An original Porta-Plane™ Design

Carbon Kestrel™

CONSTRUCTION GUIDE

&

OWNERS MANUAL

Indoor/Outdoor Portable Electric Powered
R/C Flying Wing Kit

Ace Sim RC

Medford Oregon USA

WWW.ACESIM.COM/RC

Carbon Kestrel

Congratulations on your purchase of the Carbon Kestrel kit. This indoor or light wind yard flyer is very efficient and performs well with just the little GWS brand LPS motor and a pair of small LiPoly cells. It is stable in flight yet offers exceptional controllability with it's unique wing shaping system.

With a GWS IPS 1S motor the CK becomes an aerobatic wing for in close stunts. Plus, with a 2S 1200 pack you can get over 30 minutes of full throttle fun!

SPECS:

- Span = 30 inches
- Area = 246 square inches (1.7 square feet)
- Length = 14 inches
- MAC = 8.5 inches
- AR = 3.5:1
- RTF Weight = 4 to 6 oz
- Wing loading = 2.5 to 3.5 oz/sq ft

TABLE OF CONTENTS:

GEAR:

Motors:
GWS LPS 7.2 volt "C" drive (6.2:1 ratio) with 7x6 prop for docile flight.

GWS IPS "DX-1S" drive (4.14:1 ratio) with 8x6 slow flyer prop for speed and aerobatics or use a 9x4.7 SF prop for slow indoor use.

Or a light CDROM brushless motor for the ultimate performance.

Batteries:
Lithium Polymer 2 cell series pack (7.4 vts) of less than 2 oz weight - i.e. 2S Kokam 700 or 2S E-Tec 1200.

~2 oz - 6 cell NiCad or NiMH pack.

Receiver: Pico receiver (GWS R4P) or equivalent.

Servos: 2) Hitec HS-55 servos or equivalent (i.e. GWS Naros)

ESC:
Pico speed control (i.e. GWS ICS-50) or equivalent
Brushless ESC for CDROM motors.

Radio:
3 channel with elevon or delta mixing or can add a separate mixer to non-mixing radio.

TOOLS:

ruler
pencil
sharp pointed scissors
hobby knife with sharp point
needle nose pliers
needle and thread
1/16" drill bit w/motor or pin vice
1/8" drill bit
diagonal cutters
small screwdriver for servo horn screws
single edge razor blade (optional)
hemostats (optional)
spring clamps (optional)

SUPPLIES:

CA thin glue
CA gap-filling glue (optional)
accelerator (optional)
masking tape

FEATURES:

If you're the proud owner of our Carbon Falcon, you already know how well wing warping effectively controls the craft. The Carbon Kestrel also offers the same great handling only on a lighter, smaller, less complex airframe.

Airfoil shaping is done without any ribs with a unique wing bow for a semi-rigid single surface under-cambered wing.

Wing warping is direct via a torque tube to tip rod activators offering elevon like control with no control surfaces.

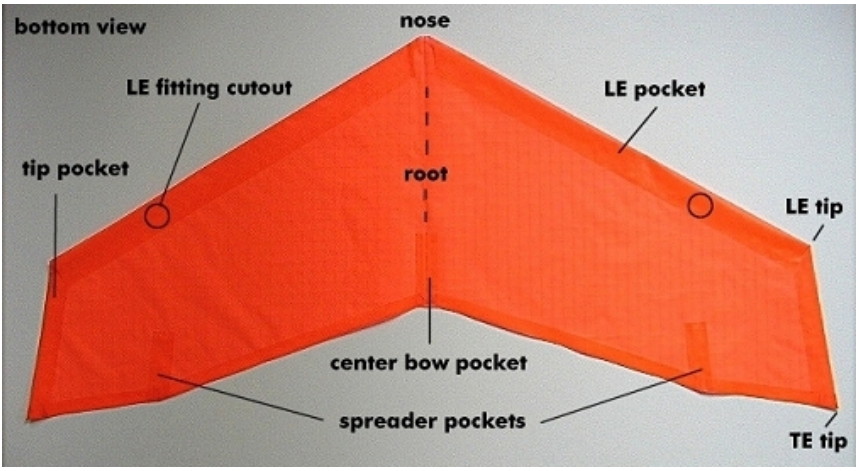
Most of the hard work is already done for you like pre-cutting all carbon fiber tubes and rods to length. The sail is cut and taped and almost ready to go except for a few details.

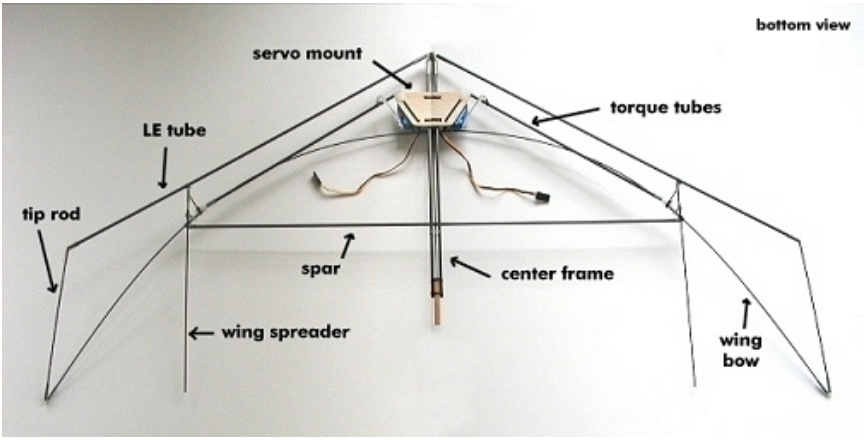
Building requires you to measure and cut lengths of vinyl tubing for fittings. Then CA and lash these together or directly to the frame. Your gear is just hung with bands to the frame and the servos are wire-tied to their mounts. The entire construction should only take a couple evenings of casual work to complete.

Please read over these instructions completely and understand all the steps prior to starting construction. Don't worry why things are done the way they are, only that you understand how to do them. Once assembled and working it will all make sense. If you think there are better ways to do something, please wait until it is flying well in its stock form before making any changes. This will give you a reference to compare your modifications against.

This design has evolved from a dozen different configurations, revisions, and refinements. It has also undergone thorough flight testing. The CK flies very well but needs to be constructed properly to achieve its high level of performance. Many parts are serving multiple purposes that may not be apparent at first so just follow each step and you will be rewarded with a unique, great flying portable wing.

Due to the exclusive systems utilized in the design, we've had to invent terminology to document the plane's construction so to reduce confusion, please familiarize yourself with the parts diagrams so you know what we're talking about.





PARTS LIST:

1) Ripstop poly sail

Carbon Tubes & Rods

1) Cross spar tube -	.125 x 19"	
2) Leading edge tubes -	.125 x 16"	
2) Center Frame tubes -	.125 x 10"	
2) Torque tubes -	.125 x 9"	
2) Wing bow rods -	.06 x 19.875"	(19 7/8")
1) Root bow rod -	.05 x 10"	
2) Wing spreader rods -	.06 x 7.5"	(7 1/2")
2) Tip rods -	.06 x 5.875"	(5 7/8")
2) Torque tube lever rods -	.06 x 1"	
2) Spreader standoff rods -	.06 x .5"	(1/2")

Wood

1) Servo mount plate -	Lightply – laser cut
1) Motor mount stick –	3/16” square x 1.75” long
2) Stir stick shims	

Nylon

8) Wire ties
2) Wire clamp bearings
2) Bolts
2) Washers
2) Nuts
2) Torque rod fitting sleeves

Clear fitting material

16 in) small diameter tubing
16 in) large diameter tubing

Miscellaneous

2) spreader rod tip covers
1) length .032 music wire
1) TE tension hook
1) 16” length repair tape
1) 3 yds lashing thread
1) length servo mount tape
   elastic bands
1) Owners manual

Hardware

2) Servo horns (used as control horns)
4) Dubro micro links

FITTINGS:

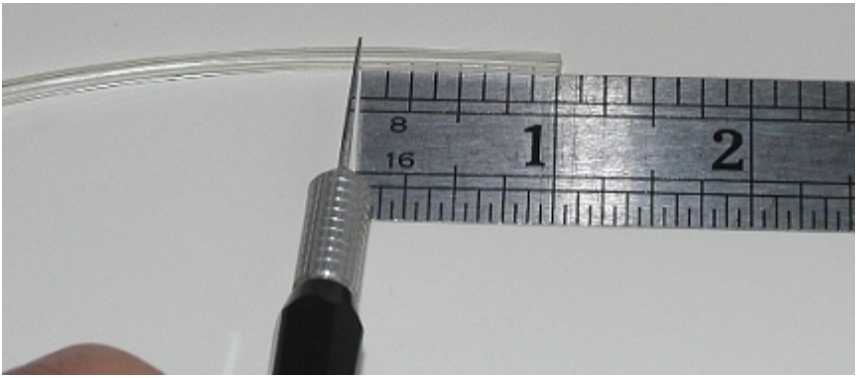
Before we get started on the frame, there are a couple simple construction techniques you need to learn to build your CK.

Fitting material

There are two diameters of clear flexible tubing supplied. The large is for the tubes and heavy rods and the small is for the thin rods.

(We'll refer to these as "fitting material" from now on to eliminate confusion with the term "tubing", used for the carbon fiber "CF" tubes).

Cutting – Line up the specified size fitting material next to a ruler to the length needed and slice off the piece with a hobby knife or sharp scissors. A single edge razor blade on a hard surface works well also.

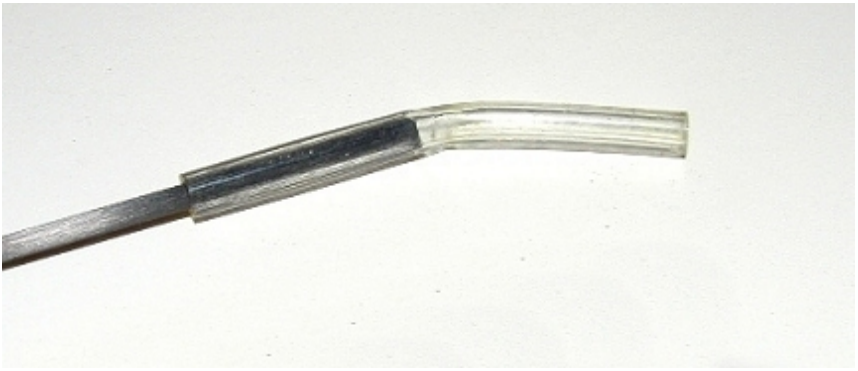


GLUING NOTE:
For CAing these fittings, I set up a little "glue pot" by taking a plastic bag (no wrapping film - it will leak) and put a tape roll ring inside. Press down the plastic to make a little dish and put a few drops of CA in it to work with. If you don't smear it around

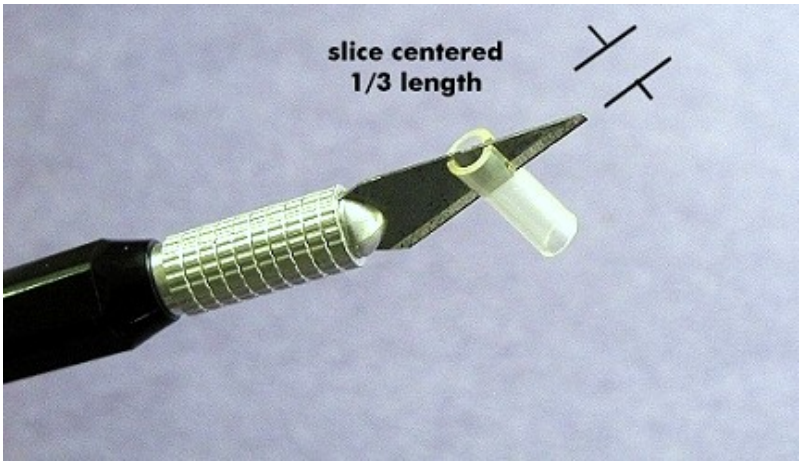
it will stay liquid for a long time. Use a thin stick or toothpick for an applicator. One of the stir sticks with an end pointed works well for this.

Fitting Types

There are basically two types of fittings used.
a) Sleeves or elbows are simply a length of the fitting material inserted half way onto the ends of the tubes or rods to be connected.

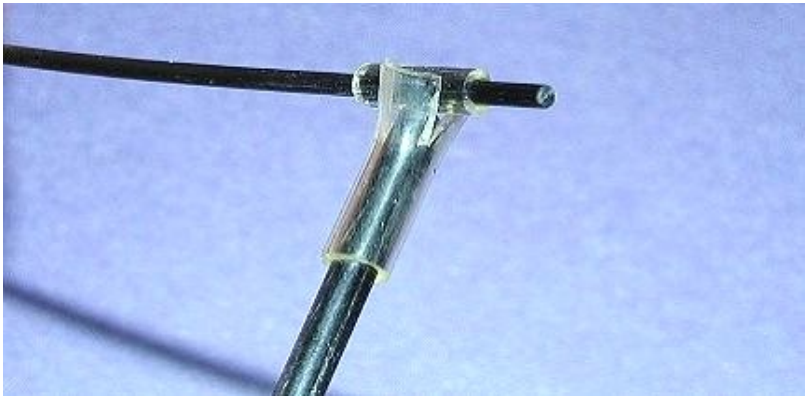


b) "T" fittings are made from a piece with a lengthwise slice 1/3 of its length into one end. Care should be taken to keep this cut centered in the material, as it's easy for the cut to want to drift off to one side.

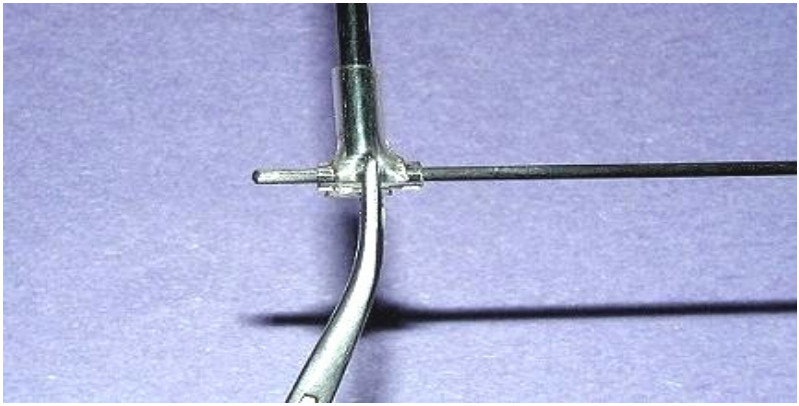


These "ears" are then spread open and CAed direct to a tube or to another fitting to form a "T". Always insert a length of rod or tube in the parts prior to gluing or lashing. This prevents the

vinyl from collapsing and changing shape. Just be careful not to glue the piece into the fitting!



Since the ears need to be pressed flat to the joining piece, clamp with hemostats or hold with needle nose pliers. You can add elastic bands around the handle to make it a clamp.

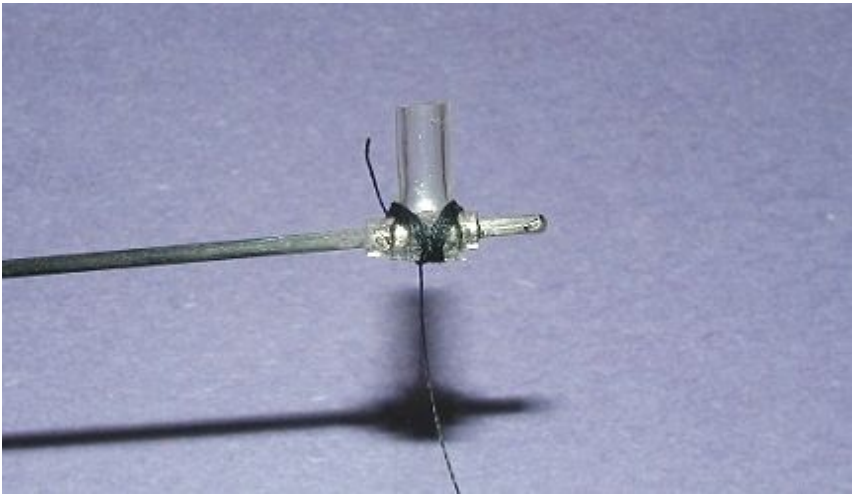


Wick thin CA just under the ears and look to see that it spreads out evenly under them. Hold till dry and hit with accelerator if available. Recheck your measurement to be sure the fitting didn't slide off center or didn't seat fully. If it isn't right, you can easily peel the fittings apart and start over.

Lashing Fittings

Some fittings require lashing for strength. Take your polyester thread and either hold, tack or tie one end on and wrap as shown securely. Insert a rod in the fitting first so you can't wrap the thread so tightly that it can’t be inserted later. Check this tightness before gluing to be sure the rod can be removed. The lashings around CF tubes and rods should be wrapped very tightly

however. Carefully wind trying to get each wrap to lie next to the last one if possible. Don't pile up an excess of thread. A single layer is usually all that's needed in most cases.



When finished, hold the loose end tight and tack it off. Next wick CA into all the thread. You only want to wet it, not drown it. You can tell when you have enough, as the surface will be shiny all over. Trim the loose ends and it's done.

Fitting Cut List:

Quantity	Length	Size	Location
1)	3/8"	small	nose insert LE stop
2)	3/8"	small	part torque fitting
2)	3/8"	small	part spar fitting
8)	3/8"	small	4)spreader T fittings
1)	3/4"	small	nose - root-bow fitting
2)	1"	small	TE tip / wing-bow elbows
2)	1”	small	LE/torque/spreader
3-5)	1/8”	small	stops (see text)
2)	1/2"	large	part spar fitting
1)	1"	large	wing bow sleeve
2)	1"	large	LE / tip elbows
2)	1.5"	large	center frame sleeves
2)	1.75"	large	LE nose/center-frame fittings
2)	3/4"	poly	torque rod sleeve (pre-cut)

Cut all the pieces to length and lets start making the fittings.

