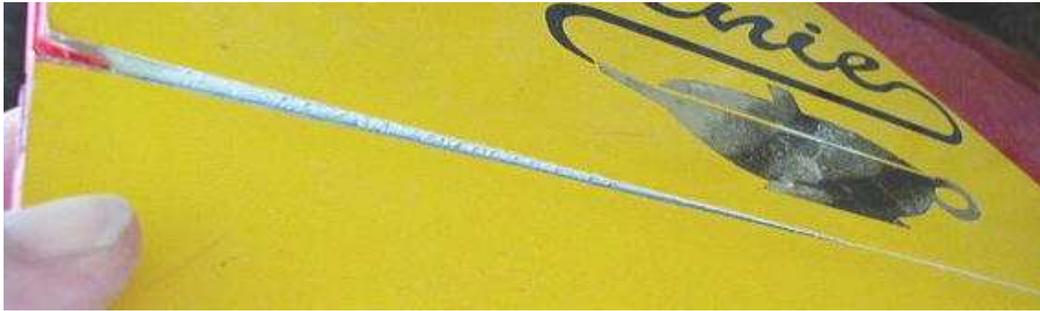


## CONST. FILE #7, HINGING OPTIONS by Harley Michaelis (2/24/09)

**FABRICATION & INSTALLATION OF INDIVIDUAL KEVLAR "EASY HINGES":** Friend Winston Okerlund came up with this idea for easy full deflection of flaps & ailerons. Next to tape it's the easiest way to go. It's far more durable than continuous Kevlar skin hinges, which can easily rip as shown below on a top-hinged aileron. If you've used skin hinges & want to go with them, you're on your own.



After bagging, ailerons & flaps are removed, edges trued & beveled for down aileron & flap reflex. See CONST. FILE #3, Part 1. With straight edge, a tapered hingeline can be scored on the paint to cut with the bandsaw. A worn blade removes least material. A straight edge can be taped down as a guide, but tape may lift paint when removed. If flaps are to be constant chord, a guide as pictured below can be clamped to the table, The TE rests on the protruding part & butts the vertical edge as the cut is made. Ignore the notch.



Installation of servos, harness, RDS shafts & pockets must be completed before this hinging. In the picture below of #29 big Genie, six hinges were used for a flap. Starting  $\frac{1}{2}$ " from the 3" extension & spaced  $3\frac{1}{2}$ " apart, the outboard hinge ends  $\frac{3}{4}$ " from the end of the center section. On the GP or SGP,  $2\frac{7}{8}$ " spacing works for 6 hinges.



For insertion, some stiffness has to be imparted to the soft Kevlar. Lay 1.7 oz. Kevlar cloth on waxed bagging Mylar, window glass, Formica sheet, etc. Wet out with thin bagging epoxy. Epoxy makes the Kevlar subject to easily ripping. Thoroughly blot to leave dry looking. When cured, peel off. On the shiny side, remove wax residue with a degreaser. Hinges with the weave on a 45 degree bias work well. Cut into 1" strips & then into 1-1/2" hinges. Fold & crease each way one time. These mike out at just .006" but cannot be ripped in the hands of us ordinary mortals.

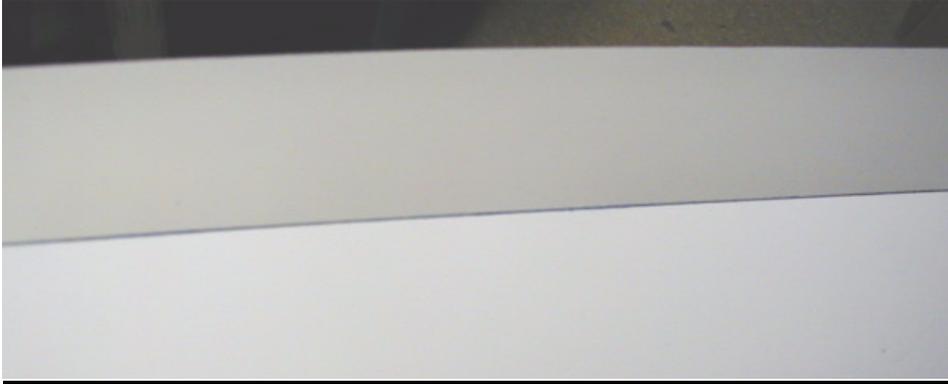
First pic below shows how a stick is used to uniformly space hinges. Sharp single edged razor blade is perfect for cleanly making 1-1/2" x 1/2" slots under the skin.



After slotting is finished glue hinges one by one on the wing side. When the glue is dry, protruding hinges & the flap drive shaft are slipped into the slots & the pocket.



Here's a completed installation on an LT/S flap. Five hinges were used. One is inboard of the RDS pocket & another near the outboard end. The others are evenly spaced between.



