CONST. FILE #3, PART 1, WINGS (December 21, 2009)

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Updates in this edition of this file are mostly related to blade box assembly for angled blades & getting matching dihedral where tips butt the center. Pics have been added on page 8, 10 & 11. Changes anywhere herein from the prior posted edition are highlighted in this orange color.

All wings, except the non-bagged, sheeted Easy LT/S, are similarly built using cores, text & pics that follow. Drawn plans aren't used. The longest section is the 58" Big GENIE center.

Friend Winston Okerlund, sinoker@charter.net, used wing design programs to achieve near elliptical lift distribution in the quad-taper wing planforms. Genies are not ultra-light floaters so don't employ current airfoils designed for them. See AIRFOIL, PANEL SECTIONS & WING PLANFORMS file about the bagged wing ships.

Core Sec. 1's are joined to make a flat center section. 2, 3 & 4 make flat tips. After bagging, the squared-off Sec. 4 ends are contoured & finished. The airfoils & planforms used provide excellent all-around performance for traditional thermal competition. Common ½" thick servos nicely fit.

CNC PRECUT CORES: Wing structure calls for dense foam such as Spyder, Dow High Load 60, Foamular 600, etc. See the What's Available file about pre-cut cores.

PRE-BAGGING WORK

Go to the separate "INITIAL CORE PREPARATION" document. Do those steps & then return here. This pic shows how to square up core ends with a sanding block made as described in CONST. File 1.

Where core sections 1 & 2 butt, as needed touch up to match so the four hard balsa endcaps can match in profile. Do not join tip core sections 2, 3, & 4 until later called out.

CF SPAR SELECTION. Go to the COSTS & MATERIALS LIST file. Carefully review the section on spars. They come untapered & double tapered (DT). . .thicker at the middle than at the ends. There are choices to make & you need to know what is actually in stock & available to purchase.

SPAR LOCATION: Butt the Sec. 1 outboard ends. There, illustrating on the BG, the spar is to be centered 2-1/2" back from the core LE's. For ½" spars, make short marks across core tops 2-1/4" back. Next, butt & tape the inboard ends together. Mark across the cores between the 2-1/4" marks to denote the spar front line. Mark another line ½" behind it. Do similarly for a 3/8" spar, making the front spar line 2-5/16" back, etc.

Butt the Sec. 2's to the Sec. 1's. Extend the spar lines 3-5/8"on the 2's. Centered between them, mark the line of the blade on the 2's.

For the LT & GP/SGP, similarly locate & center the spar 2-3/8" back from the LE.

HARD BALSA ENDCAPS: On 1/16" ply, mark around the end of a core section 1 or 2 to make a master endcap pattern. From ½" balsa sheet or ½" x 1" strips, cut 4 blanks. Trace around the pattern to cut individually or stack cut. Use the disc sander, sanding drum in the drill press or sanding blocks to get a matching set.

Across their tops & down the sides, mark spar center/blade lines. Endcaps will later be trimmed to 3/8" when beveled for dihedral. The four endcaps add 1-1/2" to wingspan.

AILERON SERVO LEAD PATHS: Draw straight lines on the Sec. 1 core tops from 2" behind the spar rear at the center to 1-1/4" behind it at the outer ends. Part 2 has a picture showing how the aileron servo leads then conveniently pass over the flap servos & out of the centered grommet.

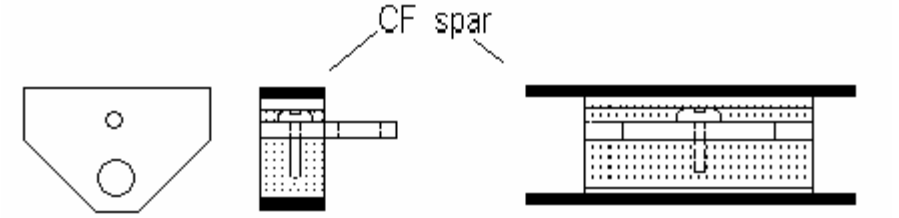
SECTIONING CORES FOR THE SPAR: Between the spar lines, mark which ends butt at the center. Without flattening the core, carefully band saw just behind the front line first, then ahead of the rear one. The removed strips are too narrow to use for webs, but save to find web height.

Smooth core pieces to the spar lines with a 12" #80 grit sanding block. From stresses released, front & rear pieces may now be slightly different lengths. Trim to match. With Dremel & a cutting disk, trim CF spar ends so the length matches the overall length of the butted Sec. 1's.

VERTICAL WEB HEIGHT: Stand a removed core strip on its bottom. At its inboard end, stack the centered CF spar pair flat over 1/16" ply. Hold those items down flush with an upright dowel, etc. Carefully mark or nick the dowel at the top of the core strip. That's the uniform height for webs, main bolt sub-assembly & blade boxes. There's no need to measure it. This leaves 1/16" for Kevlar thread wrap & balsa/spackle fill over & under the wrapped spar to level things to the main cores.

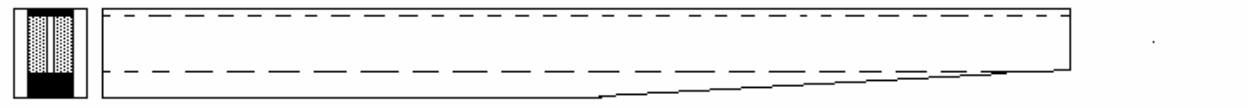
For webs, use light balsa with grain vertical or dense foam such as scrap pieces included with the packed cores. Except for Spyder, foam is most compression-resistant top to bottom of a slab. Test with thumb & forefinger. Cut scrap pieces to spar width, then to web height.

MAIN BOLT "HARD POINT" SUB-ASSEMBLY: See illustrative drawing. Length is arbitrary. 1" Is plenty. 1" x 1/8" aluminum plate is in the parts pack. Square up ends & trim diagonal corners to fit spar. A single screw at the center is fine. The sandwiched-in plate makes a rugged "hard point" for wing attach. Make wood layers from hard balsa, bass, etc. Locate the plate within the layers so the bolt head top will be even with the skin. Typically, 5/16" to 3/8" of wood goes under the plate.



