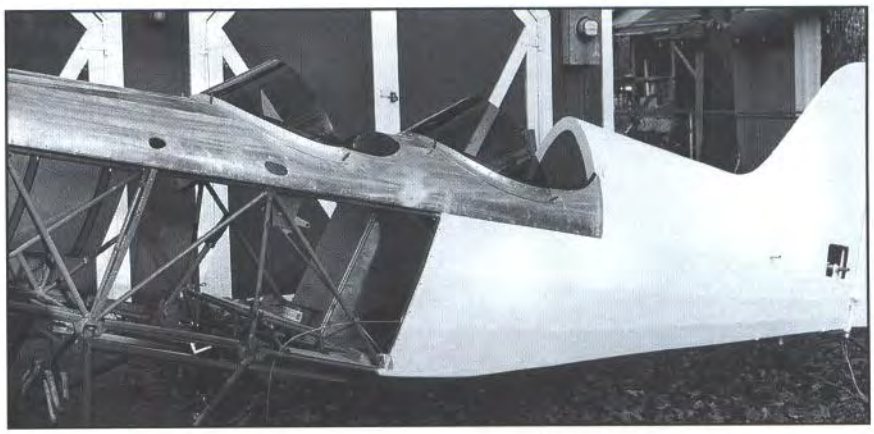
Windshields - And How To Form Them

by Neil Sidders



O.K. You've spent all this time building your open cockpit dream ship and now it's time to decide on a windshield. You basically have 3 styles to choose from. Flat wrap, bubble, or multi faceted. Sometimes the character or the airplane will help you decide the style of windshield you will use. Look at the Hatz. A flat wrap looks fine, but it's such an antique looking design that a multi faceted windshield really looks great. But just try to imagine a Pitts Special with a multi faceted windshield. It just doesn't fit the character of the Pitts the way a bubble or flat wrap does. Sometimes a need for a new twist on an old style comes along. The most recent example of this is the MG-2 that Jim Moss rebuilt. The 5 panel windshield on this airplane became a key styling feature that helped bring it's many other great features together. Yes, I really like the MG-2!

As much as I like the multi faceted windshield, I think they should be reserved for airplanes with narrow head rest on top of round, stringered fuselage backs.

My own choice for my Acro Sport II was now narrowed down to a flat wrap or bubble. I like the bubble, but there is always a chance of distorting the optics when the bubble is blown. This makes good quality bubbles cost more than I think they should, so I decided to make my own.

Someone once told me (I think it was Ben Ellison) that reducing drag on a biplane is like throwing pebbles in a pond to drain it. I think there is probably a lot of truth to that, but if I wanted something fast, I would not have built a biplane. At the same time there is no point in making it slower than it has to be because of a poorly fitted windshield.

Any open cavity is a tremendous drag producer. Barnaby Wainfain had a good article in "Kitplanes" a few months back that addressed this. From that article we learned that the bubble style might have a slight advantage over the flat wrap where the air leaves the edge of the windshield at the top. The only real hope for reducing drag is to reduce the size of the opening and using a steeply sloping windshield that extends back as far as possible without making it difficult to get in or out. The rear windshield should be slightly higher to help deflect the down wash from the top wing that seems so intent on pounding the pilot. I think the rear windshield should be as tall or taller than the turtle deck in hopes to reduce the drag that could be produced by the large head rest area used on the Pitts, Skybolt, Acro Sport type designs.

After 6 or 8 different patterns, taping them in place and climbing in and out of the cockpit a few times, the two patterns in the drawing were deemed proper. These patterns were transferred to 1/8" acrylic (plexiglass) sheet. Polycarbonate (lexan) could have been used, but it scratches more easily and is more prone to turning milky. Polycarbonate is used in the auto industry for head light lenses because it is easy to mold and is very durable. The scratching problem is eliminated by a hard coating process that is expensive and not generally available outside the industry. The early plastic lenses were actually a composite of acrylic molded over polycarbonate. The neat thing about polycarbonate sheet is that it can be bent in a sheet metal brake making it possible to build a multi faceted windshield without the need of a complicated frame.

After the pattern was transferred to the paper backing on the acrylic sheet, I used a band saw with a fine tooth blade to cut out the windshields, then sanded the edges smooth with a belt sander. While the paper is still in place, it's a good time to round the edge that will be exposed. I just used a sanding block by hand and finished up with #600 paper.

The method used for forming is straight from one of Tony Bingelis' books. I made a form consisting of two identical formers with a 12 inch radius (see drawing) and covered it with aluminum. The problem came in finding an oven large enough to heat this much plastic. When you're at a loss as to what to do, call the Preacher! In this case that meant Bro. Dave Fortuna, fellow EAA member and very resourceful individual. Another church member, David Key is in the silk screen business and he has this big oven he bakes the shirts in to dry the ink." I bet he'll let us use it" says the Reverand.

