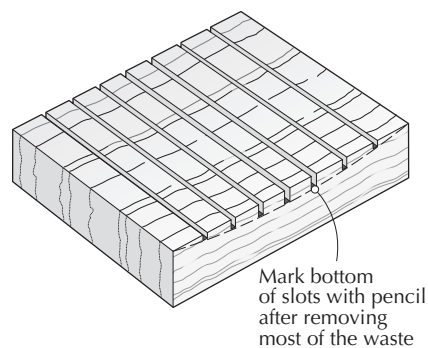
## Establishing Depth Reference

A recent project required making a series of small wooden panels with shallow concave faces. For efficiency and accuracy, I decided to make a series of preliminary cuts on the table saw to establish the basic concave surface, then clean up the faces with an angle grinder and disc sander. It worked great.

After marking the contour on the end of a workpiece, I set my table saw blade to cut just shy of the contour line for my first series of identical cuts. Then I moved my rip fence, reset the blade height and made the next series of cuts. After completing all the reference cuts, it was easy to then grind away most of the waste. When I was  $\frac{1}{8}$ " or so from the desired surface, I stopped and drew pencil lines in the shallow remainder

of the saw kerfs. This provided a very clear reference for the final rough grinding and finish sanding. As long as I stopped just after the pencil lines disappeared, I was assured of a nearly perfect shape. The same principle can be applied to a variety of shapes. And, for that matter, you can use a portable circular saw or drill for the job.

— Don Pinkal,  
Colorado Springs, Colorado



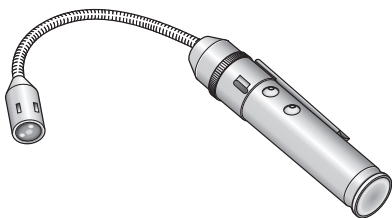


## Cheap On-board Task Lighting

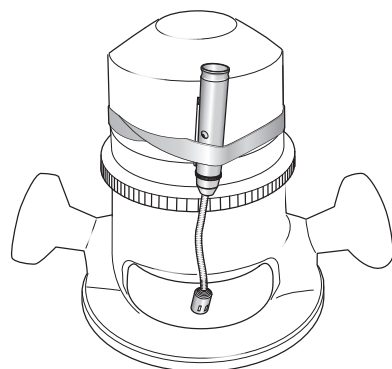
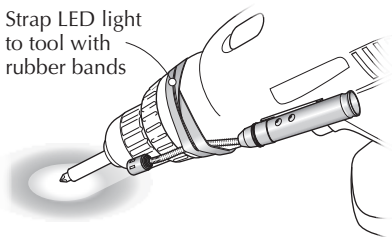
I've been noticing a lot of new tools these days that come equipped with on-board task lighting. Then while recently perusing my local home-improvement center, I noticed these small battery-operated flexible-shaft lights equipped with a light-emitting diode (LED). They cost only about \$5, and include a laser pointer as well as a magnetic body.

I bought a couple and found that they mount easily to many drills, routers and other hand-held tools. I simply strap the body of the light to the tool using heavy-duty rubber bands, and adjust the flexible neck to direct the light just where I want it. It's very helpful for operations such as drilling holes inside cabinets and other dark areas, or routing mortises and decorative inlays. It sure is an inexpensive way to upgrade my old tools and bring them into the LED age.

— Andy Lincoln, Dearborn, Michigan



Strap LED light to tool with rubber bands



## A Tracing Mouse

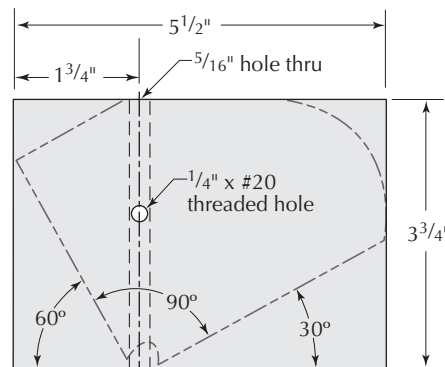
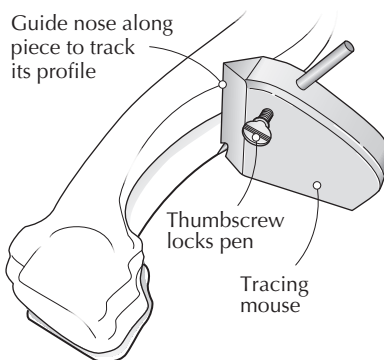
I'm often called upon to reproduce antique furniture, and have found that many sculptural parts can be difficult to trace accurately. I've seen old-timers tape a pencil or a length of lead to a block of wood to accomplish this task, but I found the technique cumbersome. As a result, I came up with this more elegant tracing "mouse."

I started with a hardwood block 1" thick x 4" wide by 5 1/2" long. I used the drill press to bore a 5/16"-diameter hole through its width to fit a commonly available straight-sided ballpoint pen (but use whatever bit accommodates your chosen pen). I centered the hole across the thickness of the block, setting it back about 1 3/4" from one end. Next, I cut a 30° wedge off of the bottom and

squared up the leading edge to that. On my disc sander, I formed a knife-edge nose at about 60° to the side. I kept tweaking and sanding until the end of the pen tip aligned with the knife-edge of the block. Once the pen tip was in proper alignment, I sanded a comfortable radius on the rear end of the block. To secure the pen, I drilled and tapped a 1/4"-20 hole to intersect it, and installed a 1/2" long, 1/4"-20 thread thumbscrew (Lee Valley #00N35.02, [lee-valley.com](http://lee-valley.com))

Using the mouse is as easy as it gets. Just push the pen down until it contacts the paper, lock the thumbscrew, butt the knife-edge against the part, and trace your pattern.

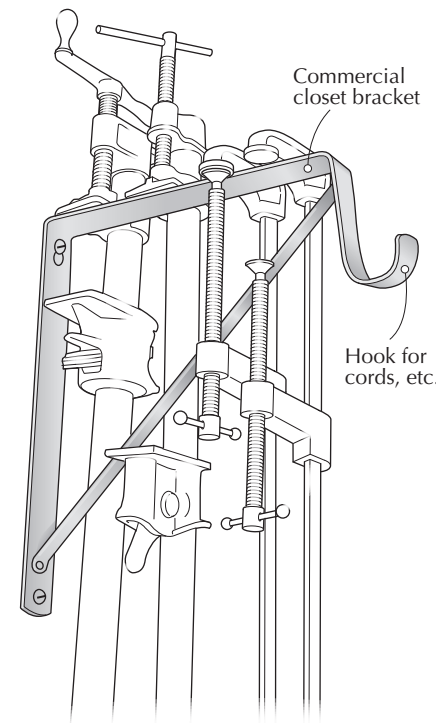
— Craig Bentzley, Chalfont, Pennsylvania



## Off-the-shelf Clamp Rack

I have a humble number of bar and pipe clamps and no time or desire right now to build a dedicated clamp rack for them. Instead, I installed a standard closet bracket on my shop wall for the purpose. Now the clamps are centrally located and easily accessed. I hang the clamp head on the top of the bracket, and the lower strut keeps the clamp body from swinging. I can also loop coiled extension cords on the hook at the end. You can find closet rod brackets at most home-supply stores. **PW**

— James Keller, Matthews, North Carolina



# Adapting the Lessons

Philadelphia Chair: Incorporating carving instruction learned from a master.

I'm building a Philadelphia Chippendale (rococo) chair. This has proved to be a fabulously difficult piece of woodworking that has challenged me at every step. From the very first saw cuts, I've made mistake after mistake in shaping and joining the twisted and curved parts that comprise chairs of this style. At this point, I have the back of the chair glued up and 90 percent of it carved. I have a ton of cleanup work to do and the most difficult carving, the leafage on the crest rail and knees of the cabriole legs, left to do. The side rails are roughed out and the joints are done. I've roughed the cabriole legs to shape and carved the ball-and-claw feet while referring to (no kidding) my February 2009 *Popular Woodworking* article "Making a Ball-and-claw Foot" (issue #174).

In this article, I'll look at the assembly and detailing of the seat rails. This seems like a simple step, not worthy of precious page space. But if this project has taught me anything, it's taught me that every single step has been wholly unfamiliar and deceptively complex. As you'll soon see, this step is no different.

## Goals

This is one of those jobs where halfway through the fit up, the scant reference faces are going to start disappearing. So it's worthwhile to set a few goals: I need good tight joinery. The basic structure of a rococo chair features few, but highly stressed, joints. There are no lower stretchers to help counter the force of someone leaning back on the chair or moving themselves closer to a table with their full weight on the seat (a feat few chairs without casters can survive for long). A rabbet in the front and side seat rails must be cut to support a drop in "slip seat." The rails must be faired in with the legs, and



**Many lessons.** *This is my first formal chair. Sometimes when I look at my work, I only see my mistakes. But in this case, I'm thrilled to see this fabulously beautiful chair coming to life in my shop. I have no delusions about the quality or grace of the finished product. But for me, building this chair has taught me so much. In this article I'll discuss the assembly of the seat rails.*

some moulding and carving is required to unify the design.

English chairs of the same period often featured upholstery that wrapped the outer surface of the seat rails (Chippendale wrote that he preferred this design). But Philadelphia chairs typically had exposed seat rails, so I have to do all this work neatly. Lastly, glued-on knee returns must be joined to both the leg and the seat rails to soften the transition between the vertical leg and the horizontal seat rail.

## Getting Good Fits

As you may recall from my December 2008 article (issue #173), the side seat rails are twisted. The tenon in the front leg is square with the floor. The tenon in the back leg is angled to remain in line with the rear legs, which are farther apart at the top than they are at the floor. For the seat rail to fair into the vertical front leg and the angled rear leg, it must twist. This is really not as complicated as it sounds. When I originally cut the mortises, I flushed the front joint. All I



really have to do is plane some portion of the seat rail to match the rear leg. But how much should I plane?

I dry-fit the rails and marked the portion to be planed away. To fair in even a small step, you have to plane the entire length of the rail. Starting with a jack plane, I removed excess wood quickly. The hard line that resulted was softened with the smooth plane. You don't need to fair this too much. You just want to remove the sharp corner to prevent one facet from catching and reflecting light.

### Cutting Rabbets

Next, I cut the rabbet. The rabbet, cut into the front and side rails, supports a drop-in slip seat. The slip seat is a wooden frame comprised of four sticks mortised and ten-

oned together, then upholstered. But the rabbet that holds it is a little bit tricky. It must be marked from the outer surface of the rails to ensure the moulding that will decorate the upper edge of the rails will be a uniform size.

When I can, when it matters, I prefer to use my moving fillister to cut rabbets. A moving fillister plane is like a big skew rabbet plane, but it has an adjustable fence and depth stop. But in this instance, the inner face is no longer parallel to the outer. So I chose to work to my gauge lines with a firming chisel, hogging away material as if I was digging a hole. The resulting rough surface was quickly and easily brought to the lines with a simple skew rabbet.

I did use my fillister plane to create the



**Fair the rail.** The plumb side seat rail must be faired into the angled rear leg. I marked the intersection with my striking knife, in preparation for planing the excess material away.



**Bad bevels.** I planed away the excess material using my trusty jack plane. The result is a beveled seat rail. If I left it like this, the different facets would catch and reflect light differently, drawing attention where I would not like it.



**Smooth finish.** I finished the outer face of the side rail with my smooth plane. I softened the line between the facets, and finished smoothing and fairing the rail to its adjacent legs.



**Chiseled rabbets.** I cut the rabbets for the seat using my trusty  $\frac{5}{8}$ " firming chisel. Because the outside face of the rail is the reference face, no fenced plane will be helpful. No matter what tool I use, I'll have to do some amount of cleanup. So I chose the fastest tool I could.



**Skewed finish.** A simple skew rabbet plane (a rabbet plane with an angled or "skewed" blade) quickly cleaned up the irregular surfaces from my chisel work.

shallow step on the outside of the rails in preparation for a small moulding that will decorate the top edge of the rails. The cross section of the moulding is delicate and elliptical, as is typical of this period.

### Decorative Carving

I finished the lower edges of the seat rails with some decorative scroll work. I freehanded the shape on one side rail then traced it onto the other. On the period chair I'm using as inspiration, only the front rail's scroll work was carved. This low-relief work, maybe only  $\frac{1}{16}$ " deep, didn't really set me back as much as I originally thought it might. The carving isn't actually proud of the outer face of the rail. It just looks like it is. The ground is "pillowed" rather than a consistent flat surface. It's an illusion and an effective one in my opinion.

The tops of the legs were carved to match the moulding at the top of the seat rails and also to match the rabbet for the seat. Mahogany is a very easy wood to work, so this job was fairly simple. I sawed as much as I could of the rabbet and simply chopped the wood away using a sharp chisel. The rounded inside corner of the rabbet, which is telegraphed to the outer moulding and in turn to the front of the leg, may have served an important function.

If the slip seat had sharp corners, the upholstery would wear quickly there. Though I doubt the upholstery could have rivaled the cost of the original chair, it probably could have gotten closer than one might think. An expensive imported silk damask may have been chosen to adorn a chair like this. Reducing wear on the top cloth would have been an appreciated design feature.



**Cleanup ahead.** Guiding a hollow plane with my fingers allowed me to get close to the shape I wanted. This is a quick process, taking less than a minute. But the finished moulding (see the opening photo) will need to get cleaned up with a gouge or scraper. Looking at period chairs hasn't convinced me this isn't exactly how this moulding was cut. The mouldings change shape in a way that tells me they weren't merely the result of a plane.

### Traditional Cross-grain Approach

With the chair dry fit together, I turned my attention to the knee returns. I labeled them "knee blocks" in a previous article and while there is no hard and fast convention, knee block can also refer to the reinforcing glue blocks behind the knees (a.k.a. glue blocks). For the most part, the knee returns on Philadelphia chairs have their grain oriented vertically, parallel to the leg. This is also usually true of lower chests on "high-boys" (high chests) and "lowboys" (dressing tables) with cabriole legs from this period. Because the stock must be as thick as the leg stock, and in this case wider (a full 3"), these blocks are sometimes comprised of a couple laminations. And just because I know someone's going to ask: Yes, some-

times the laminations that make up the knee blocks have grain running at right angles. Yes, there's no way to account for cross-grain movement and there doesn't seem to have been any attempt made. Yes, every incarnation of these are known to have suffered some damage. They pop loose from the side rails when the rails shrink up. The laminated blocks delaminate. It's a tricky design with no clear-cut solution. What I'm showing is a typical approach.

### The Challenge of Carved Knees

The knees of this chair will be richly carved, as you saw in the last issue. Those carvings will extend to the knee blocks that, if you recall, were attached to the leg in the last article.

This is an issue with which I'm really struggling. The reasons we showed that leg with the knee returns attached are: 1) It's easier to carve the knee with the leg off the chair and the knee returns attached. 2) There's no evidence of gouge misses on the seat rails of the originals.

The carvings at the tops of the knee returns come very close to the rails. We're speculating that they must have hit the seat rails once in awhile, yet no such marks are evident. Overcuts, gouge marks, rasp marks and other tool marks are evident elsewhere. Why not here? If the chairs were refinished (they almost always are), why didn't the



**Proud illusion.** C-scrolls decorated the front seat rail of the chair I'm copying. By fairing the surrounding "ground" into the stabbed-in upper edge of the scroll, period chairmakers created the illusion that the C-scrolls were proud of the surface of the rail. They were not.



**Imperfect is OK.** The tops of the legs were carved to match the moulding and the rabbet. With the rabbet finished, I've reassembled my chair to finish the fillet or step before shaping the curved moulding. This is all just chisel work; it's not difficult or time consuming. None of my work is perfect, but the originals aren't either. None of us will get better at this sort of stuff unless we try it.





**Knee returns.** *I used my 12" frame saw to scroll out the shape on my knee returns. These blocks soften the transition between the cabriole leg and the seat rails. I left my line and cleaned up to the line with my carving gouges.*

refinishing remove the other marks? Did the carver simply clean up the surface of the seat rails later?

It doesn't seem so. I would prefer to glue up the chair and attach the knee returns last. Attaching the knee returns to the legs means I have another surface competing with the mortise and tenon for the location of the rail. If I relieved the tenon a little to allow me to slide the rail down against the knee return, I'd lose structural integrity and also mess up the alignment of the mouldings and the rabbet at the top of the chair. Yikes!

## Conclusion

The assembly of the seat rails should have been a straightforward glue-up. But as I expected, I encountered still more challenges. The side rails had to be faired carefully. I was worried about how many times those mortise and tenons were put together and pulled part. I think they get looser with every dry-fit. The lack of good reference faces made the rabbet for the seat just a bit more difficult than any rabbet I've ever cut. The moulding seemed to go all right until I had to match it in the end grain at the top of the legs. Be sure your gouge is super sharp before you try this (and don't ask me how I know that).

I decided to glue the knee returns onto the legs as Christopher Storb suggested in my June 2009 article (issue #176). I'm hoping to get a good glue joint there when I glue the chair up, but I'm not convinced it's going to be OK. **PW**

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Visit Adam's blog at [artsandmysteries.com](http://artsandmysteries.com) for more discussion of traditional woodworking techniques.

# John Hall's Frame

One half of the famous Hall Brothers designed this piece of art.

**H**istory was never an interest for me. It was my least favorite subject in school and much to my professor's dismay, I found that class to be a great place to catch up on some much-needed sleep. But as a woodworker, I am beginning to change my tune.

Recently, I have become infatuated with Greene & Greene furniture. Darrell Peart's book "Greene & Greene: Design Elements for the Workshop" (Linden) was my first real introduction to the techniques behind this style.

Oddly enough, the first piece in the book that caught my eye was not even a Greene & Greene creation. It was a walnut frame with ebony plugs, designed and built by John Hall. John and his brother Peter were the lesser-known geniuses behind what we recognize today as the "Greene & Greene" style. They were the craftsmen who took the Greenes' designs and brought them to life in wood. And judging by the whimsical yet elegant nature of this frame, the Halls were capable designers in their own right.

Recently, I attended a Darrell Peart class at the William Ng School in Anaheim, Calif. Peart mentioned that he knew the grandson of Peter Hall and would arrange for him to bring the original Hall frame to the class. I am pretty sure my jaw dropped to the floor when I heard the news.

The very next day, Gary Hall came into the class with the frame tucked under his arm. I knew I wanted to reproduce this piece,



**Fate steps in.** In a strange twist of events, I found myself face to face with the original of this John Hall-built frame. It's not as "puzzling" to reproduce this original design as it might appear.

so with Hall's permission, I feverishly photographed, traced, measured and outlined every possible detail.

With just about zero experience making a reproduction, I could only hope that I didn't miss something.

One adornment that I will never forget was the engraving on the back of the upper rail. It read "John Hall—1909."

Given the fact that 2009 marks the frame's centennial, I believe it's an appropriate time to honor this project with a reproduction.

## The Templates

The first order of business is to make a reliable set of templates. Use the drawings to transfer the shapes to a sheet of 1/4" plywood, then cut them out at a band saw.

