

# CARF-MODELS

## *P-47 Thunderbolt      Instruction Manual*



### History

Long before “super-sizing” became synonymous with American culture, Republic Aircraft unveiled the P-47 Thunderbolt. An Alexander Kartveli design, the P-47 was the largest single seat fighter aircraft of WWII. With eight .50 caliber machine guns and provisions for bombs, rockets and drop tanks, fully loaded, the Thunderbolt could weigh as much as 8 tons!

Although the obvious lineage to previous Kartveli designs, the P-35 and P-43, is apparent, the P-47 was a completely new and much larger aircraft built to accommodate the most powerful piston engine at the time, the Pratt and Whitney R-2800 radial. In typical Kartveli fashion, form followed function as the engine’s turbo-supercharger was buried in the belly of the beast, thus, creating its characteristic profile.

It is said the Thunderbolt was nicknamed “the Jug” by the British who considered the shape of the fuselage as similar to the glass milk “jugs” of the time; or because upon first glance, someone declared the ungainly fighter to be a “Juggernaut!” Whatever the origins, the name “Jug” is used to this day in reference to the P-47.

First deployed as a long-range escort fighter, the P-47 really came into its own when it transitioned to ground attack, amassing an incredible obituary of axis vehicles: In addition to

## ***CARF-Models P-47***

[www.carf-models.com](http://www.carf-models.com)

bringing down 3,916 enemy aircraft, the Thunderbolt destroyed 6,000 tanks, 9,000 locomotives, 68,000 trucks and 86,000 rail wagons in 746,000 sorties of all types. In Europe, Thunderbolts flew more sorties than P-51s, P-38s and P-40s combined.

In the Pacific, Colonel Neel E. Kearby of the Fifth Air Force destroyed 22 Japanese aircraft and was awarded the Medal of Honor for an action in which he and his Thunderbolt downed six enemy fighters on a single mission.

By the end of WWII, the 56th Fighter Group was the only 8th Air Force unit still flying the P-47, preferring it to the more modern P-51. The 56th claimed 665.5 air victories and 311 ground kills, losing 128 aircraft in the process. Lieutenant Colonel Francis S. Gabreski scored 31 victories, including three ground kills; Captain Bob Johnson scored 27 (with one unconfirmed probable giving his tally as 28); and 56th FG Commanding Officer Colonel Hubert Zemke scored 17.75 kills. Despite being the sole remaining P-47 group in the 8th Air Force, the 56th remained its top-scoring group in aerial victories throughout the war – quite a testament to the deadly effectiveness of the P-47.

In homage to this historic aircraft, Composite-ARF has reproduced the P-47D “Razorback.” While perfectly suited to a large radial like the RCS/Moki 215/250, a DA120 or equivalent can also be substituted and will provide ample power to motivate your Thunderbolt on its next sortie...



*"Target spotted...six o' clock low... Tally Ho!"*

## **Liability Exclusion and Damages**

You have acquired a kit which can be assembled into a fully working R/C model when fitted out with suitable accessories, as described in this instruction manual. However, as manufacturers, we at CARF-Models are not in a position to influence the way you build and operate your model, and we have no control over the methods you use to install, operate and maintain the radio control system components. For this reason we are obliged to deny all liability for loss, damage or costs which are incurred due to the incompetent or incorrect application and operation of our products, or which are connected with such operation in any way. Unless otherwise prescribed by binding law, the obligation of the CARF-Models to pay compensation is excluded, regardless of the legal argument employed. This applies to personal injury, death, damage to buildings, loss of turnover and business, interruption of business or other direct and indirect consequent damages. In all circumstances our total liability is limited to the amount which you actually paid for this model.

## **BY OPERATING THIS MODEL YOU ASSUME FULL RESPONSIBILITY FOR YOUR ACTIONS.**

It is important to understand that CARF-Models Co., Ltd, is unable to monitor whether you follow the instructions contained in this instruction manual regarding the construction, operation and maintenance of the aircraft, nor whether you install and use the radio control system correctly. For this reason we at CARF-Models are unable to guarantee or provide a contractual agreement with any individual or company that the model you have made will function correctly and safely. You, as operator of the model, must rely upon your own expertise and judgment in acquiring and operating this model.

## **General information about fully-composite aircraft structure and design**

All the parts are produced in negative molds, manufactured using vacuum-bagged sandwich construction technology. All parts are painted in the molds, either single color or designer color schemes.

The kit utilizes materials and building techniques that may not be familiar to conventional ARF and (wood) RC model builders and while the aircraft is not extremely difficult to construct, it should not be undertaken by an inexperienced builder or flyer. You should be intimately familiar with giant scale aircraft and the higher demands placed on structures due to greater flying weights, high-powered gasoline engines, and the associated heavy duty radio equipment and hardware required.

### **Take Care:**

Composite sandwich parts are extremely strong, but fragile at the same time. Keep in mind that these high-performance airplanes are designed for minimum weight and maximum strength in flight. Please take care, especially during transport, to make sure that none of the critical parts or linkages are damaged. Always handle your airplane with great care and it will provide you with many hours of pride and pleasure.

Before you get started building and setting-up your aircraft, please make sure you have read this instruction manual several times, and understood it. If you have any questions, please don't hesitate to contact us. Below are the contact details:

- **Email:** [info@carf-models.com](mailto:info@carf-models.com)
- **Website:** [http://www.carf-models.com/public\\_carf/pages/common/start.html](http://www.carf-models.com/public_carf/pages/common/start.html)
- **FACEBOOK:** <http://www.facebook.com/pages/CARF-Models/353925798982>
- **Telephone:** *Phone your C-ARF Rep!!! He will be there for you.*

**NOTE to buyers/builders of this kit:** This manual was written in the United States.

Some products are shown that may not be available in other countries. Please note that when specific U.S. products are mentioned, they will be accompanied by this symbol @US to indicate their origins. Wherever possible, a generic description of the product will accompany the symbol so that the builder may find a suitable substitution.

## **The Model and its Builder**

CARF-Models has created the most accurate prefabricated P-47 Thunderbolt available today. Although the model is not difficult to construct, the qualified builder will possess advanced skills and knowledge associated with large, heavy, high-powered scale RC model aircraft construction, set up, and flight.

## **Landing Gear and Engine Selection**

The CARF-Models P-47 is designed for retractable main and tail gear. In collaboration with Sierra Giant Scale, custom retracts (#270500) are available and strongly recommended as an integral component of your new Thunderbolt. The custom scale struts are designed to compress during the retraction process so that the full scale length when extended is available, while compression during retraction allows a scale strut and wheel bay position in the wing. As a side effect, once the radio is switched off, the plane sinks into the struts just like the real P-47, where the fading hydraulic pressure made the plane sit low when the engine and hydraulic systems were switched off. A pair of scale wheels (# 270550) are also offered to complement the retractable mains. A scale retractable tail wheel assembly is also offered (#270600) along with a sturdy tail wheel (# 270650)

As with any complex, heavy, high performance, (expensive) scale model, engine choice is CRITICAL! The bigger and heavier our models get, the more closely they mimic the flight characteristics of the full scale aircraft after which they are modeled. While a P-47 can be landed with a dead engine, and no doubt P-47 pilots were indeed faced with the dilemma of bailing out or landing “dead stick,” YOU do not want to ever find yourself in that unfortunate position!

This aircraft was designed for the Moki 215/250 5 cylinder radial. The Moki will greatly compliment the scale realism of this aircraft while providing reliable power for realistic performance. Another excellent choice is the DA120 twin. Mounting provisions and instructions for both engines are provided.

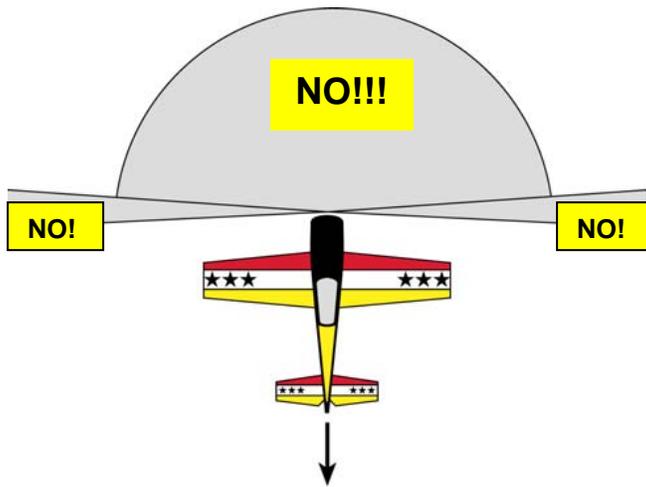
A scale 30 inch 4-blade propeller is offered as an available option for the P-47, but only the Moki 250 possesses the necessary horsepower and torque required to spin this propeller (#270700). Solo Propellers can provide the matching P-47 4-blade hub, adapter and spinner.



*CARF-Models 30" 4-blade prop*



*4 blade prop hub [www.soloprops.com](http://www.soloprops.com)*



**Propeller Arc  
DANGER ZONES**

**SECURE aircraft  
BEFORE starting  
engine!**

**MAKE SURE that  
all spectators are  
FAR in front OR  
behind the aircraft  
when running  
engine!**

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## *The P-47 Thunderbolt*



## Accessories Required

- 8 high performance servos – (2) Ailerons, (2) Flaps, (1) Elevator, (1) rudder, (1) throttle, (1) retracts. All servos used on flying surfaces should have a minimum of 200 in. ounce torque – digital servos are highly recommended for their superior resolution and holding power. Ball bearing outputs and metal gears are a MUST.
- Dual 2600 mah, 6v+ receiver batteries (minimum)
- Heavy Duty switches and servo extensions (22 gauge, minimum)
- PCM or 2.4 GHz radios are recommended for their superior rejection of engine ignition noise and other ‘RF’ generated by large scale gas aircraft and hardware
- Scale Retractable Main Gear; Item Number: 270500
- 7” Main wheels (# 270550)
- Scale Retractable Tail Gear; Item Number: 270600
- Tail wheel (# 270650)
- Pneumatic completion pack for P-47; Item Number: 270800
- Moki 250 or 215 5 cylinder radial...OR
- 100cc to 120cc twin cylinder gas engine
- 1 liter (32 ounce) GASOLINE tank and GAS fuel line

## Building Materials required

- 30 minute and 3 hr. epoxies
- Cut glass or MicroBalloons filler
- Thin and Thick CA glues
- Blue Loctite @US (thread locking compound)
- Alcohol and lacquer thinner
- Standard modeling tools

## Optional accessories

- CARF Fine Silver paint: Item #970024
- CARF Hardener: Item #970012

## Scale detail resources

- Combat Legend P-47 Thunderbolt by Jerry Scutts
- P-47 in Scale and Detail by Bert Kinzey
- Scale Aviation Modeller International; Volume 10, Issue 2; Feb. 2004
- P-47 Thunderbolt in Action; Squadron Signal Publications
- P-47 Thunderbolt in Action No. 208 by Larry Davis; Squadron Signal Publications



***Let us Begin –***

As with any new kit, a thorough INVENTORY is in order. To that end, a comprehensive parts list and numbered pictures have been provided as follows:

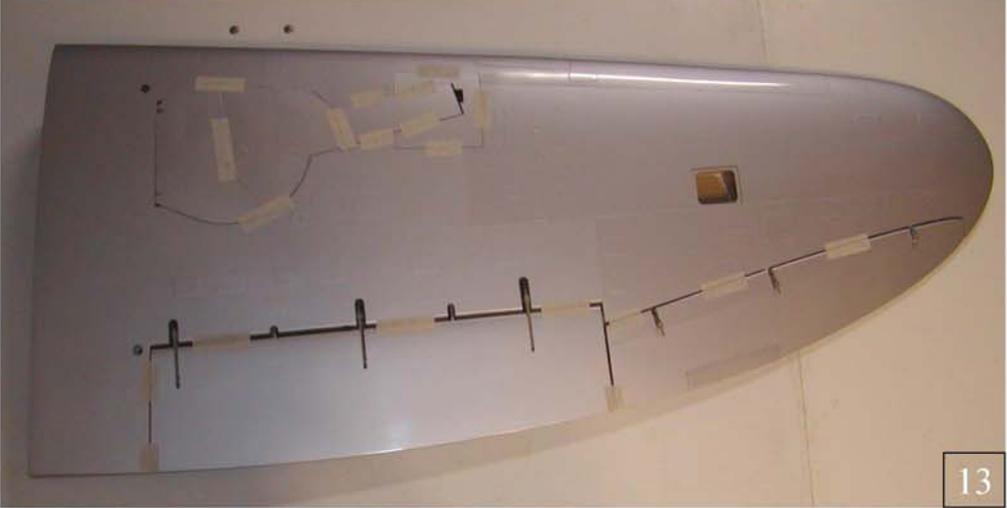
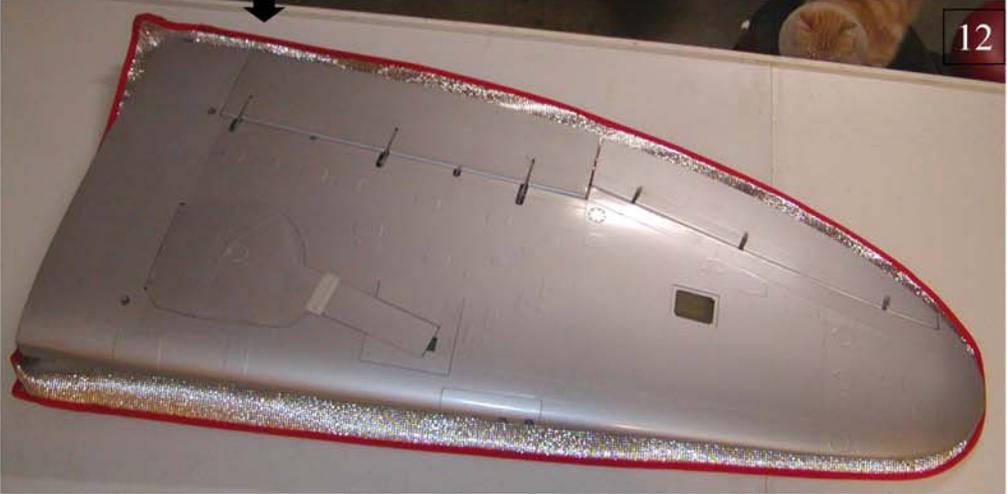
<b><u>Identifier</u></b>	<b><u>Quantity</u></b>	<b><u>Item Description</u></b>
1	1	Fuselage; includes air outlets and tail gear doors
2	1	Front Canopy Frame
3	1	Rear Canopy Frame
4	1	Cowling
5	1	Carbon fiber engine mount
6	1	Fuselage bottom hatch
7	1	Front (cowl) air intake
8	1	Air outlet cover
9	1	Turbo-supercharger outlet cover
10	1	Antenna pole
11	2	Aileron servo hatches
12	1	Right Wing w/aileron, flap, gear doors
13	1	Left Wing w/aileron, flap, gear doors
14	1	Right bomb mount
15	1	Left bomb mount
16	1	Cockpit Air Intake
17	2	Gun barrels (1, 2, 3, 4)
18	1	Right stab and elevator
19	1	Left stab and elevator
20	1	Vertical fin and rudder
21	2	Wing tubes: 30x610mm and 40x610mm
22	2	Fin and Stab tubes: 20x150mm and 20x380mm
23	1	Clear canopy
24	3	Stab and fin protection bags
25	1	Milled wood parts bag - contents
26	1	Hardware bag - contents





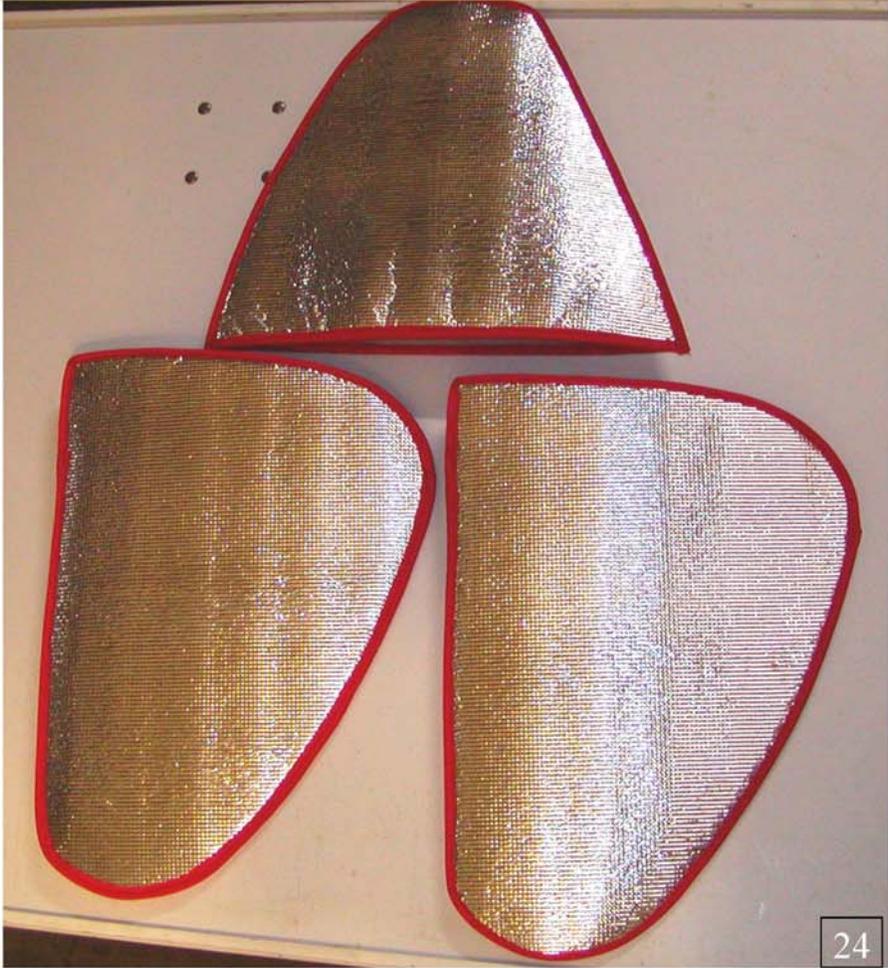


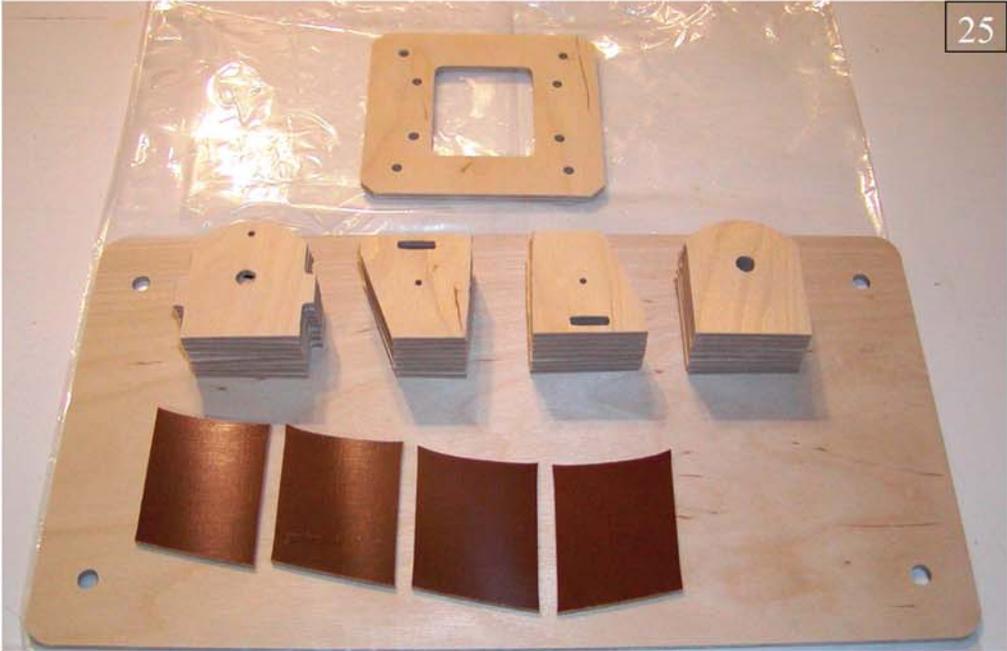
Right wing shown with surface tape removed, sitting atop included wing bag.



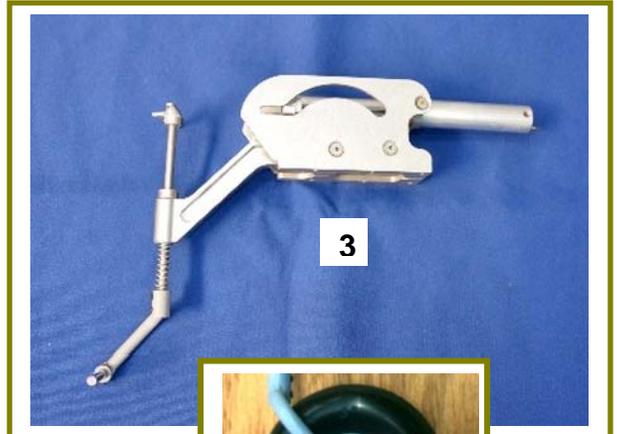




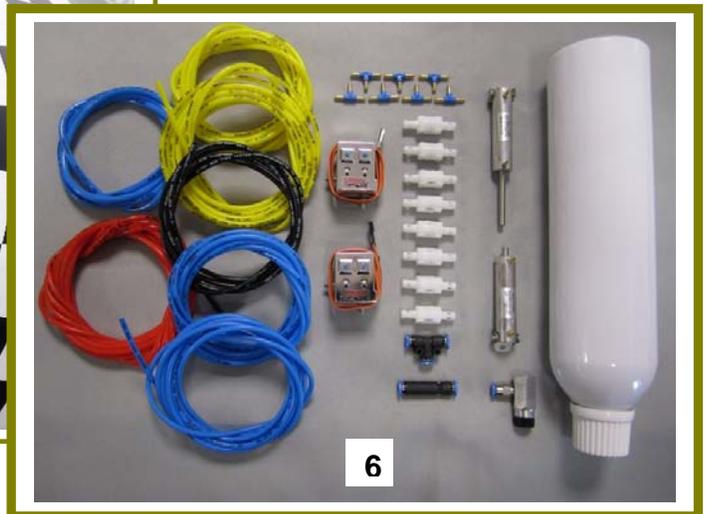




**Recommended Accessories**

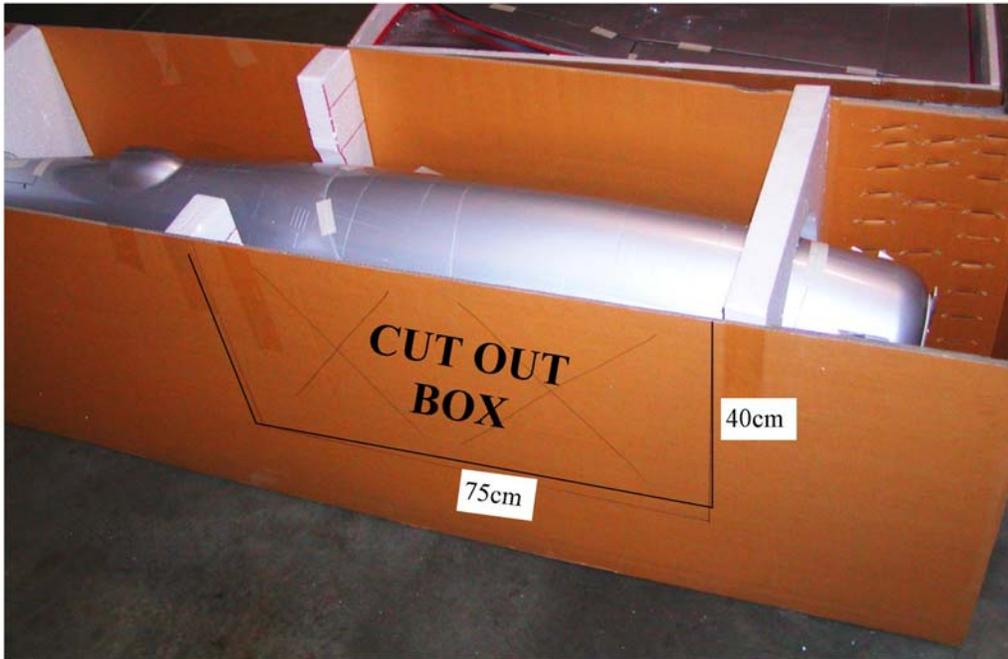


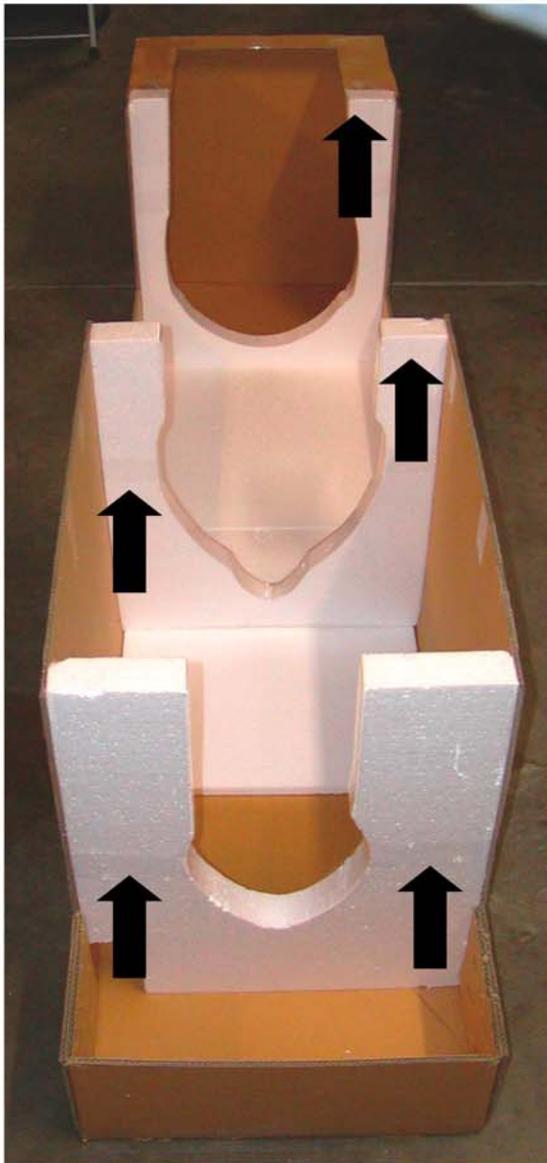
	<u>Accessory</u>	<u>Item #</u>
1	Scale Main Retracts	<u>270500</u>
2	Scale 7" Main Wheels (2)	<u>270550</u>
3	Scale Retractable Tail gear	<u>270600</u>
4	Scale Tail wheel	<u>270650</u>
5	Scale 4-blade Propeller	<u>270700</u>
6	Pneumatic Completion Pack	<u>270800</u>



**Handling the P-47**

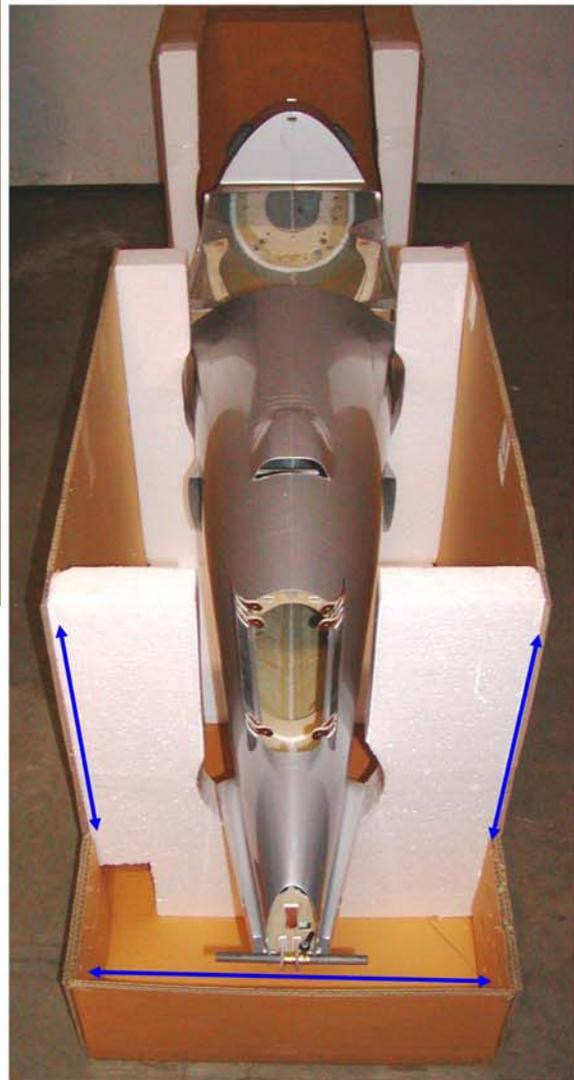
A cradle can be created from the included packing materials to assist in holding the fuselage for the installation of radio and other internal workings. The following photos are self-explanatory:





**Line cradles with packing tape to keep foam from crumbling.**

- Use clear packing tape on foam inserts to secure to box.**
- Cut out rear portion of box as well.**
- Foam blocks should be cut out to allow fuselage to be placed in cradle from above.**



**CONSTRUCTION**

The CARF-Models P-47 features precut servo pockets and mounting holes with spacing appropriate for JR digital servos – the 8611A will drop right in.

Larger servo screws are provided and strongly recommended for all servo installations.

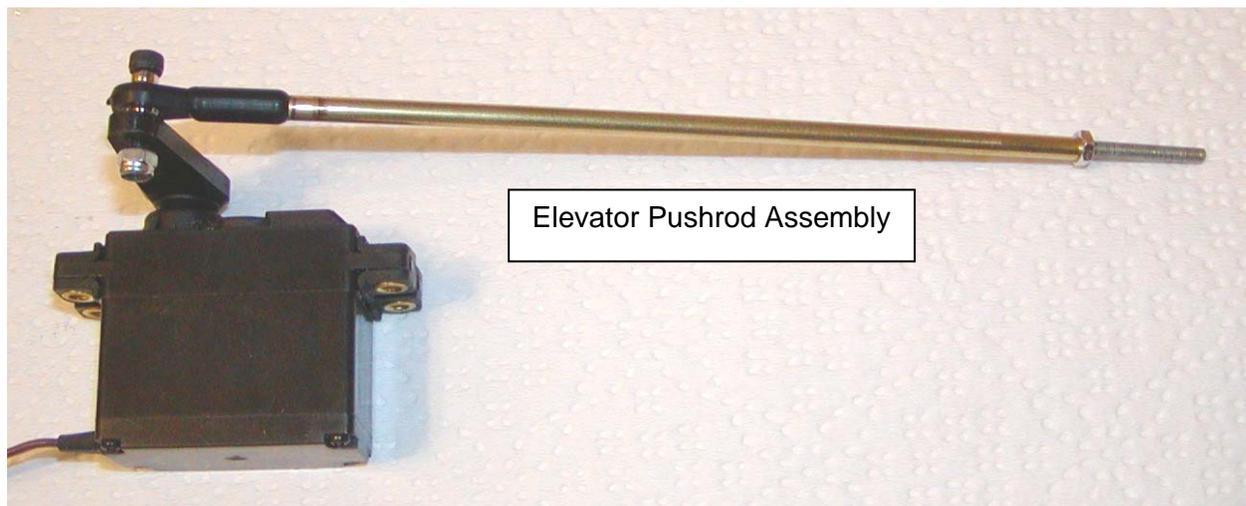
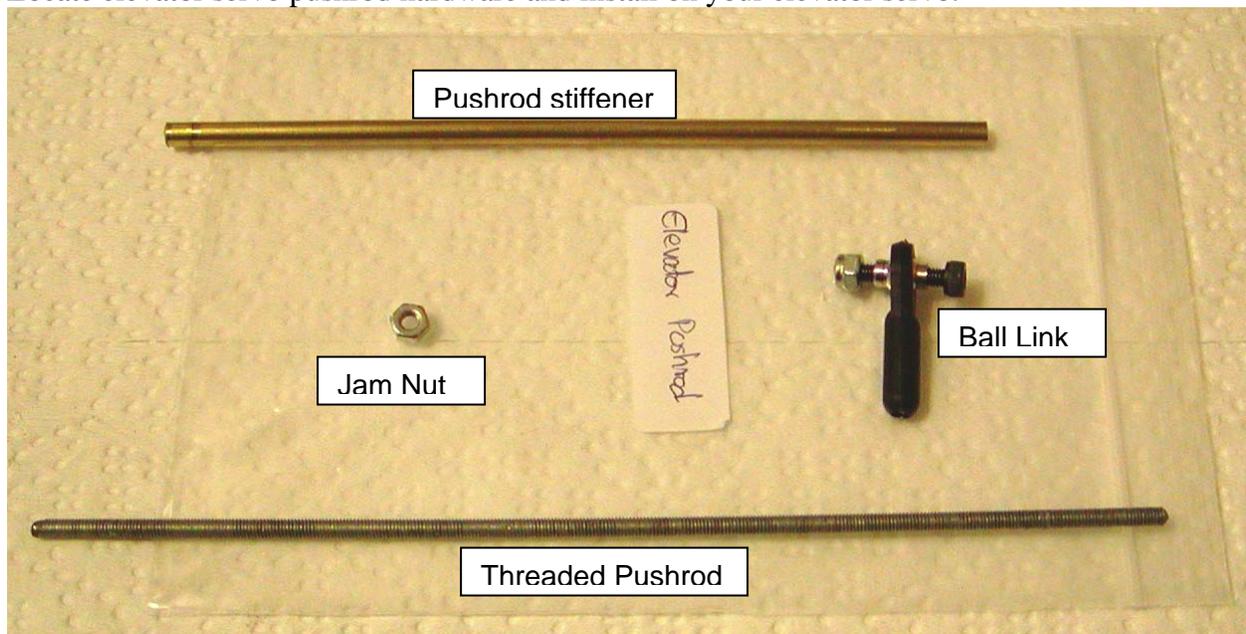


Use of other servos is up to the individual builder and may create additional challenges.

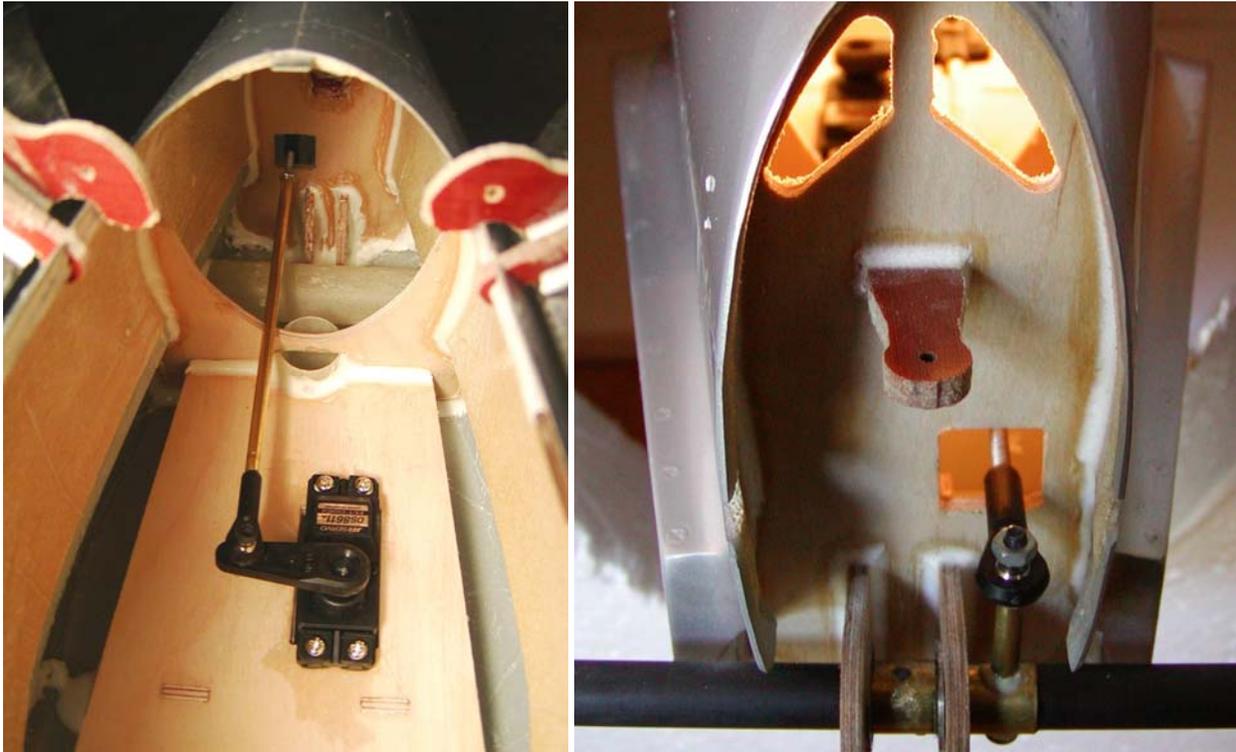
Note: When applying epoxy other glues to composite surfaces, ALWAYS lightly sand then thoroughly clean (with lacquer thinner or alcohol) surfaces that are to be glued. This will create a superior bond.

**Elevator Servo Installation**

Locate elevator servo pushrod hardware and install on your elevator servo.

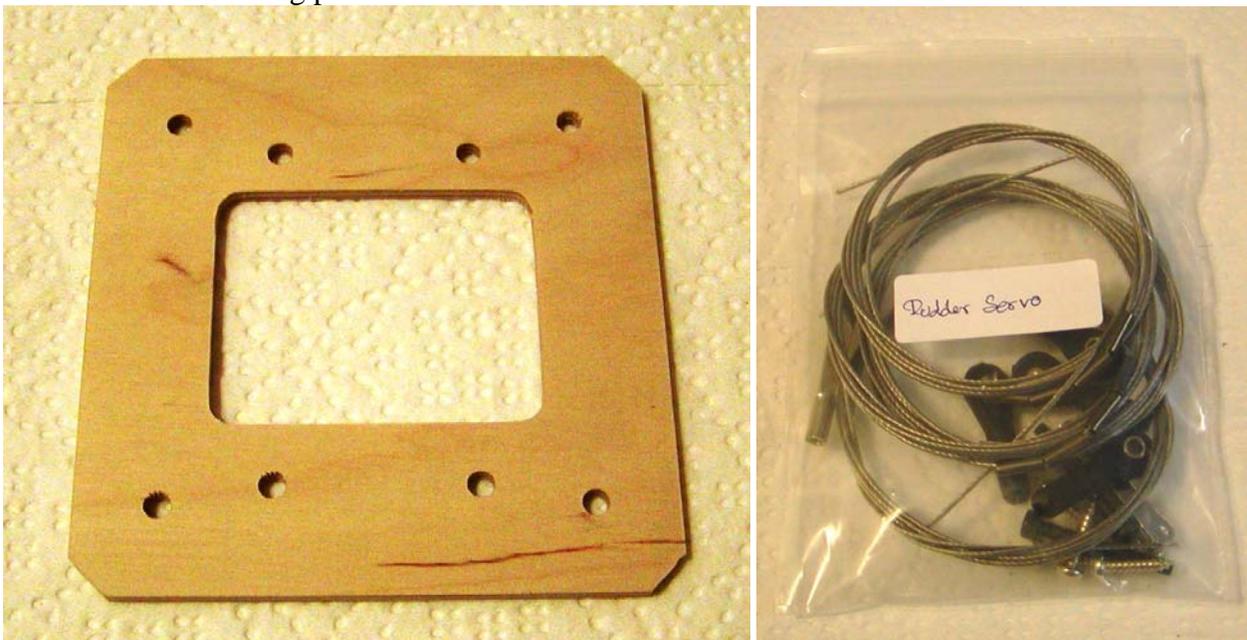


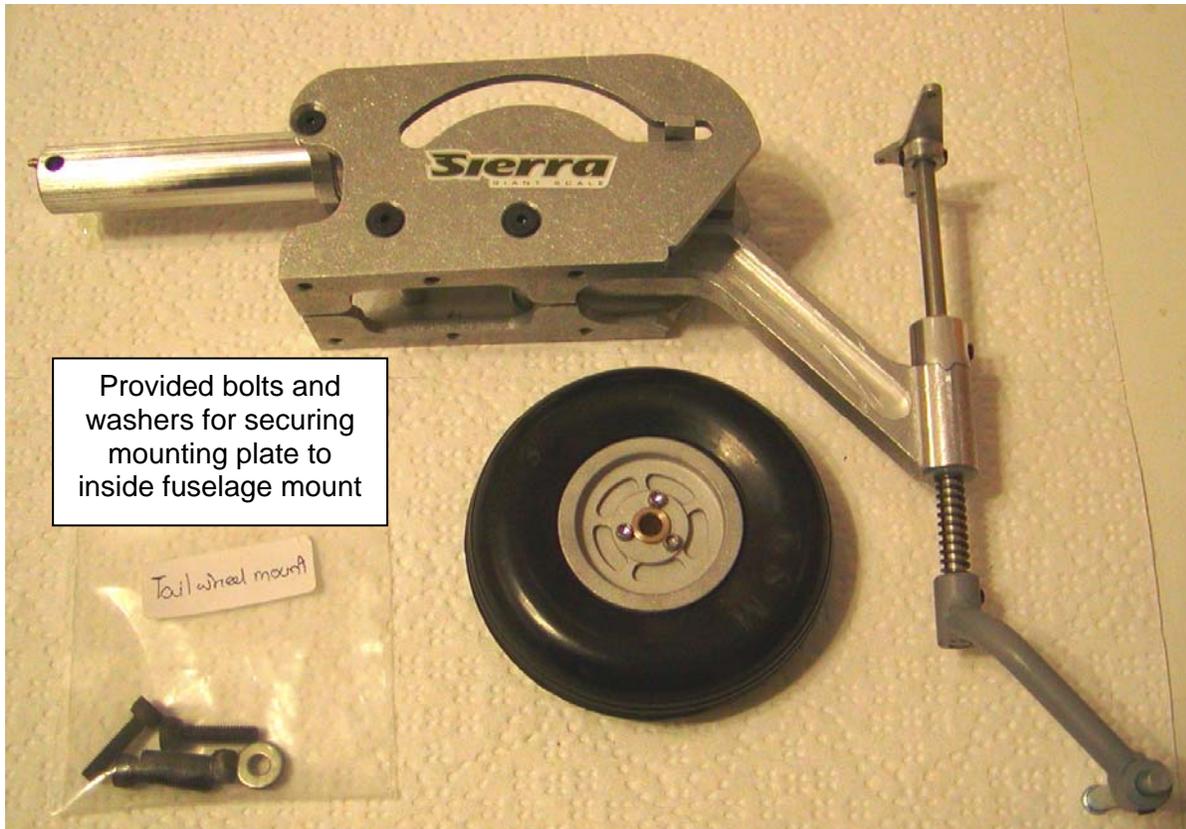
The elevator servo should be mounted in the pre-cut pocket using the provide servo screws. The pushrod is then threaded into the pre-installed elevator torque rod ball link.



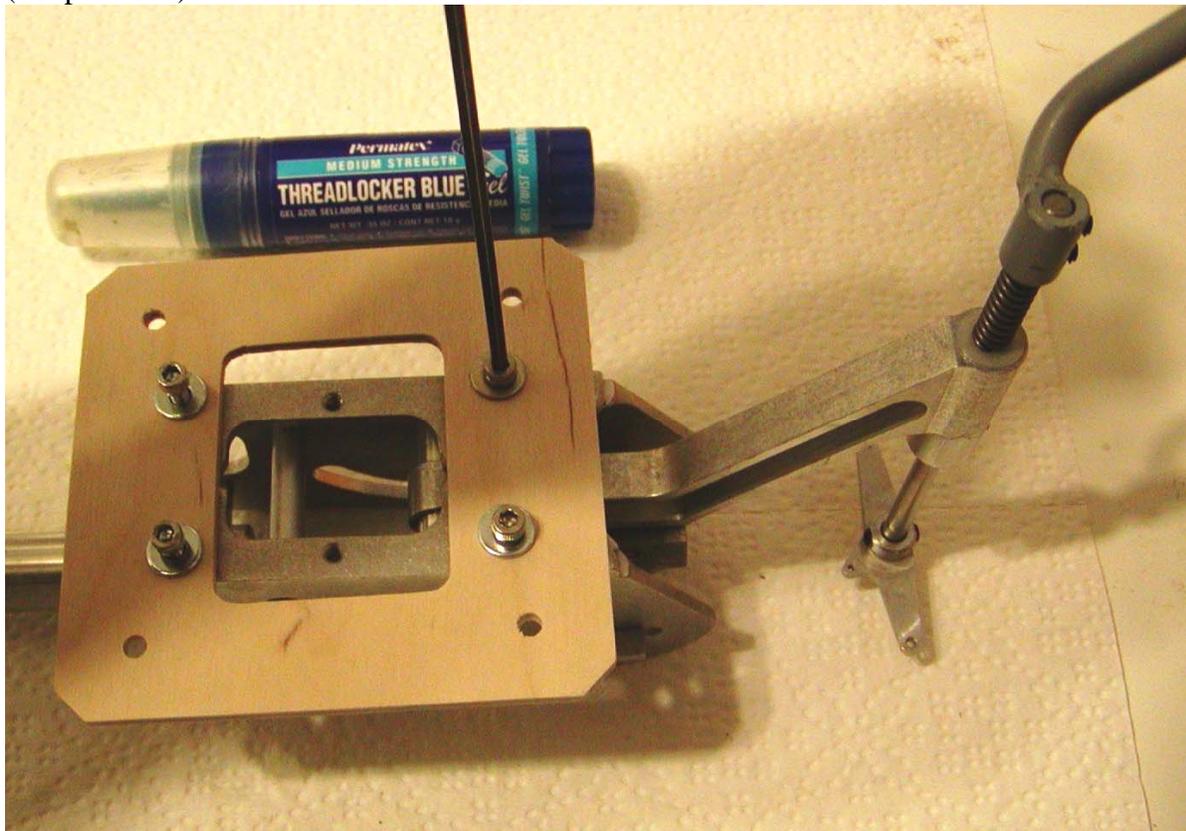
**Retractable Tail wheel**

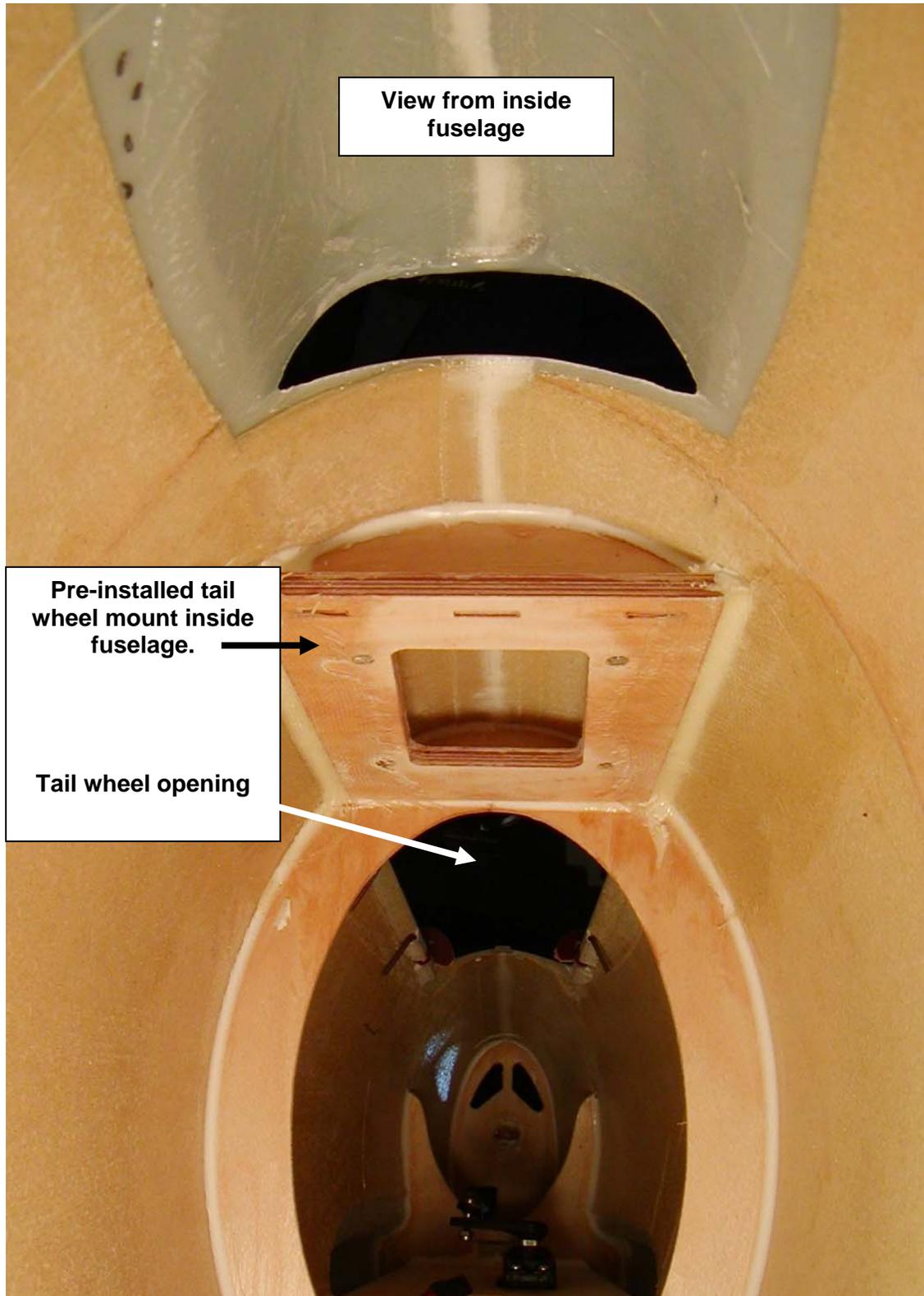
Your P-47 is designed to accommodate the Sierra Precision tail wheel unit. Locate the included hardware and mounting plate.



