



## 10 TIPS FOR SUPER-STRONG GLUE JOINTS

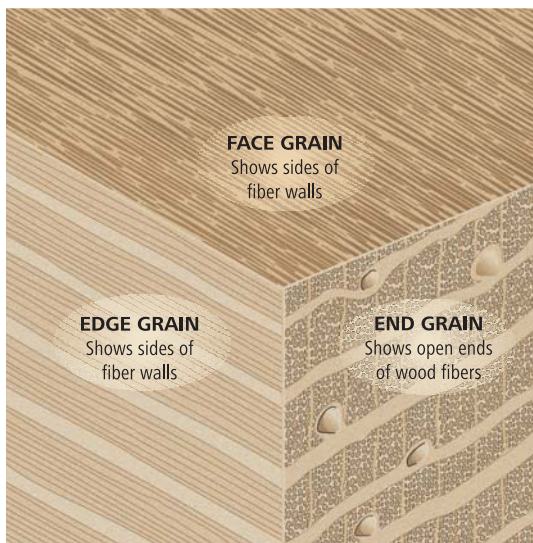
Learn the right techniques for gluing up joints, and your projects will go together quickly and easily — and stay together permanently.

Gluing up anything, from a simple panel to a complex case, will go well if you plan ahead, dry fit and mark your parts, and have your supplies ready when you begin.

Gluing up a project is an intimidating process for many woodworkers. That's because after many hours carefully crafting project parts, we know we have only minutes once the glue is spread to get everything assembled correctly before the glue sets. And there's no going back once the pieces are joined. Many also worry, even after the most successful glue-up, whether the joints will withstand the test of time.

But instead of being stressful, gluing can be one of the easiest parts of project construction. You just need an understanding of what makes a good glue joint, along with how to prepare, assemble, and clean up the project parts afterward.

That's precisely what we'll show you over the next few pages. Along the way, you'll also learn about the three most useful types of woodworking glues. But it all begins with a basic understanding of the material to be joined: the wood.



## UNDERSTAND WOOD STRUCTURE

You don't need to understand the intricacies of wood's cellular makeup to be a good woodworker. But knowing about the *basics* of wood structure will help you produce strong glue joints.

Wood is made up of millions of tiny individual cells, or fibers. They vary in type, size, and purpose, but all share two traits. First, the fibers are hollow. Second, most of the fibers run parallel to the tree stem, meaning they run *lengthwise* in a board.

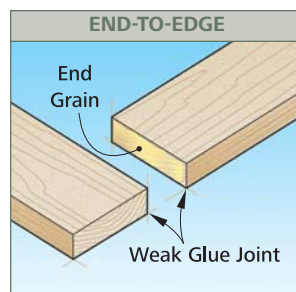
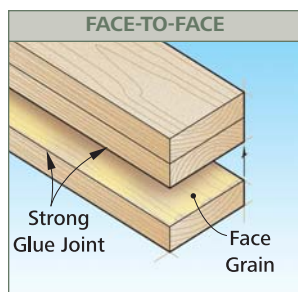
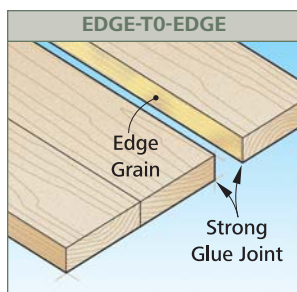
Take a close look at a board, then, and you'll see different parts of those fibers exposed (*Illustration, left*).

Note that you can clearly see the fiber walls on the faces and edges of a board. On the ends of a board, though, you see the open ends of the wood fibers. A simple way to remember this is to think of wood as a bundle of drinking straws.

What it all means to gluing is simple. The faces and edges of a board offer a lot of surface area for the glue to bond

with. So these surfaces can simply be butted together and glued effectively.

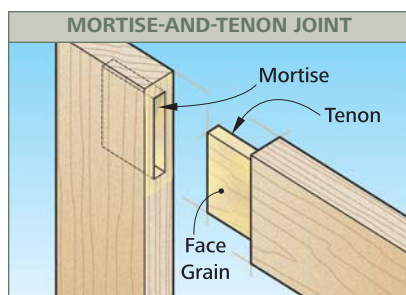
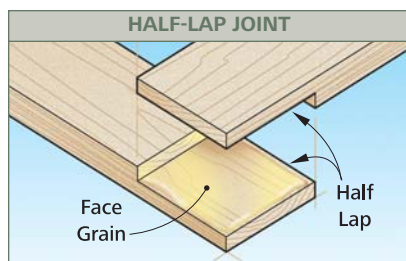
End grain, though, offers almost no surface area for the glue to bond with. So an end-grain joint needs more for a strong connection — either a mechanical fastener or some type of machined joinery.



