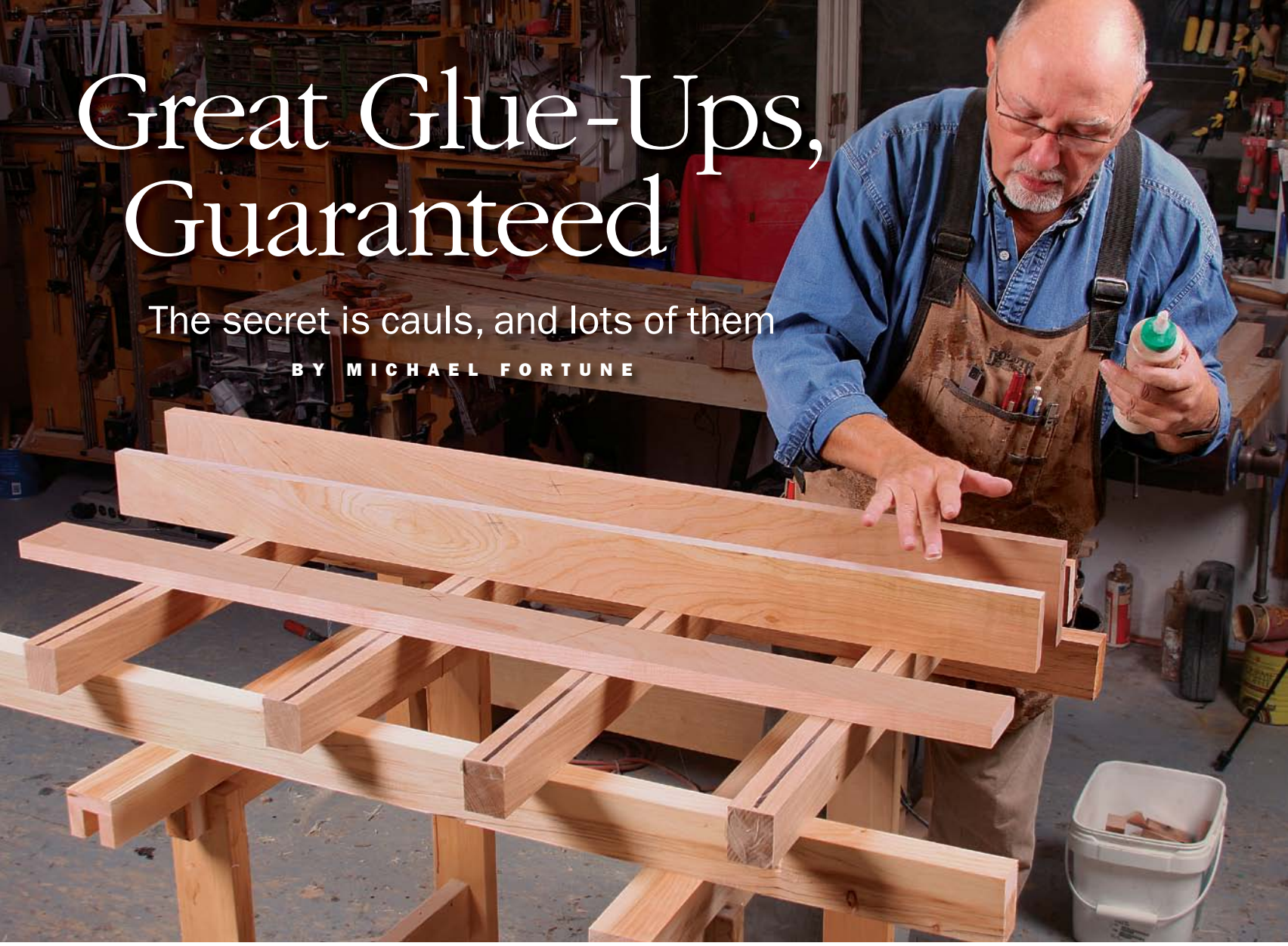
Great Glue-Ups, Guaranteed

The secret is cauls, and lots of them

BY MICHAEL FORTUNE



The essential glue-up kit

Fortune keeps commonly used hardwood cauls in buckets, ready to go. For more on his favorite cauls and clamps, see Fundamentals: "Gearing up for glue-ups," p. 22.