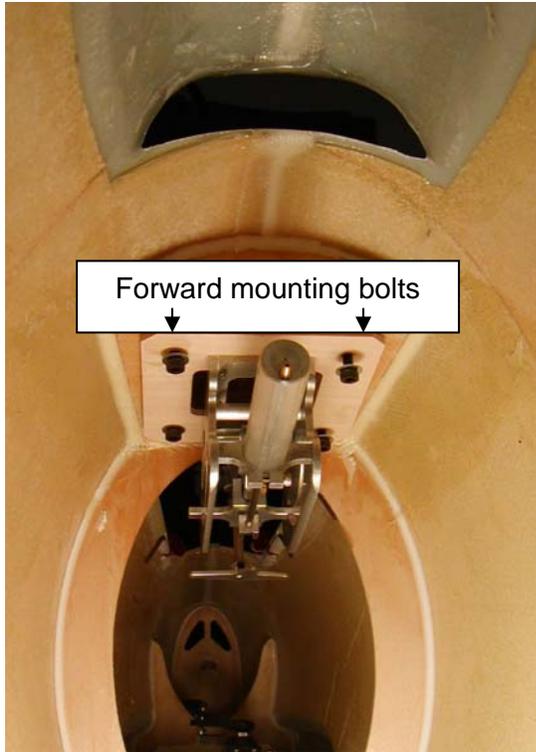


Mount the Sierra tail wheel unit on the ply mounting plate using 6x32 bolts and washers @US (not provided). **Be sure to use Blue thread locker on all screws and nuts!**

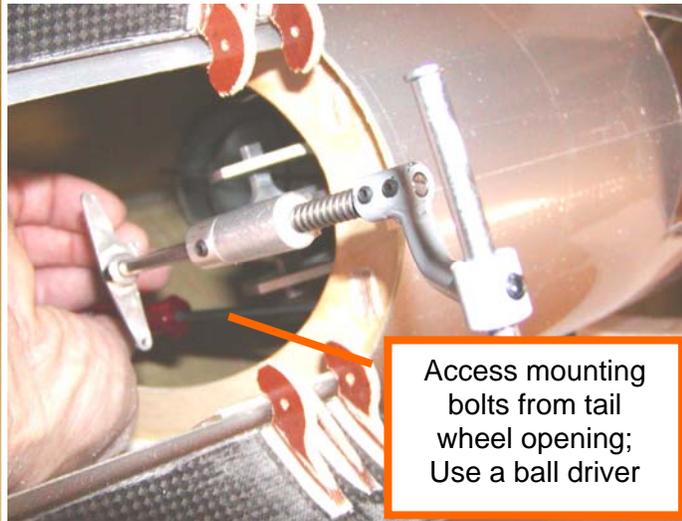




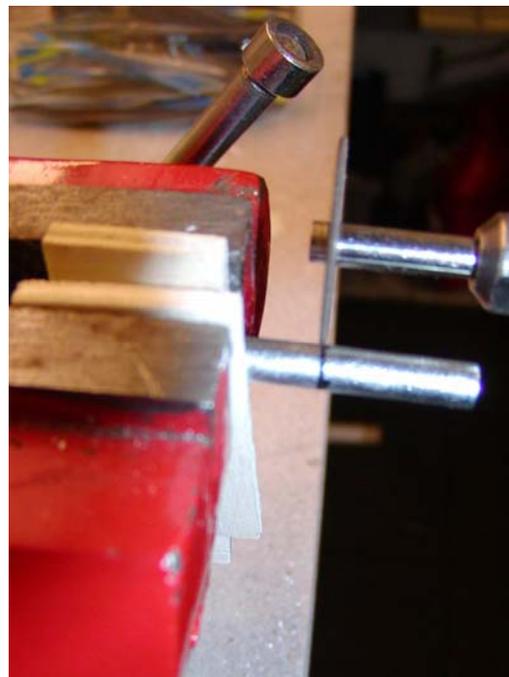
**The tail wheel unit mounting plate is bolted inside the fuselage to the pre-installed mounting plate using the provided bolts and washers.**



Installing tail wheel mounting plate mounting bolts can be challenging...Get all bolts started before tightening. IF you have REALLY LONG ARMS, you can reach the forward plate bolts from the wing opening. USE THREAD LOCKER!

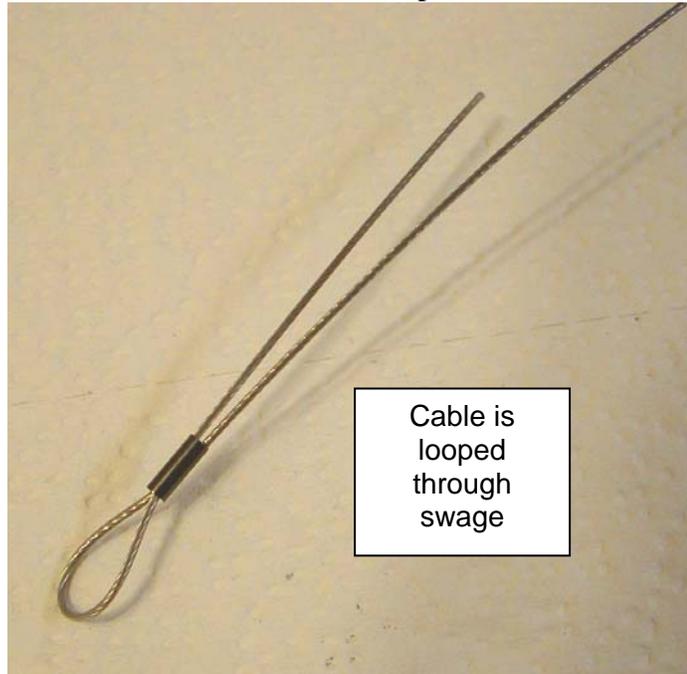


Use high speed cut-off wheel to shorten axle, then file smooth.

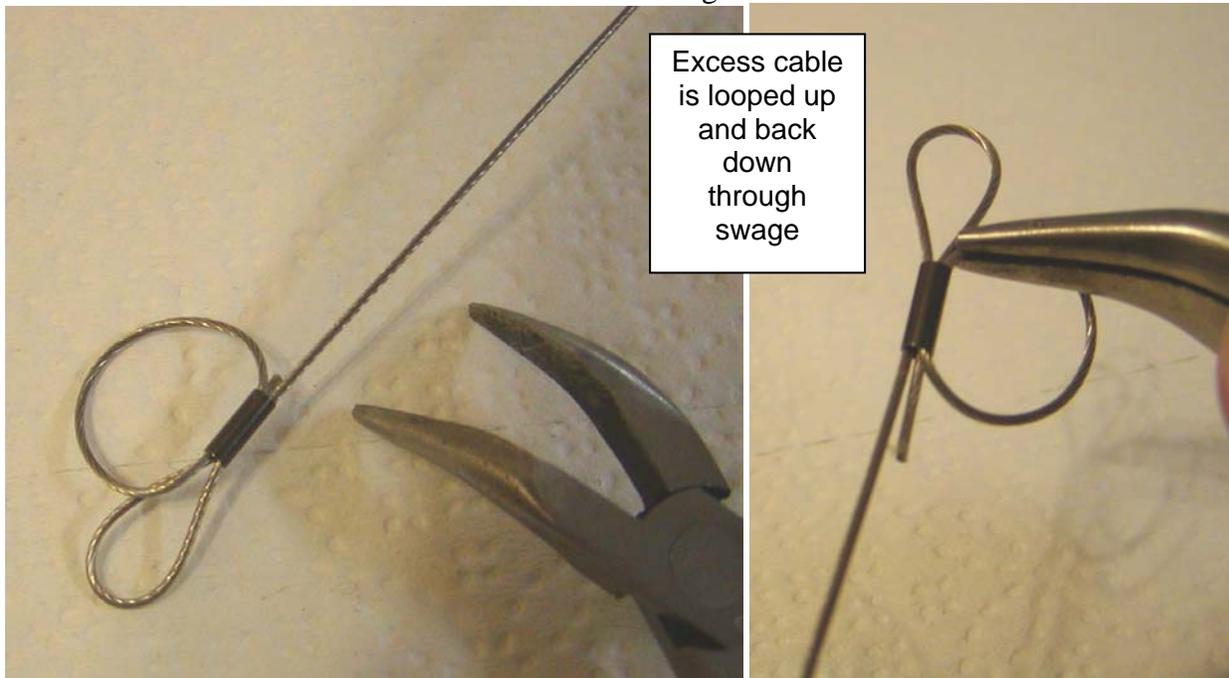


**Tail Wheel steering cables**

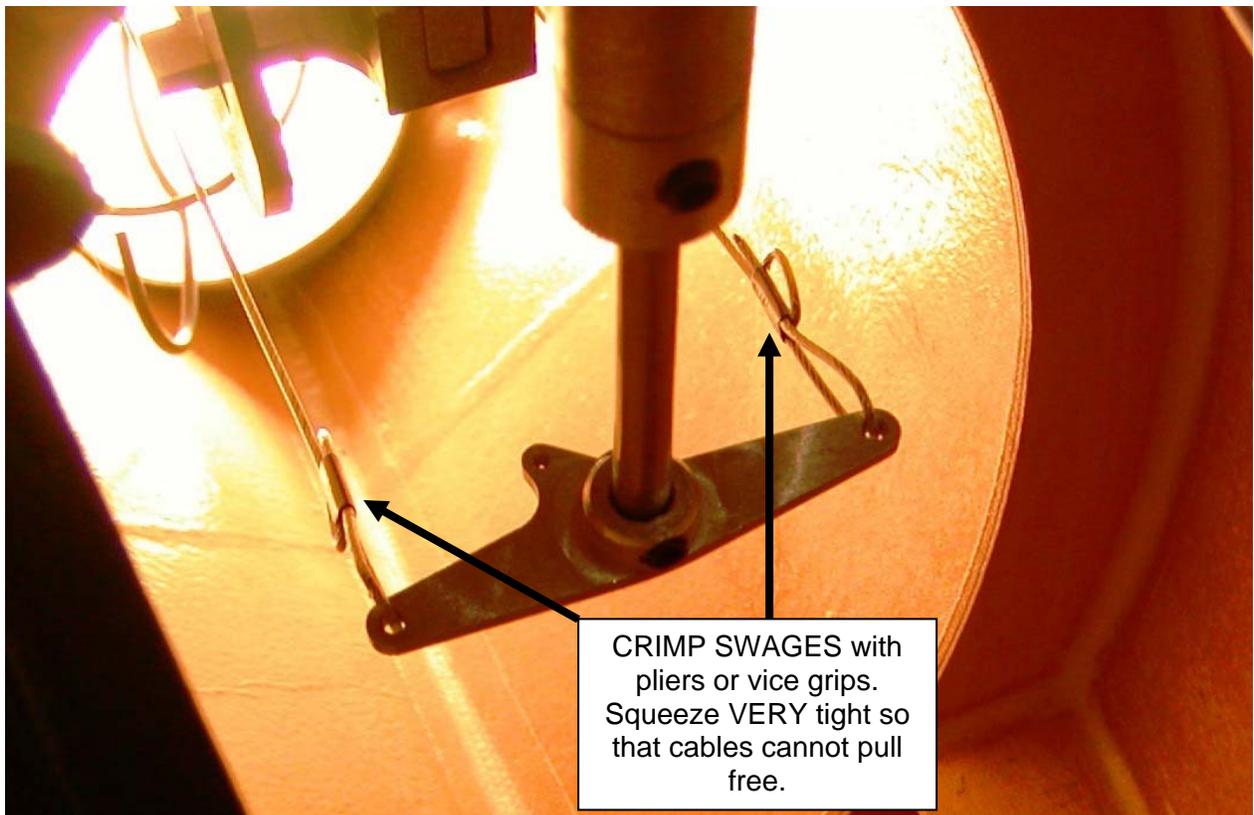
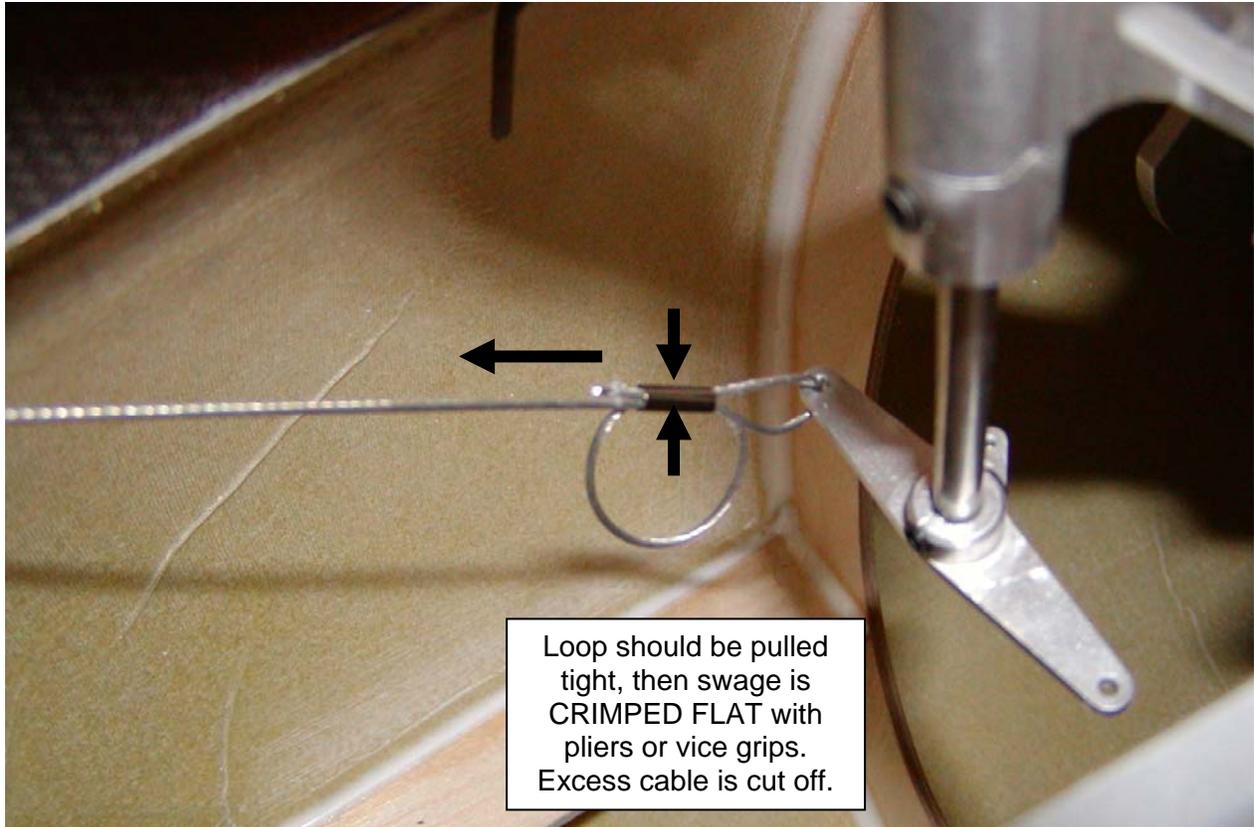
Locate the tail wheel and rudder servo hardware pack. The pack contains four cables: (2) 130cm cables and (2) 100cm cables. The tail wheel cables are the shorter, 100cm pair.



The following is an illustration of the correct manner in which the cables are looped and secured, then how the cables are to be attached to the tail wheel steering arm.



The following is how it looks when attached to the tail wheel steering arm.

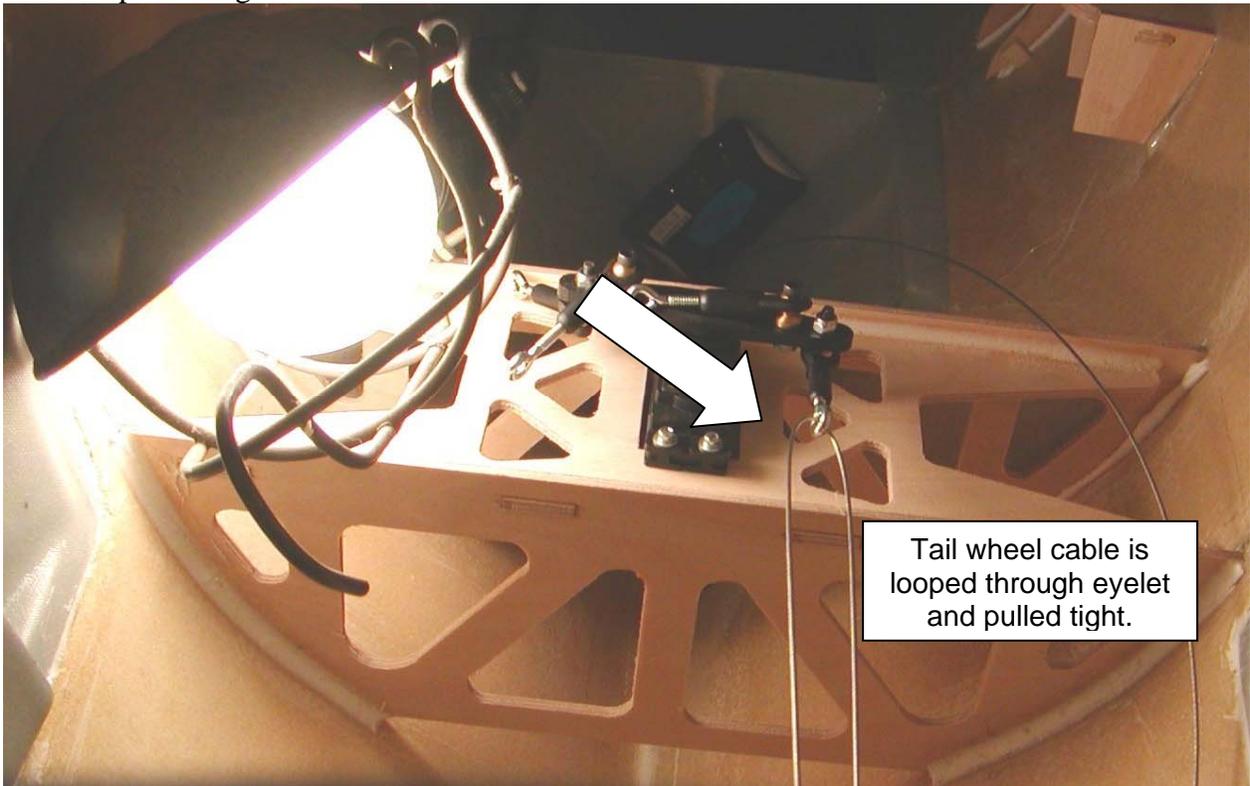


**Rudder / Tail wheel Servo**

The rudder hardware pack is used to make the ball link attachment points at the rudder servo. The tail wheel links are positioned outboard on the arm; rudder links on the inner holes. See photos:



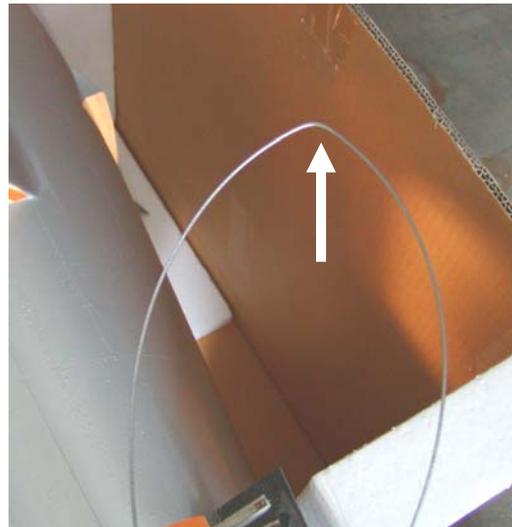
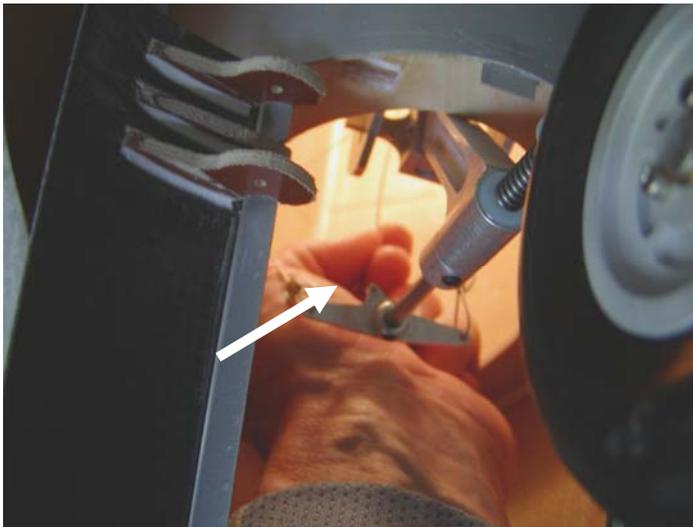
Mount the rudder servo in the pre-installed tray using the provided servo screws. Feed one tail wheel cable forward and through the ball link 'eyelet.' Grasping the excess cable from the tail wheel opening, PULL the cable tight to create a bend in the cable. This provides a marker for cable loop and length.



**NOTE:** Due to the location of the rudder tray, this is admittedly a challenging procedure! Take your time; do it right. Check the cable lengths several times **BEFORE** pulling loops tight and crimping.

When checking cable length and pulling cable tight, Rudder servo arm **MUST** remain stationary and neutral. A servo driver is very helpful in powering servo and holding at neutral position. You may also connect your receiver and battery to accomplish this.

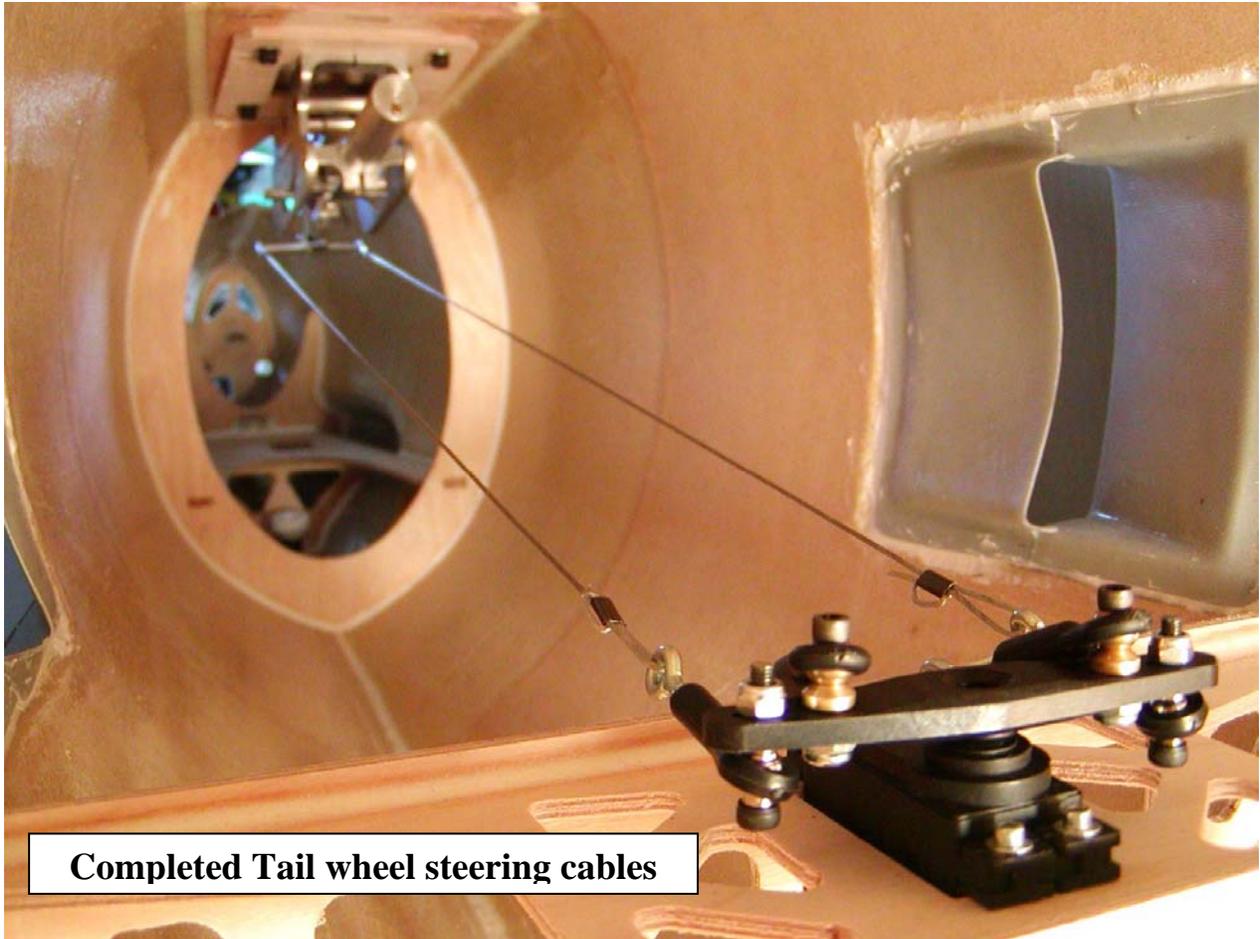
**CHECK** that the Rudder servo is centered, with trims centered **BEFORE** making cable measurements.



After pulling cable, remove and see the bend in the cable marking the area where it will be looped at the servo ball link eyelet. Using the same technique as that used for securing cables at the tail wheel tiller arm, the cable is looped back through the swage and crimped flat with pliers and the excess cable is cut off.



Perform this same procedure with the other tail wheel cable, making sure the tail wheel and rudder servo are **CENTERED BEFORE** crimping and cutting.

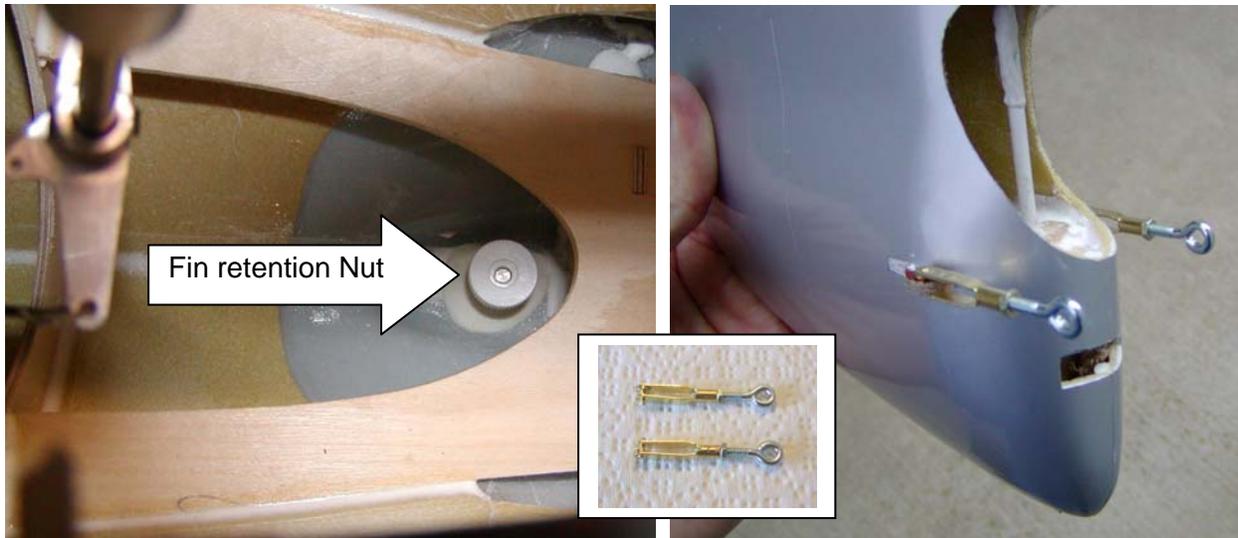


Completed Tail wheel steering cables

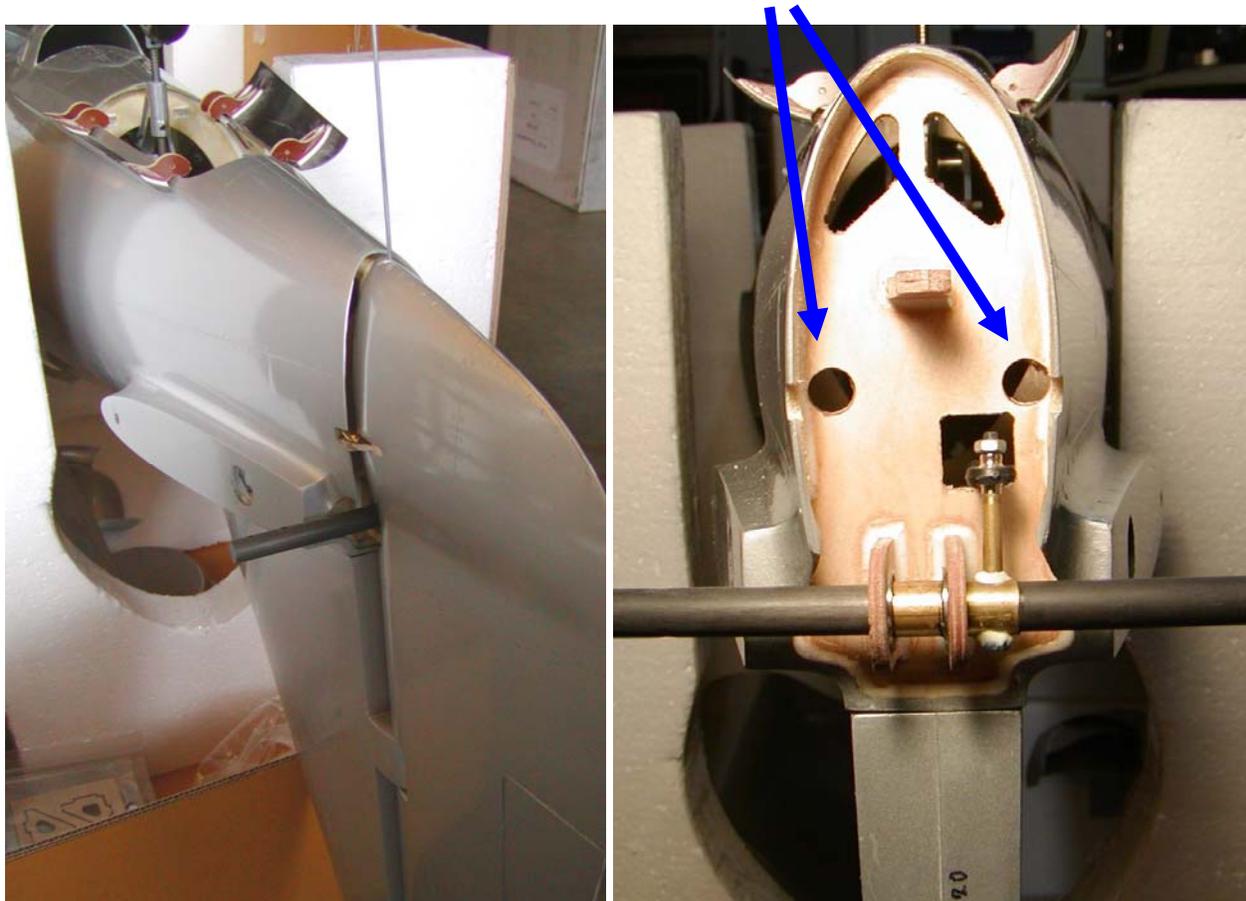
### Vertical Fin and Rudder Installation

Locate the vertical fin, 20mm x 150mm aluminum fin tube, and rudder. Also find the rudder hinge pin (0.075" wire@US) and knurled nylon retention nut. Trial fit.



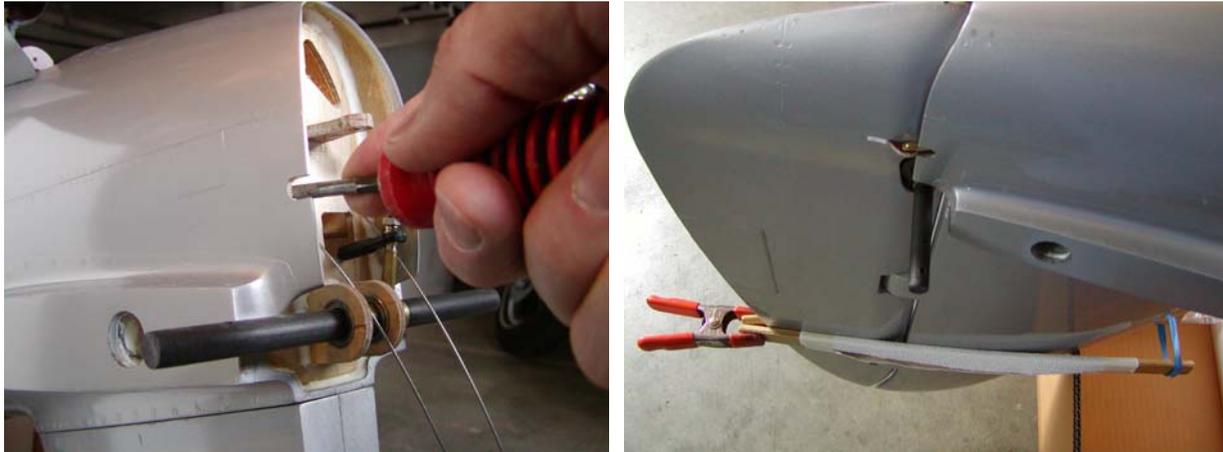


The rudder clevises and eyelets are part of the rudder hardware pack. Assemble clevises, eyelets and jam nuts as pictured (NOTE: included hardware may be slightly different than shown@US) and attach to rudder horns. Trial fit rudder to fin using supplied rudder hinge pin. Remove the rudder and drill two 10mm holes in the fin former for rudder cables.



Using the same method as shown and described previously, attach remaining two 130cm cables to rudder clevis eyelets. Trial fit rudder, feeding cables forward to wing saddle opening and work rudder to check for binding. If necessary, relieve rudder clevis openings with a round file such

that rudder deflects smoothly left and right with no detected binding. Once complete, secure the rudder so that it is held firmly centered. This can be done with two rulers, clamped on either side of the fin and rudder.



As with tail wheel cables, rudder cables are looped through rudder servo ball link eyelets and pulled tight, grasping excess cable from the tail wheel opening. The resulting bend in the cable marks the loop position. As emphasized previously, the Rudder Servo **MUST** be held securely centered along with rudder while making cable measurements! The same loop, swage and crimping techniques are used to finish the rudder cables. The rudder hinge pin should be cut to length with some extra to make a short 90 degree bend. A small slot can be cut in the rudder to recess the hinge pin. Retain with clear silicon glue or heavy duty clear tape.



Rudder hinge pin is recessed into small slot

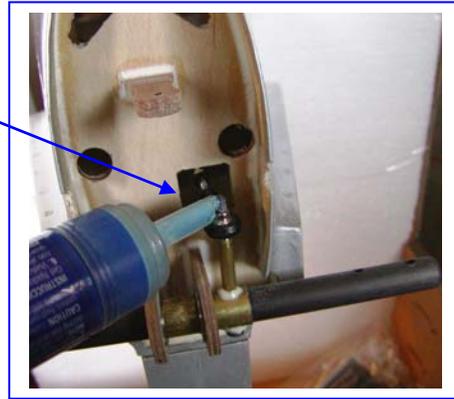


**NOTE:** Rudder servo ball links must be removed then reinstalled throughout this process as the cable loops are created and secured. Patience and perseverance are integral to successful completion. Be sure to allow extra adjustment on both the rudder clevis and servo ball link eyelet to take up what little cable slack remains once cables are properly completed.

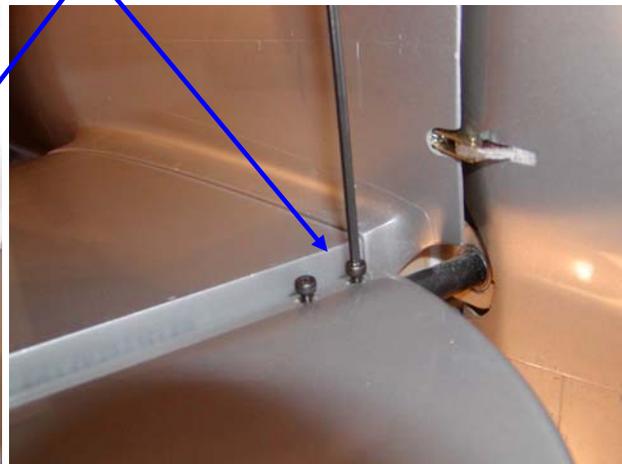
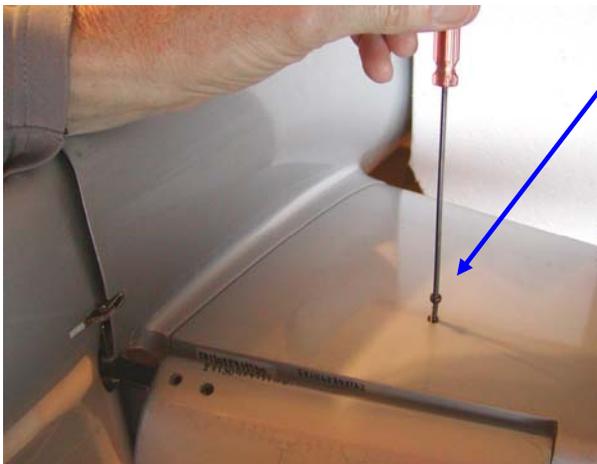
**Horizontal Stab and Elevators**

**NOTE: Remove torque rod arm retention nut, apply thread-locking compound, and re-tighten.**

Locate the 20mm x 380mm aluminum stab tube. Remove the stab retention bolts from the tube and slide tube into position. The left and right stab and elevator assemblies should be trial fit. Using a bright light, check to make sure the threaded holes in the stab tube are perfectly aligned with stab holes so that retention screws are easily inserted and secured. **DO NOT** force these bolts. If they do not thread in easily, check and adjust alignment until they do.



**DO NOT** cross-thread or in any way force stab or elevator bolts when installing. IF any resistance is encountered, REMOVE stab and elevator and verify bolts will easily thread into their respective locations.



**Elevator retention bolts are threaded into the carbon fiber elevator torque rod. It is equally important that you NOT cross-thread or in any way force these bolts! If necessary, remove**

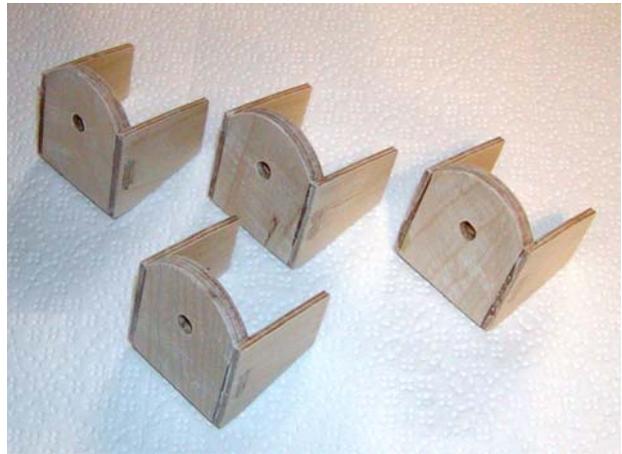
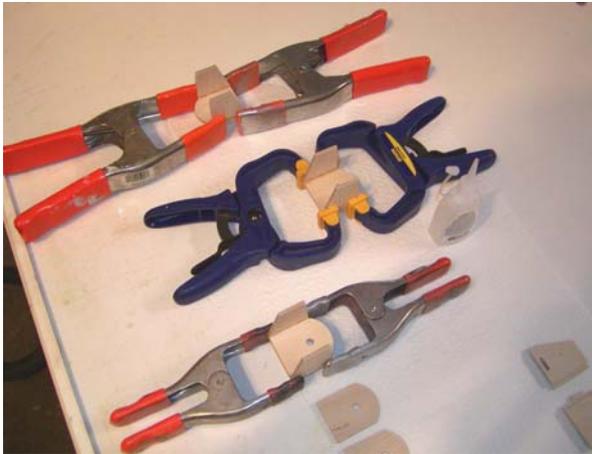
the stab and elevator and trial fit the elevator retention bolts into the CF torque rod to verify correct angle of insertion and proper thread ‘purchase.’

### **Equipment Tray**

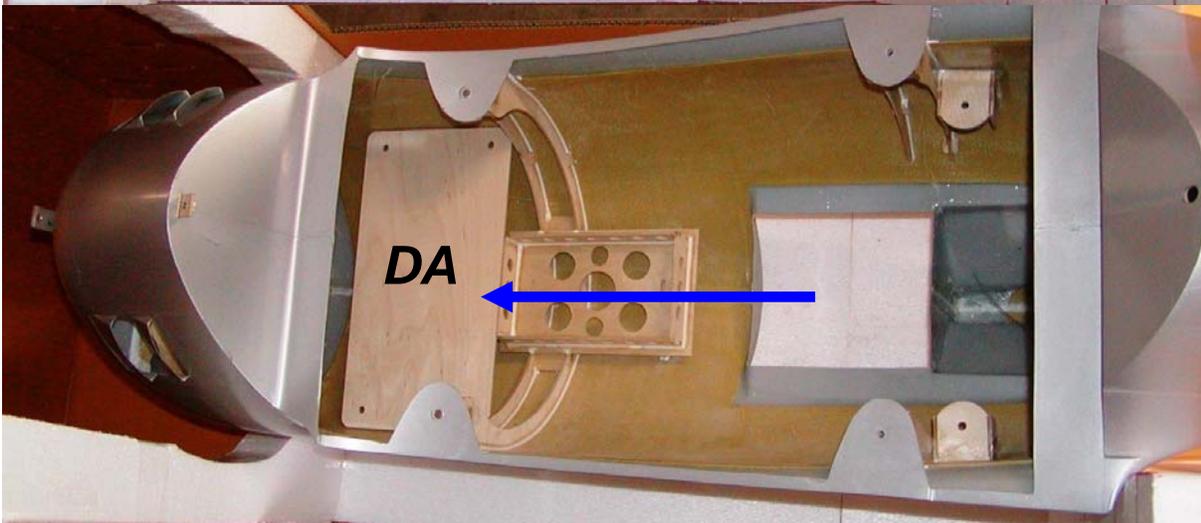
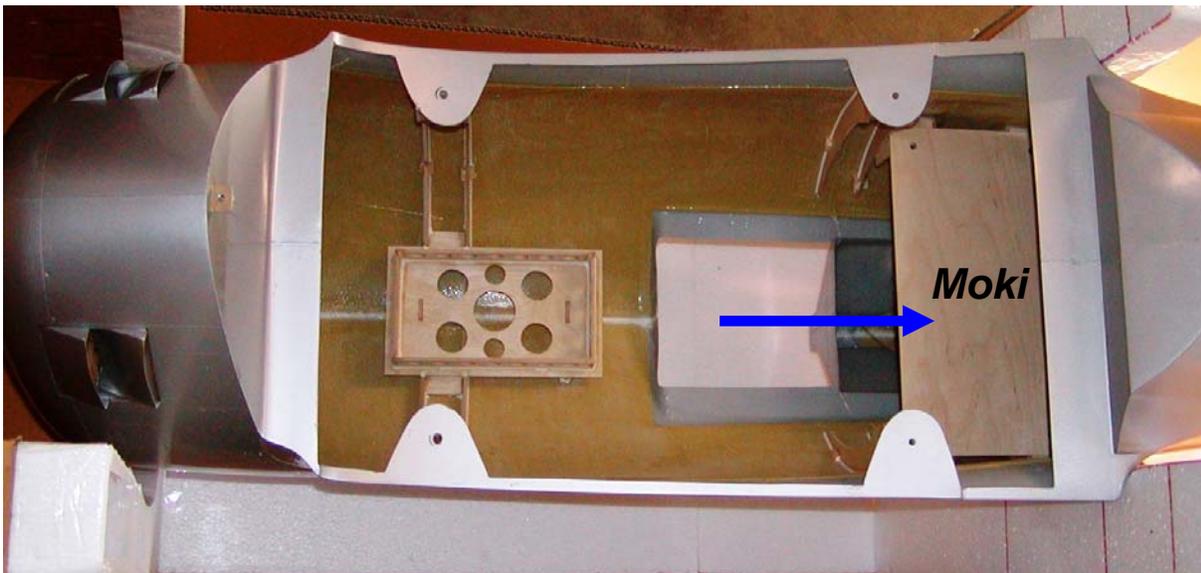
Locate the milled wood parts for the equipment tray. The tray mounting lugs are constructed from the pre-milled parts as shown.



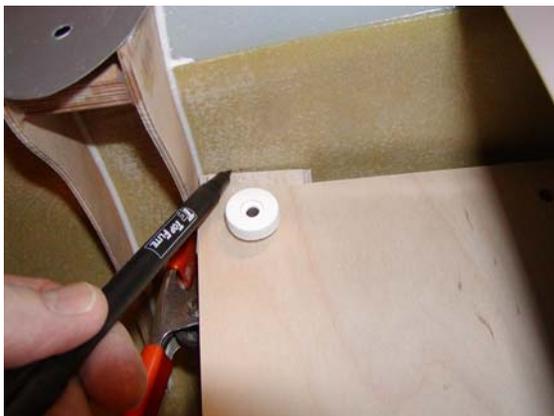
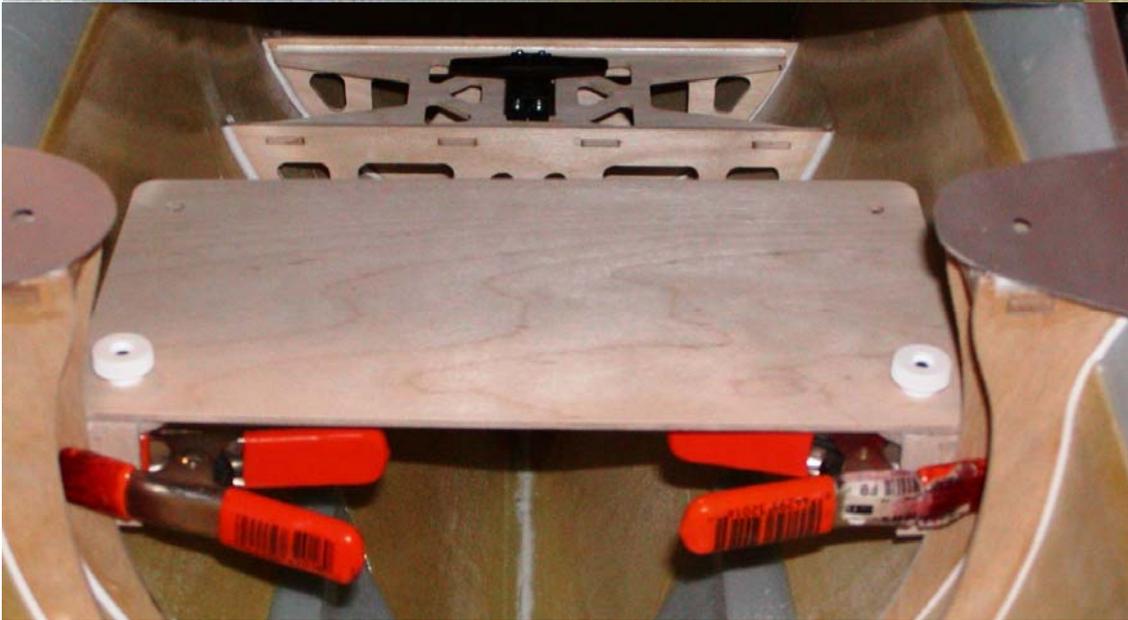
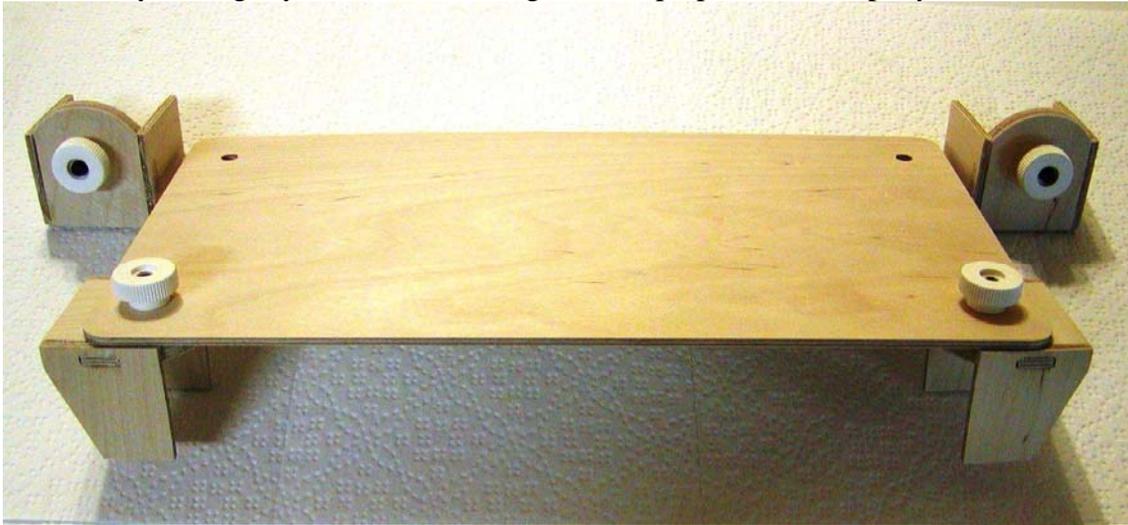
Side and top pieces are clamped then thick CA is used to glue side supports to top mount. Use epoxy to glue top mount doublers. Epoxy is used liberally and parts are tightly clamped to allow excess to squeeze into open spaces. Four mounts are constructed using the supplied wood parts. Once epoxy is set, sand and set aside.



