

Shopmade Squares



Four precision tools
from a quarter
sheet of plastic

BY GARY WILLIAMS

A good square is an indispensable tool in the shop. So it makes sense to have several of them within easy reach of your workbench. For checking small parts, a 2-in. machinist's square is a good choice. As parts get bigger, a 6-in. try square or 12-in. combination square is nice to have. And for larger parts, a framing square comes in handy.

But there can be a need for a shop square that's sized somewhere between a combination square and a framing square. For an especially big project, like a cupboard, it would be handy to have a shop square that's even bigger than a framing square.

Unfortunately, you can't run to the hardware store to get such odd-sized shop squares. And you won't find them in a mail-order catalog or at any nearby woodworking store. So I decided to make my own. That way I could size the shop squares to suit my needs to a tee.

Just one word: plastics

To be of any real value, a shop square needs to be dead accurate. So when making one, it's best to use a stable material that won't warp when the relative humidity starts changing. I ended up choosing acrylic plastic sheet, a product sold under trade names such as Plexiglas and Lucite.

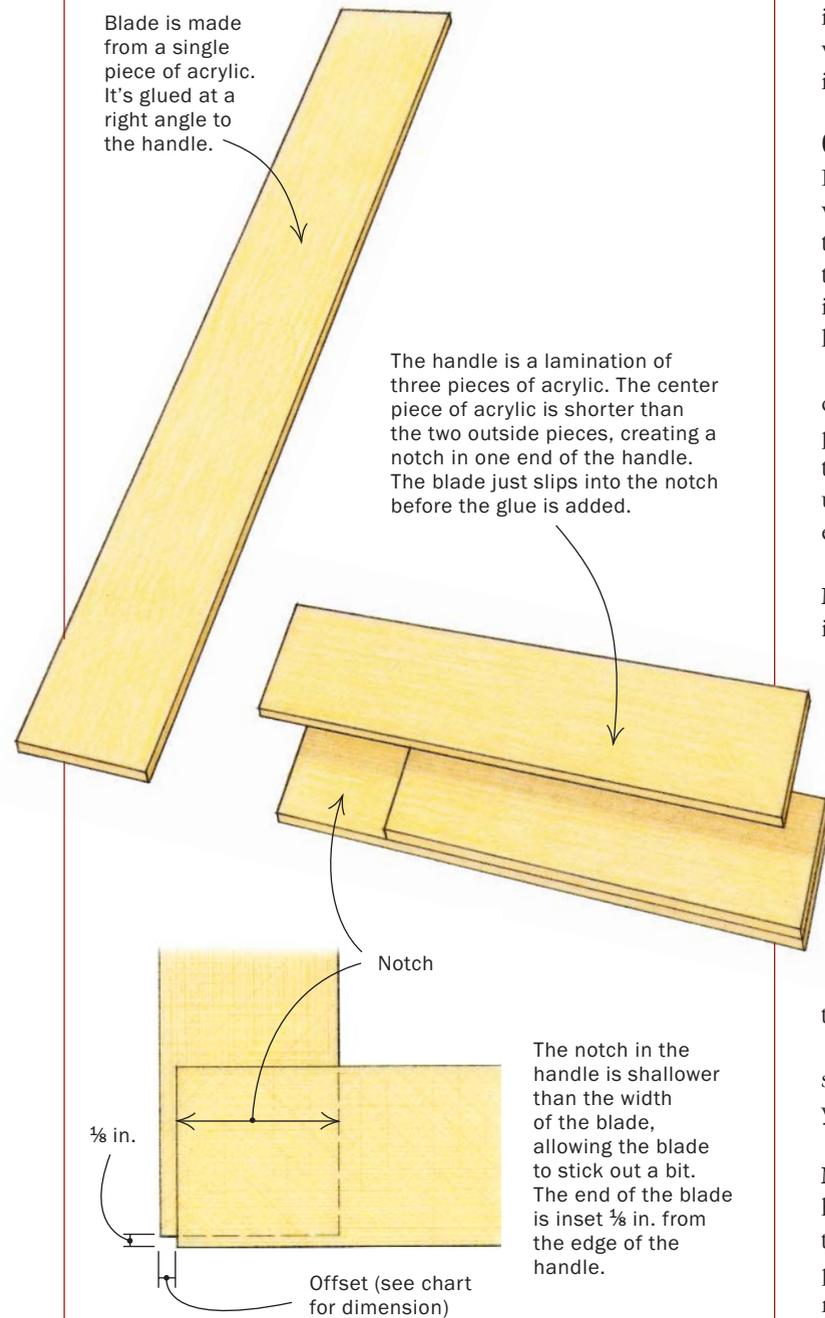
Don't worry if you haven't cut acrylic sheet before. A sharp, 60-tooth, carbide-tipped combination blade does a nice job. The acrylic colors you're most likely to find locally are white or clear,