Center the hole for the bolt 7/32" ahead of the spar. Grind or file off excess plate.

BLADE BOXES: Boxes are made as one-piece items to divide into inner & outer halves. In the drawing below, black denotes ply, gray the 1/8" x 3/8" spruce or bass uprights & white the balsa used only on the inboard half to make it spar width. Core Section 2 will be angled up relative to the outboard halve to impart dihedral.



Dihedral is provided by (1) making the boxes as illustrated above for use with 3/8" straight blades or, (2) as detailed a bit further on, by grinding & filing ½" blades to an angle. For the BG, GP & SGP, blades are 8" long & for the LT, 7". Cut pieces for the boxes ½" or so longer to allow for accurate trimming of ends after they are assembled.

(1) BOXES FOR STRAIGHT BLADES: the more ply used for the bottom, the less blade needs to be ground off, but have at least 1/16" ply on the top. For tops & bottoms, cut ply strips 7/16" wide.

Cut four of the upright pieces, making sure they are straight, match the 3/8" blade height & are actually cut square to stand upright. Mark & wax what will be the interior 3/8" edges of the uprights when assembled. Don't get wax on the 1/8" edges.

BLADE BOX ASSEMBLY: Mark & spray the top layer of the bottom stack with CA accelerator. With CA plus, join the ply strips for the bottom, keeping all flat.

As shown below, position the uprights with waxed blade & waxed razor blades centered against the bottom stack. Holding everything down flush & straight, apply a drop of instant CA outside at each end & then outside at the center of each upright. These drops can be faintly seen below.

If using .050 blades, a waxed piece of 1/16" bar aluminum may be used for this step.

Remove all blades. Finish wicking along the outside edges. Trim excess bottom edges on the bandsaw, disc sander, etc. Mark & spray accelerator on the ply strip for the top. Invert the uprights flat to it, press & wick together. Trim excess top edges. Sand sides flat & smooth.

For BG, GP & SGP, trim boxes to 7-1/4" in length & for LT to 6-1/4". When divided & the two 3/8" end caps attached to the cores, 8" & 7" blades will fit. Mark around boxes at their exact centers.

(1): TRIMMING BOX FOR 4 DEGREES OF DIHEDRAL: 1/16" rise in 3-1/2" is one degree. 3-1/2" from the center, mark a vertical line. Intersect it with a mark ¼" up from the bottom. Mark the angled line. Remove most with band saw & then finish with a belt or disk sander.

If you got it right, the trimmed bottom should uniformly touch the work surface when the other end is raised ¼" at a point 3-1/2" from the center.

If needed, with grinder or file, trim the blade so none protrudes beyond the trimmed bottom. Round & smooth the blade ends so they don't gouge the slots when inserted. Keep them waxed & polished. Don't insert them if wet as this can swell the wood & inhibit blade removal.

The untrimmed box half is raised the thickness of the bottom CF spar. This makes it possible to cap the trimmed half's bottom. Use 1/32" ply, grain crosswise. You must not plug the blade slot, so wick the ply to the trimmed area & then trim the excess.

Sand the 4 edges of the outboard half, ready to wrap. If using a ½" wide spar, attach 3/32" harder balsa to both sides of the inboard half. The BG blade boxes will look as in the picture below if ½" spars are used. If using 3/8" spars, attach 1/32" balsa to the inboard halve.

Undivided BG boxes for ½" spars once used are shown here. After dividing, outer halves are to be closely wrapped with Kevlar thread to prevent splitting out under launch stresses. Inner halves go between the CF spars before wrapping.

Mark which box is R & L. Divide into "inner" & "outer" halves. ID "in", "out", "top" & bottom".

(2) STRAIGHT BLADE BOXES & BLADES GROUND TO AN ANGLE

See the separate document that describes how to grind & file ½" blades to an angle.

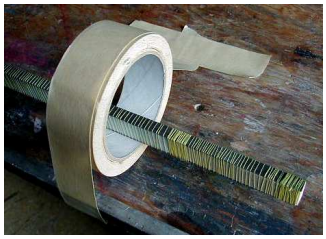
Initially, make these boxes with 1/8" thick tops & bottoms. Add to the bottom to get to web height. Mark which is the top. After dividing the box at its center, the outboard half along its bottom can be tapered toward its outboard end. See pics on pg. 8. When jacking up the center section to set dihedral between Sec. 1 & 2, this tapering optionally allows a bit more dihedral before the outer box end pokes out of Sec. 2.

Now really pay attention! With either box type, under vacuum, bagging epoxy will find any opening & will plug the slots. Look along where the trimmed boxes were capped. Also, after dividing the boxes, meticulously seal the inboard ends of the inboard halves & the outboard ends of the outboard halves with a cap of 1/32" balsa. Check seals by blowing into the open ends. If air passes, find & fix the leak(s)! The other ends will be sealed after the endcaps have been attached.

SPAR ASSEMBLY: This assumes you have the spars, boxes, bolt unit & webs ready to use. If one CF spar is constant thickness & one is double-tapered, put the constant thickness one on the bottom. This is to raise the inboard half a bit more & add some leeway in angling & adjusting the outboard half in the slot in core Section 2 when dihedral is being set.

If both are double tapered, lay the bottom spar on the workbench, smooth (unstepped) side up. Using CA+, bond the bolt unit & blade boxes to the bottom spar. Be sure they aren't inverted. With light coat of quick epoxy, glue webs in place. Wipe excess. You can do the assembly over waxed paper, working on a side to get parts squared to the bottom spar. Use masking tape to keep webs against the spar. When cured, remove tape. Position the assembly upright.

Have weights ready, such as lengths of bar steel or steel tubes (see next page) filled with lead shot. Now work on a flat plane surface. As the top spar is attached & weighted, the bottom spar will be pressed flat & thus meet the bottom core bed flush. As needed, spackle & sand the assembly to fill & smooth the vertical surfaces, ready to wrap. Wax the protruding part of the bolt plate all over so any epoxy that fills the hole under vacuum can be more easily removed.