**LOCATION of the equipment tray DEPENDS UPON ENGINE CHOICE:** IF using the Moki 215 or 250 radial, the equipment tray must be installed just aft of the cockpit; IF using a DA120 or similar engine, the equipment tray must be installed forward of the front wing mounts.



Using the included bolts and Nylon nuts, attach the front equipment tray mounts to the tray and set into position; use spring clamps to hold while marking the mount locations on the fuselage. Remove the tray and lightly sand the mounting areas in preparation for epoxy.



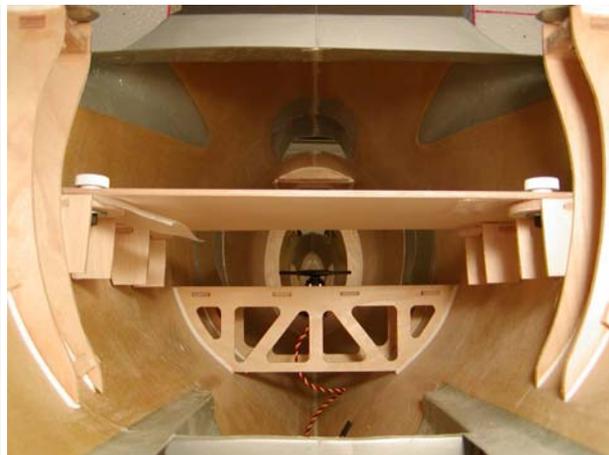
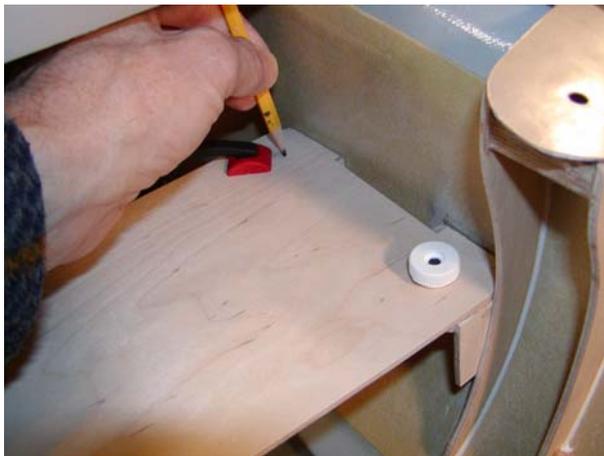
## ***CARF-Models P-47***

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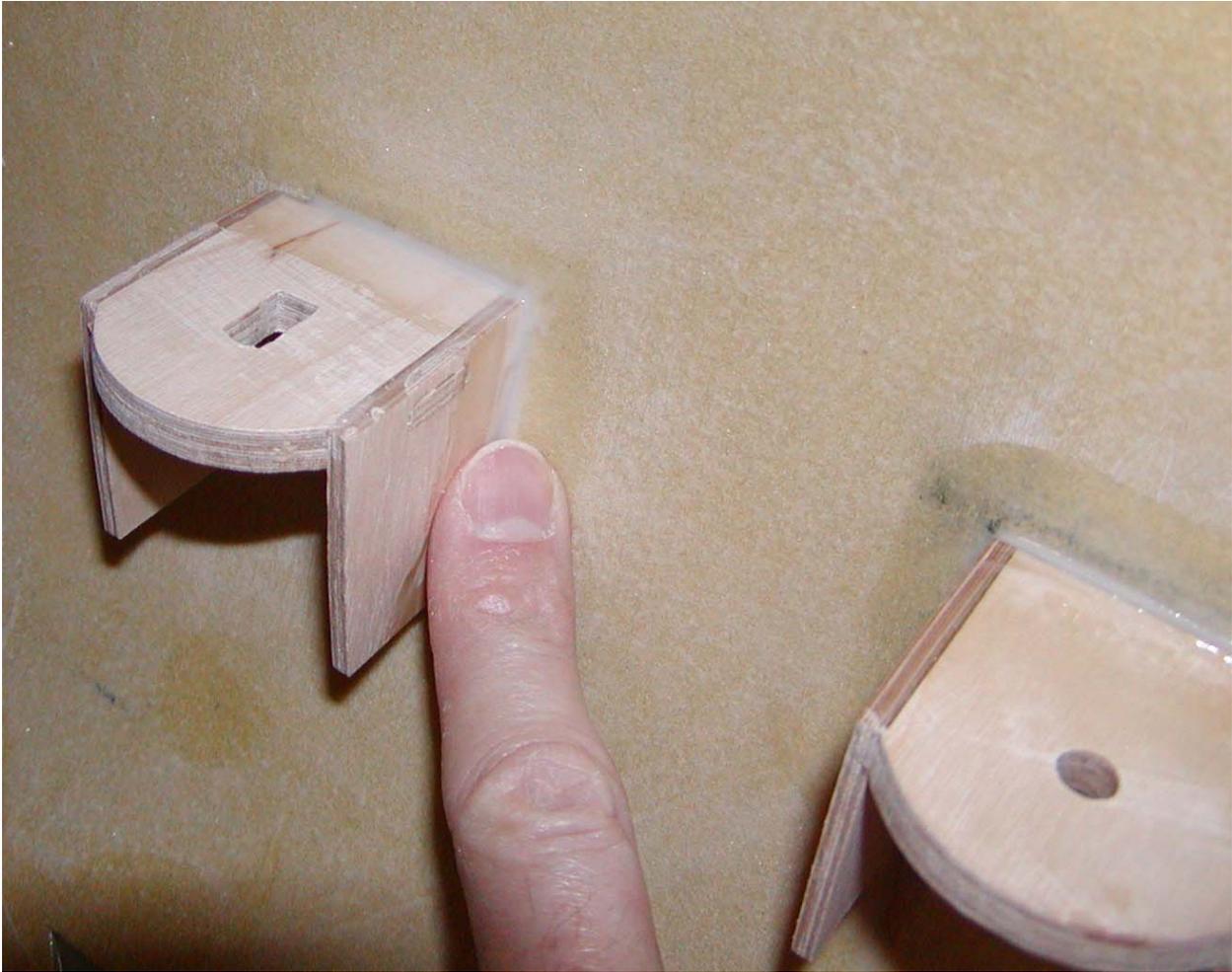
Mix 30 minute epoxy with cut glass fibers and apply to equipment tray mounts. When clamping equipment tray into position keep equipment tray free of any epoxy!



When the epoxy has set on the front mounts, locate the position of the rear mounts; mark the mounting holes and enlarge them to line up with the tray. Mark the position of the rear mounts; remove the tray; sand, clean and epoxy rear mounts in the same manner as the front mounts.



Once epoxy is set and mounts are secure, remove the tray and apply a fillet of epoxy/cut glass:

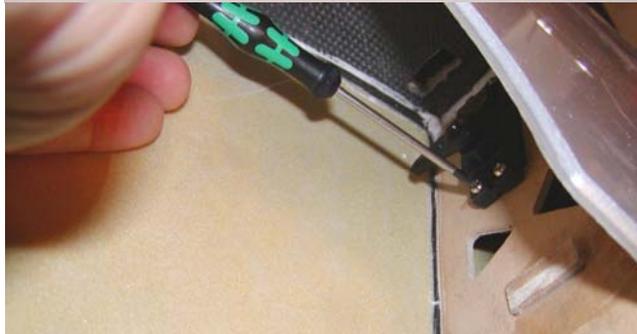


**WINGS - Flaps**

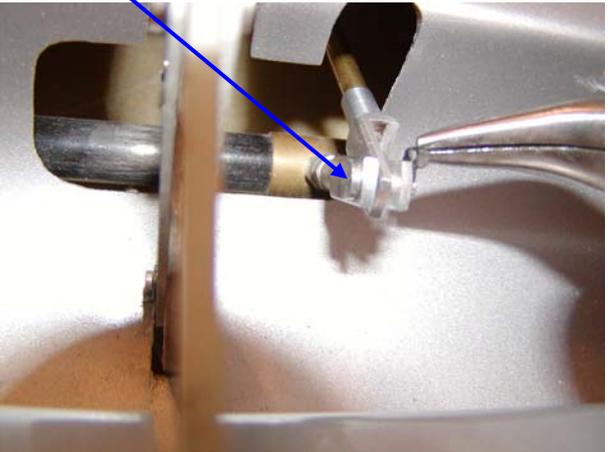
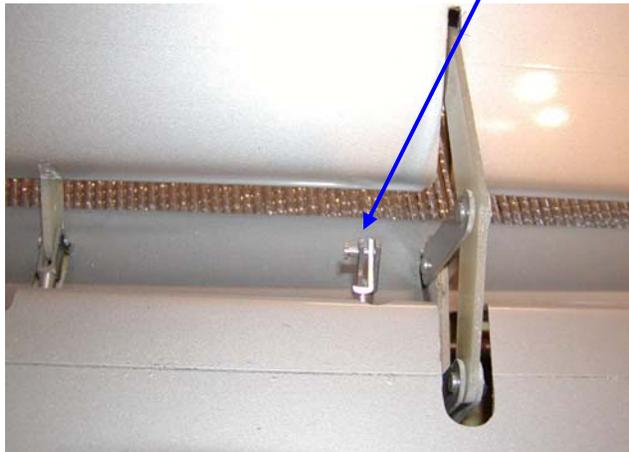
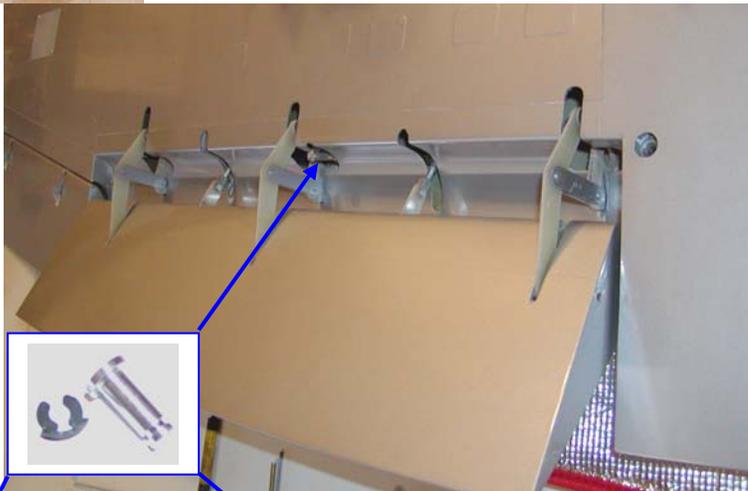
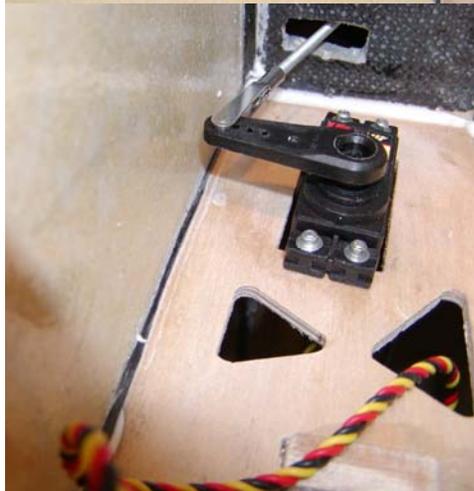
Locate the Flap servo hardware bag and make two pushrods as shown. Install the flap servos inside gear pockets using the provided servo screws.



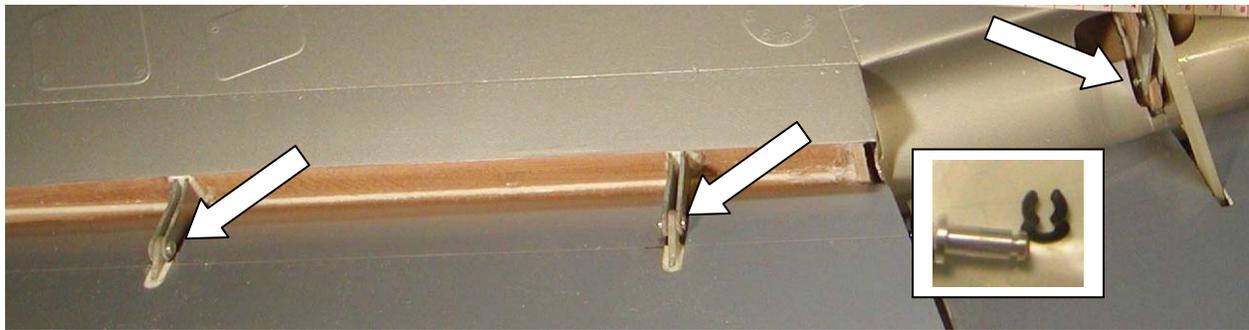
Pushrod length will vary w/servos and arms used. The measurement below is approximate.



**The flap pushrod clevis is secured to the flap tiller arm by way of a retention pin and 'E' clip.**  
**Be sure the 'E' clip "snaps" firmly into place.**

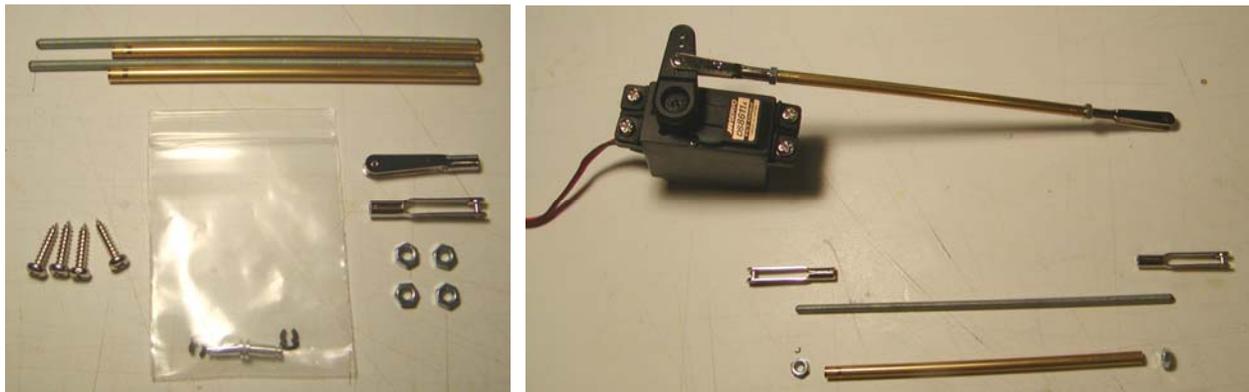


**WINGS – Ailerons**

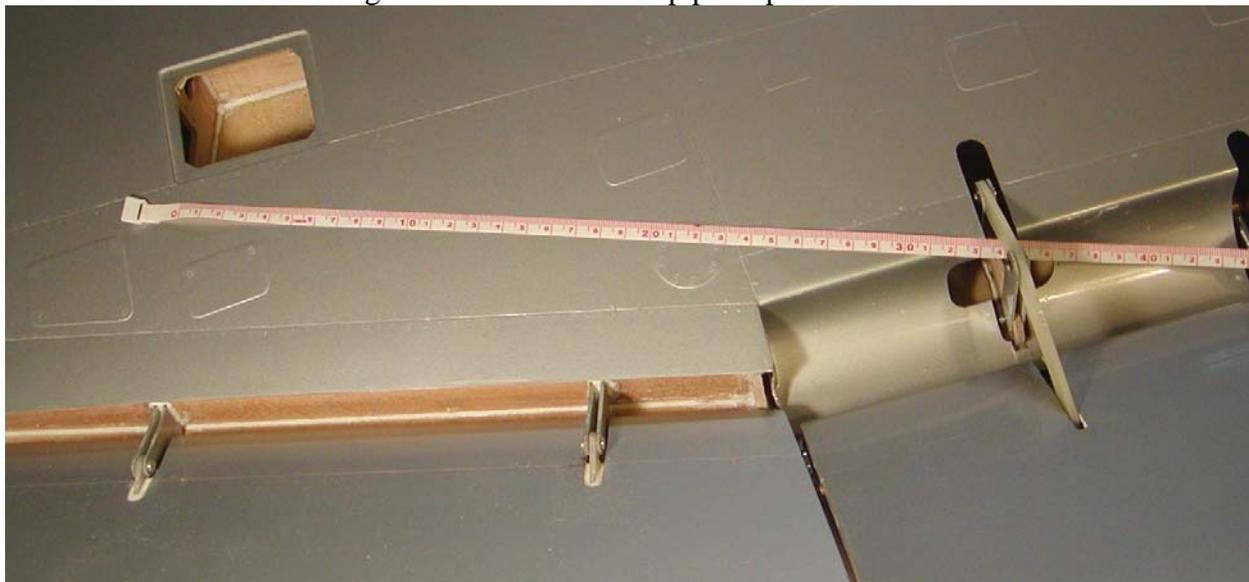


**NOTE:** Please check ALL hinges on both ailerons and flaps for the installation of 'E' clip retainers. While CARF quality checks are thorough, they are not perfect. IF any clips or hinge pins are missing, contact your CARF Sales Rep for immediate replacement.

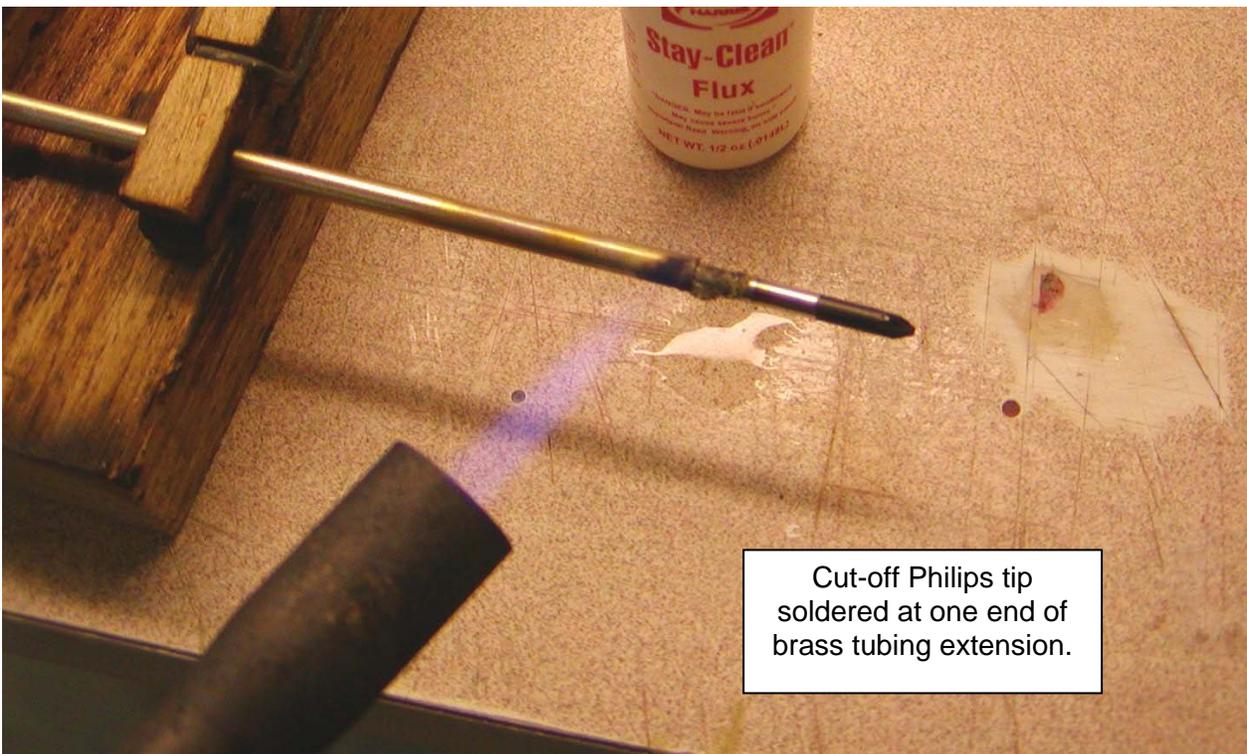
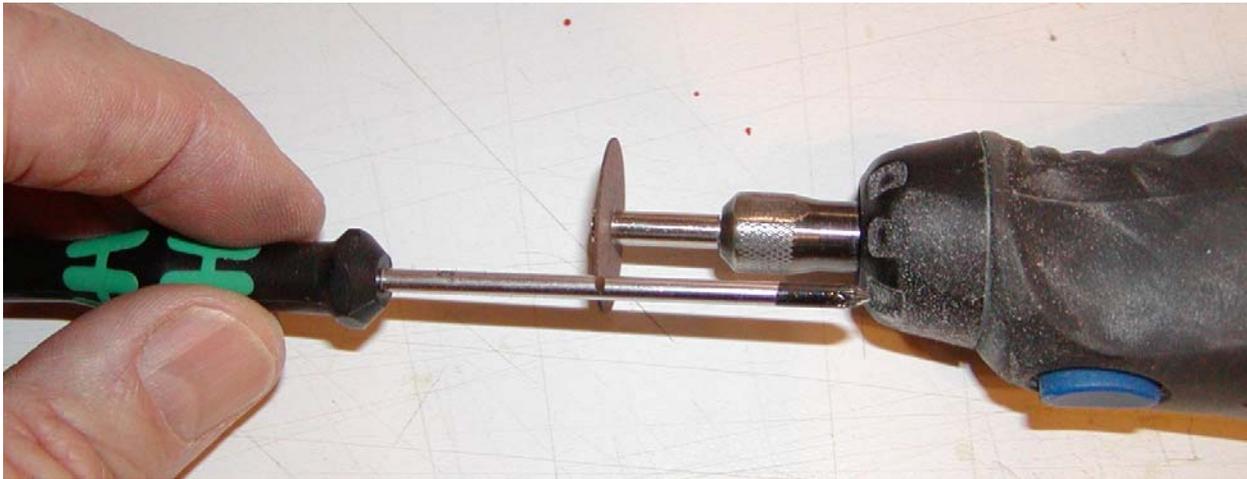
Locate the Aileron Hardware bag (120mm threaded rods) and assemble aileron pushrods as shown. For correct control geometry, a very short servo horn will be employed and the inner-most servo arm hole utilized.

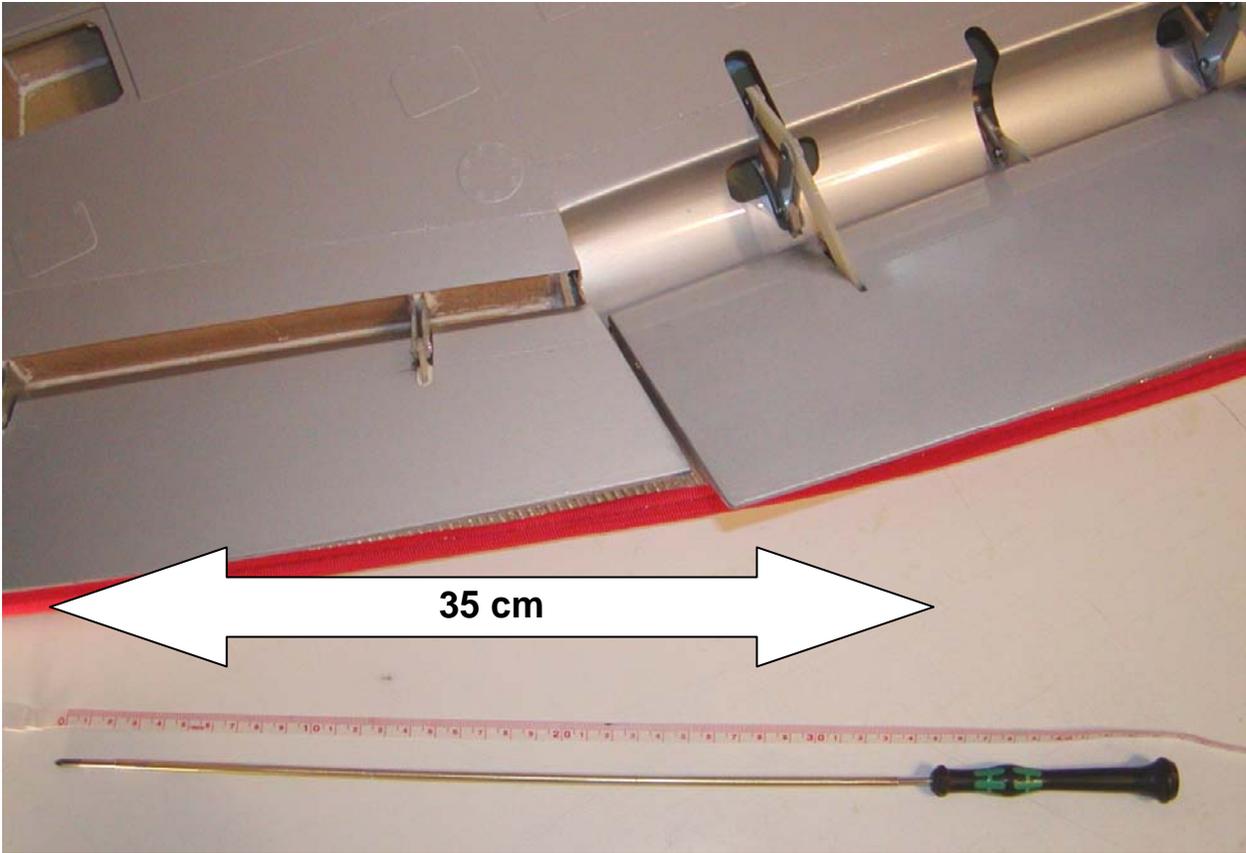


Some hardware installation challenges are inherent in any highly prefabricated scale aircraft. Aileron servo installation will require a special tool to access aileron servo screws. The preferred 'tool' is to create an exceptionally long Philips head screw driver. It must reach a minimum of 35 cm and also be slender enough to fit between the flap pivot points.



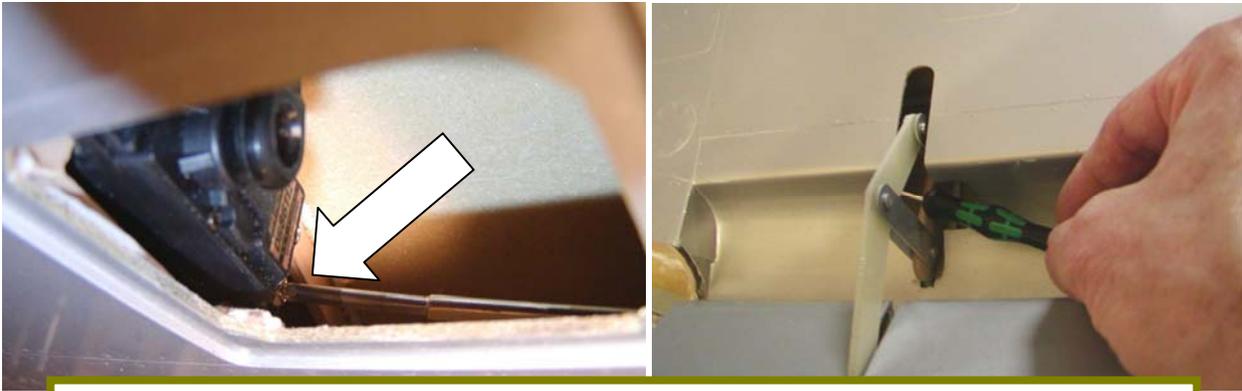
As they say, “You cannot make an omelet without breaking a few eggs!” – to sacrifice a Philips screwdriver for the greater good of aileron servo installation... a fair trade INDEED! Brass tubing is soldered to as the extension between tip and base to create the needed tool.





**The screw driver is inserted through the outboard flap pivot point.**

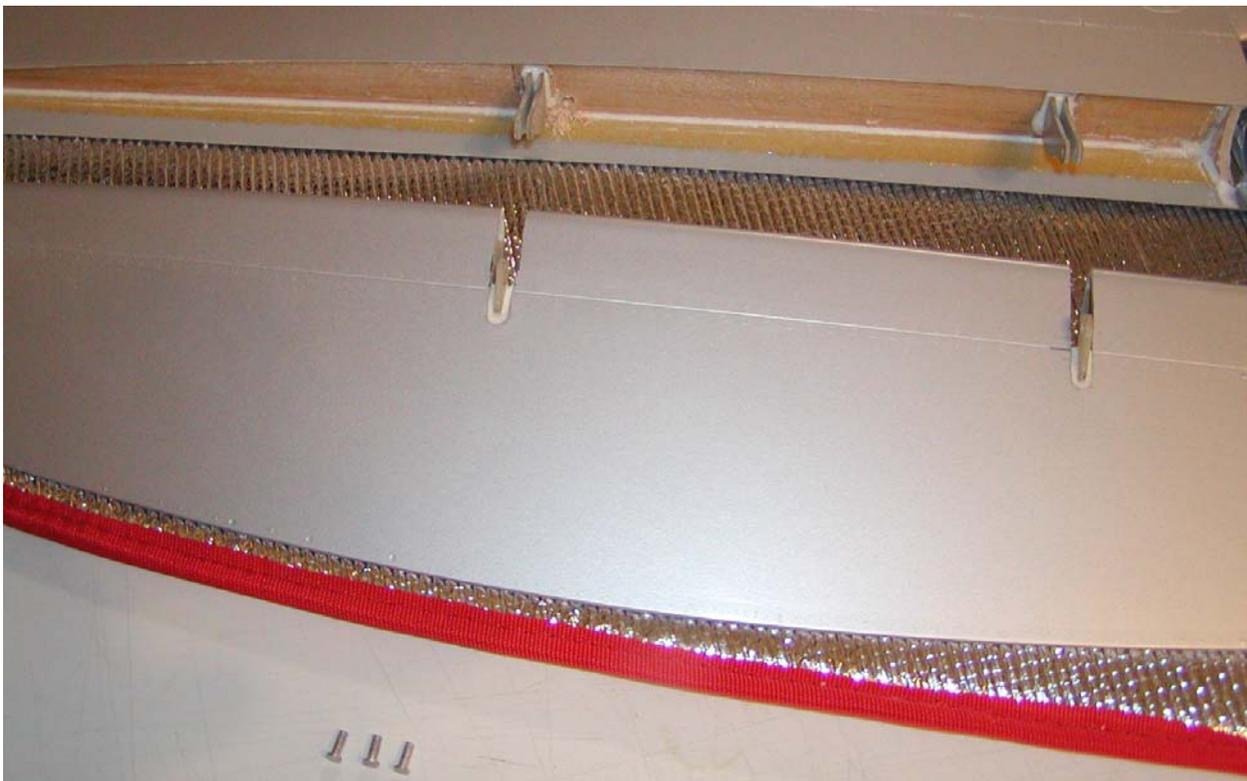


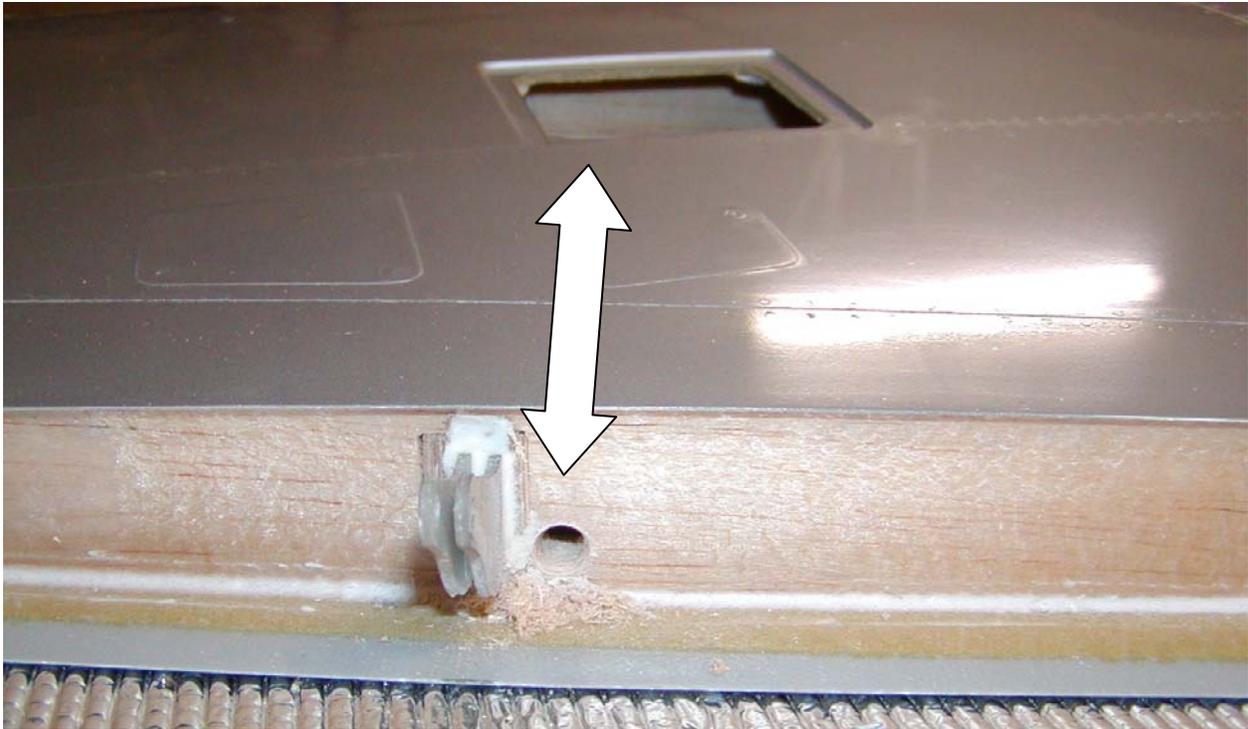


Servo mounting screws accessed from outboard flap pivot opening.

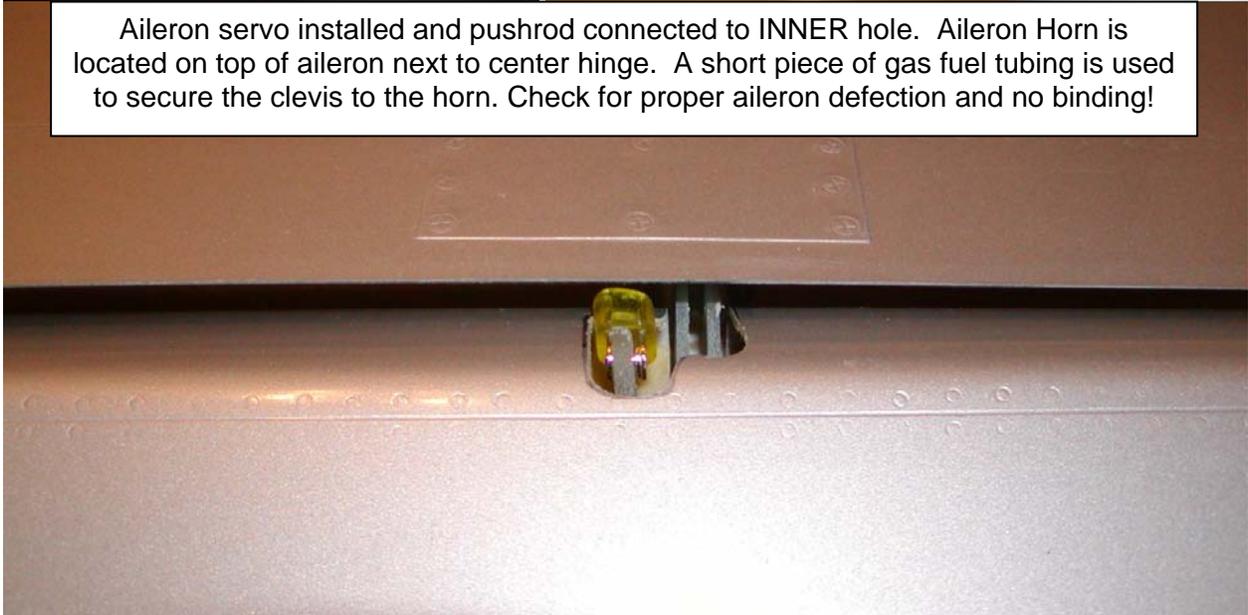
On some early production P-47s, the aileron pushrod exit hole was not drilled in the wing trailing edge spar. If yours does not have the exit hole, find the correct location on the spar by lining up the aileron horn with servo horn. The aileron horn is located on the TOP of the aileron next to the center hinge and is greatly recessed. Drill an approx. 8mm hole in the trailing edge spar.

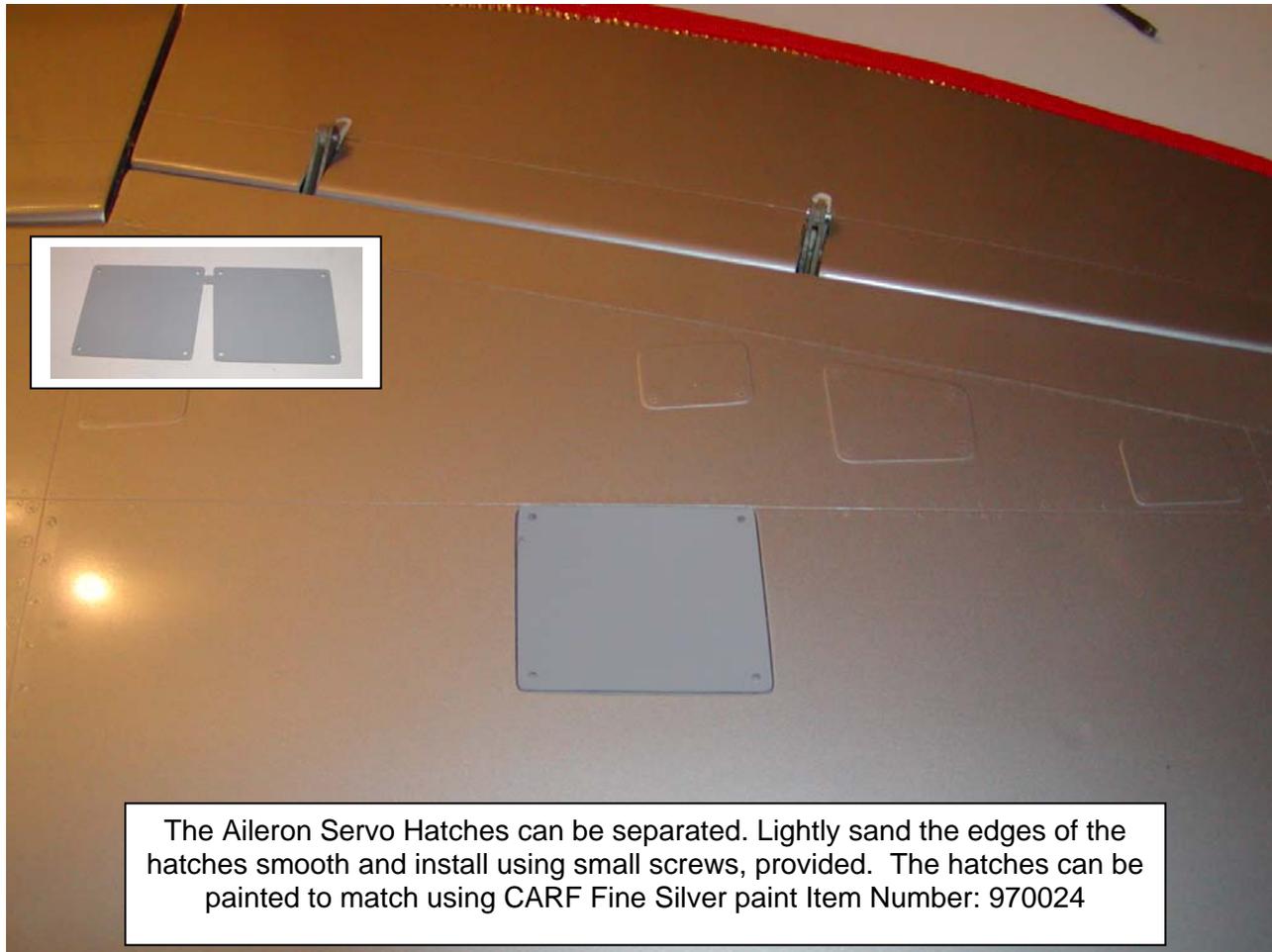
**NOTE:** Aileron removal makes this considerably easier – simply remove the E clips and hinge pins and set them aside in a SAFE PLACE!





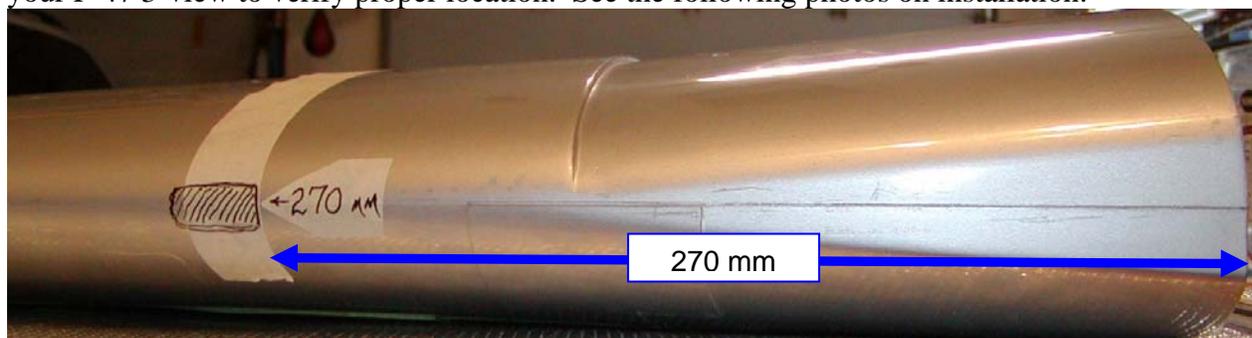
Aileron servo installed and pushrod connected to INNER hole. Aileron Horn is located on top of aileron next to center hinge. A short piece of gas fuel tubing is used to secure the clevis to the horn. Check for proper aileron deflection and no binding!





### Cockpit Air Intake

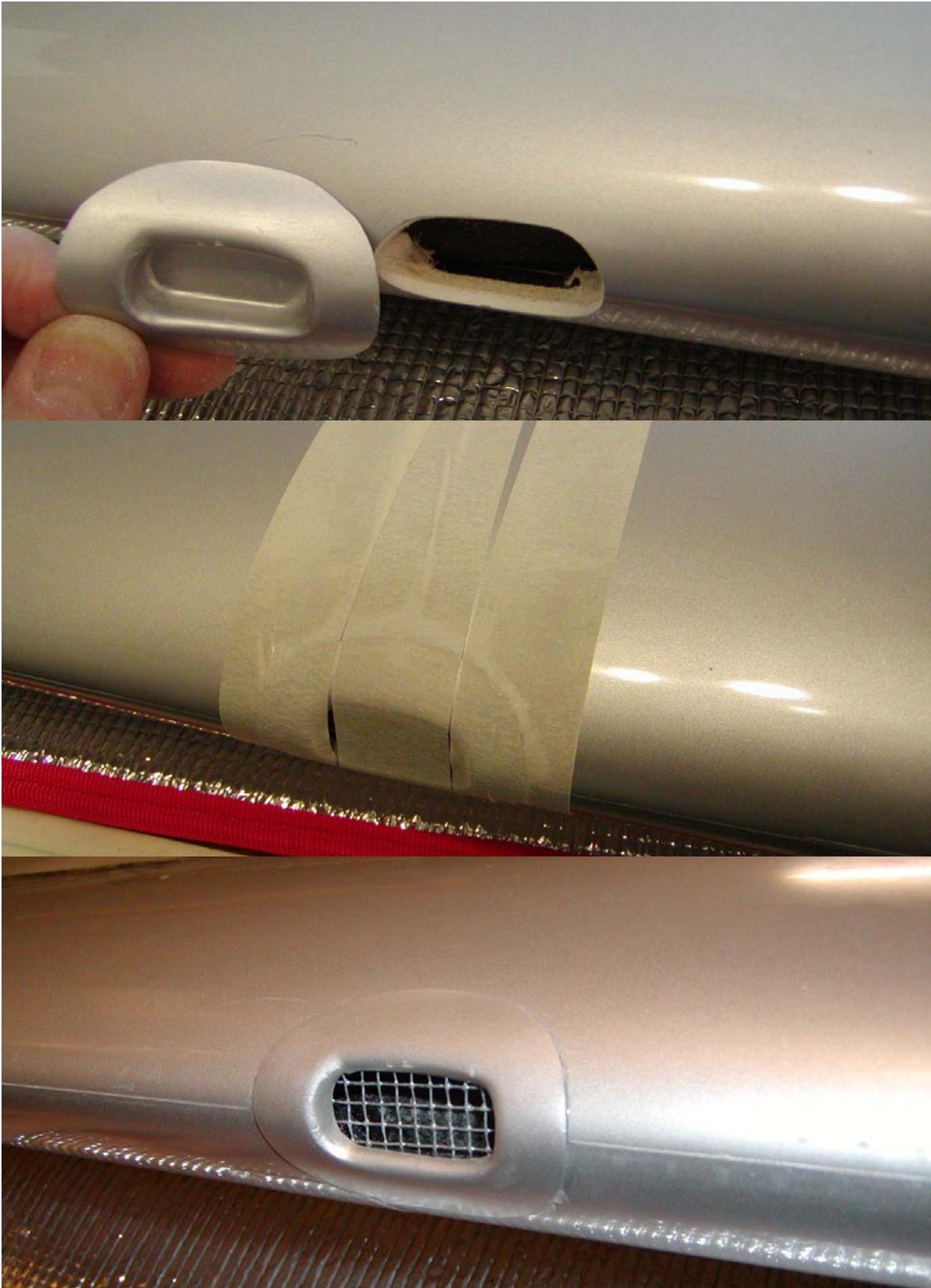
The P-47 cockpit was fed fresh air through a scoop on the leading edge of the right wing. Check your P-47 3-view to verify proper location. See the following photos on installation:



The scale location for the scoop inboard edge is 270mm from the wing center. Use a Dremel tool and abrasive bit to cut out a relief in the wing leading edge.

**CAUTION: DO NOT CARVE into the carbon fiber wing tube which is located about 1.5 cm behind the leading edge.**

Some sanding of the Air Intake will be necessary for a perfect fit. When satisfied, epoxy into position using masking tape to hold firmly in place until set. The modeler may choose to cut out air duct, paint interior flat black and add screen for additional realism.