SQUARE CONSTRUCTION

The squares are made from ¼-in.-thick acrylic plastic, a material that resists warping. Acrylic sheets can be cut on the tablesaw using a 60-tooth, carbide-tipped combination blade.

Blade is made from a single piece of acrylic. It's glued at a right angle to the handle.

The handle is a lamination of three pieces of acrylic. The center piece of acrylic is shorter than the two outside pieces, creating a notch in one end of the handle. The blade just slips into the notch before the glue is added.



The notch in the handle is shallower than the width of the blade, allowing the blade to stick out a bit. The end of the blade is inset ¼ in. from the edge of the handle.

Offset (see chart for dimension)

SQUARE DIMENSIONS

| SIZE | BLADE | HANDLE | OFFSET |
|--------|------------------|-------------------|--------|
| 48 in. | 3½ in. by 48 in. | 3½ in. by 24 in. | ½ in. |
| 30 in. | 3 in. by 30 in. | 3 in. by 17½ in. | ¾ in. |
| 20 in. | 2½ in. by 20 in. | 2½ in. by 11½ in. | ¼ in. |
| 12 in. | 2 in. by 12 in. | 2 in. by 6½ in. | ¼ in. |

but more interesting colors are available from suppliers like Ridout Plastics (800-542-6325). Ridout will ship you a 2-ft. by 4-ft. piece, which provides more than enough material to make the four squares shown on p. 69. You can also order the acrylic sheet on-line at www.ridoutplastics.com.

You'll also need to order special glue for acrylic plastic. The easiest to use is a water-thin product called Weld-On No. 3. It's used with a squeeze bottle that has a needle applicator and is drawn into the joint after clamping.

One design, four squares

Each of these shop squares uses a three-piece laminated handle, with the blade inserted and glued into the middle of the laminations. This construction provides a nice, thick handle like that on a try square, which I find much easier to use than a one-piece framing square. It also ensures a strong connection between the two legs of the tool.

The procedure for building these shop squares can be broken down into four basic steps. First build a glue-up jig. Next, make a plywood testing square and use it to square the jig. Third, cut out the blade and handle parts, and glue up the handles. And finally, use the glue-up jig to assemble each blade and handle so that they end up perfectly square.

Make a glue-up jig—This is really just two pieces of plywood, but it is the heart of this project. A true reference board laid exactly perpendicular to a true edge becomes an “index” for calibrating all your new squares. When the blade of a square is glued to the handle, the jig squares the two parts and keeps them that way until the glue dries.

For the jig to be accurate, the bottom edge of the base must be perfectly straight. Use the factory edge of good-quality plywood or medium-density fiberboard (MDF). If you have a large jointer, you can run the edge over it just to be sure.

It is also important for both of the long edges of the reference board to be straight and parallel. Once the reference board has been ripped, measure its width carefully at several places along the length. Use a caliper if you have one.

To complete the jig, the reference board has to be clamped square to the base. That might seem easy, but to do it precisely, you need to make one more helper—a testing square.

