

# GLASAIR News

Newsletter No. 19

4th Quarter, 1985

## SPINS IN THE GLASAIR

by Bob Gavinsky  
Vice President, Engineering

Over the past year or so, I have been learning and practicing aerobatics in our airshow Glasair RG, N84AG. It is a lot of fun. In the back of my mind, however, I have always wondered, "What will the Glasair RG be like in a spin? What if I accidentally put the plane in a spin at low level? Could I recover in time?"

After hearing three favorable first hand reports of spins in the Glasair, I decided to try spinning our Glasair RG. Even though I was violating the Glasair's placard prohibiting intentional spins in the airplane, I hoped to learn more about the handling characteristics of the Glasair.

The aircraft, N84AG, was lightly loaded with pilot, parachute, header tank full, and about 14 gallons of fuel in the main wing tank. I began all tests at about 13,000 MSL near the base of an overcast cloud layer. The Glasair RG used in this test is equipped with inverted fuel and oil systems. The inverted fuel system was in use during all spin tests to prevent fuel starvation. Empty weight of this aircraft is about 1135 lbs., equipped with a Lycoming IO-360, 180 horsepower engine with an acrobatic constant speed propeller. Our new larger rudder was also installed on the plane.

Initially, I tried spins to the right, using standard pro-spin procedures. I approached the stall with moderate power settings for the first few spin entries (19 inches, 2400 rpm). With the nose at a high angle of attack and power on, I reduced power to idle a few mph above stall speed, then pulled abruptly straight back on the stick and kicked right rudder. The first right hand spin actually didn't seem to want to spin as it buffeted in and out of a spiral and spin. This rocking horse maneuver picked up speed quite quickly and after about 3 turns, I initiated anti-spin maneuvers (opposite rudder and stick forward). This

recovery procedure worked fine and I lost about 1,000 feet of altitude. The next right spin was entered similarly. It broke, however, into a legitimate spin and began to stabilize after about two turns. After two turns I immediately initiated anti-spin procedures not really wanting it to progress any further until I knew I could stop it. I noticed that in these spins, opposite rudder did little, if anything, to initiate recovery. Forward elevator was the most authoritative control input that made recovery possible. Recovery was rather rapid with the exit from the spin vertically straight down. Recovery took about one turn. This is only an estimate, however, because the plane spun so fast (about 360°/sec.).

I tried one more spin to the right like the previous one, with the same entry procedure. It behaved exactly the same as the one before. I thought, "Well, here's some consistency." I tried a fourth spin to the right, only this time with a more aggressive entry, full power, and more rapid control inputs. It stabilized in one turn and really did make my head spin. Having confidence from the previous spins, I let it go 4 turns this time before beginning recovery, using up about 2000 feet from 13,000 to 11,000 MSL, including recovery. Again, rudder did little, if anything, to effect recovery; only full forward stick really worked. It was as if, as soon as the wings unstalled, the rudder would hook, stopping rotation quickly. Those of you who have flown the airplane know how powerful the elevator is. All of these spins were with neutral ailerons; no in- or out-spin aileron was tried.

I knew about spins from several other aircraft that I had spun — what in-aileron does (aileron in the direction of the spin), what out-aileron does, what effect power has depending upon rotation direction, what

forward elevator does if pro-spin rudder is applied, etc. I also knew that spinning to the left could be more hazardous than to the right, because of engine rotation direction. If you add power in a left spin with engines that rotate clockwise as seen from the cockpit, the spin will tend to flatten.

Gaining confidence in right spins, I decided to try one to the left. I climbed again to 13,000 MSL. Intentionally, I entered the left spin very aggressively. The spin began to "stabilize" almost immediately, and seemed to be accelerating. I let two turns pass by and decided to get out of this one. I used the same anti-spin procedures I had learned for right hand spins. Nothing happened — I mean nothing! — except that it seemed to accelerate even faster.

One more turn went by, while I quickly figured what to do, looking at the ground coming at me fast. I thought to myself, "I must unstick that wing!" How? I tried in-aileron — nothing... out-aileron — nothing...power — nothing. I still had full anti-spin rudder and forward stick. Six turns had gone by as I was fast approaching somewhere around 10,000 feet — I didn't have much time to pay attention to the altimeter. I noticed, however, that in-aileron caused the nose to lower, and out-aileron caused the spin to flatten. "Maybe I could 'rock it' from out-aileron to in-aileron, unstalling the wing," I thought. On the seventh turn, I pulled it into a flatter spin with full aft stick, right aileron, and anti-spin right rudder. Then, abruptly, I moved the stick to the full forward, left aileron position. The plane lurched forward almost onto its back as I pressed negative into the straps. Trying to keep it from going into an inverted spin, I eased back on the stick, aiming straight down, and pulled the plane back, somewhat cautiously, to a level attitude. Wow!