KEVLAR THREAD WRAPS: Sand sharp edges of the spars to blunt them. Tape a roll of tape, etc. upright to the bench to support spar end as you wrap the other side. Set dowel in a board as a spindle for the spool. For tension, run a weight (lead shot filled steel tube, etc.) into a paper towel or toilet tissue roll. Lay roll on the thread. Tack thread to spar well with CA to rotate spar forward. It takes 10-15 min. to wrap a side this way.

Wrap at close spacing by the bolt unit & then work progressively outward. Wrap snugly but without CA which greatly reduces the thread's breaking strength. Just tack down the other end well. Wraps will be well secured as the spar's attached & spackle fill is added over & under it.

½" wide spar is shown here. 3/8" provides plenty of strength.

"HOT RODDING" TUNNELS

If you have a hot wiring setup & know what you're doing, it's fine to use it to make channels for the long leads to the aileron servos, but meticulously seal the entry cuts made so bagging epoxy can't plug them under vacuum & make it impossible to run the leads through.

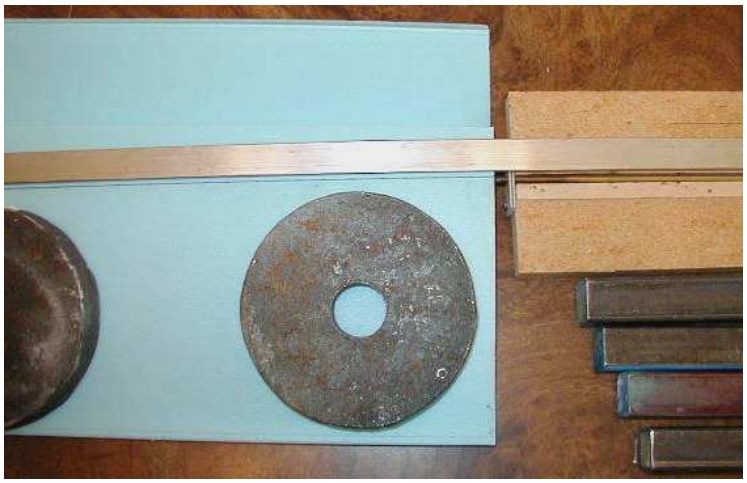
Here's my simple, safe, portable kitchen table setup. A burner on the stove (upper right corner) heats the rod. As a track in which to guide a long 3/16" rod with pointed end, I tacked 1/8" x 3/8" strips to a flat board that measured about 5" x 24". It's ¾" thickness about vertically centers the rod on a core end, core on its bottom bed. If necessary to shim the bed up to center the rod, sheet balsa can be used.

For general use, I'd made up eight weights from 1' pieces of 1" sq. steel tube filled with lead shot. New uses for these are regularly found. It's worth the trouble to make up a set.

At the front of the board, I screwed a plate of 1/8" aluminum in which I'd drilled a 13/64" hole. The hole was vertically positioned to put the rod flush to the board.

Having learned the hard way (hot rod exiting core top) that trying to make long tunnels courted disaster, the rear core sections were cut in half chordwise with a .010" thick Zona razor saw replacement blade. From either end a tunnel less than 8" long then needs to be made. Over that short distance the rod does not wander.

To center the tunnel under the marked path, as in the next pic, visually position a straight edge 3/32" to one side of the mark. Then position the board so a strip aligns with the straight edge. Weights & a hand stabilize things when pushing in the heated rod.

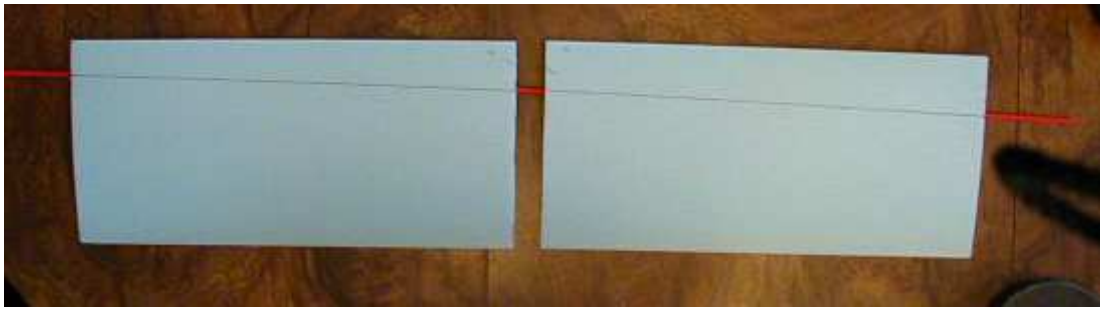


The objective is to tunnel about halfway into each piece from each end. Do one end of each, then rotate the bed 180 degrees to similarly do the other ends. Mark the rod about 8" from its front end to judge the halfway distance,

Over a red hot element or gas flame, heat the rod end well to easily penetrate the foam. Quickly push it steadily in, promptly withdraw & wipe it clean.

Butt halves together to see that the cooled rod or a dowel can be passed through both. If necessary, heat the rod again & run it through the butted pieces.

The practicality of the procedure is confirmed in the pic below showing the pieces slipped on a length of 3/16" tubing. At this point just be sure the tunnels are clear. Actual snaking in of the long aileron servo leads comes after wells are cut after bagging.



REJOINING CORES: Mask edges as shown below. Use the same masking to join core sections, paint endcaps, etc.

With the work angled, spray ends with 3M77. Remove masking. When tacky, progressively rejoin, working rearward keeping parts aligned in good contact to seal against bagging epoxy from entering & blocking the tunnel.

The "orange can" or later "brown can" 3M77 can be used but first apply a light coat where pieces butt from about 12". Let it cure to form a barrier to the acetone component in the formula in subsequent applications. To avoid wasting 3M77 drop the uncleared nozzle in mineral spirits, etc. until the next use.

Join the Sec. 1 R & L rear core pieces. Before joining the front ones, file slots for the bolt plate. So endcaps fit flush, see that cores & the spar assembly match up in length. Trim ends or add balsa shims, as needed.