Use a spindle sander, rasp, chisels or flexible sanding strips to do the final finessing of the curves. The inside of the "jigsaw puzzle piece" is carefully cut using a scroll-saw, then smoothed using various files and sandpaper.

In keeping with the original, I chose

## Online EXTRAS

To watch a video of The Wood Whisperer as he creates, buffs and installs a pillowed ebony peg, go to:

[popularwoodworking.com/aug09](http://popularwoodworking.com/aug09)



walnut for my frame. The four frame pieces are milled to size and thickness according to the sizes at right, and the shape of each template is transferred to the appropriate pieces of stock.

Cut as much of the joinery as possible while the pieces are straight and square, and start with the stopped rabbets that house the mirror or artwork.

## The Jigsaw Puzzle

Although the jigsaw-puzzle joint appears to be complicated, it's actually nothing more than a fancy lap joint. To make the joint, begin by removing the waste material on the underside of the stile.

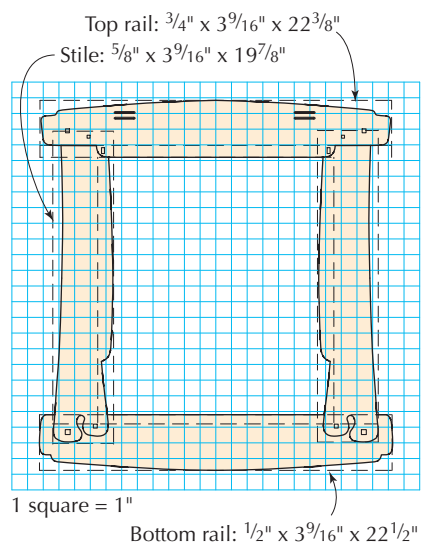
The stiles are then cut to the final shape at

a band saw. Use double-sided tape to attach the template, then trim the stiles using a flush trim bit at the router table. Or use a spindle sander to sand to the lines.

The puzzle piece cannot be cut with a flush trim bit or with power sanding. Just as with the template, this area will have to be rough-cut on the band saw or scroll saw, then finished by hand.

I use various tools for the fine work including files, rasps, chisels and a few different shop-made sanding implements. Fortunately, the two puzzle areas of the frame don't have to be identical in order to look right. I feel justified in saying this because on the original, they were not identical.

The next step is to create the inlaid por-



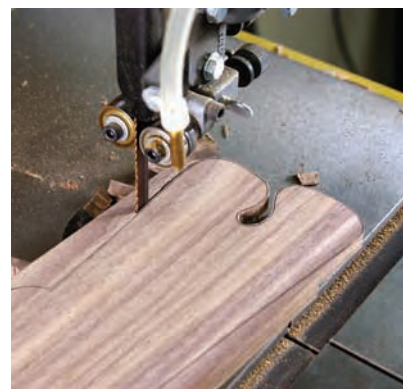
FRAME PATTERN AND DETAILS



**1 All the same depth.** Even though the parts to the frame vary in thickness, the rabbets are cut to match. Because of that, the stiles sit proud of the bottom rail and the top rail is proud of the stiles.



**2 On the level.** The joint that connects the stiles to the bottom rail requires the waste material be removed to the level of the rabbets. A miter gauge and a square-toothed blade made quick work of the job.



**3 A tight spot.** To cut inside the puzzle design is tedious on a band saw and best done with a scrollsaw.



**4 Puzzling.** Smoothing the jigsaw-puzzle joint at the bottom of the side proved to be tricky. Sandpaper wrapped around a  $\frac{3}{16}$ " dowel made life much easier.



**5 Stick and trace.** Use small pieces of double-sided tape to hold the stiles secure as you scribe the profile on the frame bottom.



**6 Sneaky work.** After the bulk of the waste is routed from the layout, work with different profiled carving tools to achieve a perfect, tight fit.

tion of the puzzle lap joint in the bottom rail. Position the stiles to the bottom rail 1" in from the end. Trace around the joint with a marking knife or pencil.

With the outline clearly scribed into the bottom rail, use a router with a 1/4" straight bit to hog out the bulk of the waste and use carving tools to achieve the perfect fit. If done properly, the joint will be nice and tight and flush on the back side with 1/8" standing proud on the front side.

The bottom rail is cut to its final shape at the band saw and flush trimmed using the

template as a guide.

Cut the bottom edge of the top rail to shape at this time. The top edge must remain straight since it is needed for cutting the small slots used for hanging the frame.

The slots are simple enough to make using a small 1/8" straight bit and a plunge router with an edge guide. Because my bit didn't plunge through the workpiece, I routed the slots from both sides. If your bit is longer, you'll do this in a single operation. Once the routing is complete, shape the top rail to the pattern.

## The Top Joints

Just like the puzzle-shaped joints at the bottom, the joints at the top are also modified lap joints. Position the top to the stiles and just as before, use a knife to trace the outline. Remove the waste material and fit the joint. The rail stands a 1/8" proud of the stiles.

The entire assembly is then flipped over and the shape of the stiles is scribed on the back side of the top rail. As before, the router removes the bulk of the waste material and chisels and gouges allow you to sneak up on the fit.



**7 Set at 90°.** Due to the rabbet in the top piece, there isn't much material for your knife to reference off of, so keep the blade square to the stock as you trace the top rail design onto the stiles.



**8 Do it again.** Double-sided tape holds the stile and top-rail connection as you scribe the profile onto the back face of the top rails.



**9 For the small job.** A drill bit is great for cleaning out the bulk of the waste of the undersized plug holes. Square the hole with a small chisel. Each hole was made about 1/4" deep.



**10 Ready for use.** When complete, the ends of the ebony plugs should look soft, shiny and scratch-free.



**11 No need for perfection.** With slightly beveled sides, you'll find that the dense ebony plugs push into the hole to create a nice tight fit.



**12 Check that pressure.** Using clamp pads to hold everything secure is a good idea. Too much pressure can mar the surface and result in additional sanding.



## The Ebony Plugs

The Hall frame features 10 non-functional ebony plugs. Most of the holes for these plugs are carefully made using square chisels from a hollow-chisel mortiser. The smaller hole is formed using an  $\frac{1}{8}$ " chisel (or you could bump up the  $\frac{3}{16}$ " holes to  $\frac{1}{4}$ " in size and use your mortise chisel).

After the center point of each hole is located, carefully lay out a square as a helpful visual reference around each point. Line up a square chisel; several taps with a mallet establish the outer edges.

Cut ebony into slightly oversized strips. Then, holding the pieces as you would a pencil, use circular motions to pillow each end. Begin the process with #120-grit paper, progress through a #2,000-grit micromesh pad and finish on a buffing wheel. The tips are then cut off to yield a  $\frac{3}{8}$ "-long plug.

Because the ebony plugs are slightly oversized, you can use a chisel to relieve some material on all four sides. Use a slight angle to create a wedge shape that makes it easy to tap the plug into the hole. You can test the

fit, but I suggest you install these plugs after the finish is complete.

## Final Touches

Use the opening photo as a guide as you begin final sanding the frame. This part of the build is incredibly important as it gives the piece its "look" and brings the four parts of the frame into one continuous flowing structure.

With the sanding complete, glue the frame together. When the glue is dry, use a chisel to square up the corners where the rabbets meet, then give the piece a final sanding with #180-grit sandpaper.

Of course, the final step is the finish. Unfortunately, no one knows what was used on the original, but it's pretty safe to say that it was either varnish, oil or shellac.

For my frame, I applied four coats of wiping varnish. I found this to be ideal as it provides a nice protective film, without the addition of a plastic look.

I hope this reproduction has made the Hall family proud, and I encourage you to

make one for yourself. It's fun and challenging, and it's a great way to honor the craftsmen responsible for the construction of the Greene & Greene furniture – a design that many woodworkers have come to appreciate and replicate. **PW**

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*Marc is a professional woodworker as well as the creator and host of The Wood Whisperer ([thewoodwhisperer.com](http://thewoodwhisperer.com)). The Wood Whisperer (an instructional Internet woodworking show) represents Marc's three passions: woodworking, technology and education.*

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## About This Column

Our "Wood Whisperer" column features woodworking thoughts and ideas, along with shop techniques from Marc Spagnuolo. Each column has a corresponding video related to the techniques or views expressed in the column available at [popularwoodworking.com/video](http://popularwoodworking.com/video).



# Knife Block

One piece of wood and a lot of bamboo skewers do the trick.

When we build an “I Can Do That” project we buy all the materials from a home center. For this project, however, I also had to stop at the grocery store on the way back to the shop.

That’s because this knife block holds all your cutlery in an array of bamboo skewers – the kind you use for kabobs. Though you’re not going to believe me, you need more than 1,000  $\frac{1}{8}$ "-diameter skewers to do the job. Good thing skewers are cheap – about \$1.80 for 100.

In addition to cleaning out your supermarket of bamboo skewers, you’re going to need some  $\frac{1}{2}$ "-thick wood. You need about 4' of a board that’s about 10" wide. I lucked out. Our Lowe’s happened to have one piece of  $\frac{1}{2}$ "-thick quartersawn red oak.

Begin by crosscutting your parts to length with your miter saw and ripping them to width with your jigsaw. The next step is to cut the finger joints with the jigsaw.

## Jigsaw Joinery

A jigsaw that’s fitted with a quality blade (such as the Bosch T308B Xtra-clean blades) can make cuts that require only a little tweaking with a chisel. The trick is to work against a fence.

First you need to figure out the exact distance from the edge of your jigsaw’s shoe to one side of the blade. I made a test cut in some scrap to figure this out. Your blade might not be exactly centered so you’ll want to check against the left and the right sides of the jigsaw’s shoe.

Lay out all the cuts on the side pieces using the construction drawing. Then make the short  $\frac{5}{8}$ "-long rip cuts that define all the fingers on the side pieces.

To remove the waste between the fingers, clamp a straight piece of scrap to your work-



**Flexible protection.** This simple knife block allows you to store any size knife.

piece that will act as a fence for the shoe of the jigsaw. This fence will guide the jigsaw to make a straight cut as you saw out the waste. First remove the waste from the ends.

To cut the waste from between two fingers you’ll have to make several cuts. Break up the waste with short cuts, then swoop in with the saw. A couple swoops and you can maneuver your jigsaw’s shoe against the fence to make your finished cut. If you take off too much your blade can deflect.

## Transfer the Shape

Now use the shape of the side pieces to mark the complementary shape on the ends. See the photo at right for details. Mark the waste then remove it from the ends using the same techniques (and the same fence) you used to cut the sides.

Now clean up the joints with a sharp chisel until the sides and ends fit together snugly. Sand your pieces and ease all the edges of the finger joints with sandpaper.



**Short cuts first.** Define the fingers of the joints with these short rips.



**Set the fence.** With the fence in place remove the easy bits from the ends.

## Assembly

To glue the sides and ends together, apply yellow glue to the mating surfaces and clamp things together. Check your assembly with a small square and adjust as needed.

Now measure the opening for the bottom. Cut a piece that fits snugly and nail it in place with a new finish nails.

Finish the exterior of the knife block with a clear semi-gloss spray lacquer.

The bamboo skewers need to be 8" long. Don't cut them on the miter saw—that's risky. Bundle them up with tape and do the operation with a fine handsaw.

To keep the bamboo skewers in place, squirt two 25 ml vials of epoxy into the bottom. Mix the epoxy with a long stick then drop the skewers in place.



**Swoop in.** Remove the waste between the fingers in stages. Here's the first swooping cut.



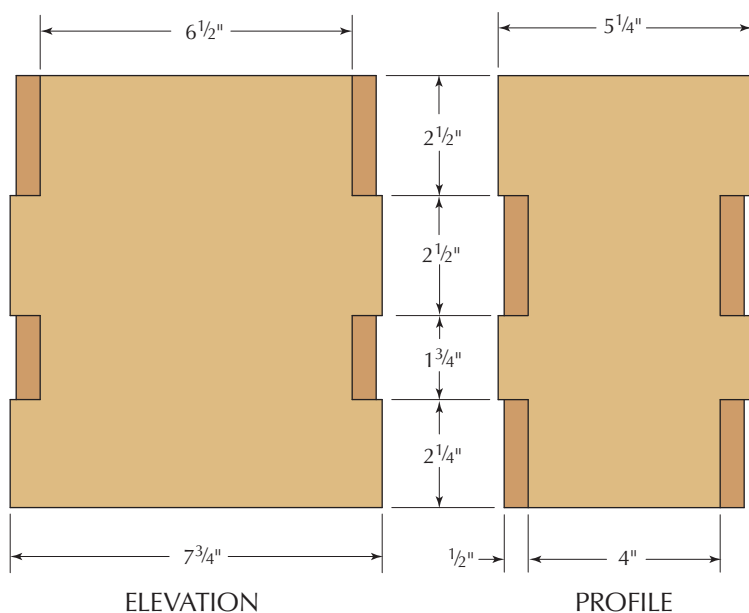
**A little tracing.** Use the cuts on the sides to mark the shape on the ends.

After the epoxy cures you're ready to pack as many knives as you can between the skewers. **PW**

*Chris is the editor of this magazine, and an avid cook and knife user. Contact him at [chris.schwarz@fwmedia.com](mailto:chris.schwarz@fwmedia.com) or 513-531-2690 x11407.*

## Knife Block

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL
		T	W	L	
2	Sides	1/2	9	7 3/4	Oak
2	Ends	1/2	9	5 1/4	Oak
1	Bottom	1/2	4	6 1/2	Oak
1,200	Skewers	1/8 dia.	8		Bamboo



## About This Column

Our "I Can Do That" column features projects that can be completed by any woodworker with a modest (but decent) kit of tools in less than two days of shop time, and using raw materials that are available at any home center. We offer a free online manual in PDF format that explains all the tools and shows you how to perform the basic operations in a step-by-step format. You'll learn to rip with a jigsaw, crosscut with a miter saw and drill straight with the help of our manual.



Visit [ICanDoThatExtras.com](http://ICanDoThatExtras.com) to download the free manual.



# The New Unisaw

Delta re-invents its flagship table saw with great success. Bravo.

There's been so much written about Delta's new Unisaw that it's difficult not to repeat the information for a second or third time. But many of the design changes are significant enough to point out once again.

The most noticeable changes are right up front. Both the height-adjustment and angle-bevel cranks are located on the front of the saw. The crescent opening on the older Unisaw that allowed the height-adjustment handle to move as the bevel angle was changed is gone. Both cranks are fixed.

But that's not the entire story. Never have we operated a saw with adjustments as easy to turn as these. The motion is as smooth as good ice cream on a summer day. And when you lock the handles, they are locked tight. Also, there's no backlash in the setup.



**Added strength.** The insert plate's continuous rim adds support, but requires that safety gear be pulled before the plate can be removed.



## Unisaw

Delta ■ 800-223-7278  
or [deltaportercable.com](http://deltaportercable.com)

### Street price:

- 3 horsepower with 52" fence ■ \$3,000
- 3 horsepower with 36" fence ■ \$2,874
- 5 horsepower with 52" fence ■ \$3,199

For more information, go to [pwfreeinfo.com](http://pwfreeinfo.com).

Another great feature located front and center is the bevel dial. Delta says the angle is correct within one-quarter of a degree. We say it's never been so easy to set an accurate bevel cut. This is a big improvement.

A big change compared to the older model is the addition of a riving knife. If you are a woodworker who doesn't use the splitter and anti-kickback pawls on your saw because the setup is cumbersome—and certain jobs couldn't be completed with them in place—you will certainly enjoy the riving knife.

During our testing period, we found no reason to remove this safety device. It's simple to lower the knife when making a non-through cut and it's equally easy to reposition the knife to add the see-through blade guard and pawls. Any knife adjustment is done via a front handle.

The Biesemeyer fence is a new design, too. The handle locks down with an extra click to assure users it is latched. When you lift the handle to release its hold, a magnet grabs the handle and holds it upright as you make adjustments. Both of these changes are details, but add to the overall experience.

Our saw arrived in near-perfect adjustment. Fit and finish were first rate. There were no major changes to make and the

assembly went as instructed.

Operating the saw is what you would expect from a top-tier machine. The saw is solid and does not shake during startup or while running. Cuts are simple to make and easy to see. The accuracy and smoothness of the cut are better than with the older model. However, there is one area of concern.

If you operate your current saw without dust collection (or if it's undersized), you'll have issues with this saw. Due to its blade shroud, the Unisaw requires dust collection above 650 cubic feet per minute (cfm) at the saw. To meet the requirement, you'll need at least a 1½ horsepower collector or about 1,200 cfm. Without collection, a visible plume of dust exits from behind the blade.

Overall, the new Unisaw is a much better table saw. After six years of research, design and production Delta has re-invented and improved its flagship table saw.

—Glen D. Huey

## Czeck Edge Marking Tools

Yes, you can mark out your joints with a pocket knife, a craft knife or a sharpened piece of Chevy bumper. But once you've tried a well-made marking knife, you're unlikely to go back to your old ways.

Czeck Edge Hand Tools is one of the newest makers of marking tools in the market, so I purchased two of the company's knives and a bird cage awl this summer to give them a workout.

All in all, I was impressed. All three tools were finely turned and finished. The steel and brass components were melded seamlessly into the wooden handles. And the steel was very good.

The Kerf Kadet knife (\$37.95 to \$41.95, depending on the wood) is well suited for woodworkers who cut dovetails by sawing the tails first. The spear-point knife is thin at .028" with an 1<sup>5</sup>/<sub>16</sub>"-long blade. I particularly liked the three ridges on the tool's ferrule, which make the tool easy to grip when you are holding it like a pencil.

The Pattern Pilot knife (\$43.95 to \$47.95) is a beefier knife for bigger hands and general joinery tasks. The blade is .058" thick and 1<sup>7</sup>/<sub>8</sub>" long. The handle is also thicker and a shade longer.

The bird cage awl (\$49.95 to \$53.95) isn't really a marking tool as much as it is a boring tool. (You can, however, use the tip like a scratch awl.) By twisting the tool back and forth, you can easily make screw holes for hinges or bore holes for installing lock sets. They are easier to use than a gimlet or even a cordless drill when you have just a few holes. The ornate shape of the awl makes it comfortable to grip, and the tool really beavers through the wood.

If you're ready to put your Boy Scout knife away, the Czeck Edge tools will make



### Czeck Edge Marking Tools

Czeck Edge ■ bobzajicek1@gmail.com  
or czeckedge.com

Street price ■ \$37.95 to \$53.95

For more information, go to [pwfreeinfo.com](http://pwfreeinfo.com).

it easier to scribe fine lines, and let you do it with class.

—Christopher Schwarz

## A Beefy, Battery-powered Jigsaw

Milwaukee has added a jigsaw to its M18 line of tools – M18 refers to the 18-volt line of Lithium-ion battery-powered tools.

This jigsaw features tool-free adjustments in two key areas. The standout area is shoe-angle adjustment with just a flip of a lever. Milwaukee's lever is long with a full-size "landing pad," so it's a snap to catch the lever with your thumb or finger. When locked, the lever is positioned directly under the body so it's out of the way.

