

## Don't Scare the Deer

Cutting a canopy has long been a fear-inducing process, but these tricks can help

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**C**utting the canopy. It's enough to make the most experienced airplane builder wipe a sweaty palm on the old work apron before picking up the tools.

The canopy will usually come oversized from the manufacturer, and the builder is expected to cut, trim, and fit it to mate perfectly to the individual airplane. The job need not be terrifying if it is approached with the right tools, conditions, and attitude. Make up your mind before you approach the canopy that it is going to be a slow and deliberate process, and you won't let yourself become impatient or frustrated.

Canopies on most homebuilts are usually made of the acrylic plastic polymethyl methacrylate, usually called plexiglass. Plexiglas is actually a brand name for a product made by Altuglas International, but the name has come into generic use, usually spelled with two s's. Plexiglass is great stuff. It is clear, retains good optical properties when molded and won't yellow or deteriorate in direct sun. Scratches can be polished out.

Even better—and unlike other clear plastics such as polycarbonates—you can break it. What's great about that? Imagine you've stubbed your low-wing airplane's toe and ended up inverted—on the ground. It's unlikely that the door or canopy will still open, but a strong blow with a sharp heavy object will shatter the plexiglass and give you a path of escape. Given these advantages, you can see why designers favor plexiglass.

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It's not perfect, though. It has one quality that makes cutting big, expensive plexiglass parts a nerve-wracking exercise. Plexiglass is "notch-sensitive." In other words, small nicks along the edges can almost instantly become long cracks. British RV-4 builder Eric Marsh remembers the day he cracked his canopy while working in the garden shed at his hotel on the Duchess of Devonshire's estate: "Guests at the Cavendish had their serenity disturbed, I'm afraid. When the Perspex bubble cracked, my shriek could be heard for three miles and the deer that usually graze below the dining room didn't reappear for weeks."

### Getting Started

Notch sensitivity increases with brittleness, and plexi's brittleness increases noticeably in cold temperatures, so the first order of business is to bring the shop and the canopy to working temperature. Fortunately, this is also working temperature for most humans, too. If you are the hardy type and cheerfully work in winter shop temperatures down in the 50s, put on your short sleeves and turn the heat up. If you live in a climate so severe that you can't get the shop temperature up to 70 to 80°F, work on something else until spring.

Make sure the canopy is well supported, and that you can walk all the way around it. Uneven weight distribution or leaning on the canopy while you reach across it to finish a cut can turn one of those notches into a crack. Once the canopy is marked and supported, the shop is warm and the

proper equanimity of mind achieved, it's time to make the first cut. There are a number of tools that might be used for this job. The common thread is that they are all rotary, rather than reciprocating. No saber saws or hand saws, please.

Few builders are bold enough to mark once and cut once. Fitting canopies or windows is almost always an iterative, cut-and-try process. The first thing is to mark the canopy for initial cutting. Obviously, scratching a line with an awl or razor knife is the last thing you'd want to do on a notch sensitive material—the marking tool of choice is the Sharpie pen or a grease pencil.

Some solvents and chemicals will attack plexiglass, so be very careful what you use to remove marks. A small squeeze bottle with a pinhole tip, filled with denatured alcohol, is the eraser of choice.

Cutting and sanding plexiglass will fill the air with statically charged dust that will stick to hair, clothes, shoes, and the shop cat. It will also stick to eyeballs and lung tissue; so before you pick up the tools, protect yourself. Wear a dust mask, full eye protection and make sure a shop vacuum is handy. Good gloves might seem awkward at first, but if they protect your hands from an errant cutting

disc, you may yet learn to play guitar.

Jeff Rogers runs Airplane Plastics, an Ohio company that makes hundreds of canopies a year. "We use small, thin, circular saw blades on die grinders in our shop," he says. "They are fast and make a good cut, but they do require a bit of skill, especially if you are cutting a curve. These blades tend to travel in a straight line."

Many builders recommend abrasive cutting discs mounted on air-driven die grinders. Van's Aircraft actually

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includes a couple of these discs with their aircraft kits.

"They worked pretty well," one RV builder reported. "I had the best luck when I put the disc on a small air grinder. It doesn't have a lot of torque and would slow down if I applied too much pressure—sort of a built-in safety valve. I tried the same discs on a powerful electric die grinder and it was almost scary. The disc never slowed down, and the heat it generated threw long strands of melted plexiglass all over the place. I went back to the air grinder in a hurry."

With the cutting disc, a cut in 1/8- to 1/4-inch plexiglass (the normal range of thickness in canopies or windshields) will take two or three passes to penetrate. Be very careful to keep the disc in the track of the previous cut. If it grabs the edge it can be out of the groove and make an ugly and irreparable track across fresh plexi before you can react.