When assembling furniture parts, there is one rule I always remember: Glue is a slippery film. Once it is applied and clamps are tightened, everything wants to slide. Restraining those parts—holding them in perfect position—is just one reason that I use clamping cauls. Cauls are simply extra pieces of wood, usually wrapped with tape or coated with wax to resist glue, held in place with additional clamps.

In this slippery situation, the direction of the clamping force is critical. So I choose and position clamps so that their force will pass through the center of the joint, and at right angles to it.

As a pro woodworker, I can't afford to invest hours of time making perfect parts only to end up with gappy joints, crooked assemblies, or bumpy tabletops that require a lot of planing or sanding. And with the right clamps and cauls, I don't have to.

For a full rundown of the glue, clamps, and cauls I've come to rely on over the years, turn to Fundamentals on p. 22. In general, I use Titebond III, because of its longer working time, and low-tech F-style clamps and pipe clamps. Their small jaws let me know exactly where I am applying force. As for cauls, I generally make them from hardwood and apply clear packing tape to one edge to resist glue.

The dry run: Follow this checklist

With the exception of panel glue-ups, a dry run is essential to make sure that you have everything you need for the glue-up, that the joints will close perfectly, and that the assembly will be square. Here's what to do now so you won't have surprises later.

First, make sure the parts are clearly marked for their positions in the assembly. Marking on a glue face doesn't work well because the glue will obscure the marks. That's why I usually employ the triangle method on a visible face, using light pencil marks. Having mistakenly assembled parts upside down before, I am very methodical

Photos: Asa Christiana; drawings: Vince Babak

Panels

Divide and conquer

By using cauls and gluing only a few boards at time, Fortune produces perfectly aligned panels with no planing necessary.

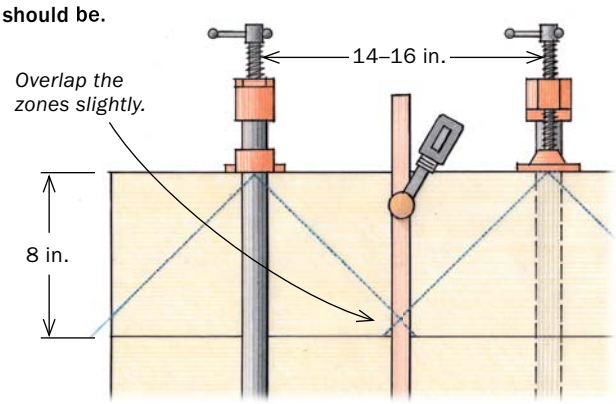
1 ***Smart setup.*** *Whether on a table or sawhorses, run stiff cauls across the bottom with your boards on top. You need to spread glue along one edge of each board only, and then rub them together a bit as you assemble them. Do not try to glue up more than three or four boards at once.*

2 ***Tighten cauls first.*** *With the boards pressed lightly together, you can clamp the cauls fully. Place a pair every 9 or 10 in. Fortune used longer cauls here, anticipating a second stage (below).*

3 ***Close the joints.*** *Alternate pipe clamps top and bottom, with small waxed pads under the pipes to keep them from staining the wood and to keep the jaws centered on the edges.*

MIND YOUR PRESSURE ZONES

Clamping force radiates outward at 45° angles, so the width of the outside boards determines how far apart the clamps should be.



4 ***Level the ends, too.*** *Fortune uses short, flat cauls to align the very ends of the boards.*

Stage two for wider panels

For panels wider than three boards, Fortune works in stages, making two subassemblies and then joining them as shown.

Cambered cauls on top. *With two smaller assemblies done, Fortune completes this wide tabletop. He rejoints the mating edges and uses cambered cauls on the top to get good pressure on the one glue joint in the center and keep the parts aligned there.*

about marking! Mark on a piece of masking tape if you are squeamish about writing on your project or you are assembling a part that has been prefinished.

The next step is to choose clamps that will direct the force properly, and cauls that will keep the parts in perfect position when you tighten those clamps. But before putting on every last clamp and caul, I lightly clamp the assembly together so the joints close and I can apply a glue-resist. If you read my recent article in *FWW* #232 ("Never Struggle with Squeeze-Out Again"), you know I apply wax along every joint during the dry-fit, which makes squeeze-out a snap to remove later. Any silicone-free furniture wax will work. You just rub on a small amount using a piece of scrunched-up tissue. Later, when the glue is dry, squeeze-out simply flicks away, usually in one piece. And the wax residue washes away easily with alcohol.