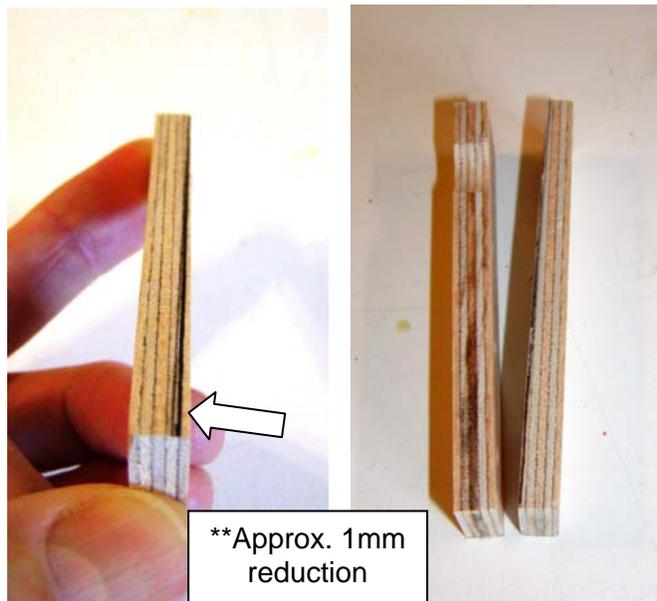
It is *assumed* that if you have chosen to build this aircraft, you are an experienced modeler with previous scale war bird experience. Despite the high degree of pre-fabrication, it must be understood the CARF-Models P-47 is a complex miniature aircraft that requires skill, patience and care to complete. The following steps are the most demanding segment of the 'build' and you should approach them methodically, understanding each step and its affect on previous and subsequent steps before proceeding or applying adhesives. Proper operation of retracts and gear doors are essential for both realism and **LANDING SUCCESS!**



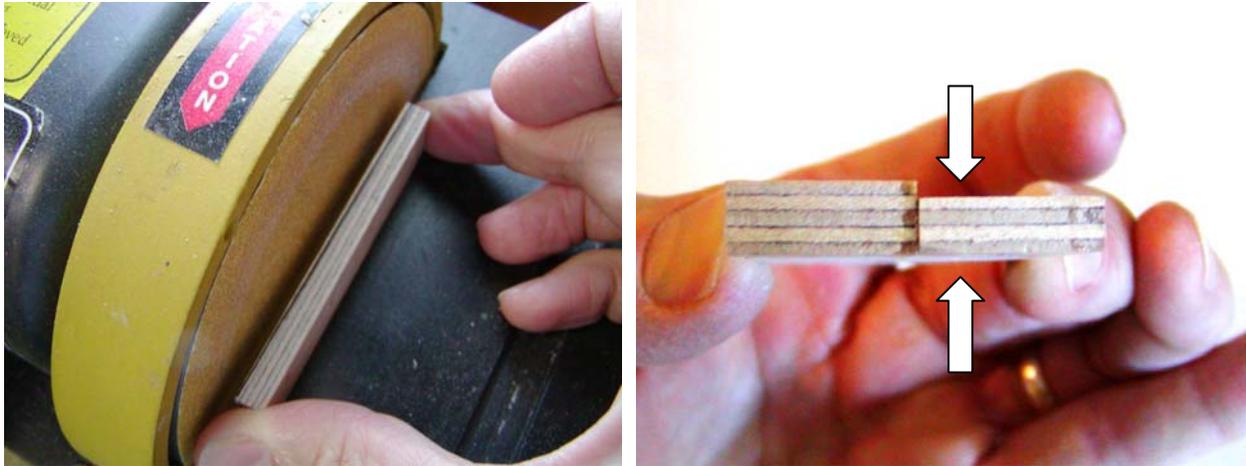
### Main Gear retracts and gear doors

The main gear must be spaced up from the gear mounting plates so that the gear frame does not contact the top wing skin. The most robust gear mounting platform is achieved by fully interlocking the gear plates with the wing main spar, thus their position is fixed. Use of a 6mm spacer becomes mandatory. The spacers must also be *slightly angled*\*\* so the wheels retract into the wings far enough to allow gear covers to mount flush with the bottom of the wing. Acquire the necessary parts from the Wing hardware and Milled wood parts bags.

4mm x 25mm gear mounting bolts and blind nuts. 6mm wood spacing parts.



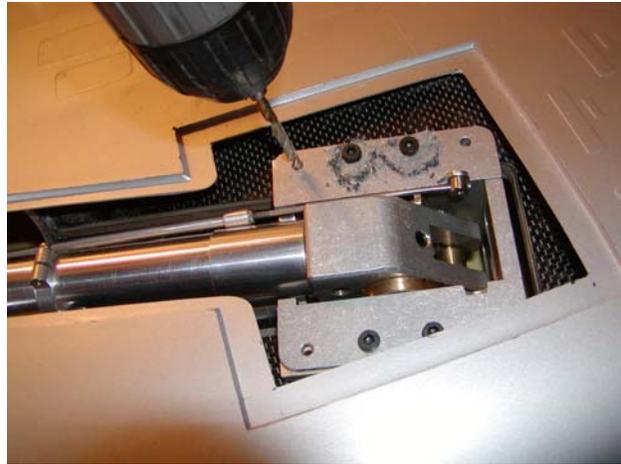
\*\*Approx. 1mm reduction



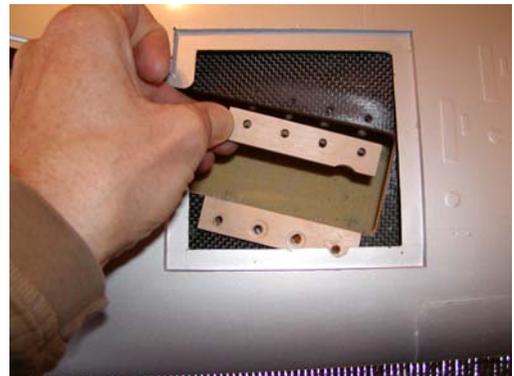
Position the gear such that they are centered within the gear cut-outs and also check gear retraction (with wheels mounted) to make sure there is ample clearance around gear scissors and wheels to clear wing skins at all positions. A hand pump is very handy for extending and retracting gear for testing purposes. Once satisfied with the gear position, mark mounting holes and drill.

**NOTE:** It is easier to mark and drill 2 – 3 holes then mount gear temporarily so that remaining holes can be accurately drilled with gear held in place.

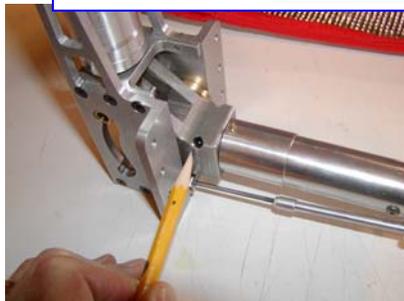


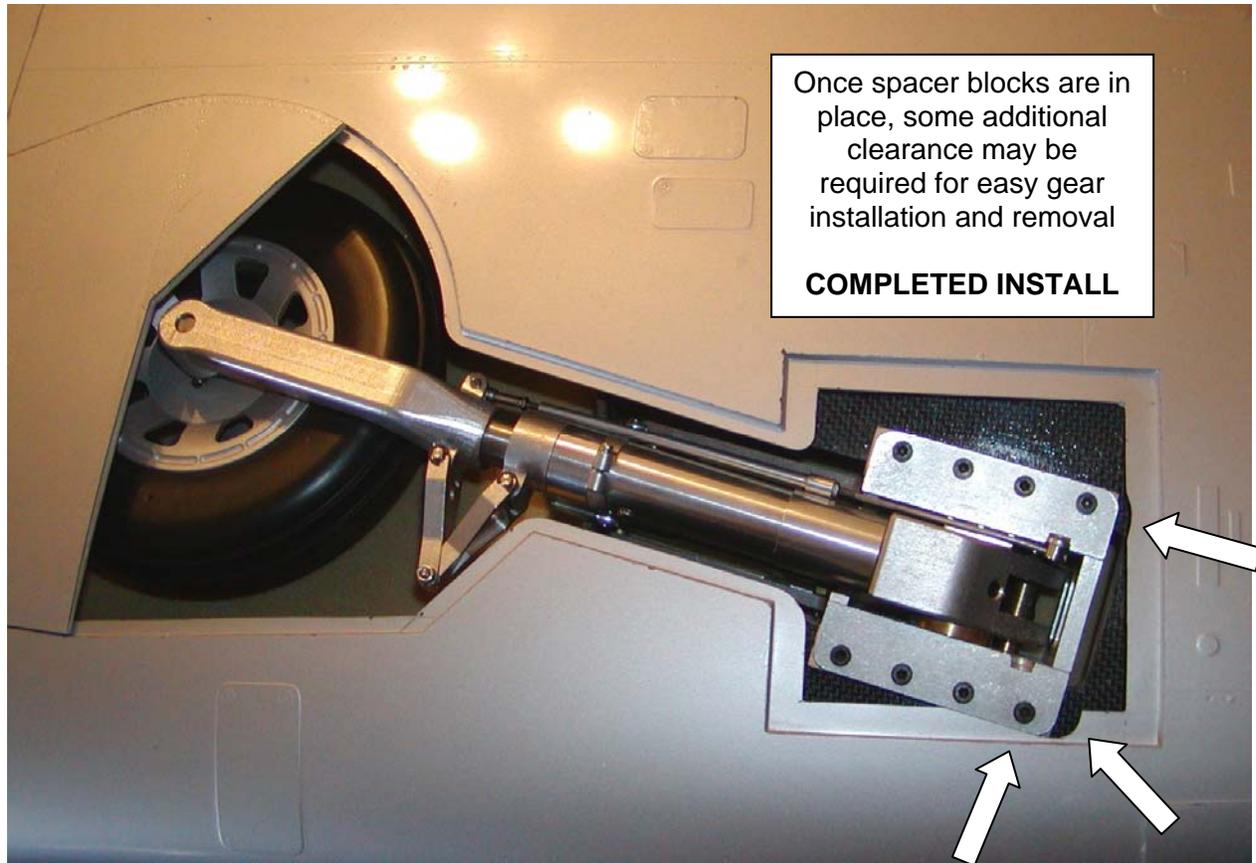


PROTECT  
YOUR WING  
WHEN  
DRILLING...  
insert a thick  
piece of wood so  
that your drill  
does not  
penetrate the top  
wing skin!



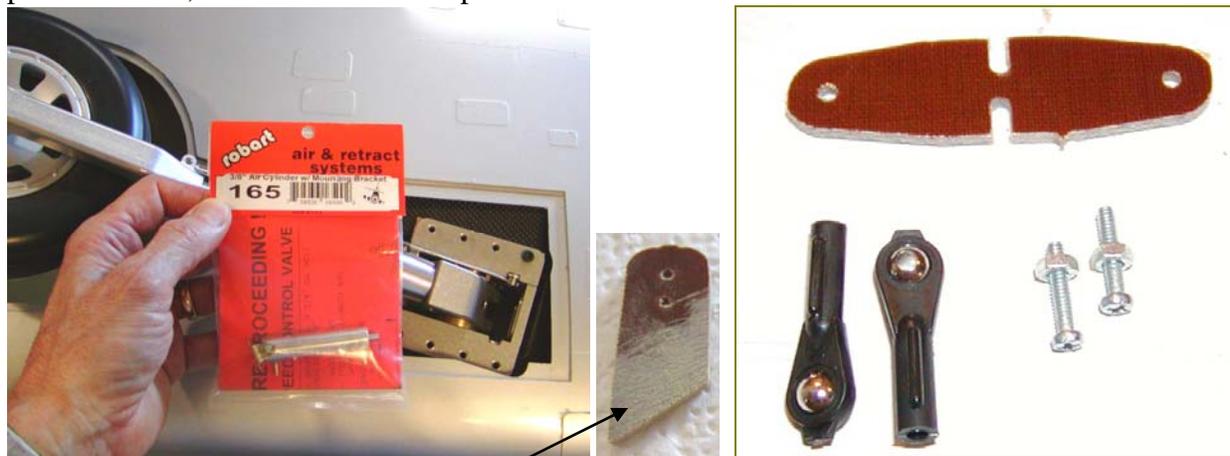
Check and re-check for proper clearances and smooth gear retraction.  
Wheel angle is adjusted by loosening the locking studs at the base of the gear struts.  
**THE WHEELS MUST POINT EXACTLY STRAIGHT AHEAD BEFORE PROCEEDING AS  
ADJUSTMENT LATER WILL AFFECT GEAR DOOR FIT!!!**



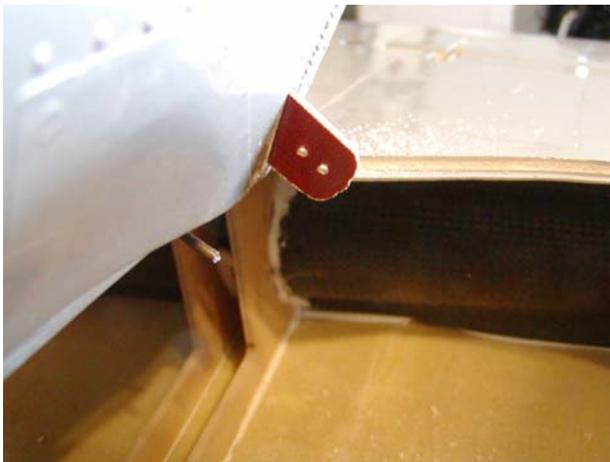
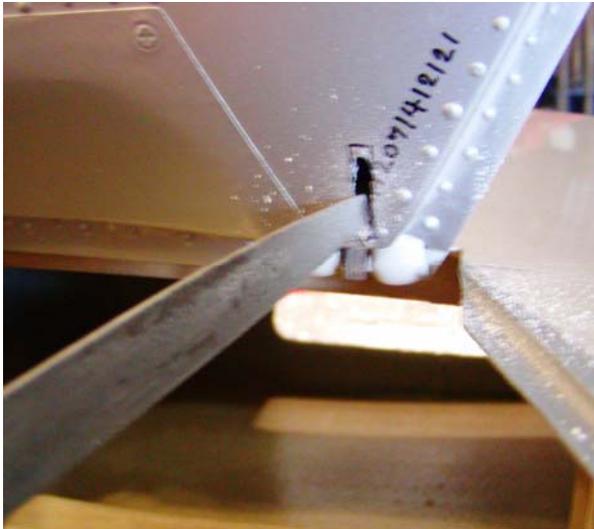


## Gear Doors

Proper opening and closing of gear doors is JUST as critical as proper gear retraction. There are several ways to accomplish this using the Robart cylinders included in the pneumatic support kit. The following illustrates a simple and reliable gear door activation set up using the included phenolic arms, ball links and wood parts.

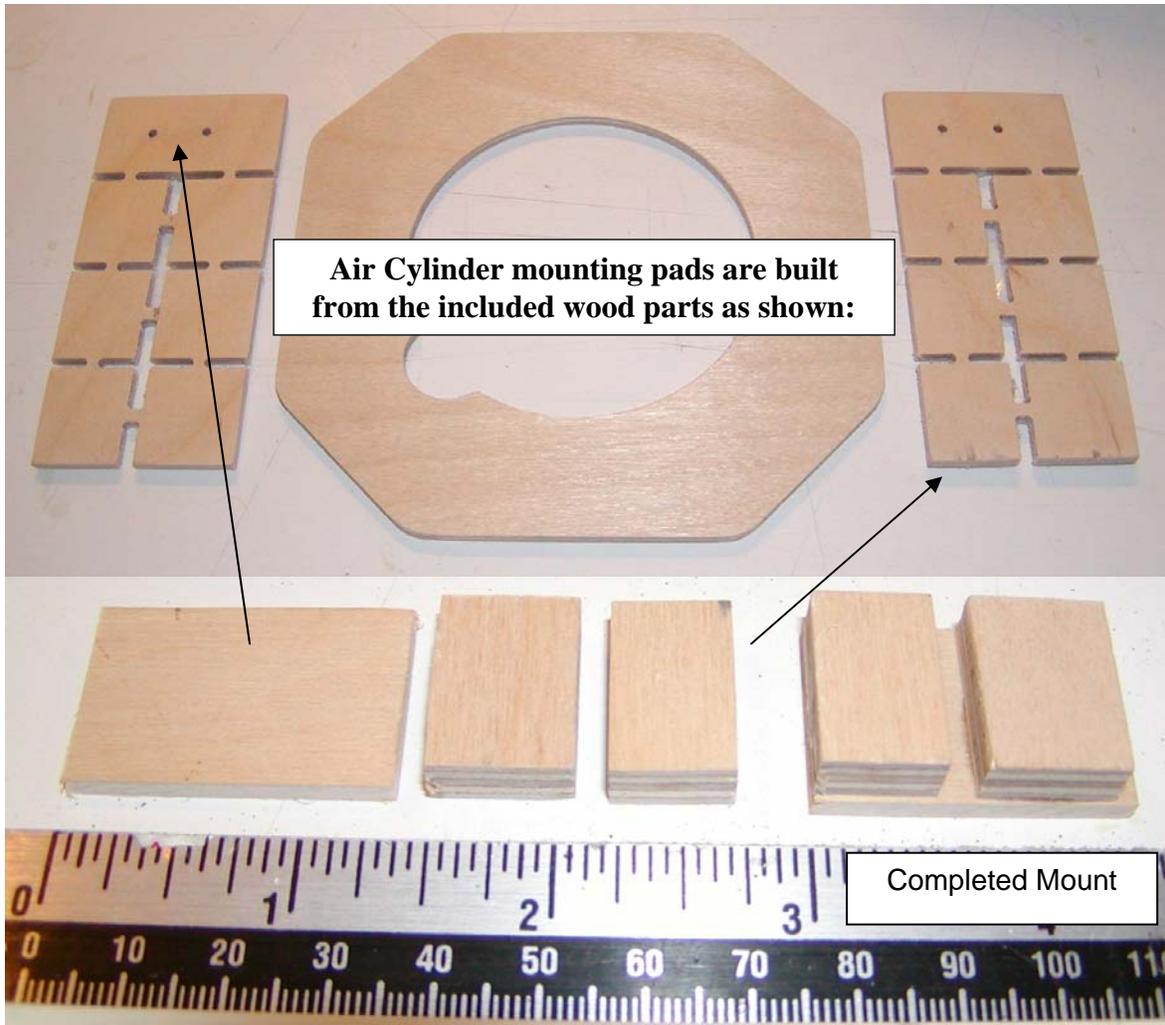


Abrade gluing surface as shown then using epoxy and cut glass mixture to bond into slot.

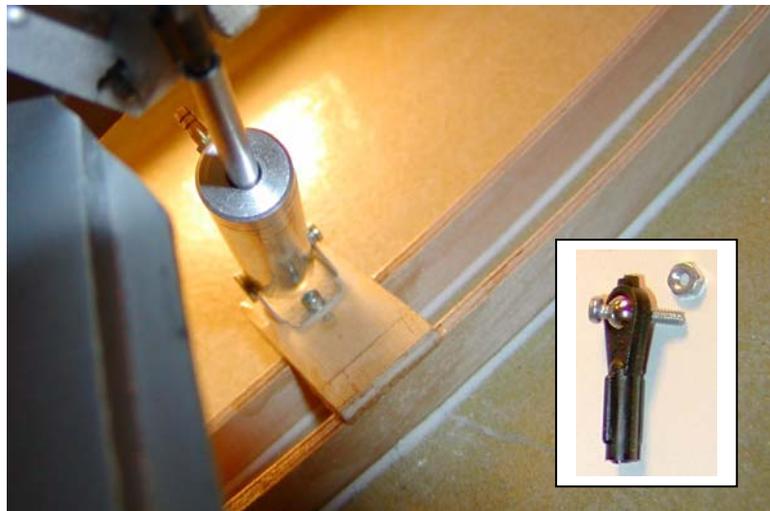


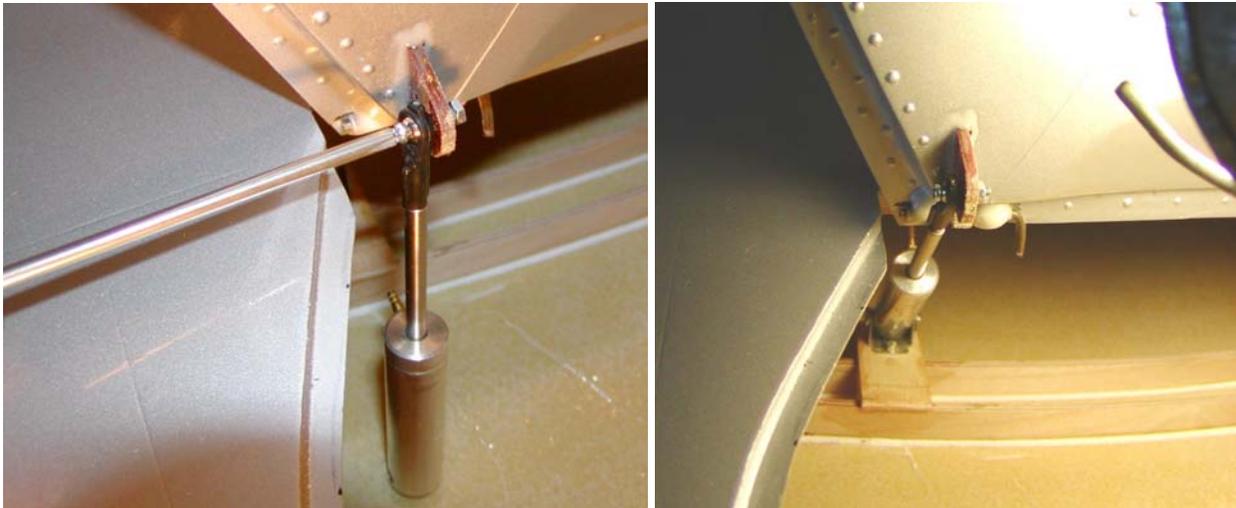
The air cylinder piston/rod is threaded for 2-56. An SAE threaded insert is used (not included@US) to connect ball links to rod. The ball links will securely thread onto any 2-56 stock.



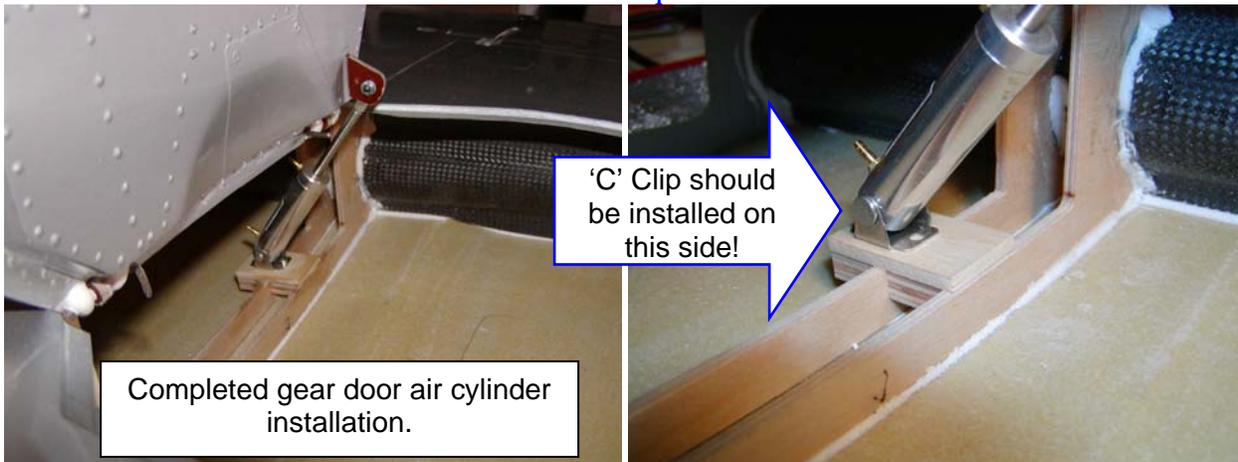


**Position and mount cylinder as pictured (left) then epoxy ply mount into position (right) to line up with gear door horn.**

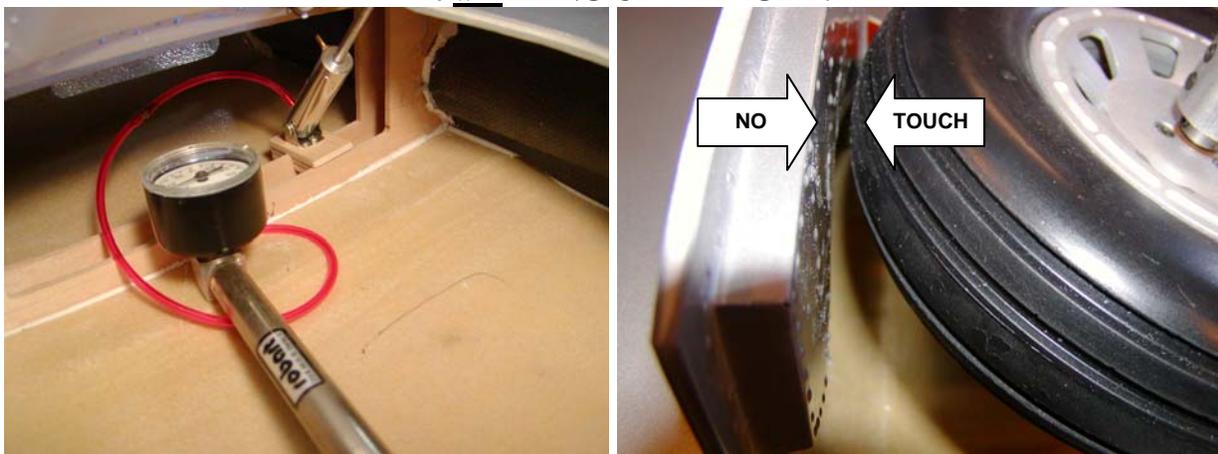




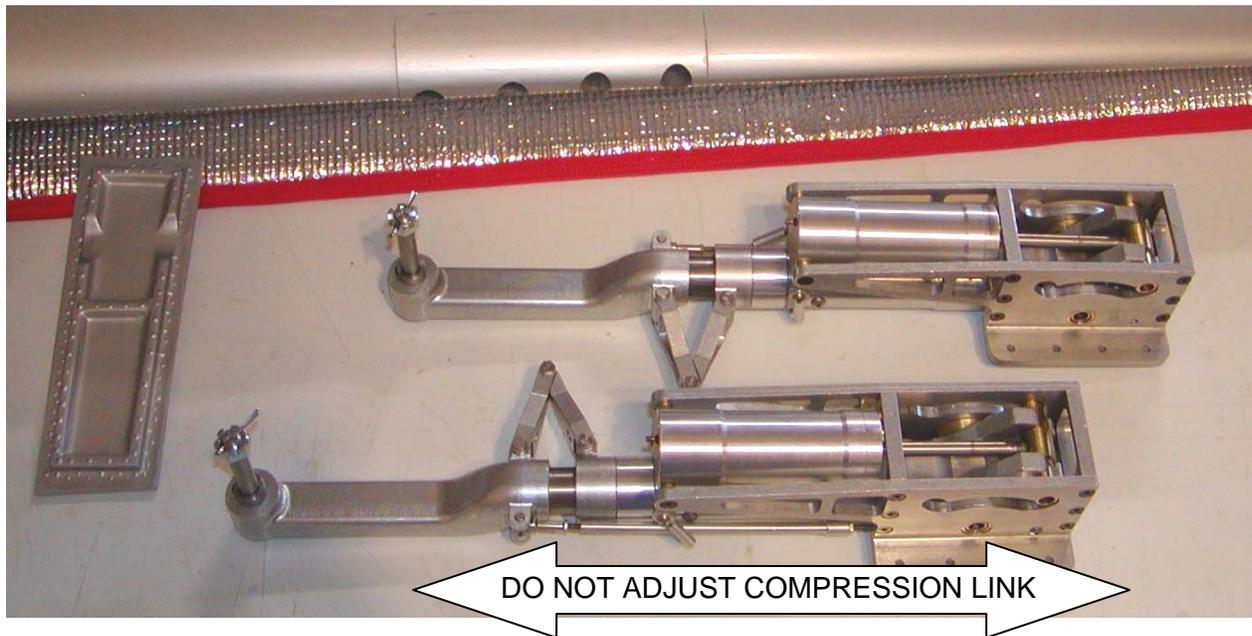
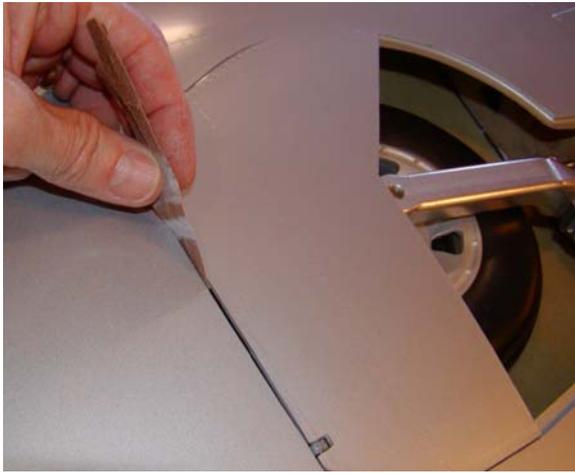
**NOTE:** If 'C' clip is not located on the accessible side of air cylinder, be sure to remove and reinstall pivot pin and C clip so that it is. This will allow easier cylinder replacement should it ever be required.



**Check gear door for proper open/close using hand pump. Main gear must also be checked for proper gear door clearance. NO RUBBING, NO TOUCHING! If it rubs on the ground, it will HANG UP in FLIGHT!**

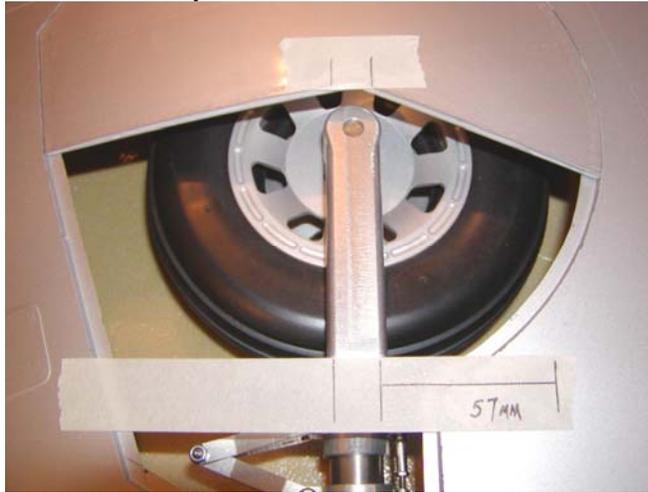


IF additional wheel clearance is required, sand wing skin as shown (below left) to allow gear door to open wider. Additional door throw may require ball link adjustment. **DO NOT adjust gear compression link for additional wheel compression / clearance. This is factory set!**



**Wheel Covers**

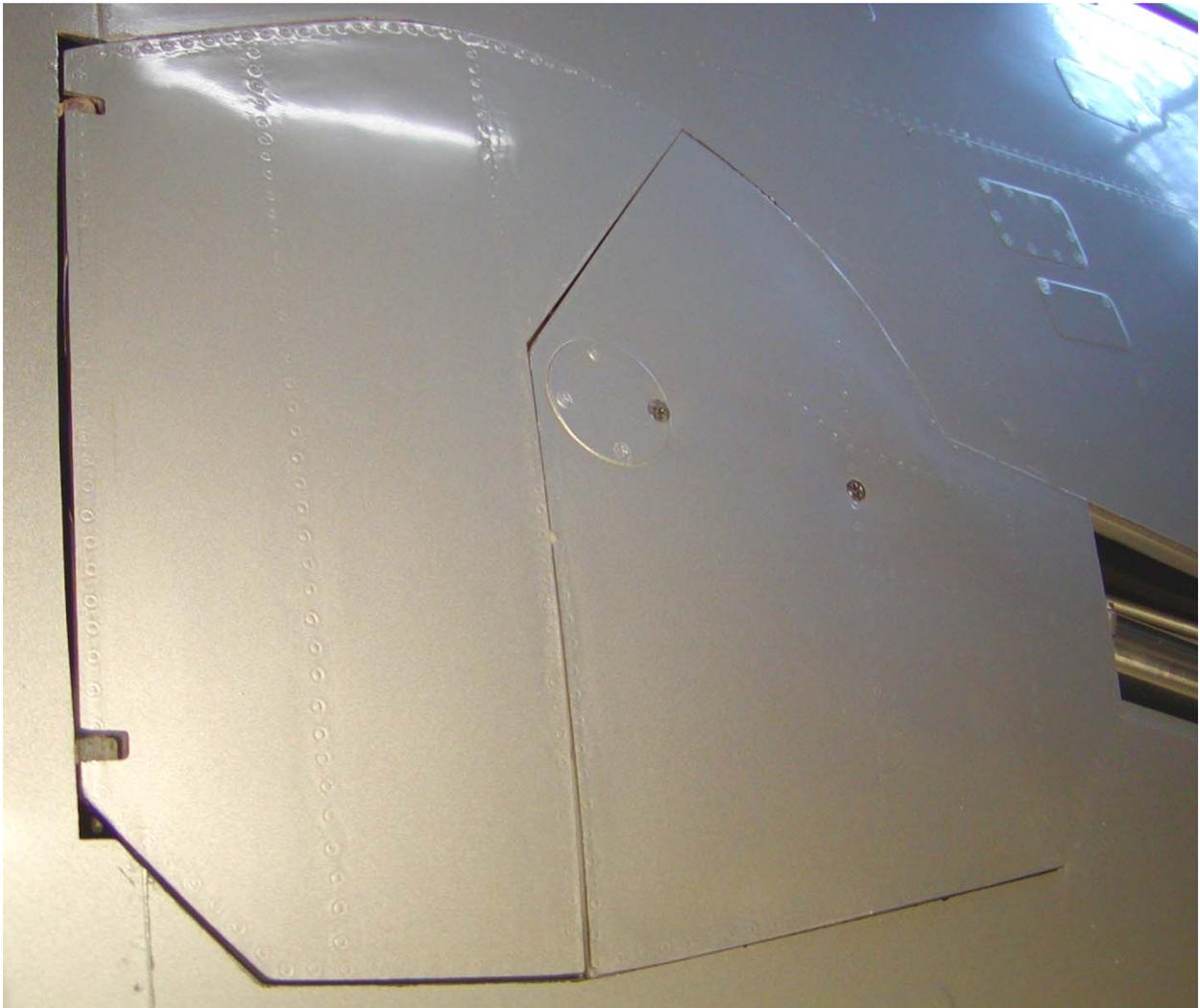
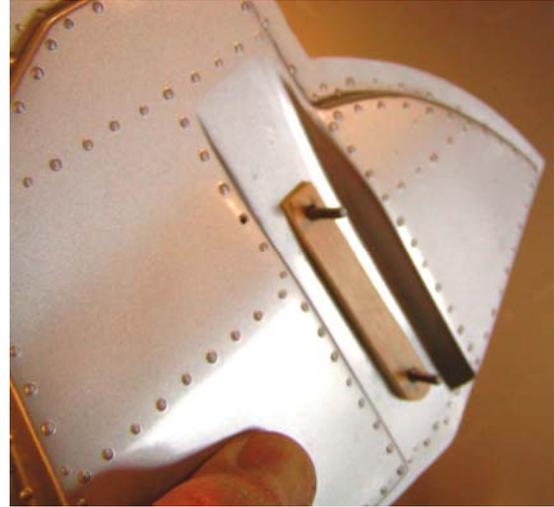
The wheel covers are mounted to the gear forks using the supplied countersunk screws. The holes can be correctly located as follows:



Once holes are drilled through the wheel cover and a few millimeters into gear legs, remove wheel cover. Insert scrap ply between gear legs and wheels to protect from drill bit and finish drilling holes. Holes are then tapped for the 3mm countersunk wheel cover screws.



The wheels covers will most likely require spacing away from the gear legs for proper and secure fit. Using scrap wood, make spacers, contouring to shape until the wheel cover can be fastened using both screws; it should fit into wheel opening and not interfere with gear retraction.

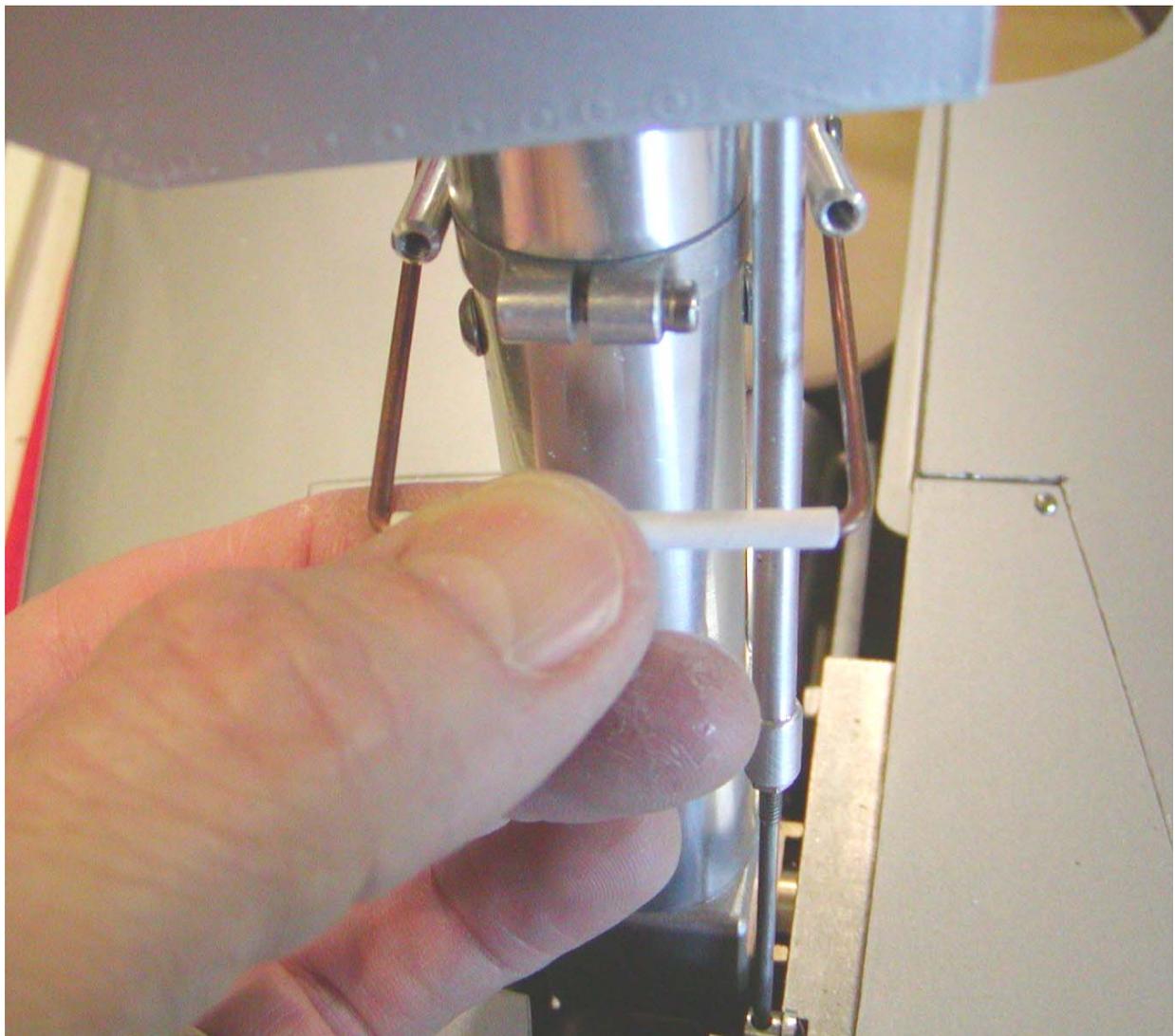


**Strut Covers**



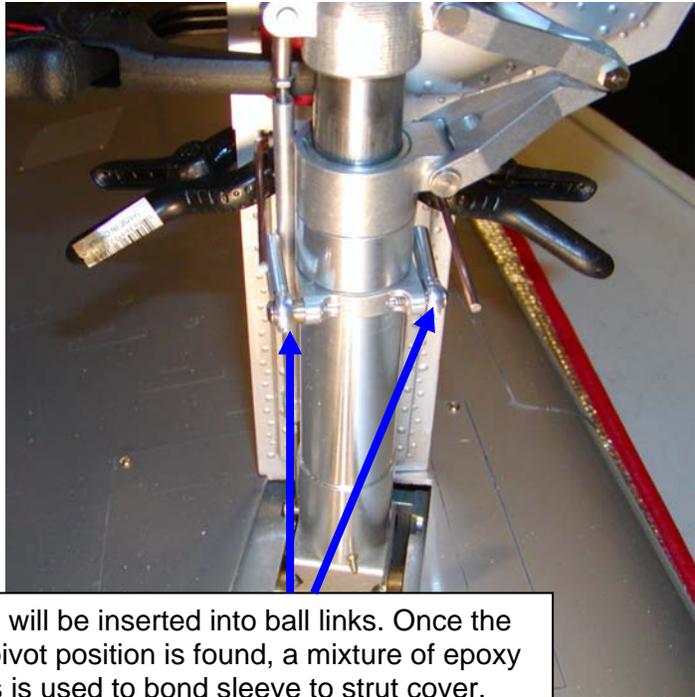
Fitting strut covers requires PATIENCE. There is no specific manner in which to guarantee a perfect fit...this is a trial and error process in which you “creep up” on the proper fit. However, the following photos and tips will minimize the potential for errors!

From the Wing hardware bag, locate the strut cover hinge wire and sleeve. The hinge wire is inserted in the sleeve and bent as shown below so that it matches the exact width of the strut cover ball links mounted on the landing gear strut.

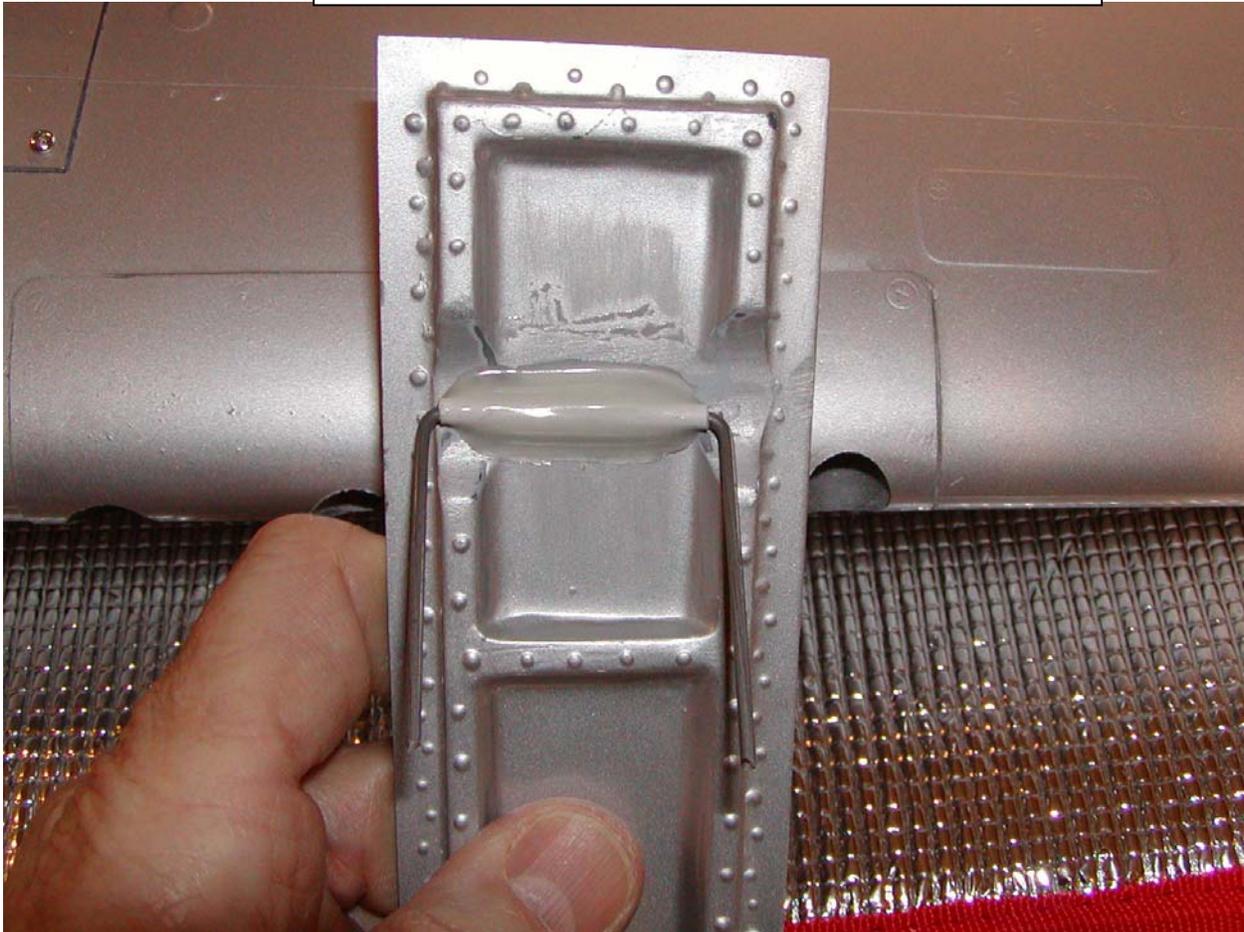


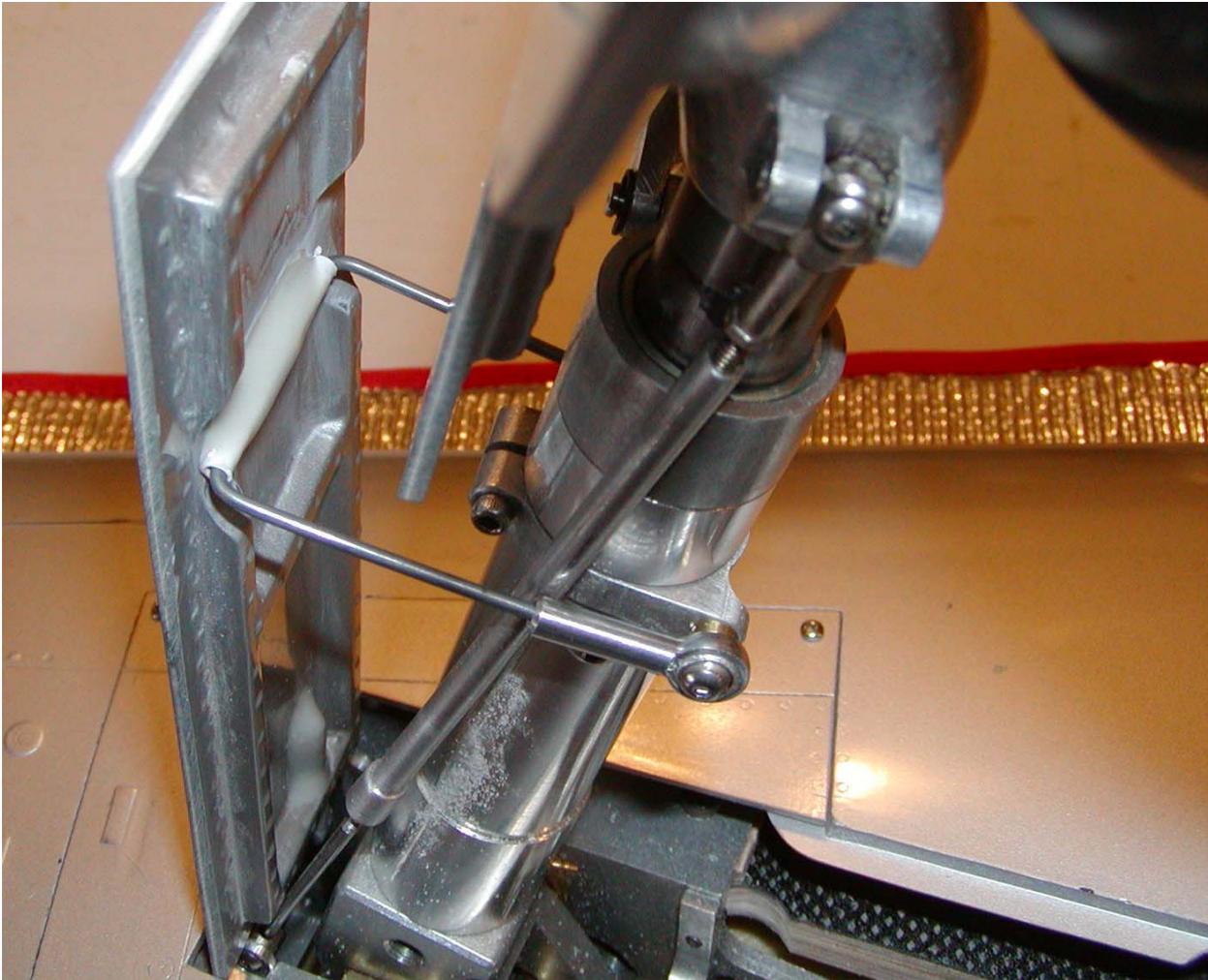
Clamp the strut cover to the strut so that an approximate position for the hinge wire and sleeve can be located and marked on the inside of the strut cover. Once satisfied with the positioning, the sleeve can be epoxied. Use sand paper to rough up the gluing surfaces of both the strut cover and hinge pin sleeve. Clean with alcohol then glue with a mixture of epoxy and cut glass to create a stronger bond.