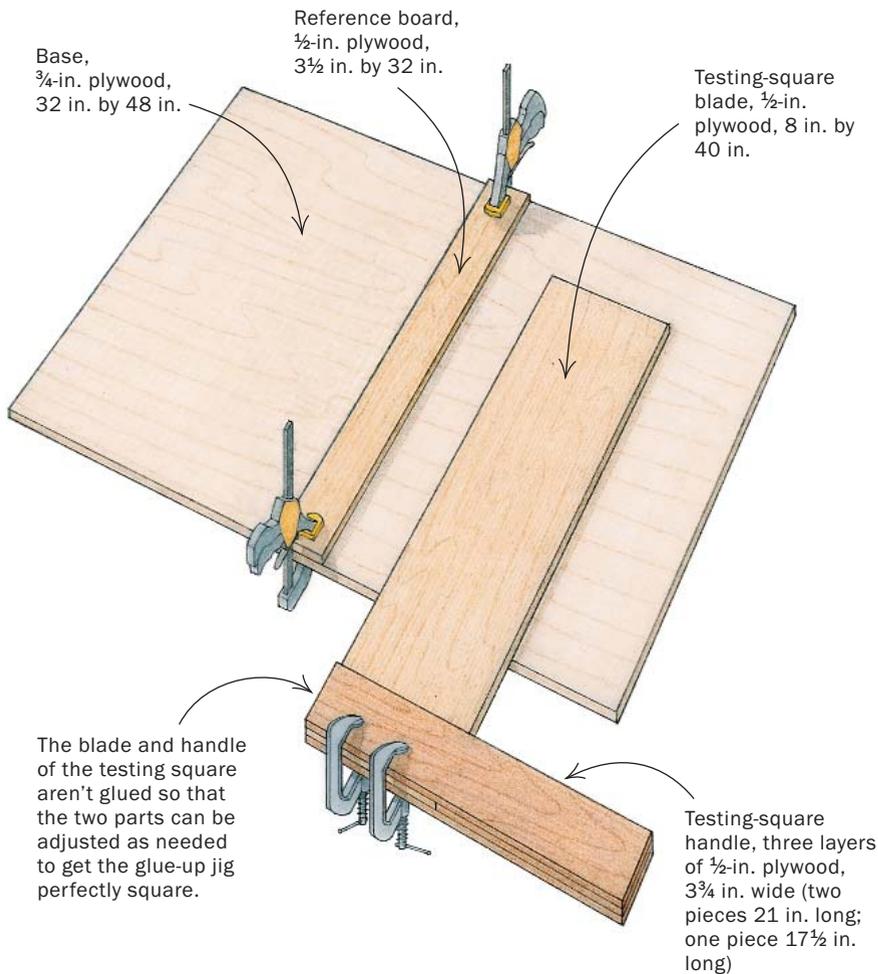
Make a testing square—Like the shop squares, the testing square has a blade and a laminated handle. But instead of acrylic plastic, the testing square is made of ½-in. plywood. And it differs from the plastic versions in one other important way—the blade isn't permanently attached to the handle. Instead it simply slips into the notch in the handle and is held in place by a pair of clamps. The clamps can be loosened, allowing the blade to pivot in the handle, and that's the secret to using the testing square to square the glue-up jig. I'll talk more about this later.

Rip a 4-ft.-long blade and three pieces to make the handle. Size is not critical, but make this square big enough to be sturdy. Then glue up the three-part handle. And as has been the general rule from the get-go here, straight and parallel is the goal. So when the glue dries, rip both sides of the assembly again.

Squaring the glue-up jig now becomes a matter of flip-flopping. First position the reference board so that it's roughly perpendicu-

A GLUE-UP JIG ENSURES A PERFECT 90° ANGLE

The blade and handle of the square are assembled on a simple, two-piece jig made up of a reference board that's mounted exactly 90° to the lower edge of the base. To get the jig angle just right, you need the aid of a testing square.



For the jig to be accurate, the base must have a perfectly straight bottom edge. A good factory edge works fine, but if you have doubts about the straightness of the edge, run it over the jointer a couple of times.

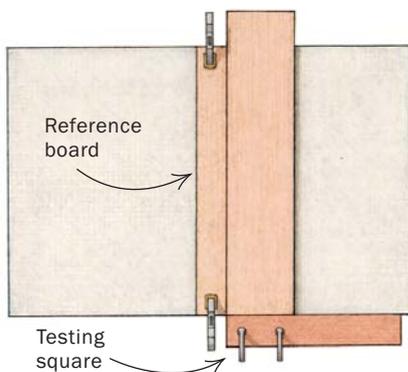


Check the reference board for parallel. The width of the reference board should be the same within a few thousandths of an inch along the board's length. If you have a caliper, this is a good time to use it.

