

Frame Miter Joints

These elegant joints are difficult to cut and clamp. These jigs can help.

The only frame joint that doesn't leave a bit of end grain exposed is the miter joint. Given that it's almost invisible when done right, it's visually appealing, so you see it used for picture frames, for architectural trim, when assembling mouldings and occasionally in face or door frames.

But it can be a problematic joint.

Structurally, it's a bit weak. Because it mates one tangentially cut end-grain surface (sometimes called "short grain") with another, it's weaker than a long-grain-to-long-grain joint. It's stronger than end-grain to end-grain, but not much. Run some fasteners into a miter joint and you're driving them into end grain, where they won't hold well. Angling the fasteners helps, but not a lot.

Also, a miter is tough to cut accurately. Haven't we all struggled with a frame that isn't square and has joints that don't close because some of the cuts were half a degree off perfect? Try all sorts of approaches – miter saws, table-saw jigs, stationary sanders, even hand tools such as block planes and miter



Photos by the author

Spline and dovetail keys are basically just exposed splines. After the joint is glued up, just saw or rout a slot through its edge, then glue a key into the slot. Typically, the key is a contrasting wood so it can stand out.

trimmers – but nothing seems to work.

On top of that, joint assembly is maddening because you have to find a way to prevent the mating pieces from sliding out of line when you apply clamping pressure.

If that isn't enough to make you shy away, wood movement stresses the joint and degrades its appearance, especially with stock

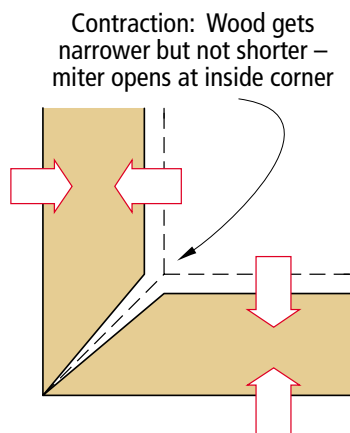
that is wider than 3". As the wood expands, the joint tends to open at the outside; when it contracts, the joint opens at the inside. The wider the stock and the more unstable the species, the more pronounced the effect.

For this reason, it's a good idea to limit the stock width you join with miters. Picture framers and trim carpenters compensate for this effect by layering several thinner mouldings to create large frames.

Making the Cuts

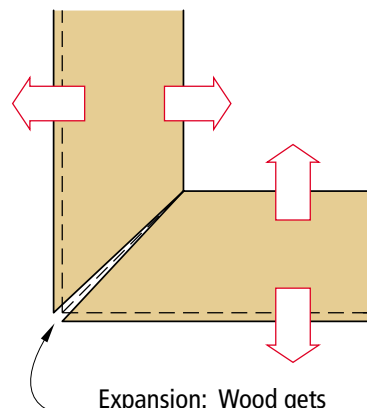
Cutting the miters seems to be a simple task. You can use several different types of power saws, but the real trick is in cutting a precise angle that yields a square joint.

Power miter saws and radial-arm saws have adjustment points that can create inaccuracies. A detent (a factory-made "stop")



Contraction: Wood gets narrower but not shorter – miter opens at inside corner

Effect of wood movement



Expansion: Wood gets wider but not longer – miter opens at outside corner

by Bill Hylton

Bill Hylton is the author of several books on router woodworking and furniture making. He will be giving seminars at select WoodWorks 2003 shows. See woodworks2003.com for more information.

for the blade at common cutting angles) can have just a tiny bit of play. The pointer on the scale can be off a hair. The tools have pivot points that can develop play.

Nevertheless, these tools will produce acceptable results. And having a well-tuned saw helps. When you make a critical cut, check the angle against a reliable angle square. For 45° angles, a plastic drafting triangle is both accurate and inexpensive. The other critical point is that your stock must be cut precisely to length. Even small variances can spoil the fit of the assembled frame.

A woodworker who gets little practice may get better results using a sliding cross-cut table or a miter sled on the table saw. Sliding tables are pricey, and not all saws can accommodate one. An adjustable miter sled is more reasonably priced. Or you can make one yourself, as shown at right.