**BUILDERS TIP: All of the strut cover bonds can be made temporarily with small amounts of CA glue and Accelerator, until the final positions are achieved**

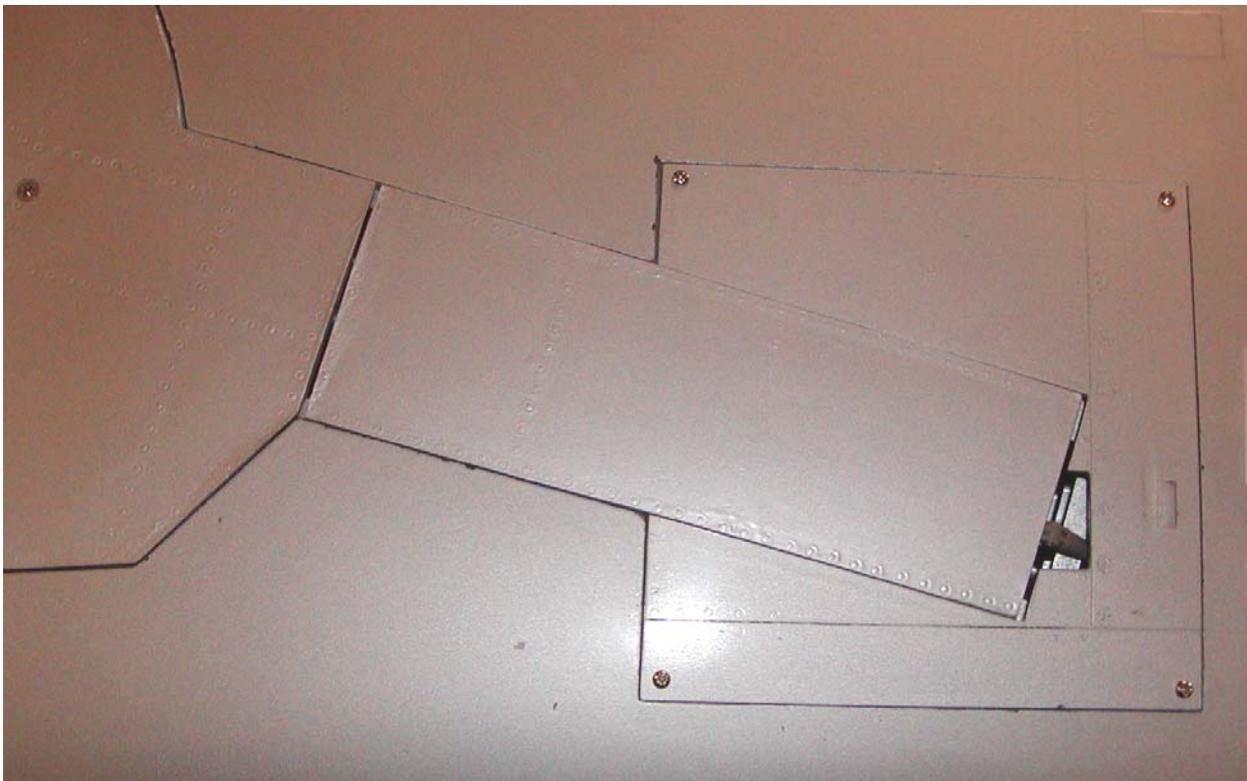
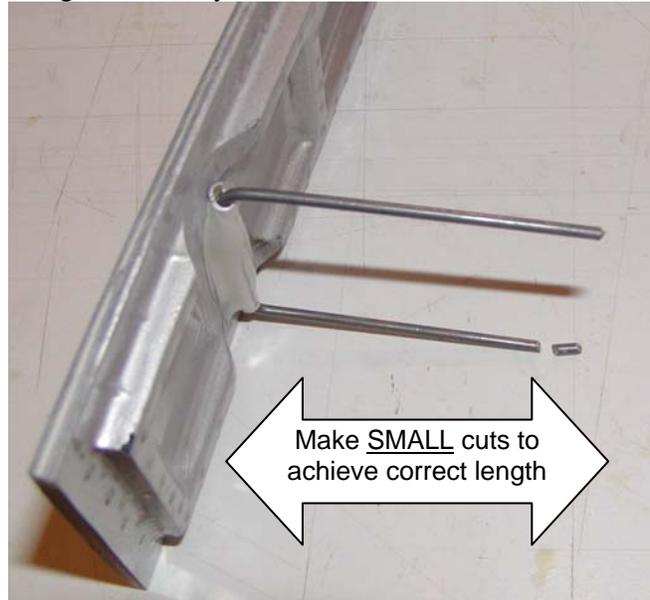


Hinge pin ends will be inserted into ball links. Once the correct sleeve/pivot position is found, a mixture of epoxy and cut glass is used to bond sleeve to strut cover.





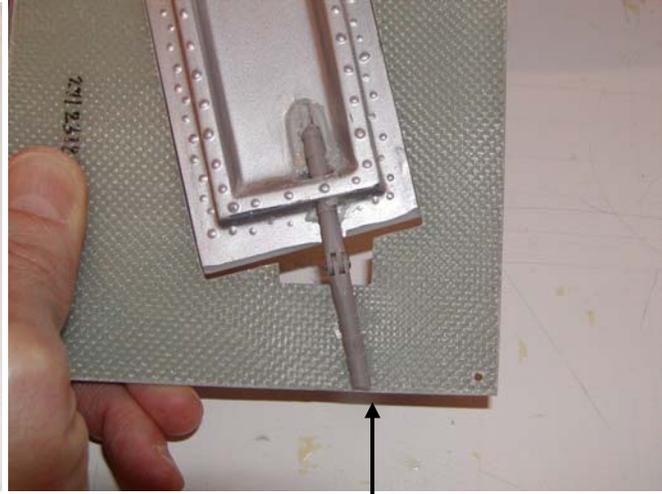
The hinge pin wire is cut to length a little bit at a time until the proper length is achieved such that the strut cover will lay perfectly flat when the gear are fully retracted:



Locate the large Robart hinge point from the hardware pack. Drill a hole at the base of the strut cover as shown. The hinge point should be temporarily attached and the strut cover taped to the gear cover. **NOTE THE LOCATION OF THE HINGE PIVOT POINT** – the pivot point of the hinge should be 6mm from the edge of the strut cover. This is necessary to provide the proper clearance as the strut cover pivots with the gear. **When positioned properly, the strut cover can be opened and closed without contacting the gear cover at its base/pivot point.**

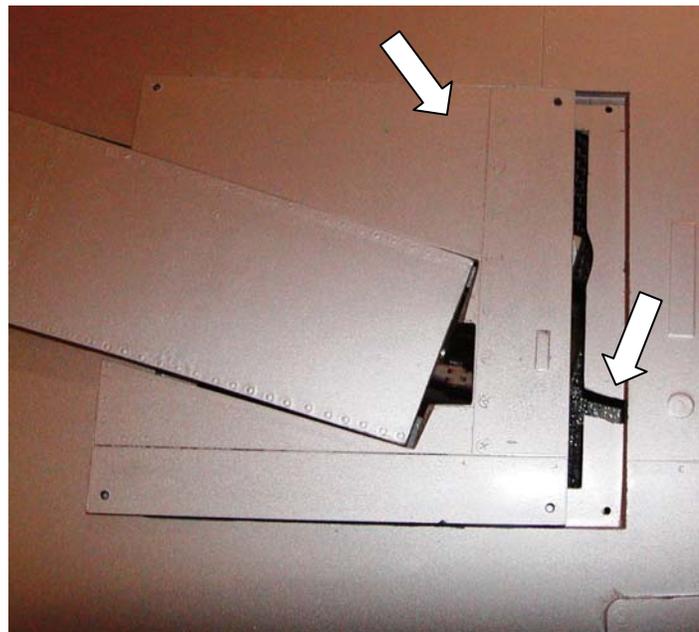


NOTE the distance from the bottom edge of strut cover to hinge pivot point – Approx. 6mm (1/4")



NOTE that hinge end must be cut off where it extends beyond the edge of the gear cover.

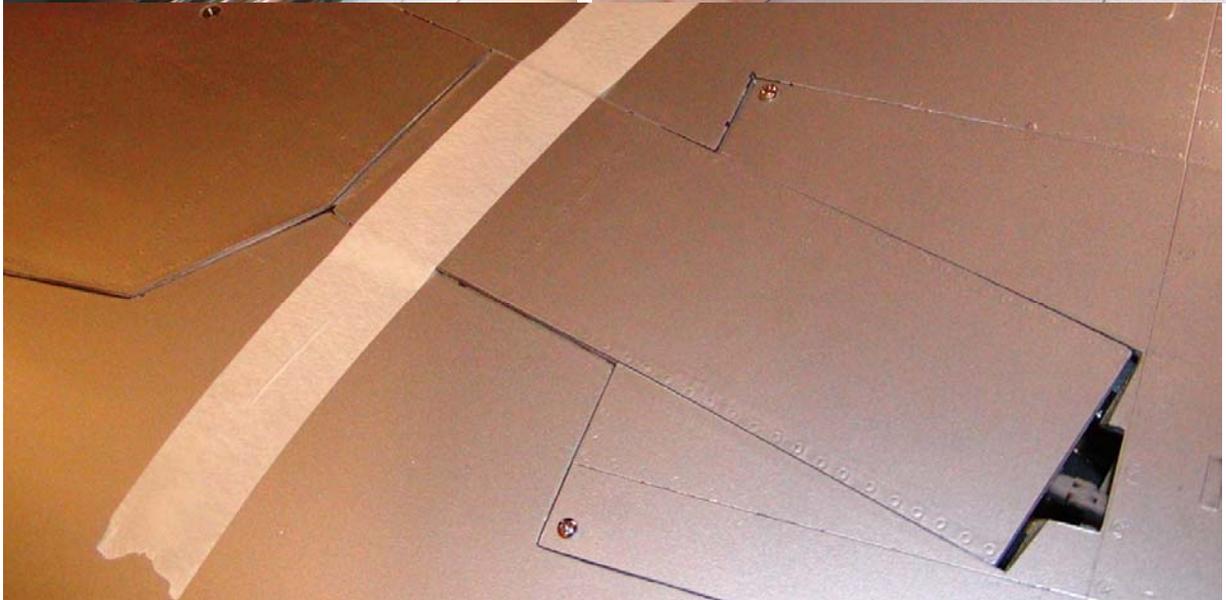
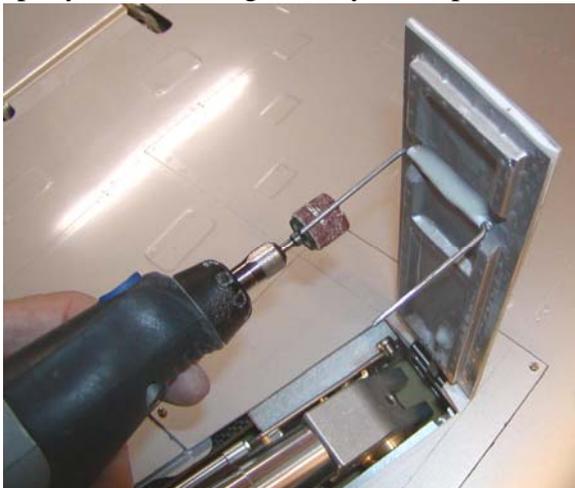
When satisfied with the fit and operation, glue components with a mixture of epoxy and cut glass. The gear cover opening must be cut out to accommodate the hinge pin:



Expect some interference between the strut cover and wheel cover. This is normal and can be remedied by sanding a bevel in the lower edge of the strut cover.

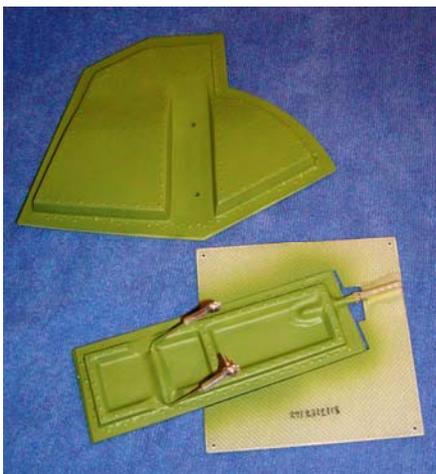
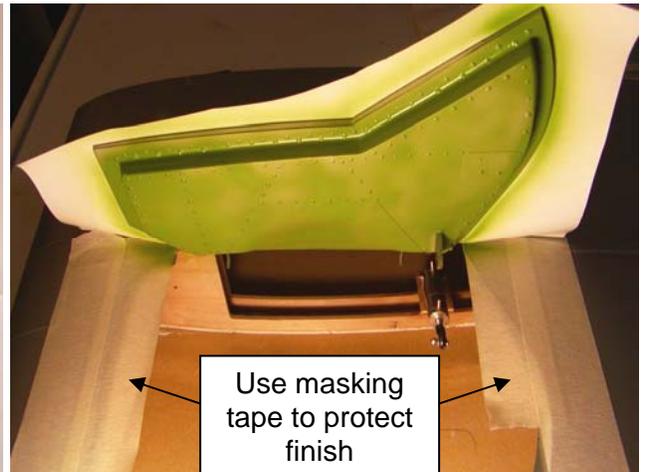
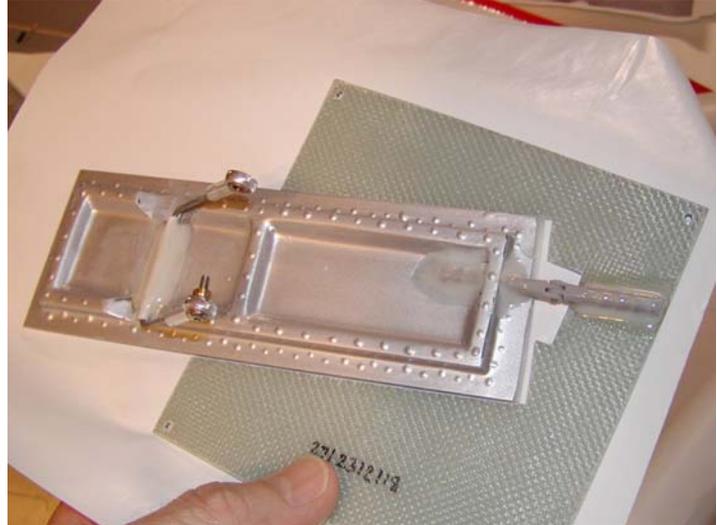


When 100% satisfied with the operation of the strut cover, abrade the hinge pins and clean with alcohol. Apply epoxy and cut glass mixture to pins and ball links. Insert pins, wiping any excess epoxy. Retract the gear fully and tape the strut cover tightly closed. Allow to dry.



**Prepping for Pneumatics**

If you are so inclined, now is the time to paint the interior areas of the wheel wells and gear doors. Everyone has their favorite methods for prepping and painting. The following shows an easy method of painting with water-based acrylic in the military spec Zinc Chromate Green. Military spec paints are available at most hobby shops that also sell plastic military models. The masking material is common sticky backed “Shelf Paper” available at most home supply stores.



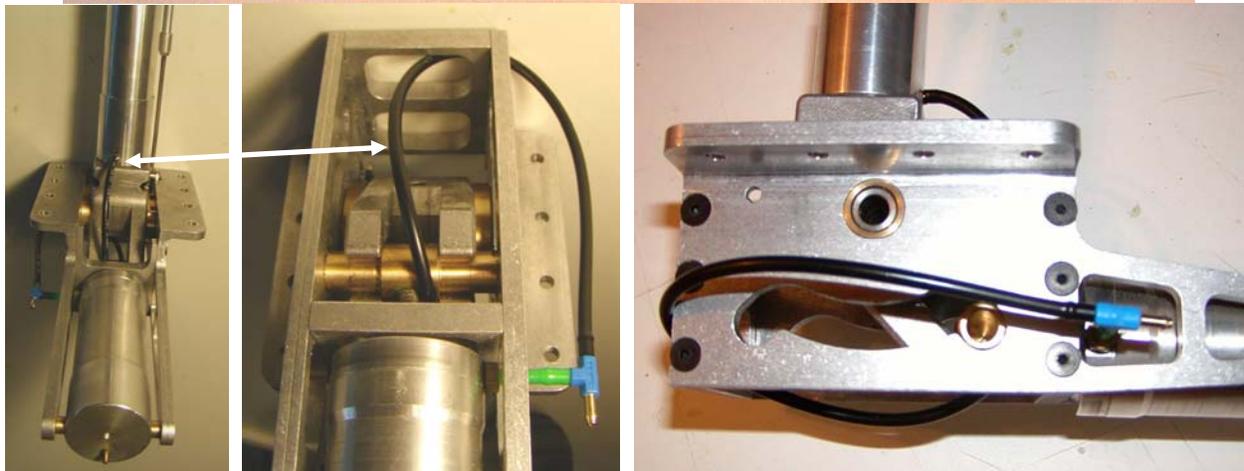
Water-based acrylic paints are very easy to use. By thinning with isopropyl alcohol, the paint dries extremely fast; fumes and overspray are kept to a minimum, and clean-up is fast and easy using soap and warm water. These paints add almost no weight and usually have a very opaque pigment that covers extremely well.

Surfaces to be painted should be cleaned with alcohol and dried. While still wet, paint overspray can be wiped off with a damp cloth. Once dry, overspray can be removed with common car cleaner/wax. Painted finish can be clear-coated if additional durability is desired.

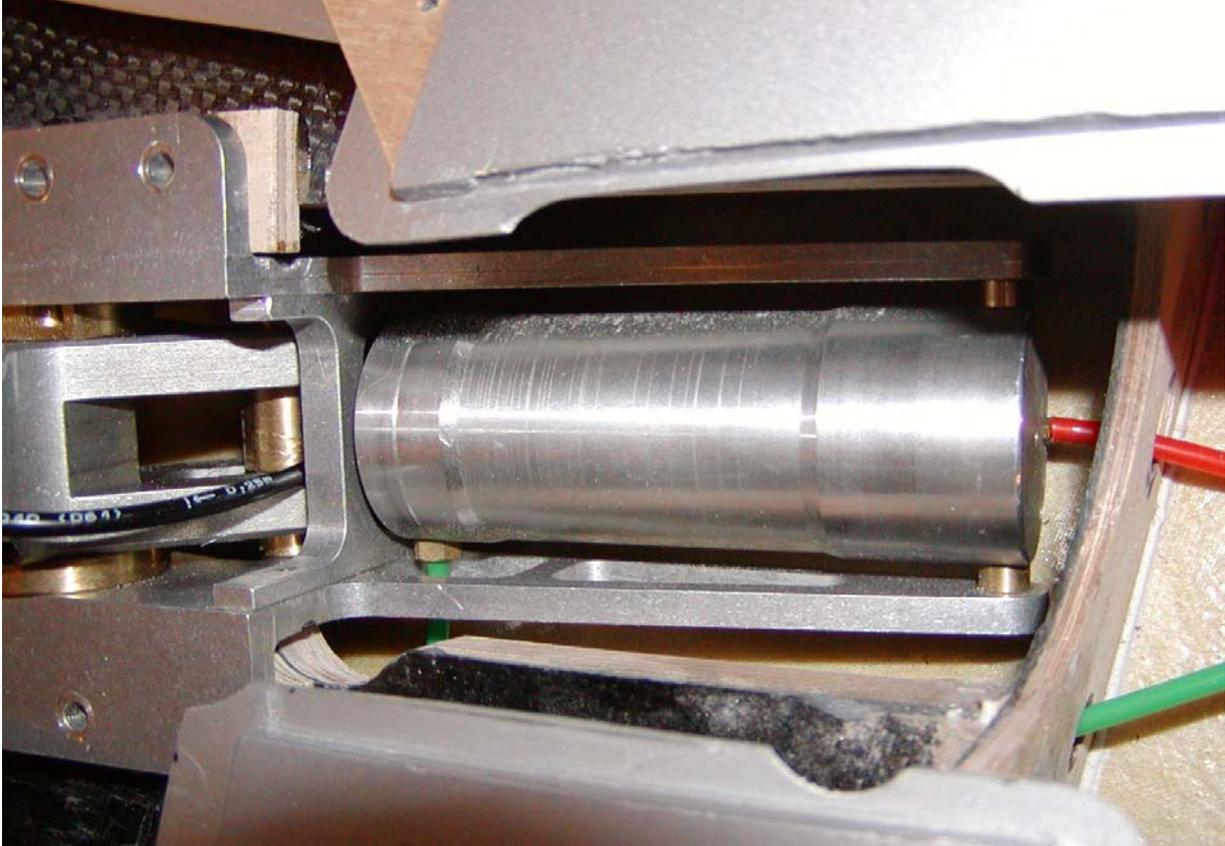
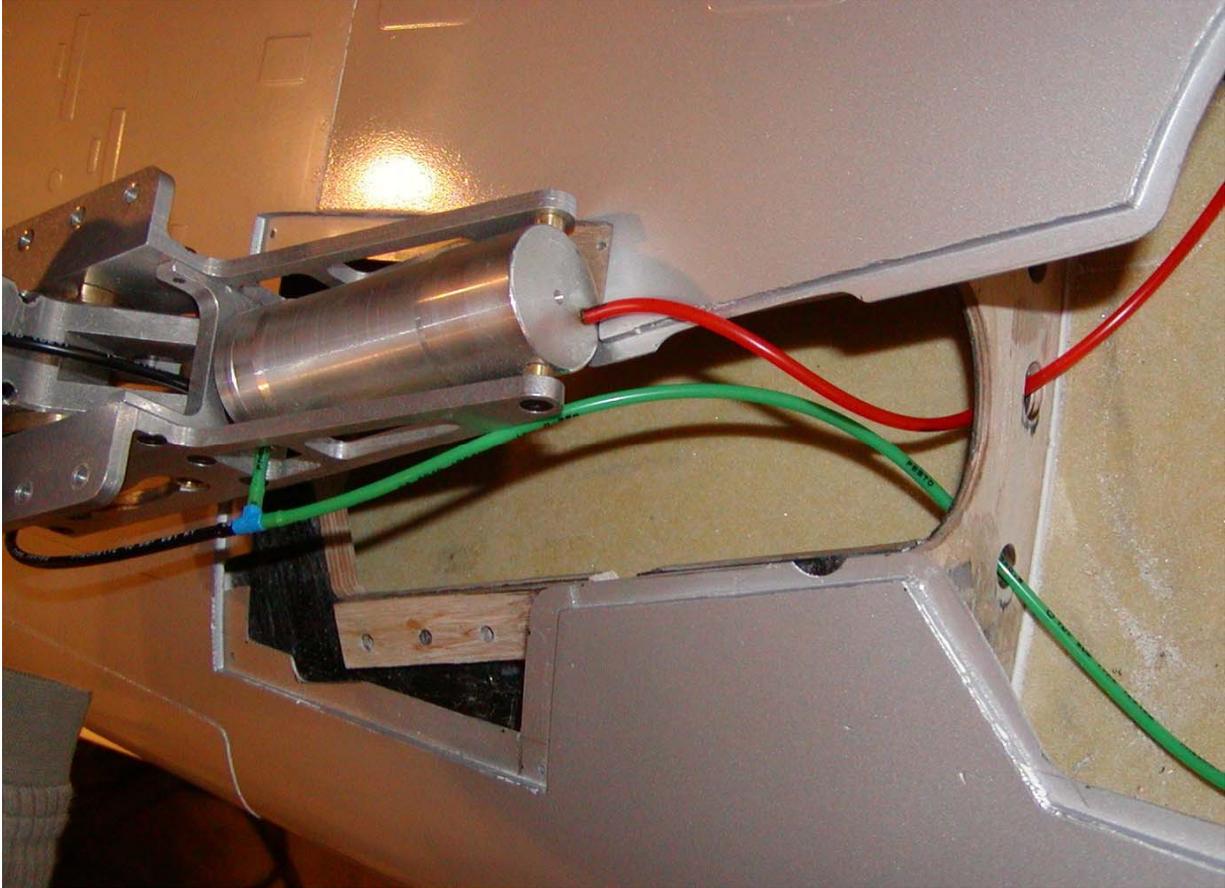
### Pneumatics

Assuming you have acquired the CARF-Models P-47 Pneumatics Support kit (#270800), the following is a logical application of the included colored high pressure air lines:

**Green** = gear extended      **Red** = gear retracted      **Blue** = air pressure      **Black** = other



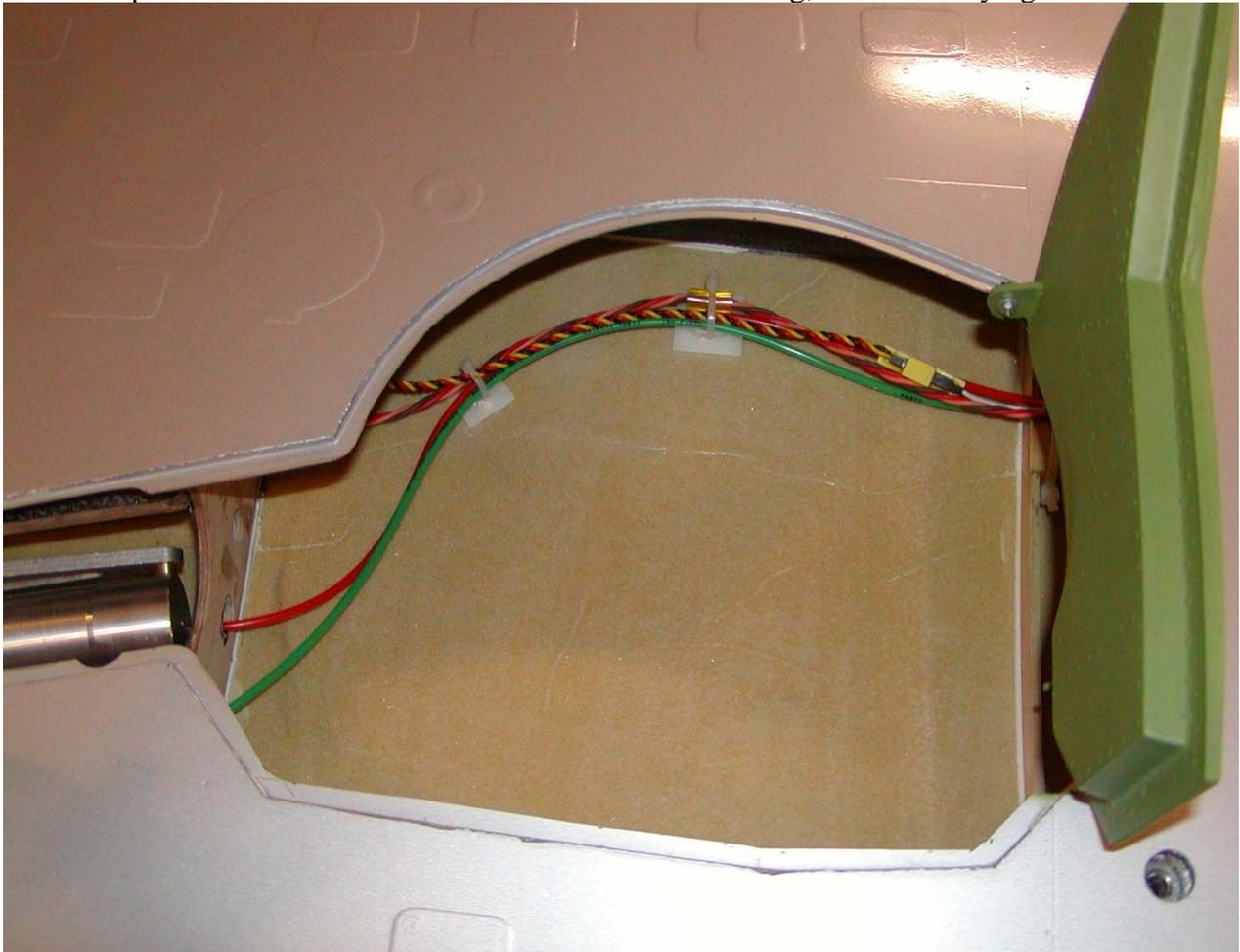
Use the black high pressure air line and a T fitting to connect the gear strut extension cylinder nipple to the gear extension nipple. Pressure applied to gear extension must extend both gear and strut.



If you have not already done so, add servo extensions to the aileron and flap servos. An aileron extension is easily pulled through the wing using any long slender rod. Use commercially available servo connector clips or heat shrink tubing to secure the extensions to the servo leads so that they will not separate in flight!

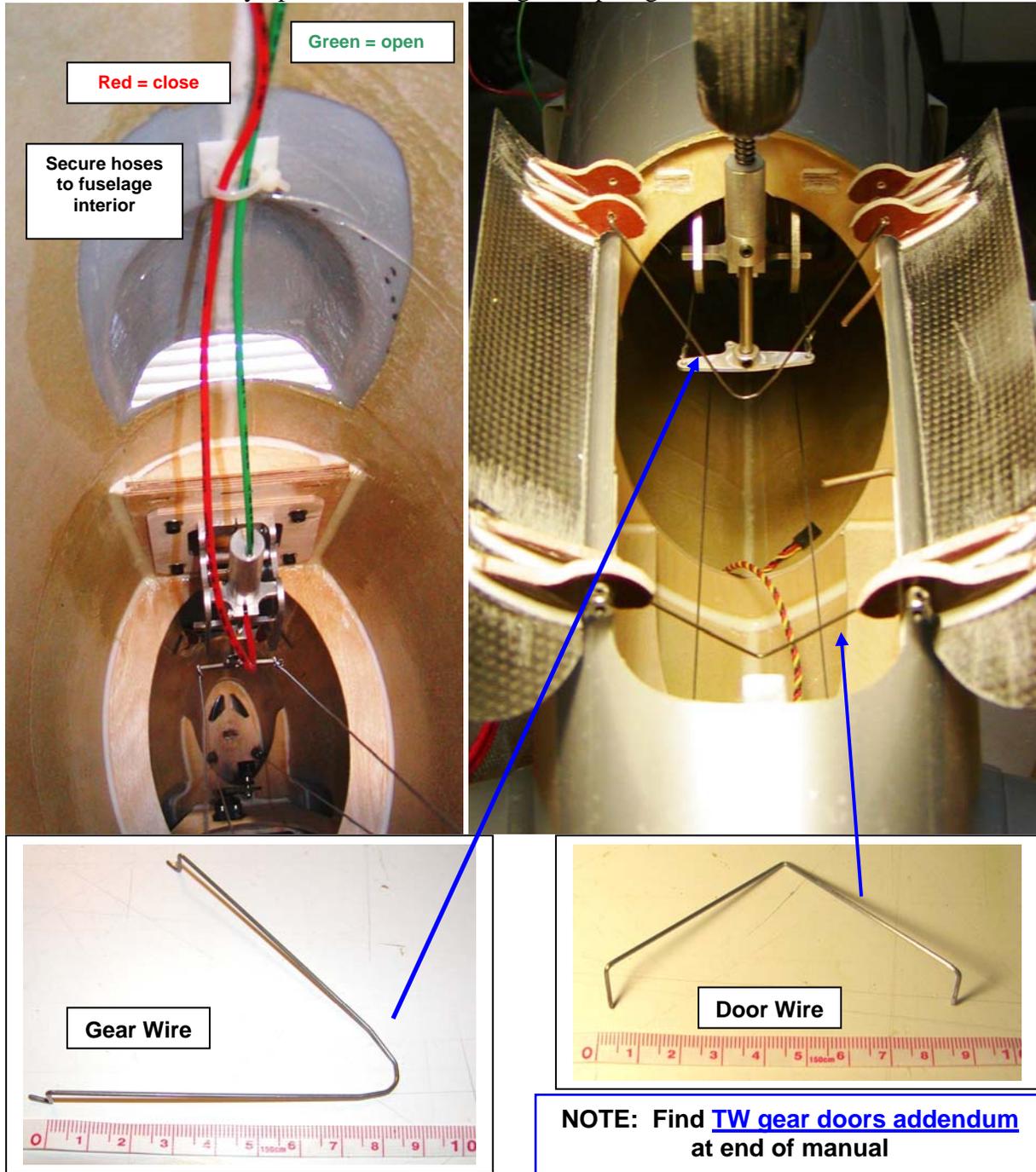


You should secure all hoses and leads in an orderly fashion so that they cannot interfere with the mechanical operation of the wing servos or retracts. Take care not to pinch the air hoses. Wires should be protected where secured and cable ties should be snug, but not overly tight:



### Tail wheel Pneumatics and Doors

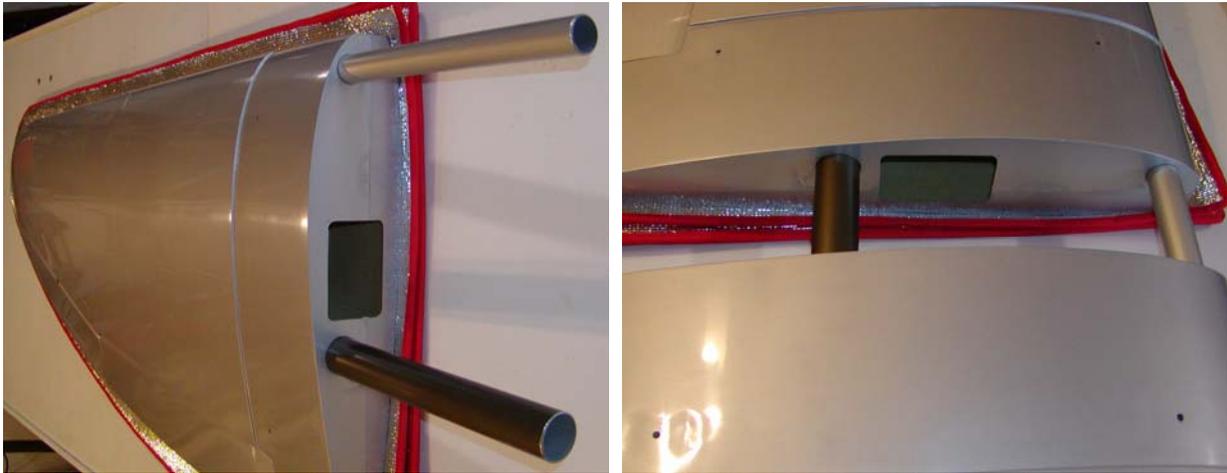
Connect the extend/retract air lines using the same convention as the main retracts. The tail wheel doors are mechanically opened and closed using two sprung wires.



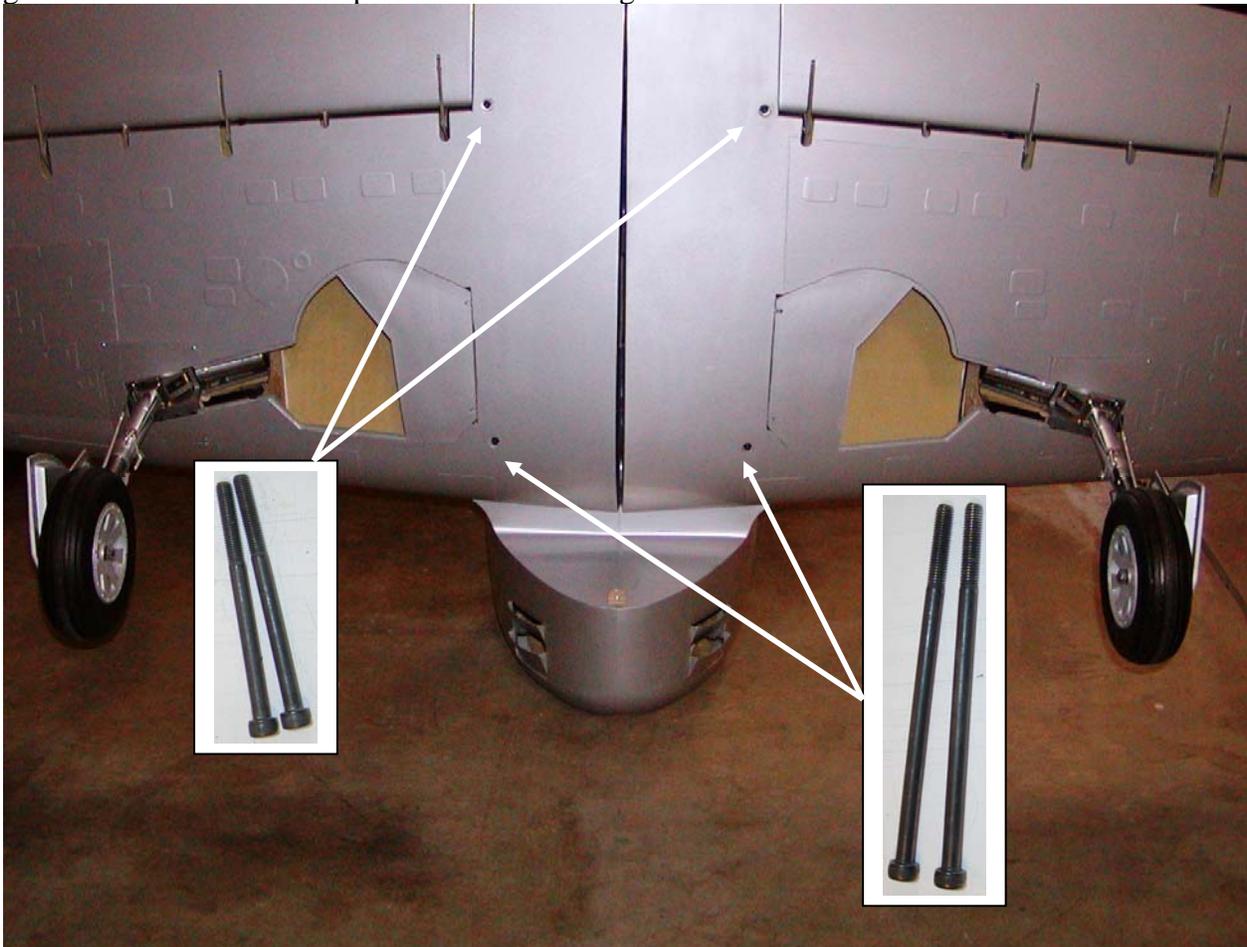
The sprung wires are made using the approximate measurements shown; some adjustment may be necessary for proper operation. Secure the wires to the horns using either small wheel collars or a 'Z' bend. The "Door Wire" holds gear doors open and closed. The "Gear Wire" is engaged when the tail wheel is retracted, closing the gear doors. Like the Door Wire, spring tension in this wire also helps to hold the doors open when the TW is extended.

**Wing – installation**

The wing halves are joined using the two aluminum wing tubes: 30x 610mm and 40x 610mm. Once joined, the wing is bolted to the fuselage using the 4 supplied wing bolts – two long, two short. It HELPS to have TWO PEOPLE!

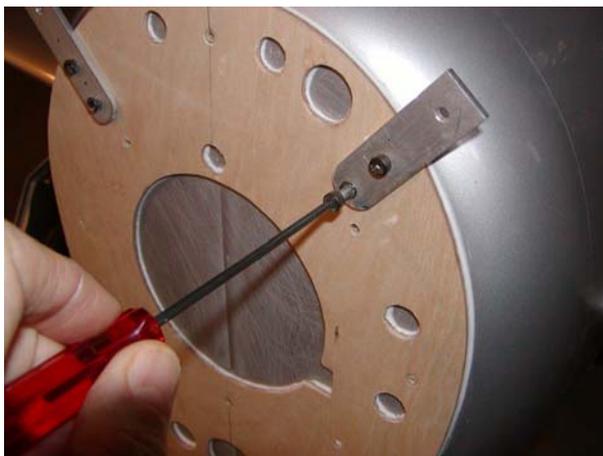


The fuselage can be set upright on the firewall for wing installation. IF setting aircraft on its nose, great care must be taken to prevent it from falling over!!!



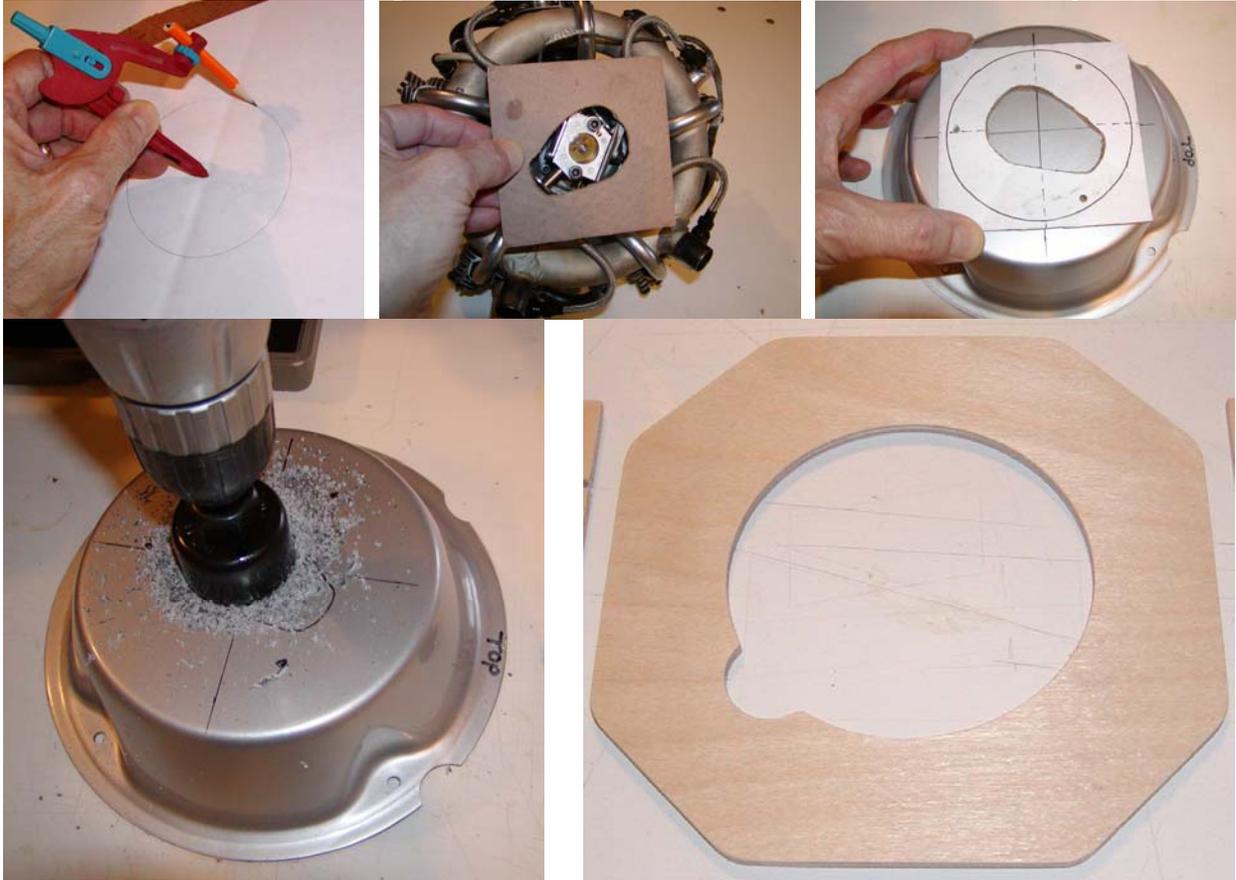
**Engine Dome – Moki**

Locate the carbon fiber engine mounting dome and engine hardware pack. The dome mounting holes must be enlarged for the mounting bolts – the larger (7) bolts are for mounting the engine and dome; the smaller (3) bolts are for mounting the cowl. The engine dome “TOP” is etched at the factory – use a black marker to very clearly delineate the dome such that it will mount to the firewall creating engine RIGHT THRUST.

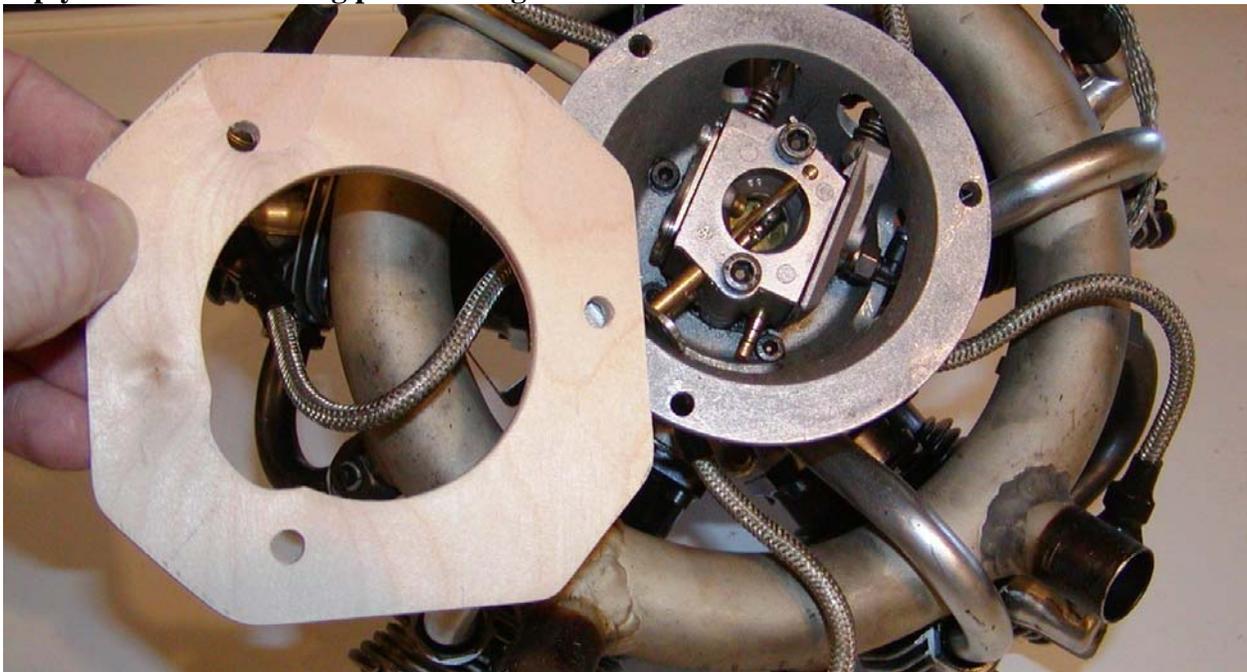


Remove the two upper cowl mounting brackets so the dome can be mounted temporarily. The ‘blind or T nuts’ will be installed on the opposite side of the firewall in a later step. Remount the cowl brackets and mark the areas of the dome that must be removed to clear the brackets. Use a sanding tool to relieve the dome for brackets.

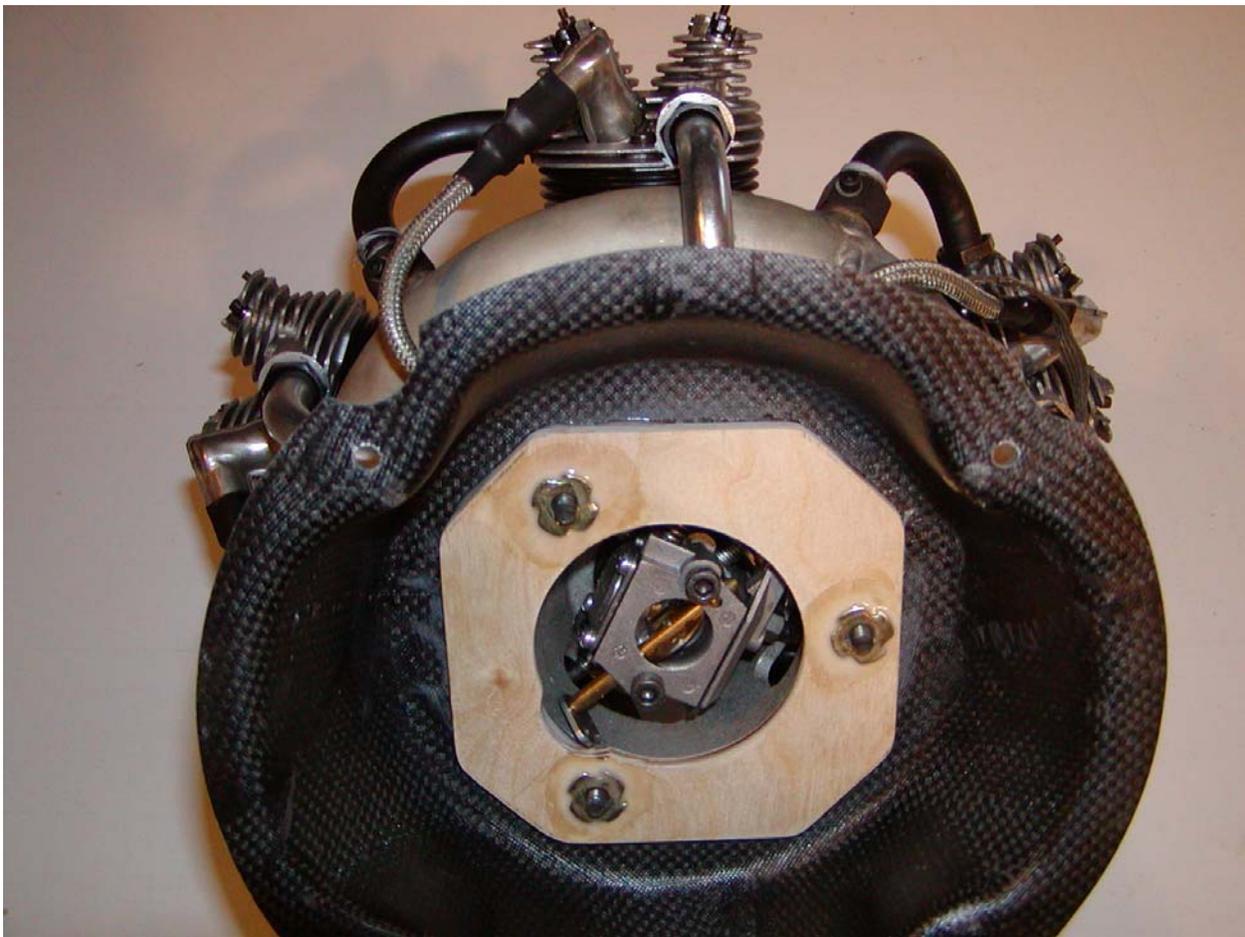
Make a cardboard mounting template for the Moki, marking mounting holes and clearance for carburetor and choke. The template will be used to transfer these locations to the engine dome.



