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NEWSLETTER OCTOBER 1999

Another Tuesday flying season has drawn to a close; as usual we had some good nights, some indifferent and some unflyable. At least three new members got to stir the sticks and hopefully will go on to full competency.

Is there any feeling in the club for weekend flying, either thermal or slope over the winter season, its something that seems to have died over recent years, my recollection is we had some good days, make your feelings known at the AGM. Speaking of which mark it in you diaries: -

09th November 19:30 hrs Cove Bay Hotel.

Bring along some ideas for a winter programme, any ideas for next year, and nominations for t' committee.

Earlier in the Summer ADS lost a good friend in Davie Davidson who passed away. Many of us knew Davie as a gentleman and an enthusiastic modeller. It was good to see such a good turn out from club members at his funeral, and thanks to Norrie for a gracious eulogy.
This months info includes a system for flap / aileron control using torque rods instead of the more usual pushrods. This system is currently sweeping America; as if constructed correctly it gives precise control and a clean airframe with no external linkages to snag. There is a commercial product available through Tower Hobbies via the Internet; they sell out as quickly as supplies are in stock.

To complete the theme of alternative materials and construction I have included info on hand cutting foam wings. There is enough information to get you started, go to B&Q and get yourself some Jabolite foam to practice on, this is cheap enough not to worry about making mistakes. Stick with a car battery charger for power, I can supply suitable wire.

Our flying activities where disrupted on several occasions over the season by football matches, the committee is keeping the pressure on the council for a move to Hazlehead Park.

The club barbecue was not a great success with few members turning up, unfortunately the breeze was a bit stiff for thermal flying, more appropriate for slope, but the weather on the day cannot be predicted when these dates are set.

Forthcoming events 26th

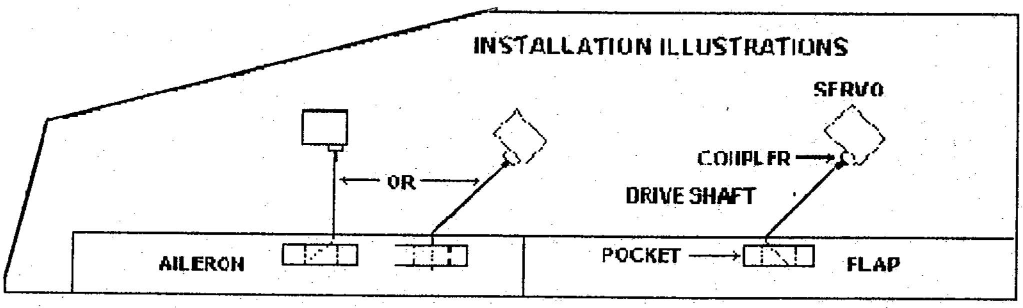
Tuesday ~~19th~~ October 19:00 bring & buy. Cove Bay Hotel.
Tuesday 09th November 19:30 hrs AGM. Cove Bay Hotel.

The Original RADS/RFDS

As designed by Harley Michaelis, AMA 3234, LSF 023

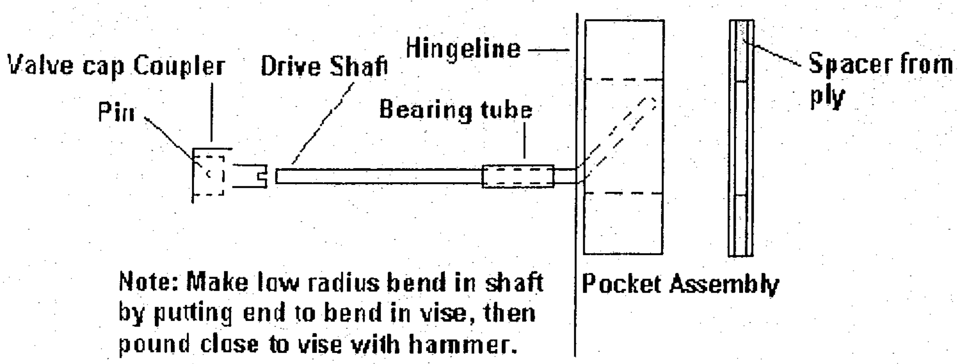
This system eliminates any need for horns, screws, nuts, backplates, clevises, keepers, straight pushrods, tube-in-tube pushrods, pull-pull cables, bellcranks, exit guides, etc. Nothing can get ripped off. Nothing contributes any slop. If servos center well & hinges, etc. allow free movement, there is a return to a well-defined neutral from either direction. The system works in most any size or kind of R/C aircraft, where separate servos are used for ailerons, flaps, or where tail pieces will accept a servo & leads.

Any modeler with ordinary tools and materials can make parts & install as I do. The essential items are (1) a splined Coupler that mounts over an output gear, (2) a Pocket in the surface & a (3) Drive Shaft between. Angles involved are 45 & 90 degrees, relative to the hingeline.

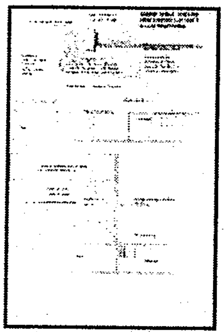


As a shaft rotates, the surface deflects & the shaft also slips slightly fore-aft within the Pocket. **This avoids any binding due to the Pocket not being in line or in plane with hinges**. A 90 degree bend is used for flap & 45 for other applications and provide expected deflections, if nothing else limits motion. Pockets need not be laterally centered in a surface. More inboard locations keep mass more centered in the airframe & puts servos where a wing is usually thicker for easier mounting, especially in thin wings.

The sketch below shows the elements closer to full size. The Coupler can be made from a solid brass (not a thin shell) "screwdriver type" valve cap, in which a hole is drilled through the skinny end, in which to bond the shaft. Tru-Flate item 47-103, found at independent auto supply retailers, is just right. Using epoxy, a socket is custom-splined to fit the output gear. A 3/32" drive shaft (4-40 rod, etc.) works for medium to large airframes. A nicer material is stainless steel "filler rod" found at welding suppliers. 1/16" is also available. HLG guys could use smaller music wire. For lightweight hand launch applications, splined sockets can be made in a nylon bolt.