SPAR SHIMMING: To avoid shredding the thread wraps when later sanding the spackle under the wraps around the bottom spar, shim spar with strips of .014" Mylar or 1/64" ply a bit narrower than the spar. A few pieces 3" or so long will do. Spray them with 3M77 to temporarily attach them.

ATTACHING SPAR TO CORES: Work on a flat plane surface. Lay waxed paper along the spar line over the beds. Attach spar first to the rear core sections. Do it leisurely using a slow-curing, expanding polyester glue (Elmer's Ultimate, etc.) Elmer's 4 oz. size has a very practical & convenient applicator spout. It's also recommended for installing the "Individual Kevlar Hinges". (CONST. File # 7) Clean spout with acetone after each use session so it doesn't get plugged with cured glue. To avoid curing in the bottle top, squeeze out as much air as possible before storing it inverted in a sealed bag, preferably with packs of silica gel to help absorb moisture.

Weight down the joined rear cores. Without wetting/dampening, apply a continuous 3/32" glue bead end to end along the spar rear side about 1/3 down from its top. Too much will cause bubbling & oozing at both the top & bottom. As the glue cures over several hours, check for & pick up or flatten any top ooze. Carefully cut away any cured ooze above core level by bending a double edged razor blade with index finger while holding it between thumb & middle finger.

Separately first attach shimmed spar to core rears. Use masking tape & weights to keep it flush to core & beds so no wrapped spar protrudes above the core. Any bottom oozing will be flattened to the wax paper & not interfere with later spackling there.

Top picture: Weights keep the rear core flush to the bed. Tape & steel bars keep the spar flush to the core & bed while curing.

Bottom picture: Front cores are lastly attached using tape & weights to keep things in contact & down flush.

Locate & cut slots for the outboard box halves in the Sec. 2's so 1 & 2 align at their LE's. Due to the bottom spar thickness, thicknesses of the wraps & shim strips, inboard box halves will be raised some above the core bottoms. This is good. You'll see that when the outboard box is later secured to Sec. 2, a bit more dihedral can be imparted without the box's outboard end poking out of Sec. 2. Most carefully mark which box edge is TOP so you don't put it in inverted.

After the outer box is later wrapped with Kevlar thread & installed, fill over & under it with balsa & spackle to level with the adjacent core.

SLOTTING THE ENDCAPS: Determine where the slot should be vertically positioned so endcaps will align to the core ends. With 1/16" bit, make a series of holes at the slot locations. Angle the end caps on the rotating bit to partially open the slots. Use a 1/16" jeweler's file to finish neat slots so mounted endcaps will align to each other & the cores.

BEVELING HARD ENDCAPS FOR DIHEDRAL: Lacking a bandsaw or other motorized tool for this, attach an endcap to a wing panel, support the panel on a board jacked up 2 degrees. Use #60 grit sanding block to bevel the endcap.

Tilt bandsaw table 2 degrees or tilt a 3-1/2" board 1/8" (2 degrees) as shown in the next picture. Clamp it to trim endcaps 3/8" wide at their bottoms. Surplus ¾" endcaps are shown for illustration, but use ½" hard stock. To trim, press endcap to the tilted board edge. One goes through LE first & the other TE first so beveled faces will butt.

Here, with bandsaw table not tilted, a 1/8" x 3/8" strip (extreme left) has been attached to the edge of a 3-1/2" board to tilt it 1/8". The guides for the blade should be set to prevent blade wobble. Use a sharp blade or a straight line cannot be cut.

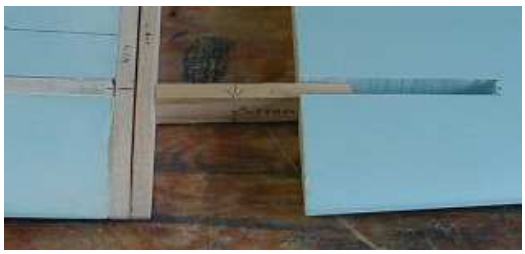
Final fit of tips to center after bagging can be no better than your work in matching endcaps to the cores & to each other.

After the 4 endcaps are beveled & sanded smooth, mark which goes where. Using a thin coat of epoxy, cap the beveled sides of each one with 1/64"ply. Carefully trim away excess ply & epoxy. Open clean slots in the ply cap for the blade. Epoxy center endcaps to core ends. Use masking tape to get good contact & keep in place.

CAPS-FILLING SPAR RECESSES: Apply masking tape, the thinner the better, either side of the .014" bottom recess. Fill it with light spackle. On top, soft balsa fill attached with epoxy is fine to contour to the core or to partially fill & then top off with light spackle.

After sanding the fill smooth, remove the tape. Wrap 100 grit aluminum oxide sandpaper around a wood block. Level the spackle. During bagging, the Mylar will preserve the slight contour of the airfoil over the spar.

This new pic shows tapered bottom of the outer box made for use with an angled blade.



Slip a blade into the center section. Slip on the tip endcap. Slip on the outboard box being sure it's not inverted. Block up the other center section end 4 degrees. Blade here was ground to an angle & box bottom tapered to better clear the work bench. Center can be jacked up another degree if more dihedral is wanted for turning ability.

BG center is here jacked up 4 degrees with 4" of foam block out 56".

Be sure to wrap the box with Kevlar thread before final installing it in Section 2. Smear epoxy to the core vertical edges & horizontally slip on the box to butt, but not attach the endcap. Pick up the excess epoxy on top.

When cured, epoxy the endcap to the core, but avoid epoxy near the blade slot which is to be later plugged with waxed soft balsa.

Repeat on the other side, blocking up an identical amount. With light balsa & spackle, fill over & under the Kevlar thread wraps to core level.

With 3M77, join core sections 3 & 4 to the 2's by the method shown on page 6.

See the pic on pg. 11 about fitting balsa pieces in the rear of the cores near the center to give a wood edge to the flaps & the extension between them. Add the .003 tape to the wood LE's.

After bagging, the weight of the tips will slightly spring the blades at rest on the ground & show a gap on top. When airborne, this closes to eliminate that parasitic drag. Read about intentional tip aero-elasticity in the "What's A Genie?" file.