## MACHINE JOINTS TO ADD GLUE SURFACE

From *Tip 1*, we know that end-grain joints are weak. Yet many projects call for them. In a door frame, for example, the ends of the rails (horizontal members) mate with the edges of the stiles (vertical members). If the pieces are just butted together and glued, the joint will fail.

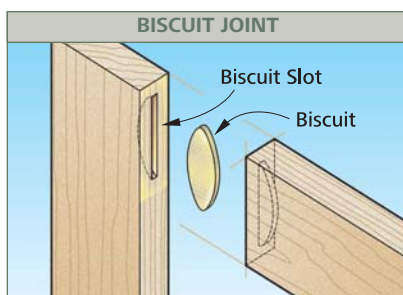
The secret to creating a strong glue joint is to add surface area. That's done by machining the mating pieces to add face-grain to the joints. Several types of joints can accomplish this. A few are shown in the *Illustrations* below.



**Half-Lap** — One of the simplest ways to add face grain is with the half-lap. In this joint, half the thickness of each mating piece is cut away where they overlap. This forms a strong joint and keeps the faces of both pieces flush.

**Mortise-and-Tenon** — A mortise-and-tenon is similar to a half-lap in many respects. In this case, a slot (known as a mortise) gets cut into one of the mating pieces. Then, the end of the other piece is cut on both faces and edges to form a tongue, or tenon. The mortise-and-tenon offers two advantages over the half-lap: The glue area is larger, and the joint is invisible from both sides.

**Biscuits** — A modern variation on the mortise-and-tenon is the biscuit joint. Here, the mortise and tenon are replaced by matching slots cut in each mating piece, and a plate (commonly called a biscuit) that fits into them.



## START WITH SMOOTH SURFACES

One notion that's been around for years is that two surfaces that will be glued together should be slightly roughened up, so the two pieces can get a bit of "bite" on one another. Another misconception is that if those surfaces are too smooth, all the glue will just squeeze out of the joint when the pieces are clamped together.

As it turns out, both of these ideas are myths. For a strong glue joint, the two surfaces to be joined have to be as smooth as possible.

To really understand why, you'd have to dive further than necessary into the

science of how glues bond. But it's important to know that glue bonds at a molecular level, which means the glue and wood actually "fuse" together. If there are gaps between the pieces caused by rough surfaces, this bonding process can't happen efficiently.

What you need to do, then, is make the mating surfaces flat and perfectly smooth, especially when you're after a "seamless" joint, such as a glued-up panel for a tabletop.

To create these smooth surfaces, keep your saw blades, planer and jointer knives, hand planes, and chisels sharp.



## "YELLOW" GLUES

By far the most common and useful glues in woodworking are polyvinyl acetate glues (PVAs), most often referred to simply as "yellow glues." These glues are similar to ordinary white glue (school glue) but in a more refined version. Manufacturers give them names like "wood glue" or "carpenter's glue."

When it comes to bonding wood, yellow glues are tough to beat. They bond with wood fibers on a molecular level to form glue joints stronger than the wood itself. And yellow glues are the "go-to" glue for about 90 percent of all woodworking projects.

You'll find yellow glue in a variety of formulations from standard glue for indoor projects to water-resistant, and even waterproof glue.

There are also slow-setting versions that give you extra time to get complex assemblies put together.

Best of all, yellow glues are inexpensive and easy to use.







## POLYURETHANE ADHESIVES

Polyurethane glue is the relative new kid on the woodworking block. It works differently than standard yellow glue and can offer advantages in certain situations.

First of all, polyurethane glue is waterproof, meaning it can be used for projects that sit outdoors. This type of glue is also flexible to withstand climate extremes well.

Polyurethane glue bonds non-porous materials, as well, such as glass, metal, and plastic. So it's ideal for projects that include these materials.

