THE COMPOSITE FUSELAGES by Harley Michaelis (Sept. 5.'09)

Keith Smith of Pacific Sailplanes approached me about doing these. His credentials, with a background in composite creation and testing for industrial and military applications, were an arm long. Anticipating that availability of composite fuselages would be an incentive for more to complete a ship, I agreed to carve plugs for the Big Genie/Genie Pro and the LT/S fuses.

After later designing the slimmer, longer, glassed-over fuse for the Smooth Genie Pro, the original Big Genie fuse shown below began looking bulky. After marrying the Big Genie wing with the SGP fuse, the now-favored "Big Smoothie" was born. New plans drawn August, 2009 show only the slimmer fuselages.

These pics are of the GENIE PRO that used the same fuselage as the original Big Genie. Near 5' long, the bare shell weighs about 12 oz. With essentials added and painted, it's a bit lighter than the Big Genie glassed-over fuse but not the SGP fuse. Also, with a drilled out one piece nose block for lead shot/resin mix for balancing out, the all up, RTF weight of ship runs 10-11 oz. less than the original Big Genie even with the Big Genie wing. The lighter weight means higher launches on winches typically used at thermal contests and slower landings. Conclusion: Unless there are compelling reasons to use the composite, use the SGP fuse with the Big Genie or Genie Pro wing.

A proprietary blend of many different cloth weights and weaves makes the fuses well suited to thermal competition. They are substantial. The boom area is resilient. The narrow area by the fin is reinforced with CF. All corners, external and internal, are rounded where important to avoid stress risers. They are not to be equated with fuses made from heavy glass layers or the coarse CF/Kevlar weaves that block the Tx signal and require an external Rx antenna.

Where CF reinforcement is used in the fin area, it's placed to not block signal reception. It's 2.4 Ghz friendly. A fully extended regular antenna can go down the fuse on a 1/8" sq. balsa stick.

A molded-in fin for the 16" tall GENIE & GENIE PRO tail would have caused sky high shipping cost for the way "oversize" carton needed. To avoid that, a slot is molded into the fuse to receive the regular balsa fin shown here and detailed in File 1, or a separate, but heavier accessory epoxy/glass fin. Fin and skid are faired in and glassed-over using epoxy.

That tiny bump under the dorsal is one of the molded-in, micro-nacelles where a pull-pull rudder cable exits the fuse.

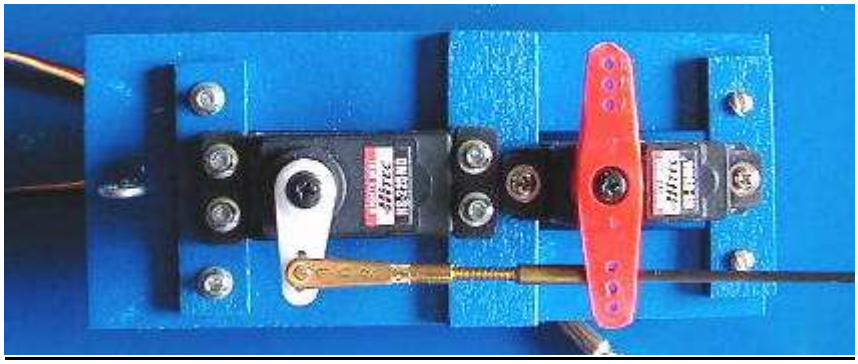
For info on pricing, accessories, shipping etc., see www.pacificsailplanes.com/. Go to the Online Store. The contact e-mail is info@pacificsailplanes.com. Pacific Sailplanes is at 15358 Violetlane Way, Canyon Country, CA 91387-1861.

WORKING WITH THE FUSELAGE

The LT/S fuselage comes with an integral fin, so item 4 is not applicable to it.