Basic RADS Layout



Genie RADS/RFDS Layout Showing Plug-in Tips

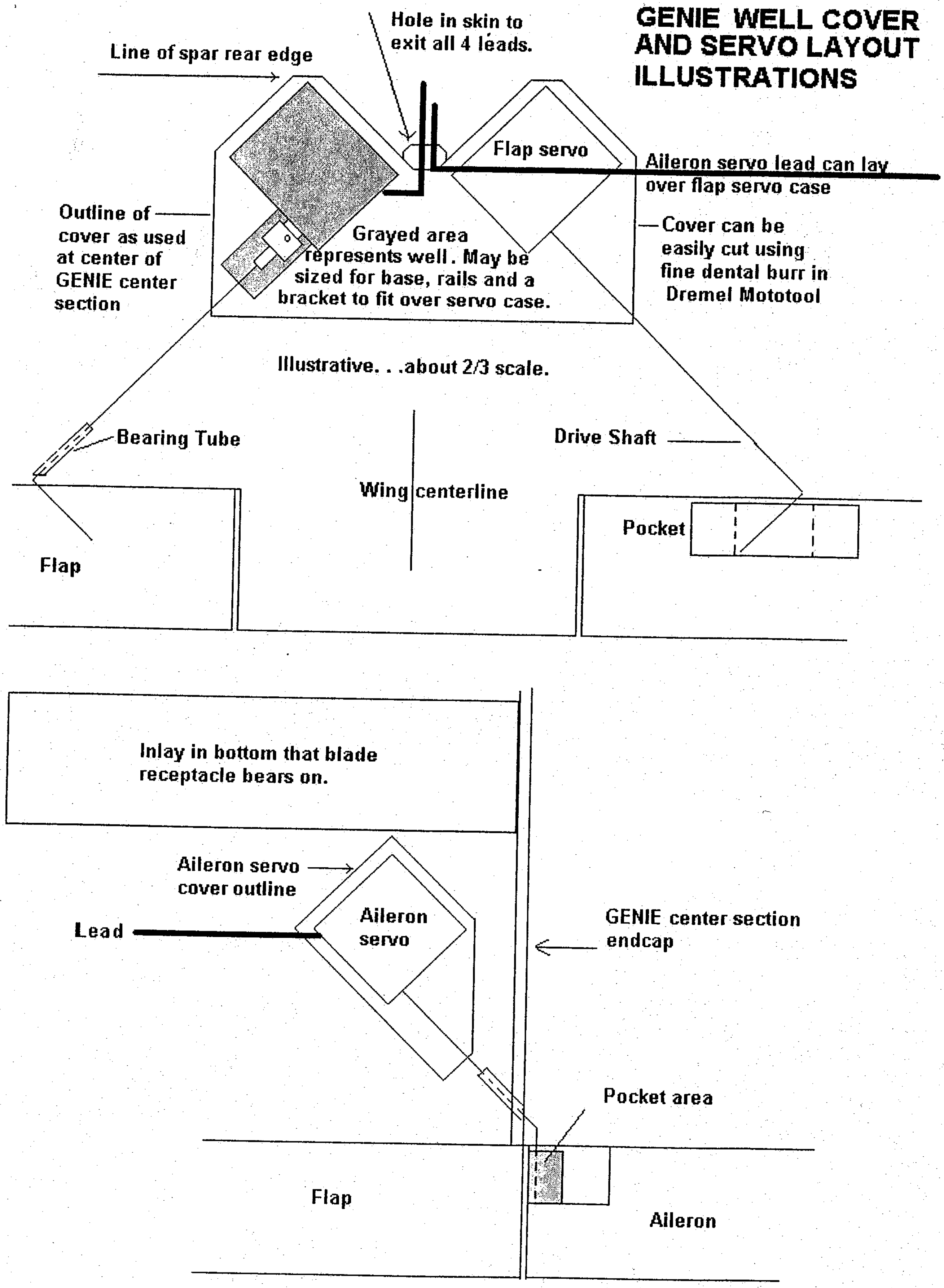
(Click to enlarge and print)

COUPLER: Drill 3/32" hole thru cap. For smaller shaft, shim later with bits of tubing, CA'd. Coat servo case top & gear with PVA, Pic Slicker, paste wax, Chapstick, etc. Fill screw hole with wax. As needed, round end of a piece of 4-40 rod, etc., to just seat in the hole. Wax rod. Run cap onto it to center around gear. With cap against case, temporarily bond to rod with tiny bit of CA. Fill cap about 2/3 with quick epoxy. Avoid bubble. Press to case, hold a few minutes. Let cure well. Pull off, take out rod. Clean parts.

POCKET: Make from thinner, non-textured laminate (Formica, Nevamar, Wilsonite, etc.) used to face kitchen cabinets. (Free samples at building supply). Spacers are ordinary aircraft ply, uniformly sanded for a snug fit to the shaft. Thin CA bonds parts. Put smooth side of laminate inside. Make pockets 1/2" x 2" or so, with spacers 1/2" square. For HLG's, miniaturize. Locate servos close to the hingeline as practical to keep shafts short to minimize flex. Then locate pockets laterally, setting front edge back 1/16" from the hinge pivot line. Where possible, place Pocket near top surface if top-hinged or near bottom if bottom-hinged & so shaft bent end (5/8" to 3/4" long) is laterally centered in the slot. For sheeted frame surfaces, mount Pocket inside the sheeting on a broad base of thin (1/64" etc.) ply.