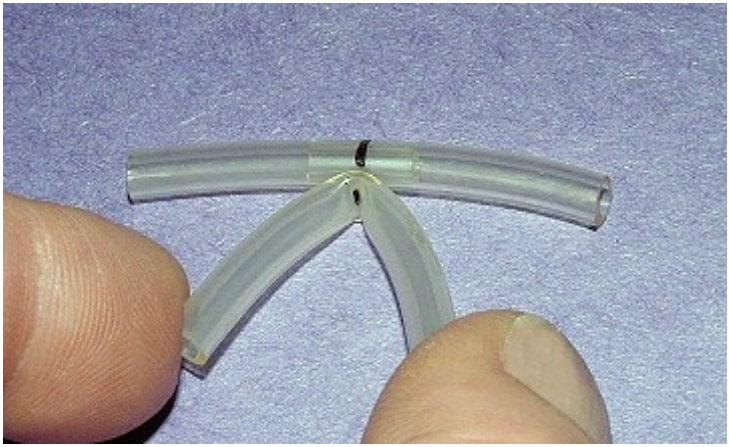
Nose Fitting

This is the hardest part to make so let's get it out of the way. It will give you experience for making all the rest.

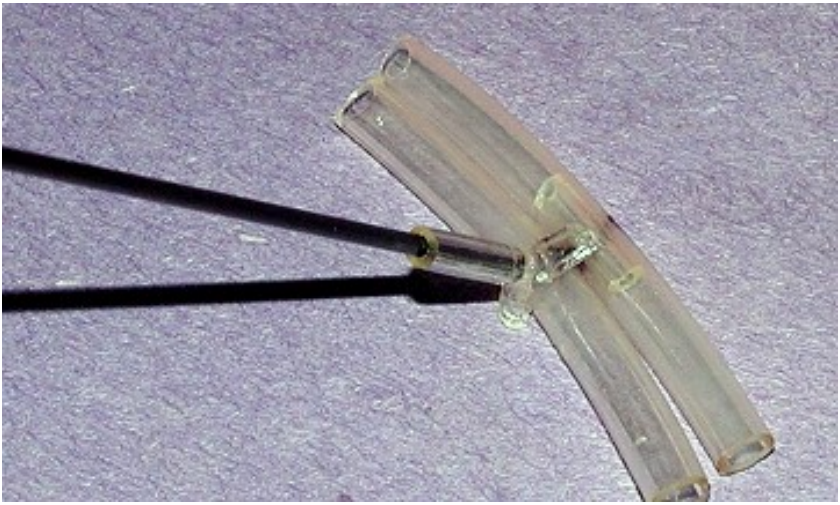
Basically this is two large elbows and a small "T" piece attached in the middle. Measure and mark the centers of the large elbows. Now insert the short small piece centered inside the larger front LE piece using a rod as a tool.

This acts as a stop for the LE tubes to prevent them being forced too far forward in the event of an impact.

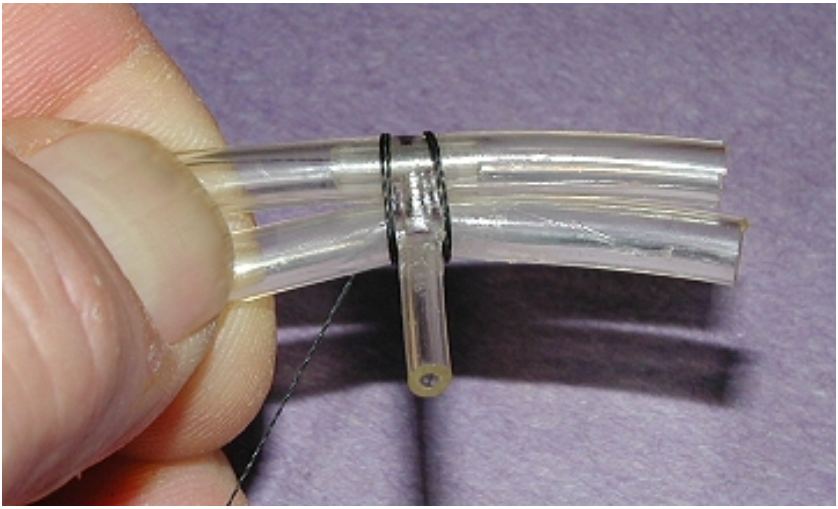
Now with the two large lengths both curved back laying flat next to each other, tack these together in their centers with the lower one held bowed.

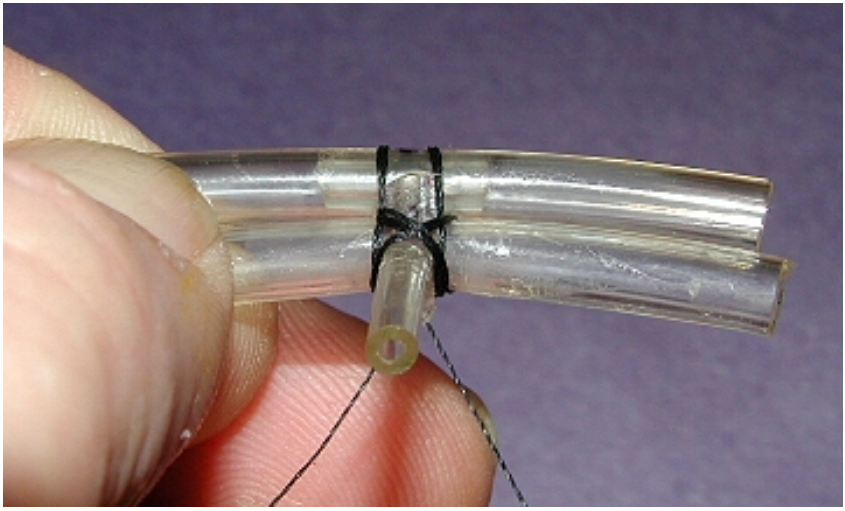


Next tack the "T" piece in the center keeping it tight and flat straddling the bottom piece and leaned back at an angle. Insert a rod to help hold it but don't let it get glued in the process.



Lash criss-crossed around both large parts and the "T" piece as shown. Be sure to alternate the crossing over each ear of the "T" so it's securely contained.





The center tubes can be fitted into the rear elbow to check for fit. The T fitting is used for the front attachment of the root bow rod that is located above the center frame.

Tip Fittings

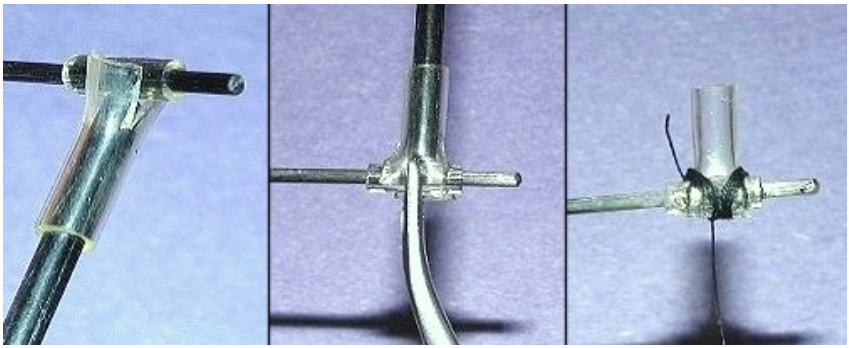
The LE tip fitting is just an elbow. Install it halfway onto the LE tips and the smaller tip rod will just float inside the excess within the sail pocket.

The TE tip fitting is the same only the smaller diameter fitting material is used and is installed on the tip rod end.

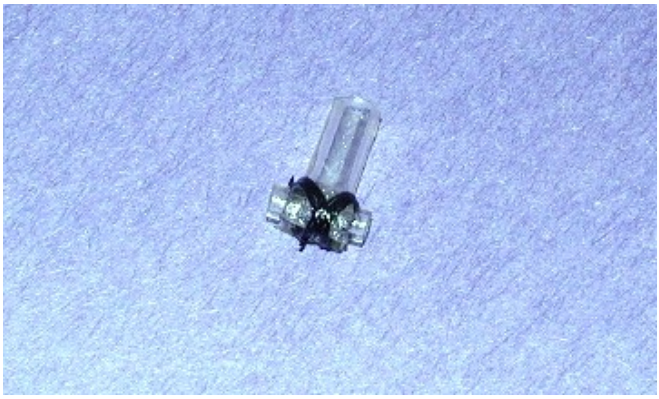
T-Fittings

We'll need a few small T fittings made from the thin fitting material. With rods fitted into them to hold their shape, center the slit ears around the center of the joining piece. Clamp, wick and it's done. You'll need four of these T assemblies from the small fitting material for the spreaders and their standoffs.

You will also need two fittings made with large fitting material on the T uprights but small material for the horizontal part. These are for the spar tube attachment to the wing bow.



These two spar fittings should be lashed as shown for strength.



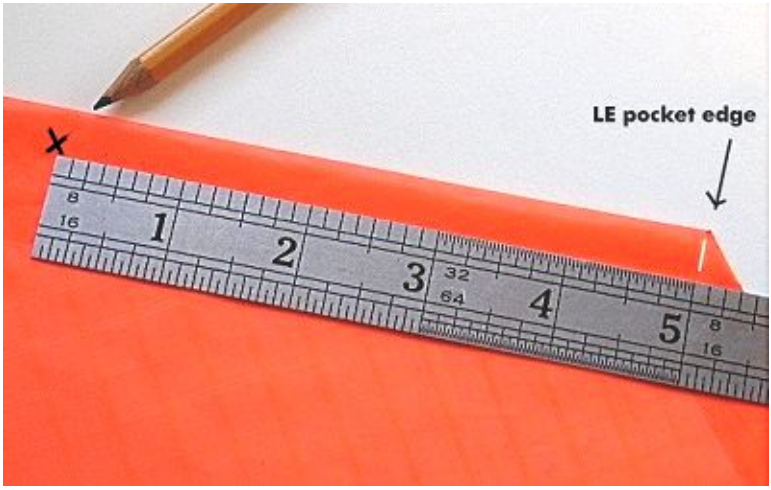
SAIL:

The sail is pre-cut to shape with the hems and frame pockets completed. You'll only need to trim some cut-outs for fittings and reinforce areas with the supplied ripstop peel and stick repair tape.

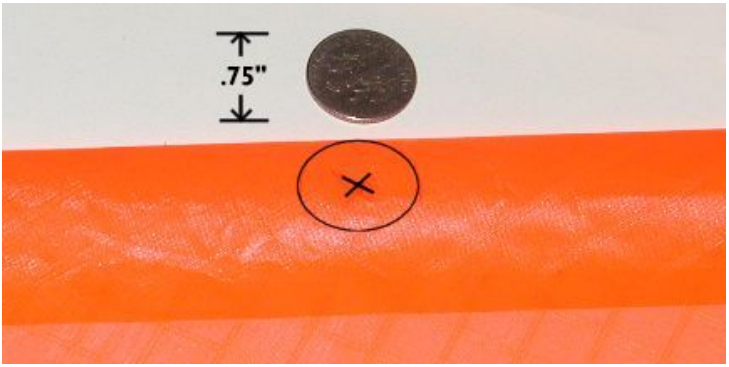
LE fitting cutout

These need to be about the size of a dime and centered over the fitting with the hole starting from the LE fold line and cut only from the bottom of the pocket. Do not cut any material from the top surface of the sail. The bottom of the sail has the pocket edges and sleeves on it.

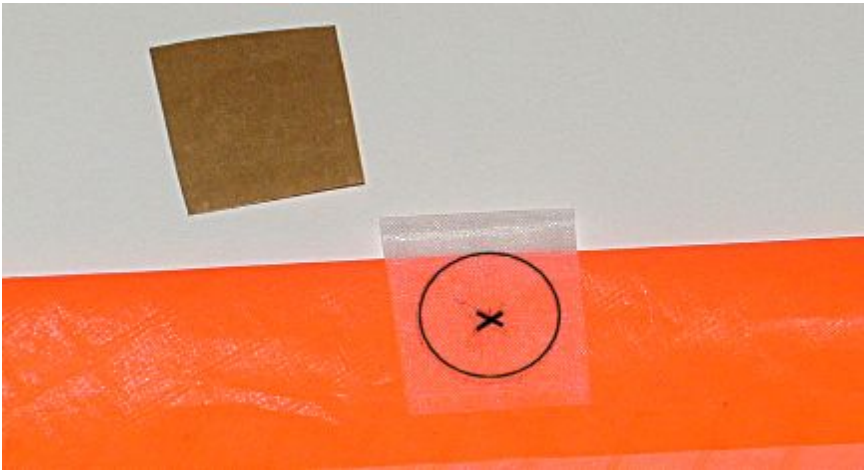
To locate, measure 5 inches in from the tip LE pocket edge and mark.



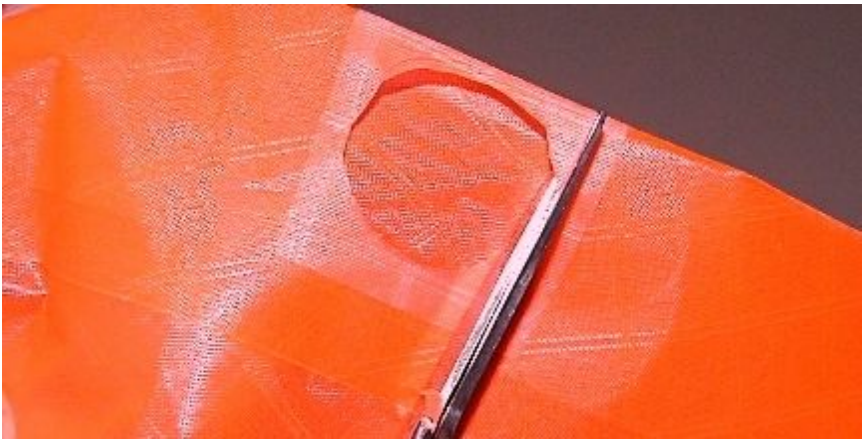
Center a dime on the mark and with its edge close to the LE, draw around it.



Now apply a 1.5 x 2 inch piece of reinforcing tape centered over the circle wrapping about 1/4 inch of it around to the top.



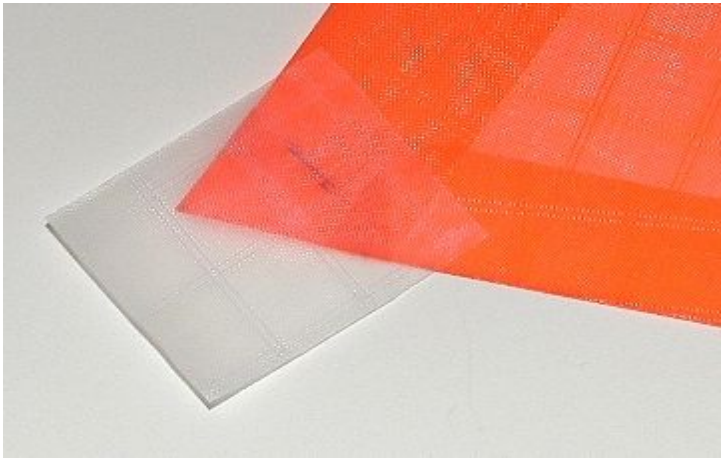
Start in the center and being sure you don't cut through the top of the pocket, pinch the fabric and start a small hole. Trim outward until the cutout is complete.

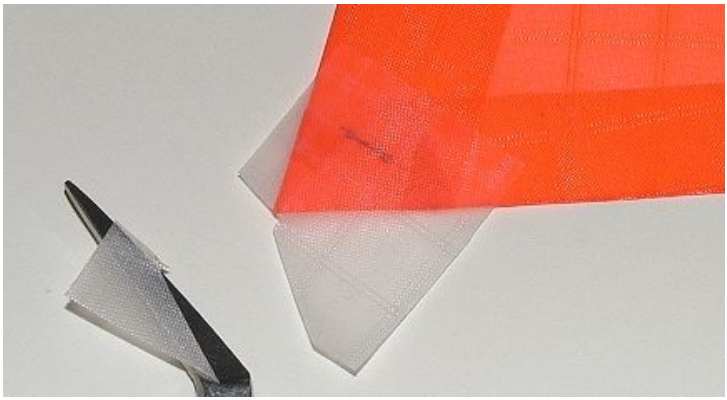


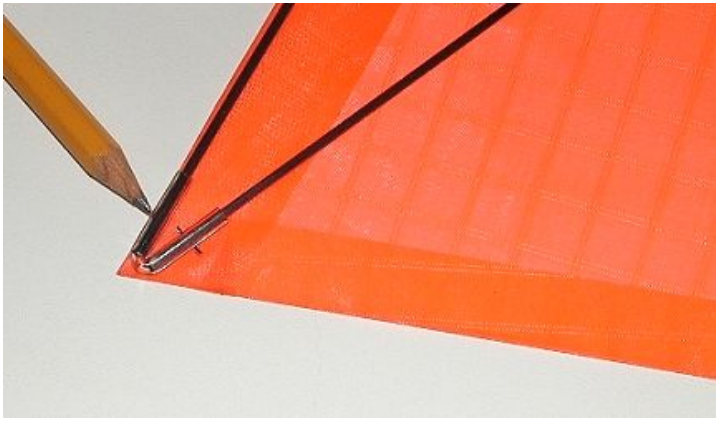
TE Tip Pocket

Since the tip rod is inside the tip sleeve and the wing bow connects to it at the tip TE you need an opening cut into the pocket for the tip TE elbow to exit. The wing tension is held here however so you want enough pocket intact to hold the load.