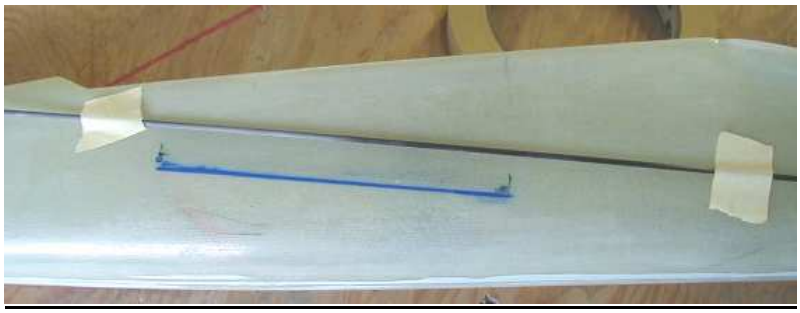
The instructions that follow deal with;
(1) Hiding seam lines.
(2) Fitting/installing a plywood tray for the R and E servos and switch installation.
(3) Installing a plastic tube for the CF stab pushrod.
(4) If using the balsa fin, prepare as in CONST. File 1. Mount & glass-over it with epoxy.
(5) Locating and installing T-nuts under the saddle for wing attach.
(6) Installing a tow hook.
(7) Fitting the canopy rear end to the mounted wing.
(8) Keying and retaining the canopy.
(9) Opening the micro-nacelles for the rudder cables.
(10) Painting.
(11) Ballasting

(1) During production, fuse halves are joined "wet" for well bonded seams. ICING PUTTY, as appears white here (see FINE FINISHING file) is ideal to smooth the overlapped seams level.



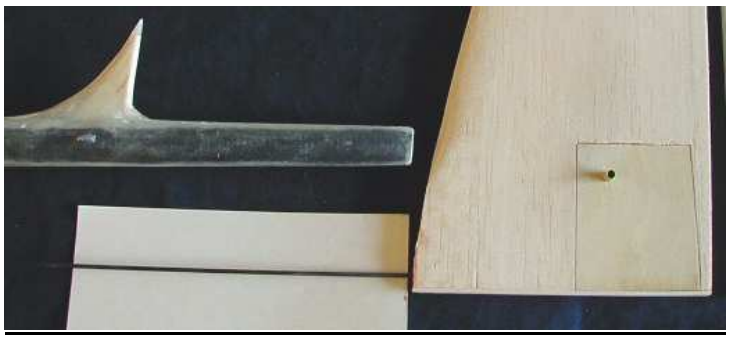
(2) For the BG or GP make a 1/8" ply tray 1-7/8" wide. Size length for servos to be used. Here the tray is 4-1/2" long for a Hitec 225 (left) for stab and a narrower 85 BB behind it for rudder. A 5/8"wide slot was cut from the rear (right) to 7/8" from the front end. Not visible, a 1/8" x 3/8"ply brace is then glued across the bottom rear. Center crosspiece is fixed, ends positionable to butt to servos.

Before installing the tray, temporarily mount servos to establish screw holes. Micro Fastener's #2 socket head screws seat easily with a hex head driver. The stab output arm extends toward one side so the pushrod clears the rudder servo case during deflection and to hug the fuse side where it runs down a tube. It may be necessary to shim the rudder servo so the stab pushrod 2-56 coupler clears the 2-way output arm (red) the rudder cables attach to.



Tape the pushrod to run in a straight line from fin to servos. Blue line indicates tray location, so output arms align to the pushrod, and so servos clear fuselage bottom. Remove servos to install the tray. Locate it well forward, just leaving room to insert battery and Rx.

Before mounting servos, secure tray along its edges with a bead of flexible CA glue, top & bottom. Spray accelerator. Bond with fuse is neat & incredibly strong. Rudder servo (left) here was shimmed 3/16" (unpainted items) so the pushrod would pass under the rudder cables. A tube for the pushrod, later detailed, has to be installed <u>before</u> the clevis & threaded coupler are permanently attached to the CF pushrod.



A slot for the fin comes partly opened. File the inside edges to make a centered slot 5/16" wide.
The rigid, coarse, flat Permagrit sanding file works well. After the bell crank hardware/pushrod are installed, a balsa cap is put on the bottom of the fin. Round its edges to fit the rounded bottom of the slot.

