Doors that Stay Flat

How to ensure that your frame-and-panel doors come out flat—and stay that way

BY STEVE LATTA

For doors to hang easily and swing true, they need to be flat. It sounds obvious, but making doors that stay flat is easier said than done. No matter how much I emphasize proper techniques with my students, there are always doors that end up with a twist. In almost every case, the problem could have been avoided.

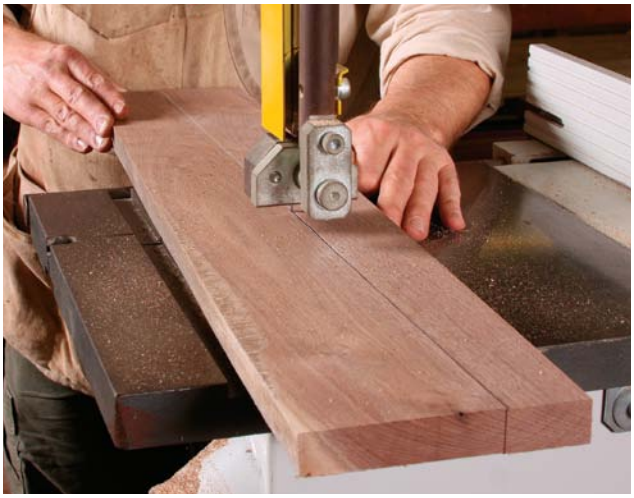
Flatness is the result of a painstaking process that starts with choosing the right stock, followed by patient milling and careful joinery and assembly. While building a basic frame-and-panel door, I'll share the techniques I use to make sure my doors come together flat and stay that way.

Pick straight stock and mill it gradually

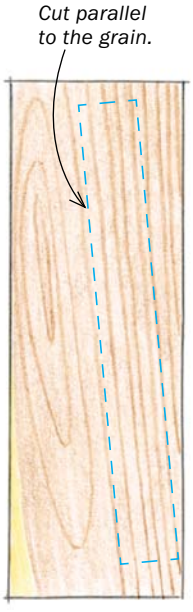
If you want your door to stay flat, the rails and stiles have to be resistant to twist. The best way

Milling: Start with the right stock

Straight-grained, dimensionally stable stock—as in rift- or quartersawn lumber—is the right choice for door frames. Structurally, it moves more predictably and is less likely to develop twist than flatsawn stock. And its subdued grain pattern is less jarring visually.



Straighten the grain. *If the grain runs at an angle to the edge, mark a line parallel to the grain (top), then bandsaw to the line (bottom). Clean up the cut at the jointer.*



BIG DOORS GET A BIG BANG

Drop relieves stress. *For larger doors, like those on armoires, Latta actually drops rough parts on the floor! The impact releases internal tensions and lets the parts finish warping before final dimensioning, he says.*

Photos: Henry P. Belanger

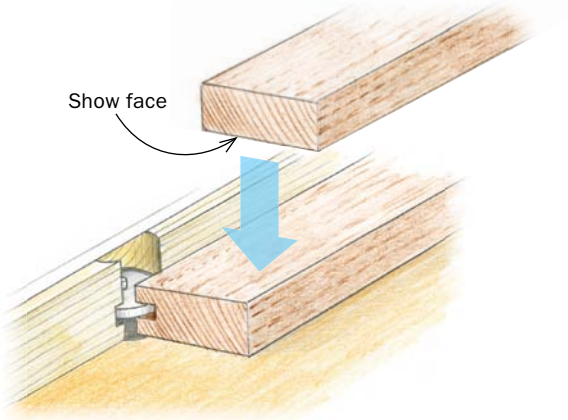
Joinery: Know your show face

When cutting the joinery, use the show face (usually the front) to guide the workpieces. Referencing off the show face ensures that the joinery will line up and the pieces will be flush on the front of the door where it is most obvious.

GROOVES AND MORTISES FIRST

FRONT FACE DOWN

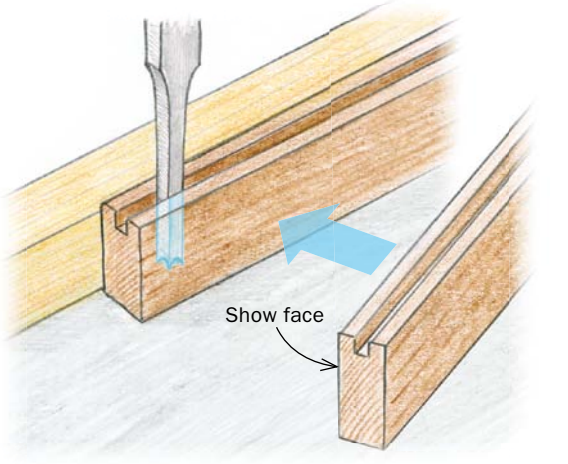
By referencing the front faces against the router table, any surface or thickness variations will end up on the back of the door.