A few more seconds and I would have had to think about bailing but. I was about 9,000 MSL as I reached level flight attitude.

Needless to say, I didn't try a spin to the left again. I tried one more spin to the right after the left spin and let it go about 4 turns; the airplane recovered fine.

I have a few theories (one of which is the direction of engine rotation) on why this particular aircraft seemed to exhibit less than desirable spin recovery characteristics when spinning to the left. More actual testing, however, would be needed to verify these theories. Every aircraft is different and will exhibit different flight characteristics.

I was lucky, I could just as easily not have been so lucky. We cannot stress this point more, DO NOT intentionally spin any model of Glasair aircraft. There are too many variables and unknowns to deal with, such as; type of entry, control inputs, CG, control rigging, wing and stabilizer incidence angles, aircraft weight, stall strip placement, etc. Everyone's airplane is different and will exhibit different spin and recovery tendencies. Spinning an aircraft with unknown flight characteristics is probably one of the most dangerous test flight operations possible.

Our very first prototype, N88TH, was spin tested to a very limited extent. It was spun 3 times in both left and right spins with very favorable results. The aircraft was lightly loaded with pilot, parachute, and minimal fuel. It spun quite nose low and responded favorable to conventional anti-spin control inputs. At that time we were primarily interested to see if the aircraft exhibited "normal" spin tendencies in both directions, and that recovery would be possible in the event of an accidental inadvertent spin. All of our prototype Glasairs exhibit very docile stall characteristics with the inboard leading edge stall strips installed. All of our builders, to our knowledge, have reported similar stall characteristics.

In conclusion, the type of entry determined the "personality" of the spin and how it stabilized. Conventional anti-spin control inputs did not work with this particular aircraft, especially in spins to the left. The aircraft rotated fast and lost altitude fast while in a spin. Opposite rudder had little, if any, effect on recovery. Recovery was always vertical, taking

about one to two turns. To put the aircraft into a spin took deliberate control inputs.

If a person is familiar with standard spin recovery techniques, he should be able to prevent the airplane from ever going beyond a one turn spin, or even entering one. It takes about 2 turns before the spin begins to stabilize. Anyone who is considering any aerobatics in the plane should have spin training in another aircraft like a Pitts so he knows what to do in the event of an inadvertent spin.

The power-off stall characteristics are quite docile. (When the stall strips are installed correctly, the plane actually tends to mush straight ahead during power off stalls.) Power on stalls (rpm over 1500) are more pronounced and will drop off on a wing more easily. We recommend NOT doing power on stalls over 1800 rpm for they can more easily cause a spin entry. Allow yourself 4000 to 5000 feet AGL when practicing any type of stalls.

Spin discussions should not put a fear of slow flying into anyone. Slow flight is the best practice to become thoroughly familiar with an airplane's control and handling characteristics. Practicing slow flight and stalls should be done on a regular basis to build confidence. This will help you maintain short field take off and landing proficiency. If you do not maintain slow flight and stall proficiency, you may notice a gradual tendency to fly faster approaches and longer, sloppier landings. Confidence in your aircraft's ability to fly slowly and stay in the air should be maintained.

When doing aerobatics in the Glasair at or below the stall speed, such as in a hammerhead stall or similar maneuver, keep the angle of attack of the wing to the relative airflow low so as not to stall the wing. With the stall strips properly installed, you will notice plenty of buffet prior to a stall at any airspeed; so neutralize the stick to prevent stalling whenever this buffet is felt. Aerobatics in the Glasair should only be undertaken after competent instruction. We recommend getting some acrobatic training in a plane certified for intentional spins, such as a Pitts or an Eagle, before attempting aerobatics in a Glasair.

The question of unintentional spins may be nagging you while reading this article. You are probably thinking, "I sure don't intend to do any

intentional spins in my Glasair, but would like the grace afforded for human error and an unintentional spin without any dire consequences." Please be assured that there is a world of difference between a full stall when the nose drops and the spin starts, and a fully developed intentional spin. In our Glasair demonstrations and flight testing, on occasion we have arrested unintentional spins when the wing drops off, the lose lowers, and rotation begins. As long as the pilot recognizes the stall and spin entry, and then initiates proper anti-spin control inputs in a calm, purposeful way, the spin has always stopped within 1/2 turn and with minimal altitude loss. From our experience, we believe that unintentional spins should never fully develop unless the pilot is simply asleep at the stick.