The next step is to put on all the clamps and cauls, tighten everything, and then check diagonals to be sure the assembly is square. Some people put a square in the corners to check glue-ups, but that will give you an incorrect reading if the parts are even slightly bowed.

If things aren't square, trim the joints if needed or reposition the clamps to make it so. But the main reason to check for square now is to be sure you can reach through all the clamps and battens to check again later, when the glue is on.

One other note: Left exposed overnight, tropical woods will develop an oxidized surface that acts as a glue-resist where you don't want one. So with woods like bubinga and wenge, I always lightly scuff-sand the surface of the joints immediately before applying the glue. By the way, this oxidation also happens with domestic woods if left for a week or two, so do the same to those joints.

Easier panel glue-ups

I was taught that panel glue-ups will always come out somewhat misaligned, and that planing, scraping, and sanding are inevitable. That is simply not true. With the right cauls and a bit more preparation, you can assemble dead-flat tabletops that will require

Edging

Narrow edging that disappears

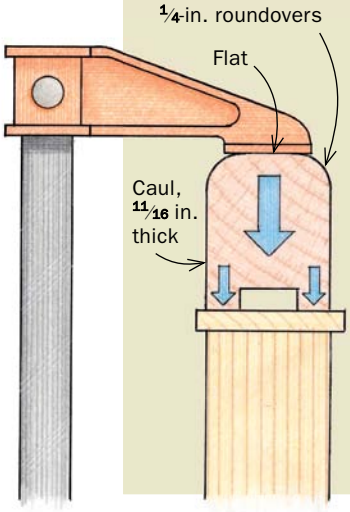
Fortune prefers to edge plywood with thin strips, which are less obvious than thick ones. His specialized cauls apply even pressure for undetectable glue joints.

Cauls are easy to make. *Round the edges of a board on the router table, then rip caul pieces off both edges at the tablesaw before grooving them as shown, with either a dado set or a single blade and multiple passes.*

Keep the panel vertical. *This makes for fewer drips. Apply glue to the edge but not the edging, which will start to cup immediately. Where F-style bar clamps won't reach, cam-action edge clamps work wonderfully.*

CLEVER CAULS

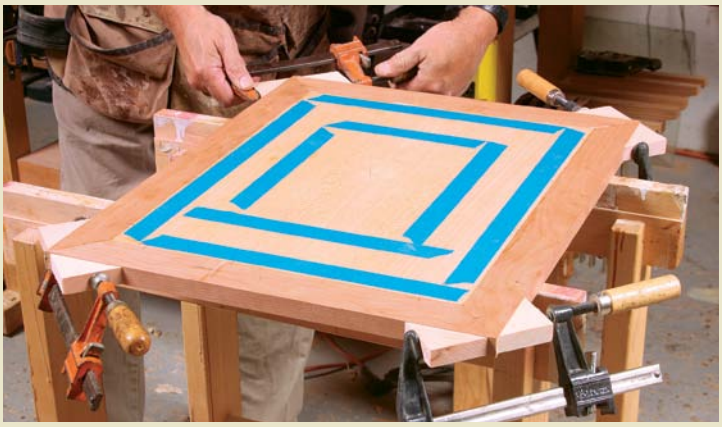
These cauls are grooved on the inner face to apply pressure at the edges, where it matters most, and partly rounded on the outside face to be sure that clamping force is centered on the caul.



Mitered edging frames a panel

Wide edging is best for tabletops, where it frames a plywood panel nicely. Fortune uses biscuits to align the edging and strengthen the joints. The trick is getting good pressure on the miters.

Glue blocks are the secret. *Fortune makes these angled clamp blocks from pine, a bit thinner than the edging. Attaching them is easy: Apply glue and simply rub them into position. Wait an hour, and the joint can be clamped.*



Clamp the corners first. *Clamp across the glue blocks, aligning the clamps with the center of the miter. The biscuits will keep the parts level enough for now.*

Cauls on top. *The edging is a bit wider than the plywood panel, so the blue tape accounts for the offset. Short cauls on the top side are enough to ensure that the edging stays flat.*