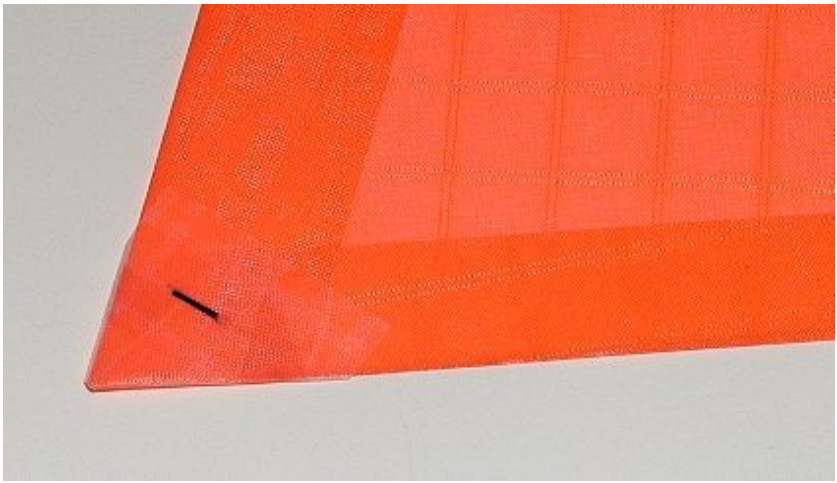
First reinforce the corner with piece of the ripstop tape as shown with a 1 inch x 2 inch piece.



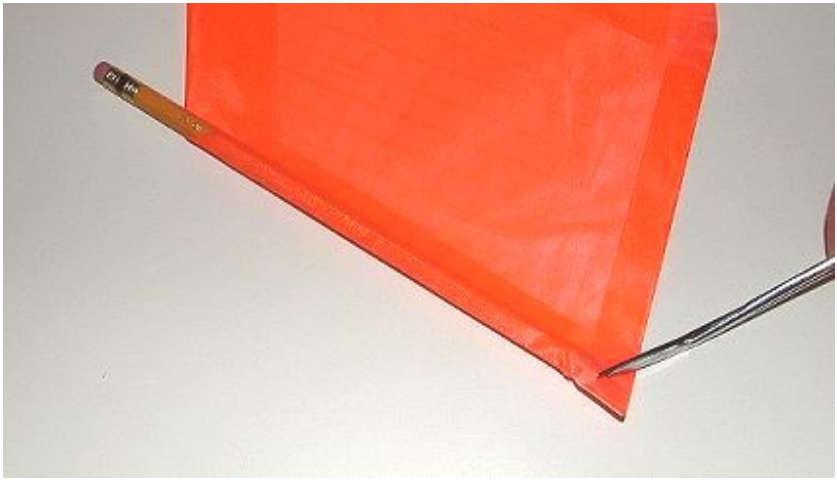




Make the opening about 1/2 inch up from the tip in the bottom surface of the corner.

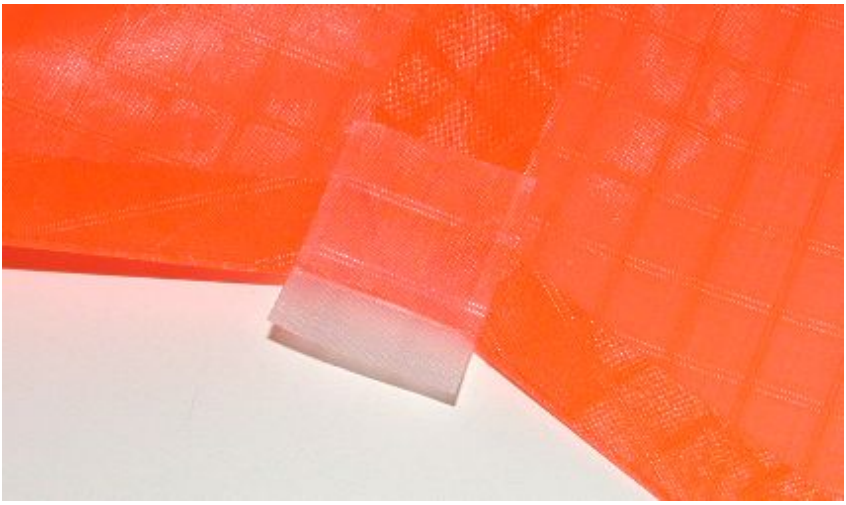


It only needs to be long enough for the sleeve to exit at a slight angle and again, be sure to cut only through the bottom surface of the pocket. A pencil inserted in the tip sleeve makes this easier.



Sail TE Hook

Add a 1 x 2 inch piece of the repair tape around the TE at the root, having 2/3 on the bottom and 1/3 on the top.

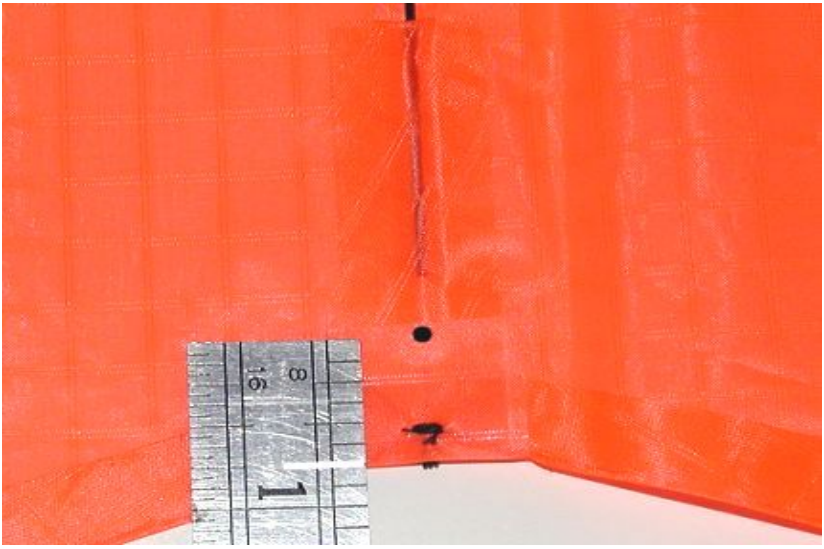


Position the hook with its flat side down centered on the **TOP** of the sail at the root TE. Have the hook eyes forward and sew through the eyes and sail with a few loops of thread.

Add a small drop of CA on the threads on both sides of the sail to prevent it from unraveling.

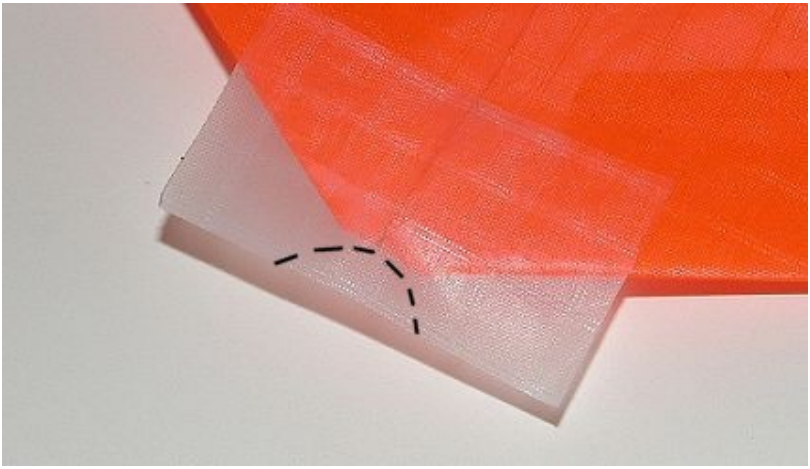
Root Bow Opening

Measure forward 3/4" on the center line of the root sleeve from the TE edge and punch a very small hole only through the bottom sleeve layer of material. The root bow rod will exit the sleeve here.

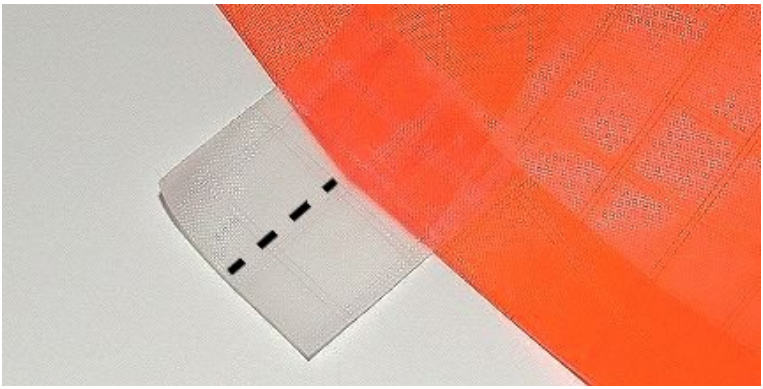


Sail Reinforcements

Using a 3 inch length of the 2 inch wide ripstop tape, add a reinforcement patch to the nose opening.



Also wrap a 1 x 2 inch piece around the TE at both spreader pocket ends.

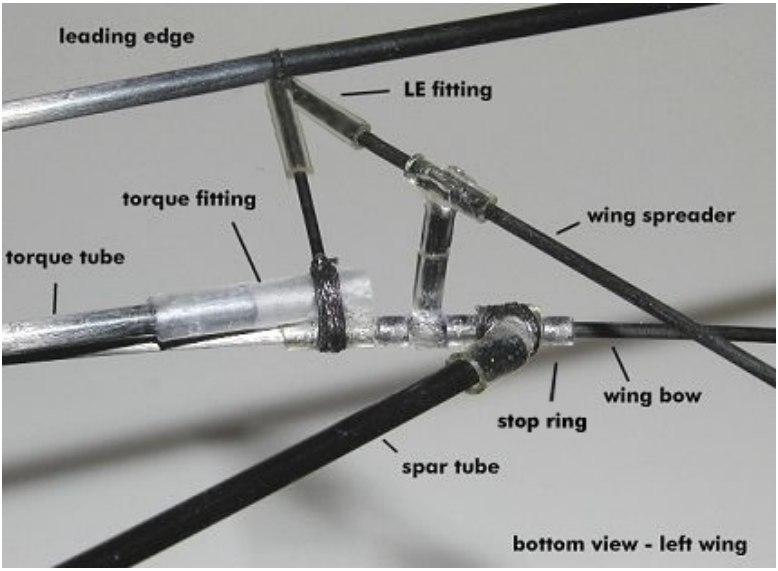


Do the same with the tip LE corner with a 2 x 2 inch piece slit at the sail corner as before so it can fold over evenly. Not only is this tape good for reinforcements but also it is great for repairs if you start to develop tears from those less than perfect landings.

Sail Construction Notes

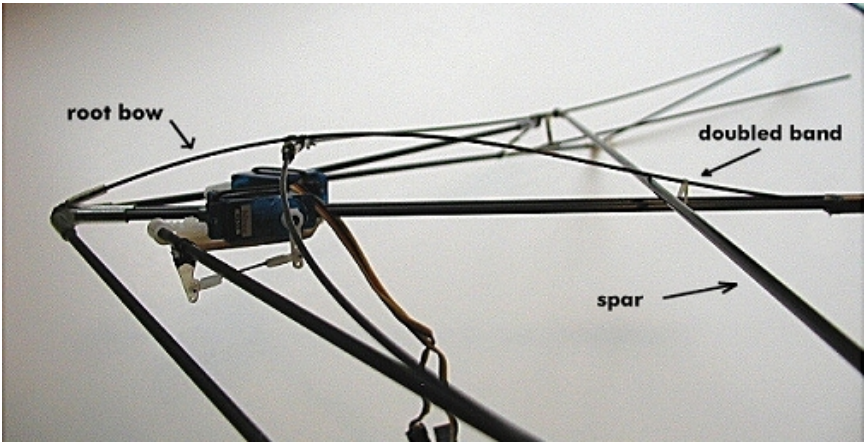
The seams we make in the sail use a special tape that is applied with pressure and then heat set. If a seam ever comes loose, you can reattach it using a trim or sealing iron set to medium heat. Use lots of pressure on it over a hard flat surface. Keep the heat on the tape line only and keep the iron moving as the ripstop fabric can pucker if it gets too hot.

FRAME CONSTRUCTION:

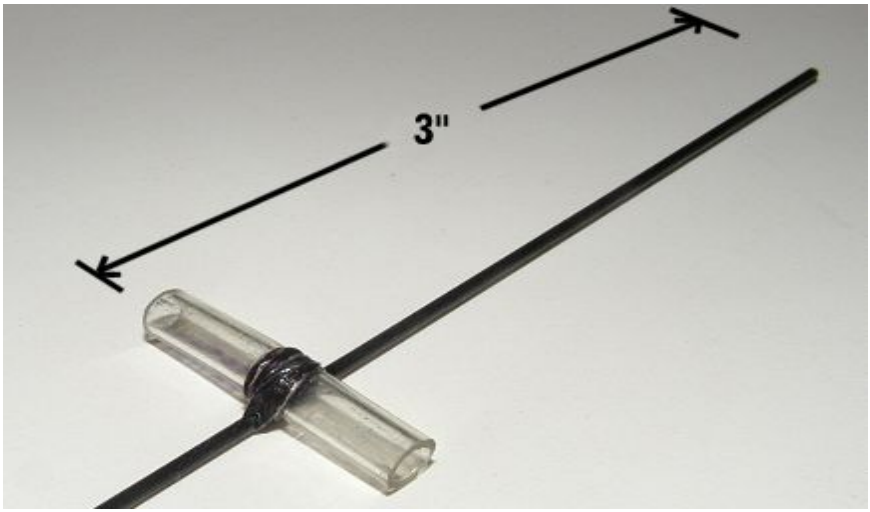


Root Bow

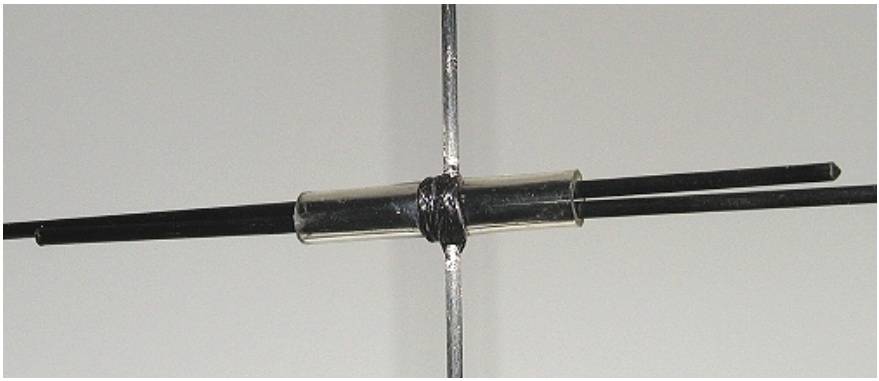
The root needs an airfoil shape so we'll make a shaping "rib" by bowing a thin rod from the nose small center "T" fitting back over the spar and ending in a hole drilled in the motor stick. A band around it and the center frame tubes behind the spar creates the airfoil.



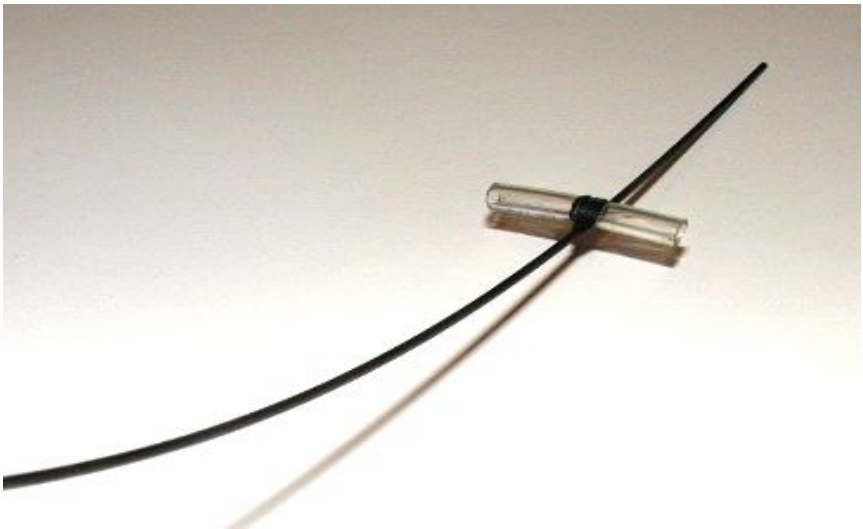
Center and lash on the wing bow sleeve where indicated. This fitting is best installed with the wing bow rods inserted through it so when lashed it can't compress so far that these rods can't be inserted later.



Use a criss-crossed lash to hold the fitting square to the rod. Don't glue this lashing yet but tie it off tight instead for now.



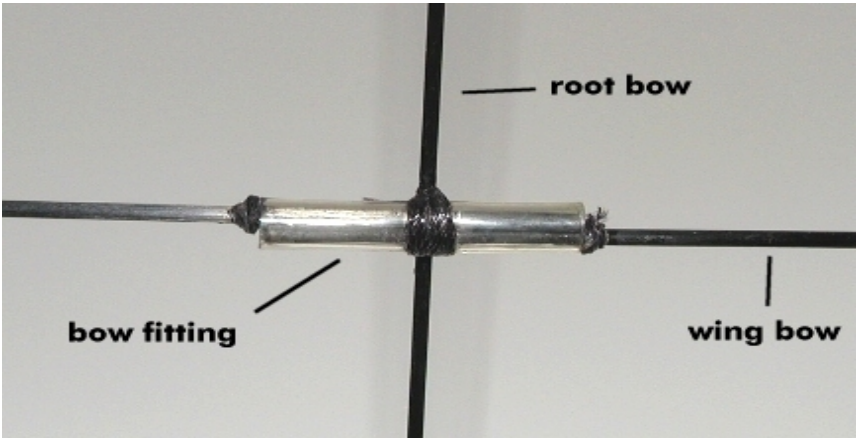
Now before gluing the lashing, with the center bow bowed, find it's natural direction of least resistance by rolling it while keeping it pressed down. Once found then align the fitting so the bow is vertical to it. If you don't mount the wing bow fitting square to this direction, the center bow will have a tendency to want to lean over one way or the other once it is under compression. Now coat the lashing well with CA.