NASA has carried out an extensive research program on spinning using a Grumman aircraft. Their report, "Exploratory Study of the Effects of Wing-Leading-Edge Modification on the Stall/Spin Behavior of a Light General Aviation Airplane," NASA Technical Paper 1589, is good reading material. This report is available from the National Technical Information Service, Springfield, Virginia, 22161.

There are also many books on spinning and spin recovery, and good articles often appear in aviation magazines (see the August, 1984 Sport Aviation and the February, May, October, and November, 1985 Sport Aerobatics). We recommend going to your local aviation type store for books such as: Stalls, Spins and Safety by Mason, Anatomy of a Spin by Lowery, All About Stalls and Spins by Gentry, Aerobatics by Williams, Flight Unlimited by Muller, and Aerobatics Today by O'Dell. Remember, however, that every airplane is somewhat different and the techniques used for one aircraft may not work for another. Even a Cessna 150, with certain control inputs, has undesirable spin recovery characteristics.

We have placarded the Glasair against spins for a good reason, please respect our precautions. We do recommend that all Glasair pilots become familiar with proper spin recovery techniques and, if possible, get some professional spin training in an airplane certified for intentional spins.

## BUILDER HINTS

### D RIB CAPS

One builder sent in a suggestion for fabricating caps on the upper edges of the D ribs. When the upper wing panel is bonded on, they are adhered to the D rib caps using fiberglass mat cloth in a manner similar to the bonding of the upper panels to the main spar cap. This eliminates the necessity of applying the difficult laminates in the corners between the D ribs and the upper wing panels after the upper panels are bonded on.

To fabricate the rib caps, first fit the tops and bottoms of the ribs to the wing panels, following normal procedures. Do not bond the ribs into the wing panels yet.

Make a jig from a piece of 2 x 4, using the upper edge of the D rib as a pattern. Use a band saw to cut the 2 x 4 to match the upper contour of the Drib.

Make up a precured two layer laminate 2-1/8" x 20". When cured, cut the laminate to match the length of the D rib.

Trim away 1/16" from the top edge of the D rib for its full length to allow for the thickness of the precured laminate and the fiberglass mat cloth.

Affix the 2 x 4 jig to the top of a work bench, shim the D rib 1" above the surface of the bench (use scraps of 1/2" foam), lay the precured two layer laminate against the contoured side of the 2 x 4 jig, and force the D rib against the precured laminate so that the laminate conforms to the upper surface of the rib. The builder suggesting this method drove two large nails into the workbench against the lower edge of the rib to hold the rib against the precured laminate.

Form a thick Q-cell radius in the corner between the rib and the precured laminate and, when the Q-cells have cured, apply a two layer laminate between the rib and the underside of the precured cap laminate. Overlap the two layer laminate for at least one inch onto the face of the D rib. When this two layer laminate has cured, flip the entire assembly over and repeat the Q-cell radius and the two layer laminate on the other side. Make sure that the cap is kept perpendicular to the rib.

Now the D rib with its cap can be bonded into the wing as usual. When

the upper wing panel is bonded on, apply a 2-1/8" wide strip of fiberglass mat cloth (U) the top of the D rib cap and saturate with resin in a similar manner as the bond between the main spar cap and the upper panel.

The quality of the bond between the upper wing panel and the D rib cap will depend, to a large extent, on how well the contour of the rib matches the contour of the wing panel. For this reason, take extra care in contouring the top of the D rib. The outboard flange of the D rib cap can be inspected visually for voids after the upper panel is bonded on, using a bright light through the inspection hole.

### FT MAIN GEAR SUPPORT STRUCTURE

One of our builders recommends using 9/16" thick wood strips on the inside of the lower wing panel to help keep the laminates in place when forming the "L" shaped capstrips on the lower edges of the B ribs for the FT main gear support structure. The wooden "fences" are temporarily bonded (using "hot glue") parallel to the ribs on the inside of the lower wing panel. The sides of the strips against which the laminates will be applied should be waxed so that the laminates don't adhere to the wood. This builder reported that the wood strips effectively kept the thick laminates from slumping out of position during lamination.