Slide the lever to the right to unlock the shoe, slide the shoe assembly forward and set it to whatever angle you need, then flip the lever back to lock. There are detents for seven common angles – 0° and 15°, 30° or 45° to either side of 0° – and in-between angles are easily and quickly set.

Blade change is tool-free as well. Simply lift the Quik-Loc tension lever fully open, install any T-shank blade and release the lever. You have to fully install the blade – push it in firmly – to achieve the correct hold. If not properly installed, the lever closes but the blade can fall out.

The blade travels at a maximum of 2,200 strokes per minute and varies with the pull

of your trigger (I prefer a dial to set my stroke speed). Total travel of the blade is 1" with five orbit-action settings.

The Milwaukee cordless jigsaw is properly balanced, and heavy. At 7<sup>3</sup>/<sub>4</sub> pounds, it takes a strong arm to hold this tool as you start your cut. After you're into the cut and the shoe is fully planted on the workpiece, the M18 jigsaw is easily maneuvered and is weighty enough to not bounce around.

Of the cordless jigsaws I've tested, this is the only tool that sits upright on the battery (other saws rest on the shoe). This keeps the handle positioned and accessible for increased production. Also included is a shoe cover, anti-splinter device and trigger lock – not a big deal, but nice.

The M18 jigsaw kit (2645-22) comes with the jigsaw (2645-20), two 1.4 amp-hour batteries and a 30-minute charger.

If you're a battery-powered tool fan, or have purchased other Milwaukee M18 tools,



### Milwaukee M18 Jigsaw

Milwaukee ■ 1-800-729-3878 or  
[milwaukeeetools.com](http://milwaukeeetools.com)

Street price:

- 2645-22 ■ \$370
- 2645-20 (tool only) ■ \$225
- Replacement battery ■ \$86

For more information, go to [pwfreeinfo.com](http://pwfreeinfo.com).

this jigsaw is the one to have. But for the substantial dollars invested, I'll stick with my old corded model.

—GH



## Blue Spruce Mallets Are Shockingly Durable

Until November 2008, I always preferred a square-headed mallet for driving chisels. On that day (it was a Sunday) I picked up a Blue Spruce Toolworks mallet and was instantly converted.

The revelation was not just that this mallet is round—it's that it's remarkably sound. Its curly maple head has been infused with acrylic under vacuum pressure. As a result, the head is more durable than any other wooden mallet I've ever used.

Since I purchased this mallet, I have used it to chop out more than 100 dovetails and dozens of mortises. The mallet still looks brand new. After showing it around to the other editors, two of them also bought mallets (one with a red head and one in blue—the vacuum process allows them to add dye).

Senior Editor Glen D. Huey has also been giving his Blue Spruce mallet a workout. The only blemish on his mallet is the result of it striking the metal hoop on the top of a chisel's handle.

The mallet weighs 1 lb. and is 8<sup>5</sup>/<sub>8</sub>" long overall. The head is 2<sup>1</sup>/<sub>4</sub>" in diameter with a

3<sup>1</sup>/<sub>8</sub>"-long striking surface. Despite its small size, the mallet has a lot of punch thanks to the acrylic-infused head.

Other details: The turned handle is African blackwood, and it is secured to the head by a stainless steel tenon—there's a nice brass bead between the head and handle, which is for show.

Despite the plastic nature of the mallet, you would be hard-pressed to sense that the head was anything but a well-finished and dense wood. It does not feel artificial at all.

Of course, when you put the tool to work, it's immediately obvious that the tool is different—it refuses to dent, unlike other wooden-faced mallets I have used.

The mallet is \$80. Dave Jeske of Blue Spruce said he is currently designing a square-headed mallet using the same technology—so soon everyone should be happy.

— CS



**Blue Spruce Mallet**

**Blue Spruce Toolworks ■**  
[bluesprucetoolworks.com](http://bluesprucetoolworks.com)

**Street price ■ \$80**

For more information, go to [pwfreeinfo.com](http://pwfreeinfo.com).

## Skil's New 18-Volt Lithium-ion Drill/Driver

Skil's new drill/driver (2895LI-02) is the core of a new collection of 18-volt, Lithium-ion powered tools and is featured in a number of combination packages.

There are many improvements over the Skil drill (2815-02) we tested in our group review in April 2008 (issue #168). The keyless chuck size has been bumped up from 3/8" to 1/2", for one. And the ease of which the battery attaches to the drill and charger is also improved.

The drill/driver features an all-metal geartrain and a two-speed gearbox—one high-torque setting (0/450 rpm) and a second high-speed setting that pushes the speed up to 1,400 rpm—to tackle most required tasks. Combined with a 20 + 1 clutch setting and a three-position slide switch, this drill/driver should do all the work needed around the home or on the jobsite with ease.

So how does the drill operate? We returned to our group review test methods to find out. We set up to drill 1" holes in 1<sup>3</sup>/<sub>4</sub>"

poplar. After the first couple holes were complete, the drill began to shut down during use. A quick release of the trigger would get things going again—only to experience the same happenstance with each hole. Finally the tool stopped altogether and the flashing-light readout on the battery indicated things were too hot to operate.

After the battery cooled to a point that the testing could proceed, the lights indicated less than 10 percent of the total power was left in the battery's charge. Four additional holes were drilled before the flashing indicator lights once again appeared. In the three attempts to complete the testing cycle (where we drew the line and stopped the test) a total of 12<sup>1</sup>/<sub>2</sub> holes were drilled.

It's safe to say that while this drill has newer battery technology and is affordable, it's a tool for homeowners to use around the house and not the drill/driver for professional use—unless it's relegated to the role of backup. **PW**

— GH



**Skil 2895LI-02 Drill/Driver**

**SKIL ■** 877-754-5999 or [skiltools.com](http://skiltools.com)  
**Street price:**

- Drill/driver with one battery ■ \$109
- Drill/driver with two batteries ■ \$149
- Replacement battery ■ \$69

For more information, go to [pwfreeinfo.com](http://pwfreeinfo.com).



*All the right features. A till box lid that supports the chest lid, a brass half-mortise lock and iron strap hinges are a few features of a traditional blanket chest.*



A masterpiece of design  
that's sure to add to your  
woodworking 'bucket list.'



# *Pennsylvania* Blanket Chest

BY GLEN D. HUEY

Originally built as a six-board chest (four sides with a top and bottom), the design of the blanket chest has evolved throughout time to meet end-user expectations.

First, feet were added to bring the chest off the floor. Additionally, small items stored inside a blanket chest would be difficult to retrieve, so furniture makers added drawers—one, two or sometimes three below the main storage area.

Investigation of construction methods, finishes and wood choices uncover a multitude of differences. You'll find chests that are nailed together, those that exhibit the finest dovetailed corners and examples that incorporate post-and-frame construction.

Finishes on antique blanket chests range from painted façades, to oil and wax, to surfaces that are stained and shellacked. The exterior finish is usually tied to the wood selection—or visa versa. Painted pieces were often built from pine or poplar and painted with a distinct “country” look—many of these chests are highly valued and collected. Blanket chests built with expensive hardwoods such as cherry and walnut were pieces that only the wealthy could afford.

## Get Ready to Rumble

There are a couple places you could begin construction on this blanket chest. You could move to the feet, which are not dependant on your chest size. However, I prefer to go boxing. Prepare the material for the front, back and two ends of the chest box.

This chest box is dovetailed at the corners. Because we're building in walnut (a more expensive material) it only seems right to build the piece using a more involved technique. This article is not a lesson in hand-cut dovetails, but that is the suggested method if being “involved” were the path of choice. If you dovetail by machine, that's great. But dovetails should most definitely be used.

Regardless of how you create your dovetails, you need to determine how to orient the pins and tails. To think this through on any piece of furniture, evaluate the stresses the piece will endure then plan the joinery to counteract those stresses.

If this chest were crammed full, the majority of the push from items stored inside would be directed at the front and rear of the chest, the longest sides of the box. To offset that pressure, the dovetails should

be oriented with the pins on the front and back, and the tails on the ends—outward force to the front of the chest would tighten the dovetail joints and increase the holding potential.

However, if you examine any number of antique blanket chests, you'll notice the reverse is true in most chests. Aesthetics wins out over structural design. The chest looks best when the tails face the front.

Do any layout work on the inside faces of the panels. Step one is to locate and lay out your drawer area and where to run the groove for the chest's flat-paneled bottom. After your layout is complete, mark out your pins, and start sawing and chopping.

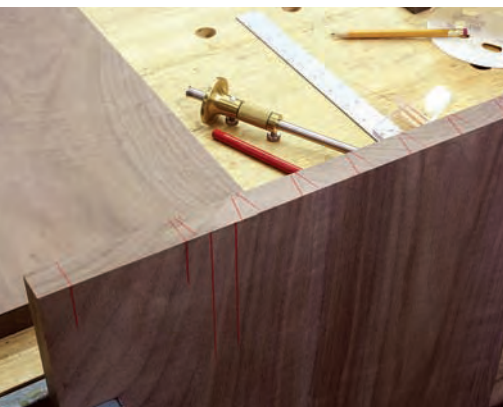
Next, transfer the layout from the pin boards to the tailboards. I use my band saw to define the tails. Remember to stay inside the transferred lines and that the more tails you have in your work, the tighter to the lines you can cut. After the two lines of the tails are cut, make one slice down the middle of the waste area to facilitate easy removal of the waste—the material collapses as it's chiseled from the panel. Test the fit of your joinery and make any necessary adjustments.

## It's Not a Secret Now

A lot of the work on the blanket chest box, besides the dovetails, is the grooves for the till box. Due to a secret compartment under the till, there is extra work over and above any normal grooves.

I look for an easy process to create my grooves. The process must be repeatable so it can be replicated on the front and back box pieces. To me, that means plywood, a straight router bit and a bushing to guide the router.

In using a template, two areas require attention: where the bottom grooves begin and where the front groove ends. It's best to locate the grooves for the till so each falls into a dovetail tail – if the groove were in a pin area, routing would be more difficult due to the narrowness of the pins. Use a plunge router and do not allow any grooves to extend to the edge of your panels.



**Plan ahead.** Lay out the critical aspects of the chest before marking your dovetail lines. Locate the drawer area and mark the groove for the storage bottom panel.

A plywood spacer is used to locate the second groove without repositioning the template. Double-sided tape is an option to keep the spacer in place, but because you're guiding the router into the template, there is little chance of the added piece moving.

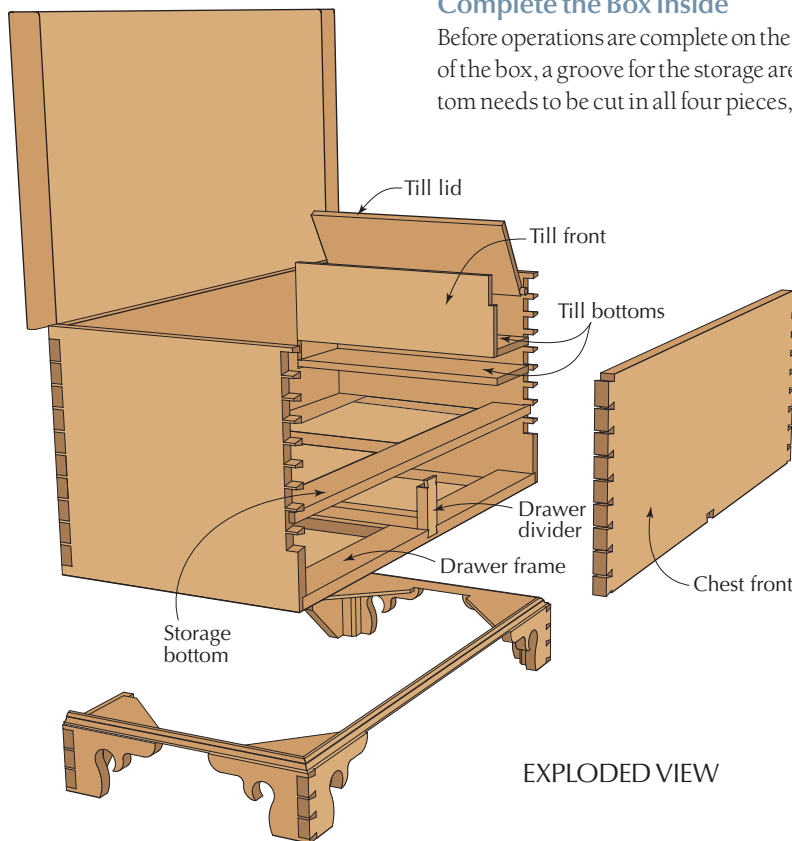
Of course the two grooves for the till bottoms extend to the till front. The important point of the front groove is its stopping point. Stop the groove 1" from the top edge of the panels so there's room for the till top and

a small amount of extra open space. This stop can be adjusted, but keep in mind the till box lid acts as a support for the chest lid – something that's evident by wear patterns on antique blanket chests.

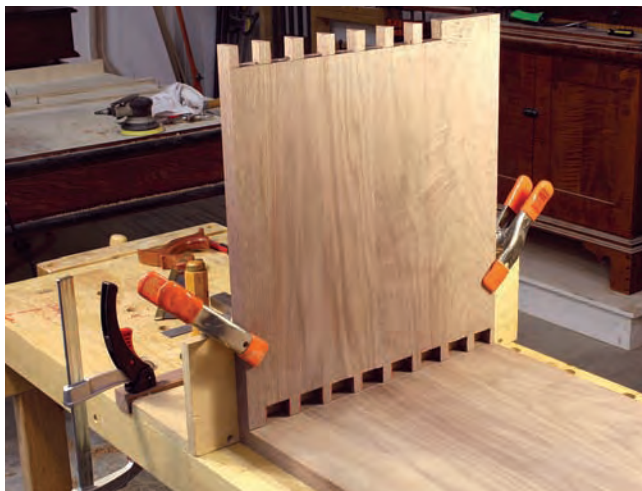
The lid for the till box is  $\frac{3}{8}$ " thick and is held in position and operated via an integral dowel shaped into both ends of the top. Drill a  $\frac{3}{8}$ "-deep hole spaced  $\frac{1}{8}$ " above where the till front groove terminates, and  $\frac{1}{8}$ " off the dovetail scribe line.

## Complete the Box Inside

Before operations are complete on the inside of the box, a groove for the storage area bottom needs to be cut in all four pieces, a rab-



EXPLODED VIEW



**It's like a third hand.** A homemade 90° jig makes easy work of holding the ends in position to make the transfer to the tail board a breeze.



**Plywood guide.** An L-shaped template guarantees accurate 90° corners – so long as the template is set square to the case.



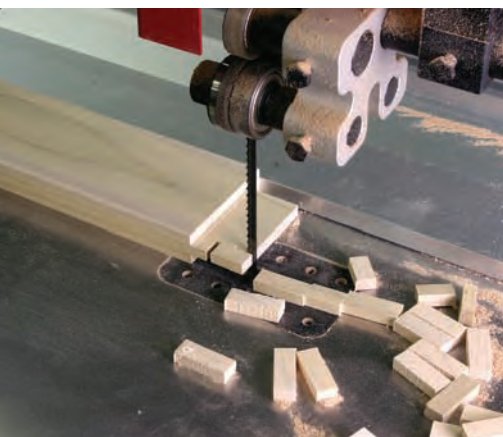
bet at the bottom edges of the back and end panels is routed for the drawer frame and the two  $\frac{3}{8}$ " grooves for the till bottoms are routed in one end panel (make sure it's the correct end panel).

Grooves for the storage bottom and rabbets for the drawer frame are made with a  $\frac{3}{4}$ " pattern bit and a straightedge. As with the till grooves, set up the storage grooves to terminate in a dovetail tail area in the front and back panels (a stop cut). Positioned as such, the grooves can blow completely through the end panels without issues.

Because the drawer frame is  $\frac{3}{4}$ " in thickness, the rabbet also has to be  $\frac{3}{4}$ " wide. I generally would create these rabbets at a table saw in a two-step cut or with a dado stack, but these rabbets need to be stop-cut as well – and that's a difficult operation using a table saw. If you blow through the corners, small openings appear, so I routed the rabbets with a pattern bit and guide fence.



**A simple hinge.** Proper positioning of the hole for till lid's integral dowel ensures the lid closes to the till box properly, and without binding against the end of the box.



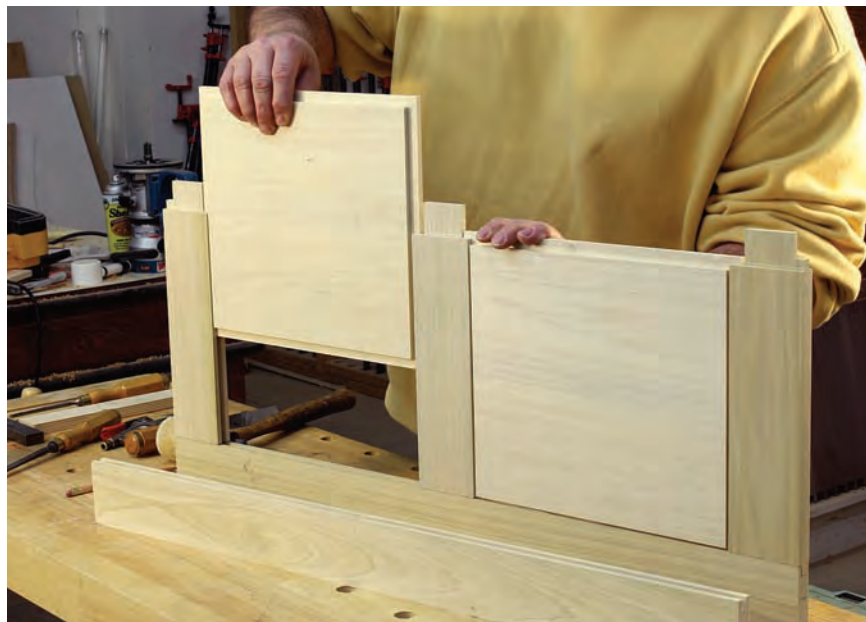
**Filling in spaces.** The small notch in this tenon is a haunch. The haunch fills in the groove created to house the flat-panel tongues. Tenons for the drawer frame need no haunch.

Here's the rub: Because the corners are so fragile, they still broke out as I assembled the box. But if that happens, worry not because the applied moulding around the bottom edge of the box covers those areas. After the project is complete, the only indication of this mishap is at the back of the chest.

The grooves for the till box bottoms are cut using your router along a straightedge, but instead of using a pattern bit, you'll need to use a guide bushing with a  $\frac{3}{8}$ " bit



**Correct position saves time.** If your grooves fall half into a pin area and half into a tail, you're required to do stop-cuts on all panels, increasing your workload.



**A change due to exposure.** The primary difference between the drawer frame and storage bottom (shown above), beyond the lack of flat panels and a groove to house those panels, is that the front rail of the drawer frame is exposed and therefore constructed with primary wood.

as before. I found it best to slide the end panel in place, then transfer the position of the grooves to the end panel.