The way the oven works, it has a bank of heating elements in top and a conveyor the shirts travel on. As it is designed, the conveyor runs any time the heat is on. This feature kept the plastic from being heated enough before it came out the other side. What we did was fold an old sheet to the width of the conveyor so we could hold the plastic in place under the heating elements. I cut a piece of cotton flannel large enough to lay the plastic on and then put them on the folded sheet. We let this travel on the conveyor until the plastic would be completely heated by the oven, then kept it in place by holding on to the sheet. We found it helped to heat soak the plastic if we covered the ends of the conveyor. We ran oven at 250-F and it seemed to work well. I don't know how accurate the thermostat is so, you might

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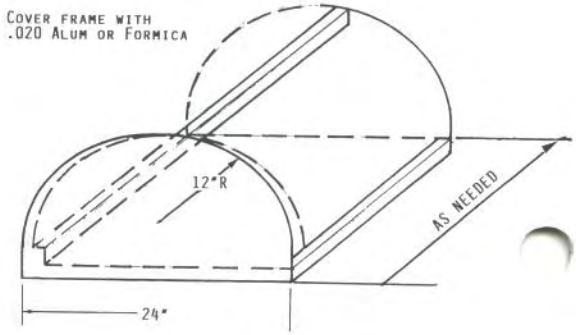
want to practice on some scrap. When the plastic is hot enough to form, it has all the properties of a wet noodle. You have about 20 seconds to go from the oven to the form, so make sure your partner knows what you are expecting. When the plastic is ready, pull the sheet from the oven, and pick up the flannel sheet with the plastic on it by the four corners and lay it on your form, lining it up with some pre-determined marks. If you have it hot enough, it will lay very tightly to the form. If you have any dents or kinks in your form, they will be in your windshield.

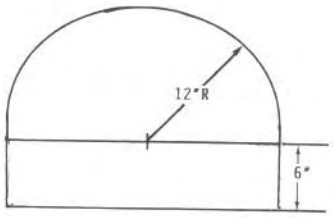
I wish I could take credit for figuring out how to make the flanges to attach the windshields to the fuselage, but I can't. Lou Stolp had some really good how-to articles in the Starduster news letters and this was one of them.

My flanges were made from 2024-0 aluminum .060 thick. In the Stolp article he used .040 material and I think this would be better than the .060 I used. The .060 material simply caused more time to form.

The mounting holes were drilled in the windshields first, 1/2" from the edge on 2 inch centers. The flanges were formed to match the flat wrap of the windshields and the holes transferred through the plastic tape as a gasket between the acrylic sheet and the aluminum and bolted the flange to the windshield with 5-40 screws.

Now the high-tech metal forming takes place. I clamped a broom handle in my bench vise and used a wooden mallet to massage the aluminum into a slight curve as needed until it fit the fuselage. Once it fit pretty good, I used a short piece of broom handle to finish the radius with the windshields held in place on the fuselage then used a rubber and plastic faced hammer to set the flange tight against the fuselage skin. This may seem like an over simplification of the process, but that's the way it was done and I'm happy with the results.

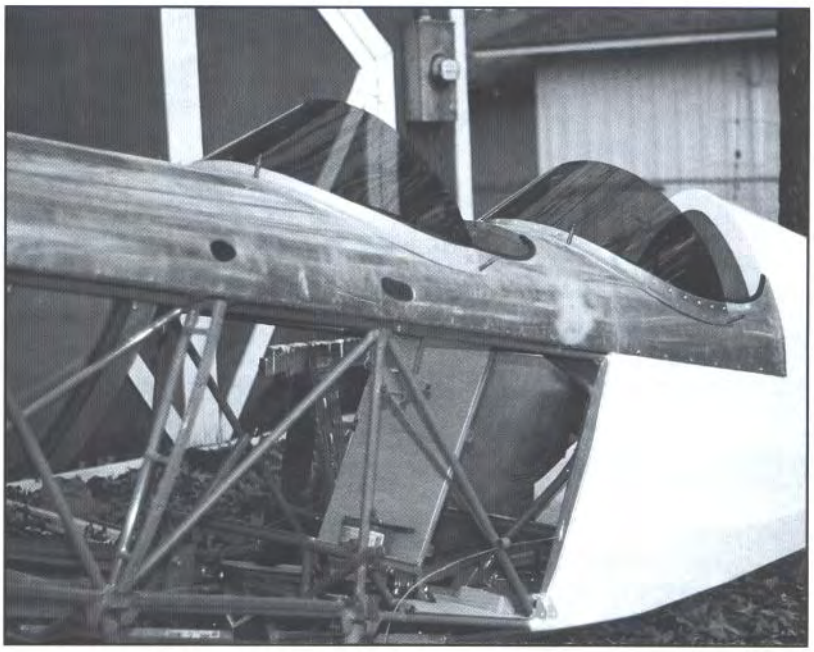




Drawings by Bill Blake

FRONT WINDSHIELD

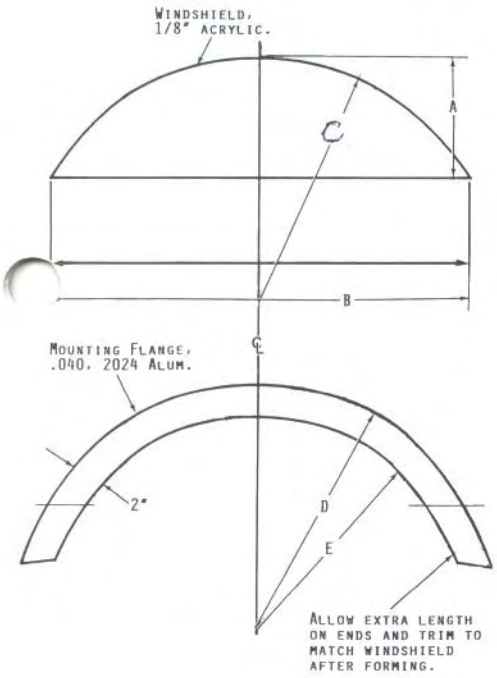
A	12½"
B	41"
C	23"R
D	24"R
E	22"R



Opposite page left– Laura Sidders, age 7, gives her father Neil a helping hand.

Left above– Hot plastic sheet assumes shape of form and when cooled windshield is ready for trimming.

Right– Neat installation of front and rear cockpits on the Acro II. Clecos hold flanges in position for final assembly.



REAR WINDSHIELD

A	13¼"
B	45"
C	26"R
D	27"R
E	25"R