FOAM CORE STRUCTURES: Make snug opening for Pocket. Epoxy in, flush to one surface. Fill to other side. On bottom of cores, before skinning, outline servo with Coupler attached. Well needs 1/4" or so clearance at Coupler end, so it can slipped off the gear. If bagging, fill Pocket with waxed soft balsa and seal anywhere epoxy could meander. Prepare templates (outline on clear plastic, mylar, etc.) to show precise servo/well cover perimeters, relative to reference points on the structure. Make pinholes at key points. If skin is removed 1/8" or so beyond well, you have a cover to tape back. Be sure you have reference marks to know where to cut hingeline. Cut skin. Router wells. In neutral, the notch in the cap should be accessible. As needed, orient the servo to align axes of shaft & Coupler. This may require tilting with a beveled base of balsa under the servo base or servo. Servos should be rigidly mounted. Use of a ply base with rails at case ends for screw-mounting works well. If the case does not have side lugs for flat mounting with screws, a snug fitting strap to fit over the case to secure the rails can be made from 0.030" sheet aluminum.

GENIE WELL COVER AND SERVO LAYOUT ILLUSTRATIONS



DRIVE SHAFT TUNNEL: Cut flaps & ailerons loose. Clear Pockets of any waxed fill put in. Use long drill bits, etc. to work tunnels toward the Couplers. For 3/32" shafts, bits of telescoping plastic or aluminum tubing down to 1/8" ID can be epoxied into the tunnels, as bearings, just ahead of the bends. 1/8" OD nylon can be slipped on the shaft ahead of the bend. Carefully angle & locate bearings so coupler & shaft axes align & so surfaces align well with wing. A useful tool in installing bearings is a piece of 3/32" rod CA'd into a length of 1/8" OD brass tube. Keep it waxed to avoid bonding the bearing to it. When partially set, remove tool, insert real shaft and slip on the aileron or flap to final check the alignments.

DRIVE SHAFT LENGTH: When ready to hinge, size to length so with 3/8" inserted in the cap, the elbow lays just ahead of the hingeline. Mark shaft at 3/8". Heavily rough that end & insert. If 3/32" hole fits rod too tightly, open with #41 bit so CA can thoroughly wick around it. Bend point (elbow) location & 1/16" pocket setback avoid prying as surface moves. Put shaft & servo in neutral.

SHAFT BONDING: Be sure the hole in the cap is free of all traces of CA used to temporarily bond the rod while making the splines. To avoid inadvertent bonding of cap and gear, again apply PVA, wax, etc. to the gear. With shaft inserted to the mark made on it and everything in neutral, wick fresh thin CA between shaft and cap by applying it at the notch. Excess should drip out, but could work to the forward end of the hole and maybe around the gear. . .hence the PVA. ***Allow hours (yes, hours!) for the CA to fully cure.*** Cap can be pried off and repositioned like an output wheel. When all is finalized, drill a 1/32" hole through cap and gear for a pin to retain cap.

HINGING: Clear continuous tape hinge material works well, but apply a few "Z" hinges at either end first to keep surfaces aligned to wing. Bottom skin will need to be notched ahead of hingeline to allow full down rotation of flap shaft. For servicing a servo, cap can be pried off and servo removed.

RUDDER, etc. Mount servos near hingeline. Shafts can be very short.

RETROFITTING IN ARFS: As needed, reshape wells to install servos. Where possible, route leads into any precut lead grooves. Fill old well gaps with scrap foam. Remove enough skin beyond filled-in areas so old & new foam can be bridged with new skin. Level new foam to the old. Attach new skin with epoxy, bagging when possible . . . or otherwise smooth, fill, paint. If film is used, cover with matching or contrasting color, trim material, etc. Work a tunnel under skin. Remove foam from surface to mount Pocket. Seal around it to avoid plugging opening with epoxy as it is mounted.

MAINTENANCE: Apply a little powdered graphite inside a slot. Occasionally blow out to keep clean.

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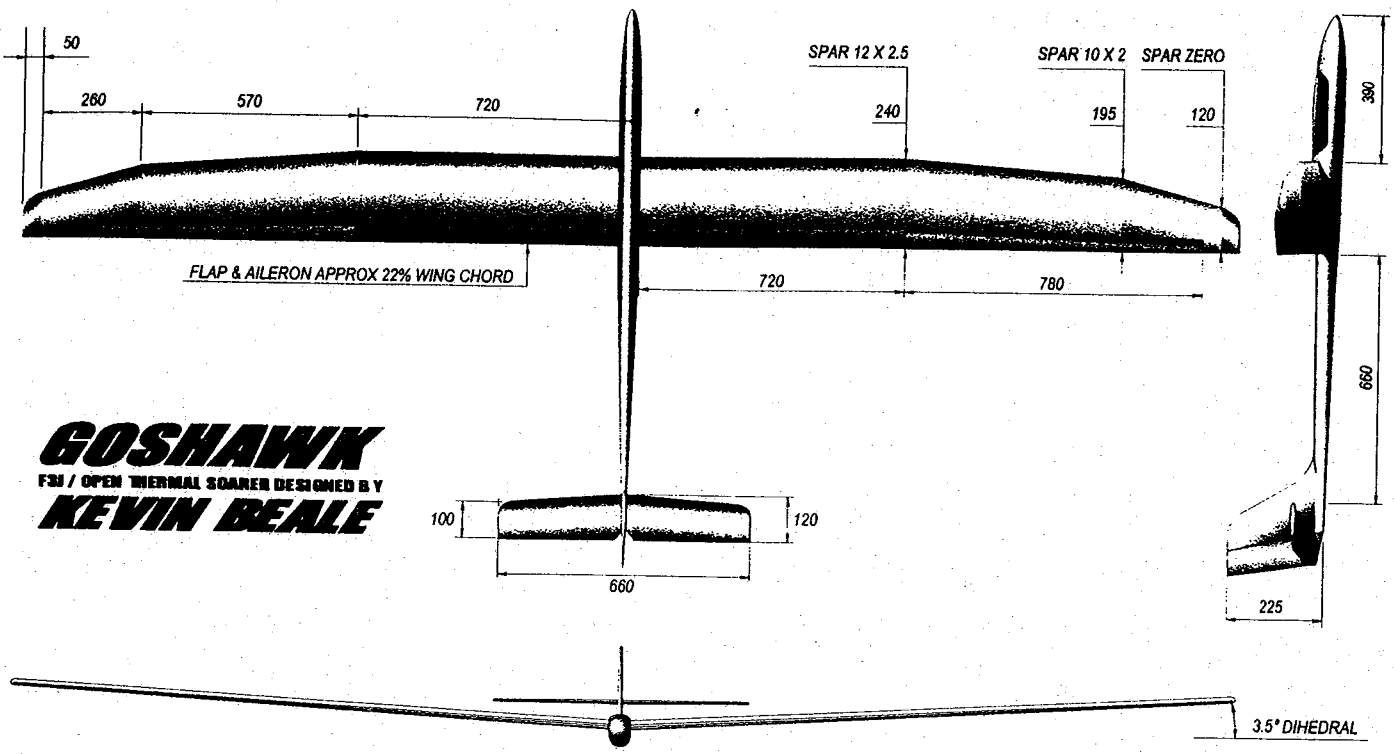
GOSHAWK