This is the hingeline on an aileron on #29 big Genie. Eight of the hinges were used, spaced 4" apart. The inboard hinge was placed just outboard of the hard slot at the end of the aileron.

Use the strong, slow-drying Elmer's Ultimate. The four oz. see-through squeeze bottle was \$5. It has a practical spout & cap system, much preferred to Gorilla. Don't dampen the hinges as the glue will bubble & ooze, get on the creases & make them stiff. The glue isn't water soluble. Acetone will cut it, but is death to paint or foam.

All hinges are to be first attached to the wing side. For flaps, prop up the panel on its LE, top toward your belly. Squeeze a small blob of glue on a tile, etc. Pull skin away from a slit with the thumbnail. With thin glue knife pick up a small amount. Apply it sparingly & deeply inside. With toilet tissue, wipe off your thumbnail & the foam face. Slide in the hinge. Bend it, position it against the foam & let it unbend. Do all. Let glue dry 2-3 hours.

If not yet done, this is a good time to apply a thin bead of epoxy inside the skin edges around the recessed flap pockets. Painted the same color as the adjacent foam, it gives a nicely finished appearance.

Make opposing slits in the flaps. To avoid a big hassle, cleanly open the slits enough for easy insertion. The glue will expand & fill. Straighten all hinges to practice a "dry run" inserting them. Decide if it's easier to work outboard to inboard or vice-versa. Insert the bent end of the sized shaft into the pocket. Position the flap to clear the wing 1/32" & the razor saw thickness from the extension. When satisfied you can do it for real, apply glue into all the slits for one flap & attach it. Repeat for the other surface. Similarly do the ailerons, working outboard to inboard.

**HINGE REPLACEMENT:** If a hinge gets dislodged in an extreme situation, best bet is to replace it with a new, smooth one. Remove the old one by carefully cutting it loose from the skin. Then first secure the new one to the wing side. Let the glue cure. To get it into the surface side, fully deflect the surface to curl and stuff the hinge in place. A few attempts may be needed. Extra hands help. Then apply adhesive. Another way is to cleanly clear out foam between the surface skins to glue & position the new hinge against the skin. Then fill back in with a foam or balsa plug.

### **SILICONE HINGING**

Silicone does not adhere well to raw foam. Begin by thinly coating it with quick epoxy. Smooth with a finger & let it cure well. If epoxy gets on the painted surface, leave it be. It can later be lifted off due to the wax residue from bagging.

Continuous silicone hinge, unless applied to create a thin membrane, tends to be too stiff. Actually, a couple of inches at the ends & center of a flap are entirely satisfactory. Wing inverted, butt surfaces together. At each hinge spot apply a 3" or so long piece of ordinary paper masking tape, not the blue stuff. Make sure it's sticking right up to the hinge line or silicone will get under it.



A small syringe without the needle makes a good applicator. Trim off any housing around the nozzle. Let the taped surface droop over the edge of the workbench.

The GE Silicone 2 shown in the above picture has a fancy cap, but the stuff hardens in the end of the nozzle after one use. Loctite Permatex clear RTV silicone stays fluid with its common cap on. I've had a tube around for years & it's still good. Squeeze about  $\frac{1}{2}$ " into the rear end of the syringe. Push it to the other end with the plunger. Holding it nearly vertical in the groove, apply a thin bead on the exposed masking tape. Smooth the silicone with the edge of the little finger to form a thin ribbon.

Don't close the flaps & squish the ribbon. Four blocks, shaped as shown below, avoid that & assure vertical alignment of the flaps to the wing during cure. After propping the work up on the blocks, separate any obvious strings of silicone with a toothpick.

Determine just where the blocks should be positioned horizontally to align flaps and wing. Weight the wing down to retain that. After 6-8 hours the silicone should be partially cured. Peel back a little tape to check status. If all looks good, remove the tape to facilitate full curing, but keep the flaps blocked up.



From  $\frac{3}{4}$ " wood, cut four 1" x 6" flap supports. Bevel the rear 2" at 20 degrees to keep flaps aligned to wing as the silicone cures. Note protruding drive shaft, the rear epoxy socket for a dowel keying pin & the blade slot.

When well cured, check flap operation. If all looks good, you can leave it as is, add additional hinging or apply clear tape continuously along the bottom. If silicone got under the tape, it is not bonded to the skin due to the wax residue from bagging. Lift & peel off the excess. If you think you can improve on your work, slit the hinges, slice off the silicone with a sharp blade & start over. Silicone can be used to repair split continuous skin hinges, such as the ripped one shown at the start of this document.

**ALL-TAPE HINGING:** Taping is a quick & easy way to go, but unless you use more expensive types it needs to be frequently replaced due to splitting. Adhesive may separate from the tape. There is always danger of paint lifting away when tape is removed. Risk is reduced by gently heating tape with the heat gun, but too much will

**harm the paint. Common 3M Scotch #600 tape is cheap, works reasonably well & the adhesive usually comes off with the tape.**

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