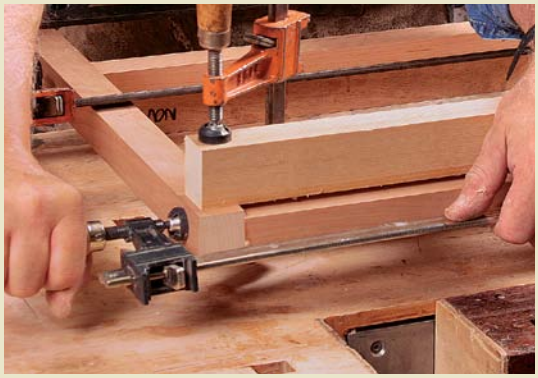
Clamp the middle. *These clamps ensure that the center sections of the edging are tight to the panel too.*

One last caul. *As a last bit of insurance, Fortune clamps short, flat cauls across the corners (above). The glue blocks are easy to remove afterward (right). Just bandsaw them close, and plane away what is left.*

Mortise-and-tenon frames

Even with full-length tenons, clamping pressure can pull parts out of alignment. Again, cauls offer peace of mind.

Selective gluing. *Fortune puts most of the glue in the mortise, and just a bit on the tenon shoulders, but none on the tenon itself, where it would be squeegeed off and end up as squeeze-out.*



Caul first, clamp second. *Put a stiff caul across the frame, and tighten it firmly (left). Then fully tighten the clamp (above). Fortune prefers F-style clamps for many glue-ups, as they can be positioned right on the centerline of the joint, helping to keep the parts level.*

only moderate sanding to get ready for a final finish. And you won't need biscuits or splines to align the boards. Those are dangerous anyway, often making a surprise appearance when you crosscut the end of the panel.

Provided that you have machine-planed your boards to uniform thickness, the first trick for a good glue-up is smart edge-jointing. Mark the boards carefully, and then put the top face against the jointer fence for one board, and the bottom face against the fence for the next. This way, the joint will always be tight and flat even if the fence isn't square to the table.

Next, for perfectly flush joints between the boards, you need a minimum of three pairs of extra-stiff cauls, and enough to have a pair every 9 in. or 10 in. along the glue-up, starting near the ends. I tighten the cauls first, which keeps the middle of the panel flush and flat as I bring the boards together.

But that's not the whole story. The cauls won't work for edge-gluing more than three or four boards at once. So the other key is to do wide glue-ups in stages.

I use pipe clamps for panel glue-ups, alternating them on either side to maintain even pressure along the centerline, and I put thin waxed pads under the bars. These lift the clamp jaws so they align with the centerline of the panel and keep the bars off the gluelines, where the iron can react and stain the wood very deeply.

As I mentioned, I don't bother with a dry run, and because the glue scrapes off easily, I don't bother with the glue-resist either. Most PVA glues will set within two hours, so the clamps can be removed and the squeeze-out scraped off with a common paint scraper (I regrind the edge from time to time). If left longer than that, the squeeze-out will begin to bond to the surface, and chipout can occur along the glueline. Avoid the urge to machine-plane the assemblies, since the grain is rarely all going in the same direction.

Tight dovetails

Like most woodworkers, Fortune leaves his pins and tails a little proud, and planes them flush later. He uses notched cauls to get good pressure on the tail boards.

Custom cauls in a jiffy. *Start with a block of wood large enough to make four cauls. Hold it against a tail board (left) to mark the notches. After notching the block on the tablesaw, slice off the cauls on the bandsaw (right), slightly thinner than your workpieces.*

Glue the tails only. *Any glue on the pins will squeeze out into the inside corners of the box, where it is harder to remove.*

Precise pressure. *Notched cauls reach around the slightly protruding pins to put firm pressure on the tails, for tight joints all around.*

If you are adding another board or group of boards, be sure to scrape away the glue first so the cauls can do their job, and re-joint the mating edges. Here I use cambered cauls on the top side, so I'm sure to get good pressure on that center glueline.

You'll be surprised at how flat your panels come out. At the most I do some work with a card scraper to level the joints, but usually I go from glue-up right to the random-orbit sander.

Wipe and check. *This is one time when you want to wipe away a bit of the wet squeeze-out, so you can see the joints clearly and make sure they are fully closed.*

Invisible edging on plywood

I tend to use thinner edging on shelves and doors where I want an unobtrusive look, and wide mitered edging on tabletops.

Square plywood cases

Fortune tends to put these together with biscuits and butt joints, making for a wobbly glue-up. But he has solutions for that, too.