F3J / OPEN THERMAL SOARER DESIGNED BY

KEVIN BEALE



FUSELAGE —— EPOXY / GLASS / KEVLAR.
WING —— GLASS SKINNED OBECHI VENEER / WHITE FOAM CORES.
SPAR —— WET LAID CARBON BOOMS WITH 0.5 PREFORMED WEB.
WING JOINER —— 0.5" DIA HIGH TENSILE ALUMINIUM.
TAILPLANES —— 0.25" BALSA SHEET.

SPAN ---------------- 3200mm.
ASPECT RATION -- 15:1 APPROX.
WING SECTION ---- SD7307.
LOADING. ----------- 10.2 oz sq ft.
WING SECTION ---- SD7037

DRAWN —— B HENWOOD — 13/10/96

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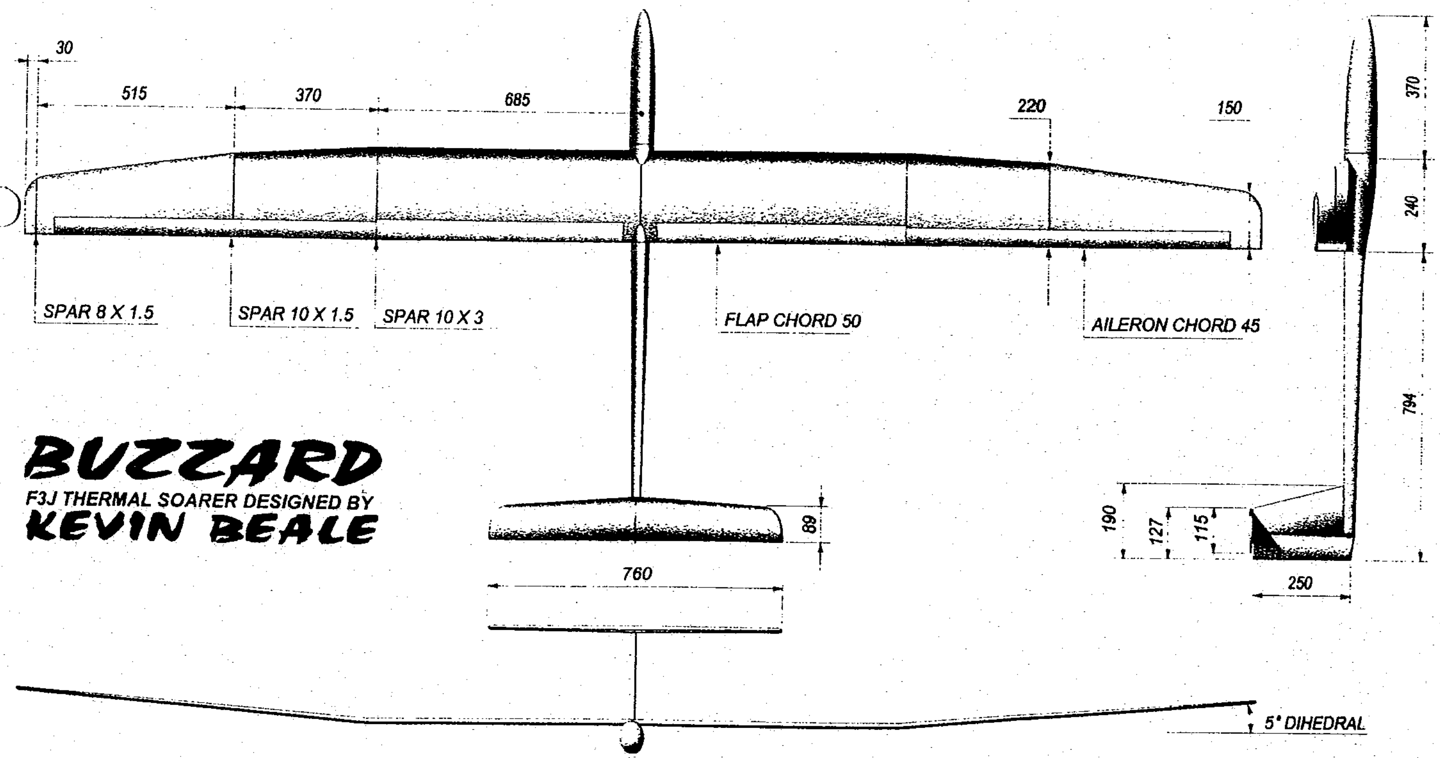
BUZZARD

F3J THERMAL SOARER DESIGNED BY

KEVIN BEALE



FUSELAGE —— EPOXY/GLASS/KEVLAR.
WINGS ——— OCHECHI SKINS OVER GLASS ON BLUE FOAM CORES.
SPAR BOOMS – CARBON WET LAID INTO WING TO SIZES SHOWN.
SHEAR WEBS – 0.5mm CARBON.
SPAN ------------------------ 3200mm.
AREA ------------------------ 70.07 sq dm.