## Partial Assembly

With the routing complete, it's time for a partial assembly. If you were to assemble the box completely as you fit the till components and storage bottom in place, you would need the arms of an octopus or help from two assistants. To reduce the possibility for mistakes, glue only the back to the two ends at this time. Add glue to the back dovetail joints, assemble the box, then add clamps. Make sure to keep the box square.

## Panel and Frame

While the glue dries on the back dovetails, turn your attention to the storage bottom panel, drawer frame and till box pieces.

Traditionally, the storage bottoms of blanket chests were single panels captured within the four sides of the box. Due to wood-movement concerns, I chose to make my panel in pieces assembled with a flat-panel design. With this setup movement issues are eliminated.

Because all the tool setups and cuts are identical in design – just a couple measurements are different – build the drawer frame and the storage bottom at the same time. Measurements for the two are taken from the assembled chest box.



**From square to round.** Use a rasp or file to round the stub into the dowel ends that fit the previously drilled holes. The fit should be tight, but operable.

The rails for both assemblies are joined with mortise-and-tenon joints. The center rail of the drawer frame acts as a drawer runner and catches the drawer guide.

The panels for the storage bottom are rabbeted on both faces to create a centered  $\frac{1}{4}$ " tongue that slips into grooves on the inside edge of the frame. I do this work on my table saw, but a rabbeting bit in your router would just as easily do the trick.



**Let it slide.** Remove the material to allow the till front to slide. Set the blade height to 2" (the  $1\frac{5}{8}$ " secret compartment opening plus the thickness of one till bottom). Guide the cut with your miter gauge, then use a handsaw to complete the task.

Cut the mortises in the long rails (three poplar rails and the one walnut rail that's the front rail on the drawer frame) and make your tenons on the short rails. Don't forget to haunch the tenons used for the storage bottom.



**Split into two.** The drawer area is divided to create two smaller drawers. The divider is dovetailed in position, but the thickness of the joined areas is only  $\frac{1}{4}$ ". The width of the divider can easily be changed, but make sure the piece is centered so your drawers match.

After all milling operations are complete, add glue in the mortises and on the tenons as you slip the frame and bottom joints together. No glue on the panels in the bottom, though. The panels need to move freely with changes in humidity.

## Pennsylvania Blanket Chest

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	COMMENTS
		T	W	L		
❑ 2	Chest ends	$\frac{3}{4}$	15	$16\frac{1}{2}$	Walnut	
❑ 1	Chest back	$\frac{3}{4}$	15	32	Walnut	
❑ 1	Chest front	$\frac{3}{4}$	$11\frac{3}{4}$	32	Walnut	
❑ 1	Lid	$\frac{3}{4}$	$17\frac{1}{2}$	33	Walnut	$1\frac{1}{4}$ " TBE*
❑ 2	Breadboard ends	$\frac{3}{4}$	$2\frac{1}{2}$	$17\frac{1}{2}$	Walnut	
❑ 1	Drawer divider	$\frac{3}{4}$	$1\frac{1}{4}$	$4\frac{1}{4}$	Walnut	Dovetail ends
❑ 1	Drawer guide	$\frac{3}{4}$	$1\frac{1}{4}$	$14\frac{1}{2}$	Poplar	
❑ 8	Feet	$\frac{3}{4}$	$3\frac{3}{4}$	6	Walnut	
❑ 1	Foot cap	$\frac{1}{4}$	3	15	Poplar	
❑ 1	Base moulding	$\frac{11}{16}$	$\frac{3}{4}$	72	Walnut	
❑ 1	Middle moulding	$\frac{7}{8}$	$\frac{5}{8}$	72	Walnut	
<b>Till Box</b>						
❑ 2	Bottoms	$\frac{3}{8}$	5	$15\frac{3}{4}$	Walnut	
❑ 1	Front	$\frac{3}{8}$	$6\frac{1}{8}$	$15\frac{3}{4}$	Walnut	
❑ 1	Lid	$\frac{3}{8}$	$5\frac{5}{8}$	$15\frac{3}{4}$	Walnut	
<b>Storage Bottom</b>						
❑ 2	Long rails	$\frac{3}{4}$	$2\frac{3}{4}$	$31\frac{1}{4}$	Poplar	
❑ 3	Short rails	$\frac{3}{4}$	$2\frac{3}{4}$	$12\frac{3}{4}$	Poplar	$1\frac{1}{4}$ " TBE*
❑ 2	Panels	$\frac{3}{4}$	$10\frac{7}{8}$	$12\frac{1}{8}$	Poplar	$\frac{5}{16}$ " TAS**
<b>Drawer Frame</b>						
❑ 1	Front long rail	$\frac{3}{4}$	$2\frac{3}{4}$	$31\frac{1}{4}$	Walnut	
❑ 1	Rear long rail	$\frac{3}{4}$	$2\frac{3}{4}$	$31\frac{1}{4}$	Poplar	
❑ 3	Short rails	$\frac{3}{4}$	$2\frac{3}{4}$	$12\frac{7}{8}$	Poplar	$1\frac{1}{4}$ " TBE*
<b>Drawers</b>						
❑ 2	Fronts	$\frac{3}{4}$	3	$15\frac{1}{8}$	Walnut	
❑ 4	Sides	$\frac{1}{2}$	$2\frac{5}{8}$	$13\frac{3}{4}$	Poplar	
❑ 2	Backs	$\frac{1}{2}$	2	$14\frac{3}{8}$	Poplar	
❑ 2	Bottoms	$\frac{1}{2}$	$13\frac{3}{4}$	$13\frac{7}{8}$	Poplar	

\* TBE = Tenon both ends; \*\* TAS = Tongue all sides

## Till Box Pieces

While the box is in clamps, take the appropriate measurements for the pieces that make up the till box. Mill the pieces to fit to the routed grooves.

The two bottoms extend to, but do not encroach on, the front groove. Make the fit on these pieces snug so there is little chance that the pieces could slide to open a small gap at the front of the till.

The till front fits tight from top to bottom to disguise the fact that it slides upward to expose the secret compartment area. This piece should also be snug between the front and back panels, but be able to slide while in place.

## Supplies

### Horton Brass

800-754-9127 or [horton-brasses.com](http://horton-brasses.com)

4 ■ rosette pulls with oval backplate  
#RT-5 ( $2\frac{1}{2}$ " boring)

5 ■ keyhole escutcheon  
#H-66

1 ■ half-mortise chest lock  
#CL-2

Call for pricing.

### Nathan's Forge

877-848-7903 or [nathansforge.com](http://nathansforge.com)

1 pr. ■ 9" fish tail strap hinges  
\$40

Price correct at time of publication.





**Hand or power.** Whether you're a Neanderthal or a power-tool guy, a handsaw is best to define the dovetail sockets.

To get the till box lid length, measure the chest box from inside to inside and add  $\frac{5}{8}$ " to the overall length. The dowels that hold the lid in position are  $\frac{3}{8}$ " long. The addition of the two dowel lengths is  $\frac{3}{4}$ ". The  $\frac{1}{8}$ " differential provides the gap on either end of the lid ( $\frac{1}{16}$ " on each end).

To form the dowels on both ends of the lid, make the defining cuts at your table saw. Raise the blade to  $\frac{3}{8}$ ". Make one pass over the blade to form the  $\frac{1}{8}$ " notch at the lid's back edge, then reposition the fence to leave a  $\frac{3}{8}$ " square stub. The remaining waste is removed at a band saw. Shape the tenon to round.

At this point the glue should be set on the dovetails. Remove the chest front, then check the fit of your till parts by positioning the pieces and re-installing the chest front. It takes extra hands to get everything in place, so work carefully. Check the fit of the storage bottom as well. Make any necessary adjustments.



**Easy peasy.** Drawer frame installation couldn't be simpler. A small bead of glue along the rabbet and a few nails driven through the frame is all it takes. Just remember to align your dovetail socket correctly.

With the till pieces in position, use a sharp pencil to mark the area that's cut away to allow the till front to slide up. Remove the chest and till fronts, then make the cuts at your table saw.

Test the fit and slide of the till front by putting the chest together again. Add clamps to get a true reading of the slide-ability. If the fit is too tight, lightly sand the ends of the front to make movement easier. If the movement is too sloppy, you'll need another till front to work with.

### Work Around the Drawers

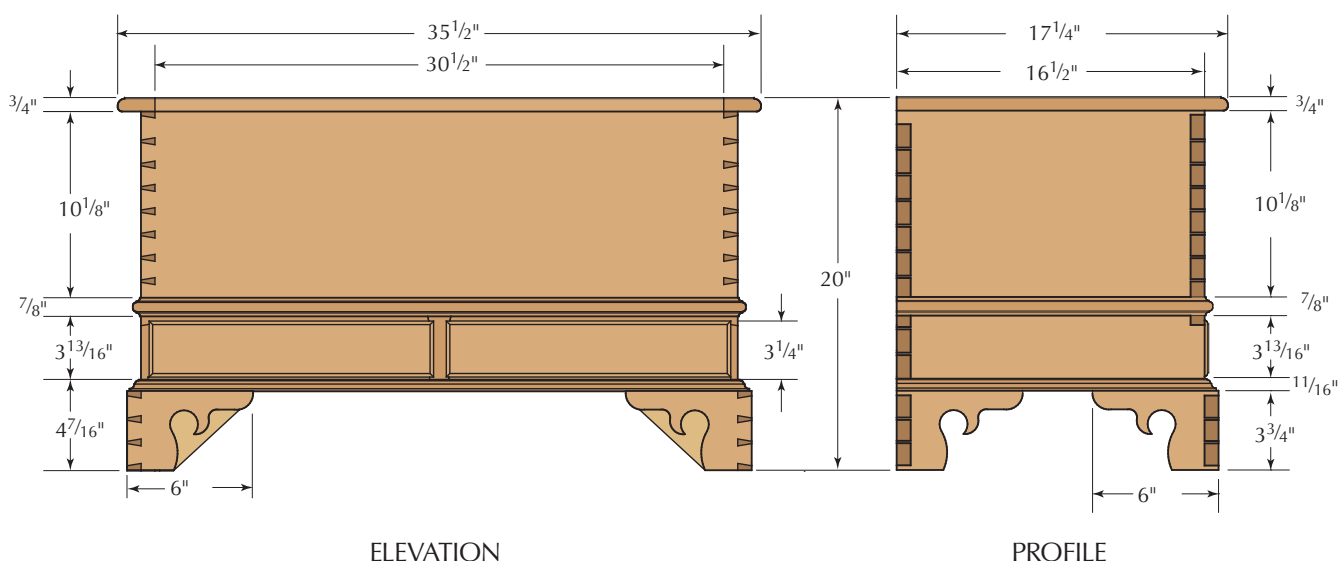
Before final assembly of the box portion of the chest, you need to fit the drawer divider to the chest front and drawer frame.

The divider attaches with dovetails. Begin by notching both ends of the divider leaving a  $\frac{1}{4}$ "-thick tongue that's  $\frac{3}{4}$ " long on

each end. Saw the dovetail into the divider ends. With the chest front installed and the drawer frame in position (walnut rail to the front, please), place the divider at the center of the drawer opening. Scribe along the dovetails to transfer the layout onto the other pieces.

Create your tail sockets with hand tools – just as you would the chest dovetails – or use a router with a  $\frac{1}{4}$ "-straight bit to hog out the waste material. For the frame piece, place a backer board against the top edge, then remove the waste with your router setup. Any cleanup is chisel work.

Test the fit of the divider and if all is well it's time to assemble the chest box. Install the storage bottom and the till pieces (no glue is necessary), then add glue to your pins on the chest ends. As you fit the chest front into position, wrangle the till pieces in position





and fit the till lid's dowels into the holes to finish the assembly of the box. Add clamps until dry.

Flip the assembly onto its top, then position the drawer frame to the box. The fit should be tight, but still fit in place. Because the grain direction of the box and the frame pieces run the same, simply add glue to make the connection, followed by a few nails to acts as clamps.

The blanket chest box is complete with the addition of the drawer divider—add glue and tap in position—and the drawer guide. The guide is fitted behind and square to the divider, and is glued and attached with a couple #8 x 1<sup>1</sup>/<sub>4</sub>" wood screws run in through the frame below.

## Base and Middle Mouldings

The base moulding is a classic ogee design routed on the edge of a wide board, then ripped to size. The pieces are flush with the bottom of the box.



**Two profiles, one installation method.** Both the mouldings are mitered at the corners and wrap the front and ends of the chest. Grain orientation is not an issue, so glue along the entire length of the moulding and use 1" brads to hold the pieces to the box.



**Keep a close eye.** When transferring your foot pattern to the actual foot, watch how you set the pattern. On the rear feet assembly especially, it's easy to lay out and profile the wrong foot.

The middle moulding begins as a piece of stock that's 7/8" thick. A cove-and-bead router bit is used to profile both faces of the stock before being ripped to final thickness. The middle moulding fits 3/4" above the drawer opening. The position is arbitrary—I chose to expose the dovetail of the drawer divider. Just make sure to be level.

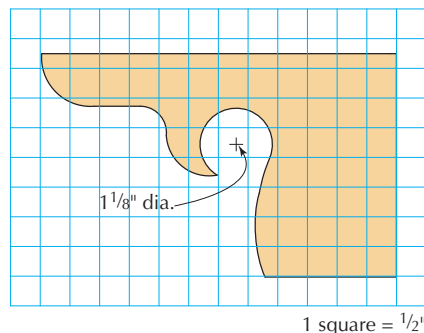
## On Dovetailed Feet

The chest sits on bracket-style feet that are dovetailed with the tails showing to the front of the chest. Mill the pieces according to the cut sheet, create the dovetails as you did for the chest box and assemble the feet in pairs, but don't add glue.

Next, develop a pattern for the foot profile. Match the correct position of your pattern to the feet assembly (it's easy to get things turned around) and trace the profile onto each foot. Use a small drill bit to transfer the hole location to your feet. The feet at the back of the chest (those not seen) are not shaped—a 40°-angle cut is made beginning 1" down from the top edge.

Chuck a 1<sup>1</sup>/<sub>8</sub>" Forstner bit in your drill press to drill the hole that forms the spur of the feet. (Align the spur of the bit with the hole marked in the foot blank.) Use a band saw to cut the profile on your feet followed by a spindle sander to smooth the cut and shape to your line. After the feet are shaped, add glue to the pins and assemble the pairs.

The foot pairs attach to the chest directly, so a thin cap is fit to the top edge of the feet. Use a rabbeting router bit to create a 1/4"-deep rabbet that's 3/8" wide. Stop short of the ends of each foot. Mill the pieces for the cap to size, round the point to match the routed



FOOT PATTERN

profile, then attach the caps to the feet with glue and brads.

The foot unit is then attached to the chest and is held flush with the base moulding's front. A bit of glue and a couple #8 x 1" wood screws hold the unit in place. To complete the feet-to-case assembly, add a reinforcement block in the corner.

## Top It Off

Because the exterior of the chest lid is exposed to humidity changes and the interior is sheltered, there is a possibility of movement and warp. The lid for this chest is simply a slab cut to the correct length and width with one important upgrade—breadboard ends to help keep the lid (or any panel) flat.

Create a 1<sup>1</sup>/<sub>4</sub>" tongue on the ends of the lid. Use a marking gauge to scribe lines on both faces of the lid and mark both ends, then use a router, pattern bit and a straight-edge jig. (My jig is two pieces of 3/4" plywood glued and screwed together.)

It's important to have the joint between the breadboard and the top panel tight. To



**Grain strength.** The grain direction of the foot-assembly tops runs the length of the pieces for added strength. Both legs of the triangles are cut with the saw set at 45°.



**Ride the block.** The feet corner blocks are slightly longer than the height of the feet, and the blocks are directly under the corner of the chest. These two factors help the longevity of the feet, the area that shows the most wear in antique chests.



**Stick out your tongue.** Two pieces of plywood make the best straightedge for use with a pattern router bit when forming the tongue for breadboard ends, especially if your panel size is large.

ensure that happens on the show face, set the straightedge just covering the scribe line when routing the top face, and on the bottom face set the straightedge with the line just exposed. That small variation guarantees a tight joint line. Climb cut the end of the tongue, then complete the pass in a traditional manner.

Next, form the tenons on the tongue. There is a  $\frac{3}{8}$ " area that runs the length of the top, and three tenons that are equally spaced along the end. Begin the outermost tenons 1" in from the edges. Use a saw or combination of saws to remove the waste material, then clean up any areas with your chisels.

Mill the breadboard ends to width and make the length a couple inches longer than needed (trim to size after lid construction is complete). Create a groove on one edge to match the tongue on the lid.

Slip the breadboard on the tongue and transfer the locations of the tenons. Fit the front tenon tight from side to side, but create a small amount of gap for the two other tenons. (Adopting this setup forces any seasonal movement toward the back of the lid.) Mark the tenon locations, then cut the mortises to complete the work. Make sure to allow for seasonal movement. When complete, the breadboard should slip over the tongue without the use of a mallet, but still be snug.

The breadboards are secured with glue and square pegs. Drill holes completely through the breadboard ends at the center of the tenons, slip the ends off to elongate the holes for the center and rear peg, then slide the end back in place and drive  $\frac{1}{4}$ "-square pegs into your holes.



**Seasonal movement concerns.** As you transfer the tenon locations, make sure to leave side-to-side space on the center and rear tenons. This forces any movement toward the back of the chest and keeps the edge of the top and breadboard ends flush throughout the year.



**Not just glue.** Square pegs help hold the breadboard ends in position and are attention grabbers if made of contrasting hardwood. Just make sure to elongate your holes to ease wood movement due to cross-grain construction.

To finish the lid work, trim the ends to size, sand all edges flat and profile the three show edges with your favorite router bit. I used a classical cove-and-bead profile for the top edge and a  $\frac{3}{16}$ " roundover profile on the bottom edge.

## Drawers

In keeping with the period design, the drawers are built with through-dovetails at the back and half-blind dovetails at the front. The drawer bottoms are solid wood panels that are beveled to fit into  $\frac{1}{4}$ " grooves in the sides and drawer fronts. The bottoms slide in those grooves, but slip under the drawer back. The bottom is held in place with a single nail that's driven through a slot in the drawer bottom and into the drawer back.

## Finish and Hardware

Generally, you apply finish prior to installing any hardware. But on this blanket chest, it's best to fit and position the strap hinges (take the width of your till box into account)

## Online EXTRAS

To download a SketchUp file and read about scaling the size of this chest, go to:  
[popularwoodworking.com/aug09](http://popularwoodworking.com/aug09)

and install the half-mortise lock and catch prior to finishing.

This chest is finished with three coats of amber shellac (sanded between coats), and the last coat had a few drops of "Reddish Brown" TransTint dye added to impart a red appearance to the overall look. That is followed up with a single coat of pre-catalyzed lacquer after sanding with #400-grit silicon-carbide sandpaper.

Re-install the hardware, add the drawer pulls and escutcheons and the blanket chest is ready for use at the end of your bed – the traditional location – or anywhere you have the need for storage. **PW**

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# 3 Ways to Make RAISED PANELS

BY ROBERT W. LANG, CHRISTOPHER SCHWARZ & GLEN D. HUEY

We explore the best ways to raise a panel with a router, handplane or table saw.