For later reference, NOW measure & record the exact center of the main bolt hole from the outer edge of the right endcap & from the LE. A hole will be made there through the bagged skin.

CORE LE TRIMMING: ¼" medium density balsa for leading edges is a practical option. This, the glass tape & the Icing putty makes the fine finish possible shown in the next two pics and when dinged, is easy to smooth up with Icing putty. Set the bandsaw & a fence to remove ¼", including blade kerf, from all core sections. Leave the hard balsa endcaps intact. As needed, make a notch in the core by an endcap to begin a cut.

At the vertical fronts at the LE breaks, round the cores by sanding back 1/16" or so, then sand top & bottom to restore to adjacent core thicknesses. The carriers will then fit flush to the cores during bagging & the overall wing will have a nicer appearance. This rounding can also be done at the TE on wings where the Section 4's rake forward.

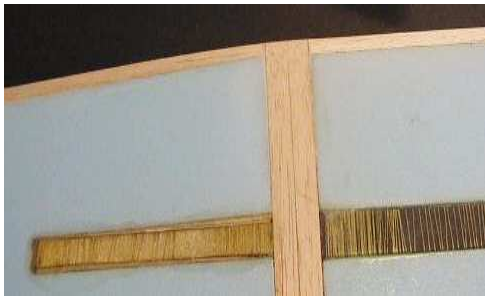
What LE finish? There's no reason to settle for ratty looking, drag inducing, unreinforced LE's of cloth over foam. See the Fine Finishing file.

These have a wood LE glassed-over with .003" tape before bagging. Learn how ICING putty is used after bagging to get a smooth, pit-free, glossy painted LE with minimum effort. Of course you can get this kind of results. Just follow the instructions step by step.

For those who prefer to not do the wood LE, VictorF, a fine builder in Russia, has developed a very nice technique of putting a glass-cf wrap on the intact foam LE as a pre-bagging step. Go to http://www.rcgroups.com/forums/showthread.php?t=1000012 to view his LT/S build.

ADDING LE'S: Cut ¼" medium balsa, into 3/8" strips. Bevel tops 25 degrees. 2 strips butted at the center are fine. Use quick epoxy to attach one at a time. Apply a light coat to the core. Wipe away excess at the top or bottom. Tape strip in place.

When doing the tips, work outboard from the endcap. Slit strips to bend around the core at the LE breaks.



Shape LE with sections mounted on the blade. The 12" blocks do it in ½ hour or so. Use trimmed off core LE's as a visual guide. BAGGING ORDER: Center section must be bagged first & then trimmed to equal end chords. Then cut flaps loose. This defines the precise aileron root hingeline. With this known, the CF plate & ply parts that make up the durable hard slot for aileron operation can be pre-installed in the tip cores. Pictures below show the hard slot installation. Go to CONST. File 10 for details.

CAUTION: Under vacuum, bagging epoxy will enter space between endcaps, cores, boxes & around the holddown plate between the spars. Seal everything well with spackle.

To prevent blade slots from getting plugged, jam wedge-shaped, waxed, soft 1/16" balsa plugs through all four endcaps & deeply into the slots. Trim excess. Mark plugs with colored pen to easily find after bagging,

OVERCAPS: ½" foam overcaps are attached to endcaps to prevent carriers from being pulled down over endcap edges under vacuum to cause distortions. Thin, double sticky 2" reinforced carpet tape attaches overcaps to endcaps & can be later cleanly peeled off in one piece. Cut along the center of the roll to make 1" wide strips. With protective paper on, press tape to endcap. With very sharp blade, cut, lift & trim paper & tape flush to endcap edges. Remove paper & press overcap in place. If needed to stick better, spray overcap inside edge with 3M77.

PRE-BAGGING .003 GLASS TAPE TO LE'S: Prop up panel. Cut pieces 3" over length. Stick up vertically with masking tape at the ends. Make 2-3 passes with 3M77. Let dry a minute. Stick clean masking tape over the sprayed ones to handle. Starting at an overcap, center the tape.

Stretch to the other end. Press all along the pointy LE. With waxed paper, smooth the tape down flush overall. Lightly sand tape edges to eliminate the ridge.

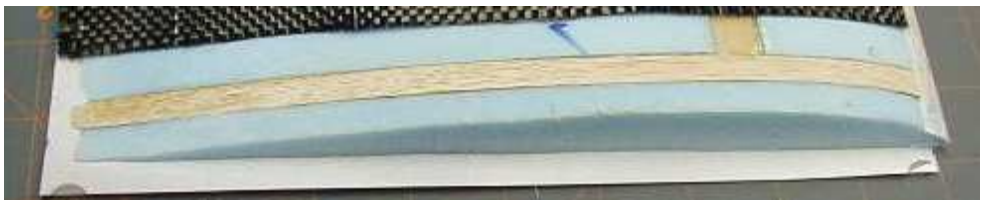
Centered 1-1/2" either side of the center line, remove foam to receive 3/8" x 3" balsa strips that match the airfoil. This makes the 3" wide extension between the flaps rigid. After bagging, cut to the hingeline with a razor saw replacement blade. Paint wood for nice finish.

If using the LT/S composite fuse, now cut a plate of 1/8" ply, 1-1/2" sq. Starting 1" from the core TE at the wing center, inlay it flush with the core bottom. The rear mounting bolt will seat to it.

BAGGING OVERVIEW: "Carriers" are .014" Mylar plastic sheet between which cores go during vacuum bagging. They're waxed & spray painted. Glass first, then CF cloth to form a panel's skin are placed on the carriers, simultaneously rolled with epoxy & trimmed along carrier perimeters. The core's then sandwiched between the carriers & slipped into the vacuum bag. Bottom beds on the outside support the work. Top beds are weighted down to avoid twists & keep things in place. As epoxy cures, the skin is bonded to the core & the paint transfers to the skins outside surface. Fully cured & out of the bag, panel edges are touched up. What follows through page 16 is "must read" before doing anything.

FLAT PLANE BUILDING BOARD OR BENCH: This is critical to get finished panels with no built-in twists. Get it worked out in advance. Check with a carpenter's level.