Fit ¼" soft balsa to fill the hollow dorsal. See pg. 5 about balsa fin installation and glassing over. <u>This follows installation of a tube for the pushrod detailed in (3) below</u>. In the pic above, all's been done as described in CONST. File 1, preparatory to glassing-over the fin. For knuckle hinging of the rudder the fin

extends further back from the ply inlays than seen in the above picture. See File 2. Above, the pushrod is in, as seen on the white background. At this stage, use a Dremel with cutoff disc to shorten it to extend to the output gear of the mounted stab servo. Cap the bottom of the fin and be sure the pushrod isn't bonded. If using the glass fin accessory, after fairing it in, proceed similarly as detailed for the LT/S composite fuse.

(3) The pushrod is to pass through a tube (3/16" thin-walled Sullivan, etc.) Slip the pushrod/fin in place. Size tube to extend from fin to 6"or so from the stab servo. Run the tube to the fin. If quick epoxy won't stick to it, shrink 1" HS tubing pieces to it. Put one at the tail end, another midway between there and the rear hole in the saddle, one at the rear hole and another centered on the side by the tow hook block. Outside on the fuse, for visual reference, mark HS locations.

Tape the drive pin in neutral. Up front, final trim the pushrod for proper length with coupler slipped on (not glued yet) and clevis centered on the threads.

Viewed in profile, the tube should run in as direct a line as possible from the stab output arm to the fin. The tube and pushrod will sag in the boom area. That's okay. Apply quick epoxy over the HS tubing at the rear saddle hole. Press it to the side while curing. Remove fin and pushrod. Determine thickness of a balsa shim to support the tube at its rear end so the pushrod is centered in it. Epoxy it in place and epoxy the tube to it.

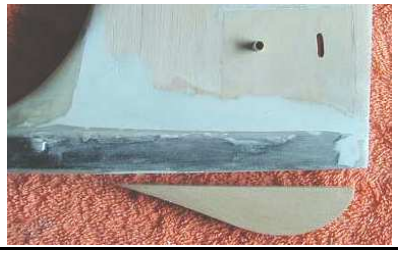
At the midway HS tube, drill a 1/8" hole through the fuse. Bend a pin to reach inside to pull the tube to the inside. Work epoxy through the hole. Use the pin and gravity to keep the tube and epoxy against the fuse inside. Do the one by the tow block, keeping the tube flush to the fuselage inside. To deal with clevis attach and detach, the remainder of the tube is left to float. Bond the front coupler to the pushrod.

(4) Polyester finishing resin, as used with the glassed-over wood fuse, won't cure over epoxy. ICING polyester putty will. Jump ahead to the FIN INSTALLATION pic and text box below about installing the plain balsa fin. Then as shown in the s/b/s pics, add ICING fillets and apply glass cloth with epoxy resin. Thin, bagging epoxy is ideal. Mix 12-15 CC's for the initial cloth attachment. Mix in a little acetone to thin it for easier brushing down of the cloth. Roll off excess resin with toilet paper to look almost dry. Since bagging epoxy cures slowly, let it set over night and longer as needed to sand off in a white powder. If it gums up the paper it's not cured enough. The subsequent "flow coat" takes less resin and is left to level out for final wet sanding with progressively finer grits, ready to paint. Have something else to do while resin cures well.

FIN INSTALLATION: Start this using a bead of quick epoxy and micro-balloons or Cabosil on the cap's underside. Apply it from ½" behind the front of the cap to avoid it getting to the pushrod. The fin is pressed in, spaced a bit less than 1/32" from the dorsal stub. The block with the dowel on the saddle is to visually get it upright. Brace the fin to hold it upright as the epoxy hardens. When bonded, but still pliable, jam soft 1/32" balsa (grain crosswise) between the fin and dorsal to get and hold the fin perfectly upright. Wick CA glue either side of the balsa to firmly bond all together at the dorsal. Trim excess balsa and sand the edges smooth.

Use the epoxy mix to bond the fin to the slot's top, making small fillets. Use softer, sandable ICING putty to make them fuller and to level out the fin/dorsal joint. Similarly do the skid. After all's cured and feathered out, attach light glass cloth. Direct hot sun speeds epoxy cure.

The left pic shows ICING to fillet/feather fin to the dorsal and fuse. Make a cardboard pattern of the fin down to the skid. Use to cut one ¾ oz. cloth piece ½" over width to apply and wrap around the LE. Don't cover the nacelles. Cut the other one without the wrap around. Center, the ¼" bass skid is on and all's glassed-over. Don't get cloth or resin on the rear end of the fin where it's to be concaved for the rudder. It looks crude, but block sanding with progressively finer grits as the separate Glassing-over file details can make it uniformly smooth for the final coat mentioned. Then, used wet, #220 followed by #400-600 works well on the epoxy, ready for primer and paint.