**T**raditional raised panels appear in almost every furniture style since Roman times, though the way to make them varies wildly.

All the methods, however, fall into two different camps: One method is to use a tool that is specially designed to do the job, such as a panel-raising plane or a panel-raising router cutter. The other method is to use a basic woodworking tool (such as a table saw or a rabbet plane) and a little bit of cleverness to do the job.

In our shop at *Popular Woodworking*, we use at least three different methods to create raised panels for doors and drawer bottoms. What follows is a step-by-step tutorial in each.



# Raising Panels With a Router Table

I learned to make raised panels in a commercial shop with a big shaper equipped with a power feeder. The results were predictable and consistent, and the process went quickly with only a bit of finish sanding needed after machining. A router table with a good cutter is the next-best thing.

There are two key elements to success: good material preparation and proper machine setup. With those in place, the actual making is the quick and easy part. I'm a fan of quick and easy, and I like being able to make profiles with a curve and to

have a consistent, flat tongue around the perimeter of the panel.

If the panels-to-be aren't dead flat with straight edges, the relationship between wood and cutter will vary as the piece is machined. This results in variations in the completed panel that take a lot of time to work out by hand sanding or scraping.

The setup is equally important; make the tongue too thick and you get to make another pass, make it too small and you either start over or live with an annoying rattle whenever you open or close a door. It takes a while, but

if you get it right the first time the reward is moving on to the next step with a pile of crisp panels.

And of course the cutter can make or break the entire enterprise. Good ones have an extra set of wings for shearing material, and they leave a nearly perfect surface. If you try to save a buck with a cheap cutter you'll spend more time sanding and have more tear-out to deal with.

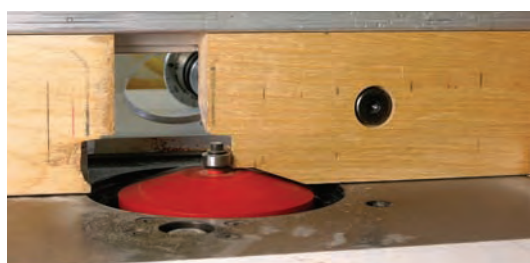
Below are the methods I use for setting up and making raised panels. —RL



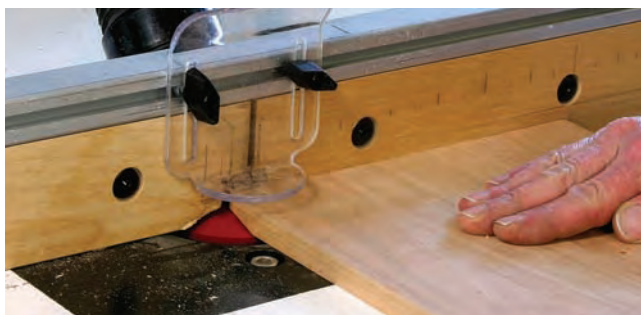
**1 Off to a good start.** There are two crucial settings to make: the height of the bit and the distance the cutter extends from the fence. I start by setting the height and use an adjustable square on top of a panel blank to leave a  $\frac{1}{4}$ "-thick groove.



**2 Get off the fence.** For the final cut, the bearing on the cutter is flush with the face of the fence. This is a simple setting to make and return to. Get it close for now so you can make cutouts in the fence to match the cutter profile.



**3 Slow down and be careful.** Raised panel cutters are big so you want to minimize the amount that is exposed and slow the router down if it has a speed control. I set the router speed to its minimum and ease the sliding fences into the spinning cutter to make a zero-clearance opening. If that makes you nervous, remove the fences and cut the profile of the cutter with a jigsaw or band saw.



**4 Steps to a great cut.** Set the fence so that only about half the cutter is exposed before making the first cut. I usually make three passes – two that remove about half of the material and a final light pass (about  $\frac{1}{16}$ ") to clean up and leave a smooth surface. Place a guard over the cutter and hook up the dust collector.



**5 Begin with the end.** Cutting across the grain can lead to tear-out as the cutter exits the wood. Make the cross-grain cuts first and the long-grain cuts that follow will clean things up. Keep the panel flat on the table and be aware of where your hands are at all times.

**6 Getting close.** Move the fence and set it in front of the bearing about  $\frac{1}{8}$ " before making the next pass around the perimeter. For the final cuts, set the bearing flush with the face of the fence. If the corners aren't lining up, either the panel is curved or your hand pressure is inconsistent.



**7 Fine finish.** The last pass leaves a consistent tongue and a clean surface. A quality cutter is worth the investment unless you like to sand and sand in awkward places.



# Raising Panels by Hand

When I was about 12, I raised my first panel, and I did it by hand. Since that time my voice has gotten deeper, I've gotten furrier and my methods have changed a bit. Now when I raise a panel, I'll usually rough out the shape on a table saw (like Senior Editor Glen D. Huey shows in this article), then I'll clean up the nasty saw blade marks

with a skew block plane. I find this method to be fast and produce nice results.

However, raising a panel entirely by hand is actually quite easy to do and doesn't require a lot of tools. All you need are a couple cutting gauges and a rabbet plane. Though I show using both metal and wooden rabbeting planes in this article, I prefer using a

metal rabbeting plane because its fence has a longer reach, so I can make a wider bevel.

The first step is to back off the nicker in your rabbeting plane. Though you have some cross-grain cuts to do, the nicker isn't going to help you. Next, set your cutting gauge and rabbet plane so they are making the same width of cut. —CS

**1 Define the field.** Use your cutting gauge to define the field all around all four edges of your panel. Begin with light strokes and then increase your downward pressure to make a fairly deep cut. This bevel is  $1\frac{1}{8}$ " wide.



**2 Define the tongue.** Use a second cutting gauge to define the thickness of the finished tongue. Run the fence of the gauge along what will be the backside of the panel. Make this cut on all four edges.



**3 First get cross.** Now sink a rabbet that is the width of your bevel and about  $\frac{1}{8}$ " deep. Work both cross-grain bevels first. Note the block of wood at the end of my stroke that prevents me from splching the edge.



**4 Then with the grain.** Then sink the same rabbet on the long-grain sections of the panel. Don't press too hard on the fence. The skewed blade will pull the fence against the panel.



**6 Check your cut.** Use a mullet that is the depth and width of your finished groove to check the edge. When the tongue fits and the corners look good, stop planing.



**5 Lean into it.** Now shift the fence so the tool will take a slightly wider cut – usually  $\frac{1}{8}$ " wider will do it. Why? The bevel is longer than the rabbet. Tip the plane and work the rabbet into a bevel. Work down to the line on the edge of the panel.



**7 Use your eyes.** Clean up the cross-grain bevels first. Then the long-grain bevels. With each pass of the plane, you'll see the bevels come into the same plane.



**8 Cleaning up.** Sometimes I'll use a rabbeting block plane or skew-block plane to dress the surfaces and clean up any wonky areas. A plane with a skewed blade makes cleaner cuts on the cross grain, but that plane is at home today.



# Raising Panels on a Table Saw

In the home-building industry, I built stairways, bookcase units and raised-panel fireplace walls for new home construction. At that time it was important to raise panels as fast as I could. My tool of choice was my shaper. I spun a three-wing cutter of various profiles in a 5-horsepower machine to crank out the necessary parts.

When I moved to building furniture, the need for churning out so many parts

all but disappeared, but I did need to raise panels for many of my pieces. My shaper use dwindled to the point that it was a burden to clear junk off the machine's top to put it in use. I needed another method to create raised panels, and I no longer had the need for different profiles.

The main woodworking machine in most shops is a table saw. So that's where I turned. And today my raised-panel-making tool of

choice is still a table saw—with a fence extension for increased accuracy and safety.

A series of specific steps is all it takes to make raised panels at a table saw. Building techniques allow you to set up this process the same way every time you need to create a panel. As an example, most often we fit raised panels into frames that have  $\frac{1}{4}$ "-wide grooves that are  $\frac{3}{8}$ " deep, and the thickness of your panel can range from  $\frac{3}{4}$ " down to  $\frac{1}{2}$ "—I prefer  $\frac{5}{8}$ " as my panel thickness. If you consistently build to these settings, this setup works every time. If you vary in your groove width or depth, you'll need to fine-tune your setup, but the procedure is the same.

If your table saw is anywhere close to tuned up, the process is simple and repeatable, and uses fundamental skills. It's a matter of adjusting the table saw blade tilt and height, along with accurate fence positioning.

—GH

**1 Setup by the numbers.** Set the blade tilt to  $12^\circ$  and position your fence so the distance between the fence and a tooth pointing toward the fence is exactly  $\frac{3}{16}$ " as the tooth passes below the table saw top. Why this setting? If you cut your panel edge at  $12^\circ$  and have the fence spaced correctly, the post-cut angle on your panel sits tight to the bottom of the frame groove while just touching the arris as it rises out of the groove.



**2 Feel the blade height.** To set the height of the blade to create a raised panel, hold the panel tight to the fence extension and crank the blade up until the edge of the blade's tooth that's farthest from the fence is flush with the face of your board. That sets a  $\frac{1}{8}$ " reveal for the raise portion of the panel. Now you're ready to cut.



**3 Accuracy and safety.** Here you can see how the fence extension aids in making this cut safe and trouble-free. Remember to cut the end grain first. This reduces the chance of grain blow-out along the long-grain because those edges are formed last. Notice how the blade just barely peeks through the panel freeing the waste material. This is what I look for. Cut all four edges.

**4 Measure for fence position.** Adjust the blade angle back to  $90^\circ$  and set the height to just less than  $\frac{1}{8}$ ". To get the fence properly adjusted for the final step of squaring the reveal, lay your panel face up with one edge tight to your fence, then use a rule to measure the distance from the fence to the edge of your cut.



**5 Take a nip to square.** Set your fence to the measured distance plus  $\frac{1}{16}$ ", then flip the panel face down as you run four passes (one pass on each edge of the panel) over the blade to square the reveal and complete the raised panel. All that's left is sanding. You might be surprised to find out that I use power for this step as well. **PW**



# The Case for







**Up and down.** Above are two new bevel-up smoothing planes from Lie-Nielsen and Veritas. The vintage tools are the older bevel-down style planes. Both designs flatten and smooth the wood – the differences are in the details.

# Bevel-up Planes

BY LONNIE BIRD

I can clearly remember my first experience with bench planes. I was in high school shop class and while I was leveling a joint with coarse sandpaper wrapped around a sanding block, the instructor stepped up and leveled the joint in seemingly an instant with a bench plane. And the surface created by the plane was smooth; it didn't have the deep ugly scratches that remained from the coarse abrasive. I was so impressed with the speed and precision that I immediately went out and purchased a No. 4 bench plane for use in my shop at home.

But like many woodworkers I quickly became disappointed when I tried to put it to use. Admittedly, I didn't understand the complexities of tuning and using a plane. However, later on, after I learned to flatten the sole, sharpen, tune and use the plane, it still created occasional tear-out. A few years later woodworking tool retailers began offering thicker blades and heavy chipbreak-

**A craftsman makes the argument that bevel-up planes are easier to tune for end grain and difficult woods.**

ers. So I purchased these aftermarket parts for my plane to soup it up. Its performance improved a little more, but the results still left something to be desired, especially when I used the plane on wood with even a hint of wild figure. Fortunately, today there are better options.

By now many woodworkers have heard the news about bevel-up handplanes. The design differs significantly from the Bailey and Bed Rock-style planes that have been so popular for the past 100 years. At first glance, the most obvious differences are the lack of a frog and chipbreaker, and the substan-

tially thicker blade. However, the most significant difference is the incredibly smooth surface that you can create with one of these unusual-looking planes. But I suspect that not all woodworkers have been swayed. Like the pins-first vs. tails-first dovetail debate, bevel-down vs. bevel-up plane design is another woodworking argument that will be nurtured for years to come. However, the purpose of my article is not to stir up animosity among woodworkers who are convinced of the superiority of their old Bed Rock planes (hold the e-mail, please).

Instead, I just want to help woodworkers who want to enjoy using handplanes and have, perhaps, become frustrated in their attempts to use the antiquated bevel-down style planes. Give a bevel-up plane a try, and I think that you'll find what I and many other woodworkers have found: Bevel-up planes are remarkably easy to tune and use, and when tuned with a high cutting angle, they virtually eliminate the tear-out associated with bevel-down-style planes (and the tedious scraping that always follows). And unlike with the fancy infill planes from England, you won't need to apply for a sec-

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**Taming wild woods.** Bevel-up smoothing planes excel at smoothing woods that make other planes balk. Their secret? It's easy to get a high cutting angle with these planes.



ond mortgage on your home to purchase a bevel-up smooth plane.

In fact, in the woodworking school that I operate, we switched to bevel-up smooth planes several years ago and never looked back (block planes and shoulder planes have been bevel-up for years; more on that in a minute). Everyone who tries a bevel-up smooth plane is sold on the ease of tuning and the superior results. Gone are the old problems of tear-out and chatter associated with Bailey/Bed Rock-style planes. That's because bevel-up planes have several design features that work to eliminate planing problems, such as a lower center of gravity and

a substantially thicker blade. Also, the bed and sole of a bevel-up plane are one piece instead of two castings. Essentially, bevel-up smooth planes look much like a scaled-up block plane; they have fewer parts than bevel-down-style planes and the bevel-up blade position allows for easy modifications to the cutting angle. And because there are fewer parts, tuning is faster and easier.

For example, making a mouth adjustment with a Bailey-style plane can be a time-consuming process of trial-and-error. After adjusting the cutting depth, the frog is moved forward to close the mouth. However, because the frog is fastened to an inclined

surface, the cutting depth increases as the frog is adjusted. This necessitates re-adjusting the cutting depth and trying again.

In contrast, a bevel-up plane ends this ritual. Just slide the plate at the toe of the plane, twist the front knob to hold it in position and you're done.

Still another great feature of bevel-up planes is the lack of a chipbreaker. On a bevel-down plane, the chipbreaker, or cap-iron, is screwed to the blade. As the name implies, the job of a chipbreaker is to break and curl the shaving as it exits the mouth. When properly adjusted, the chipbreaker also applies pressure near the cutting edge to stiffen the blade and reduce chatter.

In contrast, the bevel on the blade of a bevel-up plane curls the shaving. This feature, coupled with the dramatically increased blade thickness, does away with the chipbreaker. Eliminating another part simplifies tuning the plane. And when it's time to sharpen, there's no need to remove a chipbreaker and re-install it afterwards. Additionally, because the bevel faces upward, the bed supports the blade closer to the cutting edge.

However, more than any other aspect of the design, it's the high cutting angle that makes the greatest contribution to the superior performance of these planes. While traditional bevel-down Bailey-style planes use a 45° cutting angle, bevel-up planes can be quickly tuned with a much higher angle such as 50°, 55° or even 60° or more. The higher cutting angles work much like a scraper to break and curl the chip effectively without the nasty and frustrating tear-out to spoil your day (and your prized board).



**More bits and pieces.** The bevel-down design (in foreground) has more parts to adjust and align, including a separate frog assembly and a chipbreaker. Bevel-up planes don't have a separate frog or a chipbreaker, so they are easier to tune.

#### **Pick an angle.**

One of the biggest advantages to bevel-up planes is that you can easily swap out plane irons that do vastly different jobs, from planing end grain (at low angles) to planing figured woods (at very steep angles).



### **Choose Your Angle**

With bevel-down-style bench planes, you're stuck using the cutting angle that the plane manufacturer chooses. Keep in mind that the cutting angle of a bevel-down plane is determined by the angle of the frog to the sole, which is commonly 45°, though 50° and 55° frogs are available for Lie-Nielsen bevel-down planes. And while you can theoretically increase the cutting angle by honing a back-bevel on the blade of a bevel-down plane, it is an impractical work-around, and it still does not resolve the other issues with this outdated design.

In contrast, when using a bevel-up plane, you can choose the cutting angle that best suits the type of cut and species of wood.

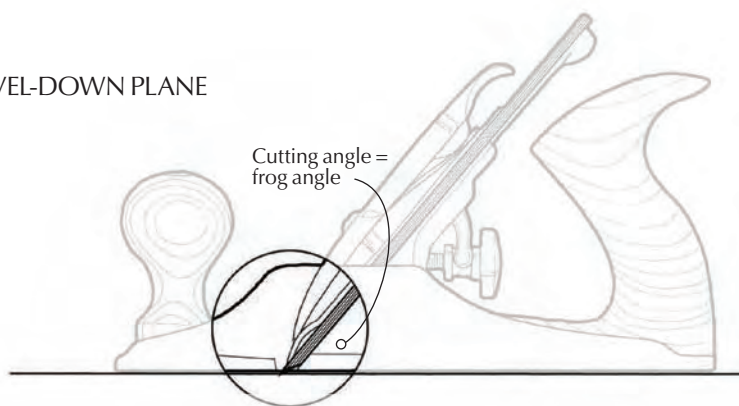


Because the bevel faces upward, the tool's cutting angle is determined by the sum of the bevel angle and the bed angle; in other words, by changing the bevel angle on the blade, the cutting angle is changed, too.

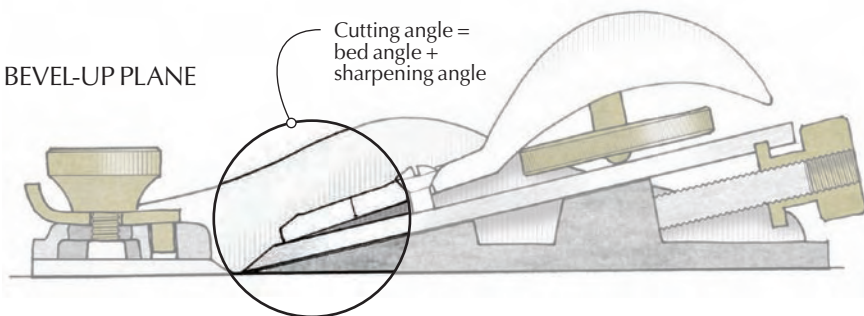
The choice of cutting angles falls within a broad range of approximately 37° to 62°; however, in reality you only need three cutting angles. Just remember it this way: A low cutting angle works best on end grain, a middle angle is a good choice for everyday planing such as fitting a drawer, and a high angle is the best choice for use on hardwoods to prevent tear-out.

More specifically, a 37° cutting angle slices end grain cleanly, and a 45° angle is easy to push and a good choice for planing soft, bland wood such as poplar. However, when planing hardwoods, especially figured stock for a show surface, I choose a high cutting angle such as 55°, 60° or even 62°. The high cutting angle will create an exceptionally smooth surface that will require no scraping. The only trade-off to the high cutting angle is the resistance created as the plane is pushed. You'd better eat your Wheaties; pushing a smooth plane tuned with a high cutting angle can be a workout, especially on dense, figured stock like a wide tiger maple tabletop.

## BEVEL-DOWN PLANE



## BEVEL-UP PLANE



**End-grain shaving.** The low bedding angle of a bevel-up plane makes it simple to set the tool up to shave end grain. Here an end-grain shaving is being peeled from a quartersawn board.