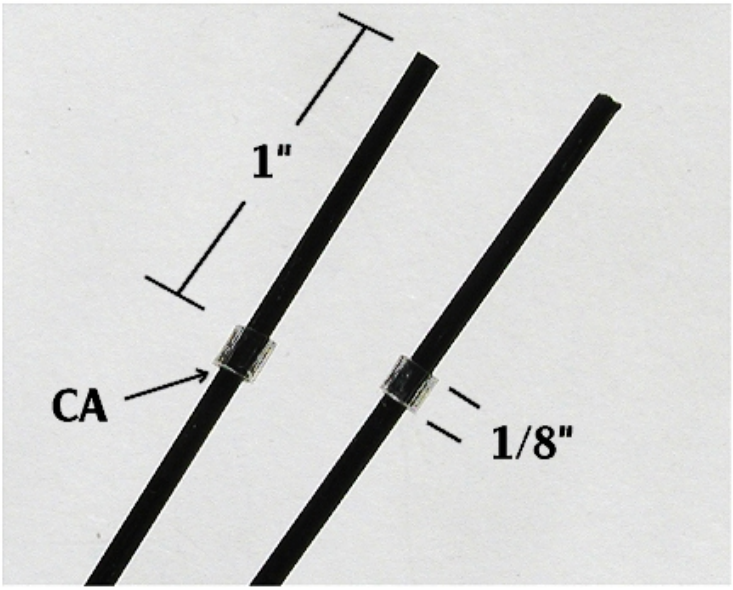
Wing Bows

These are one of the keys to the CKs fine flight qualities. We spent months in development of many flat wing versions with varying degrees of success. Not until these bows were added did the plane really start to fly with the flight characteristics we were looking for. They not only shape the "airfoil" but hold the tips under tension outward for a taught wing surface.

For portability we use two separate bow halves connected in the center through the root bow fitting.



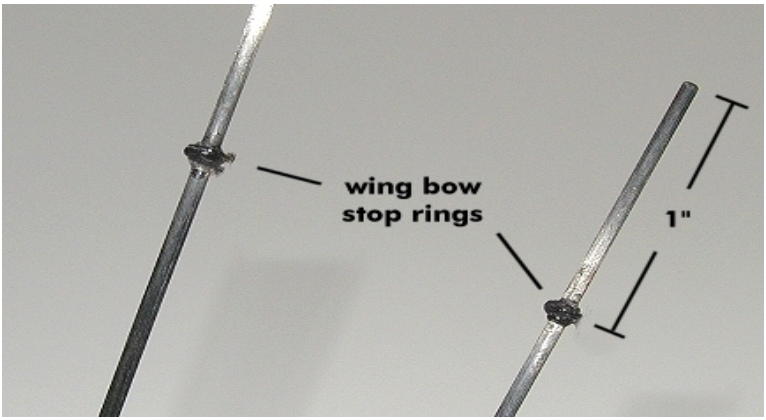
To keep the wing bows from sliding too far through the fitting, you need to add stops made either from a lashed ring of thread or short length of small fitting material CAed onto each piece. Place them one inch from the end.



To make the lashed stops instead, wrap as thin and as tall a ring as you can at the location. Tack it a couple times as you go so it

can be piled up for a substantial diameter. Finally fully coat the ring with CA and trim.

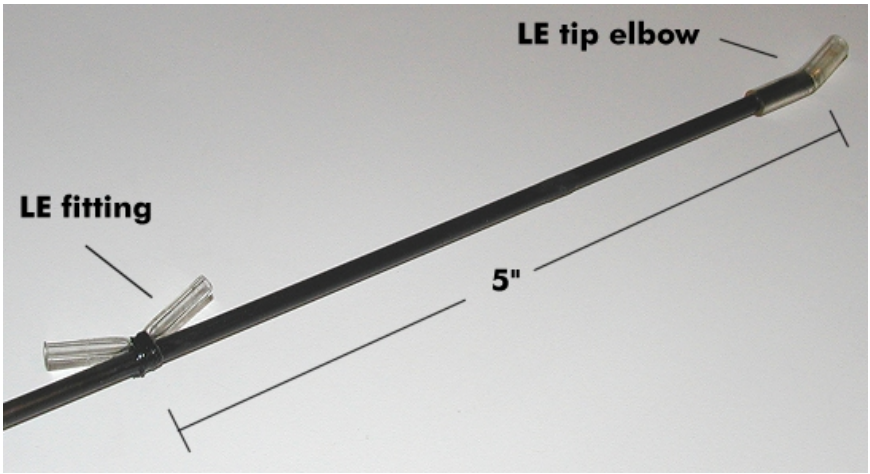
Test fit the rods in their fitting. They should be nice and snug and the rod ends should end flush with the fitting ends.



Note: If you find that later in the life of the plane that the sail tension could benefit from a tighter bow due to sail stretch, you can relocate or just extend the stop rings 1/8 inch closer to the ends which will lengthen the rods and tighten the sail.

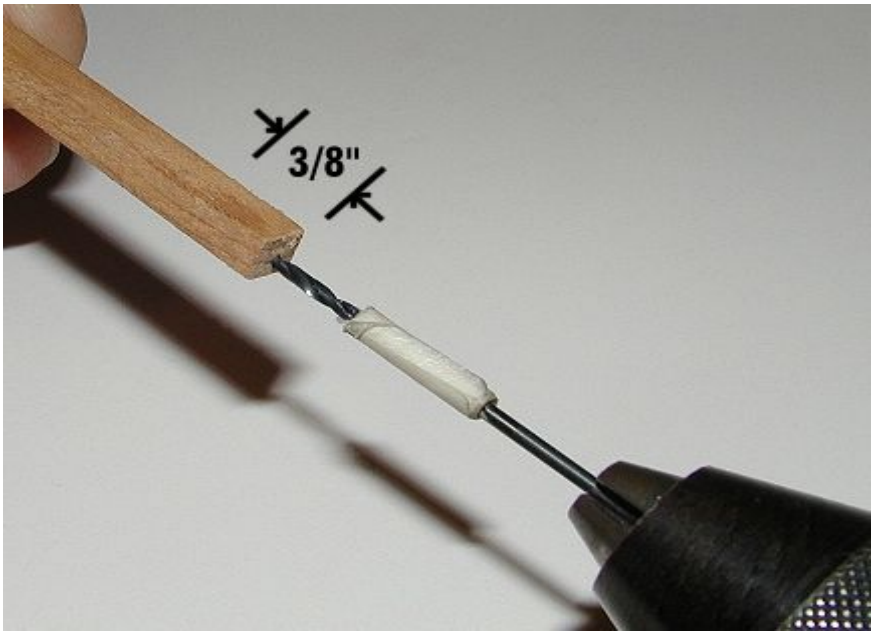
LE Fittings

Mark the location on the LE tubes where shown. Take the length of small fitting material and with it centered on the mark equally spaced, tack or hold it in place and lash it straight with the tube and very tight. Coat well with CA all around. Add the tip elbows.



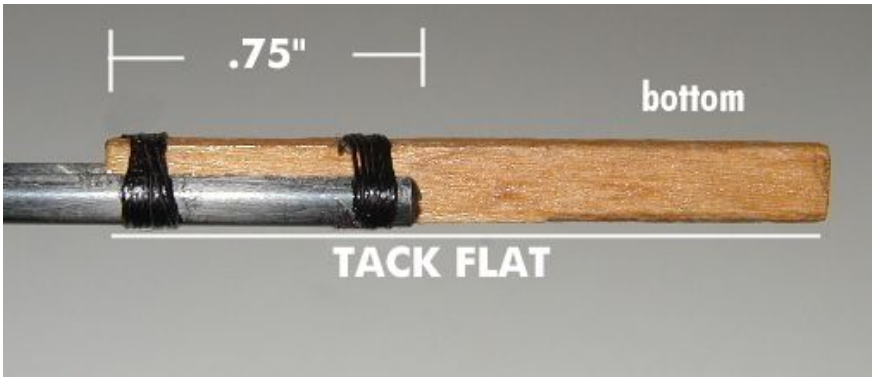
Motor Mount

Drill a 1/16 inch diameter hole lengthwise down the center into one end of the motor mount stick. Make it 3/8 inch deep. You can measure this on the bit and add a piece of tape to it as an indicator of where to stop drilling.

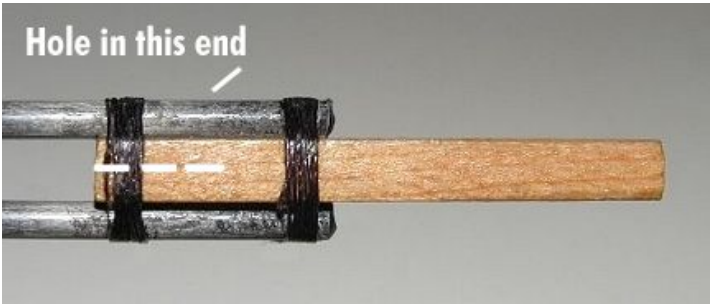


Keep the hole as straight as possible (or use a drill press if available) and don't go too deep. Now "paint" your motor mount stick with thin CA and allow to dry. This helps it from becoming loose in the motor from wear.

Next, on the sides of the stick, mark where indicated.



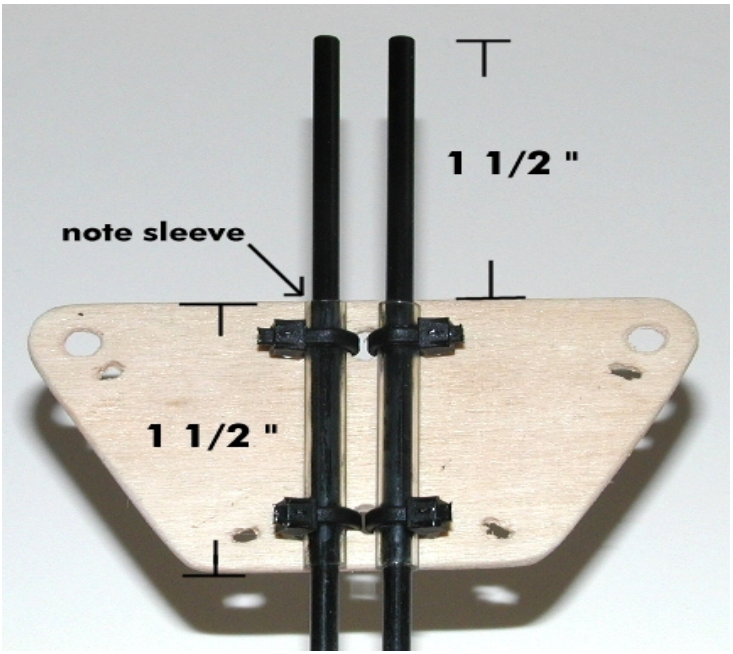
Position the stick with the hole forward between the ends of the two center frame tubes.



Lay the tubes flat down and up to the marks and assure that the two tubes are equally spaced by checking the other ends of the tubes. Tack at the correct locations. Next, lash permanently to the tubes in two places very tightly. The flat side aligned even with the tubes will go on top.

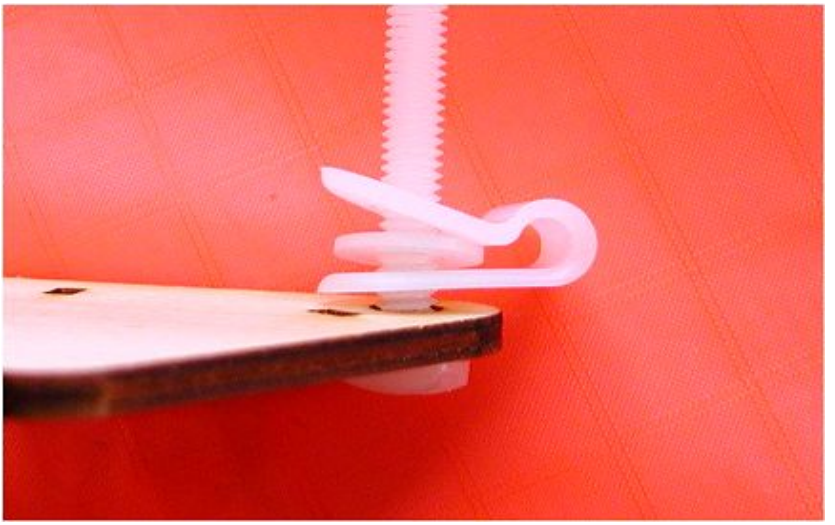
Servo Mount

Take your two center frame sleeves and slide them over the fronts of the center tubes. Locate them 1.5 inches back from the end of the tubes.

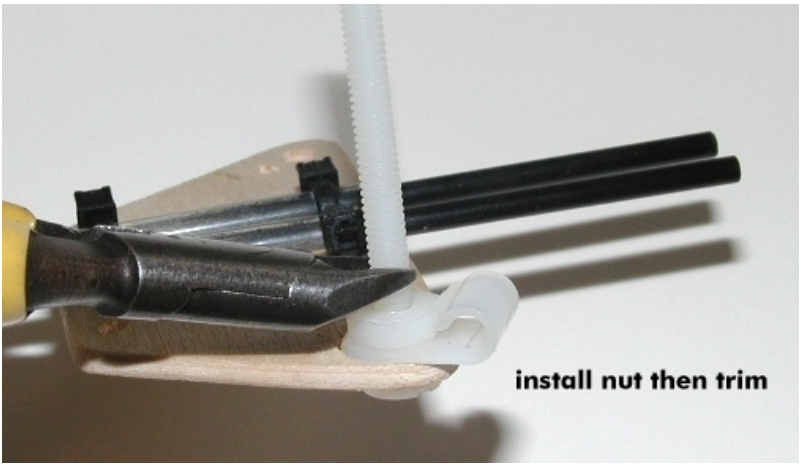


Take the servo mount plate and locate it on the bottom of the tubes with the wide edge forward. Remember that the flat side of the motor mount stick goes up. Wire tie the plate to the frame in 4 places keeping the latches on the top as shown. Pull ties good and snug so they bite into the sleeves and won't let the plate move on the frame. Be careful however as they can break if over tightened.

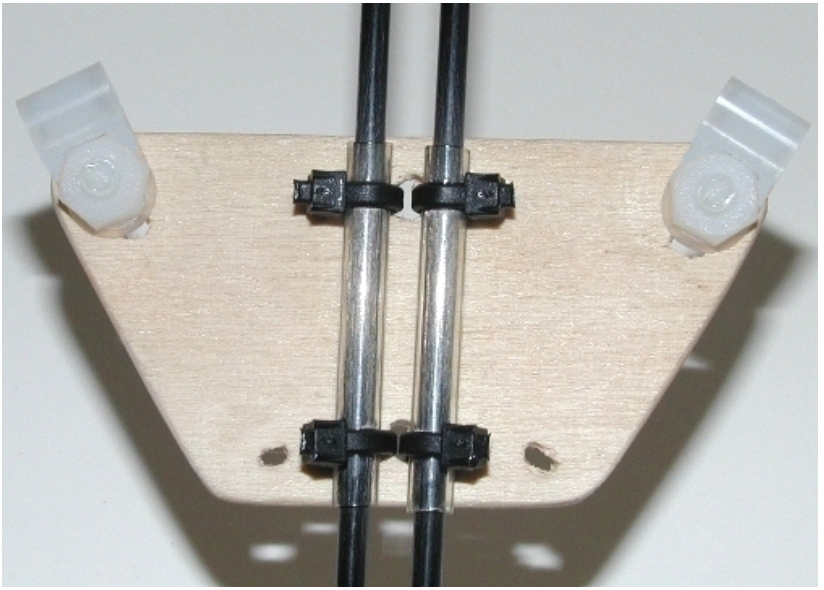
Take the two nylon cable clamps and install with a washer between the ears. These washers space the bushing diameter properly for a nice slip fit for the torque tubes.



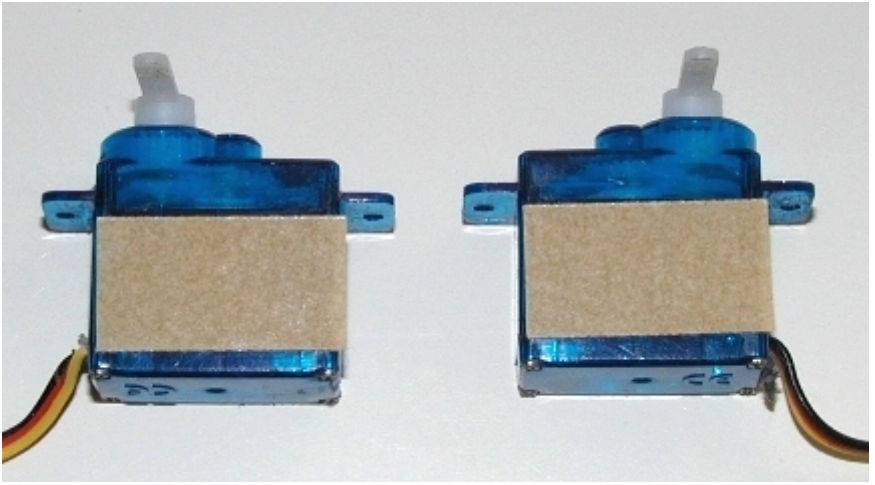
The clamps secure with the nylon nuts to the top of the plate as shown. Trim the excess bolt length not quite flush to the nut.



