

# HAWKER TEMPEST Mk II

## INSTRUCTIONS

Thank-you for choosing the 2001 version of the Hawker Tempest Mk II. I have made significant improvements to the building time, ease of assembly and wing loading, over past versions. I am confident that you will enjoy all aspects of building, flying and owning this model.

For 2001, the model is available in two different versions.

The sport version is a versatile model that can be framed quickly by keeping it simple, or dressed up with a variety of options, such as fixed, or retractable landing gear, functional rudder, and scale details such as wing fillets, wing radiators, guns, bombs and exhaust stubs.

The combat version is a more economical, slightly tougher version intended for competition combat, or other use where the scale details are not wanted.

The minimum glow power that is recommended is a powerful .15, and the maximum a "hot" ball-bearing .32 or .26 to .30 4-stroke. A .40 4-stroke will fit, if you push the firewall back, but you don't need the power, and will be penalized in weight.

For electric, I recommend an 035 to 05 gear-reduced electric, on 8-10 cells. Any combination that will swing a 10 X 8 APC at 8,000+ RPM, or an 11 x 8 or 9 at greater than 7,000 RPM will provide good power. I prefer to use 10 cells to maximize duration. Most e-flying is done throttled well back. Cruise performance is very similar to glow, however, as you use a much steeper pitch of propeller.

While this airplane has immense stability and forgiving handling characteristics, it is not recommended for the novice flyer. Even using the minimum recommended power, this is a **high performance** aircraft that does *what you tell it to* **when you tell it to**, and is capable of flying at *very high speed*.

(Updated by Manzano Laser Works, July 2017)

## **Building**

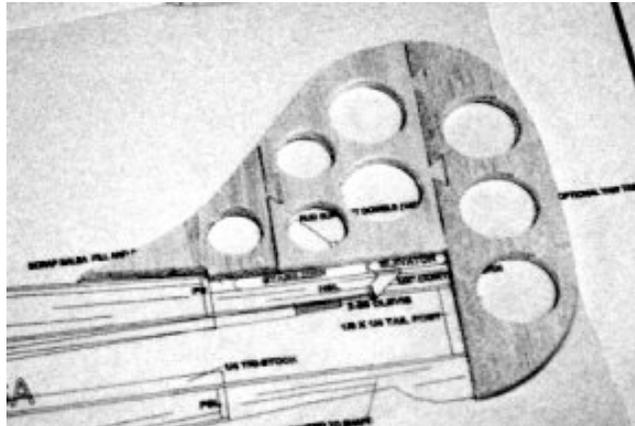
- Try to leave parts in their sheets until they are needed. To remove them simply complete the cuts where the laser cutting has been stopped for a short distance. All pre-cut parts are in **BOLD UPPERCASE** in this manual.
- Resist the temptation to beef up the structure. These things are quite strong enough as is.
- Though tabs and slots are designed to avoid misplacement of parts, always quickly dry-fit a part before gluing permanently in place.
- Should be done on a flat, straight surface, except where noted. Keep parts pressed down for most accuracy.
- Thick, thin and medium CYA glue can be used exclusively, if desired.
- All “glue” steps refer to medium CYA, unless otherwise stated.
- If you wish to cover the aircraft in 0.58 oz F/G, simply sheet the open wing bays with contest balsa.
- Always use appropriate safety practices, and personal protective equipment when building an R/C model
- If you get stuck, visit the FAQ page at <http://members.aol.com/rwdrc>. If the answer is not there, e-mail me at [rwdrc@aol.com](mailto:rwdrc@aol.com) for tech support.
- As this is a series of airplanes, they share many building steps, and I will occasionally share photos in this manual. Don't worry if the picture doesn't exactly match your kit. The steps will be the same.
- In the combat version, not all parts are labeled, and not all names are the same as the sport version. The manual is based on the sport version.
- The upper view of the fuselage plans does not match the parts exactly. I revised the parts a bit after the plans were produced. Don't worry about it, as you do not build directly over the fuselage plans. They are simply a reference that tells you where each part goes in the assembly
- **WM1-SPACER** has the name **WM1-LOC** etched on it (sport kit).

**NOTE:** The kit produced by Manzano Laser Works is the “sport” version. Please ignore any special instructions for the “combat” version.

## **Tail Section**

E1) On a flat surface, protected by waxed paper, glue **VS1** and **VS2** together. If you want a fixed rudder, also glue **RUD** in place. If you want a movable rudder, simply proceed with hinging and beveling. Using an appropriate sanding block, sand the outer edges of this assembly to a round contour. Set this assembly aside, for now.