Always mark parts. *In any glue-up, you need to know the position of every part in the assembly at a glance. Fortune uses the carpenter's triangle method, marking lightly on a visible face.*

Room for square. *During the dry-fit, make sure you'll have room later to fit in a tape measure and check diagonals.*

But in both cases, the joint between the hardwood and plywood should be almost invisible. Also, I make the edging a few hairs thicker than the plywood when I put it on. You want to be leveling the edging afterward, not planing or sanding the extremely thin veneers on today's hardwood plywood. Also, the edge of the plywood tends to swell a bit when the glue hits it, making the extra thickness even more important. To be sure the edging is slightly proud on both sides, I just feel with my fingers.

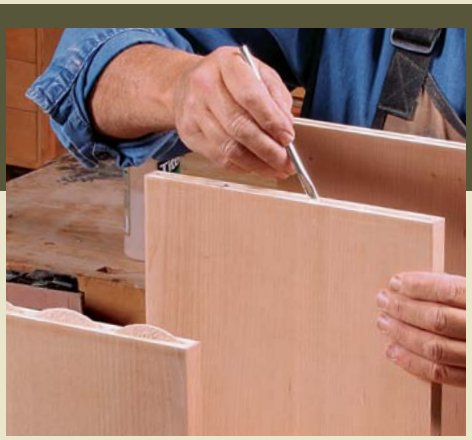
Special caul for thin edging—The challenge with thin edging is that it doesn't spread the clamping pressure. Also, once the edging hits the glue it immediately begins to cup outward, opening the joint on the top and bottom. To counter both issues, I've developed a great caul. I make these from a square hardwood blank a bit shy of ¾ in. in both directions. The inside face has a wide groove to focus clamping pressure at the edges, and the outside edges are rounded slightly so the clamp pressure is always centered (see drawing, p. 46).

Mitered edging needs more help— Wide edging is usually mitered at the corners, which need to be fitted carefully before glue is applied. Also, I use biscuits to align the edging with the panel and strengthen the miters. In fact, I use biscuits often in my work (see "Fine Furniture with Biscuit Joints" in *FWW* #227). It is best to spread glue in the slots but not on the biscuits, as they will swell and be hard to insert.

In this case, I use two types of cauls to guarantee success. I put short, flat cauls along the top edge to keep the edging flat as I clamp it. To allow for the edging's extra thickness, I space the cauls off the plywood with blue tape.