Unlike yellow glue, which cures when exposed to air, polyurethane glue cures when exposed to moisture. That means you'll have to dampen the wood to ensure enough moisture.

Most of these glues foam up and expand a great deal as they cure, too. This causes a lot of squeeze-out and can push apart joints that aren't clamped properly.



## A TIGHT FIT IS THE RIGHT FIT

Another debate that commonly arises about glue joints centers on how tightly the joints should fit together.

One side says the joint should have to be forcibly pounded together. The other says the joint should slip together easily, with just a little "play" to make room for glue.

Actually, neither side is right in this debate. If the joint is too tight, the glue can get pushed out during assembly resulting in a weak joint. If there are gaps between the mating surfaces, on

the other hand, the glue won't bond well. Again, this results in a weak joint.

When assembling a machined joint, it should go together with firm hand pressure or just a few taps from a mallet. Getting this perfect fit starts long before the glue-up begins, with "test joints" to ensure your setups are correct.

With mortise-and-tenon joints, one other tip helps ensure success. Make the tenon  $\frac{1}{16}$ " shorter than the depth of the mortise. This provides space for glue to escape without weakening the joint.

## PLAN AHEAD WITH A DRY RUN

Once you spread glue onto your project parts, you only have a few minutes to get everything together before the glue begins to set. So if you find out that parts don't fit together properly, or that you can't get everything assembled in time, you're in trouble.

Thankfully, the solution is easy. Before you spread any glue, assemble the parts dry, without glue. This applies whether you're just edge-gluing several boards or putting together a complicated piece of furniture. *Always* dry-assemble your project first.

Most importantly, a "dry run" allows you to make sure everything fits together properly, and then fix any problems.

The dry run also lets you work out a logical assembly sequence that will speed up the actual glue-up. This process often reveals "sub-assemblies" that should be glued together first.

During the dry run, it's a good idea to mark each joint with a distinctive symbol. Then you can just line up the marks during the actual glue-up to ensure that you don't accidentally position a piece upside down or backward.

## USE FRESH GLUE

Most woodworking glues have a shelf life of just one to two years. Glue older than that *may* still work, but it won't have the holding power of fresh glue.

So, how do you know just how old your glue is? Glue manufacturers don't print expiration dates on the labels. But Titebond prints a coded manufacturing date on the bottle (*Photo, right*).

To make sure your glue is fresh, don't buy more than you can use before it expires. And write the month and date of purchase on the bottle.

Also, don't let glue freeze. This can ruin the glue or at least shorten its life.



### DECODE THE DATE STAMP

Titebond bottles show the year the glue was made, followed by the month ("A" through "M;" the letter "I" isn't used).

## A LITTLE TOO MUCH GLUE IS JUST ENOUGH

There's no exact formula for determining how much glue to use in a given joint. You can see this by the ambiguous statements on glue bottles like "coat both surfaces" or "apply liberally."

If there's a general rule, though, it's that too much glue is better than too little. Excess glue may squeeze out and make a mess when clamped, but that beats a "starved" glue joint.

When applying glue, spread an even layer just thick enough to obscure the wood grain, and make sure there are no gaps (*Photo, top right*). In most cases, coating one of the two mating surfaces should do the trick.

You're actually trying to apply just slightly more glue than the joint requires. That way, when you bring the pieces together and tighten the clamps, a small amount of glue will squeeze out and form a series of small beads along the joint line (*Photo, bottom right*). No beads means not enough glue, while glue dripping from the joint line means that you've applied too much.

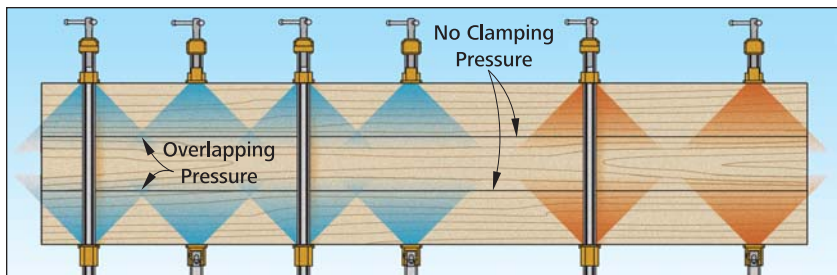
As important as it is to get an adequate amount of glue in a joint, it's also imperative that you don't spend too much time fussing around when spreading the glue. Woodworking glues have a limited amount of working time,

referred to as "open" time, before they begin to set. For most glues this usually averages about 10 minutes. So you need to work reasonably quickly (though not frantically) as you spread the glue and tighten the clamps.