The advantage of these devices compared to a miter gauge is that the work is immobilized against the fence and base throughout the cut – you aren't sliding the work itself across the table of the saw.

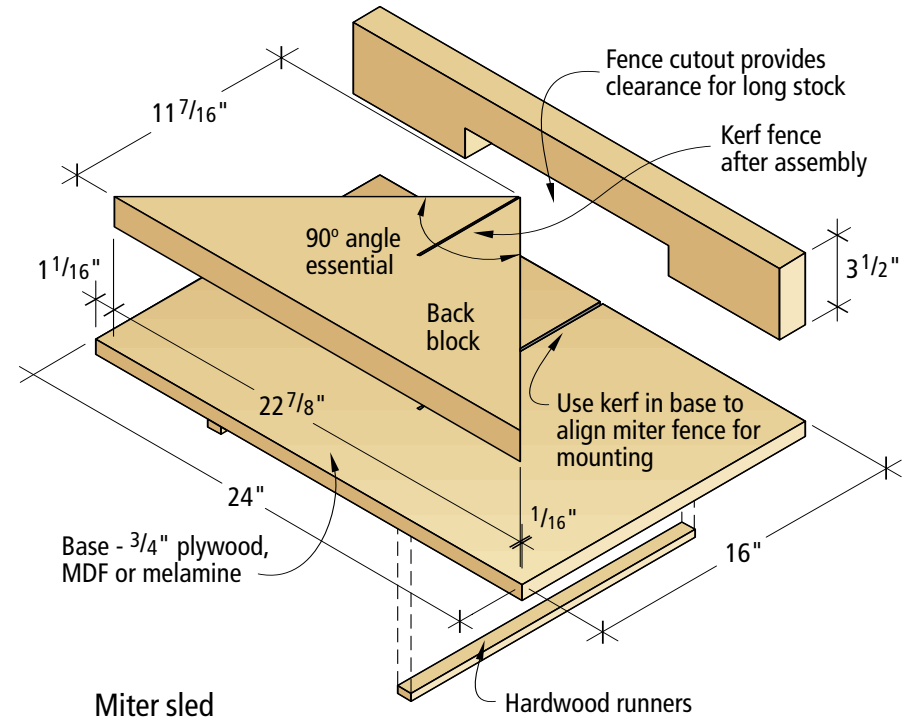
Presuming that your goal is to produce a square corner and not necessarily to produce precise, individual 45° cuts, you can make a miter sled for the table saw that will do the trick. A square-cornered block ensures that your assembled miters will be square.

While there's certainly more than one way to produce the sled, the one that worked for me was to assemble the base, runners and fence, then to saw into the base. I next cut the back block square, scribed the diagonals on the block and sawed it in half along one of them. I used the second scribed diagonal to position the now-triangular block on the sled's base. The result is a sled that helps me cut clean miters that form perfect right-angle joints. No fuss, no adjustments and no fine-tuning are required.