*Note: The parts have been updated since the photo was taken.*



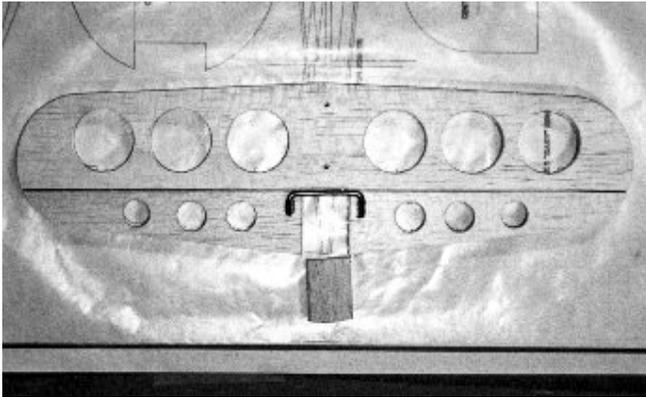
Vertical Stabilizer assembly

E2) Cut matching hinge slots on the front of the left and right **EL**, and rear of **HS**. Test fit using the hinges, but no glue.

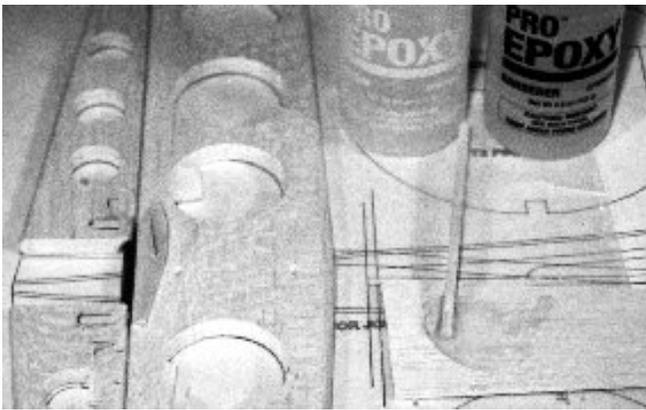
For the **sport** kit: Using the supplied 3/32 **ELEVATOR JOINER**, mark the locations required for matching holes in **HS**. Drill the 3/32" holes for the ELEVATOR JOINER, and remove a channel for the wire from the leading edge of each **EL** from these holes, towards the center of the airplane. Test-fit joiner wire. Remove from plans, take out the joiner wire, and saturate the holes with thin CYA for strength.

Sand a bevel on the leading edge of the **EL**'s, using an appropriate sanding block. Place waxed paper or plastic food wrap on the plans, and around the back of the horizontal stabilizer, and place it over the plans. Epoxy the ELEVATOR JOINER in place while dry-fitting the halves to **HS**, using the hinges as guides. Allow to cure and remove from plans. Wrap 1" sections of ~2 oz. Fiberglass cloth around leading edge of **ELEVATORS**, to reinforce the joiner wire area. Sand all outer edges to a rounded shape.

For the **combat** version: Start by beveling leading edges of **EL**'s, and then proceed as in the above paragraph, but using a 1/4" dowel, rather than the wire. See photo on next page.

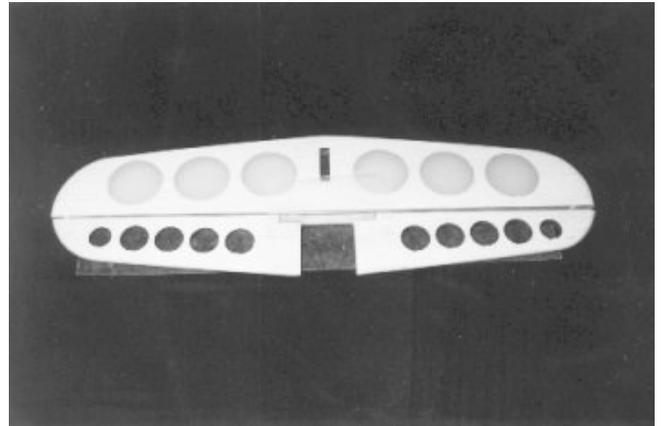


Marking joiner wire position



Epoxying joiner wire in place

Note: Shape of tail planes have changed to become more scale. Assembly steps have not changed.