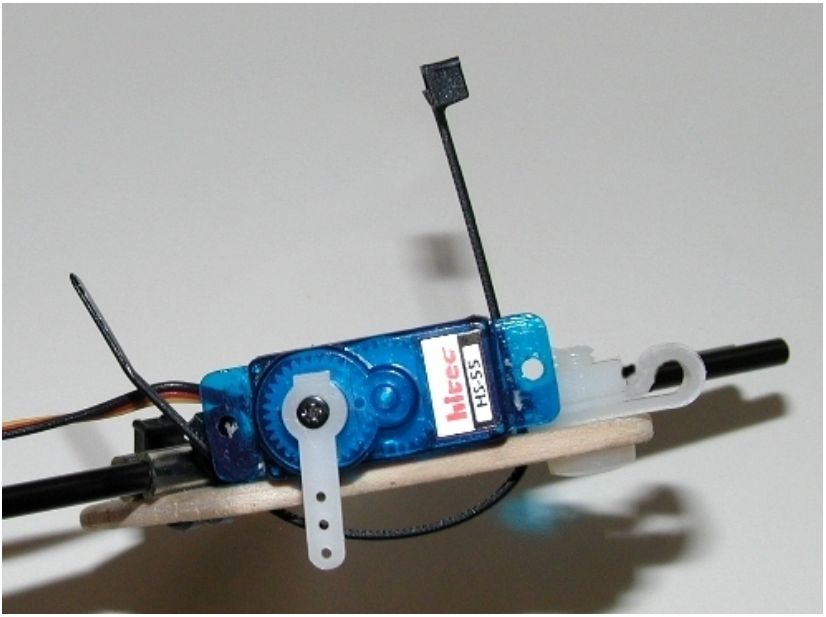
Keep the sides of the clamps aligned to the sides of the plate. Don't over tighten the nuts as you could strip the threads.



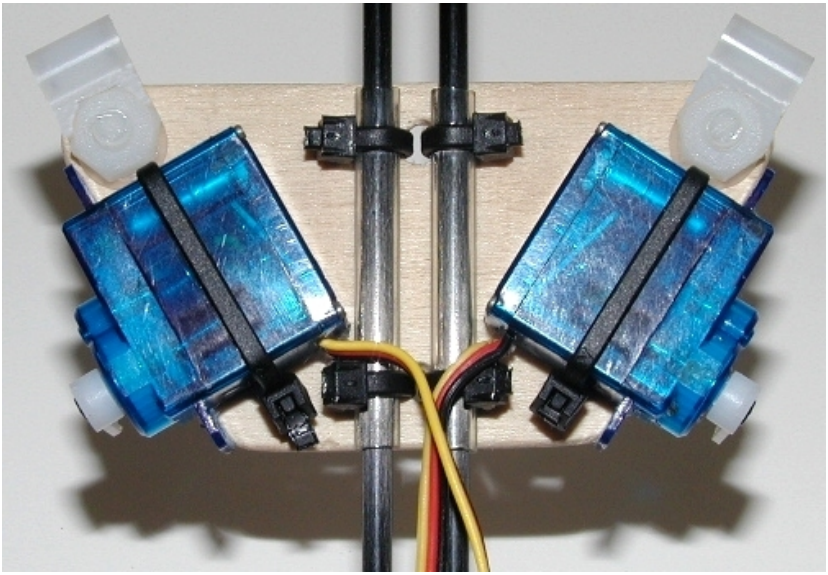
You should bench test your servos and with the trims centered install the servo horns square to the servos prior to mounting them on the plate. Apply double-sided tape to the horn side of the servo that will rest against the plate to keep them from shifting.



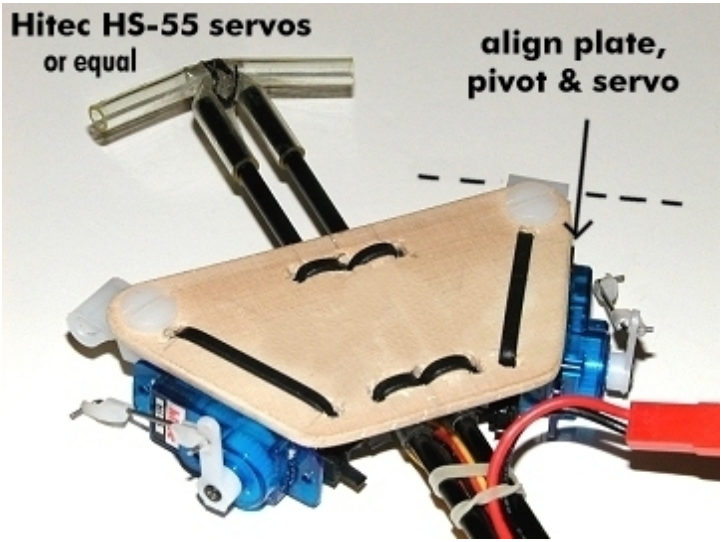
The servos go above the plate. Position them with the horns down and with the output shafts toward the rear.



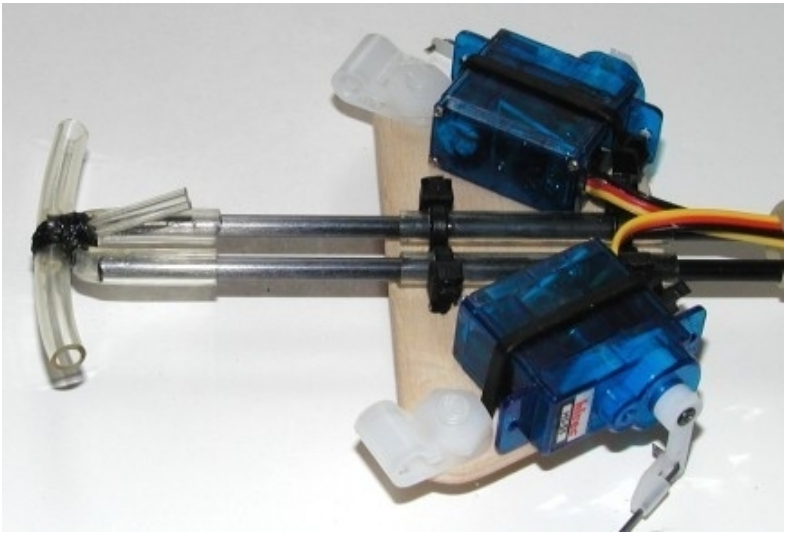
Center them between the tie openings in the plate and with the servo mount ears aligned to the sides of the mount plate.



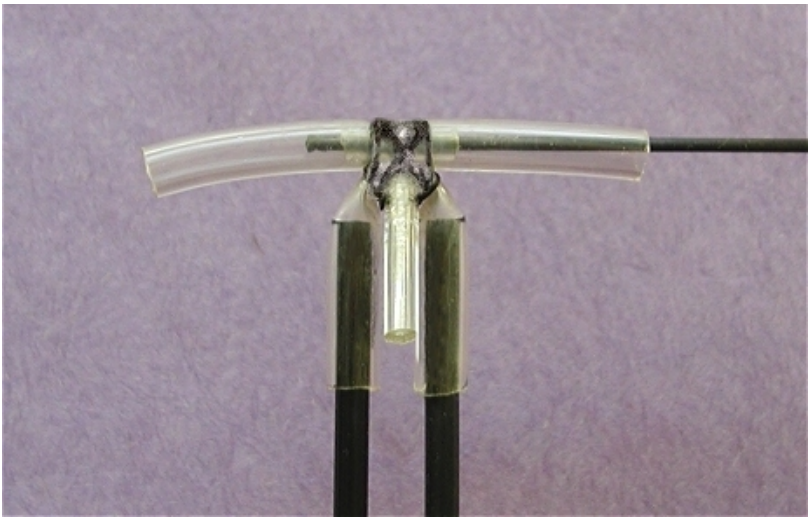
Depending on the height of the servo used, the distance they overhang the plate may vary so we will need to align the control horn location to match later. Add the wire ties to secure the servos to the plate again with the latches on top.



Nose Fitting



Insert the nose fitting onto the front of the center frame with the root bow fitting on top (servo mount plate down). Wick a drop of CA into it at the tubes.

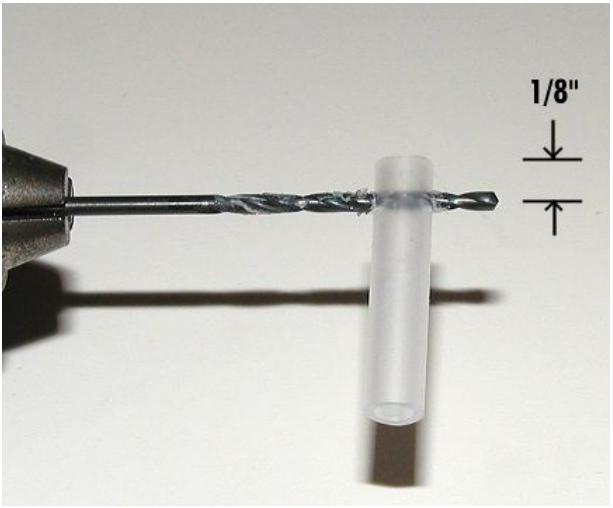


We need to add a guide hole through the front nose fitting for the root bow to seat into. Take the center bow rod and work it carefully into the inner sleeve as a temporary stop being sure not to push the inner sleeve out of position. Next take a fat pin or needle and insert it into the root bow nose fitting. Align it straight and work it through the hole in the LE fitting and on through the inner sleeve stopping when reaching the rod.

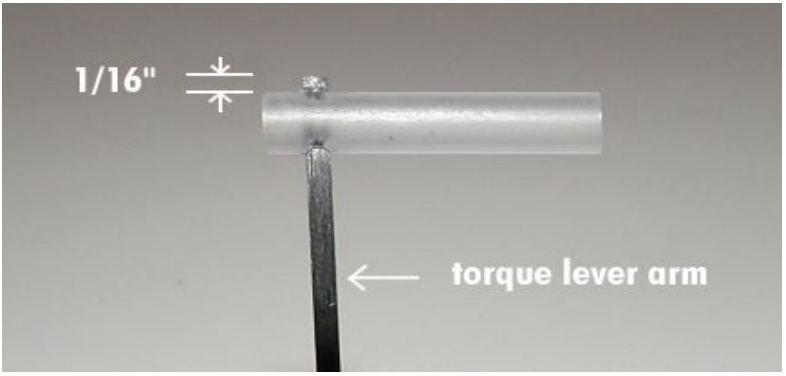
Remove the pin and rod and test fit the rod in its fitting. Work it carefully all the way in making sure it reaches the center of the inner sleeve. This will prevent poke-through on impacts.

Torque Tubes

The torque tube fittings start with the larger rigid poly sleeves. Measure 1/8 inch from an end and bore or drill a very small hole for the lever arm rod. Use a 1/32 diameter bit if available. Keep the holes centered and perpendicular to the tube.



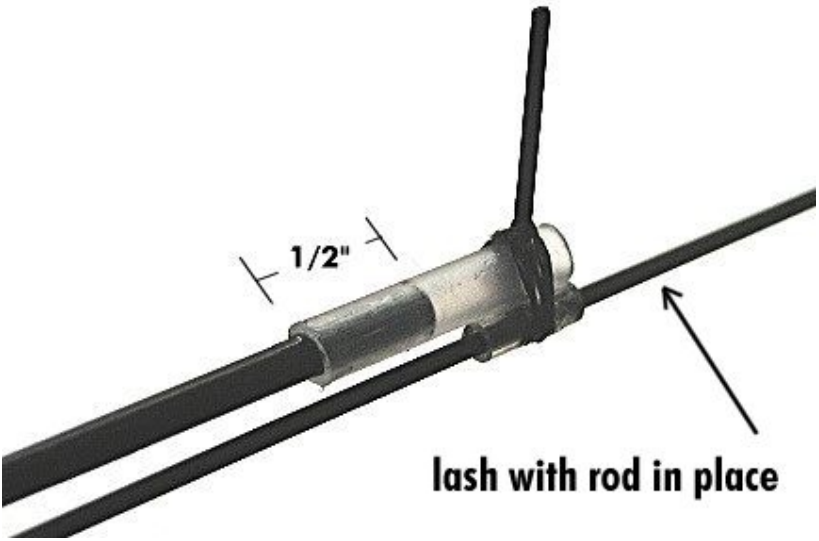
You want a tight fit for the rod so if boring the holes, start small and when it's just big enough to force the rod through, push it out the other side until 1/16 inch of the rod is extended.



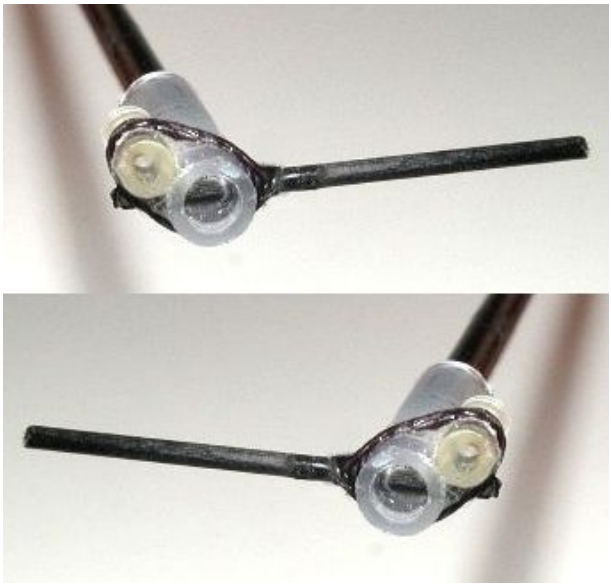
Insert the torque tube 1/2 inch into the torque fitting. These fittings are already a tight fit on the ends of the tubes but add just a very small drop of CA at the edge of the fitting to secure them to be safe.

Now position and tack the small fitting piece next to the short end of the lever rod and locate it flush with the end of the poly tube.

Insert a wing bow rod partway into the small fitting so it doesn't get smashed when lashing. Lash criss-crossed tightly around both pieces on either side of the lever rod. Coat thread well with CA all around fitting.

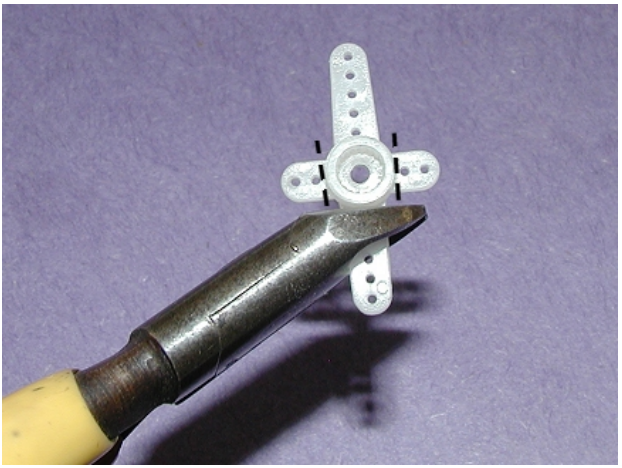


Do the same for the other fitting only mirror the position of the small sleeve with the first assembly.

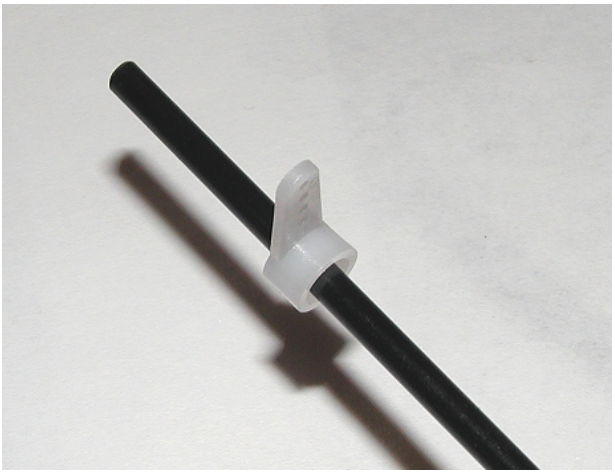


Control horns

Take the two servo horns and if necessary, trim any excess ears off the hub. Drill a 1/8 inch hole straight through the hub. Don't over-drill as you want them a tight fit on the torque tubes. It's better to not ream them when pulling the drill out, just stop it turning when through and unscrew it out of the hole by hand. This leaves a little extra material in the hole.



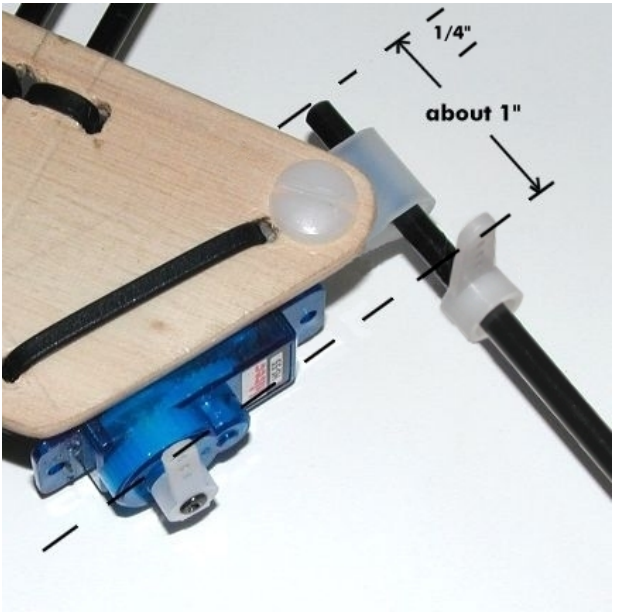
Insert them about an inch over the ends of the torque tubes.