### FITTING COWLING

The engine tends to settle or sag on the Lord mounts after 50 to 100 hours of operation. For this reason, we recommend that, when initially fitting the cowling to the engine, you jig the engine so that the spinner is 1/8" to 3/16" higher than the cowling. The alternative is to shim between the Lord mounts and the engine crankcase when the engine starts to sag.

### RG TOWBAR

Be aware and make sure that the towbar does not contact the lower scissors on the RG nose gear when moving the airplane on the ground. If the handle is raised too high and levers against the scissors, the scissors can be damaged.

### WATER LEVEL

An early issue of Glasair News suggested using a water level for all the leveling operations necessary when building the Glasair. This is such a handy device that we decided to describe its use again.

The water level is simply a reservoir (we've used an old coffee can) with a tube attached near the bottom. The tube should be at least 20 ft. long so that, when the reservoir is placed in a central location, the tube will easily reach to all points of the Glasair airframe. The reservoir is filled with water and placed in a fixed position. The tube will fill up with water to the level of the water in the reservoir; and the water level in the end of the tube can be used as a reference from which to measure for leveling the airframe during construction.

Use the water level for leveling the wing jig table, for marking waterline 100 on the fuselage, for mating the horizontal stabilizer and the wing to the fuselage, and numerous other operations.

Some cautions should be observed in using the water level. First, take the time to work any air bubbles out of the tube since they can prevent the free flow of water from the tube to the reservoir, thereby giving unreliable height readings. Secondly, make sure the tube isn't pinched or kinked anywhere for the same reason. Finally, a variation of the water level which uses a long length of tubing (without the reservoir) should be used with caution. Because of the manner that plastic tubing is extruded, capillary action can be stronger in one direction with the result that the level of the water can be different at opposite ends of the tube.

### FUSELAGE SLING

One builder folded an old bedspread into a belt about 6" wide and used this as a sling for the tail cone of the fuselage. He secured each end of the sling to the rafters in his shop and rested the fuselage in the sling just ahead of the vertical fin. This, combined with a single swivel point attached to the engine mount, enables him to easily rotate the fuselage by himself to any position.

I do not intend to cause a panic about the Glasair in regards to spins for it takes very intentional control inputs to cause a stabilized spin. I

hope that what I have learned will be of benefit to you and that flying your plane is a safe and rewarding experience. I certainly love flying ours!

## MORE ON ENGINES

### O-320 CARBURETOR LOCATION

The article on engines in the last newsletter contained some inaccurate information. In that article, we stated that carburetors on O-320 A, B, and C series engines are located toward the aft side of the underside of the sump, and that carburetors on O-320 D and E series engines are located toward the forward side of the underside of the sump. Unfortunately, the situation is not that simple. Some of the early series engines (A, B, and C) have the forward carburetor location that is suitable for use on all Glasair models, so some of these early models can be used without having to swap the oil sump and intake tubes. Also there are at least two of the later model engines (O-320-D2H and O-320-E2G) that have the carburetor mounted in the unacceptable aftward location.

## NEW GAS CAP

We now have available a new gas cap which uses a different locking method than the old cap, and which should not be subject to the same problems of the gasket swelling as the old cap. The new cap can be purchased as a complete assembly, or just the actual cap can be purchased and the old sleeve modified to accept the new cap.

If the gas cap has not yet been installed, or if the sleeve has been bonded into the upper wing panel but the wing has not yet been closed, you will make your fueling much easier by purchasing a new style cap. If the old cap is already installed in a finished wing, it will probably be easier to modify the sleeve in place rather than trying to remove the old sleeve and install the new one.

If you want to modify the old gas cap sleeve, we will supply instructions and a pattern that can be used as a guide for filing. A hole for a stop pin must also be drilled in the sleeve and the pin pressed in. The instructions

### UPGRADING FROM 150 to 160 HORSEPOWER

In the "Engines" article we also said that the 150 hp (low compression) O-320 engines can be upgraded to 160 hp by installing a set of high compression pistons and heavier wrist pins. We realized, after the article was published, that it is also necessary to install a set of the high compression 1/2" valves. Make sure they are high compression valves; not just any 1/2" valves will work. Engines that originally had 3/8" valves will require new valve guides and keepers for the 1/2" valves, and may also require new valve seats and rocker arms. At any rate, expect to have some cylinder head work done if you are upgrading a 150 hp engine to 160 hp.

will include suggested procedures to help prevent debris from being introduced into the fuel system.