### VISUAL CUES SHOW THE RIGHT AMOUNT OF GLUE

Spread glue in a thin, even layer, making sure to coat the entire surface (*top*). When clamped, small "beads" of glue will squeeze out along the joint (*bottom*).



## SPACE CLAMPS EVENLY

Gluing up a solid-wood panel seems simple. It's just a series of straight, square edge joints. Yet keeping a panel flat and free of gaps can be challenging. The key to success is in proper clamp positioning.

To prevent gaps, you need enough clamps to distribute pressure evenly. Clamp jaws exert pressure at roughly 45° angles, and you want the pressure to overlap slightly (*Illustration, left*). So for boards 4" to 8" wide, place a clamp about every 8" to 10". Narrower boards require even closer clamp spacing. Also, alternate the clamps over-and-under the panel (*Photo, left*) to keep the panel flat.

Finally, tighten the clamps by either starting at one end and working toward the other, or starting in the middle and working toward each end. Tighten them just enough to draw the joint together.



## SCRAPE AWAY SQUEEZE-OUT

Squeeze-out is not only inevitable, it's an important part of a good glue-up. But that means it needs to be removed. Here again, we find two schools of thought on how to best remove this excess glue.

One advocates wiping the squeeze-out away immediately with a damp rag. Often, though, clamps prevent you from getting to all of the glue. And it's easy to push glue into the pores of the wood. This glue residue may not be visible until you apply a stain or finish.

A better way to remove squeeze-out is to scrape it off (*Photo, right*). Wait until the glue beads dry to a rubbery texture

and no longer ooze liquid when you press on them with a fingernail.

Most yellow woodworking glues will harden adequately in about 20 or 30 minutes. And, conveniently enough, this is about how long you need to wait before unclamping the assembly. That means the clamps won't get in your way when scraping the squeeze-out.

After scraping off squeeze-out, a small amount of residue may remain. Wait a few hours, and then sand this away.

If squeeze-out hardens completely, use caution to prevent tearing the wood fibers as you scrape off the glue.



### SCRAPE ALONG THE GLUE LINE

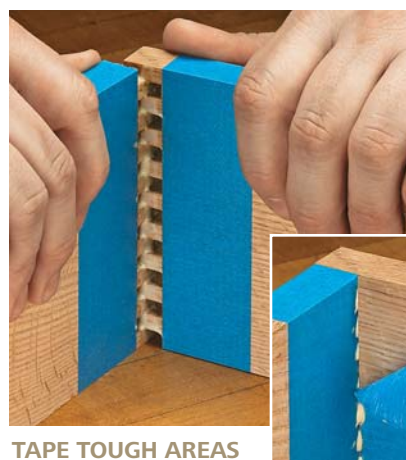
Allow squeezed-out glue to dry until rubbery (20 to 30 minutes), and then remove it with a chisel or scraper.

## STOP SQUEEZE-OUT

Most of the time, cleaning up squeeze-out is no big deal. But in instances where the squeeze-out is hard to get to, you'll need to take a different approach.

One of the simplest methods is to place masking tape along the joint line before gluing and clamping (*Photo, near right*). Any squeeze-out will collect on the tape, which you can just peel away once the glue gets rubbery.

If you absolutely need to prevent squeeze-out, another option that works in some situations is to cut relief kerfs in one of the mating pieces to catch it (*Photo, far right*).



### TAPE TOUGH AREAS

In hard-to-reach areas, apply tape before gluing. Any squeeze-out will stick to the tape instead of the wood.



### KERFS TRAP GLUE

To stop squeeze-out completely, two kerfs are cut into this applied molding. They catch the squeeze-out and stop it.

## EPOXY ADHESIVES

Epoxy has long been the adhesive of choice for bonding dissimilar materials and making waterproof joints and coatings.

Epoxy is made up of two parts: a resin and a hardener. When mixed together, they form an adhesive that is rock hard, waterproof, and won't shrink. By varying the type or quantity of hardener, manufacturers can manipulate everything from working time to strength to spreadability.