**Get curly woods straight.** Planing highly figured grain with a high-pitch blade is where bevel-up planes shine. High planing angles reduce tear-out in figured woods.



This is why I switch to a 45° cutting angle for planing a stack of poplar drawer parts.

## Setting the Cutting Angle

When tuning a bevel-up plane, there are three important angles to keep in mind: The bevel angle of the blade, the bed angle of the plane, which is typically 12°, and the cutting angle, which is the sum of the two previous angles. To modify the cutting angle, just change the bevel angle (or better yet, just swap blades for one with a different bevel angle). It's that easy. By having three blades ground to different bevel angles, you'll in effect have three different planes for the price of one.

## Knowing the Limits

As I mentioned earlier, the range of cutting angles from which to choose is approximately 37° to 62°. By now you may be wondering, if a 37° angle produces good results on end grain wouldn't a lower angle be better still? Perhaps; just keep in mind that a 37° cutting angle requires a 25° bevel angle. Lowering the bevel angle a couple more degrees will create a sharper cutting angle with a cleaner cut and less resistance. However, a bevel angle below about 22° or 23° will probably test the limits of the steel and the edge will likely fracture. Besides, a 37° cutting angle will create wispy thin cuts on most end grain.

On the other end of the scale, creating a cutting angle beyond about 62° increases the cutting resistance to the point that you'll find it difficult to push the plane. And a 62° cutting angle is sufficient for creating a silky-smooth surface on challenging stock.

## Other Bevel-up Planes

As I mentioned earlier, block planes and shoulder planes also have the blade mounted bevel-up. So you can change the cutting angle to suit your needs by changing the bevel angle.

When I'm working wood, I think of block planes as scaled-down smooth planes. I use them for smoothing surfaces and leveling joints in areas where a bench plane would be unwieldy. Because I reach for block planes so frequently, I have a number of them and each is tuned for a different cutting angle. Also, keep in mind that block planes are available in a low angle, 12° bed, and a standard angle, 20° bed. To trim a miter, it's best to choose a low cutting angle. You'll get the



**Other bevel-up tools.** Block planes (foreground) are ideal for trimming chores and planing end grain. Shoulder planes (background) adjust tenons, rabbets, half-lap and bridle joints. Both types of planes harness all the powers of bevel-up smoothing planes and allow you to easily change the cutting angle for different chores.



**High-angle shoulder plane.** I keep this shoulder plane sharpened at a high cutting angle to handle long-grain rabbets, especially in figured material.

lowest cutting angle by starting with a plane that has a low bed angle. To create a high cutting angle for smoothing, I use the standard-angle block plane with a 20° bed and grind the blade to 40° to create a 60° cutting angle. This setup allows me to smooth a tiger maple post block on a dressing table without the slightest risk of tear-out.

As the name implies, shoulder planes are designed for trimming tenon shoulders to improve the fit of the joint. And although they work great for fine-tuning a shoulder, I don't limit them to that. In fact, I often use shoulder planes for smoothing away mill marks in rabbets on a lipped drawer or door

prior to applying the finish. So I have one shoulder plane tuned with a low cutting angle for trimming end-grain shoulders and another tuned with a high cutting angle for smoothing long-grain rabbets.

Once you experience the results you can achieve by using different cutting angles, you'll start finding other applications for this concept. I even have paring chisels that I've ground to 60°. But that's a different article. **PW**

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# FEDERAL-STYLE INLAY

## *Bellflowers & Stringing*

BY ROB MILLARD

Small pieces transform your work  
from austere to awesome.

**S**ignature features of Federal-style furniture include bellflowers and stringing that often adorn furniture legs, but are also found on table aprons and tambour doors.

Bellflowers have regional characteristics. There are Baltimore examples with three- or

five-part petals, Boston examples with the flowers in three parts, and one-piece bellflowers associated with New York furniture. It's the New York design that is the focus of this article.

Despite being made in one piece, the combined effect of the sand shading, connecting loops and the teardrop pendants adds a stately look to the completed project.

### Where to Begin

The first step is to draw the stringing, bellflowers and connecting loops at full size. A drawing shows the locations of the individual elements of the bellflowers and stringing, but it can't always convey how the finished inlays look.

On my first such leg I used  $\frac{1}{16}$ " stringing, which looked fine until I applied the finish, where the resulting contrast made the stringing look heavy. Make the stringing  $\frac{3}{64}$ " wide—just  $\frac{1}{64}$ " less in width—and the appearance is greatly improved.

The outside stringing runs from the cuff-banding up to a mitered intersection with the



**Show and tell.** Inlay on a furniture leg, specifically the bellflower design, is a simple method used to ascertain a piece's regional origin.



curved stringing that then extends downward to the first inlaid dot. These curved sections are not a segment of a circle, but a segment of an ellipse. Where these two sections come together they merge into one. The bellflowers and the connecting loops are graduated in size.

From your drawing, make simple templates and a story stick; these are at the heart of inlaying the patterns. The story stick is made from a piece of scrap wood and the curved templates are made from thin plywood. I make one template with two radii on a single template, marking them so I don't get confused. The template for the ellipse is marked for use in making both the left- and right-side inlays.

### Bellflowers

Bellflowers are sawn to shape at a scroll-saw. Begin with a stack of five sheets of holly veneer sandwiched between two sheets of  $\frac{1}{8}$ " plywood. Five sheets allow an extra bellflower of each size in the case of a mishap. The profile should flow with even curves, but often my sawing is not up to par. Occasionally I have to refine the shapes with gouges of various sweeps—symmetry is important, but period examples are not always perfect.

The top of each bellflower is sand shaded. To accomplish this, pour about  $\frac{1}{4}$ " of sand into an iron skillet that's placed on a heating element (I use an electric hot plate, but a propane camp stove is another choice). The grain size of the sand has considerable influence on the outcome of the shading; very fine sand results in more controlled, uniform shading.

The goal is to have a uniformly graduated shaded area, with no hint of charring. Aim



**Trompe l'oeil.** A quick dip in hot sand shades the base of the bellflowers and convinces your eye there's added depth.

for a slightly darker "burn" than you want to end up with, because the scraping and sanding will lighten the shading. After the inlaying is complete and the finish is applied, the effect of shading results in a convincing three-dimensional look.

Above each bellflower is a "dot" of holly. I once cut these dots on the scroll saw – as you can imagine that isn't easy or consistent – I now work with a rotating punch, which cuts cleanly and consistently. Oddly, these dots are typically not graduated in size on New York pieces.

Below each bellflower is a teardrop-shaped piece of holly. These are quickly and easily cut with a 6mm, No. 7 gouge. Using a cutting mat (the type made for quilting) will preserve the cutting edge of the gouge and the rotating punch.

### Layout

Certain parts of the drawing have to be transferred to the actual leg. This is where the story stick comes in. It will accurately position the bellflowers, and that determines the locations of all the other elements of the inlay. The story stick also keeps the inlays consistent from leg to leg, which is critically important for appearance sake, especially on legs with inlay on adjacent faces. A vertical centerline also needs to be established on the leg.

### Stringing

Stringing is made from solid stock or from  $\frac{1}{16}$ " veneer, depending on availability. In the case of solid stock, use a band saw to rip strips slightly thicker than the thickness of the finished stringing, then sand to the precise thickness. I use a commercial fixture mounted in a drill press but you can use an oscillating spindle sander with a straight-edge fence.

The veneer stringing is also sanded to the desired thickness. Individual strips are ripped at a band saw that's fitted with a zero-clearance insert. To facilitate bending, rip the pieces to about  $\frac{1}{16}$ " wide.

Grooves for the vertical sections of the stringing are routed to a depth of  $\frac{3}{64}$ " with a rotary tool fitted with a  $\frac{3}{64}$ " carbide end mill. Some of these tools lack power, so take your time even with a groove as small as this. Also, there can be significant run out, so get the groove right the first time because routing it a second time could result in a groove wider than planned.

The starting position of the groove at the bottom of the leg does not require great accuracy because the cuff banding (added



**Repetition.** A rotating punch quickly produces uniform dots ready for inlaying.



**Keep the edge.** A quilt cutting mat underneath your work helps to keep a sharp edge on your tools.



**Keep your story straight.** A story stick ensures layout uniformity from leg to leg.

later) covers the area, but accuracy is a must where the groove terminates at the top. The groove must consistently stop short of the top banding by  $\frac{3}{64}$ " to create a mitered intersection with the curved stringing from which the uppermost bellflower hangs.

The descending curved pieces of stringing come together at the inner edges about a  $\frac{1}{2}$ " above the top of the bellflower. To lay out this intersection, place a scrap piece of the stringing with its centerline on the centerline of the top of the leg where the upper dot is to be inlaid, then scribe along each side of the scrap stringing.

I guess one could devise a template or jig to use with a router to form the curved grooves, but I prefer to do the work by hand. A scalpel has just the right balance of rigidity, maneuverability and sharpness to form the curved grooves. A hobby knife works, too.

Use your tool to extend the outside edge of the vertical groove to where it intersects with the curved stringing. Place your template to intersect with the vertical line that was just extended, with the outside of the line routed up the leg's side. With the template location carefully fixed, scribe along it with your knife. Scribe in two steps – one light pass with the template in place, and a heavier pass after the template is removed.

To cut the other side of the groove, I had a handle made that holds two hobby knife blades that are spaced apart to scribe varying widths – a similar setup is available at my web site ([americanfederalperiod.com](http://americanfederalperiod.com)) or you could clamp two knives with a spacer in



**Accuracy is key.** A rotary tool makes short work of the straight grooves along the leg's edge.



**Get it right.** A sanding fixture at the drill press produces a precisely thicknessed strip of wood for stringing.

a small C-clamp to do the work. This setup is very handy, but it requires a light touch, because the blades are easily deflected.

Allow one blade to track in the line scribed against the template, and with careful attention so as not to apply any side pressure that could alter the spacing of the blades, scribe the other line. Then go back and deepen the second line with a standard knife. You may need to do this several times to reach the proper depth – be careful not to widen the groove as you work.



**A constant arc.** Templates establish one side of the groove for the stringing.



**Define your groove.** The double-bladed knife, tracking in the line scribed against the template, sets the width of the groove.

Remove the waste from the groove by making opposing angled cuts. When making these cuts, be careful not to angle the knife so much that it removes material outside the intended area. The result of these opposing angled cuts is a groove with a somewhat irregular bottom. There's a peak in the center. This is not a problem from a gluing standpoint as long as the sides are accurate. Repeat the same steps to form the groove for the opposing inlay.

The stringing needs to be installed in two steps. In the first step, glue in one long vertical piece – this piece has to have its top end cut at a slight angle to accommodate the curved groove – and install the opposite side curved piece. (See photo below.)

I'm a strong advocate of using hide glue for nearly all inlay work – not out of some sense of historical accuracy, but because of its unique qualities. One of these qualities is its ability to fill tiny gaps around the inlays yet not interfere with finishing. To keep the mess to a minimum, I brush the glue on the stringing, and push it into the groove with a veneer hammer.

If your shop is cool you may have to heat the stringing with an iron to keep the glue from setting. Hide glue has little adhesive properties when it has gelled. Also, be sure to clean excess glue from the open grooves so it doesn't interfere with the next piece.

The stringing becomes surprisingly pliable when wet from the glue and doesn't cut



**A softer touch.** A veneer hammer works stringing into its groove with kid gloves.





**No miter saw needed.** Trim your miters with a sharp knife while using a sharp eye.



**Be persnickety.** Scribe carefully where the stringing intersects – precise work yields a good fit.

as cleanly as when dry. A two-step stringing installation allows the glue to set and increases accuracy as the miters are cut. After the glue cures and the stringing dries, cut the miters with a sharp knife. I do this by eye, which is quite accurate.

Cut the miters on the yet-to-be-glued pieces with a single-edge razor blade, but leave the miter on the curved piece until the intersection where the two pieces become one is cut and fit. That intersection is the most difficult aspect of the entire process.

The glued-in-place piece is easy to trim; just use a straightedge to scribe a line on the centerline and remove the waste as before.

The second piece is more problematic. The long scarf-like joint is cut with a fresh razor blade, but even with that there is a tendency for the piece of stringing to rotate as the pressure is applied, making an inaccurate cut. I do this cut by eye also, but I'm

almost never able to get it right, so I have to use a chisel to refine the fit.

It helps to extend the groove down to where it's covered when a dot and bellflower are inlaid. This allows you to, for lack of a better word, jam the intersecting piece in the groove and force it to make a tight joint where the two come together. After that intersection is well fit, you can miter the curved piece to length and glue it in place.

### Scribing the Bellflowers

Number the legs and the corresponding bellflowers so they can be returned to their proper location later. To do so, hold the bellflower in position and scribe around it lightly. Scribe the line more deeply after the actual flower is out of the way.

It is best to work in from the sharp ends of the petals toward the center of the flower so as to not over-cut at the ends. Use a spiral punch to establish the location of the dots. The bellflowers and the dots are not inlaid at this time, but their location must be fixed now, because that determines the location of the connecting loops.

### Connecting Loops

The connecting loops are inlaid in much the same way as the earlier stringing, but here you can do all the pieces at the same time.

This is possible because where the stringing intersects at the bottom of each loop there is sufficient space behind the bellflower to use a razor blade to make the miters without the cuts running past what your inlay covers, unlike the previously fitted stringing.

Use a small hammer to work the stringing into the grooves of the connecting loops. A word of caution: Before these pieces of stringing are leveled they will look very poor,



**Minor corrections.** As you slice stringing, the pieces roll away from the cut. Often the scarf joint requires paring with a sharp chisel.

with the glue smears and deformation that occurs when the stringing is forced into the grooves.

### Inlaying Bellflowers

Before any bellflowers are inlaid and after the glue has fully cured, the stringing needs to be leveled. Rushing the process can leave a depression. If leveled early, the stringing, having swelled slightly from the glue, shrinks back as it dries. (See "Understanding Glues," page 54.)

Use the card scraper for this and be sure to use one that is in top form. Employ the scraper carefully because a dull scraper or a heavy-handed application of the tool can tear out pieces of the stringing.

A rotary tool fitted with the same  $\frac{3}{64}$ " end mill that was used to make grooves is used to excavate the recess for the bellflowers and dots. The depth of cut has to be set perfectly; the bellflowers are quite thin, which allows only a very small margin for error. This is even more critical when working with holly, which if scraped too thin, can appear translucent under a finish, and that would reduce the contrast with the mahogany.



**Stay tight.** With careful scribe work, the bellflower will look as if it bloomed in place.

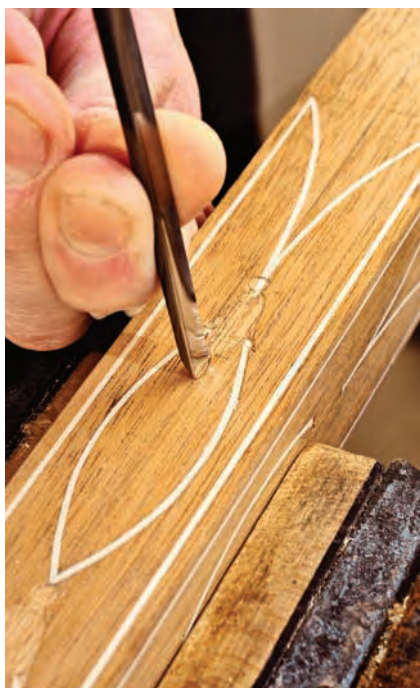




**Odd woodworking tool.** A razor blade becomes a handy tool to miter the bottom edge of the loops.



**Dig into the corners.** A skewed spoon gouge reaches into sharp corners and cleans out the recesses for the bellflowers without damaging an edge.



**Same, same.** Excavate the area for the teardrops with the same gouge used to cut out the inlay. That's the best way to get a perfect match.



**Choice of seating.** The veneer hammer seats the bellflowers into position and removes any excess glue.



**Climate change.** Sometimes it's too cold for hide glue to bond properly, so a heated block is clamped over the bellflower, while aluminum foil keeps the block from sticking to the leg. In hot weather, the block is not heated.

## Online EXTRAS

For an illustration that shows the location and details of the bellflowers and stringing, go to:

[popularwoodworking.com/aug09](http://popularwoodworking.com/aug09)

If your eyesight isn't what it used to be, use a magnifying visor when routing the recess. The magnification allows you to cut very closely to the scribe line, leaving little to clean up. What little is left is easily cleaned with a 2mm beveled spoon gouge.

The recess for the teardrops is formed with the same gouge that was used to punch them out of the veneer. This is a somewhat delicate operation. You have to angle the gouge so the bevel is vertical. The pressure on the gouge should be light or the recess will be too deep. The waste between the gouge cuts is removed in much the same way as for the curved grooves, but here the depth is critical.

The bellflowers, dots and teardrops are also installed using hide glue. Depending on climate conditions, you may get by using a veneer hammer to stick the pieces in place. However, in extreme hot or cold weather, a clamping block might be the answer.

In hot weather the glue gels too slowly, so I clamp a block over the inlay. A piece of aluminum foil sandwiched between prevents the block from sticking. In cold weather I heat the block to liquefy the glue. In all cases I lightly mist the inlays to prevent curling.

When gluing in the dot and teardrops, look carefully for a slight bevel on the piece left from the cutting action of the tool and place the larger side up; this results in a near-

perfect fit. Also try to orient the dot so its grain is running vertically.

Once the glue has cured, lightly scrape the leg to remove the excess glue, then follow up with fine sandpaper. It is when finishing that you get to see the full beauty of the inlays. The contrast, the delicate appearance and the refined look boast of fine craftsmanship. **PW**

*Rob builds Federal period reproductions and has written for Popular Woodworking and the SAPFM Journal. See more of his work and get information about his DVDs, scaled drawings and classes at [americanfederalperiod.com](http://americanfederalperiod.com).*



# Understanding

Delve into the characteristics and properties of the 7 families of glue and adhesives.

**O**K, so you consider yourself a woodworker. Let's say that your neighbor asks you what appears to be a simple wood-working question: "What's the best glue to use when making something out of wood?" How would you answer that? Most modern woodworkers use pretty much one type of glue or more specifically one "color" of glue. So with some trepidation you answer by saying, "Yellow glue (sometimes referred to as carpenters' glue) is the best glue for wood-working." Would you really be comfortable with that response or would you question your own answer?

Really, in the world of woodworking, "What's the best glue?" is one of the toughest questions, with lots and lots of varying opinions. However the fact is that yellow glue is one of many choices, but not always the best choice.

I tell people all the time that the goal of woodworking is to make furniture that your children's children will fight over to see who gets those pieces grandpa made – not fight to see who has to take those pieces.

In 20 plus years, if your work requires maintenance because the glue joints have fallen apart, your title as a world-class craftsman would no longer stick. (I just couldn't resist that.)



BY MARC ADAMS

A hundred years ago an article like this wouldn't have existed because there was basically only one type of glue. Possibly in the future an article like this won't exist either because science might develop that perfect glue for every application.