SIZING CARRIERS: Carriers are to extend ¼" beyond the core TE & some over the LE. Glass & CF cloth are to fully cover the carriers. To show how cloth fits from carrier TE to LE & how core fits between carriers an "open view" is shown below. Carriers are to extend to the outer edge of the foam "overcap", not beyond it as shown. Follow instructions below about cutting all.



To size the top center carrier, place the .014" Mylar on the workbench. Lay the center core upright on it, core TE ¼" ahead of a Mylar edge. Mark around the overcaps & LE. Cut the piece. Use it as a pattern to cut one with 1/8" less chord for the bottom. Mark ID on the outside of each carrier. With the core ¼" ahead of carrier TE's, carriers will fit some over the glass taped LE but not touch.

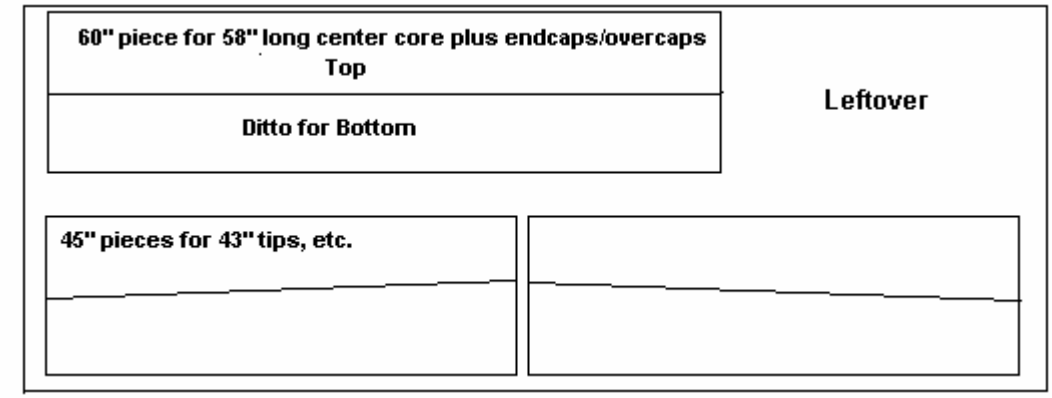
Carriers with cores folded between them must be aligned to the supporting beds. This is done by "feel" along the LE & TE. The INITIAL CORE PREPARATION document details fixing beds for that along their TE's. To feel the LE up front, notch the beds back to the LE or trim off any bed ahead of the LE. When a folded carrier has been aligned to the bottom bed, add the top beds & weights.

With glass & CF extending behind the cores that ¼", there is plenty to trim on after bagging to get a continually straight, uniformly sharp TE along the three panels.

CUTTING GLASS: Use 1.4 oz. plain weave cloth oriented 45 degrees to the TE's. Lay a carrier on it. Cut pieces roughly an inch or so beyond the perimeter. Handling gently to avoid distorting, store the pieces loosely in a plastic grocery bag. If one gets narrowed, pull on it chordwise.

CF CLOTH: The long CF fibers (tows) go spanwise. For the center, it's easiest to cut the pieces as rectangles, just wide enough to fit from TE to LE at dead center. The skinny triangular excess can be scissored off along carrier perimeters after the cloth is wetted out. Cloth may come edged with Kevlar thread. Gently remove & save it.

When cut, common woven uni-directional CF cloth readily frays. Spraying it with 3M77 before cutting, helps control it. Where it's practical to have a common, straight TE, Phil Barnes's technique of removing a single tow to define the line to cut is very useful. Tows are easily pulled out before spraying. If working with a roll or piece longer than needed, snip a tow the carrier length to pull out. Pick out 1" at the cut end. Pull it while holding the other cloth edge. After spraying along the intended cut line, let it dry before cutting.



This shows how cuts can be made for the BG wing from a 90" x 38" wide piece of CF cloth from ACP. For other widths, use squared graph paper to figure amount to buy & how to cut it with least waste.

12" wide cloth is quite convenient to work with. Two times the span in one piece will do, but if it is $1 cheaper per foot for 25', as with CST, get 25', spend less in total & have some extra cloth.

Where it's practical to have a common, straight TE as in the drawing top part, determine where to cut & pull a tow there to have enough for both center pieces. In the BG, a piece 60" long & 21" wide will do. That means first cutting an individual tow 60" from an end to pull out.

Study the next several paragraphs, so proper preparation for bagging can be made. Then, as an example, follow what was done on the #29 BG center section detailed further below.

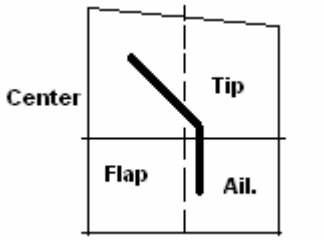
Outline the order of steps on paper. Refer to these as you do the actual bagging. So center core won't shift between carriers do this: Shorten two 1/16" flat headed brads to ¾". File ends to a point. Centered over the overcaps at the thickest point of the cores, pre-drill holes in the top carrier. After wetting out cloth & trimming excess, position core on bottom carrier. It will be hard to shift so get it centered & that ¼" ahead of the carrier TE. Position the top carrier so carrier TE's align. Push the brads through into the overcaps. In a few spots, tape carriers together at the TE, then the LE. Fold it into the drop cloth with breather. Slip into the bag.

When trimming TE's after bagging, the center section should be trimmed first to equal chords on each end. Then the tips, after bagging, can be trimmed to match up with those ends & with each other so right & left sides are symmetrical.

TIP SECTIONS: Use an overcap with brad & also a short brad near the carrier's end to prevent core shifting. When rounding the tip after bagging, trim just inside the hole made.

ADVANCE HINGING NOTE: See CONST. File #7. The Individual Kevlar Hinges, unique to ships in the Genie line, require no pre-bagging steps & give yet another reason for using them.

FLAP & AILERON CHORDS: The dimensions are easy to size after bagging & trimming the TE's. Intended chords for the BG & GP/SGP flaps are preferably 2" inboard & 1-3/4" outboard, but can be cut to a constant chord of 1-7/8". These can be increased up to ¼" for more extreme response.