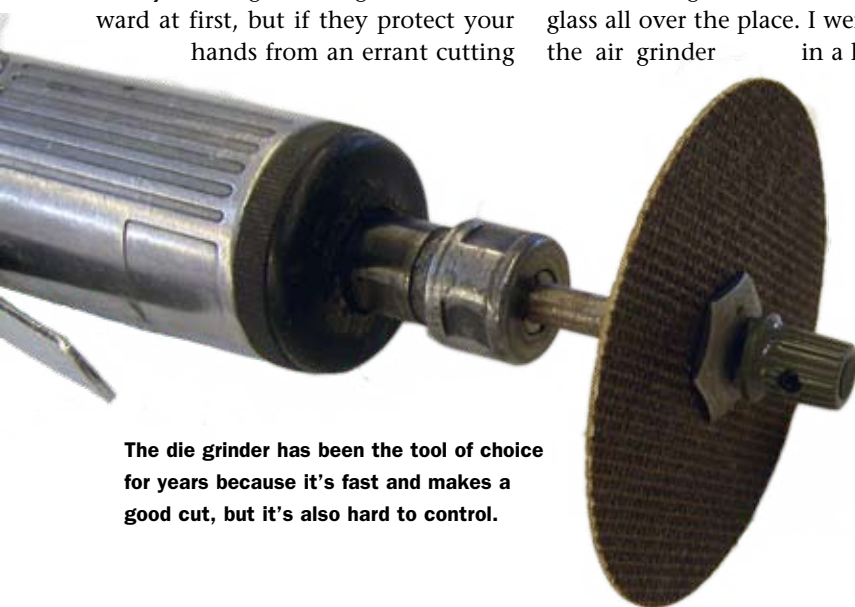
One of the drawbacks of the die grinder is that it's almost always a one-handed operation. Even if you can use one hand to steady the other, both hands are on the same side of the blade, which doesn't provide a lot of stability. Machinist Stan VanGrunsven came up with a novel solution. He mounted a bearing on the shaft of the die grinder connected to a handgrip on the opposite side of the cutting disc. With one hand on each side of the blade, control is much easier. Of course, now both hands are within range of a tool that can damage a digit for life, so be careful.

### Cutting Alternatives

These cutting discs have been the traditional tool of choice, but that doesn't mean there isn't something better out there. And maybe we've found it: T-18/RV-6 builder Greg Halverson is a carpenter by trade, and purchased a RotoZip to use on drywall when he was remodeling his own house. After the drywall was hung, he went out to the shop for a little recreational airplane building and found himself facing a big bubble of plexiglass.

"I had some plexiglass scraps left over from the last airplane, and the RotoZip was fresh in my mind, so I put them together," Greg recalls. "The RotoZip is a cross between a Dremel tool and a router, and the collet will hold small router bits. I put in a tiny 1/16-inch "veining" bit and tried it out. I knew right away my canopy-cutting angst was over."

The small diameter of the bit keeps the cutting speeds down and makes a



**The die grinder has been the tool of choice for years because it's fast and makes a good cut, but it's also hard to control.**



With the proper bit attached, a RotoZip makes quick, clean cuts with a minimum of angst.

narrow kerf. The tool is not directional and can easily be guided around curves or corners.

A big handle and a base plate make the RotoZip easy to handle. A simple guide allows perfectly placed cuts, as the base plate simply follows the edge. The resulting cut still needs sanding, but it's all made in one pass. The danger of a cutting disc slipping out of the cut during repeated passes is over.

### Finishing

However you make the cut, immediately smooth and round over the edges with an 80-grit sanding block. Rounding is just as important as smoothing. If the edges are rounded over, there is no corner where one of those nasty notches can form. This operation will go a lot faster if you

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have a small belt sander that can be managed with one hand. Finish sanding in stages to about 220-grit.

Every once in a while, some enterprising soul discovers that running a flame along the edge of a plexiglass sheet will leave an almost polished-looking edge. Tempting, but don't even think about it. The stress this induces into the material almost guarantees a crack sometime later.

### Drilling

After the canopy has been cut and fitted to the fuselage or canopy frame, it will probably need to be drilled for fasteners. However, it isn't usually the first hole that causes problems. Cracks occur most often when pilot holes are enlarged to final size. A normal twist drill is a poor choice for this task, because the spiral flutes can grab the edge of the hole and pull the drill into the hole faster than the tip can cut. The result is a large force against the side of the hole—and a crack.

There are special drills created just for plexiglass, and they work quite well. However, they may be difficult to find at the local hardware store. Another tool, widely available, has proved an excellent alternative. The Unibit, or stepdrill, was designed to cut truly round holes in thin metal. But since it has no spiral flutes and only one cutting edge, it will not chatter or try to advance itself through a pilot hole. Small Unibits, starting at 1/8-inch and stepped in 1/32-inch increments, make beautiful, clean holes in plexiglass.

When the canopy is finally trimmed, drilled and attached, you can gently close it, turn off the light, shut the shop door and tip-toe away. The hard part's done. 

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