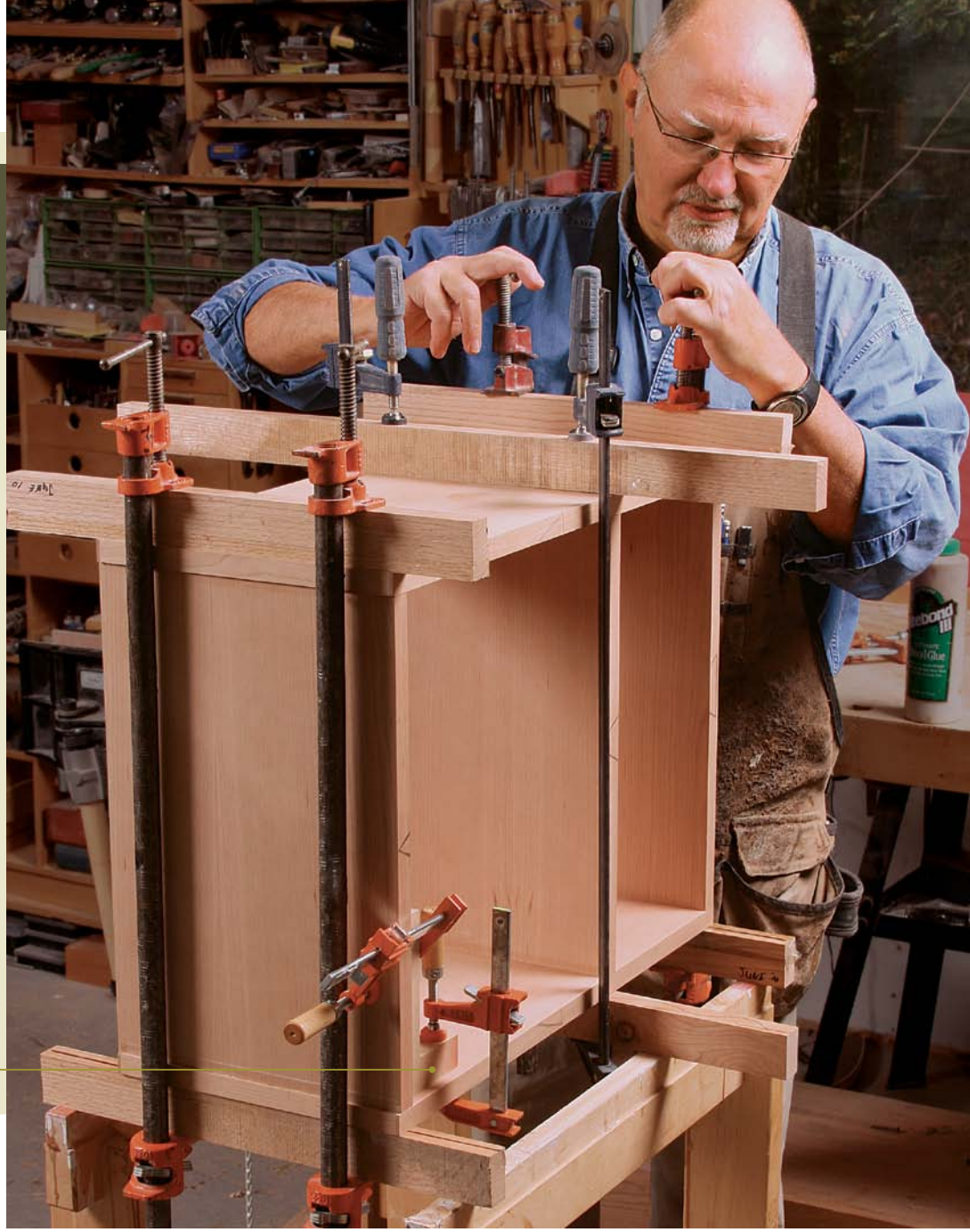
To clamp the miters tightly, I use another of my favorite cauls: simple angled blocks, glued to the frame. These are a lifesaver on angles and curves of all kinds, and they attach quickly using a simple rub joint with white glue or Titebond I (both set up faster than Titebond III). Cyano-acrylate glue also works (with the activator). You might be tempted to attach the blocks with hot-melt glue or double-sided tape, but those always creep when pressure is applied.

Don't use the cutoffs from your edging as clamping blocks; the grain is short, making the blocks hard to remove once glued on. Instead, cut softwood pieces to the same shape but with the grain running along the long edge. Make them narrower than the edging to allow the flat cauls to go on.



Keep squeeze-out in check. *For full strength but minimal squeeze-out, brush glue into the biscuit slots only, nowhere else.*

TIP Fortune uses small angle-blocks to hold panels upright, acting as third and fourth hands.



The right cauls. *Straight cauls work fine at the ends of the case, where clamps can reach, but the middle shelves get cambered cauls to be sure even pressure is applied across the entire joint.*

Cauls for tenoned frames, too

What many woodworkers don't know is that even with deep mortise-and-tenon joints, such as those on doors and table bases, parts can tilt out of alignment when clamped. So I clamp a long, stiff caul across these assemblies, too.

Through-mortises are trickier. Usually the tenon protrudes somewhat, at least at glue-up, so you have to place clamps above and below the tenon, without applying uneven pressure and opening a gap along the tenon shoulders. This also gives you access to the tenon, so you can drive in wedges (if you are using them).

Notched cauls for dovetails

Like many woodworkers, I leave my pins and tails proud about 1/64 in. and use notched cauls to work around the protrusions and get direct force where needed. I usually use poplar or basswood. Pine is too soft and will crush if the pins are close together. Also, I wax the cauls, because tape doesn't work on the uneven surface.

In theory the joint is self-aligning, but sometimes I apply a straight caul along the pins board, just below the tails, to be sure to pull the joint tight in this direction, too. But only light pressure is necessary. Too much will distort the box.

Finishing touches

Just before the project is finish-sanded, it is a good idea to wipe it down with denatured alcohol. Any glue left around the joints or errant gluey fingerprints will show up as shiny or white spots, depending on the glue.

The best way to remove any glue you find is with a card scraper followed by a light sanding. Just sanding it off may push it into the wood fibers. This step is particularly important if you plan to stain your project. □

Michael Fortune is a contributing editor. He makes custom furniture in Lakefield, Ont., Canada, and teaches woodworking throughout North America and beyond.