ASPECT RATIO ------------------ 14.61 : 1.
LOADING ------------------------ 37.1 gm/sq dm.
WING SECTION ----------------- SD7080
FIN & TAIL SECTION ------------ SD8020
CG ----------------------------------- 95mm AFT OF ROOT LE.
DRAWN --- B HENWOOD -- 13/10/96

Foam Wing Construction

Introduction

The use of expanded bead foam for construction of R/C aircraft revolutionized the model industry several years ago. Use of this material began as a substitute method of building wings. This is its primary use today but it is also used as a mold material for making fiberglass parts. It has proven its value both in the shop and in the field because of certain advantages it has over conventional materials. It is light weight, strong, easy to work with, and inexpensive. One of the main advantages of the material is the speed and accuracy of construction which is possible through its use.

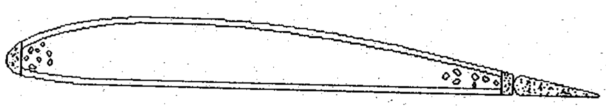
Polystyrene foam is available in densities ranging from .8 pounds per cubic foot to over twenty pounds per cubic foot. It is normally found in white, blue, or gray. The type and density of the foam that is chosen depends on the purpose that it will serve. Thick, light weight foam wings are normally made of white foam while in thicknesses from 1/2" to 6" and is used in construction of commercial buildings. Many building supply stores carry foam blocks in appropriate sizes. Often, blue foam is used for rudders, stabilizers, or control surfaces where the covering material may be thinner.

Any foam cutting systems requires two basic components:

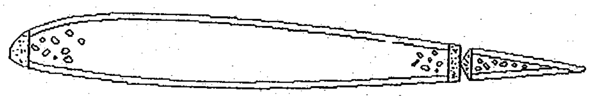
1. A frame or bow which is used to hold the cutting wire taut and guide the wire while cutting
2. An electrical power supply which is used to supply the power required to heat the wire

The quality of a core is *not* dependent on the complexity or the cost of a cutting system.

There are many different ways that a wing can be made. Adding to this the different methods of foam construction, the building is only limited by imagination. Below are diagrams which show two (2) typical wing cross sections.



Flat Bottom Wing
(Strip aileron)



Semi-symmetrical Wing
(Inset aileron)

Due the vast amount of space that would be required to *attempt* to cover this subject thoroughly, only the basics will be covered.

Cutting Bow

Most of the foam cutting equipment in use today is constructed by the home craftsman. This equipment is inexpensive and can be built from readily available parts and materials. The design that is featured here is light weight and easy to handle and is capable producing quality cores. This is by no means the ultimate design and can be modified or completely redesigned to suit the individual modeler.

The cutting frame or bow is nothing more than a device for holding the cutting wire taut. A bow can be made by bending a piece of conduit or gluing a series of dowels together. The bow can be as simple or as complicated and the builder wants provided there is a method of holding the wire at the correct tension. Basically, the bow should be light weight, easy to handle, and safe to use.

There are two basic methods of cutting foam. The first method is to suspend the bow above work surface with a counterbalance as shown in Figure 1. The counterbalance is nothing more than a cloth sack filled with sand so that the bow can be raised to any position and it will stay at that position. This leave the operators' hands free to control the movement of the wire.

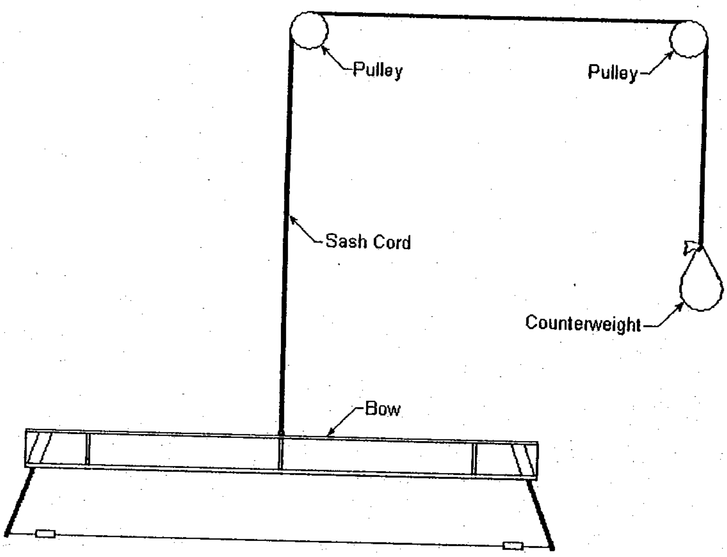


Figure 1

The second method is to allow the bow to hang below a cantilevered working surface as shown in Figure 2. The advantage of this method is that the bow is below the work surface and out of the way and the weight of the bow can aid in setting the wire tension. The disadvantage is that a special work surface must be constructed. The method used is up to the operator depending of space available and personal preference. Either or both methods can be used depending on the core that is to be cut. The same bow and work surface can be used in either method by attaching a connector to the sash cord so the counterweight can be quickly disconnected. Each method has advantages which can only be determined by use of both methods.

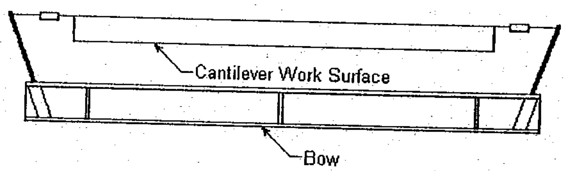


Figure 2

The design of the bow shown in Figure 3 is light weight yet very strong due to the I-beam construction and the plywood materials. The tension of the wire is maintained by the 3/16" diameter music wire so that adjustment is not required except when the wire is initially installed. This bow is capable of cutting wings up to 60" span. If longer wing spans are required, the length of the bow can be increased.