(5) The rear edge of the extension between the flaps should be trimmed so with it positioned at the rear of the saddle, the LE extends no more than 5/8" beyond the saddle high point. If more, it gets too high to fit the canopy to it.

With the wing centered and in position, run a ¼" drill bit through the main bolt plate mounted between the spars. Twirl it to mark the location on the saddle. Progressively open the hole so a ¼" x 20 T-nut can be inserted.

<u>PREVENTATIVE MEDICINE: After fuselage damage after a battery died in flight, I did a repair with 1-1/4" wide strips of CF wing cloth epoxied inside on the sides under the saddle. Using bagging epoxy, I recommend now attaching 3 such strips on each side before next steps are done.</u>

Make up a ¼" thick ply plate about 1-1/2" square to mount under the saddle. Flatten or remove the spikes on the T-nut. Radius the bottom edges of the hole in the plate so the flange contacts the underside. Drill holes in the flange to screw mount it. File off any protruding nut that would interfere with wing seating. Attach the plate with quick epoxy filled with Cabosil. Thread a waxed bolt into the T-nut to judge that it is upright.

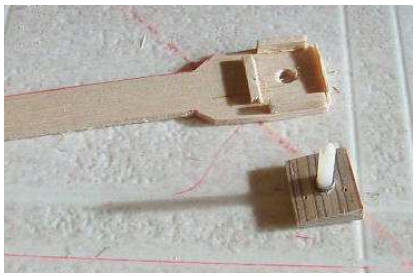
From 1/8" ply, similarly make and attach a base for a 10-32 rear bolt. To recess the rear bolt on the LT/S, place the nut approximately 2" from the TE of the extension. Before bagging, inlay a 1-1/2" square plate of 1/8" ply in the underside with its rear edge 1" ahead of the core TE.

Bolt the wing on, all squared up. Mark the centerline of the wing on the extension between the flaps. Drill a centered pilot hole through the extension and the base. Open it enough in the extension to receive the 10-32 bolt. Open it enough in the ply base to receive the narrow end of the 10-32 T-nut.

On the Genie fuse, the rear bolt is to preferably enter perpendicular to the top of the extension, so the bolt head bears flat on the 1/16" ply base of the rear fairing. To do that, the T-nut is to angle back about 12 degrees relative to the T-nut base, seated in a beveled block of ply. Trim most of the flange off the nut. Flatten the flange.

To do the angle, make a block of ply 3/8" x 1" square. Cut a ¾" or 1" square stick 4-5" long with an end squared up. Glue the ply block vertically to the squared up end so both are flush at the "bottom". Either tilt the table of the sander 12 degrees or jack up the handle ¾" in 3-1/2". With all squared to the sanding face, bevel the block. Band saw the block from the handle. Beveled side up, use a drill press to make a

centered hole perpendicular to the block bottom. Trim the block to 7/8" square, centering the nut hole. To fully seat the nut, radius the hole on the bottom of the ply plate.. Run the nut in from the bottom. Solidly epoxy the nut in place. Shorten a nylon bolt to 1" or so by cutting off the head. Trim that end to a point. Apply paste wax to the bolt. Thread it into the nut, pointed end up.



The thick end of the beveled block faces rearward and must be squared to the fuse sides. If fingers are short, a little tray, as shown, can be made to get it squared up. Coat the block top with quick epoxy. Run the pointed bolt into the hole in the 1/8" ply. Grab it to pull the block flush to the ply base. Let the epoxy cure. Unthread the bolt. Make the rear fairing.

The wing wiring harness goes down and forward through the saddle opening. The fuses are reinforced in critical areas, including along the sides at the rear of the saddle. The big GENIE fuse has a raised turtle deck. The adjacent opening was needed for seaming access and for mounting the rear bolt plate to square up the center section to the saddle.

The rear bolt goes forward where the wing is thicker so the head recesses.