### WARNING

If fuel has already been carried in the tank, extra care must be taken to prevent igniting fuel fumes while working on the tank. All fumes must be eliminated by thoroughly flushing the tank before beginning work on the gas cap sleeve. Electric tools should not be used for this operation due to the danger of sparks. Air tools or hand held files are recommended.

The complete new gas cap is available for \$59.50, and may be ordered by contacting our shipping department. If you wish to order just the cap, minus the sleeve, the price is \$44.50.

## PROJECT SCHOOLFLIGHT WORKSHOP

The Seventh Annual Iowa State University Schoolflight Workshop,

### CARBURETOR FLOAT

In the past couple of Newsletters we have discussed improvements to the carburetor air inlet and a carburetor nozzle replacement to help solve problems with the engine running roughly. Another possible cause of a rough running engine can be a problem with the carburetor float. Brass floats can develop leaks and plastic floats can absorb fuel. The reduced buoyancy of the float allows excess fuel to leak past the float needle with the result that the engine runs rich. If you suspect this problem, disassemble the carburetor and check brass floats for fuel inside, or check plastic floats to see that they fall within the specifications for proper weight.

We have also had a report of the float on a brand new carburetor rubbing and hanging up on the inside of the carburetor, causing the engine to run rich.

tentatively scheduled for June 9 through July 3, 1986, is in need of participants. The workshop, organized by the Iowa State University Department of Industrial Education and Technology, is designed to provide educators with the hands-on experience and technical know-how to implement aircraft construction programs in secondary and post-secondary schools. The workshop is open to other participants who have an interest in aviation and the basic capabilities with materials and tools. Glasair builders desiring a supervised introduction to composite aircraft construction techniques have been among the participants in the past.

In previous workshops, four Glasair RGs and one Glasair TD have been partially completed. The TD is now flying and two of the four RGs are in the taxi testing stage. If you are interested in participating in this workshop, contact Dr. John Riley at Iowa State University, (515) 294-5171 or 294-1033.

## WING TIP EXTENSIONS

Before the thicker flanges are added onto the ends of the wings, make a plywood template of the airfoil contour by holding a piece of plywood against the end of the wing and scribing around the wing. When bonding the wing tip extension halves together, this template can be used to compare and duplicate the exact airfoil shape of the end of the wing.

Other builders have recommended forming the mounting flanges on the ends of the wing first (making sure to achieve the required minimum 3/16" thickness of the wing end laminates first) and then fitting the tip extensions to the wing. This makes it easier to achieve a good match-up of the extension to the wing because the extensions can be slipped over the mounting flanges which hold the extension in its proper shape.

## GELCOAT

Finishing the seam areas with gelcoat is one of the operations that has given our builders the most trouble in trying to achieve a perfect finish for their Glasairs. It is nearly impossible, using a regular paint spray gun, to achieve a smooth surface. The result is usually an "orange peel" texture which requires considerable sanding with progressively finer grades of paper to achieve a smooth finish.

One of our builders reports good results using an airbrush to apply gelcoat. He advises thinning the gelcoat 50/50 with acetone. This method is very thrifty with the gelcoat and results in a very smooth surface with a flat, eggshell-like texture when cured. Since sanding can be started with 600 grit paper, the sanding work is greatly reduced.

## ZOLATONE

We have a report from one of our builders that Zolatone paint, which is commonly used to finish the inside of the fuselage, has a tendency to mildew in a warm, moist climate. If you live in an area of the country with such a climate and want to use this paint, this builder suggests that you apply a coat of clear acrylic over the Zolatone to prevent mildew.

## TD GEAR CREEP

When parking the Glasair TD after flying, we recommend lifting up alternately on each wing to allow the main gear legs to relax from the flexed condition they tend to assume while taxiing. This helps the gear struts retain their original shape, rather than sagging over time.

## MAKING TEMPLATES

We get questions from time to time concerning the method of making templates for such areas as the fuselage sidewall cutouts for the wing. The method we suggest is to use a compass (for drawing circles) as a pair of dividers to scribe a line parallel to the surface being duplicated. For example, to duplicate the airfoil shape of the wing for the fuselage sidewall cutouts, set a piece