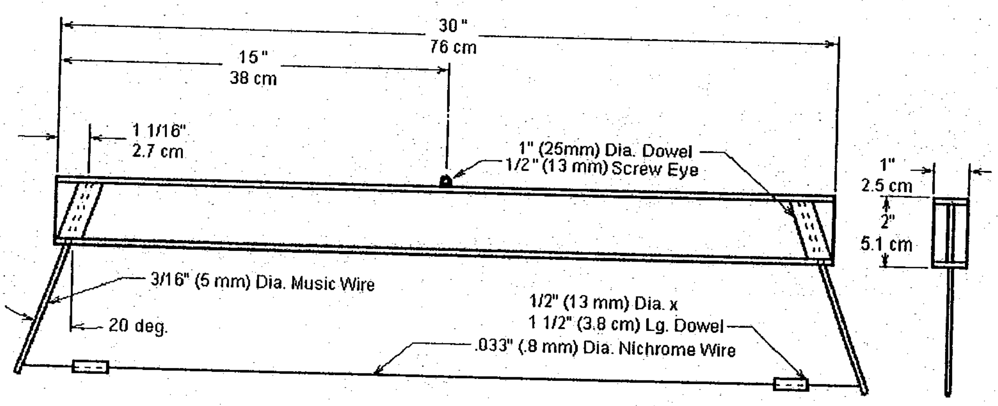


Figure 3

Construction of this frame is relatively simple and is worth the effort for the strength and light weight. The main part of the frame is constructed from 1/4" (6 mm) plywood. One piece is cut 1 1/2" x 30" (4 cm x 76 cm) and two pieces are cut 1" x 30" (2.5 cm x 76 cm). The two narrower pieces are glued to the edges of the wider piece to form an I-beam. The 1" (2.5 cm) Dia. dowel pieces at each end are optional. The dowel can be split and glued to each side of the center rib of the I-beam. The only purpose for these is to give more strength where the holes are drilled for the music wire. Finally, 2 - 3/16" (5 mm) Dia. holes are drilled at a 20 degree angle, 1 1/16" (2.7 cm) in from each end of the I-beam. The music wire provides the spring tension to keep the cutting wire taut. Two (2) pieces of 3/16" (5 mm) Dia. music wire are cut to 9" (23 cm) lengths. The end of the wires is slotted with a Dremel cutting wheel to a depth of about 1/8" (3 mm). The slot must be deburred and smoothed so that there are no sharp edges that will cut the cutting wire. The wires should be forced in the drilled holes in the I-beam as shown in Figure 3. Two (2) handles are made by drilling a 1/16" (1.5 mm) hole lengthwise through the 1/2" Dia. x 1 1/2" (13 mm x 38 cm) dowel piece. These pieces are the handles for controlling the hot cutting wire. The diameter and length of the piece is not critical and can be made to suit the operator.

The cutting wire is made from .033" (.8 mm) Dia. nichrome wire. The length of the wire is determined by measuring the distance between the music wire pieces at the widest point and adding about 1" (2.5 cm) to make the wire easier to handle. One end of the wire is wrapped two (2) turns around a brass eyelet and the eyelet is staked closed. The dowel handles are placed on the wire and the same preparation is done to the opposite end. The finished wire assembly should be about 1/2" (13 mm) less than the measured distance for proper tension. The wire is inserted in the slots in the music wire pieces with the eyelets to the outside and the handles to the inside. The connection to the cutting wire is dependent on the power source that is being used. An extension cord that is of sufficient length to connect between the bow and the power source can be used. The cord can be permanently attached to the brass eyelets. The preferred method of attachment is to fix alligator clips to each lead of the wire and connect these to the eyelets. The cord can be attached to the bow so that it will not interfere with the cutting process.

Power Supply

The quality of a wing core is directly dependent on maintaining the proper cutting temperature. This means that the power supply is the most critical part of the system. The power supply may be as simple as an automobile battery or as complicated as an adjustable step down transformer system. The most common and probably the most effective power supplies in use today are inexpensive automobile battery chargers. Another device in common use is the older larger type model train transformers. The total investment for a power supply should not be more that fifteen to twenty dollars.

There are several options available in selecting a power source. A step down transformer that reduces the 115 volt household power can be used. A model train transformer with adequate output power is an excellent adjustable power source. Inexpensive automobile battery chargers are commonly used but the most common source of power is the average automobile battery. It is best to use a power source that has a voltage in a range of 6 to 15 volts for safety reasons. Some people have connected household power through a light dimmer switch to a cutter and have been successful but this is not recommended due to the inherent danger involved.

Additional Equipment

Some additional equipment may be required depending on the type of wing cores that are being cut. If the cores are to be beveled on the end for dihedral, a box to hold the core and templates is required or the bevel templates can be fixed to the sides of the core. This will be discussed in more detail later.

A simple cut-out tool will be required for cutting recesses for landing gear blocks, aileron servos, pushrod channels, etc. Tools can be made by bending 14 gage solid wire to the appropriate shape and inserting this in a soldering gun. The use of these tools will be explained and this will clarify how the tools are made.

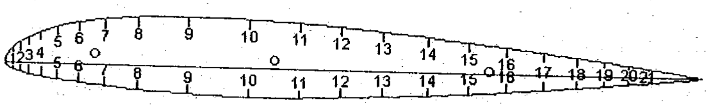
Templates

The most important item in the foam cutting process is the template. The resulting core can be no better than than the templates that are used to produce the core. The shape and finish of the core is directly related to the shape and finish of the template. The shape of the template is dependent on the wing construction, i.e.. whether trailing edge stock is used, whether strip or barn door ailerons are used, whether spars are used, etc.

The material used for the templates is a matter of preference. Almost any type of material which is heat resistant, durable and easily worked is satisfactory. Probably the most common material used is plywood because it is readily available. One of the best materials is Formica or any of the common cabinet top materials. This is available from cabinet shops and quite often scraps of sufficient size will be given away. Thin aluminum works well but may act as a heat sink at the ends of the cores causing the wire to drag.