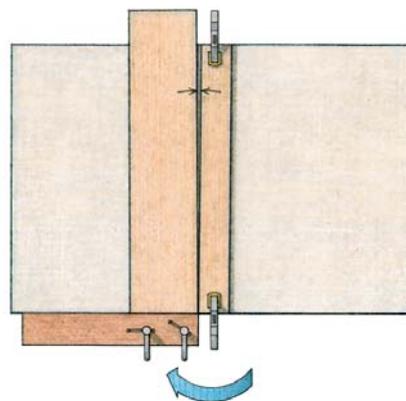


A testing square is used to square up the jig. A long blade and notched handle make up the testing square. When the two parts are clamped together, the glue-up jig is ready to be squared.

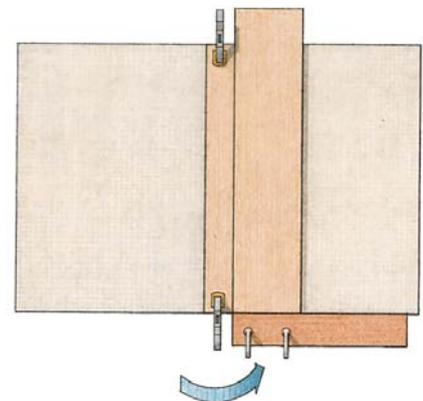
Use the testing square to align the reference board



1 Clamp the reference board roughly square to the bottom edge of the base. Loosen one of the two clamps on the testing square while holding the handle against the bottom edge of the base. Then pivot the blade until it butts to the reference board.



2 Flip the testing square. The gap that shows is exactly twice the amount that the parts are out of square. Pivot the reference board to remove about one-half the gap. Then adjust the testing square flush with the reference board.



3 Flop the testing square to the other side of the reference board and repeat the adjustment steps. Continue the flip-flop steps as needed, until the gap is completely gone. Three or four adjustments usually get the job done.

MAKE THE HANDLE

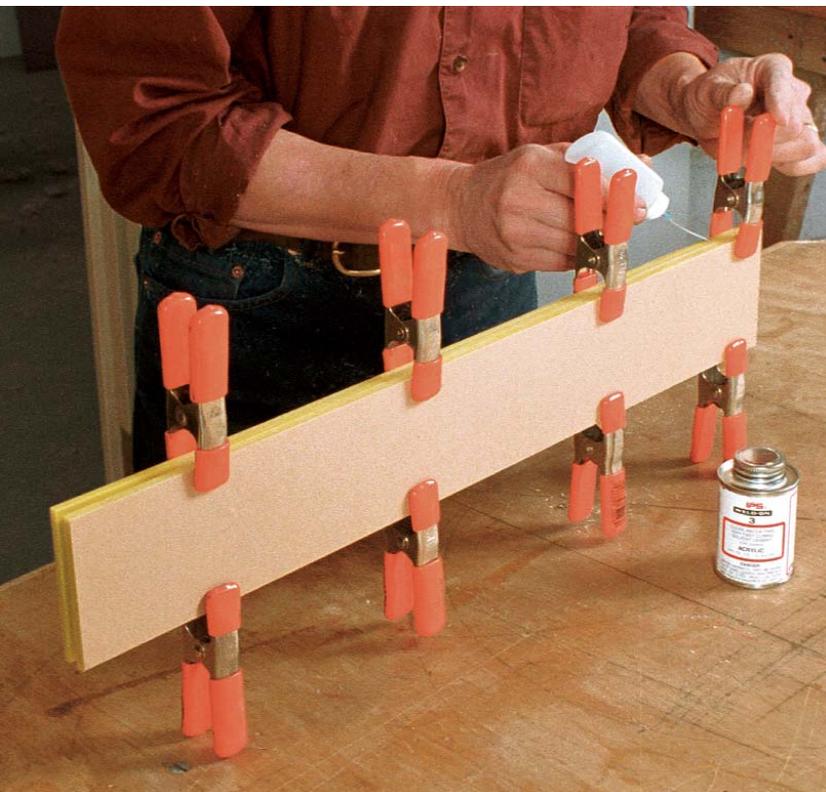
Cut the handle parts.

A sharp, 60-tooth, carbide-tipped combination blade cuts the acrylic sheet without much fuss. The paper backing on the sheet helps reduce chipout, plus it protects the plastic from getting scratched.



Chamfer the edges.

The water-thin glue, used to join the three parts of each handle comes in a squeeze bottle with a needle applicator. Sanding a light chamfer along the mating edges of the handle parts creates a shallow groove when the parts are joined together.