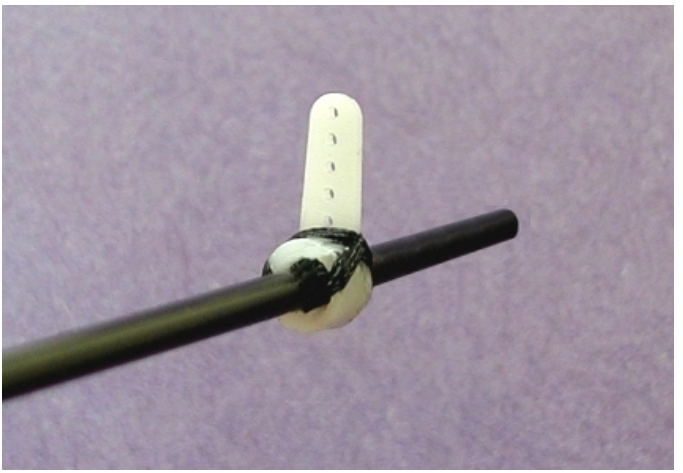
Place the torque tubes into the bearings on the servo mount plate with the end extending 1/4 inch past the inside edge.

Locate the horns on the torque tubes directly in line with the servo horn travel line. They should be about 1 inch from the ends

but this measurement may vary depending on the servo size you use. Measure and mark this location on both tubes.

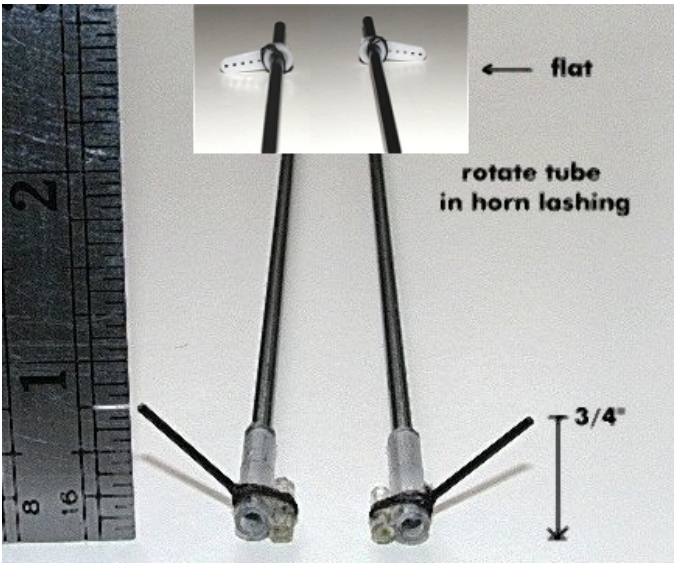


Don't tack the horns on yet but tie them on and lash them very tightly criss-crossed around the horn base and the tube. Use extra lashes here. Tie the thread off tightly for now or tack to the horn only. You should be able to rotate the horn on the tube for alignment but it should be tight and not sloppy otherwise.



Control Horn Alignment

For proper control alignment, we need to take the torque tubes and with the control horns held down against the table, rotate the tubes in the control horn lashing until the lever arm end measures 3/4 inch up with the assembly flat on the table. Be sure the horns and arms are extending the same direction and that left and right tubes are mirrored. Also be sure the horns stay on your horizontal mark on the tube where they align with the servos.



Tack the horn lashing to the tube and coat thoroughly. Cover these extra well. These must be very solid and stay square to the tube under load. If one ever pops loose you'll lose control!

Once dry, test the strength of the assembly by putting a gentle torque load on the tube while holding the control horn with one hand and the torque lever fitting with the other. You will be able to notice a little deflection in the tube itself but none should be present at either end. If the control horn rocks at all, re-lash tighter, add more wraps, and/or re-glue.

Servo Linkage

First cut the linkage wire in half. With needle nose pliers, bend a 1/4 inch square leg on one end of each half.

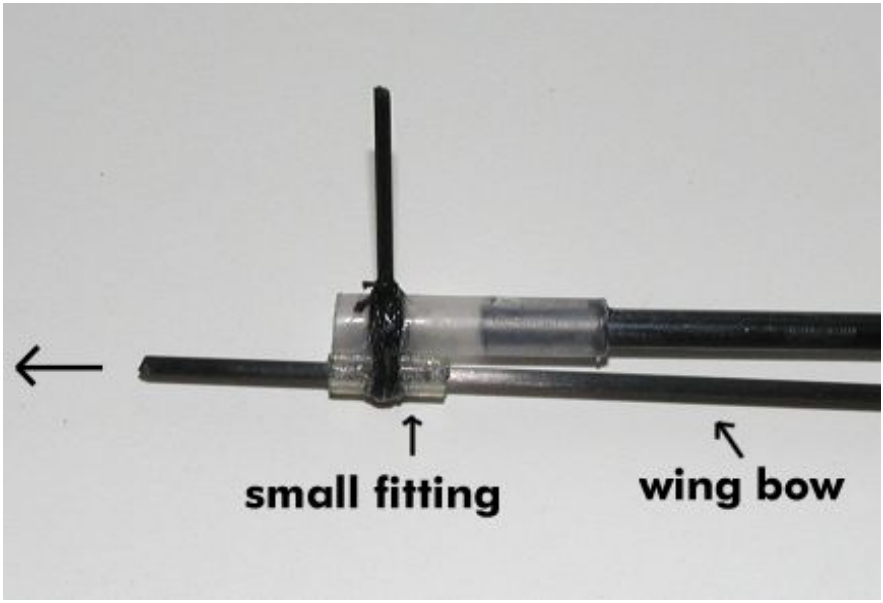
Note: If you want a V bend adjustable type linkage, add it now before the next step. We don't use it but since neither linkage end is adjustable, you may want to add it. Keep the V as small as is practical and centered on the wire to allow full travel clearance. We found that if the servo and control horns are parallel to each other and with the proper CG, the radio trim range is sufficient for any fine-tuning.

Have the horns centered on the servos and insert the linkage leg into the servo horn.

With the torque rod inserted into the bearing and the control horn aligned with the vertical servo horns at center radio trim, line up the linkage with the control horn and measure its length. It is about 1.5 inches long with my HS-55s. Remove and make the second bend keeping it parallel with the first. Trim the leg to 1/4 inch long and repeat to the same length for the second linkage.

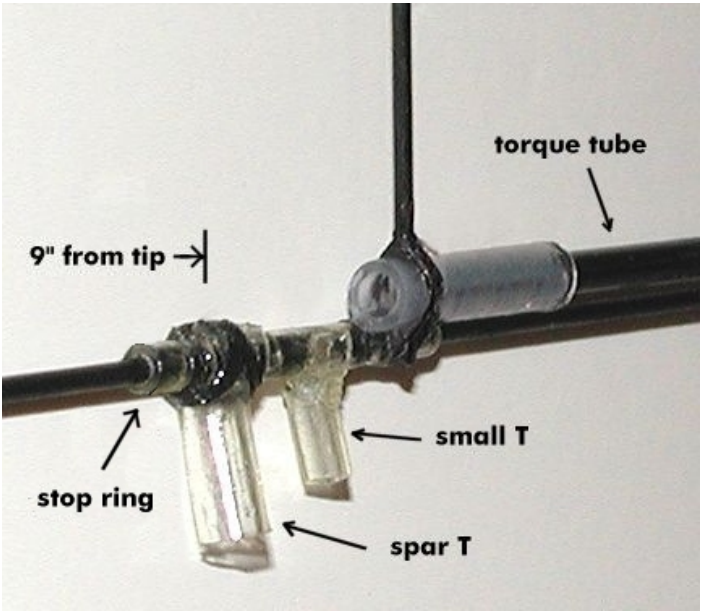
The linkage will attach at both ends with the quick link connectors once the plane is assembled later. Use the outer holes on both horns if the same length. If your servo horn is longer than the control horn, drop down a hole so the radiuses are about the same.

Wing bow assembly



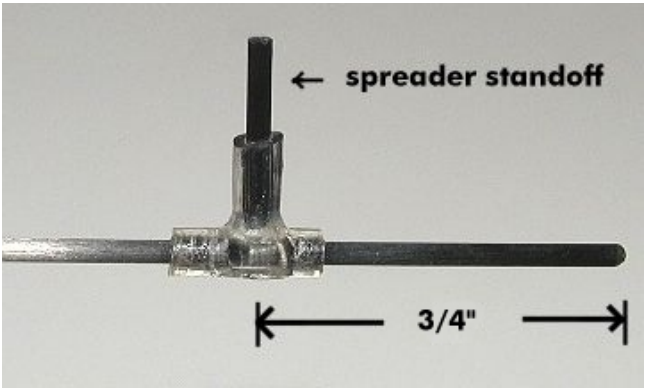
Slide the wing bows into the torque tube assemblies starting from the inside end of the small fitting. If real tight it's easier to push the fitting along with open needle nose pliers.

Now add a small "T" fitting to the wing bows. Next add the lashed spar "T" fittings. All the fittings just push up against each other with the spar fitting center located 9 inches from the tip of the wing bow. Finally add a 1/8 inch stop-ring. Except for rotating the fittings to line up correctly later, this completes the wing bow assembly.



Note: After flight testing and possible slight adjustment to the fittings locations for proper sail tension, you want to tack the stop rings on the wing bows to keep everything in place. None of these wing bow fittings ever need to be removed as the torque tubes stay with the bows for storage.

Wing Spreaders

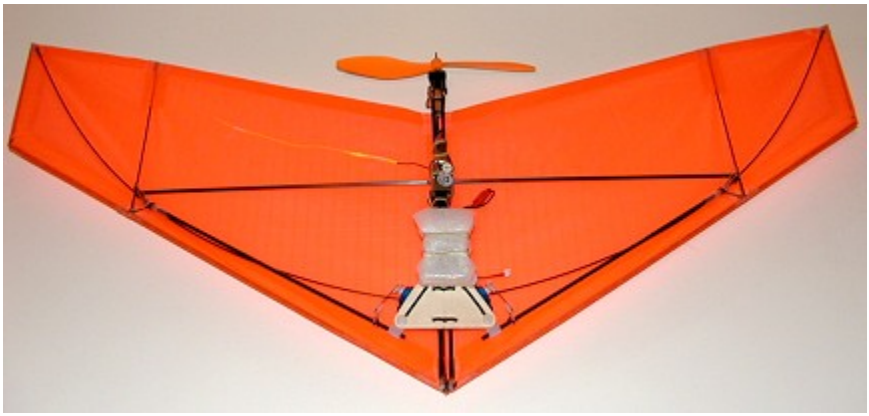


Slide a small "T" fitting onto each wing spreader rod and center them 3/4 inch from an end. Find the tip covers and install them on the other ends. Insert the very short rod pieces into the fitting upright "T"s. These can be tacked in with CA so they won't fall out and get lost.

Spar Prep

Measure the spar center and wrap a piece of repair tape around it centered in the middle. This keeps the tubes from rubbing where they cross. Mark the tape at the spar center with a pen for easy assembly reference.

ASSEMBLY:

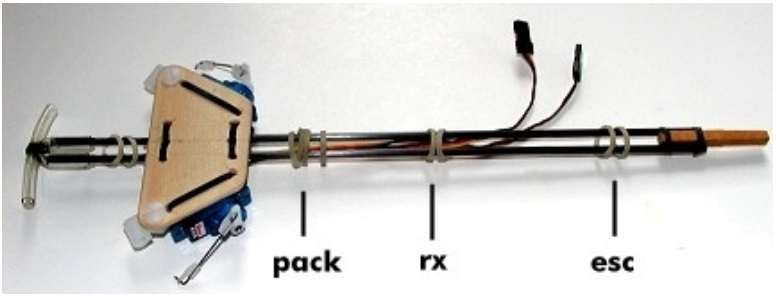


Overview

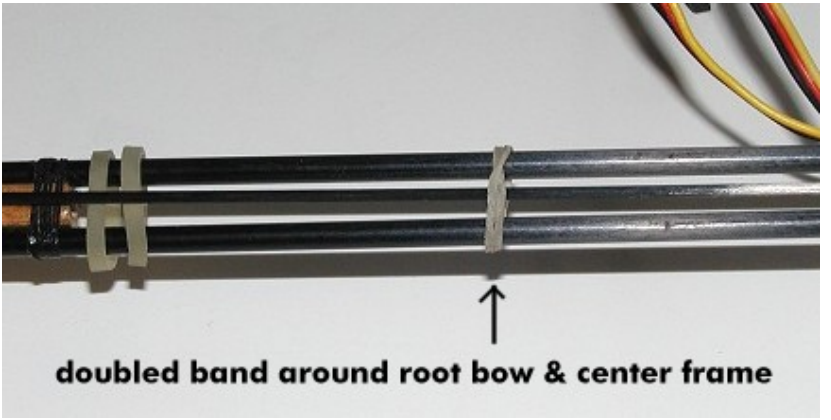
(as viewed right-side-up):
* Servo mount plate UNDER center frame
* Servos on TOP of mount plate
* Gear hangs on center frame
* Spar crosses OVER center frame
* Root bow passes OVER center frame and spar
* Wing bow fitting hangs UNDER root bow
* Wing bows lay FLAT against bottom of sail out to tip.
* Motor stick hangs DOWN on tubes
* Motor drive shaft gets positioned ABOVE motor stick

Assembly Order

NOTE: remember that even though you will probably be assembling the plane up-side-down most of the time, all references to position are with the plane upright as if in flight.



First add eight bands on the center frame behind the servo plate for holding your gear. Add another two in front if you are using the larger motors for securing the front half of the battery pack to the frame. Packs will end up about centered over the servo plate but when using the lighter LPS motor the pack ends up back about half behind the servo plate as shown in first picture. Some Velcro on the plate and pack keeps them from shifting but the bands prevent the pack from falling off.

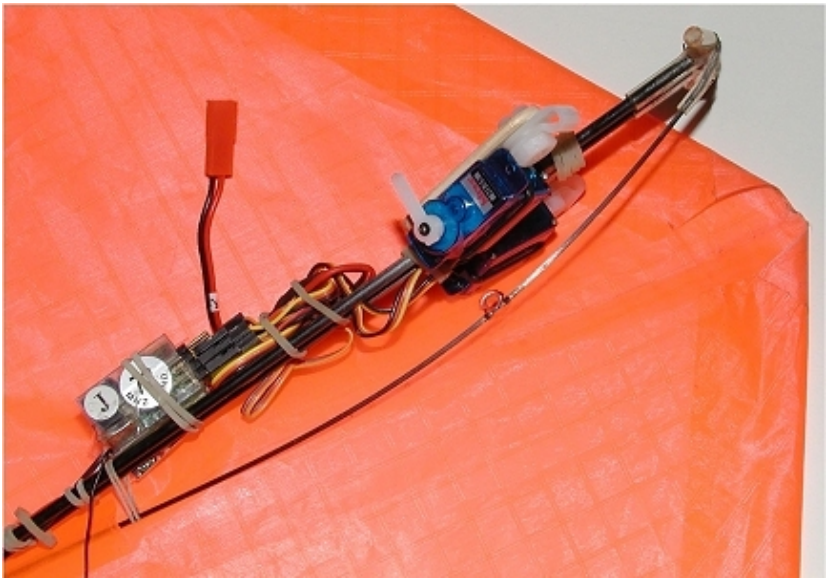


Lay the root bow on top of the center frame and add a doubled band over both frame and bow from the rear about a third the way forward.

Feed the rear of the root bow behind the band through the root sleeve in the sail bottom and out the exit hole.

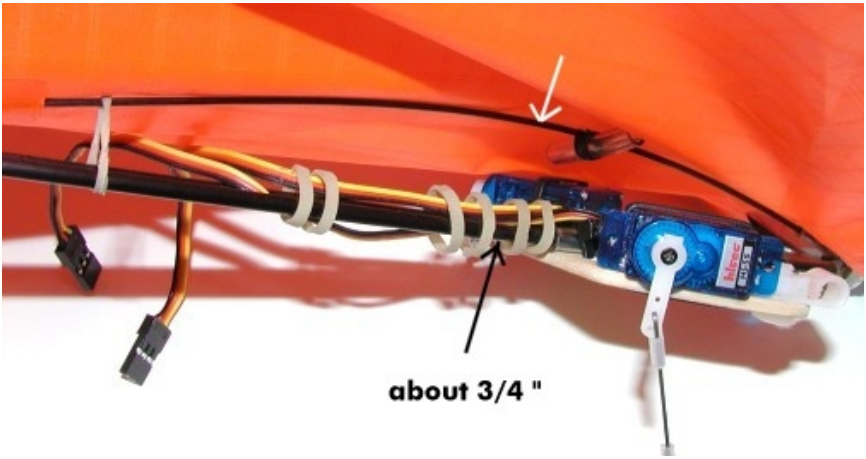
Add a short stop sleeve on the rod and insert the rear of root bow into the hole in the motor stick.

Insert the root bow rod front into its nose fitting with the wing bow fitting positioned down. Be sure the rod fully seats all the way to the center of the nose fitting's inner sleeve.



Measure the distance between the center frame tubes and the maximum height of the root bow. It needs to be 3/4 inches. If okay, slide

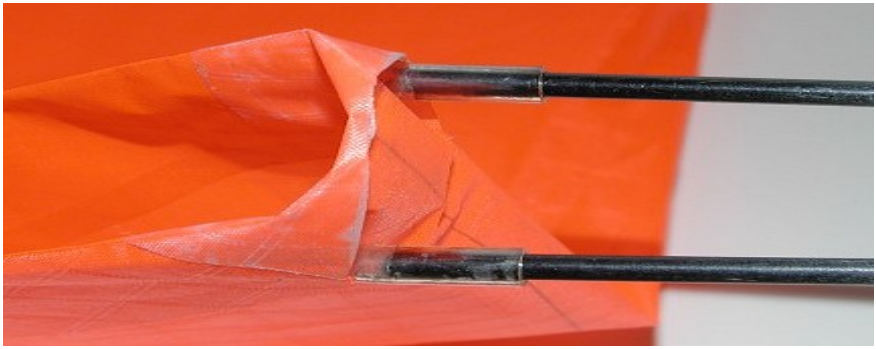
the rear stop tight up against the motor mount and wick some CA under it to secure. This keeps the rod from working its way deeper into the wood and lowering the needed wing camber.