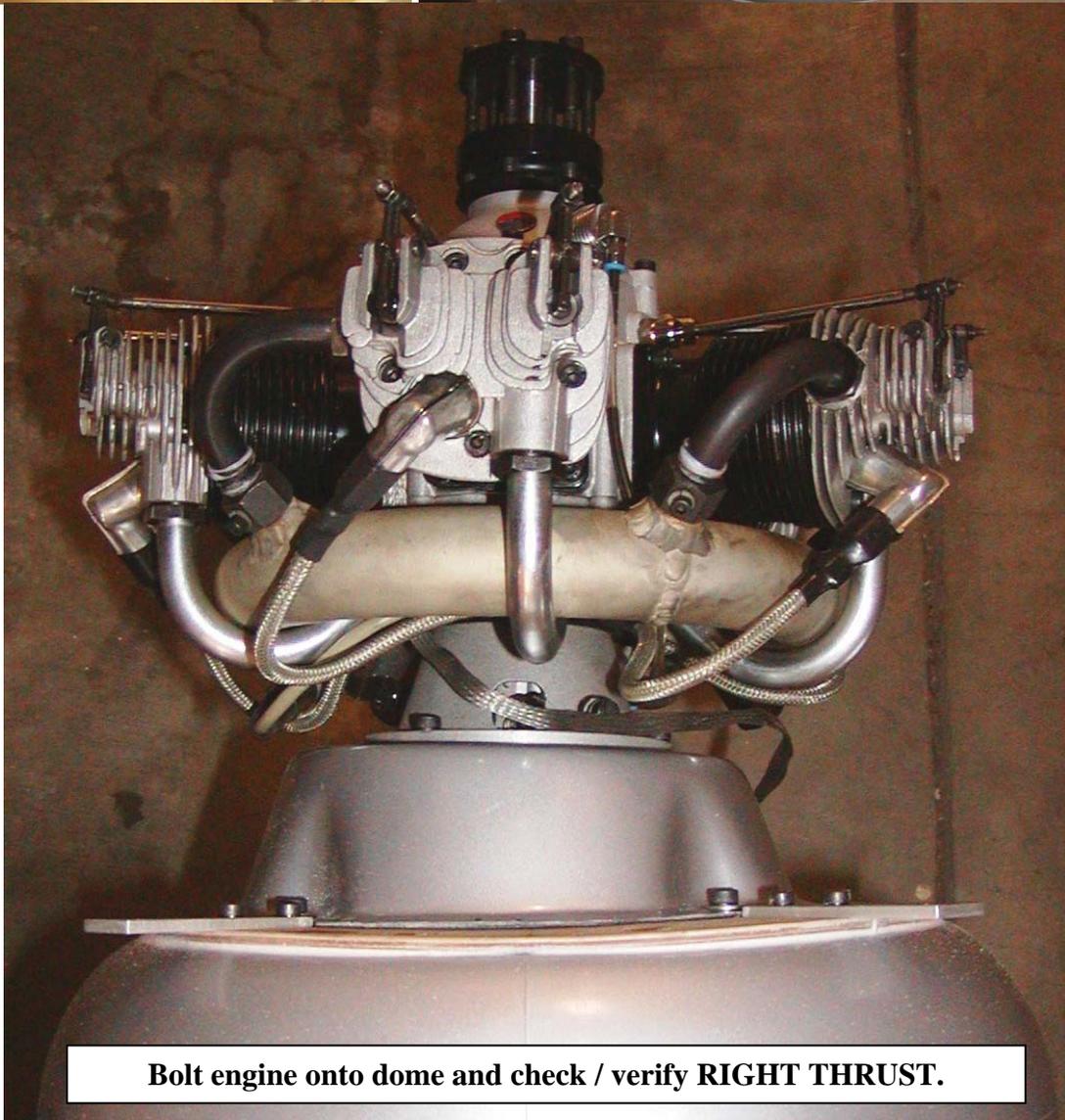
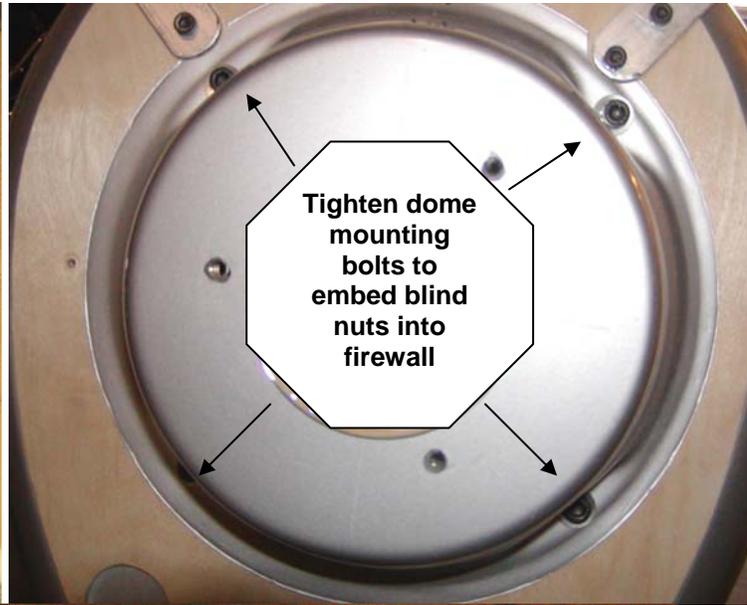
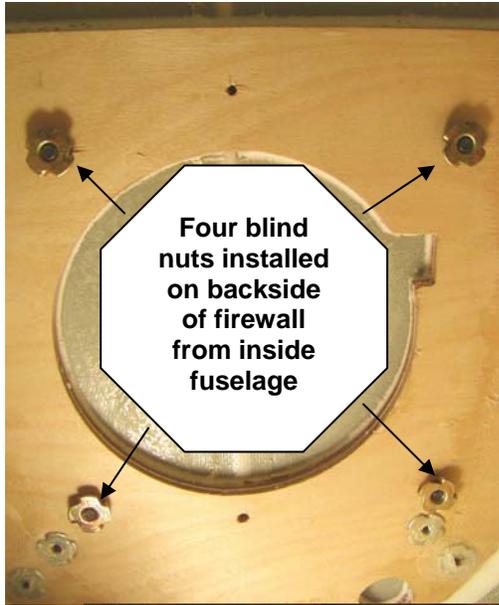
**Engine mounting holes and carburetor opening must be drilled out. Laminate the two plywood dome backing plates then glue to the back of the carbon fiber dome as follows:**



The engine dome is prepped for gluing; apply 30 minute epoxy to the plywood backing plate. Use the engine, blind nuts and mounting bolts to clamp everything in place and set aside. NOTE: it is a good idea to apply some epoxy to the blind nuts so they cannot come loose. AVOID getting epoxy on the screw threads!

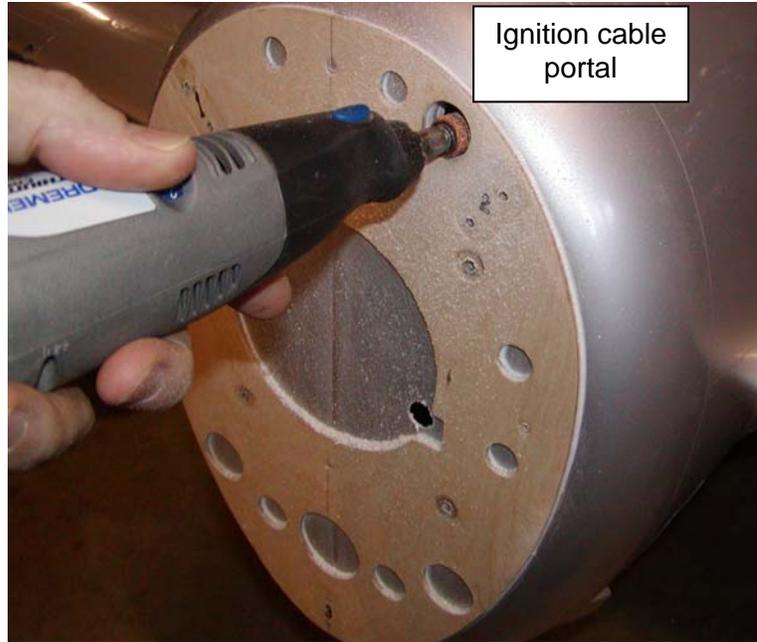
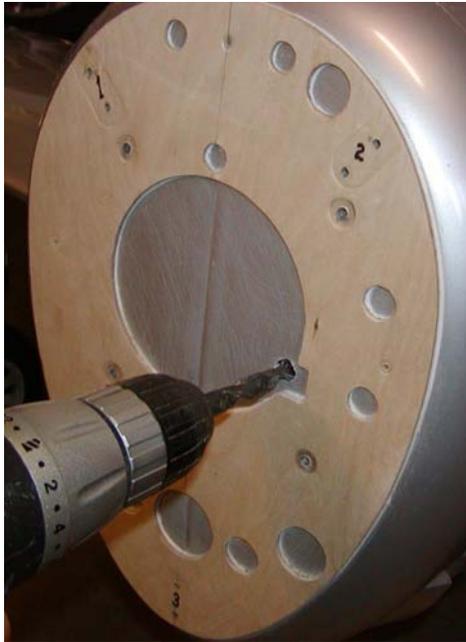


Once set, remove the engine from the dome; locate the four remaining bolts, washers and blind nuts. Apply a small amount of epoxy to each blind nut and access the 4 pre-drilled holes from the backside of the firewall. Bolt the dome in place, securely embedding the blind nuts in the plywood and allow epoxy to set.



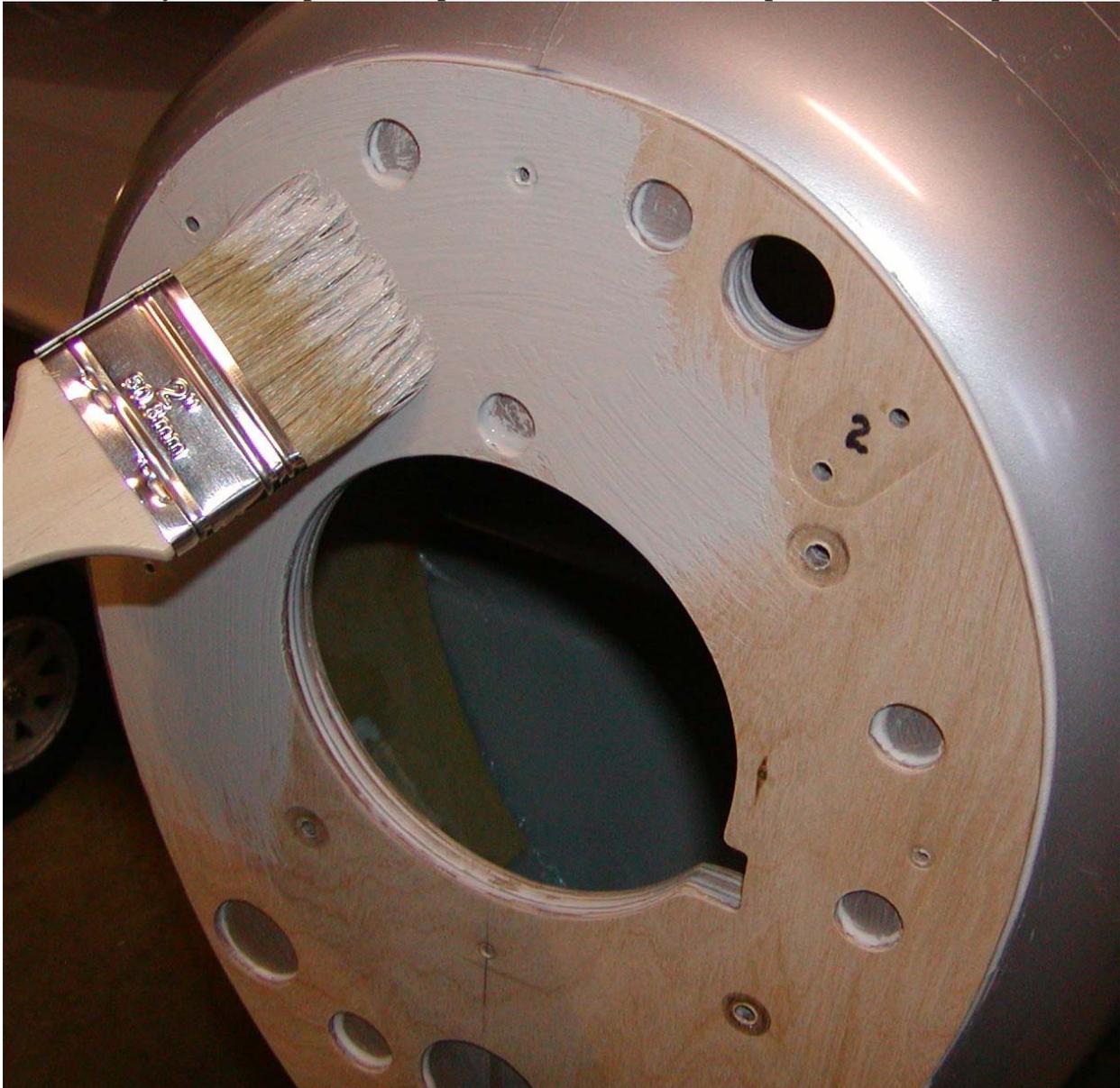
**Throttle Servo and Ignition module**

Remove the engine dome and drill large pilot holes in the firewall center section and ignition cable portal. Use a coping saw or jig saw to complete the firewall cut out. Use a high speed sanding drum for the portal.



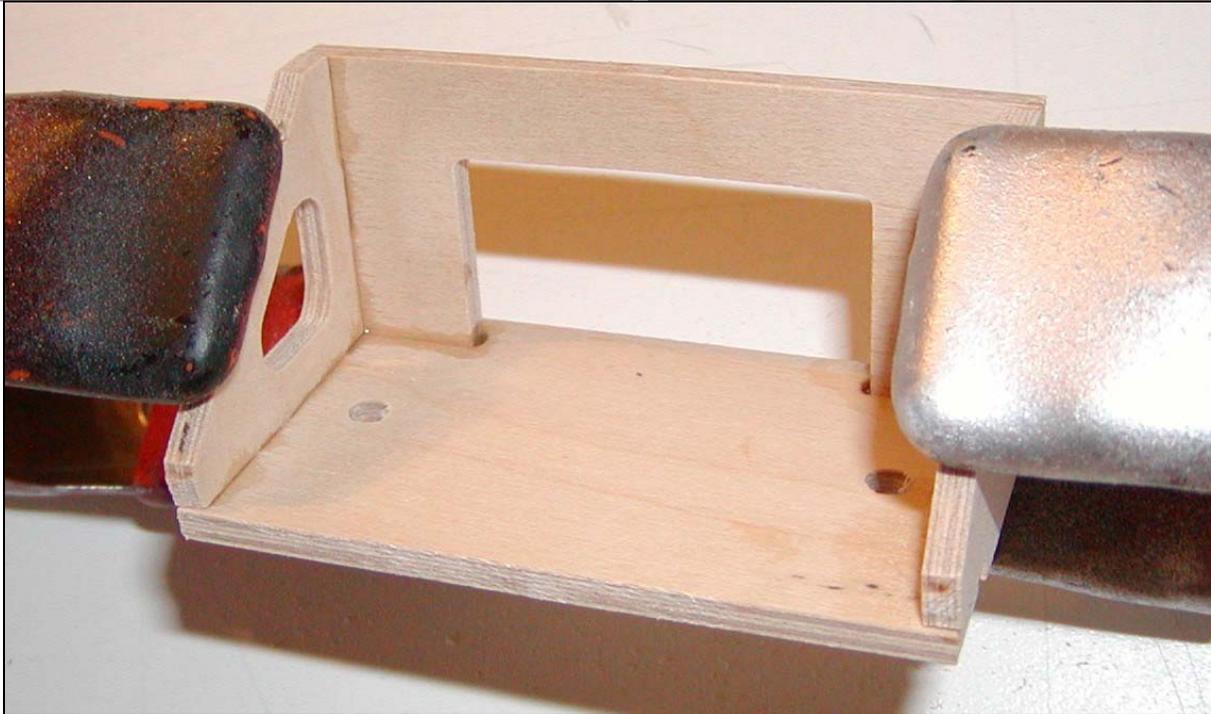
**BE SURE to round over any sharp edges on both openings with sandpaper.**

**You may choose to prime and paint the firewall. This is optional and not required**

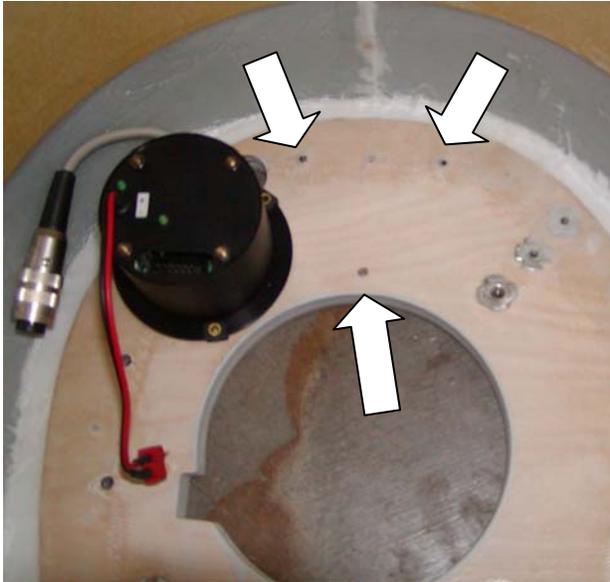


### **Servo Tray**

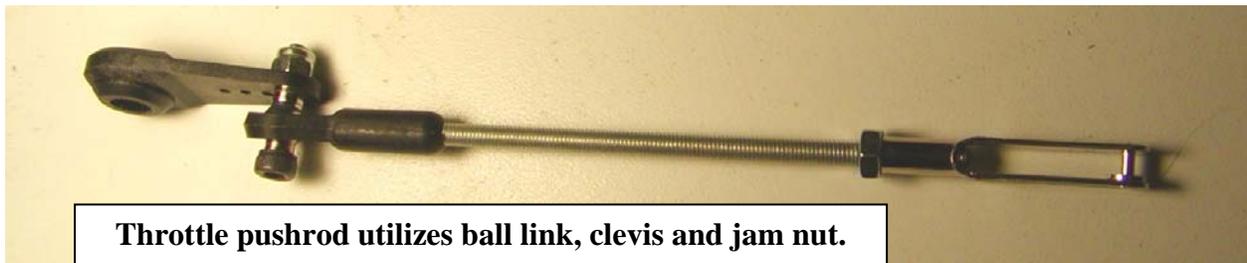
Locate the Throttle Servo Hardware pack. The throttle servo tray is built as shown using thick CA, epoxy or aliphatic resin glue. The blind nuts are pressed into place and should also be secured with a small amount of glue so they cannot back out. The throttle servo tray is bolted to the back of the firewall using the provided bolts and washers. The mounting holes are already located on the back of the firewall, but must be drilled all the way through. The following photos show the sequence of steps:



Moki Ignition Module mounting holes are also already drilled in the back of the firewall, but must be drilled through. Ignition mounting screws and nuts are not part of the hardware pack.



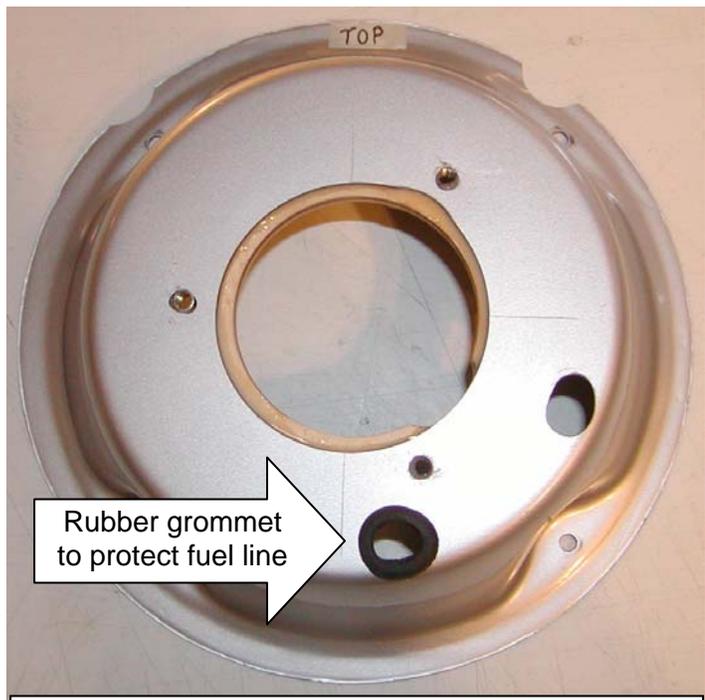
The module and throttle servo tray are mounted where shown above.



Throttle pushrod utilizes ball link, clevis and jam nut.

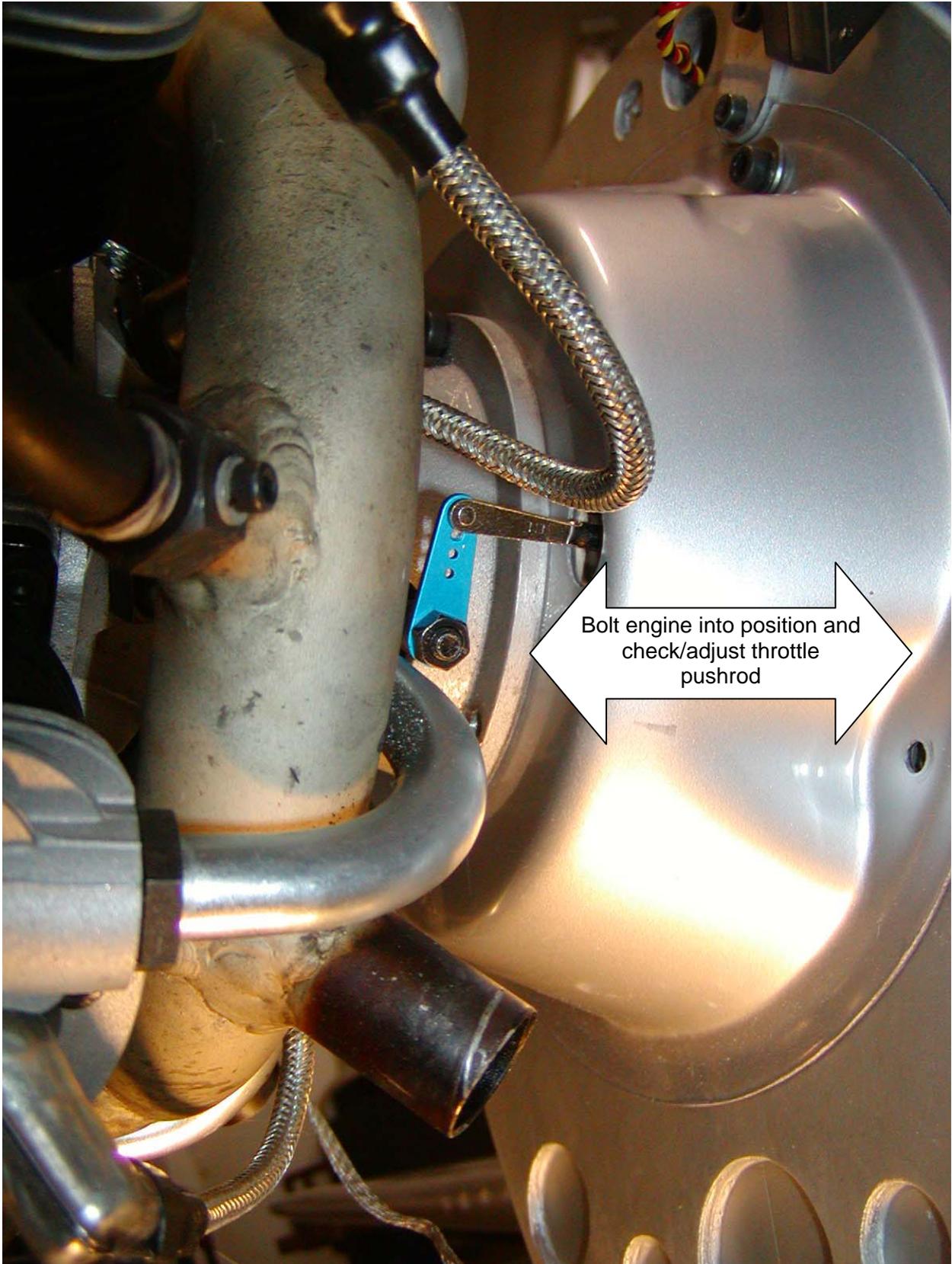


Throttle servo and pushrod installed

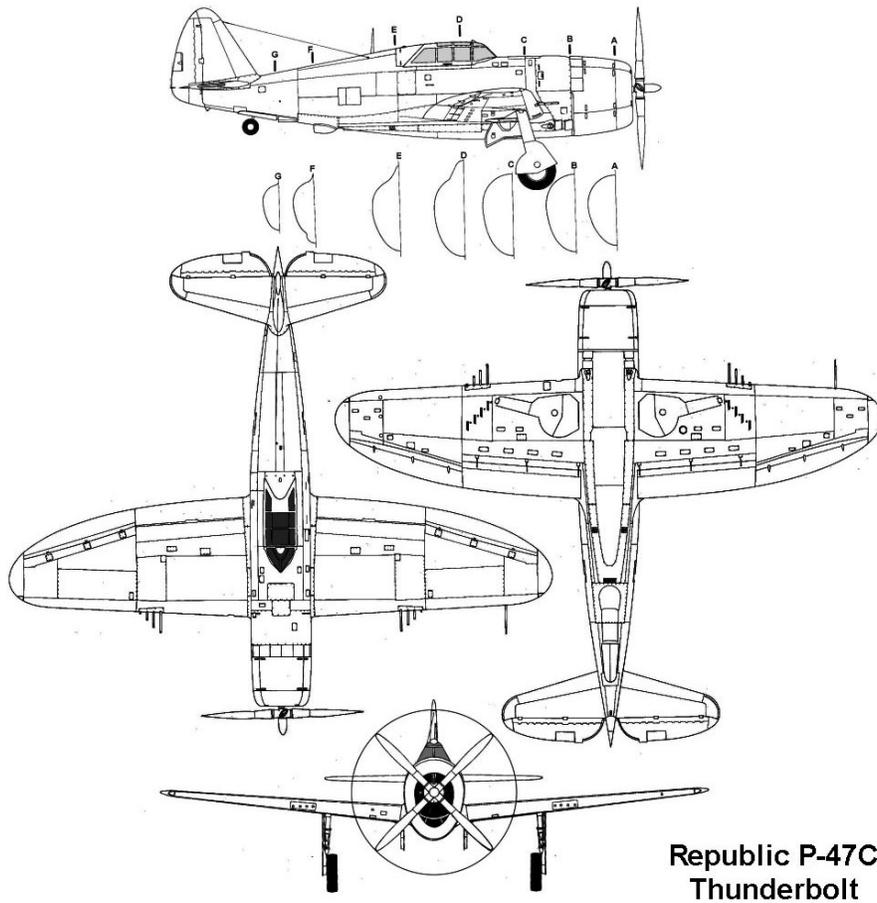


Rubber grommet to protect fuel line

Pushrod and fuel line locations on engine dome. NOTE rubber grommet inserted into fuel line hole.



Bolt engine into position and  
check/adjust throttle  
pushrod



**NOTE: The fuselage cradle can be utilized to hold fuselage inverted or upright. This may be more convenient than handling the aircraft with its massive wings in place!**

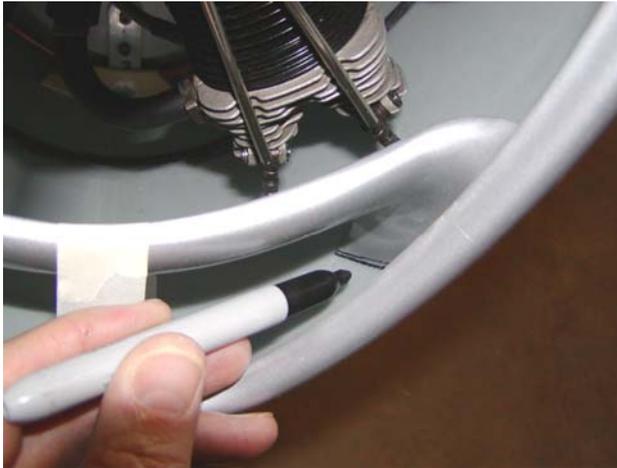


**COWL**

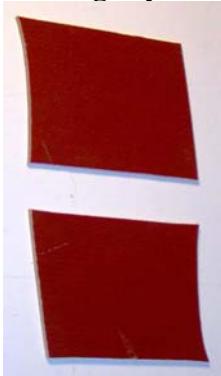
Locate the cowl baffle and check fit. Some sanding may be necessary for proper fit. The cowl should be bolted in place when fitting and gluing the baffle. The 3 cowl bolts are in the engine mounting hardware pack.



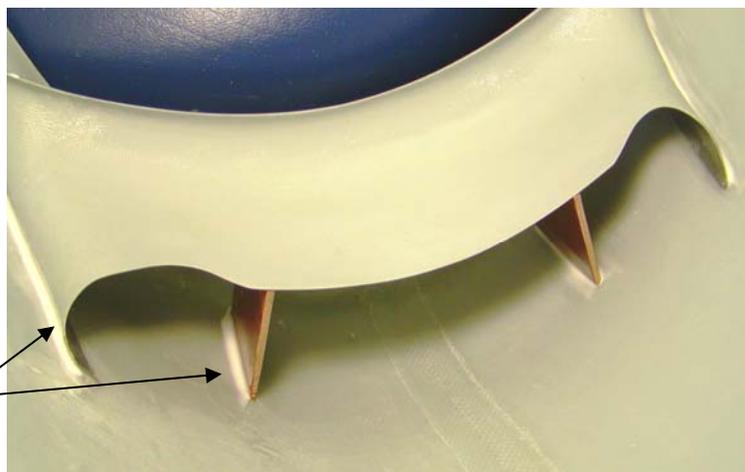
With the cowl mounted, tape the baffle into position. Look at a 3-view of the Thunderbolt if you are unsure of the correct positioning. When satisfied, mark the location and remove the cowl. Lightly sand the gluing surfaces; clean with alcohol; apply epoxy; remount cowl and tape to hold while the epoxy sets.



**The baffle reinforcements will require some sanding to fit properly. Gluing surfaces must be lightly sanded and cleaned. 'Tack' the baffles into position using thick CA as shown:**



If you are satisfied with the fit and position of the baffles, make a thick mixture of epoxy and micro balloons and apply a narrow fillet to all baffle and cowl junctions

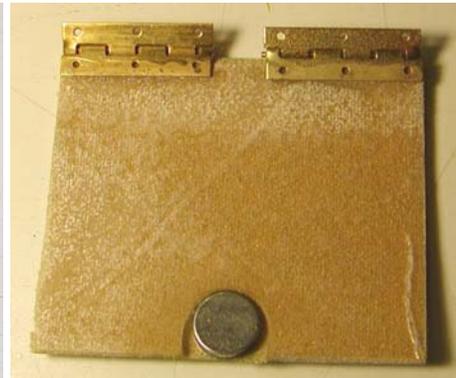


**Service Hatch**

Radio equipment switches, charge jacks, and air fill can be hidden behind a scale-like access hatch on the fuselage side, just beneath the cockpit. Ultimately, it is up to the modeler to decide. Hardware for the following option is not included:

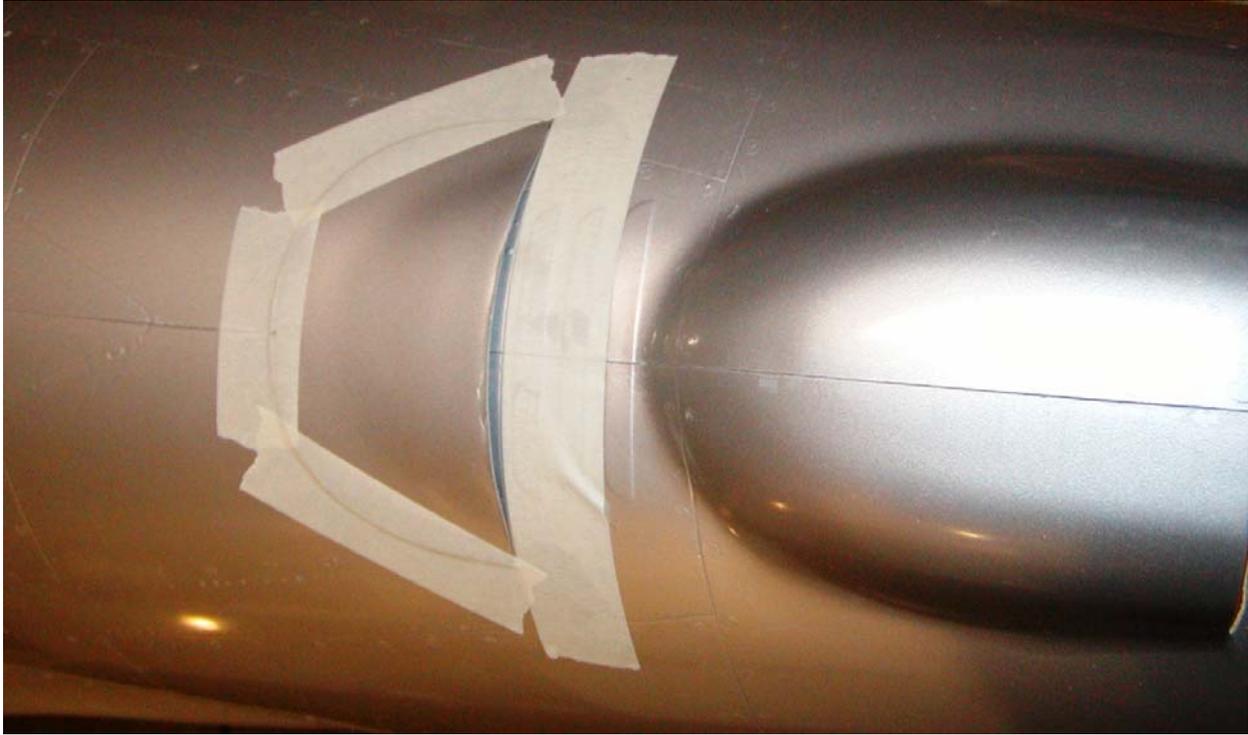


Thin ply is used to make a 'frame' for the fuselage hatch. The frame is glued to the fuselage interior. Small hinges are used for the hatch and a rare earth magnet is utilized to hold hatch closed.

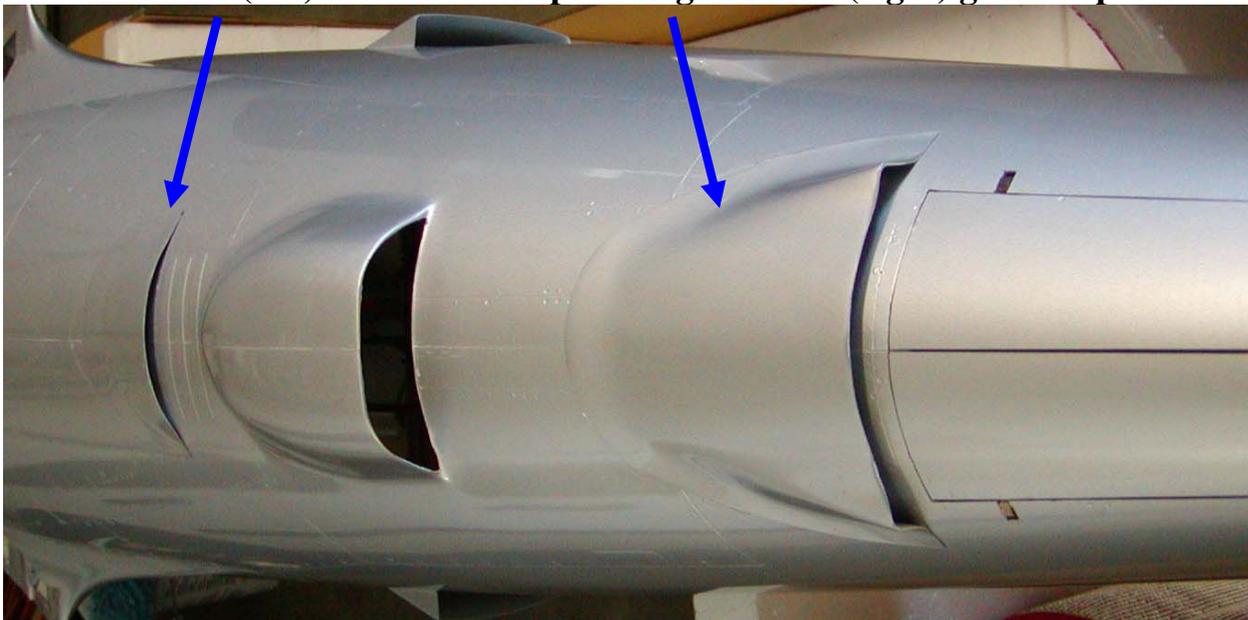


**Air Outlet and Turbo-Supercharger Outlet Covers**

Locate the Air Outlet and Turbo-supercharger outlet covers (Parts ID # 8 and #9). See the following photos for correct placement. CA or epoxy can be used. Surfaces should be lightly sanded and trial fit before applying adhesive. Some trimming of the parts may also be necessary to achieve an excellent fit. Masking tape can be used to mark the proper positions and to hold in place while glue sets.



**Air Outlet (left) and Turbo-Supercharger Outlet (right) glued in place.**



**Air Support**

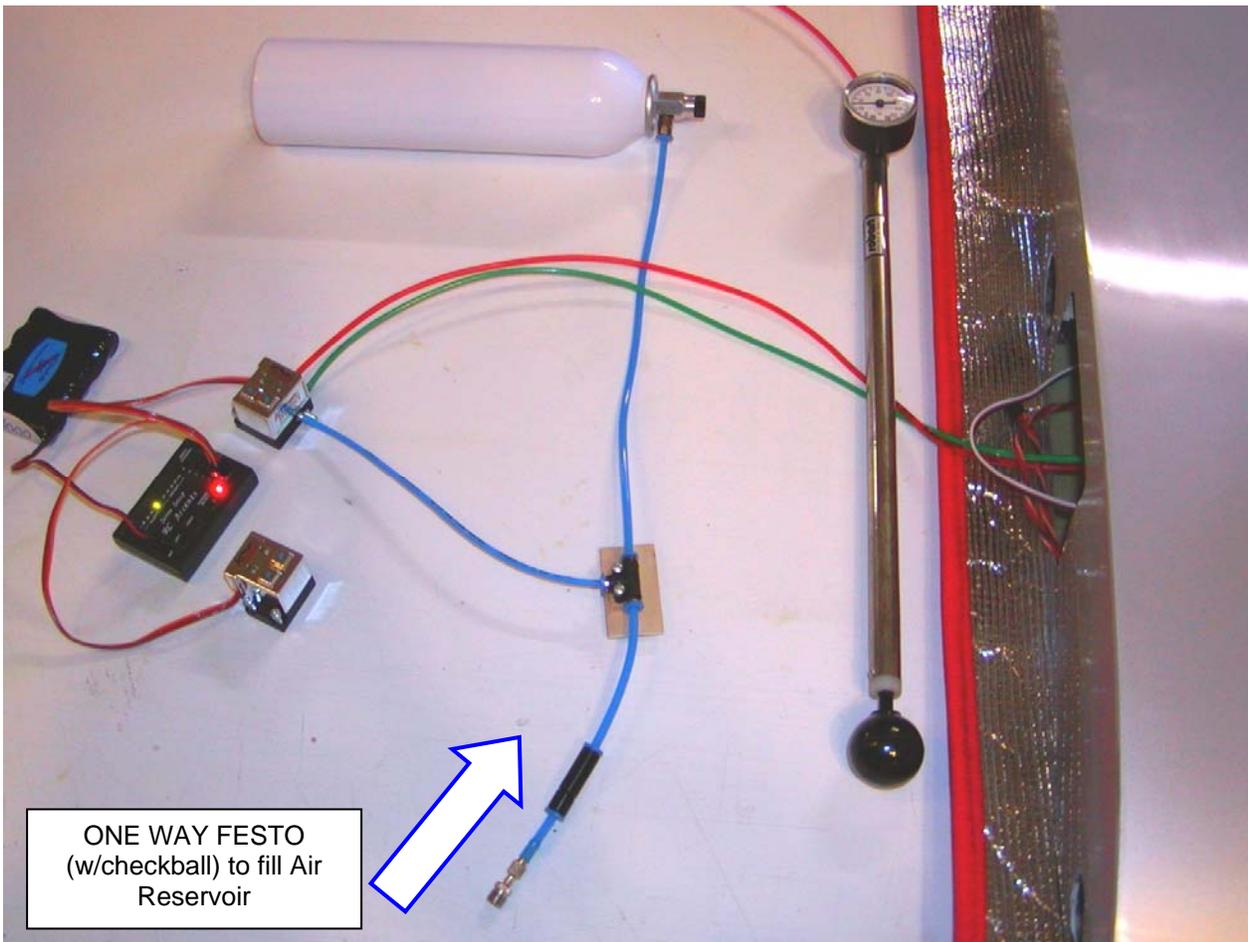
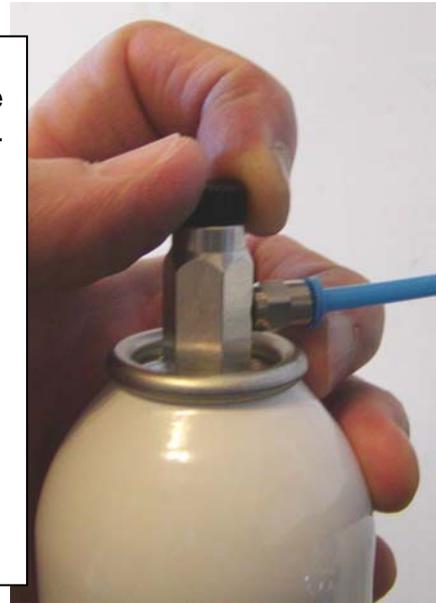
It is highly recommended that you take this opportunity to test your air system, getting familiar with the operation of the JET Tronics valves and other components integral to the retractable gear. This is best done BEFORE installation into the aircraft.



Knurled knob is turned clockwise until fully seated. This will engage air reservoir needle/seat and allow air to flow.

Make all fittings snug. DO NOT over-tighten.

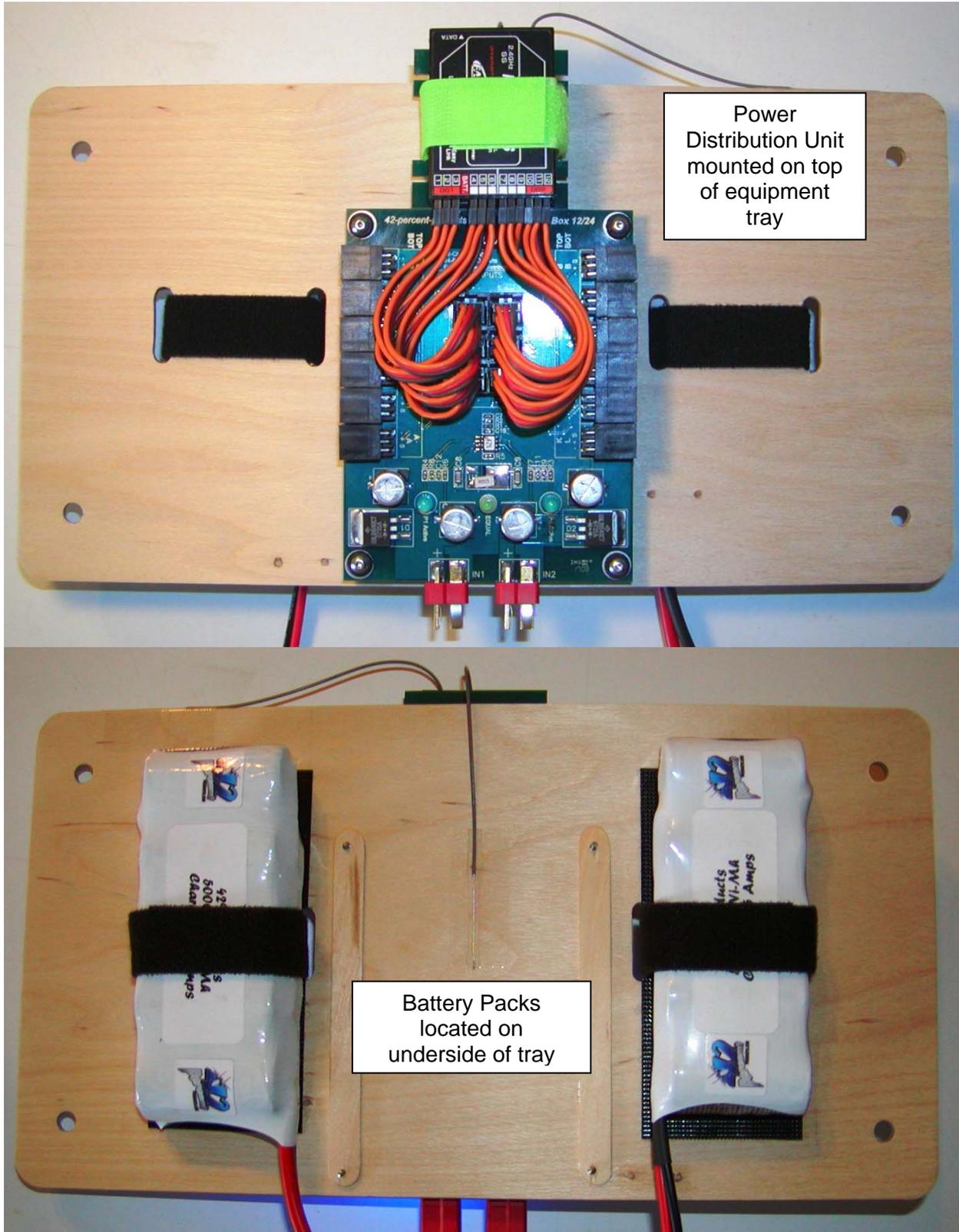
Air system operates best at 120 psi



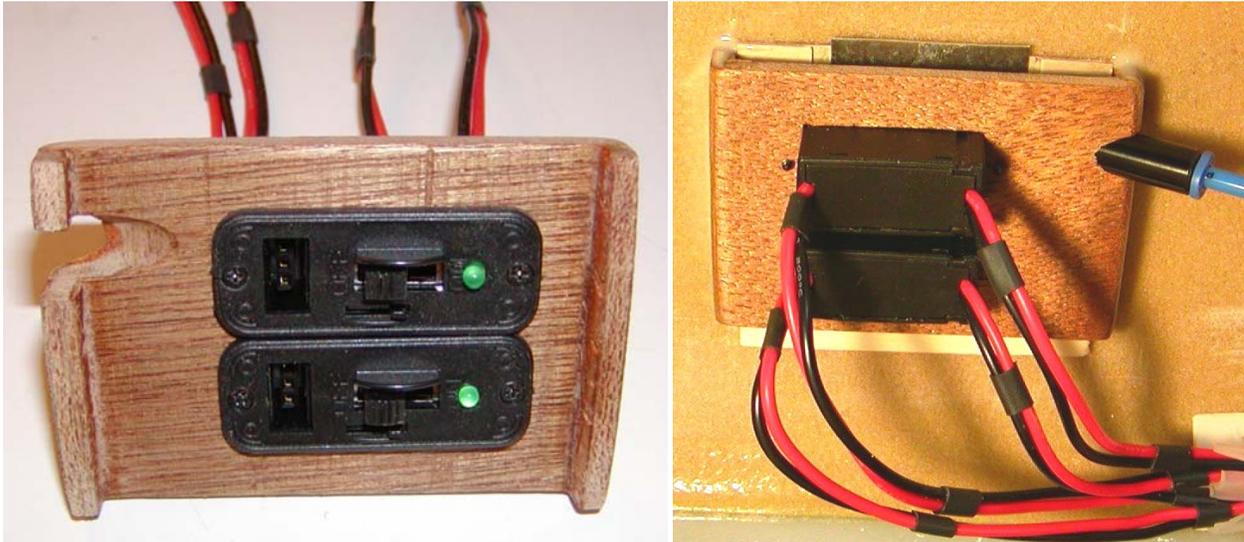
ONE WAY FESTO (w/checkball) to fill Air Reservoir

**Radio and Pneumatics installation**

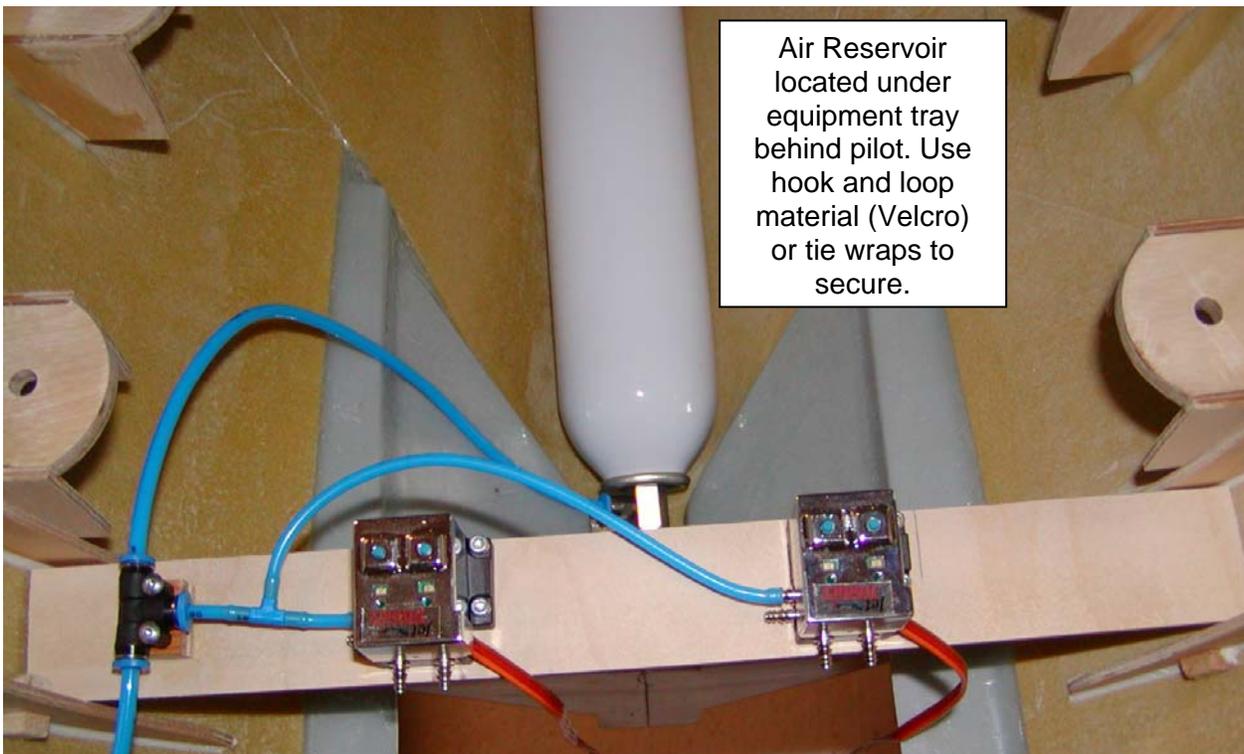
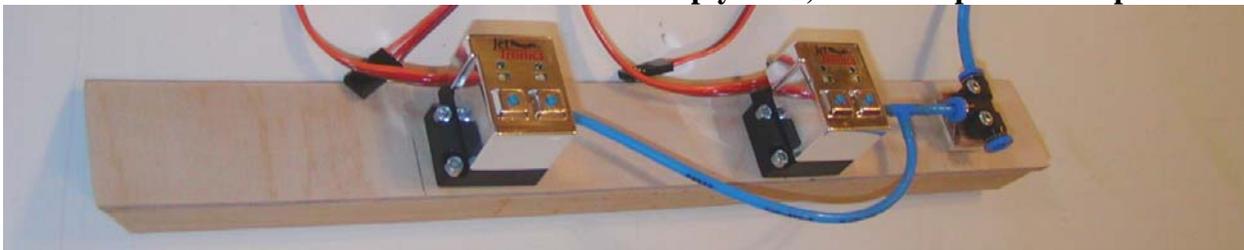
The following is a pictorial of one option. Your installation will depend upon your choice of on-board radio electronics as well as other factors.