Assemble and glue the handle. Secure the handle parts with spring clamps and check to make sure that all of the edges remain flush. With the sanded groove as a guide, run a bead of glue all along the joint lines on the handle. The glue is pulled deep into the joint and quickly forms a sturdy bond.

lar to the bottom edge of the base. Hold it temporarily in place with a clamp on each end.

Now you're ready to calibrate. Position the testing square on the jig and pivot its blade to snug up against the reference board. Clamp the square in this position.

Flop the square over to the other side of the reference board. Unless you have remarkable luck, you're going to see a gap between the board and the square, either close to the handle or out at the end of the blade.

To begin correcting this out-of-squareness, loosen one clamp on the reference board and pivot it to remove approximately half the gap. Retighten the clamp. Then loosen the clamps on the testing square, and again pivot the blade to exactly match the angle of the reference board.

Now flop the testing square back to the other side of the reference board and repeat the procedure, removing half the error each time. It might take a few of these flip-flop adjustments, but you'll soon find, on both sides of the reference board, that the edge of the blade butts along the entire length of the board. When that happens, the reference board is exactly square to the bottom edge of the base. And the jig is ready to use.

Cut and glue up the plastic parts—With the glue-up jig completed, you're ready to start making the four shop squares. The first thing to do is rip and crosscut the parts for all four squares. Rip the parts a little wide, say about $\frac{3}{16}$ in., so that they can be ripped true after lamination. By the way, if you start with a 2-ft. by 4-ft. piece, you're going to have enough material left over to cut one or two more squares.

Before you begin cutting, raise the blade fairly high above the saw table. That gets the cutting edge of the blade closer to 90°, which helps produce a better cut in acrylics. And to avoid overheating the plastic, push it as quickly as possible through the blade. As always, use eye protection—those bits of cut plastic are hard, and they like to fly. And keep your fingers well away from that raised blade.

Once the parts have been cut out, glue up the three pieces that make up each of the handles. But before starting, it's helpful here to understand how the Weld-On No. 3 glue is applied. Just run the end of the needle applicator along the joint line, squeezing a narrow bead of glue as you go. The glue immediately gets drawn deep into the joint to form a strong bond.

To make it easier to follow the joint line with the needle applicator, you'll want to add a little chamfer to the mating edges of the handle parts. That way, when the handle parts are fitted together, the chamfers create a little groove that positions the needle directly over the joint.

Hold the three parts together with some clamps. Then it's just a matter of running the bead of glue along all of the joint lines.

After all of the handles have been glued up, rip both edges again and crosscut a bit off the ends, so that the finished assembly is straight and parallel.

At this point, the hard work is done. All that's left to do is attach the blades to the handles, a step that's just about foolproof, thanks to the glue-up jig.

To help support the end of the handle, it's a good idea to clamp a piece of scrap stock to the corner of the jig. Then add a smaller scrap to serve as a spacer, which helps level the handle.

ASSEMBLE THE SQUARE USING THE GLUE-UP JIG



After cutting the blade to size, it's time to put the jig to use. But first, to help support the handle during the glue-up, clamp a scrap piece to the corner of the jig. (1) Assemble the blade to the handle, then hold the handle to the bottom edge of the jig and butt the blade against the reference board. (2) A stick of scrap stock clamped to the base of the jig keeps the blade from shifting during the glue-up. (3) When the blade and handle are properly positioned, a pair of clamps is added. (4) Use the needle applicator to apply the glue to the joint lines connecting the handle and blade.

To join the parts, just slip a blade into a mating handle. Position the end of the blade so that it ends up about $\frac{1}{8}$ in. short of the outside edge of the handle. That way the end of the blade won't stick out and get in the way when using your shop square to check an inside corner.

Now, with the handle firmly against the base of the glue-up jig, pivot the blade so that its edge is pressed against the reference board. Clamp the joint to hold the two parts in position and apply a bead of glue all along the joint lines.

Keep the parts in the jig until the glue starts to set up. A couple of

minutes should be enough time. After that, set the clamped square in a safe place and allow it to dry overnight.

With the assembly completed, only a few things remain to be done. To soften the sharp edges of your new shop squares, round over the edges ever so slightly with some 220-grit sandpaper. Then, drill a hole in the handle and find a good spot on your shop wall to hang them. □

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