Who knows – it might be that someday

we'll no longer work with "liquid" glues that require spreading on the mating surfaces, but work with a "solid" material that comes in thin sheets that you simply cut to size and place between the mating surfaces.

To activate this space-age glue might involve pressure or heat or maybe flashing

# GLUES: PART I



**Which one(s) to choose.** With the myriad glues available today – and I’m not talking about brand names – the glue or glues you select may be all that stands between failure and success of your glue joint and your project.

adhesives are man-made products that are derived from synthetic materials.

Usually the word adhesive is used as a broader term because it is more inclusive in that it would include mastics, sealants and cements. But the dictionary defines both glue and adhesive as substances that stick things together. For the sake of continuity I’ll use the word glue throughout most of this article because it seems to me to be a more natural term for woodworking.

In order to understand glues today and to make the best choice, there are a lot of issues that need to be discussed. Strength, grain direction, dimensional change, durability, compatibility, dependability, the curing process, the effects of water, the quality of “fit” of the mating pieces, storage, handling, availability and cost are just a few matters to consider when making your choice.

So to answer your neighbor’s question as to the best glue to use when making something out of wood, the correct answer should be, “It depends.”

## History of Glues

Glues have been used to hold items together for centuries. Some of the first glues were made from natural gums, saps, plant resins, animals and fish. These early glues were used for everything from broken pottery to making long bows.

The Egyptians used animal glues to bond together everything from fine arts to their

the joint with some magic ultraviolet wand. Or imagine that someday we might have something called “peel and stick” glue for joinery. Sound weird?

Today, both of these processes already exist and are currently a common practice in the veneering and furniture industry.

It’s possible that this technology could be heading straight toward us.

By the way, before we go any further, there are people who make a big deal about the definition difference between glue and adhesive. Technically, glues are biological products derived from animals or plants, and



highly decorated wood furnishings. Early Native Americans used a sticky substance to help hold the seams together in their birch-bark canoes.

The first commercial glue factory that specialized in manufacturing glue from the hides of animals began in Holland in the early 1700s. In 1910 a new product called Bakelite was developed. This began the plastic era and within a year plastic resins were introduced into the market. During World War II there was an urgent need to develop new synthetic products such as polymers and rubbers that could be used to hold all types of materials together under a variety of conditions.

But it was the Space Age that really blasted the adhesive industry into the stratosphere. Most of the glues that are now commonly used in the woodshop were developed within the last 60 years.

Today there are many different types of glues including white and yellow polyvinyl acetate (PVA), hide or animal glues, resin glues such as urea formaldehyde, epoxies, polyurethanes, super glues (cyanoacrylate) and contact adhesives.

These seven families of glues are the focus of this article. Each varies in how it dries, gets hard or cures, and all have different characteristics when exposed to heat, water and solvents. Once finally cured, each has a different degree of rigidity or flexibility

in the ways that it transfers and distributes stresses.

Remember, you don't have to limit yourself to just one type of glue throughout the entire project. Variety is the key to using modern adhesives.

### How Glues Work

In order for adhesion to work, some type of action has to take place between the mating surfaces with the glue as the tie. I used to envision that adhesion was purely a mechanical process where the wet liquid glue penetrated the porous surface of the wood through the pressure of the clamps. Then when it dried, it anchored itself to the pores by holding them tightly together. But it's a little more involved than that.

There is also a natural phenomenon that takes place through something called specific adhesion. Specific adhesion is the natural attraction of similar molecules that are held together and can't be pulled apart – imagine two panes of glass and how they cling together. To separate them, the panes would have to be slid apart.

Now imagine that those two panes of glass are separately exposed to air, dust and dirt. Once they are brought back together they can easily be pulled apart.

Specific adhesion depends on three main factors: intimate contact, compatibility of mating materials and two clean surfaces.

*“In the world of woodworking, ‘What’s the best glue’ is one of the toughest questions.”*

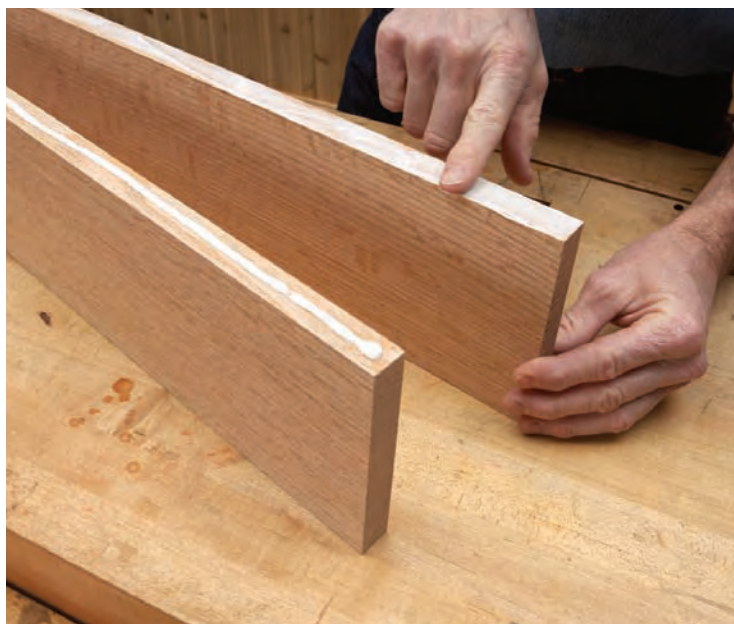
If adhesion is the process of glue bonding to the wood, then cohesion involves the building of a strong network within the glue, reaching from one piece of wood to the other.

Glues for the most part complete the job after the glue turns from a liquid to a solid and cures hard. There are basically three ways this occurs. Be aware that some glues cure through multiple curing processes.

**Evaporation.** Any glue that contains water or solvent (such as PVAs and contact adhesives) dries when the fluid it contains is spread and evaporates into the air or is absorbed into the fibers of the wood. The



**One of the earliest.** Still a big player in woodworking today, hide glue is held in high esteem by true period reproduction furniture makers and luthiers.



**A trick in reverse.** Polyvinyl acetate glues dry as the water evaporates from the emulsion. If you wish to extend your “open time,” purchase a glue that indicates a longer open time.

surrounding air often plays a larger part in the dissipation of the solvent or water. The molecules of the glue during this process are drawn together and attach to one another.

**Chemical reaction.** Epoxies, urea formaldehyde, cyanoacrylate, polyurethane glues and cross-linking yellow glues all cure chemically. This is a process where a combination of materials are added together to cause the curing process to start. As long as these materials are independent, they remain in an unchanged state.

Reactions can be initiated by mixing resin and hardener together such as with epoxy, applying water as with polyurethane glue, by adding a catalyst such as with urea formaldehyde, or by merely drying as with contact adhesive or a cross-linking PVA. One by-product of this chemical reaction is heat. All chemically reactive glues, once mixed, gave a specific “pot life,” which means that you have just so long until the glue turns into a bowling ball.

**Thermal conversion.** Some glues work by the presence or absence of heat. Heat is the most common catalyst for contact adhesives, urea formaldehyde and epoxies, and is required for preparing hide glue for use.

Hide glue works best at a specific temperature (around 145° Fahrenheit) and starts to gel at temperatures of less than 110° F. I’ve also been told that if you apply heat to contact adhesive during the evaporation

process that it helps to vulcanize the rubber and increase its strength and elasticity. Urea formaldehyde and epoxy set much faster with the introduction of applied heat during the curing phase.

### Classification of Rigidity

It is important to understand that the ultimate strength of any glue joint is a function of the glue surface area. The more surface area, the stronger the joint. However some glues, by the way they are formulated, have different degrees of rigidity and have different characteristics when it comes to heat, moisture and solvents.

**Thermoplastic or semi-rigid.** Thermoplastic glues are the most widely used adhesives in woodworking. They are generally resistant to moisture, but are not waterproof. All thermoplastic glues soften with heat and get hard when cooled. It’s possible to reactivate cured thermoplastic glues by re-heating the bond to soften it, then applying pressure during the cooling phase to reactivate the bond. Thermoplastics typically are not as strong and stiff as the wood itself and they can allow the joint to creep during dimensional change. White and yellow glues, hide glue and instant glue fall into this category.

**Thermoset or rigid.** Thermoset glues are generally more costly than thermoplastic glues, but would be the glue of choice if creep resistance or hardness is the main consideration. As a matter of fact, thermoset glues are rigid enough to support high, long term static loads without deforming. They become permanently hard and rigid when heat is applied and are very water-resistant.

Thermoset glues cure through a chemical process. Urea formaldehyde and epoxy are both examples of thermoset glues. Quite surprisingly I’ve been told that in the context of wood gluing, bonds made with thermosetting glues are no stronger than those made with most PVA glues.

**Elastomeric or flexible.** Elastomers are substances that have rubber-like properties. They can stretch and return to their original shape. Elastomeric glues can be waterproof and may benefit from exposure to heat in the curing process, but they are also fairly weak and can fail in response to excessive heat.

Contact adhesive falls into this family, as do certain plasticized PVA glues such as Titebond’s Molding & Trim glue. These glues



**Right glue for the job.** Rigidity is most important when working with bent laminations. Avoid glue “creep” by using a thermoset glue.

are somewhat flexible and can be sensitive to loss of strength with elevated temperatures – more than normal PVA.

### Water and How it Affects Both Wood and Glue

We already know that water is present in living trees. Fresh-cut wood can be totally waterlogged and no glue, including polyurethane, can effectively bond to the saturated fibers. For the best glue bonds, wood should be at least thoroughly air dried or, better yet, kiln dried to less than 10 percent (7 percent is ideal).

If the moisture in the wood is too high, glue will not absorb fully and could be easily squeezed out during clamping, which would create an unusually thin glue line making for a very weak joint. On the other hand, if the moisture content is too low, the wood will absorb glue too rapidly and that decreases the working time.



**Thermal transformation.** Many glues react to heat. Hide glue must be mixed with water, then properly heated before use. Below 110° F, a gelled clump can be pulled from the pot.



Water in wood has an impact long after the glue cures. In time, as wood swells and shrinks, stresses develop that can be great enough to rupture the adhesive bond or the wood, whichever is weaker. These ruptures can develop when adjacent pieces of wood have different grain directions, different shrinkage coefficients or have been subjected to extraordinary moisture conditions.

Usually when joinery involves two pieces of wood that are glued long-grain-to-long-grain or end-grain-to-end-grain, movement is harmonious between both pieces so glue failures are unlikely. However a high percentage of woodworking joinery includes long-grain-to-end-grain joints that create opposite force directions that can all too often result in some kind of joint failure. It is vital in any gluing process that all the wood being bonded be conditioned to the same moisture content and ambient temperature as the glue for the best results.

Don't forget that exotic lumbers (such as teak, cocobolo and rosewood) typically are higher in resins, extractives and oils, and have a tendency to repel water and inhibit bonding.

If your projects include exotic lumbers or woods about which you are unsure regarding their ability to absorb water, do a quick water-drop test. Simply place a drop of water on the surface and watch what the water drop does over time. If the drop does not absorb into your wood, then water-based glues might not be a good choice.



**A little drop will do you.** Information from a drop of water is a great indication of whether water-based glue would be appropriate for your project – if it soaks in, you're golden.

## Glue and Water

Water is used as the carrier for most wood adhesives, primarily because water readily absorbs into wood, is cheap, non-toxic and nonflammable. But water brings on a series of its own conditions. Usually a bottle of white or yellow glue contains about an equal share of solid content and water. Any glue that contains water will raise the moisture content of the wood surrounding the joint, and this causes a raised glue line. If boards are surfaced before the moisture content of the glue line equals that of the remainder of the wood, the glue joint will shrink after surfacing, resulting in a sunken joint.

Wettability is an important process by which water from the glue can wet, spread and absorb into the fibers of wood. It is vital that the water in the glue absorb into the fibers of the wood. Compression, torn grain, burnishes, planer or jointer snipe or contamination from oil or debris can restrict wood

fibers from absorbing the water from glue. This could cause the bond to fail. Good glue surfaces should be free from these defects.

The pH of the water in the glue does one other nasty thing. As the water in the glue comes in contact with both the tannins in the wood and iron from the clamps, it can cause a nasty dark stain. This will not happen with plastic or aluminum clamps.

These stains can be sanded out, but with delicate woods and veneers it is better to place waxed paper between the clamp and the wood.

## Waterproof Ratings

The testing standards to determine the classifications of glue bonds are quite rigorous. Testing is done by the American National Standards Institute (ANSI). Glues are classified as water-resistant, waterproof or low water-resistant.

Water-resistant glues are tested by soaking the cured glue joint in water for four hours before baking it for 19 hours. In order to be rated as a Type II water-resistant glue by the ANSI standards, the joint has to stay together through three rounds of this punishment. If the glue holds, then it passes.

Usually these glues are used for exterior exposure in which there will be some protection from the elements. They are also good choices for cutting boards and bathroom cabinets.

Waterproof glues are boiled for four hours then baked for more than 20 hours

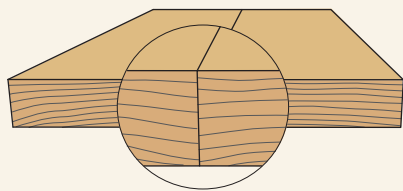


**How it moves.** In traditional dovetail joints, wood moves in the same direction. This causes less stress on the joint and is less likely to result in glue failure.

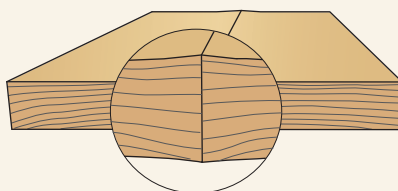


**Choose, but choose wisely.** Typical cross-grain orientation of joints such as this mortise-and-tenon requires glue with more elasticity – PVA glues are a good choice.

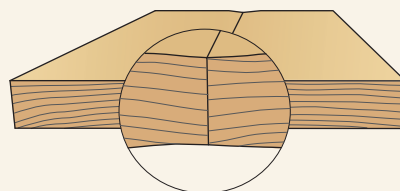
## Don't Surface Your Panels Too Soon



Prepared edge joints are flush.



Moisture from the glue causes fibers near the joint to swell.



Surfacing the joint before this moisture evaporates leaves a depression after the wood has dried.

then boiled for four hours again before being cooled down under running water. This test involves taking the glue through extreme temperature and humidity conditions as quickly as possible. After all this, the glue joint must withstand a strength test while it's wet. If the wood breaks before the glue bonds, the glue has done its job and earns the Type I rating by ANSI.

Low water-resistance glues will not stand up to frequent contact with water or high humidity and should not be used for exterior exposures. Just because a glue isn't water-resistant doesn't mean that it's not strong. Hide glue and most PVA glues (because they are not tested or rated to Type II or Type I) are classified as low water-resistant glues and are perfect for common joinery on interior furniture or cabinets.

### Handling, Storing and Using Glues Safely

Everyone who reads this article is probably guilty of not putting the cap back on the bottle. But how our glues are stored and handled can have as big an impact on the bond as the actual gluing process. Some glues are ready to use right from the bottle, some require mixing and some require heat. All glues should be stored to avoid extreme temperatures, humidity and light. The following are specific issues involved with handling, storing and using glues safely.

**Shelf life.** If it is true that shelf life could be a factor in the effectiveness of glue (and I believe it is), then we need to know what the timetable is of the products we use. Time passes fast for glue that sits on a shelf in your shop. We are a date-oriented society today; we buy our eggs and bread based on dates. If I pick up my glue bottle that I've had for the last who-knows-how-long, I'll continue to use it until it becomes so thick that it can't spread.

The "wetting" process with old glues isn't

as effective as it was when it was new. I suggest that on the day that you open your glue bottle you take a marker and write the date on it in bold print – now you know.

A good rule of thumb is that most water-based glues remain fully functional as long as they continue to flow and spread normally. It is recommended that when you buy glue you only purchase the amount that you think you will use in a year or two. Whenever you buy solvent-based glues only buy what you expect to use in six months

to a year. Hide glues, in their solid state, will keep indefinitely as long as they remain moisture-free.

We have all been told that we can extend the life of our glues by storing them in a cool environment. There are two concerns with this. First, the temperature of your refrigerator might be too cold and could cause water-based glues to freeze. Second, it is vital that if you refrigerate your glues, you take them out in time to return them to the same ambient temperature as the wood. Never apply cold glues to warm wood or vice versa.

**Pot life.** Once two-part glue is mixed, the pot life, or working life, begins. You can manipulate the pot life by heating or cooling the mixture or by changing the mix ratio. Sometimes the size of the container can slow down or speed up the chemical reaction. Beware that mixing causes friction and that friction can quickly be converted into heat and heat is almost always a catalyst to these glues.

I always stir my two-part glues slowly, and I keep in mind that once initial contact takes place the working life begins.



**Better safe than sorry.** Date your glue bottle as it's opened. This is the simplest way to ensure your glue is OK to use and not past its prime.



**It's downhill to the finish line.** Mixing the two parts of an epoxy creates heat. The faster you mix, the sooner the epoxy will set up.



**Just wait for it.**  
A soaking rag is not the answer to removing glue squeeze-out. The best method is to scrape the seam after the glue begins to set.



Today some epoxy manufacturers provide static mixers that thoroughly blend the two together without applying additional heat.

**Freeze-thaw stability.** Water-based glues are prone to freeze at 32° F and below. Some water-based glues are designed to handle the occasional freeze/thaw cycle and others just can't. Freezing can break down the polymers rendering the glue useless. Some PVA glues have a tendency to have a "cottage cheese" look after freezing. If this happens shake or stir the glue back to its original condition once it has reached room temperature.

Dale Zimmerman, senior technical specialist at Franklin International (the manufacturers of Titebond products), told me that as long as you can stir your glue back to the way it was before it froze (no lumps), it will work just fine. This cycle can happen many times without any real effect on the performance of the glue.

**Working temperatures of glues.** When working with PVA it's recommended that white glues be applied in temperatures higher than 60° F and yellow glues in temperatures higher than 55° F. The reason it needs to be relatively warm is because as the glue dries, the loss of water pulls the adhesive particles together with enough force to form a continuous film. If the drying temperature is too low, the glue particles will not be fluid enough to unwind and entangle and form a tough network. The dried film in the joint will appear whiter than normal. This is known as "chalking." When chalking occurs the glued joint loses strength and that could result in a failed bond.

Chemically reactive glues need heat to cure – the warmer the better. It's recommended that urea formaldehyde, super glue, epoxy and contact adhesive be applied in temperatures greater than 70° F. Polyurethanes can go down to 50° F but will take much longer to cure.

**Clean up/disposal.** Cleanup with water-based glues is a little easier than with solvent-based glues. Most directions for PVA glues say that you can clean up the excess squeeze-out with a warm damp rag (not soaking) before the glue dries. This is probably OK, but I prefer to let the glue dry and just scrape it off. If you scrape it off before it gets too hard there will be less of a chance of pulling up small chunks of wood fiber.

However I've witnessed lots of people who take wet sopping rags and just saturate the entire area around the glue joint with water. This just can't be good for the wood or glue. Manufacturers tell us that most PVA glues can be thinned with pure water by no more than 5 percent by weight or volume. There is a huge difference between a damp rag and a sopping wet rag in the volume of water.