For the ROTARY DRIVER SYSTEM (RDS) inboard aileron chord must match outboard flap chord as depicted here.

I like the BG ailerons to end with 1-1/4" chord 1" from the rounded extreme tip. The GP/SGP, tapered similarly, will have about 5/8" chord due to forward sweep of Section 4. See File 7 about cutting surfaces loose & hinging. See SUPPLEMENTAL LT/S File about LT flap & aileron chords.

SURFACE PREP & PAINTING: With light spackle, fill minor dings & gaps, including any where core sections were rejoined. Wipe carriers with tack cloth to remove CF hairs. Lightly coat (Meguiar's #26 paste wax) & polish carrier insides at least 3 times. To keep errant epoxy from adhering, wax but don't polish the outsides. Mark "Rt. Top", "RT. Bottom", etc. Overcap areas don't need paint to their ends. Mount carrier to cardboard box, common plywood, etc. to length needed by taping ¼" over those areas. When removing it, pull toward carrier ends.

Sprayed on lacquer-based paints dry quickest. Krylon has just changed their formula from it to enamel which dries slowly. Rustoleum has a new Specialty Lacquer that is a viable alternative to the older Krylon. However, rubbing alcohol softens the cured paint. White applied over colored top coats brightens them, but don't use primer. It can crack like a dry lake bed & show through the top coat.

Follow mfg.'s instructions. Keep the spray can moving. To avoid fisheyes & separating lines, spray light mist coats over small areas & immediately follow with heat gun in the other hand to set the paint. Don't dally with the gun & distort the carrier. When a carrier is thus covered by light coats, apply progressively heavier (closer) coats followed immediately with heat gun.

Apply to get uniform overall coverage. If a fisheye appears, smear it out with a finger & repeat above procedure. Cured, lacquer-based paint weighs little, so don't skimp if using it. Put extra coats along flap & aileron areas. Ignore clumps, lint, etc. They flatten under vacuum.

MISC: ENDCAPS & OVERCAPS CALL FOR LONGER BEDS. FIT & ATTACH FOAM PIECES EACH SIDE WHERE SEC. 1 & 2 butt so carriers are fully supported. Phil folds the work in liberally-sized polyurethane plastic (heavier drop cloth) to which light fabric as a breather has been attached on the outside with 3M77. This confines oozing epoxy inside the drop cloth & keeps it from bonding inside the nylon tube.

An extra cloth piece or paper towel bridges to the nipple where the hose is attached. The bag is sucked tight to the folded drop cloth to press carriers to the core. Have weights to put over the top beds to press all flush to the workbench before drawing vacuum.

The flat plane surface & weights avoid building in unwanted twists. Be sure your vacuum setup is functional. Have cups, mixing sticks, epoxy, roller handle, 3" rollers cut from a 9" foam one, foam picnic plate, gloves, rags, & acetone or rubbing alcohol ready.

Ample work time is essential to position cloth, roll epoxy, sop excess, trim excess cloth, position cores, tape carriers together, get in the bag properly positioned between the beds & weighted down. Slower setting hardeners that allow up to 90 minutes of work time are thus favored.

BG #29 CENTER, CLOTH & EPOXY APPLICATION

Not visible here, the painted bottom carrier is under the glass cloth under the CF cloth. To keep the bench free of epoxy, paper towel strips go under the carrier perimeter. Glass & CF cloth are wetted out at the same time. Then support carrier on finger tips to scissor off excess cloth. Toweling helps keep carriers clean for taping together.

Using 38"CF cloth, 21" from an edge I cut a tow at 60" to pull, then pulled another to make top/bottom rectangular pieces. Spray with 3M77 before cutting.

Larger graduated plastic cups are expensive. Throw away clear cups from fruit or pudding can be marked with tape after filling with measured amounts of water using a 1 oz. graduated cup. Use the 1 oz. cup to add a measured amount of catalyst.

West at 5/1 was being used. In 4 cups, 3.75 oz. resin & .75 oz. hardener were poured to mix in two 4.5 oz. batches. I mixed one to first roll the bottom. The mix was poured into a foam picnic plate for dipping a 3" piece of a 9" foam roller.

BG tips take 5 oz. or 150 CC. Using 4 cups, I prepared to mix batches of 90 & 60 CC, convenient with the 5/1 ratio West. I mixed 90, did the bottom first, then 60 to finish up.

The LT takes 6 oz. for the center & 3 oz. for a tip. The GP takes two 4.5 oz. for the center & 4.5 oz. for a tip.

If you are using a 3 to 1 mix by volume, it is easy to work in multiples of 20 CC. For example, in doing a BG tip, 60 CC of resin can be poured in a throw away pudding container marked with tape & then 20 CC of hardener in a 1 oz. graduated cup mixed in.

CF REINFORCEMENT PATCHES OVER/UNDER TIP SECTION BLADE BOXES

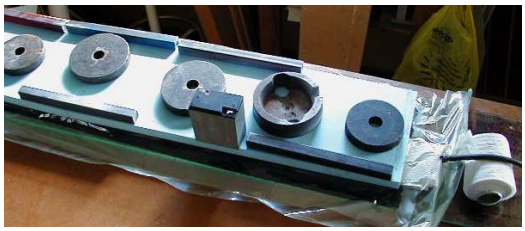
To firmly secure outboard boxes in the tip cores, rectangular patches of CF cloth, cut approximately 2" x 4" with CF tows chordwise, go on the CF cloth centered over & under the box location. Wet & roll a patch hard with a wallpaper seamer to flatten it out to minimize a bump.

Core inverted, I brushed epoxy on the endcaps, spar & the taped LE. To prevent the cloth from slipping on the carrier, starting dead center I rolled span-wise a little each way, then more to tack it down & thoroughly wet it out well, end to end, overall. This is essential to avoid dry spots that prevent paint transfer. To then pick up excess resin, toilet tissue strips were laid over the work & rolled with a hard roller. Keep some of the peeled off strips to judge cure status in the bag.

With fingers under the paper toweling, glass & CF cloth were scissored off around the carrier perimeter & toweling pulled out. The core was positioned with its TE 1/4" ahead of the carrier TE. Tops of endcaps, spar & LE were rolled. Chordwise CF reinforcement was brushed over the extension area. Remaining epoxy mix was rolled on the top cloth.