A dowel with a piece of screw L set in it can be used for a handle when painting. Screw it into one of the holes in the tow hook blocking.

(6) The tow hook block can be layers of ply attached with epoxy and glass cloth from the inside. Its center should be 6-1/4" from the rear horizontal edge of the saddle. Round the side edges so the cloth is easy to position over it. Coat the block, adjacent fuse and then apply the cloth.

(7) Trim the rear end of the canopy so it extends ½" or so behind the LE of the wing. Progressively contour it to fit around the LE.

(8) If the canopy is high, sand down the thick bottom edges. It's also thick enough on top to wet sand down near its front to best merge to the fuse profile. Use #220 then finer grits. To key and stabilize it, bevel brace edges to fit flush between the rounded interior edges of the canopy. Secure these inside with Gorilla glue. Let it set overnight. When dry, trim/sand off any glue ooze and then attach cleats to fit between the fuselage lips. To prevent the canopy from gouging the wing LE, epoxy a "stop" block under a lip for the rear cleat to butt.

A block with a slightly opened small screw eye is epoxied inside the canopy to secure it with rubber bands to a screw eye on the servo tray. Push the canopy forward and lift it at the rear to unseat it. Lift and turn it access the switch.

After installing the stab servo, put it in its neutral. Attach the output arm to point, as closely as possible, straight to the side. Program to get a right angle. Put the 1/16" drive wire of the bell crank in what appears the stab neutral position. Taper the rear end of the front coupler so it does not jam against the rudder servo output arm. Center the clevis on the coupler threads. About 3/8" of the pushrod will go into the coupler. Cut the rod accordingly with the Dremel. If satisfied that the length puts the drive pin in close to its neutral, bond the pushrod into the coupler using slower CA glue. Before it sets, put a crimp in the coupler for additional security. Mechanically adjust the clevis on the front coupler for the length needed.

Be sure the arced slots in the fin allow the drive wire full range without jamming at the top or bottom.

(9) From the rear of the tiny, molded-in nacelles, drill tiny, angled holes to insert the rudder cables. You'll be drilling through a mound of epoxy putty inside, not just the shell which the cables may easily slice. Preferably use nylon-coated cable, a fishing accessory.

(10) Typical pinholes can be filled with products made for the purpose or spackle, ICING putty, etc. Before applying a primer, Keith Smith recommends lightly wet sanding the entire fuse with a finer paper, cleaning it with cool water and a mild dishwashing detergent. Rinse and when dry, wipe it down with alcohol. I further suggest first using a degreaser to clean away any residual release agent that may be present from the molding process.

After following Keith's suggestions I applied Rustoleum Clean Metal Primer and Gloss Protective Enamel. It took several days to fully dry, but stuck well and covered scratch marks from using 320 grit. The Sunburst Yellow is a good match for Krylon Sun Yellow Gloss and Yellow Monokote used on the wing and tail pieces.

As shown below, installed items such as servos can be left mounted and masked over with pieces of manila folder curled and inserted between edges. The dowel handle can be used while painting outdoors and to hold the work in a vise while paint cures. Stuff some weight in the nose to balance the assembly at the dowel while painting.

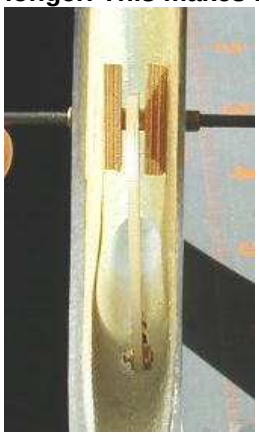
LT/S COMPOSITE FUSE

The ship in this group of pictures was first flown late fall, '05 before the fuse was painted. Launched with the switch off, the center section was wiped out and the fuse was broken in two behind the wing.

I repaired the fuse as shown the file "Anatomy of a Fuselage Repair" and got new center cores This made a like-new ship, ready for 2006 flying and with all now painted it looked better than when first flown.

It's nice to be able to work independently of manufacturers to inexpensively maintain the fleet. Even counting the cost of the glass fuse, I don't get more than about $350 into an LT/S airframe and spreading what amounts to a week of work over 6 weeks, makes it a leisurely project. I just follow my own instructions step by step to avoid mistakes.