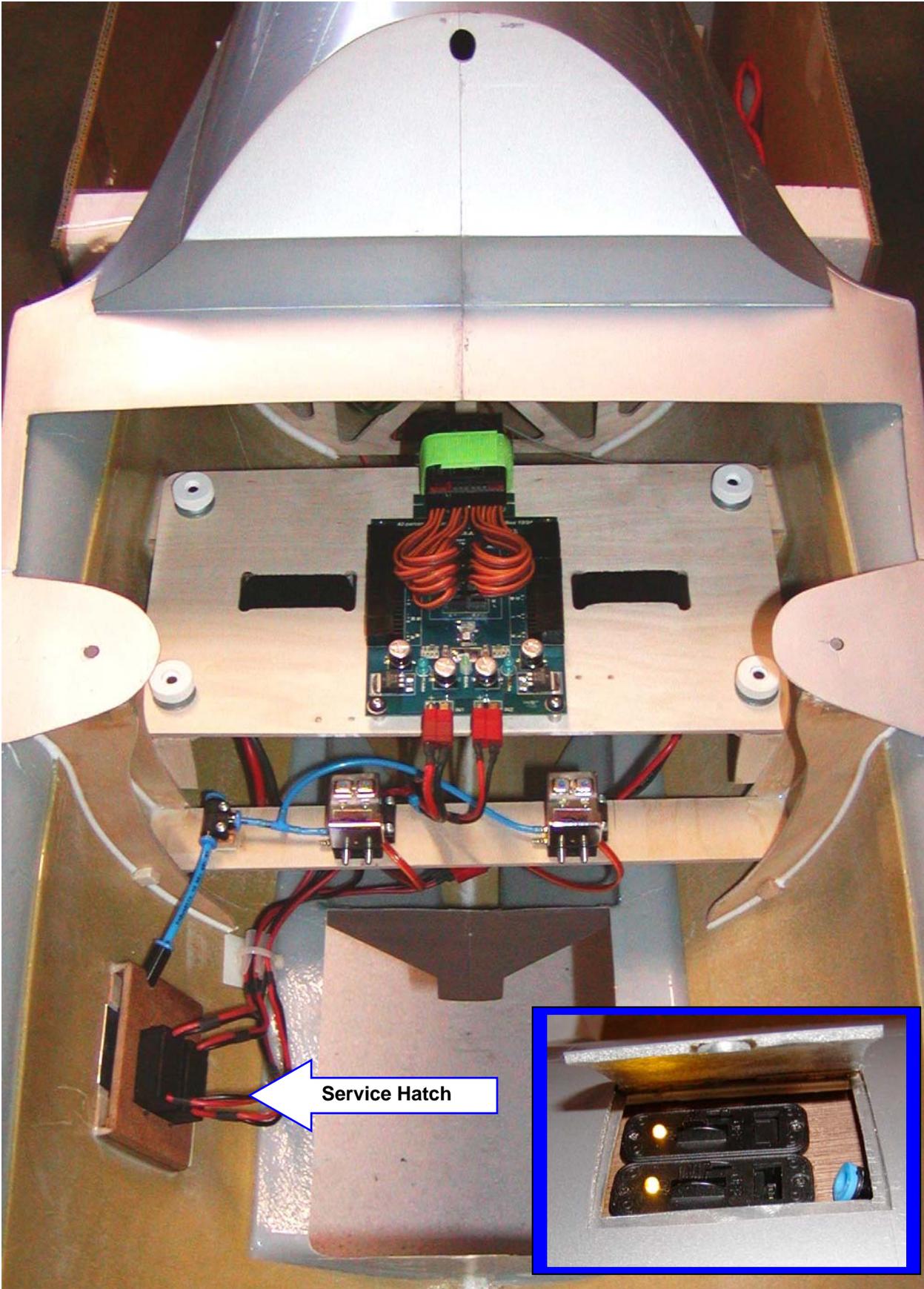


A switch mounting plate is built from scrap hardwood or ply. This will be epoxied inside the fuselage directly behind Service Hatch. Relief in plate is for Festo one-way Air Fill Valve.



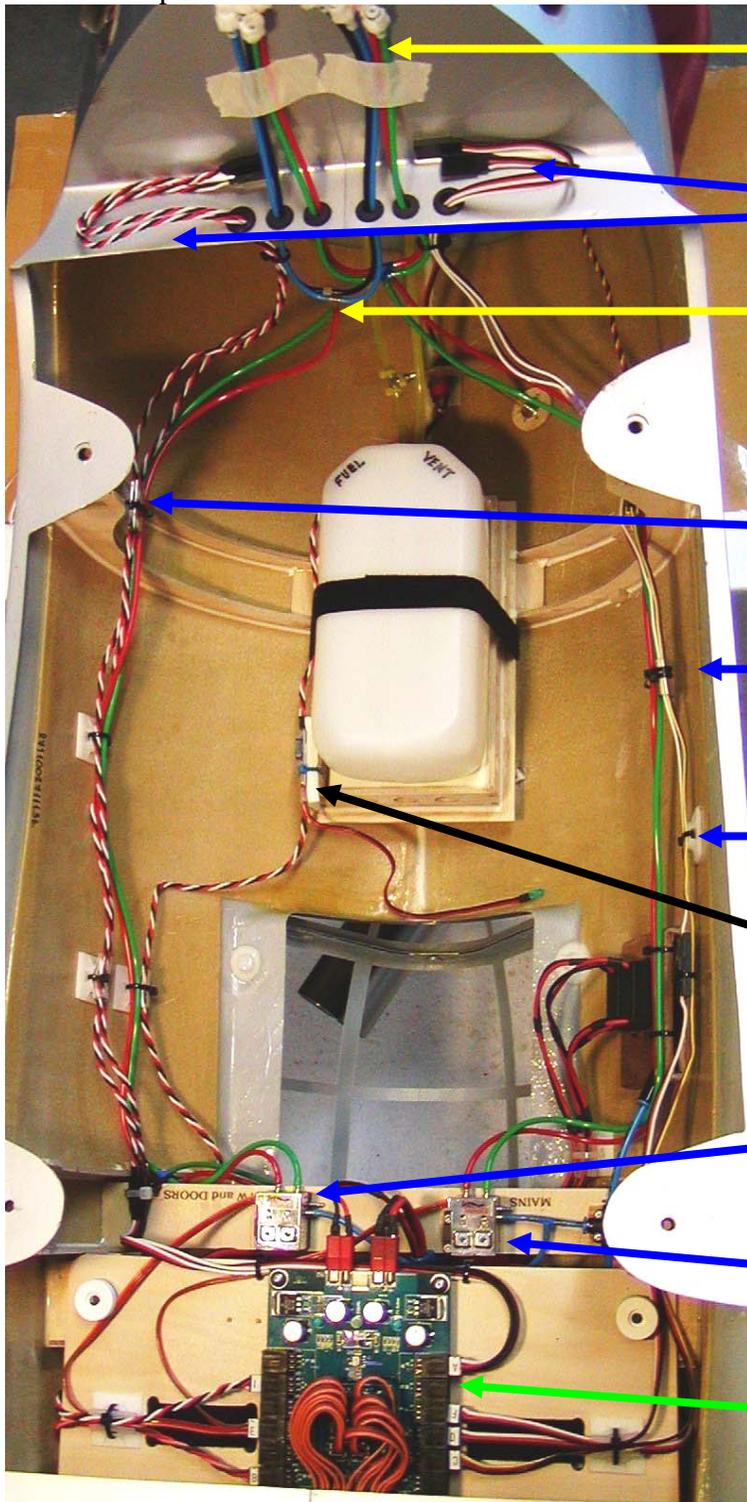
**JET Tronics Air Valves and Festo T mounted on plywood, which is epoxied into position:**





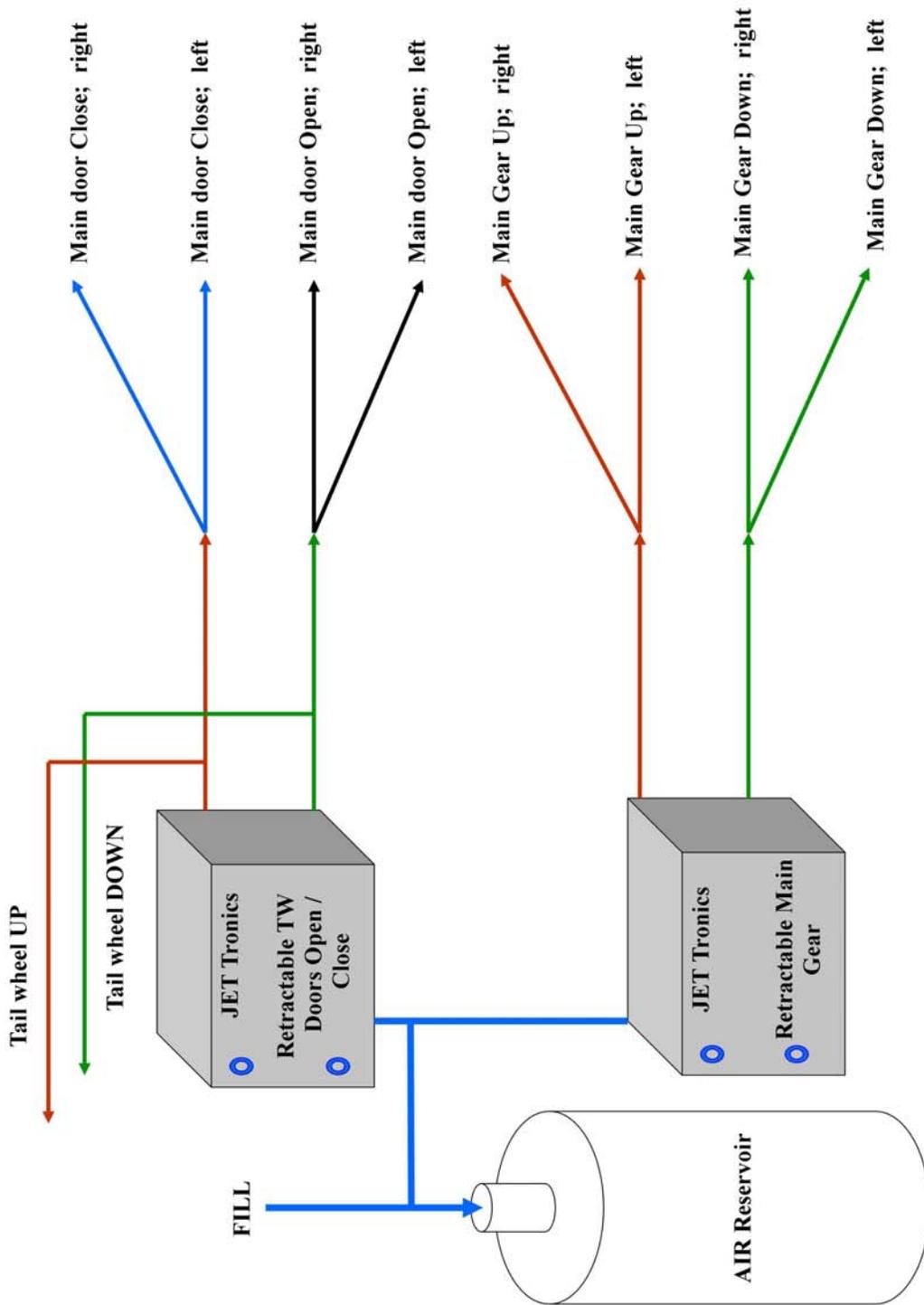
**Pneumatic Completion**

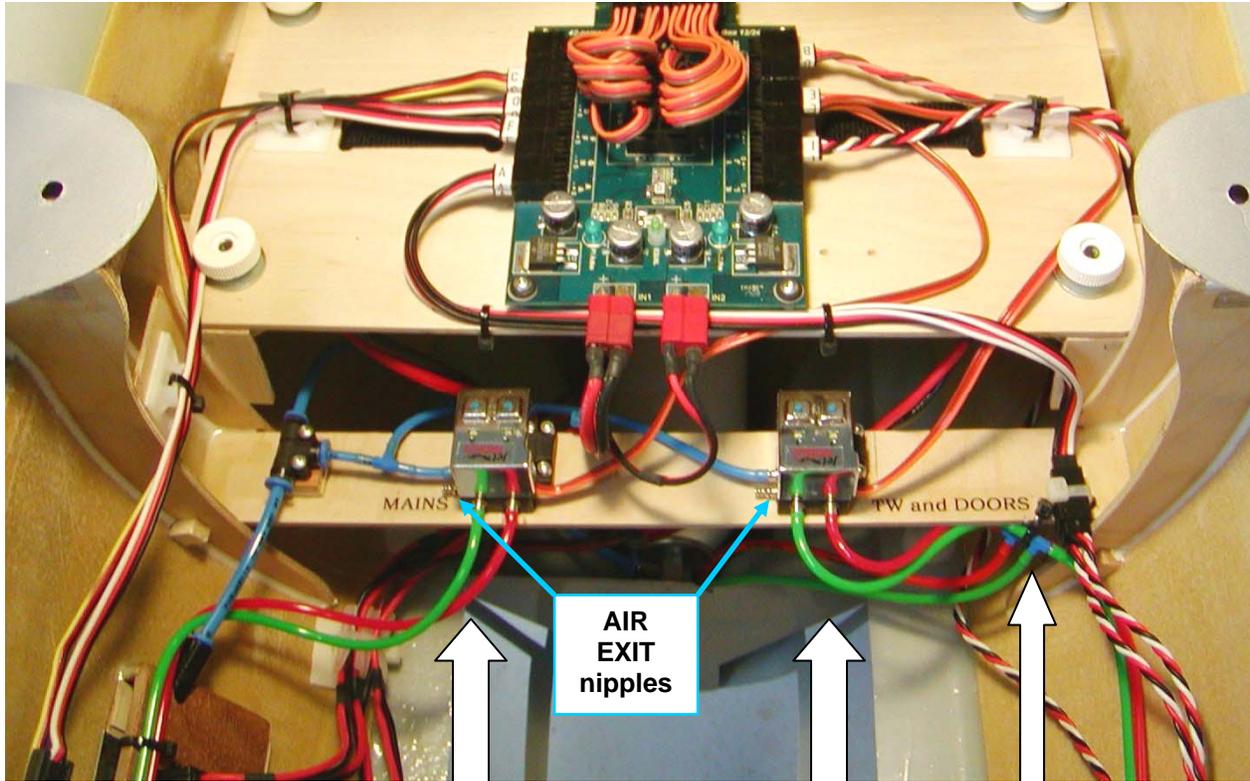
At this point in the project, we have installed retracts, wing air lines, TW air lines, air valves, and radio. It is time to complete the pneumatics installation such that correct and reliable gear and door operation can be achieved and repeated MANY times on the bench. NOTE: IF anything fails on the bench – *even once* – it is SURE to fail in the air. Leave NOTHING to chance! The following pictures illustrate an installation lay-out. Ultimately, cable lengths, locations and other details are up to the individual builder.



- Gear and gear door air lines w/Robart quick disconnects
- Flap and Aileron servo extensions
- Air Supply Lines w/ T fittings
- **Green** = Open/gear down
- **Red** = Closed/gear up
- Cables and air lines should be anchored so they remain in position regardless of aircraft attitude. Protect anchor points w/ plastic tubing
- '**THOR**' Ignition driver @US
- JET Tronics valve – TW and doors
- JET Tronics valve – Mains
- '**Blu Box**' Power Distribution Unit @US

### Pneumatics Schematic





JET Tronics Valve – Drives Main Gear  
 Green = Open/gear down  
 Red = Closed/gear up

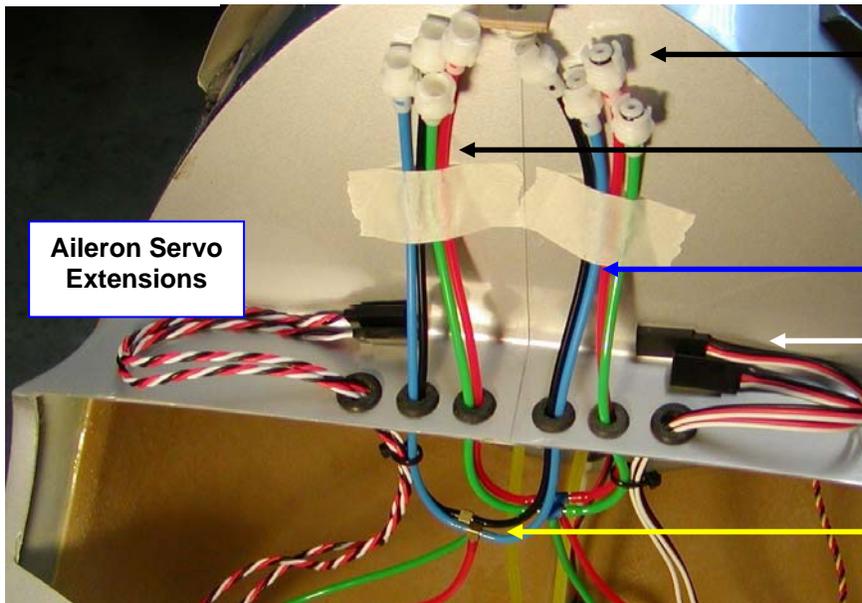
JET Tronics Valve – Drives Tail Wheel and Gear Doors

'T' Fittings and Air Lines for TW unit. Air lines going forward for Main Gear Doors

FLAP and THROTTLE SERVO EXTENSIONS

**Builder's NOTE: Keep your installation clean, precise, logical and labeled...OR... you will NOT REMEMBER what goes where!**

AILERON SERVO EXTENSIONS



Aileron Servo Extensions

Quick Disc. with 'O' Ring

Quick Disc. w/o 'O' Ring - this creates "fool proof" connections for Left and Right Wing Air Lines

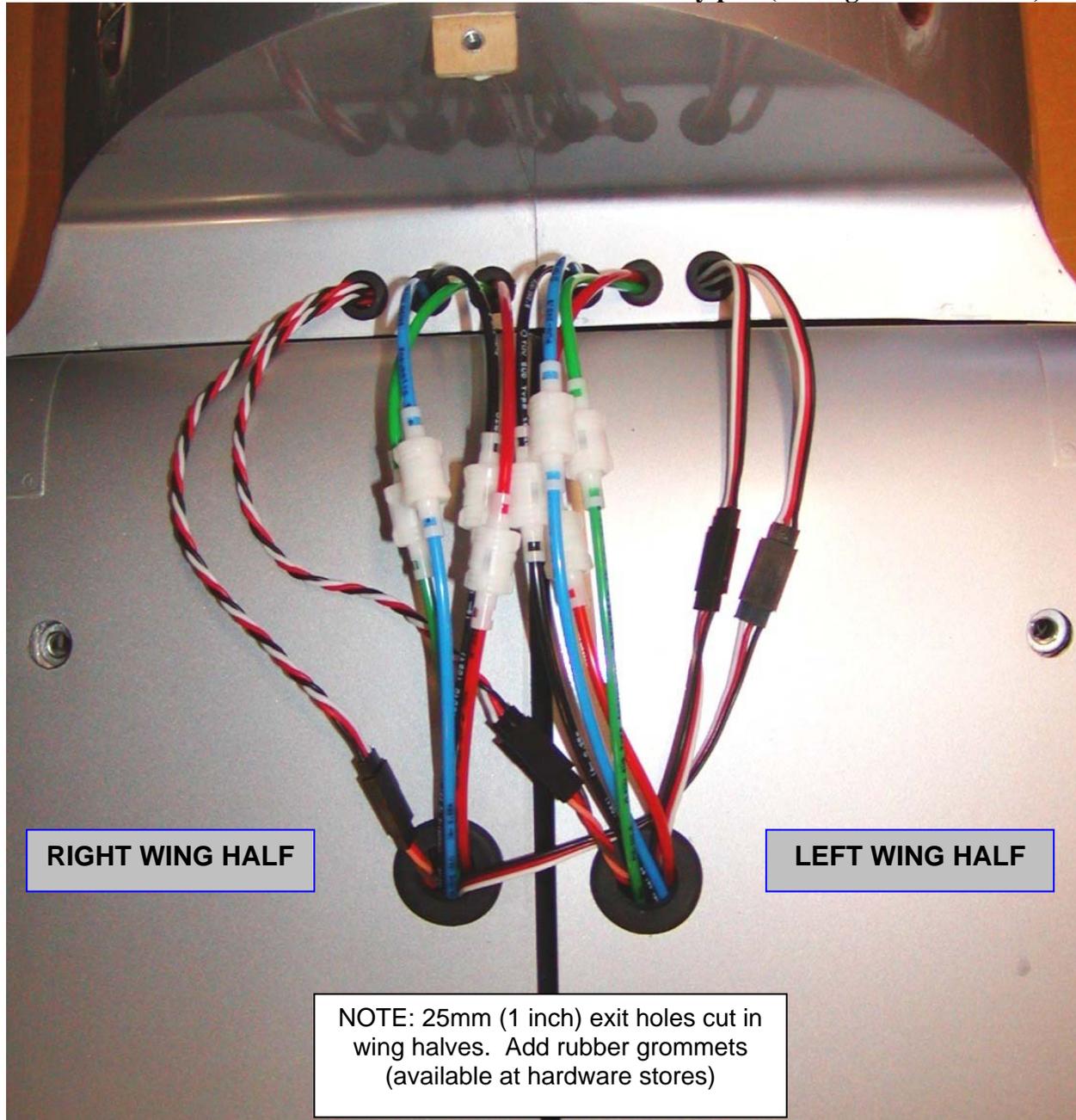
Black and Blue lines used for gear doors

FLAP Servo Extensions

Protect exit holes with common rubber grommets

'T' fittings – split air supplies to left and right wing halves

**All air and servo connectors are hidden beneath the belly pan (fuselage bottom hatch)**



### **Gear and Door Sequencing**

The gear doors must open **BEFORE** the main gear extend, and close **WELL AFTER** the main gear retract. While the JET Tronics valves do have the ability to “throttle” up/down air circuits, thus slowing retract cycles, repeatable and reliable operation (regardless of air supply or flight loads) will be achieved by using a “delay” function on the retract channel. Many radios have a Channel Delay function. Some radios only have delay on the Throttle channel, but can be configured (through mixing) to take advantage of Delay on the Retract Channel. **IF** your radio does not have a Delay function, you will need to acquire a Channel Delay device that enables the “slewing” of servo speed.

Both JET Tronics Valves must be Reset with NO throttling (the Default setting is 3 seconds of throttling – this must be eliminated). Reset the JET Tronics valves by turning off receiver, holding both blue valve buttons down at the same time, then powering up receiver. This should reset valves to no throttling of either output. You may need to repeat this procedure.

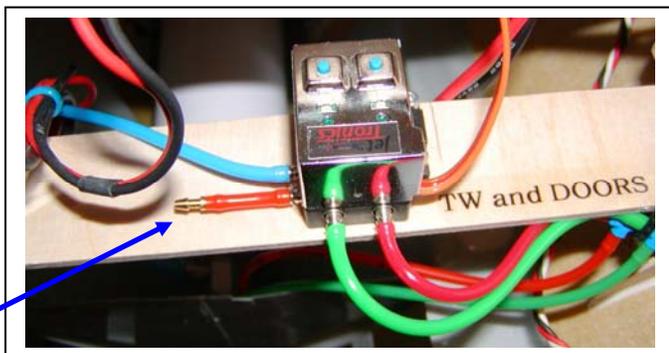
To set up the correct delays, plug both retract valves into the Receiver’s Throttle channel. Make sure throttle end-points are set to 100%, trims and sub-trims are at 0. Count the number of clicks from zero to full throttle stick deflection such that a calculation of percentages can be estimated. Example: IF throttle stick has 26 clicks from low to high throttle, then:

<ul style="list-style-type: none"> <li>• 5 clicks = 20%</li> <li>• 7 clicks = 25%</li> </ul>	<ul style="list-style-type: none"> <li>• 21 clicks = 80%</li> <li>• 23 clicks = 85%</li> </ul>
--	--

Move the throttle stick to 20% throttle. Press the green button of the Main gear valve. Move the stick to 25% throttle, press the red button of the Main gear valve. Now move the stick to 80% throttle. Press the green button of the door valve; move the throttle stick to 85%, and press the red button of the door valve.

If programming of the switch points was successful, you will be able to test the functions by moving the throttle stick slowly from idle to full throttle, and back to idle. The valves should retract the gear first, then close the gear doors and TW; the slower you move the stick, the later the doors will close. Conversely, throttling down should open gear doors first, then extend gear. This "time delay" of the slow moving throttle stick can be simulated by setting a Channel Delay function onto your gear channel. Plug the valves back into your original gear channel (make sure the end points are set in the transmitter to +/- 100%) and set the function of your transmitter Retract Channel reduce (delay) servo speed. On some radios, this can be independently set for either direction. Set the servo slow function to approx. 3 seconds (or some percentage), then activate the Retract switch. You will see that this simulates the slow moving throttle stick as you observe the timed operation of the JET Tronics valves in both directions.

Maximum reliability can only be achieved when maximum air pressure is applied to both cycles (gear up, gear down). However, slower gear and door speed can be obtained with the use of an Air Restrictor on the remaining nipple (air relief) of the JET Tronics valves. A restrictor on the output will slow the EXIT of air from the circuit. Robart offers Air Restrictors: P/N ROB189



DO NOT LIMIT the air pressure, speed or volume on ANY INPUT to gear or door cylinders. This will compromise the reliable operation of retract circuits under reduced air supply pressures and increased flight loads and. **NOTE:** It is highly recommended you DO NOT limit exit air pressure on the Mains Valve – only the doors **SAFETY OVER SCALE** BETTER to apply 100% air pressure to the Mains. Due to the weight of the gear and wheels, ‘slow up’ will be naturally occurring. AFTER several flights, you may choose to limit Main retract air exit to slow the retract circuits, but this could risk reliable, positive, repeatable, operation.

**Scale Exhaust**

The P-47 had exhaust 'waste gates' directly behind the oil coolers on the front lower section of the nose. These were opened when manifold pressure was too high; excess exhaust pressure was diverted from the Turbo-Supercharger. The location of these waste gates lend themselves perfectly to scale exhaust outlets.

The prototype CARF-Models Thunderbolt utilized canister headers for exhaust extensions. Another option is corrugated copper pipe @US utilized for hot water heater installations and found at most home improvement and hardware stores @US.

The Moki exhaust outlets are 20mm (3/4 inch) in diameter.



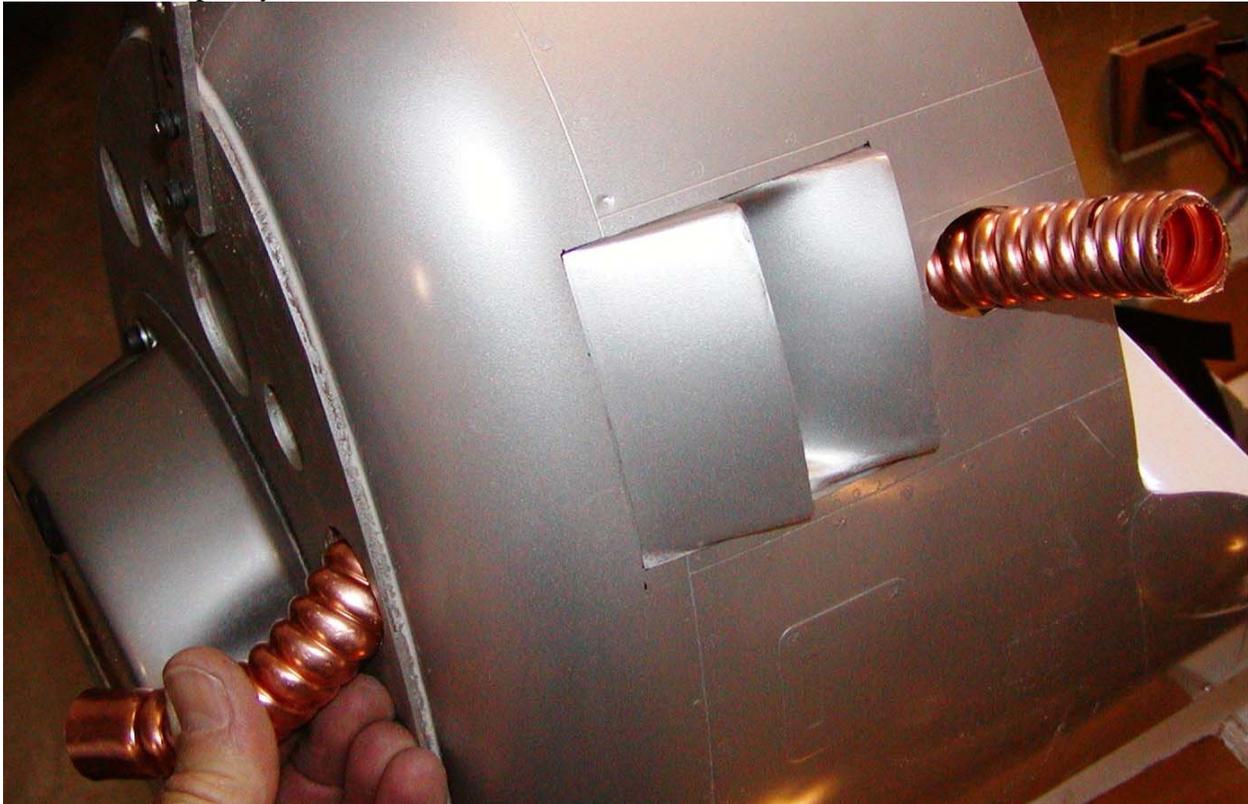
**The large end is cut off then cut again to form the tapered exhaust exit.**



**The location of the exhaust outlets is as follows:**



The finished exhaust extensions are approximately 12 inches (30cm) long. Cut the copper stock so that there is plenty of material with which to work.



Trim tubing length to fit into the tapered end such that when inserted into exhaust exit, it is flush with fuselage. Mark the exact location of the tapered end, remove and **\*\*hard solder**.

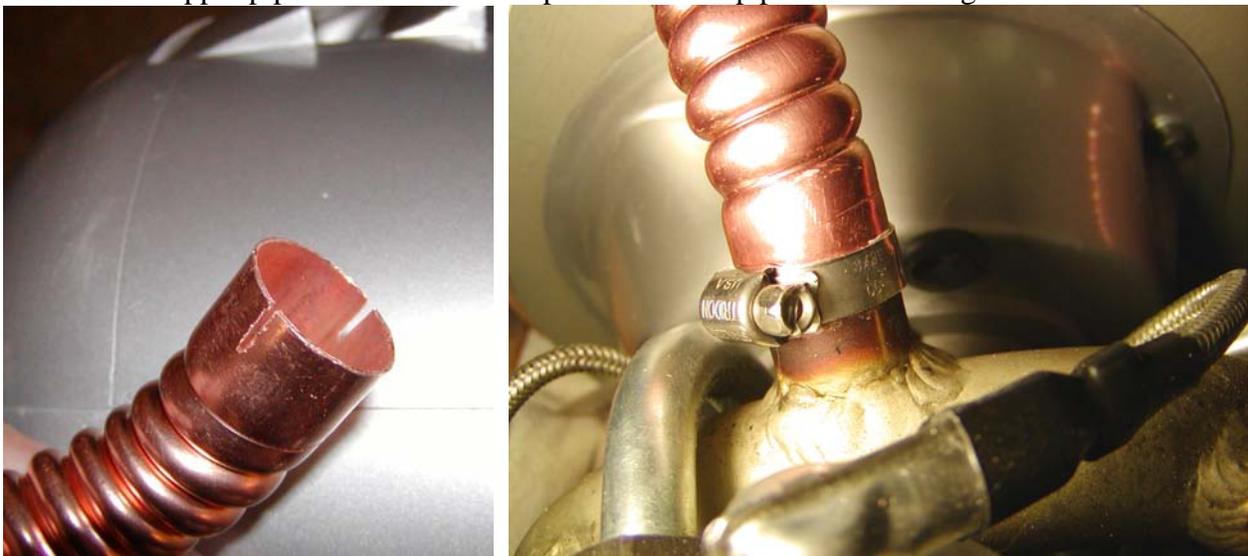


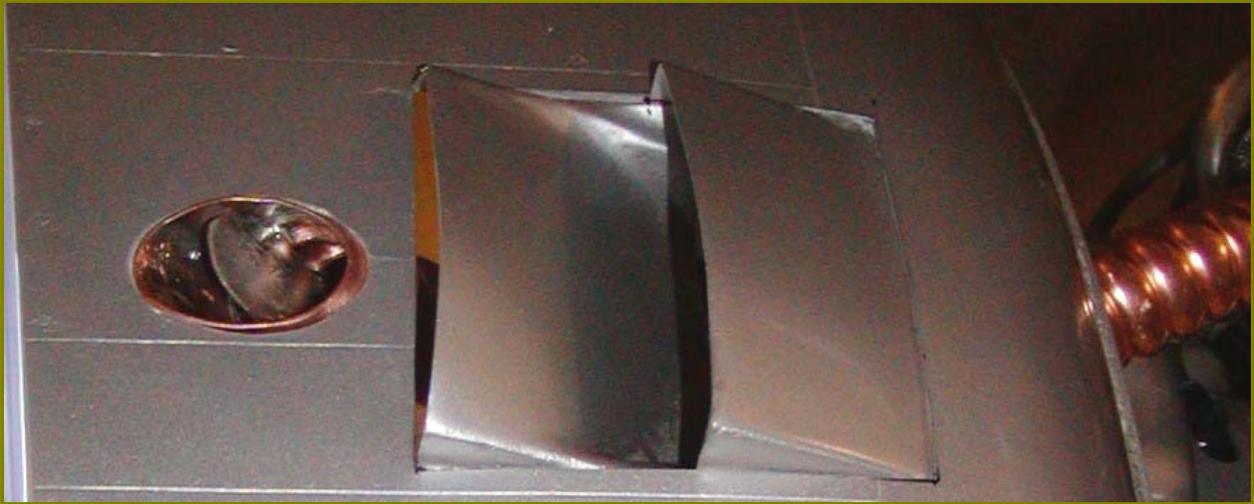
**\*\*hard solder** - using alloys that melt at greater than 450 degrees C. This includes brazing and high temperature solders. 'Hobbyist' solder will not survive Moki exhaust temperatures.

A "Waste Gate" can be made from thin tin stock and brazed into position as shown:

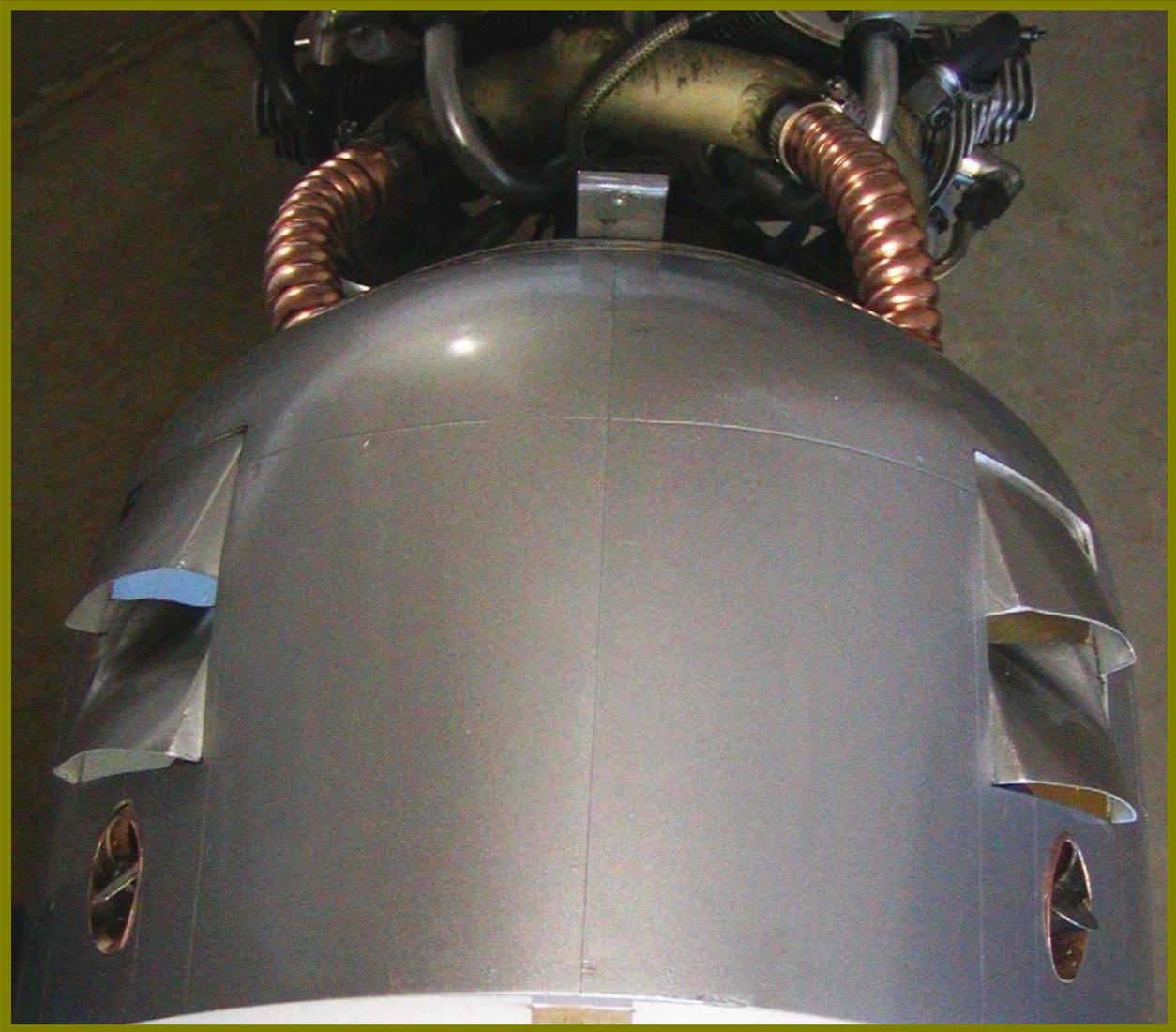


'Hose clamps' are utilized to secure the exhaust extensions to the Moki outlets. Slots should be cut into the copper pipe so that it can collapse under clamp pressure to fit tight and secure.



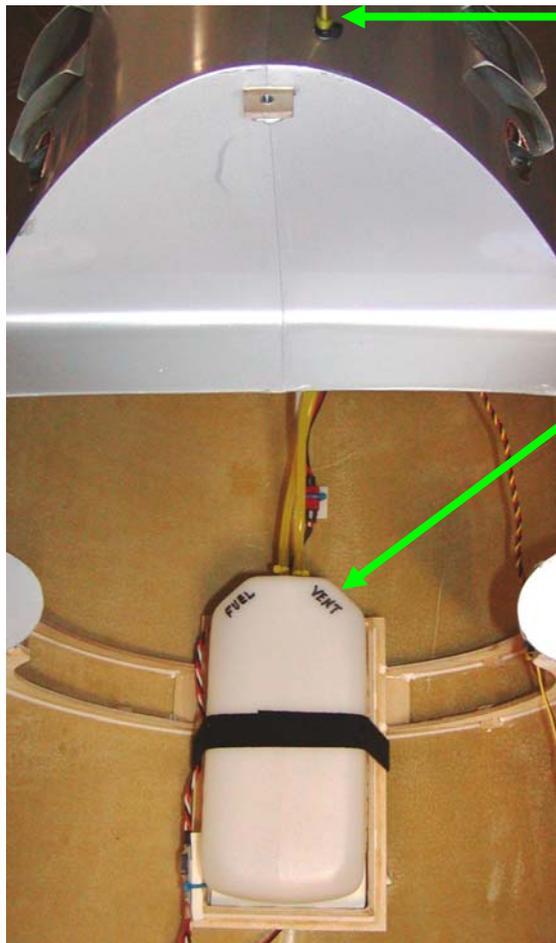
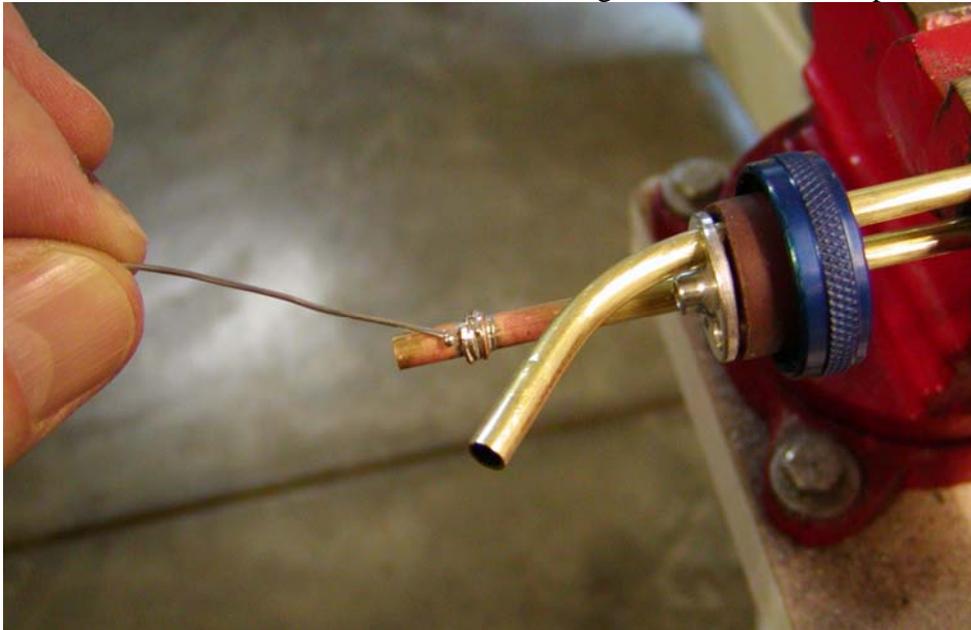


NOTE: Find [Exhaust cooling addendum](#) at end of manual

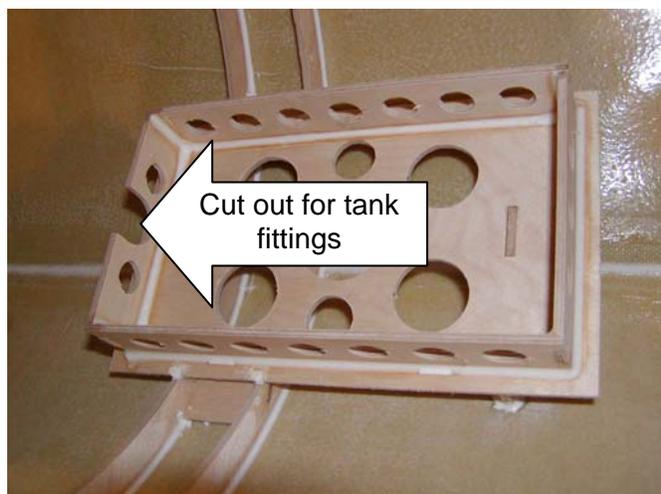


**Fuel Tank**

Whether using the 250cc Moki or a 120cc DA, 32 ounces of gas (1 liter) will be plenty; the tank tray is designed to accommodate a 1 liter sized tank. It is always recommended that you install “fuel barbs” on fuel lines and secure fuel tubing with wire or tie wraps.



- Tank overflow exits fuselage (left)
- Be sure to use GASOLINE (Tygon) compatible fuel tubing. Tie wrap all fittings for safety.
- Install thick foam rubber under fuel tank to help alleviate fuel foaming from vibration.
- Double-sided hook and loop (Velcro) strapping works best for securing tank to tray.
- Mark FUEL and VENT lines for future reference.