Start with the panel grooves. *Latta uses a slot-cutting bit in the router table. To prevent the workpiece from lifting, which will make a wavy cut, use push blocks to keep it tight to the table. It also helps to brush off the table between passes so that dust and chips don't interfere.*

FRONT FACE AGAINST FENCE

Place the front faces against the fence of the mortiser.



Use the grooves to guide the mortising. *Latta cuts the groove to the exact width of one of his hollow chisels. The groove helps him set up the mortiser. The same would work if you were routing the mortises.*

to avoid problems is to use dimensionally stable, straight-grained stock for the frame. As you mill any board, you release internal stresses that can cause wood to move out of flat. But figured grain is more prone to unpredictable movement—so save figured stock for the panel or elsewhere.

While milling the frame parts, remove material slowly and equally from both sides to minimize and balance wood movement. Throughout the process, keep stock neatly stickered on a flat surface to further discourage bows, cups, and twist.

Start with stock that is ¼ in. to ⅜ in. thicker than the final dimension and rough-rip the stiles and rails about ¼ in. to ½ in. heavier than final width if the stock allows. Larger doors need more buffer than smaller doors, so size parts accordingly. Rip a few extra pieces in case parts need to be replaced. The extras also can be used to set up joinery cuts.

Take stiles and rails to final thickness gradually. Take light passes on the jointer or planer. The dimensioning process might take a week for large doors, or overnight for small doors. After each milling session,

Drawings: John Tetreault

Cut the shoulders. *Latta uses a miter gauge that's adjusted perfectly square to the blade. The rip fence serves as the stop.*

it's important to sticker the parts and let them sit overnight. Letting the parts sit allows the newly exposed grain to acclimate to the shop and lets the wood move. If a piece keeps warping severely, replace it with one of your extras. If it won't stay flat during rough-in, assume it won't later on.

Approach solid-wood panels just like the frame parts: Size them down slowly over time, and check often for twist, bow, or crook. Distorted panels can pull the frame out of flat during glue-up.

Consistent machining ensures flush joints

Straight stock and incremental milling yield flat parts, but it takes solid, well-executed joinery to make a dead-flat, rack-free door. I use real tenons—not the flimsy stub tenons formed by a basic cope-and-stick router set—and make them as long as the frame design allows. Full tenons provide superior protection against racking, buckling, and distortion.

For speed and simplicity, I size and locate the mortises and tenons to correspond to the panel groove, which I cut first. I use a ¼-in. groove for small doors and a 5⁄16-in. groove for larger doors.

Before cutting the joinery, I mark all my front faces with crayon to keep track of their orientation. Consistently referencing off the "show" faces at the machines ensures flush joints later on. Any slight variations in thickness from piece to piece will end up on the back of the door, not the front. This marking procedure is especially critical when you are making a door with an offset (off center) panel groove.

I use a hollow-chisel mortiser to cut the mortises, matching the chisel to the width of the groove. The panel grooves and the mortises should be referenced off the same face, so here, reference the front sides against the fence. Mortises should be 1⁄16 in. deeper than the length of the tenons. This leaves room for excess glue or debris at the bottom, which otherwise might prevent the tenon shoulders from mating squarely with the stile during glue-up.

I cut tenons at the tablesaw, starting with the shoulders. To ensure consistent results,

Then the cheeks. *Latta uses a shopmade tenoning jig to cut the cheeks. Before cutting the real tenon cheeks, however, he makes test cuts on an extra workpiece.*

TIP

Set up square. *Square up both the jig fence and the blade; otherwise, you'll end up with tapered tenons.*

Too tight is just right. *When machining the tenon, you want it to barely fit the mortise. Let it acclimate overnight, then fine-tune the fit with a rabbet or shoulder plane.*

Fine-tuning: Get precision with hand tools

If you've taken care setting up your machine cuts, any fine-tuning of the fit should be minimal. The job is best done with a rabbet block plane, which is wide enough to plane the entire tenon in most cases, but a shoulder plane works, too.

Take light passes. *Remove material equally from both sides to ensure that the joint is flush. Check the fit frequently as you go.*

Check the cheeks. *Use a combination square to make sure that the cheeks are parallel and square to the rail faces.*

Now check the corners. *Lay a 6-in. ruler across each joint to confirm that it's flat and flush in front.*

use a well-tuned miter gauge that's perfectly square to the blade.