Compared to the glassed-over wood LT/S fuse, it's 3" longer aft of the wing and has an integral fin. With stabs 1" further forward on the fin to avoid notching for rudder deflection, the tail moment arm is 2" longer. This makes for even better tracking and stability on tow.



Glass fins are open at their rears. This provides access to epoxy 1/8" ply plates inside between which the pivot tube is secured. Glue the plates in one at a time. Use a length of 5/32" tube and the assembled pivot wire to align them. If necessary to square up the tube and wire to the fin, open the hole in the fin on one side to do so. When both plates are installed, remove the tube and wire to mount the joined bellcrank and pushrod. Then fit a balsa post to the opening to close up the rear. Glue extra balsa to the inside of the post for anchoring hinges to.

Tail pieces construction and rudder knuckle hinging is detailed in CONST. File 2. Plans show a narrower separate stab pattern to use with this fuselage. It does not need to be notched for rudder deflection. It butts the fin where it is essentially flat.

To avoid oversize shipping costs, the composite fin is not as tall as the LT/S outline for the fin on the plans. The rudder will not be as tall. Its actual shape is not critical, but keep the area similar and contour the hard top piece as needed to nicely merge to the glass fin as shown here.

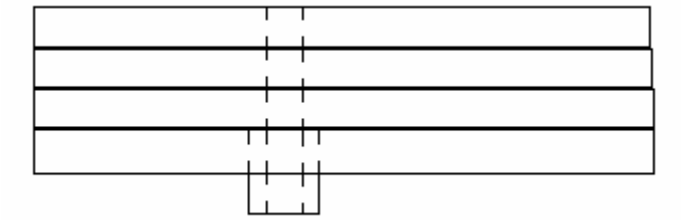
Size the rudder at its bottom so the rudder T nicely aligns the cables to the molded-in micro-nacelles.

Cut the servo tray 1-11/16" wide. Configure the battery pack OOOO with cells not over 1" high. Insert and rotate to go flat against the fuse bottom. A small receiver can go on top of it.

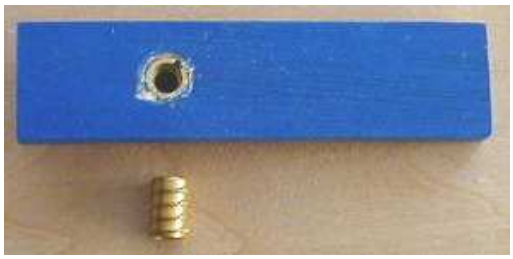
When installing the tube for the pushrod, do similarly as on the BG, attaching it at the rear of the saddle opening, by the front of the fin, midway between those points and at the rear of the canopy opening.

Rear bolt goes where the extension is thick enough to recess the head. A ply plate is inlaid in the underside of the wing core for the bolt to bear against.

(11): <u>BALLASTING</u>: This method will work with either composite fuse.



Ballasting can be done with cast lead bars measuring ¼" x 1" x 4". Each is a cubic inch weighing approximately 6.6 ounces. Four bars provide options of approximately 6.6, 13.2, 19.8 and 26.2 oz.



This is balsa painted blue to represent the lead bar. With the CG established, remove the wing. On the saddle, mark the "Wing Off Balance Point". Center one of the bars there. At the center line of the front "T" nut, mark a line on the bar. On each drill a ¼" hole there. Slightly open holes so a main bolt can be run through the stack.

Open the hole in one of the bars to put in a ¼ x 20 threaded brass insert. Making sure it's squared up, seat it flush with the "top" of the bar, leaving the remainder protruding out the bottom. Use it singly or with additional bars on top of it. If you're using more than one, align the stack and tape them together.

If the fingers are long enough, work through the front to key the bar assembly on the protruding end of the bolt securing the wing. Loosen the bolt to raise the assembly to the T-nut. Tighten it to simultaneously secure the wing and thread into the brass insert. A 2" bolt may be needed.

If the fingers are too short, remove the wing to work through the saddle opening. Attach double sticky foam tape to the top bar. Run a 3/16" wire through the top of the T nut to align the bar assembly to it. Press the assembly against the underside of the main bolt plate. Attach the wing quickly while the foam tape is holding or work with the fuse inverted.