Wood by nature is hygroscopic – it's always seeking moisture. Once the excess water has thinned the squeezed-out glue from the joint, the water that now is on the wood surface is contaminated with watered-down glue. As the wood absorbs the water/glue solution, it will "size" the wood around the joint and act just like a finishing conditioner that might inhibit the absorption of stains.

Earlier we discussed several processes that glue goes through in order to become hard. All of those processes required the wood to dry in a very specific manner. A high volume of excess water can change the delicate balance of this process.

Solvent-based glues will have specific solvents that are recommended by the manufacturer, so you should always wear gloves when working with these glues. Urea formaldehyde can usually be cleaned up with water. For polyurethane and super glues, companies recommend that acetone be used. And clean up for epoxy glues varies according to the formulation.

The best way to avoid a waste-disposal problem is to prepare only the amount of glue needed for your job. If the glue is anything other than PVA or super glue, it is recommended that this product be disposed of by a licensed hazardous waste handler or saved for household hazardous waste collection. However, if the glue has hardened, it may be thrown in the trash destined for a landfill.

## Safety Precautions

All glues in liquid form should be handled with care. PVA and hide glue are by far the safest and are considered non-hazardous. They can produce pungent smells and have a slight acidic pH that could cause some skin irritation with prolonged contact.

Solvent-based glues are much more of a hazard. It's a good idea to always wear gloves, eye protection and the appropriate type of respirator. Make sure you always have good ventilation.

These types of glues are skin and lung irritants and allergy-sensitizers, so they could cause burns to skin and eyes. Most of these are flammable or in part flammable, so extra care must be taken when working around furnaces with pilot lights or any kind of an open flame.

Epoxy, urea formaldehyde and contact adhesives use solvents that if inhaled in high concentrations present certain health risks. And polyurethane glues do not have solvents but can produce hazardous fumes if they are exposed to extremely high temperatures.

Never use solvents to clean glues off your hands. Activators for super glue contain small amounts of solvent that rapidly evaporate. Super glue is considered to be of low toxicity, but its activators are generally flammable and hazardous. Instant glues bond so rapidly and strongly that even a little sloppiness can result in an undesirable situation (wonder how I know that).

The final concern is working with glues after they have cured. I do a lot of grinding, shaping and sanding which makes a lot of dust. These hard bits of resins can be brutal on your eyes and lungs. Always wear a dust mask and goggles to protect yourself from these cured particles. **PW**

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Marc Adams is the founder of the Marc Adams School of Woodworking in Franklin, Ind., one of the largest woodworking schools in the world. For details, visit [marcadams.com](http://marcadams.com) or call 317-535-4013.

# The Woodwright's School

Check your cell phone and dozuki at the door.

Roy Underhill picks up the grungiest wooden jack plane you've ever seen and cradles the old tool tenderly in his work-hardened hands.

The tip of the plane's tote is missing. The iron is dark and short. The wedge looks like it has been struck by a thousand golf balls. The entire stock of the plane is covered in a jet-black substance, with the exception of three areas: the plane's sole, its tote and a hand-shaped area at the toe.

"It's covered in mutton tallow," Underhill says about the plane. "They used it on everything. A lubricant."

If a proper collector picked up this plane, he would do one of two things: Clean it until it gleamed or heave it into the burn pile with the rest of the world's grungy jacks. But for Underhill, this plane is almost a holy relic.

"This is the rarity I'm into," Underhill says. "See where his hands were? This plane saw a tremendous amount of hard use."

This Greenslade handplane belonged to Robert Simms, a traditionally trained English joiner who later worked restoring pieces for Colonial Williamsburg. Simms got the plane from another joiner before him. And now Underhill has it. But the tool isn't under lock and key. It's a working tool and lives in a tool chest.

As Underhill explains the plane's provenance he picks a thick shaving from the tool's mouth. It's a fresh curl of pine or ash that he's been planing in his new shop and woodworking school in Pittsboro, N.C.

This plane is one of the dozens of tools Underhill has been sharpening and tuning in preparation for the first classes of The Woodwright's School, Underhill's latest venture in woodworking education. After 30 years of writing and hosting "The Woodwright's Shop" television show on PBS, Underhill has



**All by hand.** Roy Underhill's new school in North Carolina seeks to immerse students in a 1930s woodworking experience.

decided to also offer classes in the style of hand work he demonstrates on the show.

## Part of the Town

After he decided to open a woodworking school, he had to find the right location. So Underhill scoured the North Carolina countryside until he happened upon Pittsboro, a tidy town of 2,500 outside the bustling

cities of Raleigh, Durham and Chapel Hill. There he found a storefront with big bay windows that looks out on Hillsboro Street, the town's main drag.

In addition to the other occupied storefronts, Underhill's school is next door to a vintage-looking ice cream parlor (complete with tin ceiling) and directly in front of an appealing city pub (complete with taps serv-





**Both old and older.** The tools at The Woodwright's School run the gamut, from "modern" metal-bodied planes to the older wooden-bodied planes and braces.

ing Red Oak, a local microbrew).

"Even the people who live here say it's Mayberry," Underhill says about the town. "How about another piece of cherry pie?"

Then he mentions the photographer down the street who has a wall of unusually dressed Barbie dolls.

"Well, maybe some parts are Mayberry after dark," he says with a laugh.

Pittsboro has a bit of an artistic bent. There are lots of local potters, "It seems every third person who visits is a potter!" he says. And he's met beekeepers and musicians. "And everyone seems to have a Ph.D."

Underhill has been receiving local guests with gusto as he has been setting up his shop because they are all part of his master plan.

## Teach the Young and Local

The Woodwright's School is unlike any other in the country. For starters, the shop has

only hand- and foot-powered tools. There are 10 excellent Hoffman & Hammer wood-working benches – very heavy and equally German. All of them face the bay windows and are equipped with a basic complement of hand tools – from carcass saws to bench planes – all sharp, set up and ready to go.

The walls are lined with tool chests brimming with more hand tools. A shelving unit at the rear of the room holds rows of moulding and joinery planes. Another bookshelf is stuffed with old woodworking texts.

In each of the bay windows at the front of the room are the sharpening stations. One is for saws; the other is for edge tools (there's even an AO binocular microscope there for examining your edges). The middle of the room has a treadle-powered table saw, lathe and scrollsaw.

The school also comes with an unusual mission and a set of rules for students.

About those rules: Underhill says students are welcome to bring their own tools, but he asks that you not bring tape measures ("I'll confiscate them and put them in the storage room," he says with a wicked laugh.) Also, no plastic-handled chisels. No Japanese pullsaws. "This should look like you have stepped back into a shop class in the 1930s," he says.

"We're going to be doing English-style joinery," he says. "You wouldn't build a shoji screen with a big Disston. That would be like stir-frying grits."



**Theory and practice.** In addition to the workbenches and sharp tools, Underhill keeps an excellent library of essential woodworking texts at the back of the room.

He also requests that students turn off their cell phones and wear clothing that would be fitting to the time if possible – no beer T-shirts, please. Of course, Underhill spent many years at Williamsburg, so immersing himself (and others) in a certain time comes naturally.

Why is he so intent on recreating the past?

"This is not about the past," Underhill says, his arms spread wide toward the workbenches lined up on the shop floor. "Well yes, of course it's about the past in one sense. But it's really about the future. The objective is the future."



**Making history.** The vintage tool chests throughout the school are stocked with working tools that students can use during the classes.

**The entire school.** With no electric machinery, Underhill can run his entire school out of a restored storefront.





As a result, Underhill wants his new school to educate young and local woodworkers about hand-tool woodworking. Though he knows that the school will attract



**Ready to work.** All the tools on all the benches are sharp, proper and ready to go. This is a big leg up for beginning woodworkers who might never have worked with a properly set saw or chisel.



**Sharpening station.** One of the bay windows of the shop has a table with plenty of sharpening stones and natural light for sharpening edge tools.

students from all over, Underhill says he wants to emphasize training young people so the craft has a future. And he wants to train locals to help build the community.

In February 2009, Underhill opened his school with a series of one-day classes on basic joinery. The first set of classes filled up in just hours. Those classes will lead to classes on building a tool chest. And Underhill says he's going to bring in other instructors as well.

Those people will teach a class for a week and then Underhill will shoot a segment with them during the weekend for "The Woodwright's Shop."

### The Details

What is intoxicating about The Woodwright's School is how much effort Underhill put into the details. The oilstones at the sharpening station look like they're from the right era. The bench planes are a mix of metal- and wooden-bodied ones – again, just what you'd see in a 1930s shop.

There's even a portrait of Franklin Delano Roosevelt hanging on the wall, a sticker in the window for the Works Progress Administration and a huge radio at the back of the room. In fact, the little bit of technology that Underhill allows looks curious and out of place – Underhill uses a digital camera and television to demonstrate work close-up.

There are even some details you can't see.



**For the wee folk.** If you attend the school, be sure to check under the workbench for a coin.

"Each workbench comes with one of these," he says, pointing to a pile of old English and Irish coins. "It's tradition to fasten one of these to the underside of each bench. They're for the wee folk."

So if you're a jolly European tree sprite who happens to stop by The Woodwright's School on your travels, be sure to look under the benches for the coin that Underhill has left for you. And do note how the coins are attached. Underhill has gone the extra mile and used authentic vintage hobnails.

But will all this effort pay off?

"This whole thing has been like jumping off a cliff – and then figuring out how to fly," he says. "We'll see if it works." **PW**

*If you want to learn more about Underhill's new school, visit [woodwrightschool.com](http://woodwrightschool.com).*

*Chris is the editor of this magazine and has recently republished Joseph Moxon's "The Art of Joinery" with his modern commentary. For details, visit his web site at [LostArtPress.com](http://LostArtPress.com).*



**The saw window.** The other bay window is for sharpening saws. Underhill says that when the local residents see him sharpening saws they try not to interrupt him.



**One foot-power.** The treadle table saw at the school has both a rip fence and a crosscutting guide. It makes remarkably clean cuts with (just a little) practice.



# Wipe, Don't Brush

Wiping is the efficient way to apply stain.

**T**he purpose of this article is to emphasize what I've said in passing many times in this column: It's much more efficient to wipe stain onto wood with a rag than to brush it.

Wiping is fast, almost as fast as spraying (without the downside of having to clean the spray gun). Wiping is also every bit as effective in all situations except possibly into recesses such as inside corners, fluting, deep carvings and the like.

Don't get me wrong. I'm not against brushing stains. I just don't see why anyone would do it, especially on large surfaces, and even more especially, when using any stain other than a slow drying oil-based stain. All other stains, including water-based, lacquer and all the dye stains, dry too rapidly to allow time to both brush on and get wiped off of large surfaces before the stain begins drying.

## The Basics

The basic rule for getting good results with any stain is to apply a wet coat and wipe off the excess before it dries.

You can use any tool – rag, brush, paint pad, roller or spray gun – to apply the stain. You can even dip the object into stain or pour the stain onto the wood and spread it around. It's only important that you wipe off all the excess before the stain dries.

If you let the stain begin to dry in spots before wiping off, you will get a type of blotching that is different from the blotching caused by uneven densities in woods such as pine, cherry and birch. You'll get a blotching caused by thick dry spots of stain next to clean areas where the still-wet stain wipes off easily.

If you're brushing one of the fast drying stains, not only might you cause blotching



**Wiping on.** The most efficient method of applying stain is to wipe it on using a soaking-wet cloth. Notice on this stereo cabinet, which was made without a back, I'm not having any problem getting the stain into the inside corners.

when you wipe off the excess, you may get lap marks caused by brushing more stain over stain that has dried.

Brushing is the slowest method of applying stain. So not only might you get blotching or lap marks, you're also wasting time.

It's more efficient to wipe stain than to

brush it, and you're less likely to have color problems.

## The Exception

There is one exception, however. Brushing can be more efficient for getting stain into inside corners and other recessed areas.

To use a cloth (or a sponge) successfully requires getting it very wet. I've noticed that many woodworkers resist getting their cloth wet enough so the stain flows into recessed areas. If this is your problem, you can solve it by having a cheap throwaway brush or sponge brush handy to quickly work the stain into the hard-to-get-to places.

But a brush is unnecessary. You can get stain everywhere with a cloth as long as it is soaking wet. In 20 years of refinishing old furniture, most of which required staining, I don't remember ever using a brush to apply a stain. And I rarely used a spray gun because of the time involved cleaning the gun.

I almost always used, and continue to use, a very wet cloth.

### Fast-drying Stains

Most woodworkers use oil-based stains, which dry so slowly it's rare to have wipe-off problems. But some use water-based stains, some use dye stains and many professionals use lacquer stains.

Water-based stains (all stains that list water for clean-up) dry hard as quickly as the water evaporates. This can happen very rapidly in hot temperatures.

Dye stains (for example, Lockwood, Moser, TransTint and Solar-Lux) dry as quickly as the dye solvent, usually water, alcohol or acetone, evaporates. Again, they dry much faster in warm temperatures.

Professionals typically apply lacquer stains onto large surfaces such as kitchen cabinets by having one or two employees following right behind the application person wiping off the excess stain with large cloths.

You can do the same, of course, by getting a friend to follow after you apply.

But you still wouldn't brush on the stain. Attempting to brush one of these fast drying stains onto a large surface is a sure ticket for uneven coloring.

(If you find yourself with some dried patches of stain, quickly apply more stain, maybe to smaller areas at a time, and work faster to get the excess removed. The additional stain will dissolve what is there.)

### Why People Brush

I can think of only two reasons woodworkers brush rather than wipe stain onto their projects: cleanliness and the Minwax television ad.



**Wiping off.** An oil-based stain dries slowly, which allows plenty of time to get the excess removed with a clean cloth before the stain dries. Had I been using a faster drying water-based, lacquer or dye stain on such a large object, I would have had a second person following closely behind my application wiping off. It's not important to apply or wipe off with the grain as long as you wipe off all the excess. But on critical surfaces such as tabletops I typically make my last wiping-off strokes go with the grain just in case. The grain will disguise any streaks I may leave.



**Blotching caused by fast drying.** Lacquer, water-based and dye stains dry rapidly. So they could lead to this type of blotching if some of the stain dries before you have time to get it all wiped off.

It's cleaner to brush than to wipe with a cloth that drips onto the floor and even onto your clothes if you aren't careful. But drips can be cleaned up, and you can wear old clothes or an apron for protection.

Cleanliness is no excuse for brushing.

Cleanliness can't be the only reason for brushing, however. For many years I've taught hands-on finishing and restoration



**Brushing into recesses.** If you don't get your cloth wet enough with stain, you'll have trouble getting the stain into recesses. You can always use a brush to help do this.

classes and watched with amazement as virtually everyone in the class pulled out a brush (usually a foam brush) for applying their stain. Why aren't they using a cloth?

A surprising number have explained they thought a brush was best because they saw one used on the Minwax television ad, which has run off and on for years. This ad shows someone slowly brushing a stain onto a panel, each stroke lined up perfectly side-by-side with the previous, and no trailing off as the brush runs out of stain.





**Bad practice.** Brushing a stain thick, as is shown in the Minwax television ad, and not wiping off the excess, leads to a poor bond. The way to test for good adhesion is to score the stain and finish (on scrap) with a razor blade in a cross-hatch pattern with the cuts about  $\frac{1}{16}$ " apart. Press masking tape over the cuts and lift it quickly. If the cut lines remain fairly clean, the bond is good. If the tiny squares lift with the tape, the bond is poor.

Looks easy – but it's almost impossible. You can't keep brush strokes lined up so perfectly and you can't control the release of the liquid stain so exactly over any significant length. Plus, a thickly applied stain (no wiping off is shown) will usually crack and result in peeling if struck by a blunt object.

To be fair, Minwax does present the option of wiping on the stain in the instructions on its cans – but the accompanying illustration still shows brushing.

All this aside, the basic question remains: Why brush when it's so much faster to wipe?

**PW**

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*Bob is author of "Understanding Wood Finishing" and contributing editor to Popular Woodworking. He will be teaching a hands-on furniture restoration workshop at the Marc Adams School of Woodworking ([marcadams.com](http://marcadams.com)) the week of Aug. 24.*



**Safety.** Modern VOC laws have led some stain manufacturers to replace solvent with oil, sometimes linseed oil, which can spontaneously combust. To be safe, always drape oil-stain-soaked rags over a trash can or other object to dry out and harden before disposing them.

# Hook Kids with Simple Kits

A project prepped for children passes on the love of woodworking.

A few weeks ago my daughter told me her 7-year-old twins had discovered the joy of working wood. With their Dad, they'd cut and nailed together a variety of wood scraps of different shapes and sizes. Despite their fun, the end result looked like – well – scraps that had been nailed together. Even the children seemed disappointed with the results. Could I, she asked, make them a kit that would let them make something they could use?

I was pleased and flattered that the many shop-made gifts I'd given my grandchildren over the years had kindled an interest in woodworking. My daughter's request also offered a rare opportunity to bridge a gap of six decades. So little of what I know is of interest to the twins, and so much of what makes up their lives is light-years away from mine. (I'm not a twin, I don't own a Wii system and my car doesn't even have a GPS!) I agreed immediately.

The completed project would have to be useful, as my daughter had asked. But I also wanted to come up with something that would be easy, quick and fun, as well as being impressive enough in the children's eyes to be worth the work. After weighing a few options I decided on two identical pine bookcases. What would distinguish one from the other was the way each child decided to paint and decorate it.

I did the grunt work (including prepping the stock, cutting pieces to size, routing stopped dadoses, drilling holes and sanding), labeled all the components, and added to the package a few over-long strips that could serve as shelf supports, if the children wanted to do some cutting. Their jobs were to identify each component from an exploded drawing, fasten the shelves with glue and screws, attach the back with brads, and glue



on the decorative top and bottom pieces.

I gave my son-in-law a set of detailed instructions, and suggested that he complete a dry-assembly before getting the children involved. He's not a woodworker, but he is a teacher, so I knew he'd be able to translate my instructions into language the twins could understand.

I delivered the kits and just a few days later, my daughter told me the bookcases were already done, complete with the painting and stenciling that each twin decided on. Eager as I was to see the finished products, my anticipation was tinged by a certain amount of anxiety.

Like many woodworkers who take pride in their work, I am a bit obsessive – not to mention a perfectionist and finicky. So it was difficult to hand over my project to the children. To cope, I kept reminding myself

that my goal from the outset was to have the twins enjoy building the bookcases, not to have my project come out perfectly.

Creating a kit for youngsters is a terrific way to introduce them to woodworking. Children learn to plan their work and to follow instructions. They acquire attitudes such as care and attention to detail. Properly supervised, they also learn to work safely. Carrying an idea through from conceptualization to completion helps take some of the mystery out of the things they see and use. Perhaps most important, a kit is a way of sharing know-how and erasing the years that separate generations. **PW**

*After a 30-year stint as a college teacher, Joe became a student again several years ago when he joined a community woodshop. Since then, his projects have become increasingly ambitious; he's just completed his third leather-topped cherry writing desk.*