The rib outline can be traced or copied and then transferred to the template material. Again, the method used is a matter of preference. Carbon paper can be used to trace the outline. A xerographic copy can be ironed onto the material. The copy or tracing can be glued to the material. The only thing that matters is that an accurate outline of the section be transferred to the material so that it can be cut, shaped, and finished to match the rib section of the wing.

Two templates must be made, one for the root and one for the tip. A constant chord wing requires two identical templates while a tapered wing requires two of the appropriate size and and section. The templates are numbered on both sides as shown in Figure 4.



Numbered Template

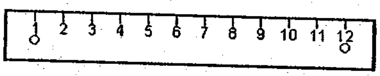
The marks are used to guide the operators in maintaining a constant cutting speed throughout the cord. The numbers are closer together where the curvature is more critical and near the end of the template. For semi-symmetrical and symmetrical wing sections, both edges of the template must be numbered.

The method of making the template is dependent on the material used and personal preferences. The drawing for the template can be glued to the template material with a spray adhesive such as 3M-77. The template is then cut just outside the outline. Final shaping is done by sanding the template to the outline. The finish must be smooth with no ripples or rough spots that could cause the cutting wire to catch or drag. Holes are drilled in the template for nails that are used to attach the template to the foam. The holes must be snug so that the template does not move during coring.

Preparation

In order for the foam wing cores to be accurate, the foam block must be square. This is relatively easy to accomplish but the importance of this task can not be overstated. Care in squaring the block at this point will result in reduced labor or inaccuracy later in the final stages of construction. The recommended tools for this procedure are:

1. A cutting bow
2. An electrical power
3. Metal square
4. Metal rule (longer than foam block)
5. Two (2) square templates
6. Nails to hold templates to foam block



Square Template

The work are should be clean and orderly. The cutting bow and power supply are connected and allowed to begin heating. The foam block is placed on the cutting table and may be attached with double stick tape, weighted, or simply held in place during trimming and squaring.

Squaring of the foam block starts with the ends being squared. This is the most important step. A metal square is used to determine if either end of the foam block is square. If it is then this is a good starting point. Otherwise, both ends of the block must be squared.

The metal square is used to draw lines across the top face of the block then the ends of this line is drawn down the sides of the block. These lines are the guides for locating the square templates. The numbered edge of the square template is aligned with the line and nails are pressed through the holes into the foam block. The end of the block is then cut off using the normal cutting process described later.

After the foam block has been squared, it is then cut to size. This is done using the same method used in squaring the foam. The core width is measured, the guide lines are drawn, and the square templates are located on the guide lines. For tapered wings, the core can be cut to the finished taper with a width equal to the finished core with at each end.

Cutting

The templates are attached to the foam using nails with large heads such as roofing nails. Locating the templates accurately is essential to the quality of the finished cores. First, the root template should be located so that adequate stock is left on the top and bottom so that the cutting wire does not burn through the outer surface. If the wing has dihedral, the tip template can be located sufficiently so that the core is cut with built-in dihedral.

The Numbered Template diagram shows the leading edge and trailing edge as black filled areas. These will overhang the core stock. Measurements are made from the bottom edge of the foam to the center of the template so that the centerline is exactly parallel to the bottom edge. The nails are pushed through the holes in the template into the foam. After the root template is mounted, it should be rechecked for accuracy.

The tip template is located in a manner similar to the root template except that the centerline may be above the centerline of the root template to account for the dihedral. Wash-in or wash-out can be cut into the core by raising or lowering the trailing edge of the tip template by the appropriate amount. Again, the template should be checked for accuracy before the cutting is started.

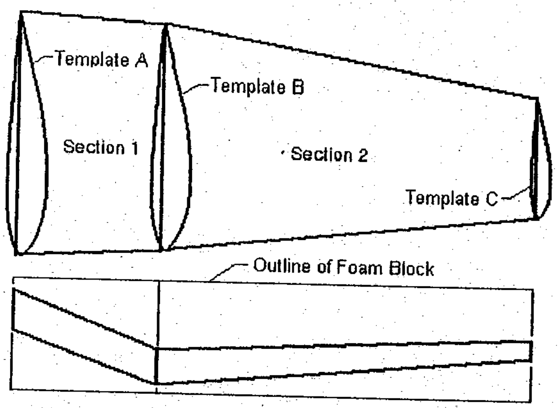
When the templates are attached, the foam is made ready for cutting. It is not necessary to mount the foam to the cutting table but this is an option of the builder. It may be attached with double sided tape to avoid having the block move during coring. The bow is placed on the cutting table and allowed to heat to the cutting temperature. The wire is tested with scrap foam to assure that the proper temperature is reached.

Although many people have developed the skills to cut cores alone, cutting the core is essentially a two person operation. One person sets the pace of the wire movement but calling out the numbers on the template as they are passed while the other person follows the lead. The follower must adjust his movement according to the instructions of the leader gradually. Sudden jerking or stopping to compensate with result in wire lag or over burning. Smooth movement is essential to cutting a smooth, useable core.

The cutting operation begins with the operators placing the hot wire on the template overhang adjacent to the foam. When the leader is ready, he says, "Now" and both operators move the wire to the foam at the same time. The leader begins to call out the template numbers as each one is reached. The wire *must* be allowed to do the cutting. Forcing the wire through the foam will result in wire lag or tearing of the foam. Either condition will render the core unusable. Both operators must reach the leading edge of the foam at the same time. When the leader sees that his end of the wire breaks free of the foam, he says, "Out" so that the follower knows that the operation is complete. The bow is placed in a safe place and the power is turned off. The core will be left in the cradle while the opposite of the core is cut which is done in the same manner.