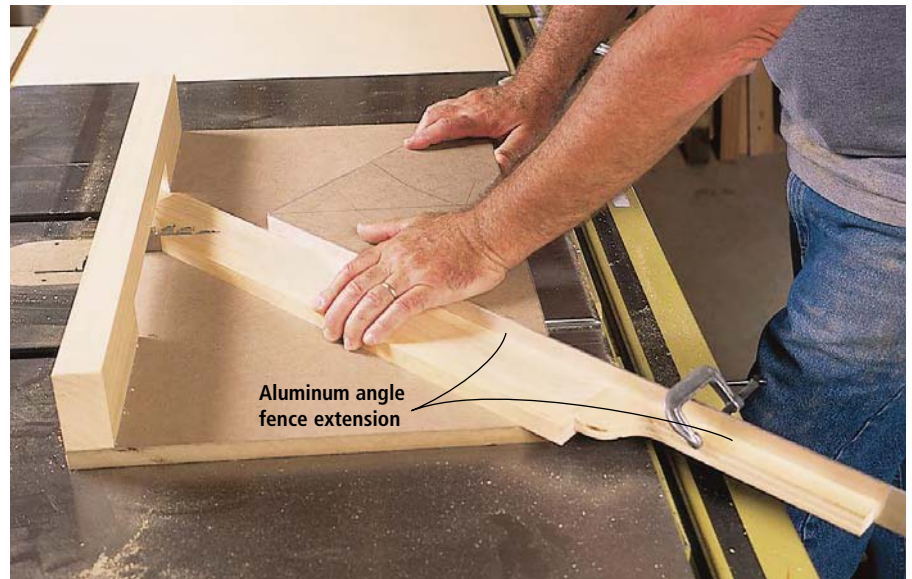
Clamping is Job No. 1

The true challenge in gluing up a miter joint is applying clamping pressure. You need to force the mating surfaces together, which requires pressure perpendicular to the glue line, but you also need to simultaneously pull the components of the frame together.

There are all sorts of specialty clamps on the market. You can buy corner clamps for clamping individual miter joints. There are



Miter sled



A miter sled for the table saw will produce perfect right-angle joints. Stops clamped to the aluminum angle fence extensions ensure parts will be properly sized.

some setups for clamping a complete frame at once. An effective and inexpensive band clamp, for example, surrounds the frame and pulls its parts together.

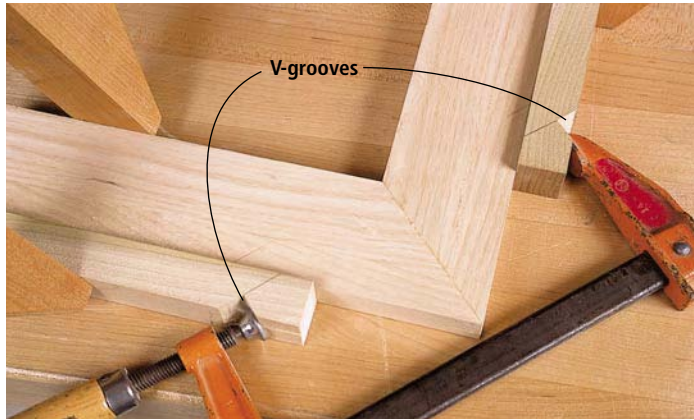
I personally favor some homebrewed approaches that use general-purpose clamps.

Miter clamping cauls provide angled surfaces so you can apply a clamp perpendicular

to the glue seam. Clamp the cauls to the mating parts, then close the joint and apply the clamp to it. Two cauls allow you to clamp a single joint and they work equally well for clamping case miters.

You can make them by cutting V-grooves to create the clamping surfaces, or you can attach beveled blocks to strips of plywood.

Miter clamping cauls help you apply pressure at right angles to the joint's seam.



You also can use four clamping blocks with V-shaped notches cut into them. This works where you want to assemble four joints at once – a complete frame – as opposed to just one joint at a time.

One way to use the blocks is to mount them to a base. The base provides a flat surface to ensure the frame isn't twisted, and the V-blocks capture the frame corners to ensure they are square. It's particularly useful for multiples and for very large frames, where the support of the base is beneficial.

I set up the board after at least one frame is cut so I can use its parts to position the blocks that are screwed to the base. Note that only two of the V-blocks are screwed to the base. At the other two corners, you fasten cleats to the base. Clamping pressure is applied by twin wedges driven between the cleats and the loose V-blocks. To prevent squeeze-out from bonding the frame to the base or blocks, wax them liberally.

For the one-off frame, you can use the V-blocks with a brace of bar clamps and several strips of packing tape. Glue the frame and secure each joint with packing tape. Set the V-blocks at the frame corners and apply the bar clamps diagonally. Alternate from clamp to clamp as you tighten them to avoid distorting the frame.