With the next epoxy batch mixed, the top was similarly wetted out and then aligned over the core to the bottom carrier & the brads inserted through the top carrier into the overcaps. If errant epoxy on the carrier exteriors interferes with taping the carriers together in a few places along the LE &

taping, dampen a cloth with acetone to help clean it off. Dry the area with clean toilet tissue, etc. so the tape will stick. Insert the work into the drop cloth with breather & into the bag. A little epoxy was left, so after the work was in the bag, Kevlar was rolled for "individual Kevlar hinges" planned for flaps & ailerons. Working alone, it took about 40 min. to get the center into the bag from the time the first batch was mixed. It's nice to have extra hands to help.

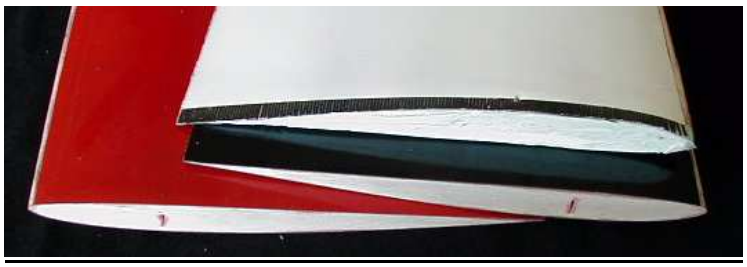


Put the beds outside of the bag with the carriers properly positioned between. Weight down & draw vacuum. Keep the work in a warm environment for the recommended time & preferably longer so the TE's are rigid & not subject to warping when out of the carriers. Aileron warps will especially cause unwanted turning tendencies.

During bagging, a residue of wax sticks to the painted skins. It helps unwanted glue, paint, smudges, hand oils & assorted handling crud from permanently adhering while the many post-bagging steps are completed. The best product I've ever found for cleaning & polishing is German made "Stahl Fix". Do a web search for Knauff & Grove Soaring Supplies in Pennsylvania.

POST- BAGGING

Panels shown are from Big Smoothie #1. Paint won't be well cured for days & is easily marred. When ready, work in the beds or over clean towels. Trim excess epoxy along TE's & LE's.



At top, the foam "overcap" is still intact. Carefully band saw off some. Dig out the rest to expose the carpet tape over the 1/64" ply cap on the endcap. Use the Dremel tool with sanding drum to trim almost to the 1/64" ply. Peel off the carpet tape. Finish with sanding block. Drill 1/16" holes through the balsa plugs defined with red marks.

Pull plug pieces out with piece of coping saw or bandsaw blade, etc.

TRIMMING THE TE'S: Trim & sand the center section so ends match in chord. Finished BG chord there will be on the order of 10-1/8" at the center. If you have a bit more, the LE will protrude further beyond the saddle high point & be higher for the canopy to fit around.

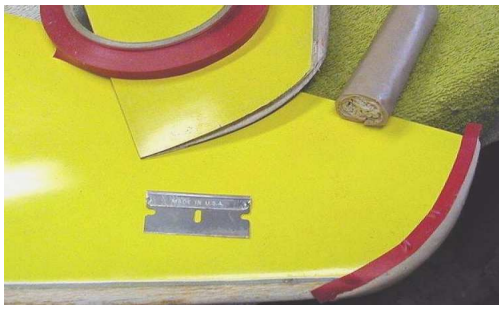
Attach a tip section. Trim TE to match ends of the center. Trim the other tip panel to match the planform of the first tip trimmed. See SUPPLEMENTAL LT & SGP FILES about those chords.

At this point you may notice that the tips do not align vertically with the center section, especially if you're using angled blades. This is addressed in Part 2 in conjunction with installing the alignment pins & sockets.

PUTTYING & ROUNDING THE EXTREME TIPS: See next pic. After bagging, contour tips to match. Make a recess between the skins in which to press 2-part epoxy putty commonly found at

hardware outlets such as Home Depot. Coat the foam in the recess with quick epoxy so the putty will stick.

Cut off a ¼" slice from the roll. Remove the covering. Wash hands. Knead putty between fingers to uniform color. Warm it with heat gun to make this easier. Clean fingers with acetone so you don't smudge the paint with residue on the fingers.



Knead a bit of the 2-part putty stick to judge working time available. Cut off a slice & roll it between palms to make a "worm" fatter in its middle. Press into the recess. Wet fingers with spit. Shape & contour putty to merge to skins. As it progressively cures it can be carved & wet sanded. It quickly hardens in the sun, ready to paint. If using darker trim paint on the putty, work in the shade. Paint on it will bubble in the sun.

Locate & open the main bolt hole to ¼" to establish the center of the wing. Mark on tape to establish edges of the 3" wide extension. Mark flap ends & hinge lines by scoring the paint on top or marking with a fine pen. A thin bandsaw blade works nicely for long cuts. Practice on sheet balsa marked with a thin, straight line. Learn to use thumb & a finger as guides. Similarly score & cut the ailerons loose. For proper RDS operation, aileron chord must match chord of the adjacent flap. Cut flap inboard ends & aileron outer ends chordwise with a unbacked razor saw. Cut the hinge line with a thin bandsaw blade. A well-used blade has minimum kerf.

Little down aileron is needed for turn. TE camber for launch requires more. Tilt bandsaw table or tape a beveled support to it. Against the blade, clamp a board. Experiment with a 5/16" sq. strip of balsa to learn how to make the bevel. Bear the inverted aileron on the support & against the board to bevel it without taking anything off the top skin. Finish up with sanding blocks.

The favored hinging method is the simple & durable "individual Kevlar hinges. If spaced 1/32" from the wing, flaps need not be beveled for reflex. It's easiest to install the flap RDS pockets with flaps cut loose & before hinging. Follow instructions in Part 2.

Craft stores carry thick, water-based acrylic paints in small squeeze bottles. Thin a little with water. Brush on raw foam for nice appearance. Let what gets on painted skin dry. Remove with a fingernail.

End of Part 1