Tapered wings present a special problem that requires special attention from the operators. This type core requires that the wire end at the tip move faster than the end at the root to avoid burning or over-melting. It is easier to feel and correct wire lag at the faster moving end so the leader should be cutting at the tip. The operators should be constantly aware of the feel of the cutting operation and communicate constantly.

Not all wings fall in the category of straight or fixed taper wings. Wings such as those for a Corsair present the final problem to the operator; how to make a multi-taper polyhedraly wing. Since the wire can only cut in a straight line, this type of wing must be made in sections and joined after covering. The detail shows how a Corsair wing might be made. Section 1 is made with templates A and B while Section 2 is made with templates B and C. This method can be carried over into making any number of sections with varying tapers and dihedrals to form a wing of any shape which is made up of a series of straight lines.



Double Taper, Inverted Gull Wing

Because the foam is very fragile and susceptible to physical and chemical damage, it should be left in the foam cradles from which it is cut until time for covering. The cradles are used to protect the finished core from physical damage and from dust accumulation that could adversely affect the adhesion of the sheeting. They are also used during sheeting to apply force to the material until the adhesive is set. If the templates for the adjoining sections are properly positioned, the cradles can be used to accurately join the wings and hold them while the adhesive sets. For these reasons, care must be taken in the handling to the cradles as well as the cores.

Sheeting

There are many different materials which can be used to sheet a foam core from brown wrapping paper to thin plywood depending on the type of model with which the wings will be used. For each type of sheeting, there may be several different methods of joining the sheeting to the core. One method or material may be ideal for one application but be totally inadequate for another. Since there are so many different methods and materials, only the most common method will be addressed.

Each of the most common sheeting materials have a special application and require different materials and skills to use. The lower strength, lighter weight materials are more commonly used for sailplane wings while the stronger, heavier materials are used for pattern or racing planes. Balsa is still the most common material for building models and this holds true for sheeting foam wings.

COMMON SHEETING MATERIALS

MATERIAL	ADVANTAGES	DISADVANTAGES
Balsa Sheet	Light weight, strong, readily available, easy to form, easy to sand	Relatively expensive, fragile, not available in adequate widths
Obechi Plywood	Very strong, hard, easy to form, easy to finish, available in large sheets	Expensive, not readily available, brittle, low compress strength
Poster Board	Inexpensive, readily available in large sheets, easy to form	May absorb moisture or chemicals, difficult to repair, relatively low compression strength
Wrapping Paper	Inexpensive, light weight, readily available in large sheets, easy to form	May absorb moisture or chemicals, difficult to repair, low strength
Fiberglass Cloth	Very strong, readily available in large sheets, easy to form, easy to finish	Expensive, heavy, requires special equipment and skills

Since balsa sheeting is by far the most common sheeting material, the method for applying balsa sheeting will be covered. Some of the practices will also apply for other covering material such as Obechi plywood and poster board while wrapping paper and fiberglass require significantly different practices.

The balsa sheets must first be prepared for use as a sheeting material. Since it is not available in large sheets, the narrow sheets must be butt joined to form a single wide sheet. Assuming that the wing panel has a semi-span of 32" and a chord of 12", the sheeting width required will be 10" allowing for a 1/2" leading edge cap and a 1 1/2" trailing edge strip. If the cores are tapered, a double width sheet can be prepared to reduce the amount for waste. For example, if a wing has a 12 in root chord and 8" tip chord, two sheets 10" wide or one sheet 16" wide can be prepared. Cutting the 16" wide sheet to the proper taper will reduce the amount of waste by 4". The edge of the sheets must be trimmed *straight* using a metal straight edge and an Xacto knife or razor blade. Every edge that will be butt joined to form the sheet covering must be trimmed.

After pieces are trimmed, they must be butt joined to form a sheet of the appropriate width. The pieces are laid edge to edge on a flat surface and a strip of masking tape is placed over each joint to hold the edges tightly together. Then the sheet is turned over and raised so that the joint is opened so that glue can be applied to the edges. A good aliphatic resin glue, such as Titebond, is applied to the mating edges. When all edges have had glue applied, the sheet is laid with the taped surfaces down on a flat surface. The excess glue is wiped with a wet paper towel or rag. This will reduce the amount of effort required to clean the surface later. The sheet is left to dry according to the adhesive manufacturer's instructions. Weight can be applied to the sheet to hold it flat if desired.

After the adhesive has cured, the sheet should be sanded to remove any ridges caused by swelling of the material at the glue joint. It is much easier to remove the ridges at this stage than after the sheeting has been applied to the core. The outer surface can be finish sanded to reduce the effort required when preparing for the finish.

There are three adhesives which have gained wide acceptance for attaching sheeting to cores; 30 minute epoxy, 3M77 spray contact adhesive, and Southern Sorghum foam core adhesive. The 3M77 and Southern Sorghum are more difficult to work with since they require that the sheeting be place exactly in the correct position the first time. The 30 minute epoxy is much easier to work with by if not done properly will cause a significant increase in the weight of the wing. The best way to apply the adhesive is to follow the manufacture's instructions. If epoxy is used, it must be applied sparingly. A plastic squeege must be used to remove as much of the epoxy as possible before the sheeting is applied to the core. The contact adhesives must be allowed to cure as shown in the instructions to avoid trapping vapors under the skin and causing damage to the core.

Regardless of the adhesive used, application of the sheeting is the same. One edge of the sheeting is placed flush with the trailing edge of the core while the sheet is held away from the core. When the trailing edge has been aligned properly, the palm of the hand is used to press the sheeting down on the core working slowly toward the leading edge. When the leading edge is reached, there should be a small amount of excess shheting overhanging which will be trimmed later.

After the sheeting is applied, the core assembly is returned to the bottom cradle and the top cradle is placed over the assembly. When the core assembly and the cradles are properly aligned, a large amount of weight is distributed evenly over the top cradle. The core assembly should be allowed to stay in the cradles for a minimum of 24 hours to allow total curing of the adhesive. Epoxy and contact adhesives continue to cure even after the cemented surfaces are joined.