I make the cheek cuts with a tenoning jig, sizing them a hair too thick so that the tip of the tenon just fits in the mortise. Then, I let the pieces sit overnight and acclimate. The newly exposed cheek fibers are likely to shrink; a too-tight fit in the afternoon often becomes a perfect fit the next morning. For that reason, I tend to schedule my work so I'm cutting tenons at the end of the day. If the tenons are still too tight, size them down with a rabbet block plane, which removes material uniformly across the whole tenon. Be sure to remove material equally from both cheeks, so you don't create misalignment problems later. Use a combination square to verify that the cheeks are parallel to the face of the rail. Assemble the joint on a flat surface and use a straightedge to see whether the joint is flat.

Because grooves run the length of the stiles, for this door, the tenons need to be haunched before you can dry-fit the rails and stiles. Establish the height of the haunch at the tablesaw, with a miter gauge, then rip to fit at the bandsaw.

Finally, size the panel. You want it to be about ¼ in. shy of the available space in the frame (more in winter, less in summer); this provides the necessary room for seasonal movement across the grain. Keep the fit tight at the top and bottom.

Keep things flat for a final dry-run

Before you break out the glue, do a dry run with the assembled door, clamps, and cauls. Start with a flat surface. Use two identical clamps (one for each rail) that are free from tape or dried glue, and make sure they're parallel—to each other and the table. Cauls should be sized about ⅛ in. thinner than the stiles, so clamping pressure is directed in line with the joints. Make the cauls ¼ in. shorter than the door, so you can make corner-to-corner measurements to check the door for square.

Dry-fit the door, lay it on the clamps, and position the cauls. Center the clamp heads on the rails and tighten them just enough to bring the joint together. Excess pressure is counterproductive.

Once you've confirmed that the door is square and flat during the dry-fit, take it all apart—you're ready to glue it up the same way. Glue should be a formality; by

Assembly:
The right cauls are key

Dry-fitting and clamping the entire door gives you one more chance to check the alignment of parts. It also gives you a chance to see that the clamps and cauls you're using won't wreck your glue-up.

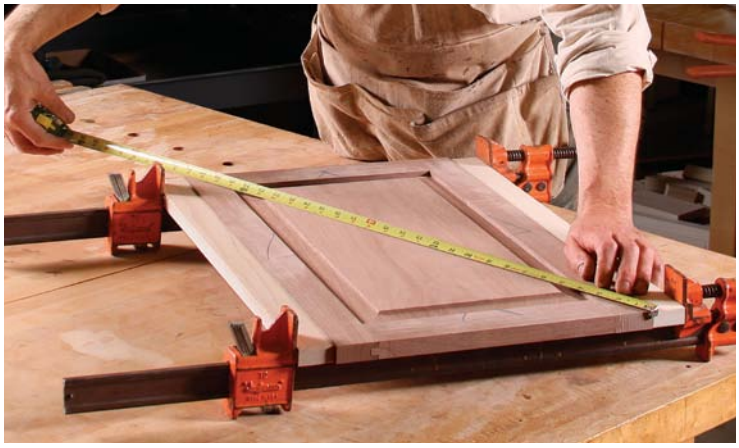
Thin cauls are more direct. *Cauls (or clamp jaws on their own) that project above the frame (left), will apply pressure unevenly, causing the door to bow. Cauls that are a bit thinner than the frame help direct the clamping pressure more precisely (above). Use a straightedge to make sure that parts are flush after you've tightened the clamps.*

the time the adhesive hits the joints, all the work of making a flat door is done.

Store doors carefully

Don't forget to store your doors properly after you glue them up. Taking the doors out of the clamps and leaning them against the wall can cause them to warp. If they're not hanging on the finished piece, doors should be stickered on a level, flat surface. The stickers should be of equal size, not random scraps from the cutoff bin. □

Steve Latta teaches woodworking at Thaddeus Stevens College of Technology in Lancaster, Pa.



Cut cauls a bit short, too. *To check for square, measure the door's diagonals. If they match, the door is square. Latta makes his cauls about ¼ in. shorter than the rails so the tape can hook securely over the corners.*

EXTRA STEP FOR BIG DOORS

An assembly surface that isn't level could cause the clamps to pull a large door out of flat as the glue dries. Check your benchtop or assembly table for flat and level, then do a dry run. The table, clamps, and door should be on the same plane.