If the height distance is too little, block up the rod to the correct height and adjust the stop ring tight up against the motor mount and CA it in place, let dry and your height should be set.

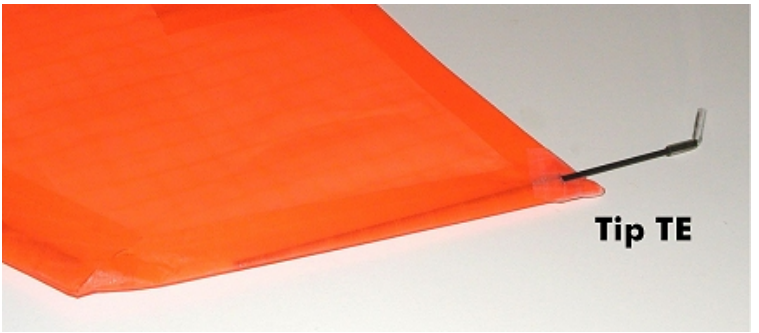
Add a couple bands around the motor stick to hook onto the TE of the sail.

Insert the LE tubes with their elbow fittings first into the sail pocket from the nose opening.

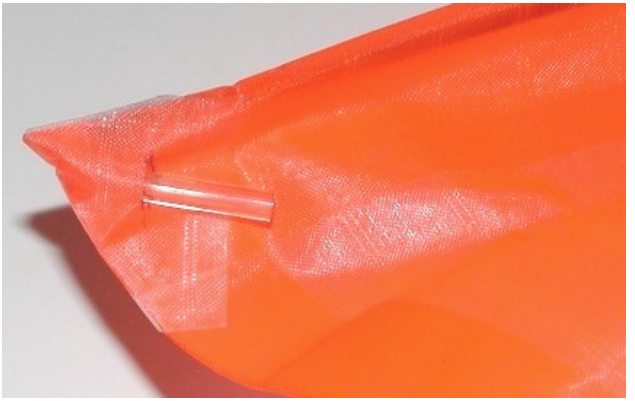


Feed the LE tip elbows around the corner at the LE tip pockets and position the LE fittings when they reach the access holes in the bottom of the sail LEs.

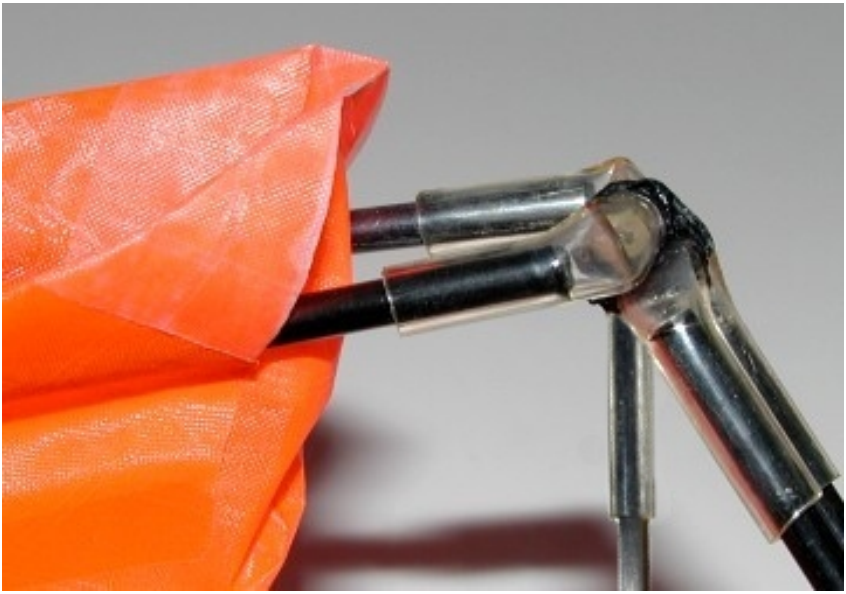
Insert the tip rods with the TE tip fittings installed into the tip pockets of the sail.



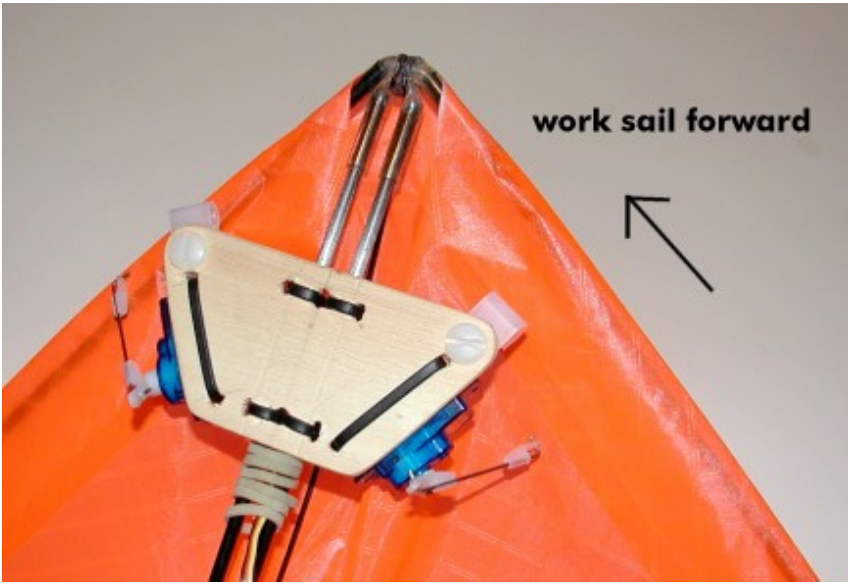
Get the rod ends started into the LE tip fittings.



Fold the tip rod TE fitting into a V as you seat the tip in the sail corner.



Attach the center frame nose fitting to the LEs by having them folded out and working them into the fittings so as not to put undue strain on the sail pocket seams.

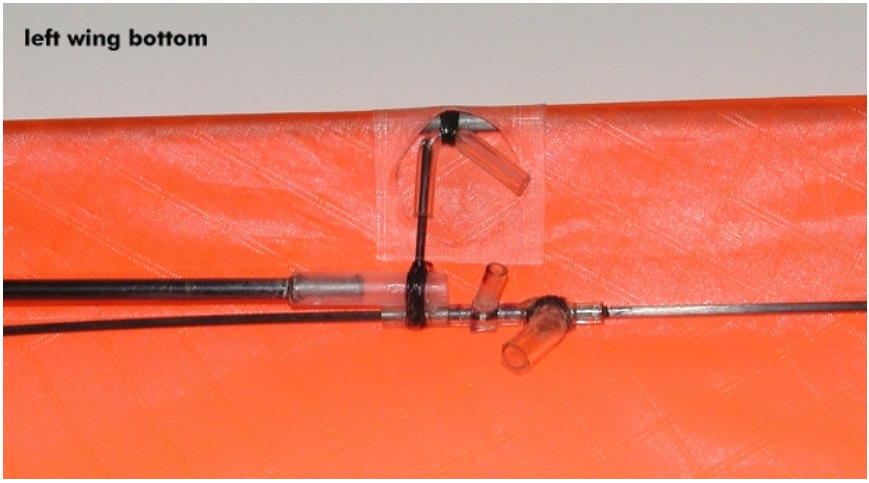


Work the sail forward on the LEs as you straighten the wings into position.

Determine the left and right completed torque tubes/wing bow assemblies by using the position of the control horns as reference.

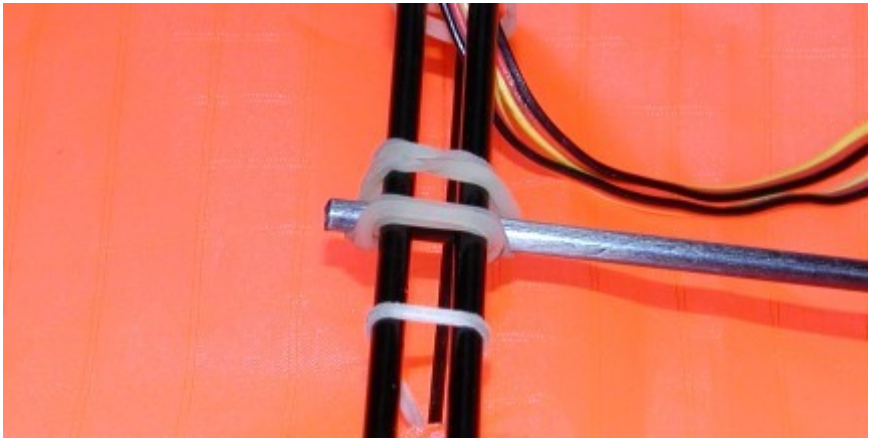
The horns hang down with the torque lever rods angled forward and down.

Insert the bow ends with stops into the root bow fitting and the torque tube ends into the servo plate bearings. Be careful not to bind or pivot the bearings in the process.

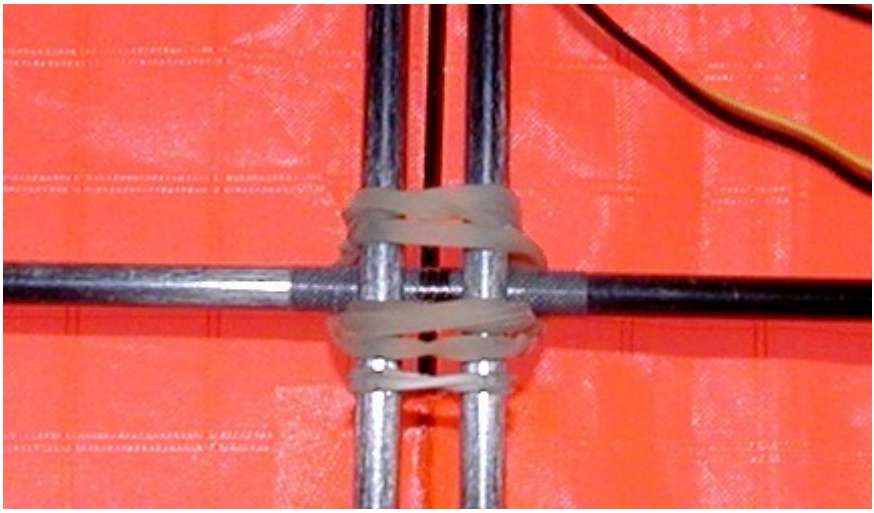


Now connect the torque tube lever arms fully into the front half of the LE fittings.

Bow back the wing bows and insert the ends fully into the tip TE elbow fittings to tension the sail.



Add the spar above the center frame with bands starting at an end as shown. Use about 3 bands here.

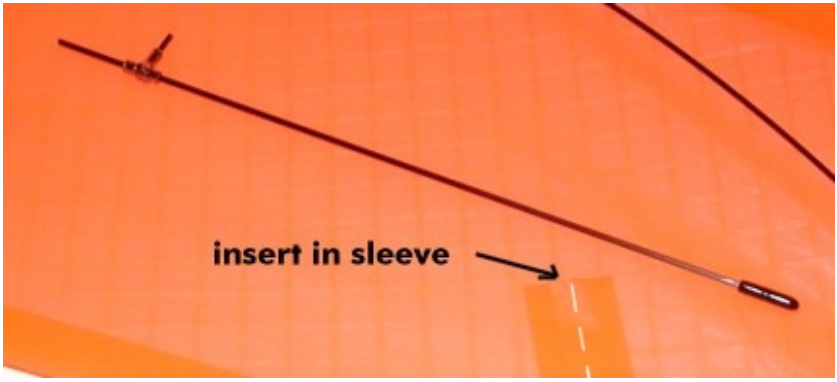


Work the spar along until it is centered on the frame.

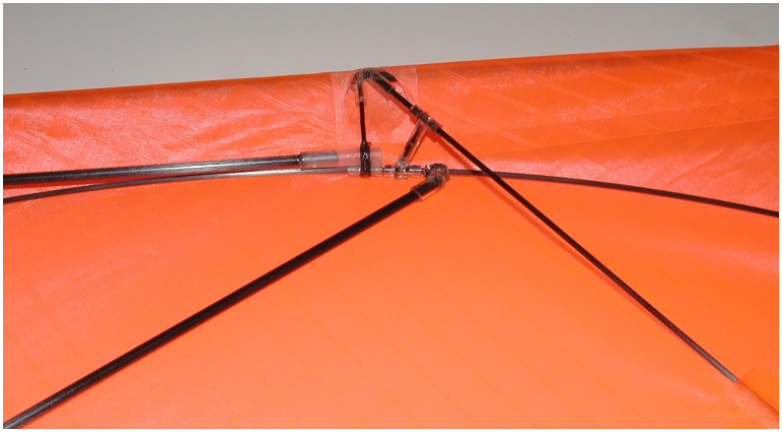
Move it fore/aft on the center frame until aligned with the spar fitting on the wing bows.

Insert the spar ends fully into their fittings.

Insert the completed wing spreaders into the sail sleeves and connect to the lower LE fittings.



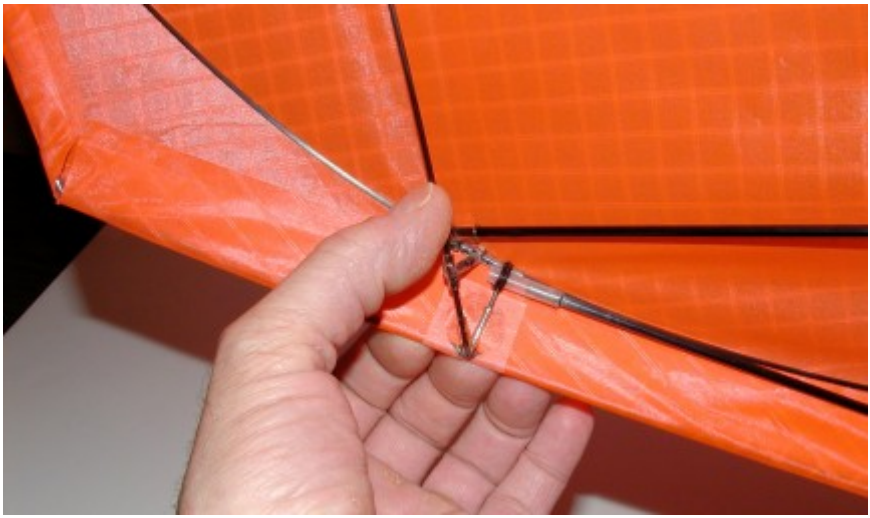
Connect the standoff to the small T fittings on the wing bows.



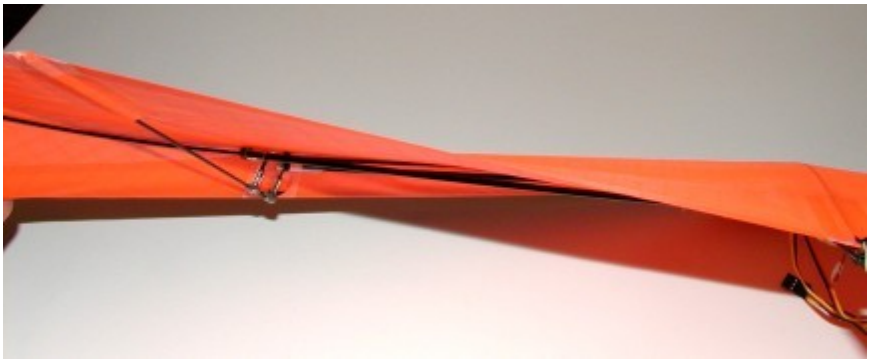
These standoffs will not end up vertical but will lie off to the sides at an angle.

Check sail for wrinkles, puckers, or any unevenness from one side to the other. Adjust spar fittings slightly if necessary in or out on wing bows for best tension. You want an even tensioned surface that is symmetrical. It shouldn't take much if any movement to even it up. Don't try to make a drum out the sail either as it has to be able to twist to be controllable.

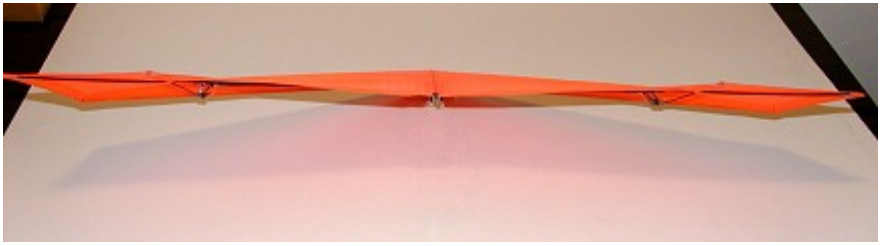
Test the wing warping operation now by grasping the torque tube lever arm with one hand and the nose with the other and twisting.



View the sail shape from the rear and move the control horns fore and aft. Once you see what the wing frame is doing, everything you've done should now make sense. The wing twist movement should not be overly tight. If it is, you can adjust the fitting locations on the wing bow slightly to relax the sail some.