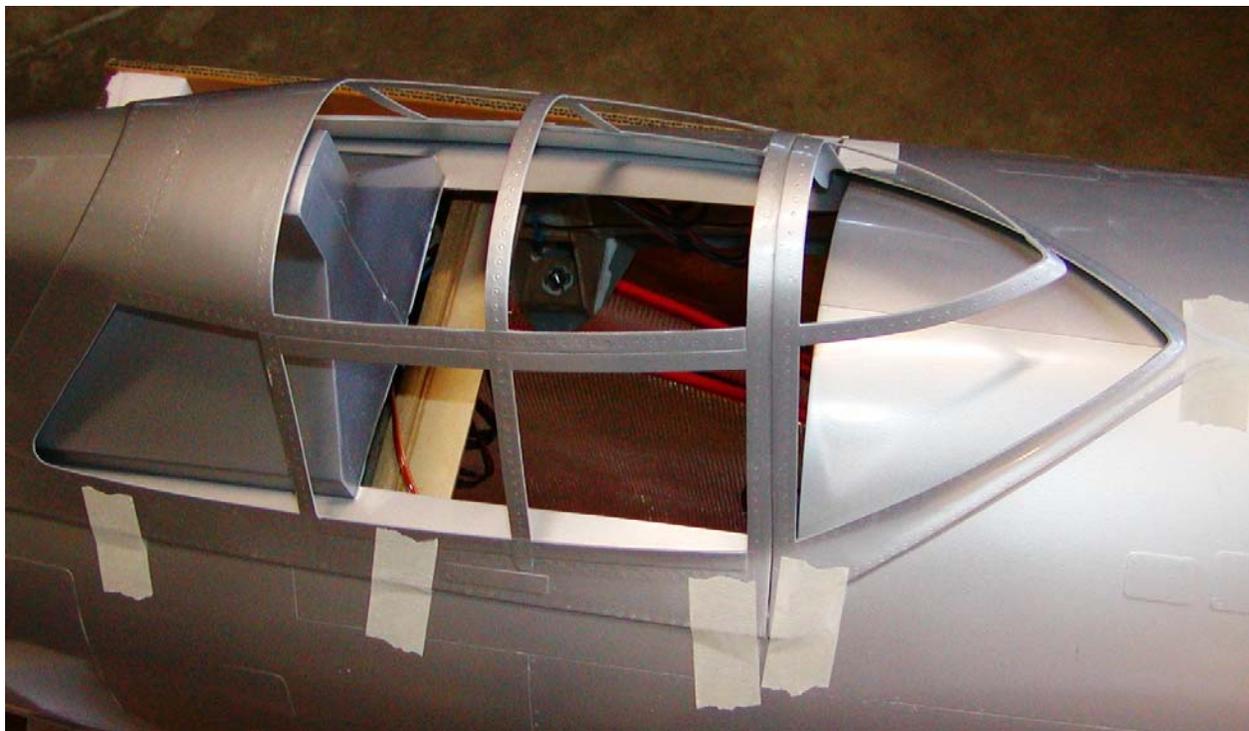
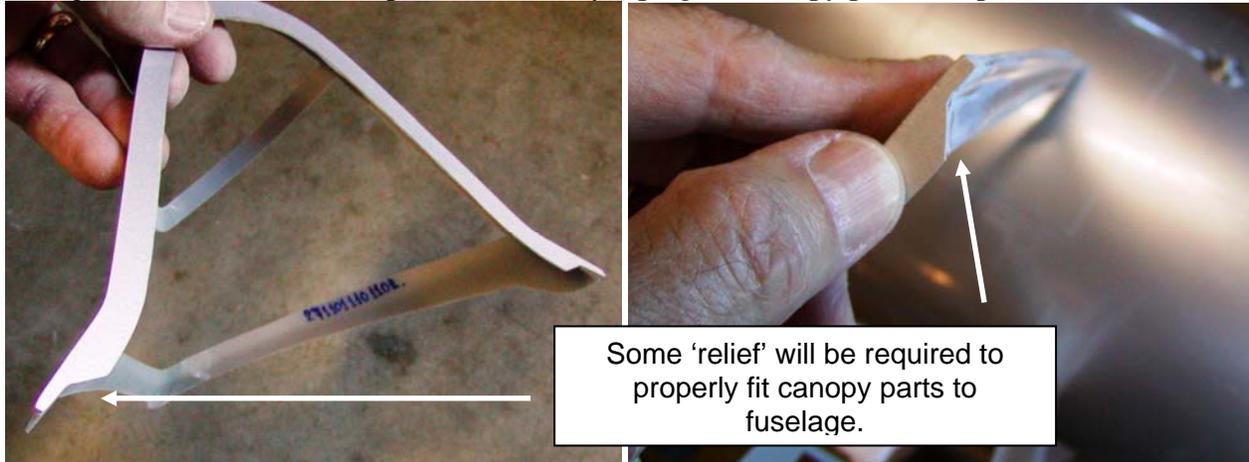


**Canopy**

The canopy pieces require the 'window' material to be removed. This is best accomplished with an abrasive wheel and high speed tool. Use proper eye and breathing protection:



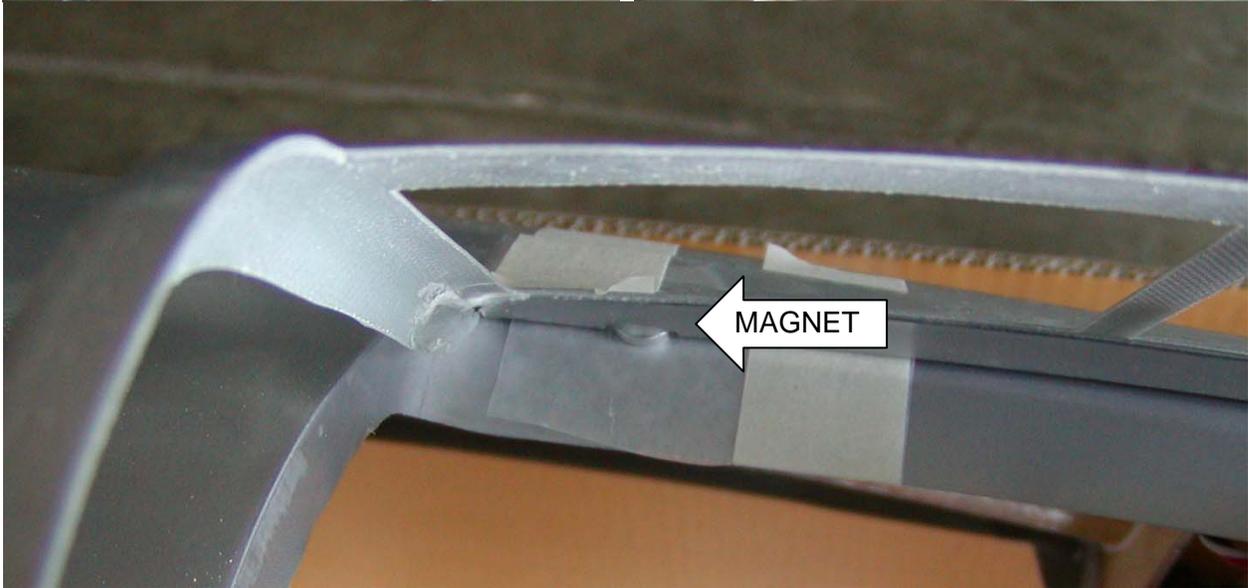
Scale modelers who intend to compete with the Thunderbolt will no doubt want a scale sliding canopy mechanism. There are several online articles as well as companies that offer hardware designed to create a sliding canopy. The following is one option that eliminates the complexity of canopy rails, yet achieves the OPEN/CLOSED positions while making the canopy readily removable for painting or cockpit service. Using “Rare Earth Magnets” @US the canopy can be configured to simulate scale operation. Start by taping the canopy parts into position:

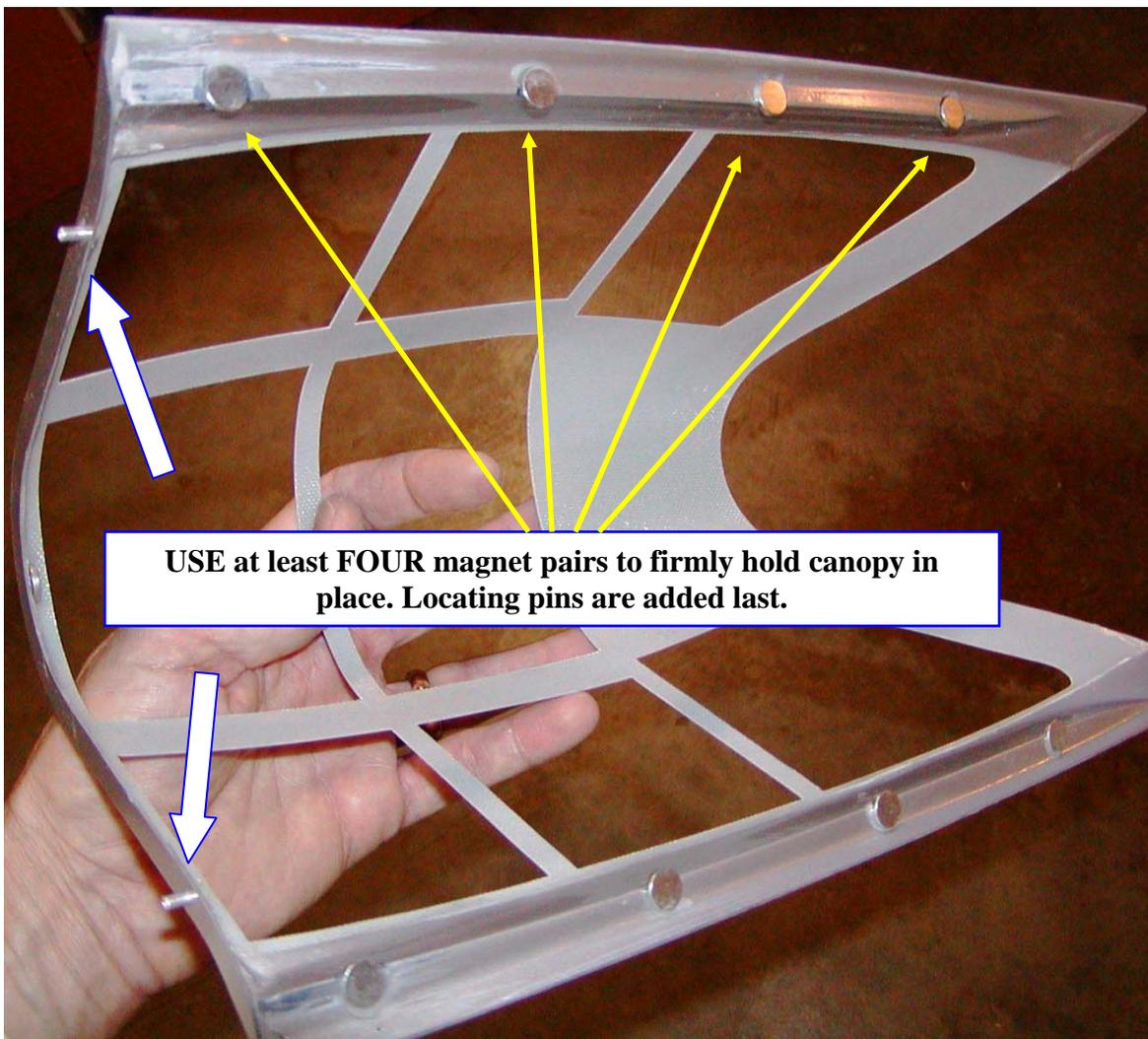
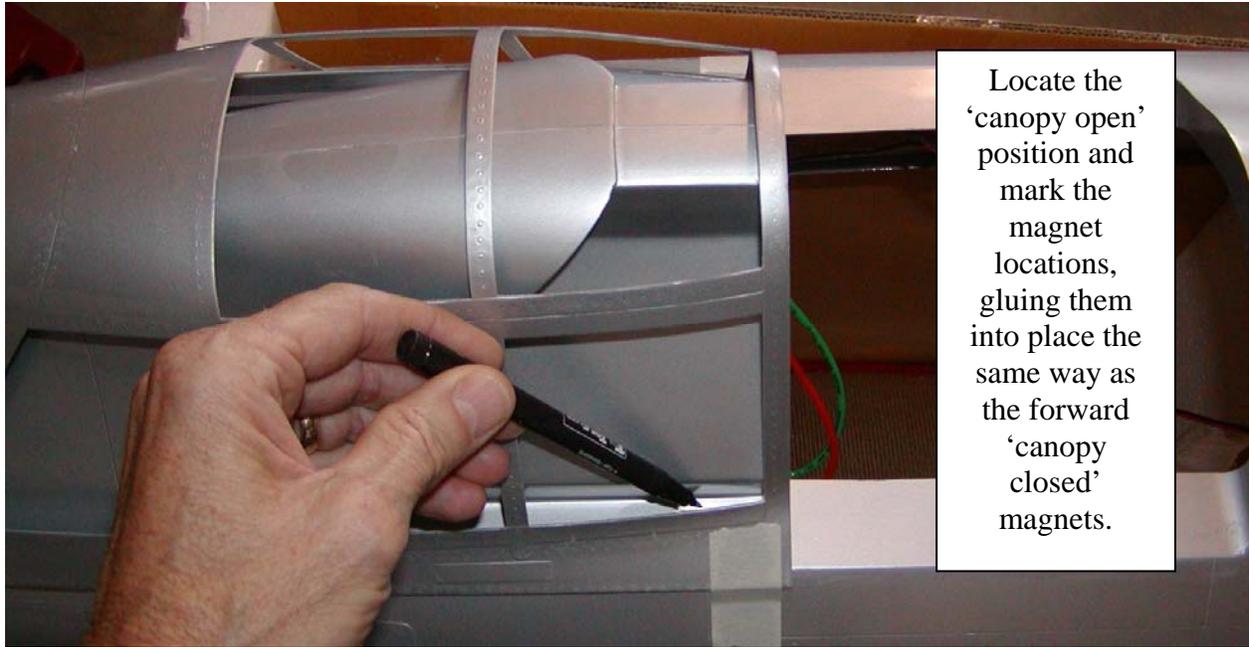


Using the same type of small round rare earth magnet as were used for the fuselage Service Hatch, mark the location of the magnets then remove canopy material so that magnet will fit “flush” (even) with the surface of the canopy.

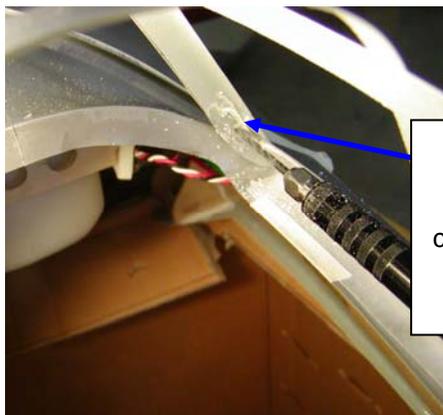
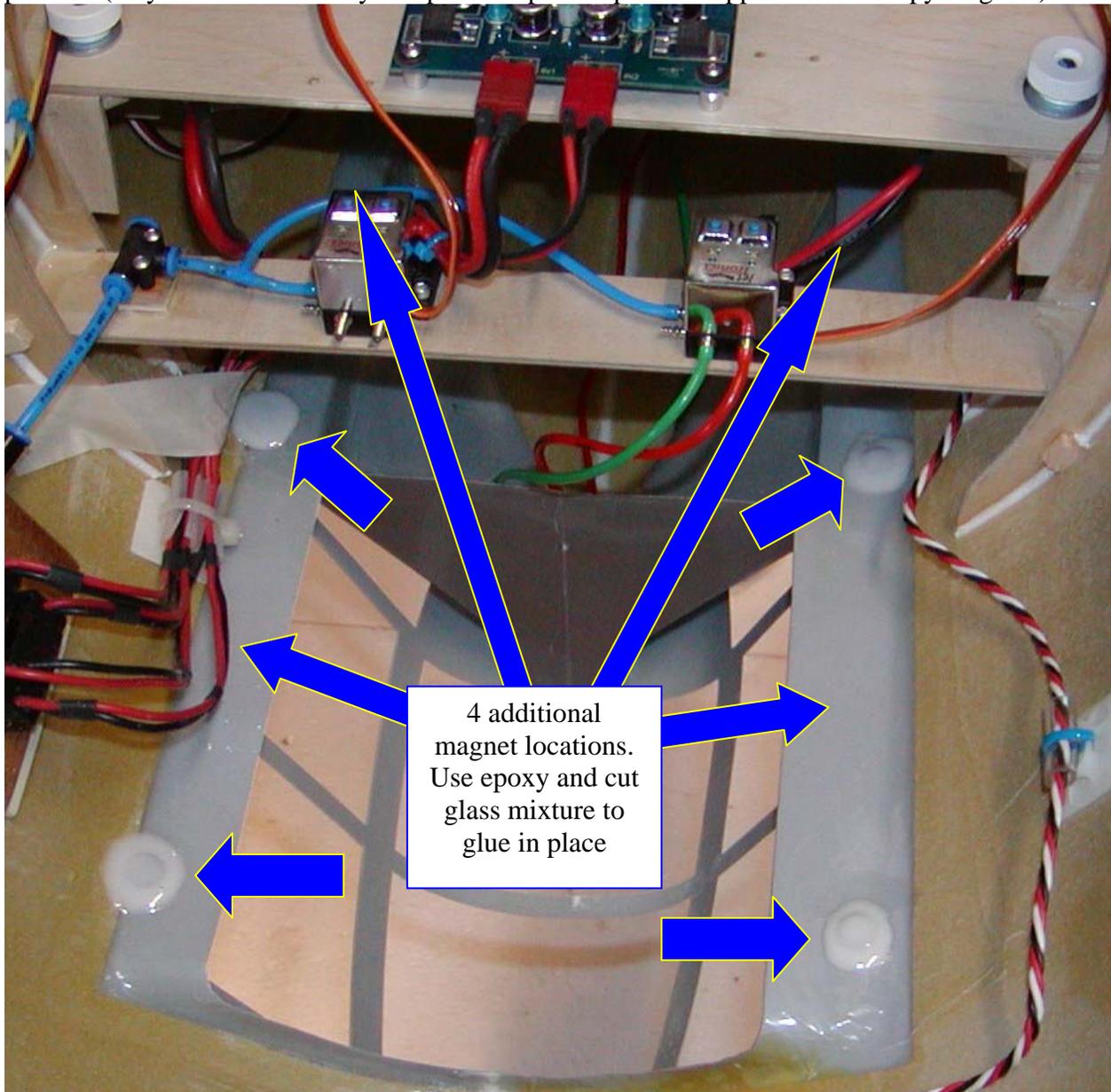
The magnets are then glued into position using a mixture of 30 minute epoxy and cut glass. **BEFORE GLUING**, magnets and gluing surfaces **MUST** be cleaned with Alcohol or other solvent to achieve a clean surface and superior bond.

Magnets are positioned by placing opposing magnets on the underside of canopy. Canopy frame is taped firmly in place while epoxy sets.

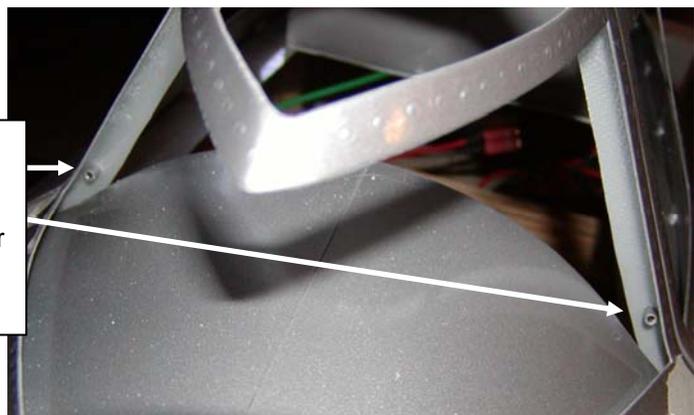




With the canopy frame firmly taped into position, the opposing underside magnets are glued into position (they will automatically 'snap' to the perfect position opposite the canopy magnets).



Drill through front canopy for locating pins



Using small metal tubes, rods or wooden dowels as a guide, drill through front canopy frame for locating pins. The pins are then epoxied into place. Trim canopy clear plastic to fit. IF painting canopy frames, do it **BEFORE** gluing clear plastic window material in place. **Always position and glue canopy parts with canopy in position. This assures proper fit.**



Use RC-56 @US or other clear drying, water clean up, multi-purpose glue to adhere the clear plastic to canopy frames. A mixture of epoxy and cut glass can be used around the plastic and canopy frame edge for a more solid bond if desired.



**NOTE:** Find [Canopy addendum](#) at end of manual

## Finishing

There are many finishing methods; each modeler has his own preferences; and the level and accuracy of finish detail is dependant on each modeler's subject aircraft. Whether or not you aspire to compete with your CARF P-47, an accurate finish should be integral to creating a truly miniature version of your favorite Thunderbolt.

The surface detail of the CARF-Models P-47 lends itself to some very easy 'weathering' techniques that will add a great deal of character and realism to your finished project.

ACRYLIC paints are offered by several manufacturers; Testors Model Master @US acrylics were used on the aircraft shown on the following pages.

Acrylics offer several advantages:

- They are water-based, and so do not create a toxic cloud in your shop or paint booth.
- They are very easy (water) clean-up.
- Can be thinned with isopropyl alcohol for Air brush application, and thus, dry very fast.
- Result in very little overspray
- They are not 'weather-dependant' – i.e. you can paint in cold, damp weather
- Extremely opaque and the resultant pigment adds negligible weight
- Very easy to 'weather' \*\*
- The Model Masters @US line of Acrylic paints offers accurate military colors
- Paint 'touch ups' are virtually invisible



The disadvantages:

- \*\*Acrylics are not very durable or fuel proof, and so must be clear coated. However, this lack of 'durability' allows you to scrape them, scratch them, smudge them, and utilize their flexible characteristics to great advantage when creating a realistic "weathered" finish

## Surface prep

Wipe down all surfaces with a water-based degreaser (like Simple Green@US), followed by a thorough wipe down with isopropyl alcohol. The aircraft surface should be absolutely clean and dry before painting. Mask off the areas for painting using a quality auto body flexible tape and/or blue painters tape, making sure the tape is firmly applied with no gaps. Protect the aircraft from overspray using newspaper or other scrap paper. The paint should be applied in several coats avoiding excess paint or build-up at the masked edges. A heat gun can be used to dry the paint between coats (a great advantage of acrylics). Once applied and dry, the tape should be removed carefully, peeling it back on itself to reveal a clean edge.

If additional masking / colors are to be applied, BE VERY CAREFUL not to peel up previously applied paint. Acrylics do have excellent adhesion, but a poorly prepared surface will allow almost any paint to lift when masked off for additional painting. It is recommended that a clear coat be applied prior to additional masking and painting. However, if you intend to 'weather' the aircraft, this must be done PRIOR to applying any clear coat. NOTE: IF you are not an experienced painter, start on something small like the canopy frame.

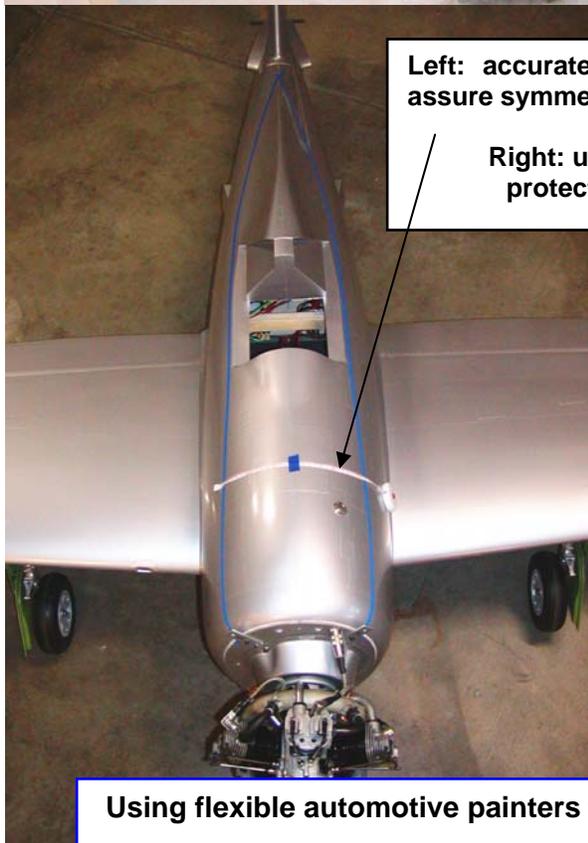
## Weathering

The incredible surface detail of the CARF P-47 allows for very easy weathering. This can be accomplished using 600 grit wet/dry sandpaper and water. Lightly sand raised panels, inspection hatches, rivets, Dzus fasteners and screws. The affect can be as dramatic or subtle as your

documentation or our personal preference requires. An abrasive ‘Scotch Brite’ pad is used to ‘burnish’ areas of high wear or heat and is perfect for giving the shiny silver topcoat a more realistic, dull, ‘scratched’ finish; the type of wear and tear that occurred in the harsh conditions of battle. Remember, the Ground Crews of WWII were usually not concerned with how “pretty” their aircraft appeared and thus, would use whatever solvent was available to clean the aircraft’s surface, even including aviation gas! This did not improve the metal finish! On the contrary, this made the finish dull, scratched and stained... but of course the end-result is dependent on your choice of subject and interpretation. The following illustrates the painting process and should help inspire you to create a realistic finish. **NOTE:** another advantage to water-based acrylic paints: IF you do not like what your result, wipe it off before it sets up and try again!



Experiment with something small...like the canopy frame. At right, notice the effect of lightly sanding surface with 600 grit wet/dry



Left: accurate measurements assure symmetrical layout  
Right: use newspaper to protect from overspray



Using flexible automotive painters tape to mask ‘anti-glare’ area on fuselage.

600 grit wet/dry sand paper is used to great affect in allowing surface detail to appear. **DO NOT OVERDUE** IT. It is the subtle illusion of weathering that adds greatly to the realism of your airplane.

IF finishing your aircraft for scale competition, it is critical that you duplicate your documentation. Just because it 'looks good' does not translate to a higher static score... it must mimic the full scale subject as accurately as possible.

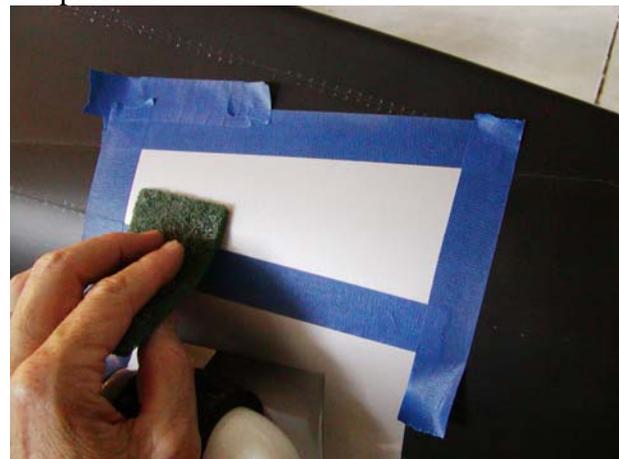


If your subject aircraft has a bare metal finish (and is not a polished museum exhibit), you can create the look of a “used” metal finish with an abrasive pad. The most common type is “Scotch Brite” – sometimes referred to as “scruffy pads.”

By taping off individual panels then lightly scuffing the surface of the shiny silver topcoat, you can create a ‘field worn/battle worn’ “used” appearance.

Scuff the finish in the direction that wear would most likely occur. Vary the pressure used on different panels and even different areas of the panel so that the appearance is non-uniform.

You may choose to do every panel, or leave some panels alone. The scale affect is dependent on the subject being modeled as well as your individual preference.





Some modelers may choose to “scuff” or “burnish” the bare metal finish prior to painting. The overall effect is quite realistic.

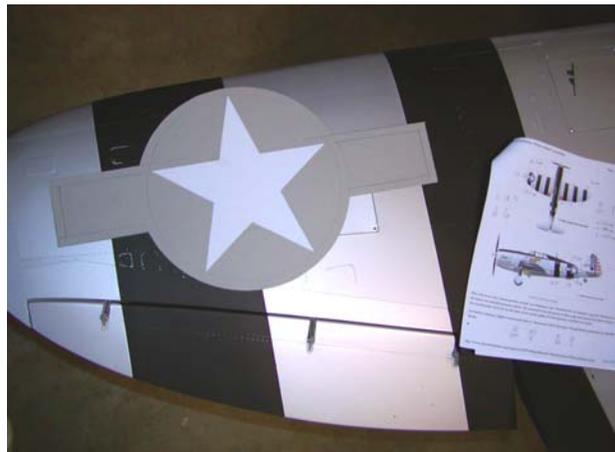
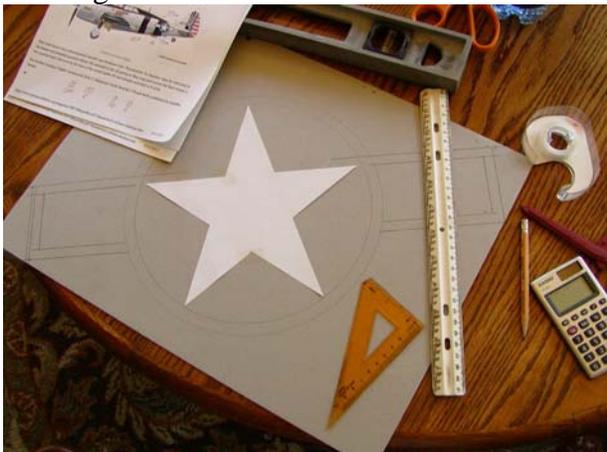


IF you do not possess the skills to apply a quality finish, you should pursue the help of an experienced scale modeler. A project such as your Thunderbolt deserves a quality scale finish. DO NOT rush this very important step as you will be stuck with the results, good or bad. Remember that no matter how much time and effort was put into your build, THE FINISH makes the final statement about your airplane. IF you lack detailed scale documentation, some liberties must be taken. Imagine the wear and tear you might observe on a full scale warbird on ACTIVE duty in primitive conditions. Would the paint be faded or worn? Would it be chipped and scratched? Would you find areas of rust or other stains? Again, this is subject to your interpretation and one area where you can express your artistic skills.

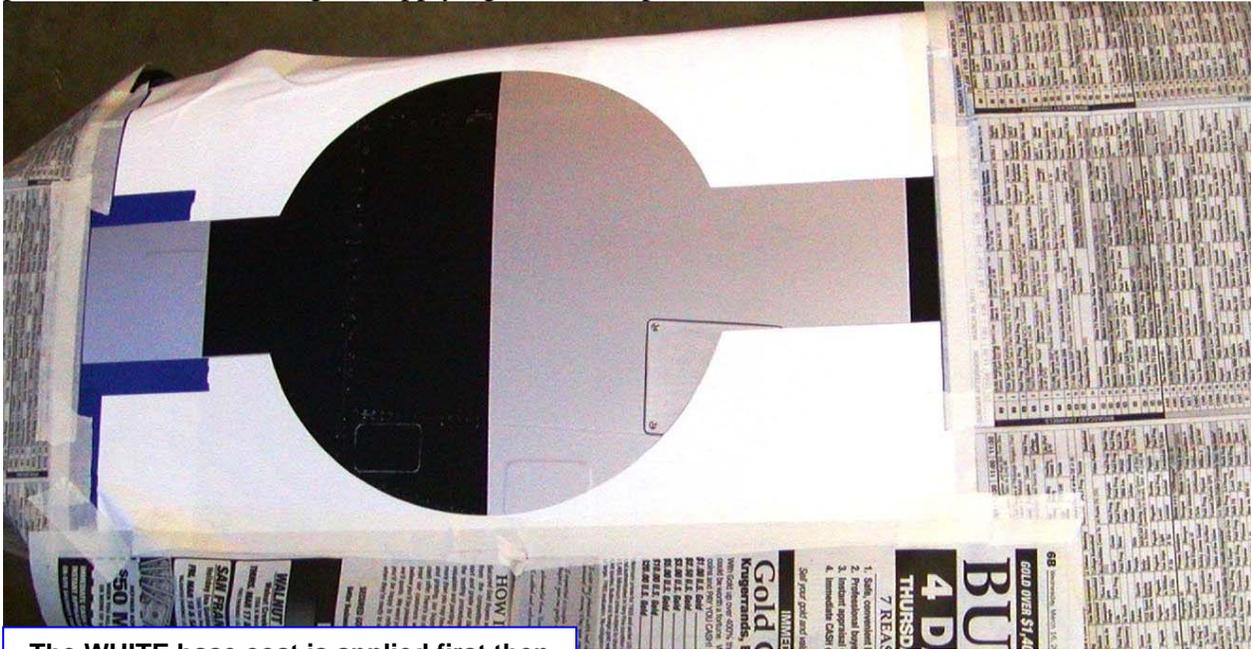


**Making Stencils**

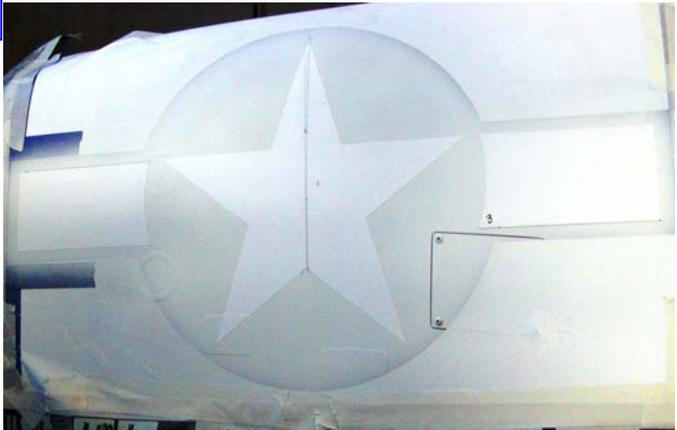
The best material for making stencils is known as Foto/Frisket Masking Film Airbrush Graphic paper @US. Common sticky-backed “shelf” paper may be used, but be sure to test to verify its adhesive will release from your work cleanly and without damaging the finish! Begin by calculating the correct size and placement for you subject markings. Create a stencil from thin cardboard or heavy construction paper and check for proper size on the model, then trace the markings onto the Frisket film.



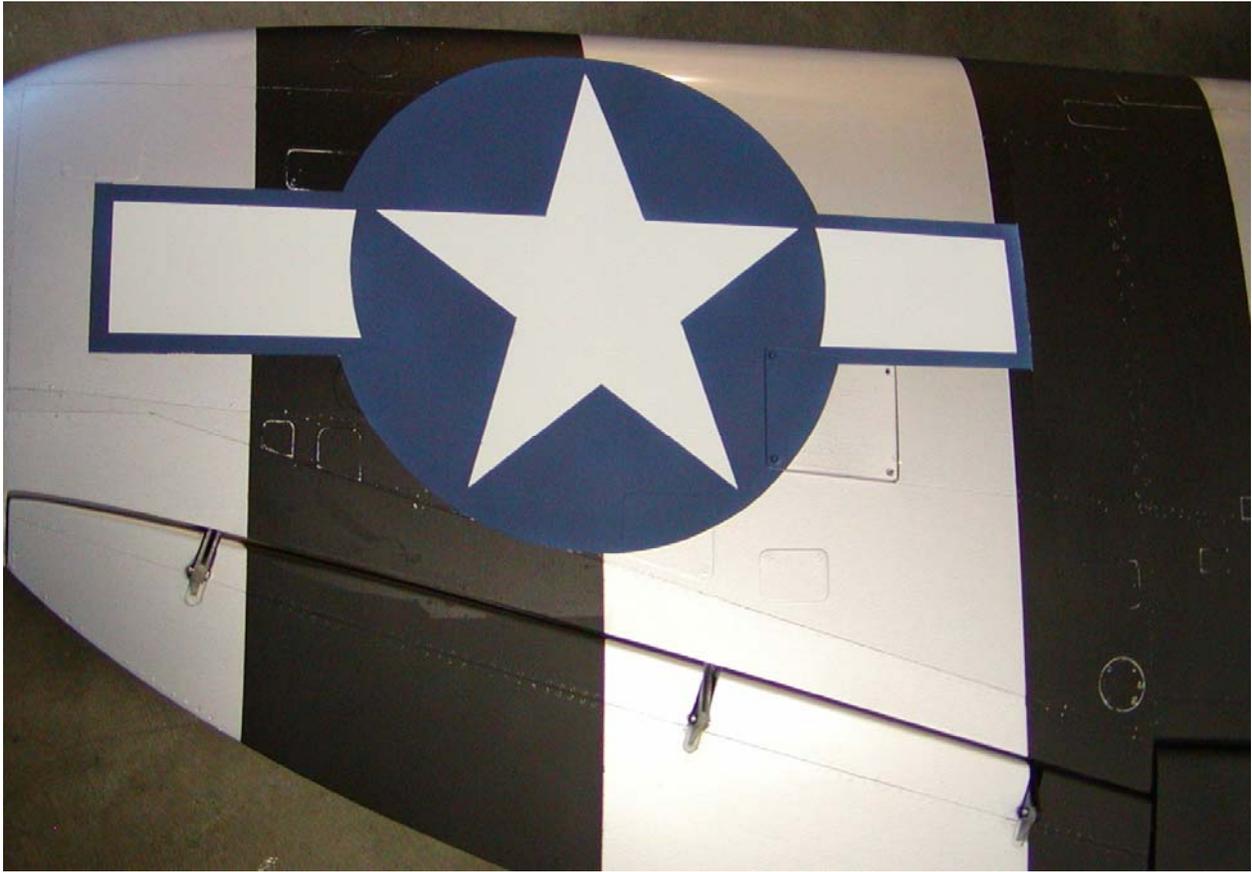
Apply the sticky-backed Frisket @US to the area you wish to paint, making very sure the edges are well sealed to the surface. It is advisable to first lightly clear-coat any previously applied paints BEFORE masking and applying additional paint colors.



The WHITE base coat is applied first then star and bar stencils are affixed



The stencils can now be very carefully removed to reveal your completed marking! These same techniques can be utilized for creating other authentic markings on your aircraft.



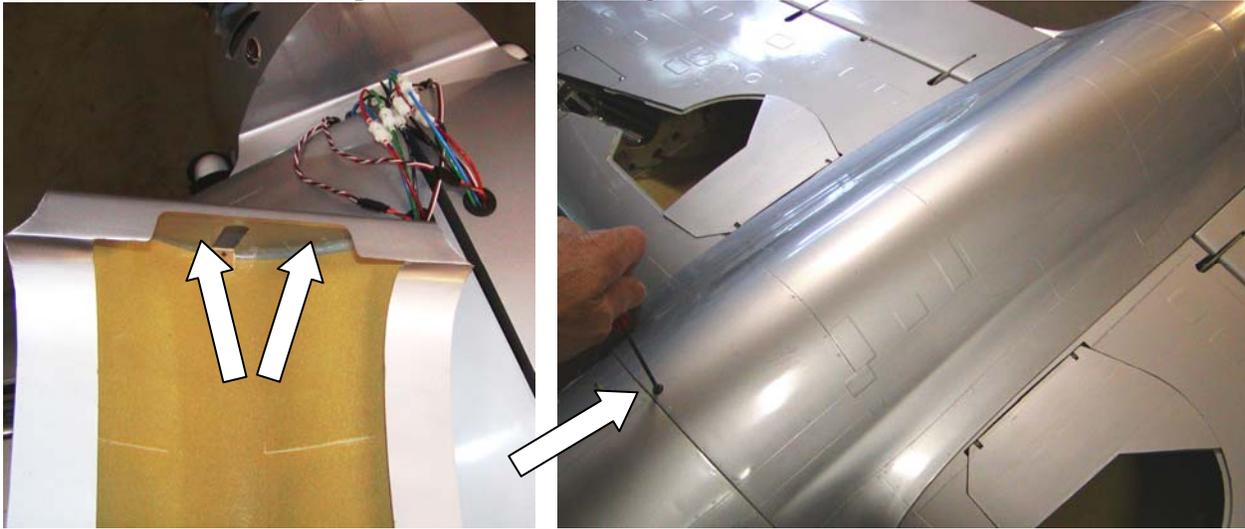
The '120' was created by painting over vinyl markings then carefully removing them, leaving the bare 'metal'



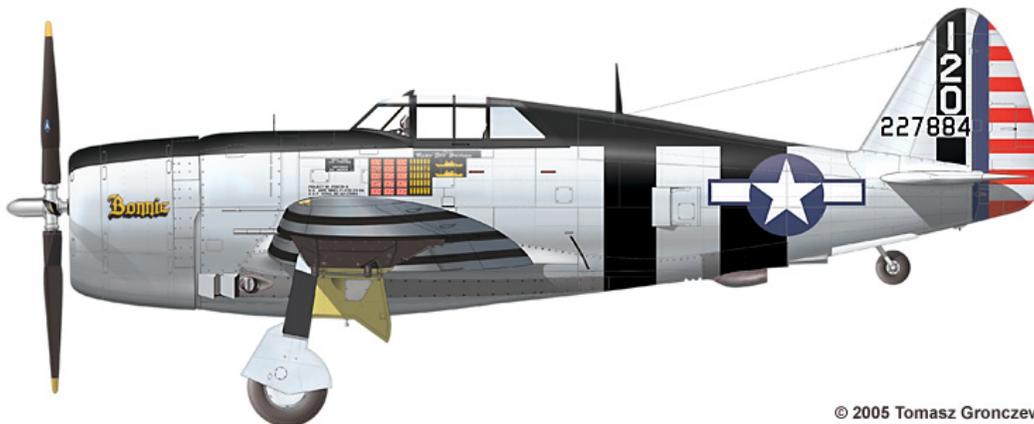
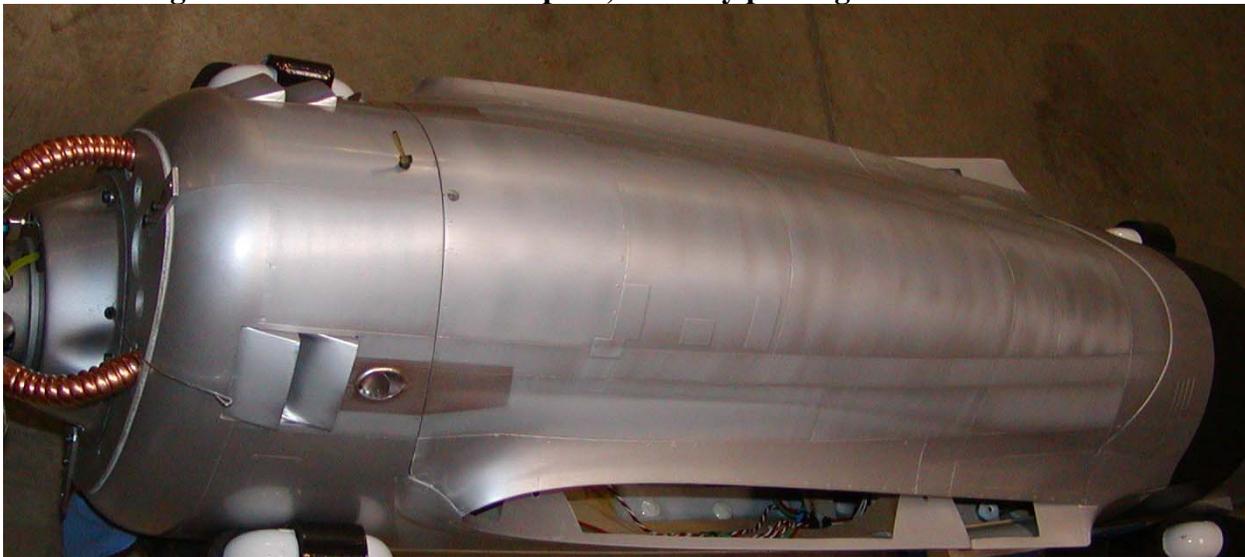
You never actually 'finish' a scale airplane... you just decide that it is time to stop ☺

**Belly Pan**

Using an abrasive cutting wheel and sander, remove material from the belly pan to clear the air lines and servo cables. The pan attaches with a single bolt.

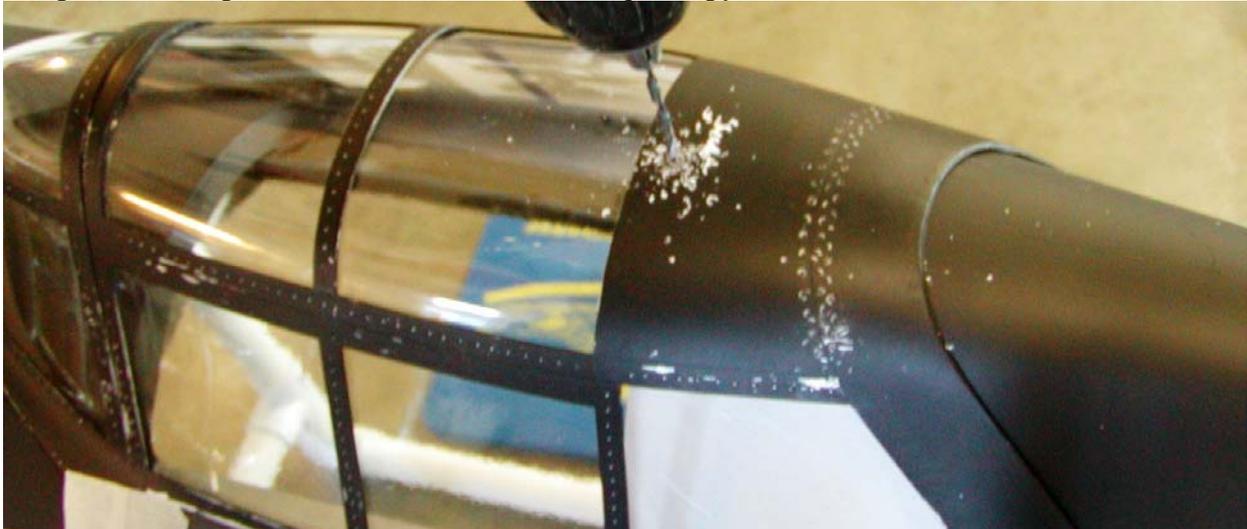


Using the abrasive Scotch Brite pads, the belly pan is given that “used” look.



**Canopy - addendum**

Upon further consideration, it was decided to add a single retention bolt to the canopy. While no flight tests were conducted using only magnets and locating pins, careful attention to *potential* mishaps dictated the additional security. Magnets have the advantage of simple installation, easy canopy opening and complete canopy removal. Again, it is assumed that a serious scale competitor will opt for some form of scale sliding canopy mechanism.



A black anodized button head machine screw (6-32) and brass threaded insert @US were used to secure the canopy. Once threaded to the correct depth, the brass insert is secured with a drop of CA glue.

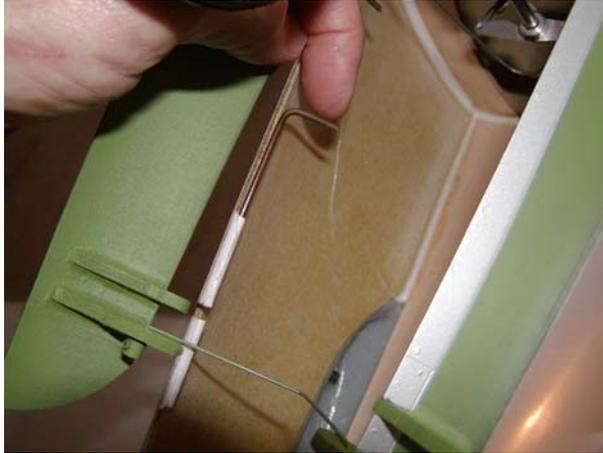


The addition of the bolt is hardly noticeable.



**TW gear doors - addendum**

The gear door hinge pins are not glued at the factory to allow the builder to remove the doors for painting. It is also recommended that you remove these hinge pins and lubricate them for easier gear door actuation. When you no longer need to remove the gear doors, glue the hinge pins so that they cannot come out in flight.



**Scale exhaust cooling – addendum**

It is recommended that you open up the firewall near the scale exhaust tubes to allow cooling air to enter the nose of the aircraft. The heated air can then exit the oil cooler openings. **BE SURE** to remove ALL dust and debris! **Your engine deserves only CLEAN AIR!**



## **Balance and Flying**

The airplane balances at 25% of cord at the wing root. Measure back from the leading edge 15.5 cm - This is the correct location of the Center of Gravity. Achieve the proper CG by shifting components inside the aircraft. Battery Packs are generally the heaviest items and can be positioned to achieve proper balance. A “worst case scenario” will require the addition of nose or tail weight to arrive at the proper CG.

**DO NOT FLY UNTIL CORRECT CG HAS BEEN ACHIEVED!**

## **Control Throws**

Ailerons and Rudder are mechanically limited by the aircraft structure and should be set for maximum travel without binding. Flaps should be set for maximum deflection, assuming the flap pushrod is on the outermost hole of the flap servo control horn (as pictured in the manual). Flaps should also be set up on a proportional channel on your radio so that any flap setting can be dialed in. Elevator travel is set to 2 cm up and 2 cm down.

## **Engine**

It goes without saying that your engine must be 100% reliable. If using the 30 inch 4-blade carbon fiber propeller, set maximum RPM on the ground to 3800. This is achieved by adjusting blade pitch angle for the proper engine load. IF the engine is not loaded sufficiently via correct propeller pitch, you risk over-revving the engine and throwing a pushrod in the air.

**Idle, transition and top end must be 100% reliable on the ground. It WILL NOT IMPROVE in the air!**

## **FLYING the THUNDERBOLT**

IF using a 100cc or 120cc gas twin, standard set-up and tuning procedures should be used to achieve reliable operation.

Assuming you are using a Moki 250 and 30” CARF 4-blade propeller, the engine/propeller combination should be tuned to spin no more than 4000 rpm on the ground – 3800 rpm is optimal. This is achieved by adjusting the blade pitch; using the Solo prop hub, set the pitch to 14” and test.

Testing your propeller set-up will require balancing the prop/hub combination as well as adjusting the tracking of the propeller tips to make sure they are as close to aligned as you can achieve. The proper pitch adjustment must LIMIT full throttle ground rpm to less than 4000! All of this is REQUIRED if you are to achieve a reliable scale powerplant. Improper balance or tracking will create excessive vibration. Over-revving the engine can cause it to lose a pushrod at full throttle!

The Moki 250/4-blade propeller will produce incredible static thrust capable of rotating the aircraft in less than 100 feet. Once airborne, retract the landing gear, reduce throttle to approximately 60% and check for proper trim. You should trim the aircraft for hands-off flight at a reduced throttle setting, then fly it through its full range of power settings to determine if it has any tendency to pitch up or down.

The Thunderbolt handles very predictably and all flight surfaces are very effective. Although the finished aircraft will weigh approximately 25kg (50 pounds), it remains fully controllable through a surprisingly broad flight envelope.

Allow yourself plenty of altitude until you become familiar with the aircraft’s handling. Try slow flight with and without flaps to check their affect.

When ready to land, the Thunderbolt is flown through a traditional landing pattern. Half flaps may be deployed during the downwind leg of the pattern to begin slowing the aircraft. You should not notice any tendency for the aircraft to pitch up when flaps are deployed at a reduced speed. On the base and final legs, the flaps should be fully lowered; decent/attitude is adjusted mostly by varying throttle settings. You will notice at full flaps that the aircraft pitches down – this is easily compensated by feeding in a small amount of up elevator. Decent will be very controllable and airspeed will be noticeably reduced. Fly the aircraft all the way down to the runway, keeping some power applied until the wing has stopped flying; only then should you pull completely off the power. That big 4-blade propeller will act as an ‘air brake’ at low rpm – keep this in mind when throttling back for landing.

Due to its rugged undercarriage, wide gear stance and thick wing, the Thunderbolt is more docile than most other WWII fighters, both on the ground and in the air. IF you have built yours with care and attention to detail, you should enjoy many, many sorties with the “Jug.”

*Off we go into the wild blue yonder,  
Climbing high into the sun;  
Here they come zooming to meet our thunder,  
At 'em boys, Give 'er the gun! (Give 'er the gun now!)  
Down we dive, spouting our flame from under,  
Off with one helluva roar!  
We live in fame or go down in flame. Hey!  
Nothing'll stop the U.S. Air Force!*