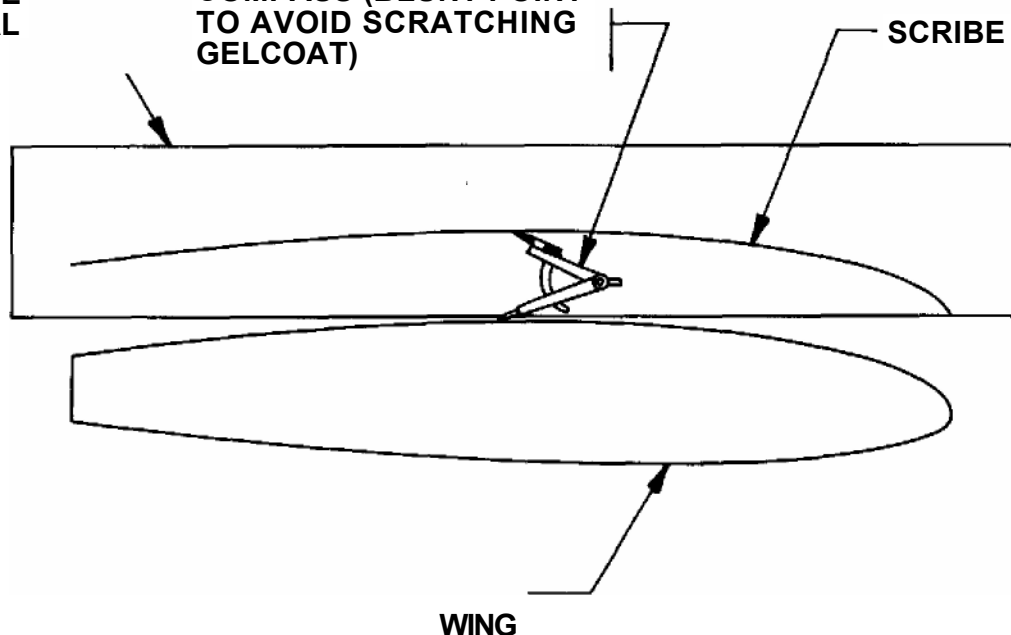
of masonite or thin plywood vertically against the wing surface (parallel to the chord line), as shown, and secure it in some manner so that it doesn't rock back and forth. Round off the sharp point of the compass so that it doesn't scratch the gelcoat surface and set the legs of the compass the same distance apart as the widest gap between the wing surface and the template material. Run the point of

the compass over the wing skin while scribing a line with the pencil onto the template material. In order for the scribed line to remain parallel to the surface being duplicated, the pencil end of the compass must be kept directly above the point while the compass is drawn over the surface. Once the line is marked, cut out the template along the line, trial fit the template, and make any fine adjustments in the fit.

TEMPLATE MATERIAL

COMPASS (BLUNT POINT TO AVOID SCRATCHING GELCOAT)

SCRIBE

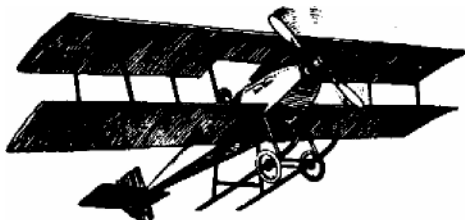


WING

## WING WALK REPAIR

In Newsletter No. 17 (Second Quarter, 1985), we discussed damage that can occur to the wing walk area of the wings and suggested using higher density foam to reinforce the area and help prevent damage. Some of our builders have reported since then, however, some difficulties experienced with methods in which the higher density foam is installed from the inside (ungelcoated side) of the wing panel. The problem seems to be that, if a thick layer of Q-cell is used to pot in the high density foam, the Q-cell mixture shrinks when it cures, which warps the smooth upper surface of the wing in the repair area.

To avoid this problem, the high density foam should be scored deeply to allow it to conform to the contour of the upper wing panel. If the foam conforms well to the curve of the upper panel, only a very thin film of Q-cell mixture will be necessary to pot in the foam. The thin film of Q-cell does not shrink enough when it cures to cause a problem.



## FLYING GLASAIRS

Since the last newsletter, the following builders have reported first flights of their Glasairs: Paul Cloyd of Friendship, WI, Harry Rasmussen of Puyallup, WA, Aubrey Warren of Niceville, FL, J.C. Hanks of Vero Beach, FL, and Frank Sigler of Portland, OR, have flown their RGs. Eugene Beatty of San Carlos, CA, Lowell Binder of Bedford, Nova Scotia, Al Harris of Carmichael, CA, Soren Schmidt of Partille, Sweden, and Dave Marko of Calgary, Alberta, have flown their TDs. Carmine Petracca of Lewiston, ID, has retrofitted his previously flying taildragger with the FT gear, a 180 hp engine, and wing tip extensions.

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