Call for Reinforcement

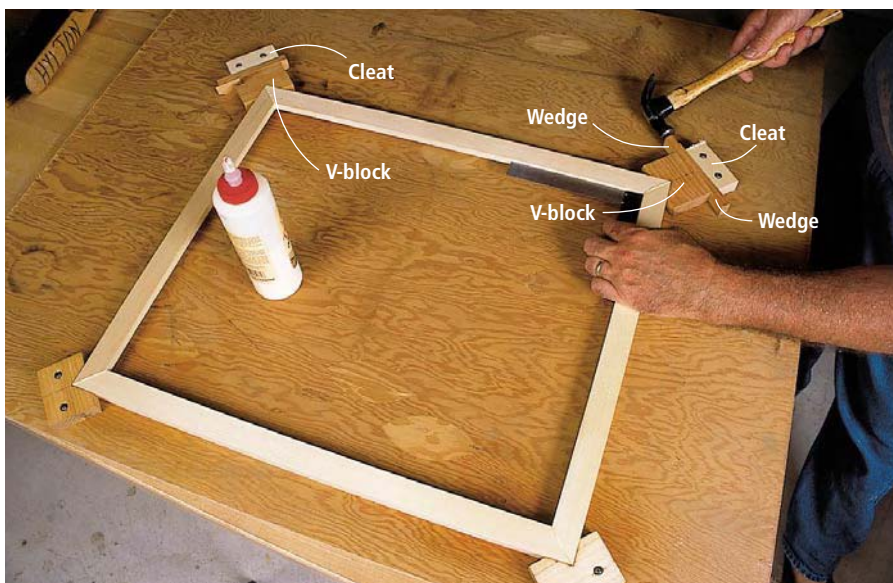
I've found that miters can be reinforced in a number of different ways.

- Picture framers commonly use nails. The joint needs to be securely clamped so the hammer's impact doesn't knock the parts out of kilter. Bear in mind that nails driven straight into end grain don't hold that well. You can improve the joint slightly by driving the nail on an angle to the grain.

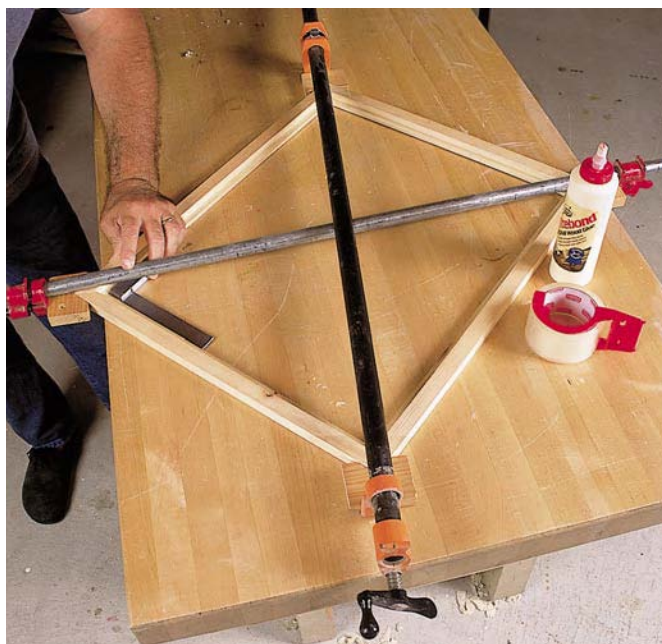
- Splines are pretty easy to incorporate, and you can hide them inside the joint. (Splines were discussed in the October 2003 issue of *Popular Woodworking* – available at popwood.com – so we won't repeat that here.)

- Biscuits also can be used. If the frame members are more than 2 1/4" wide, you can use standard No. 20 biscuits. You can use smaller biscuits – No. 10s, No. 0s or mini-biscuits – for narrower frames.

- Dowels are another option, but they are tricky to align, so I don't recommend using them with this joint.



Screw V-blocks to a plywood base to make a frame-clamping jig. Pressure is applied with pairs of wedges. Positioning the blocks – using frame parts – before gluing the frame takes only a minute or two.



Packing tape holds glued miters together while you apply V-blocks and clamps. Apply bar or pipe clamps on the diagonals and alternate tightening to avoid distorting the frame.

Unlock the 'Keys'

A reinforcement I like for frame miters is the key, either a spline or a dovetail, to add a subtle embellishment to the joint.