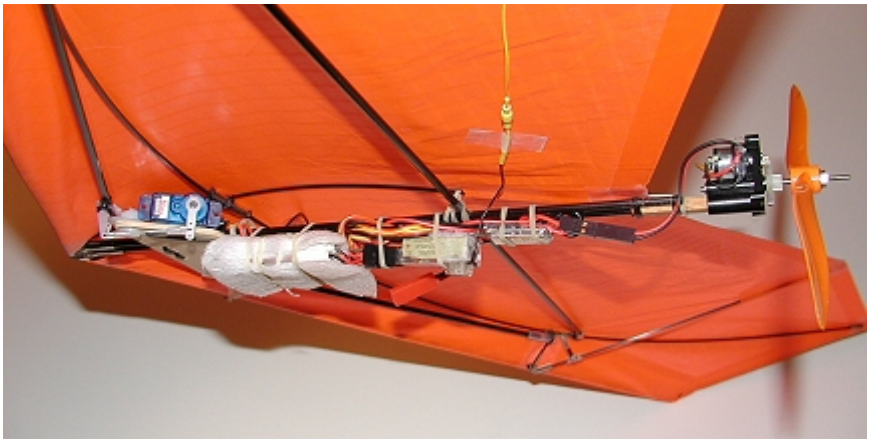


This is about full deflection



This is close to what you want to see at center trim.

Finally connect the linkage from servos to torque rods.



Hang your gear, test and adjust, program as necessary, range test and fly. (details in next section)

That's the complete list you'll do this one time only.

DISASSEMBLY

To disassemble for travel or storage, here's the order:

1) Disconnect the servo linkage.
2) Remove the wing spreaders complete.
3) Disconnect the wing bow ends at the tips.
4) Disconnect spar fittings.
5) Remove the wing bows complete along with torque tubes.
6) Rotate spar along center frame and band or remove completely.
7) Disconnect the LEs from nose fittings to collapse the wing.

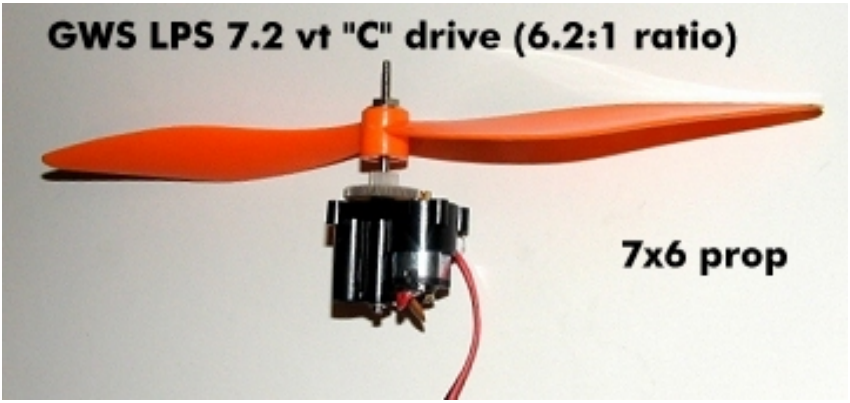
8) For further disassembly, remove LE tubes and roll sail to root.

The root section with gear stays intact in either case.

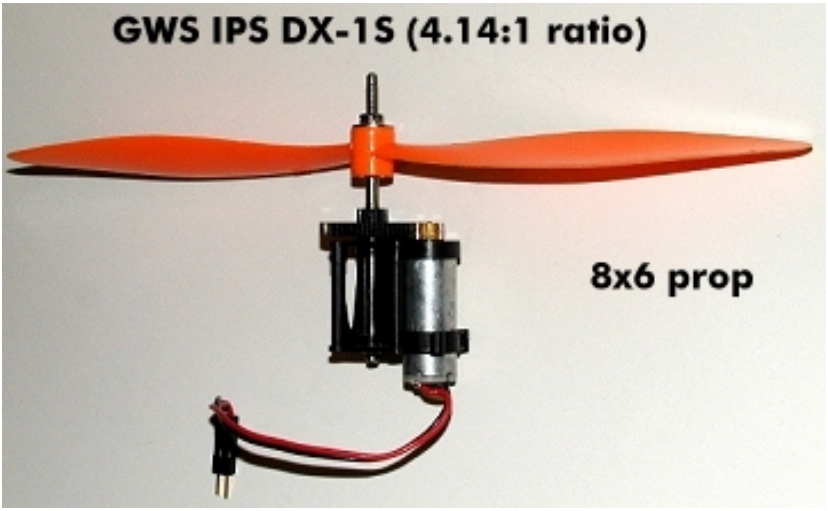
GEAR INSTALLATION:

Motor

Motor install - The LPS motor just plugs on the stick. Position the drive shaft above the mount and rotate the motor square with the plane.



For the IPS motor, add shims of the coffee stirrer sticks on either side of the mount stick to fill the excess space. If you don't want it to be convertible between motor types, the shims can be CAed to the mount stick sides. The shims can also be glued into the motor slot sides if you don't need to use it on other planes.



Wire the motor with reversed polarity to the ESC for reverse rotation pusher operation. (Red to black, black to red.) ONLY do this at the motor to ESC connection, NOT the battery connection or you will fry the ESC!

For use as a pusher the prop mounts with its lettering forward towards the nose just as it would be positioned normally on a front motor plane. Prop rotation will be the same being clockwise as viewed from the rear.

ESC

The ESC gets banded to the center frame at the rear.

Receiver

Add a thin strip of tape over the crystal to keep it in place. Wrap the RX with light foam for protection. Mount it with bands just in front of the spar.

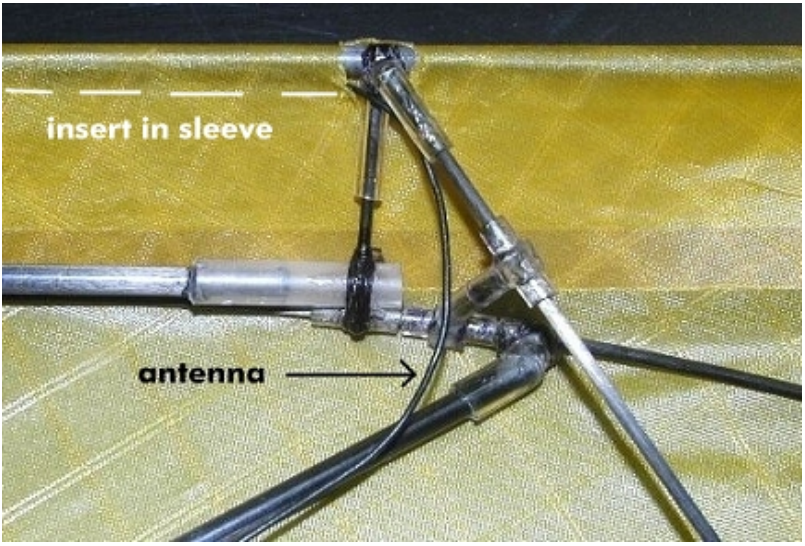
Battery

The pack gets banded in front of the receiver partly or fully onto the servo plate depending on its position needed for proper balance. It's best to wrap the pack in light foam also for some protection against impact. Add a little velcro between it and the servo plate to prevent it from slipping on launch and changing the CG.

Antenna

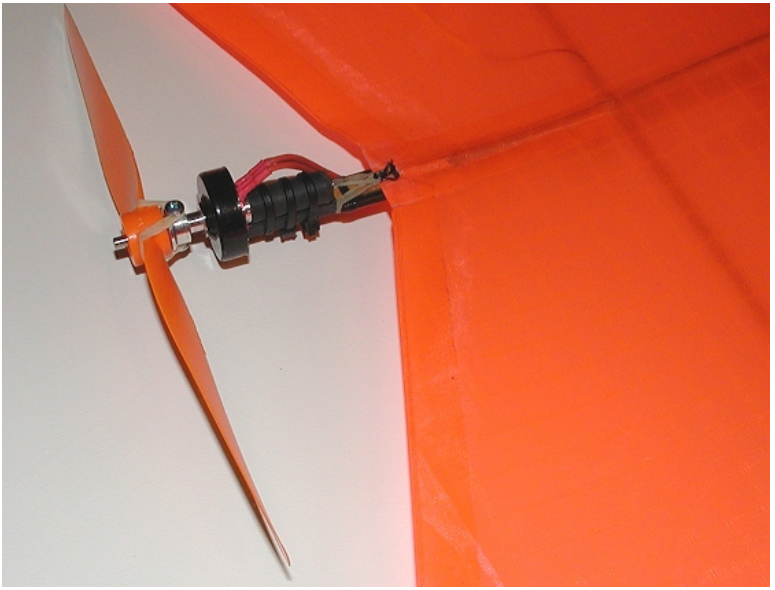
Either use a micro coil or flat film type antenna taped to the sail away from the tubes or route the stock receiver antenna around the frame. Lace it through the leading edge pocket of one wing at the nose, out the LE fitting hole and back across the spar.

Be sure there are no bare spots on the wire that could touch any frame parts. The end of the wire is at risk so a little tape over it won't hurt.



Brushless install:

Here's a LensRC 17 Turn CDROM type motor. The motor mounts with some heat shrink and wire ties to the stick top. A Castle Creations Phoenix 10 ESC is used along with E-Tech 1200 mAh 2S Lipos.

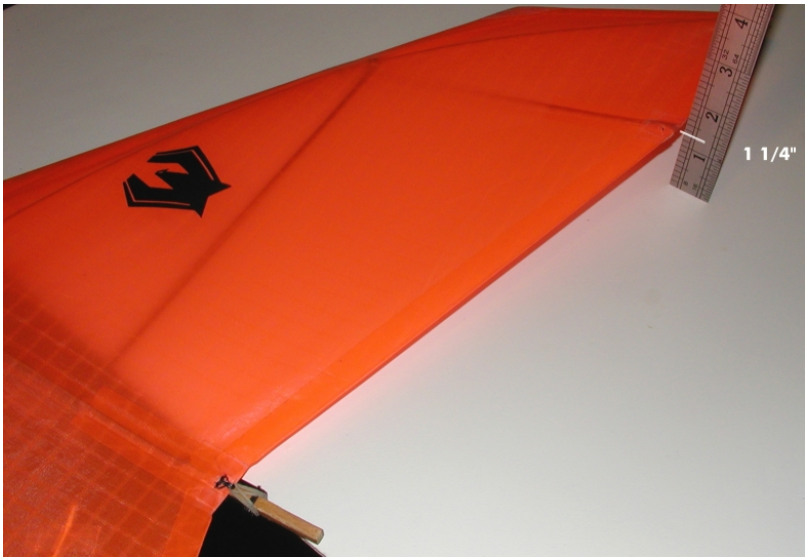


RADIO SETUP:

Program (or turn on switch) for elevon or delta mixing. You want both tips to rise with back stick, the right tip to rise with right stick, and the left tip to rise with left stick etc.

Start with the pitch directions. If they both move the wrong direction, reverse BOTH channels travel directions in the radio programming or with the reversing switches as provided. Once the elevator travel is okay then check roll control. If it is backward, then just swap the servo plugs in the receiver channels and you should be set to go.

Once everything is working properly, check to see that there is no binding at the far corners of the stick travel. If so, reduce the travel range in the transmitter or lower the linkage connection on the servo horn. Also, if you find that the horns bind on the quick link, file or trim the horn slightly shorter to clear.



Center trim:

Over a flat table, position the wing resting on the LE up to the servo linkage. Have the motor mount stick just catching the edge of the table. With the radio at center trim, measure the TE of the spreader. It should be very close to 1 1/4 inches. If not, adjust the trim so it is.

Programming:

With a programmable radio, you may want to set your elevon mix differential to 30% to 50% to reduce down travel and increase up travel of the wings in roll. This is for reducing adverse yaw in turning. Verify that the setting is doing what you want by viewing

the servo horn movement (not just the wing) as you move the stick side to side. If set wrong you may have more down then up which is the opposite of what's needed.

FLIGHT:

Safety note: Learn to fly your bird in a field of tall grass first if possible. Get proficient to the point you can catch the plane after every flight. Then if you are planning on flying in a gym, over a street or parking lot, be sure to make yourself a foam skid under the battery to protect it just in case of a mishap. The foam insert in GWS receiver packages works well. This is very important with Lithium Polymer cells since they do not have an external case to protect them and can damage easily and even catch fire.

Getting Started

When launching, grip the center frame tubes behind the spar and toss it over-hand gently toward the horizon with the wings level and the nose just slightly raised. Always toss the plane power off and into any wind and once gliding steady then add power. If something is wrong in the glide just land it and adjust the CG or otherwise as needed and try again. Powering up an unbalanced plane will only make matters worse. Also, if you get in the habit of hand launching a pusher with power on then sooner or later you will get bitten by the prop!

CG location

Note about CG: The Center of Gravity of a plane is where it balances on the ground. Depending on gear location, this might be anywhere. The correct CG for a plane to fly its best is based on a number of things and may not always be at the point indicated in the plans. The proper CG of any plane is the balance point where it flies the best, period.

Start by getting the plane balanced at the LE fitting junction on your fingertips. After test gliding and depending on your sail tension, you may find you want the CG to be slightly behind this location about an eighth or quarter inch back on the wing spreaders. This will reduce any up trim you may have needed and will increase glide and controllability. Don't go back too far or you'll lose stability and control will be tricky at best.

Trimming

Glide test without power to find the best CG. You want it to glide very flat. If it wallows around without much control, it's too tail heavy and you need to move the pack forward. Only move it about 1/8 inch at a time until you find the sweet spot. If it dives and requires lots of up trim for a flat glide then you are too nose heavy and need to move the pack back. Again, only move it a very small amount at a time until you don't need any back stick or up trim for a flat glide.

The CG of a flying wing is critical and sensitive to even the slightest change of battery pack position (as well as your other gear) so once you find the best spot for it, mark it on the frame

so you'll always know right where to put the pack. Also find the location on the LE that the plane balances level with the gear in this position so you can double check that the rest of the gear hasn't moved. This way, if it's not flying right and the pack is in the correct location, you'll know something else is wrong. Always check the pack location and/or CG balance point after any less than perfect landings.

CG Summary

(Glide tested and trimmed for level flight)
If the CG is slightly nose heavy the plane will fly almost stall proof, be very stable, and have a poor glide with limited up pitch control range.

If the CG is slightly tail heavy, it will stall easily, feel twitchy in pitch control and drop a wing easily.

FLYING

The Carbon Kestrel is considered an aileron plane so it isn't flown quite like a rudder/elevator model that you may be used to. It isn't hard to fly however and once mastered, most any aileron plane shouldn't be much trouble. This makes it a great aileron trainer due to its inherent stability plus maneuverability and crash-worthiness.

With the LPS motor, full throttle has you climbing or cruising if you lower the nose slightly. Cut power and you descend in a glide. Keep your speed up in a glide for best control.

To turn, give left or right stick and as the wing banks up, add up elevator (back stick). Center the roll control when the bank angle is established but continue to hold back stick to continue the turn. Release back stick and at the same time add opposite roll control to return to level. You may have to add a little down stick when rolling level to keep the nose from ballooning up on you.

With the IPS-S1 brushed or CDROM brushless motors, climb is much steeper and you'll have an excess of power for normal flight. Learn throttle management to maximize your duration. Think ahead and use your momentum to carry through maneuvers. The CK likes to stay on the "wing" and fly so keep your speed up for best results with the more advanced maneuvers.

With its light wing loading the CK won't like to fly in too much wind. If you do have a breeze to deal with, always make your turns into the wind until you get the feel for wind drift. You can lose a lot of ground very fast flying downwind even in just a breeze. If heading downwind and controls feel sluggish, you're flying too slow! Lower the nose and then turn back into the wind. When hauling over the ground downwind, the natural reaction is to slow down but that is just the opposite of what you need to be doing for best control. (This is probably the biggest cause of any plane getting stuck in a tree!)

As designed, the CK is a very versatile and resilient little bird. It does have its limitations however. Flying too heavy and/or with excess speed can do funny things to a flexible wing. With the little GWS motors you want the prop pitch greater-than half of the diameter. If you are planning on upgrading to one of the new micro size brushless motors, remember that they will turn at a much higher RPM so keeping your prop pitch low on these still achieves the needed speed range and then some! Note also that the more power you have, the greater the effect an incorrect thrust line will have.

TROUBLE-SHOOTING

Adding and removing power can show problems in flight in a couple ways:

1) If the plane climbs hard requiring nose down trim, the CG is too far back and/or the motor is mounted upside down with a low thrustline.

2) If when adding power the plane dives requiring nose up trim, the CG is too far forward or too powerful a motor is mounted too high.

Ideally you want it to climb moderately with power and when power is cut to level out and glide flat.

1) If the plane noses up when power is cut then your CG is too far back and/or thrustline is too high.

2) If it dives when power is cut then the CG is too far forward and/or thrustline is too low.

TIP - Any time you need to trouble-shoot an out of trim plane, always eliminate the possible causes one at a time. This way you won't be going around in circles not knowing what is working and what isn't.

Sail Tension

If the sail gets loose for any reason, flight performance and control will suffer.

Sail tension can change for a number of reasons so eyeball the spar to be sure it isn't bowed or a fitting has pulled loose or shifted if it suddenly stops flying as expected. The sail can shift forward if the LE tubes get jammed from an impact which can also loosen the sail.

Once you are proficient at flying your Carbon Kestrel and have committed to memory what the proper sail shape looks like, a quick glance will be all the pre-flight you need. You'll be catching it instead of landing it so you won't have to worry about things getting out of whack from impacts.

CONCLUSION

The CK is a great little bird to keep handy any time you want a quick relaxing (or exhilarating) flight just about anywhere. It can fly in very small areas and with a motor upgrade can cover ground (and sky) with the big boys.

We hope you have learned some things from the build and that you receive as many hours of enjoyable flight experience from your new bird as I do.

As always, we love to hear from you with comments, suggestions, praise or problems. We want everyone flying our products to have a great experience and will gladly walk you through any trouble spots you may run into with the build or flight aspects of the plane.

Email is answered in a timely fashion so if you don't hear back from me within a couple days, try again as we might not have received it for some reason. Also be sure to check the website to see if we happen to be out of town.

Also be sure to check the site once in a while for any changes or new developments to the plane that didn't make it into this manual.

Sincerely,

Ken Hill

ken@acesim.com

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http://www.acesim.com/rc