Make sure you cut a slot for the key after the joint is glued. For a deep slot – one cut into a wide frame – you can make it on the table saw, while you can cut a shallow slot using your the router table.

The jig shown at right works on either the table saw or the router table. On the latter, you can use it by sliding it along the fence to cut with a bit or by sliding it across the tabletop to cut with a slot cutter.

This approach enables you to use a dovetail key, but the table saw can make a much-deeper cut, which is important for frames that have wide members.

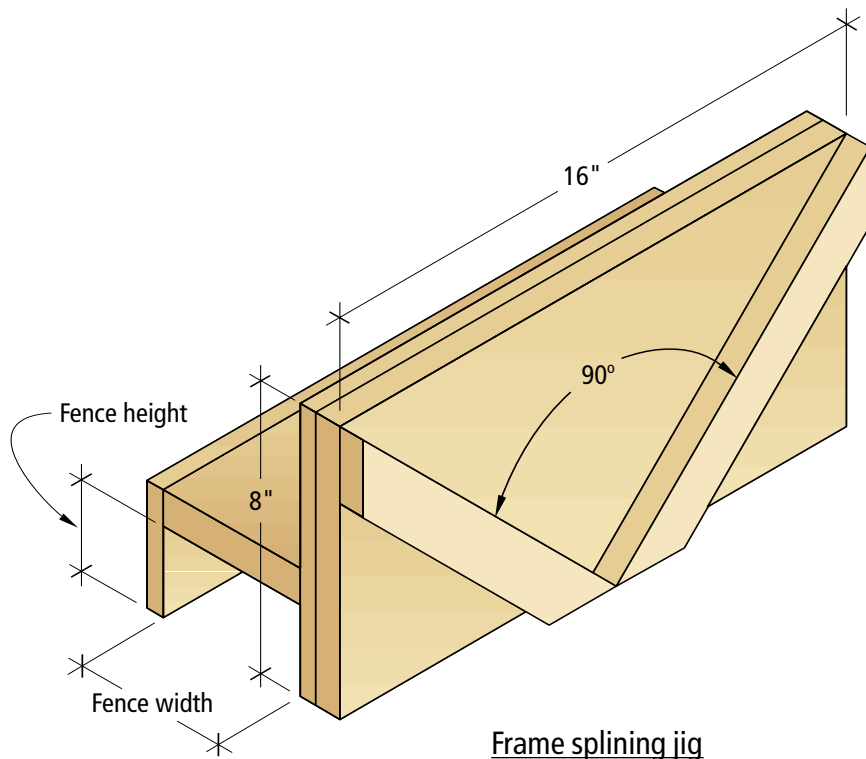
Construction should be evident from the drawing. Miter the ends of the two frame supports, then glue and screw them to the plywood back. These supports must be at right angles to each other. In this form, it can be used flat on the tabletop. If you use the jig upright braced against the fence, add the fence hook (seen in the photo at right) to it.

However you orient the jig, the frame is set into it. You can hold it tight with a spring clamp or two. Position the jig and frame against the fence and make the cut.

When using splines, you should make the cuts on the table saw. Rip strips of stock – a contrasting wood is preferred – to the appropriate thickness. If necessary, plane them to fit. Crosscut the strips into little triangles and glue one into each slot. When the glue dries, trim them flush.

Dovetail keys are easiest to cut on a router table. After slotting the frame, cut the keys using the same bit and height setting. The only change in setup is to swing the fence over the bit, housing most of it. Start with an oversized pin and methodically trim it to fit the slot. When you've got a good fit, rip the pin from the board. Repeat the process until you have enough key stock. Then you can simply cut the stock into short keys and glue a key into each slot.

When the glue dries, the keys must be trimmed flush. Saw off the keys as close as possible, then trim the remaining stubs flush with a block plane (work from the corner in, so you don't tear out splinters of the keys) or sand the stubs flush. **PW**



Frame splining jig



You can cut slots for spline keys on the table saw. A shop-made jig that straddles the rip fence holds the assembled frame.



You can cut slots for dovetail keys on the router table using the same type of jig. The slot can be centered easily by turning the frame around in the jig after the initial cut, then making a second pass.