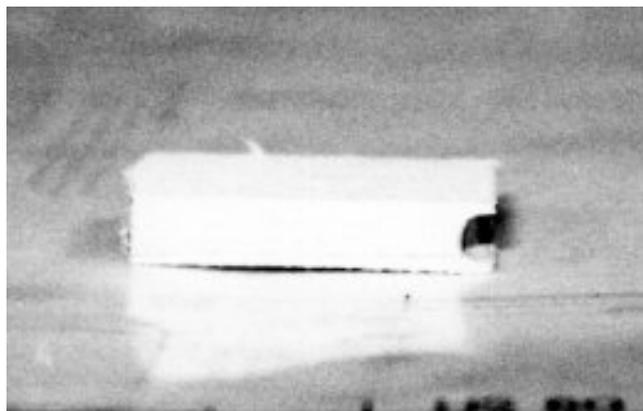


Epoxying joiner dowel in place (combat version)  
*Lightening holes have been deleted on this version.*

E3) Sandwich **HS1**, between two **HS1-A's** and glue the assembly together. Round the front slot somewhat, using a round file, to allow freedom of movement for the JOINER WIRE.

*Note: this step is only required for the **sport** version.*

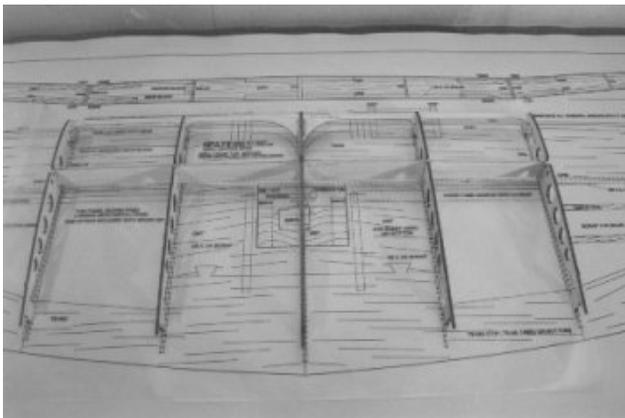
Set aside tail group, for now.



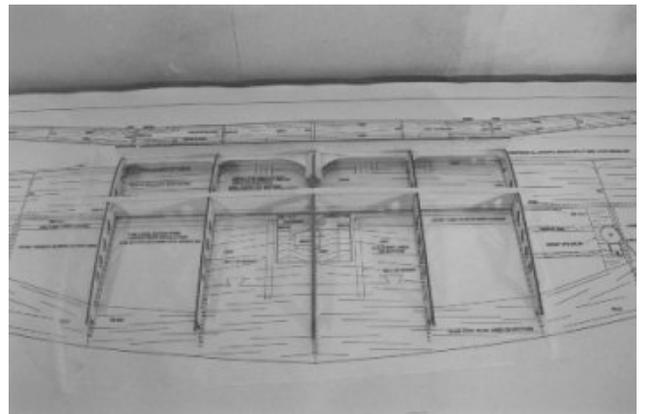
## Wing

Build the wing over the plans with the usual waxed paper, or plastic wrap to keep the parts from sticking to the plans. Tack glue scrap balsa vertically to the jig-tabs to reinforce them during use. Be sure that this won't interfere with **SUB-I/SUB-O**. If using the optional retractable landing gear, skip to the instructions included with the conversion kit, at this point.

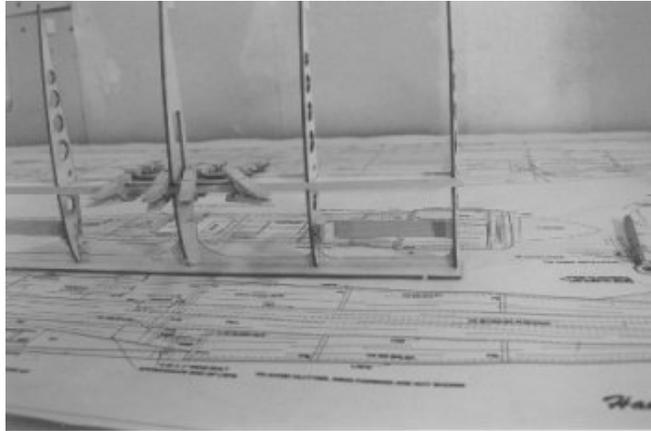
W1) Extend slot at front of **W1** so that **SUB-I** can fit into the front of the rib (later kits will come this way). Dry-fit **W1**, **W2** and **W3A** to **S/W-I**. If building with fixed gear, substitute **W2-LG**, **W3A-LG**, and **S/W-I-LG**. Slide **SUB-I** (or **SUB-I-LG**, if using gear) into the slots at the front of the ribs. Making sure that all of the jig-tabs are in contact with the building table, all of the ribs are aligned properly, and **W3A**'s are pressed firmly against the outer ends of **S/W-I**, glue each joint, using thin CYA glue. Raise the assembly from the table, flip it over and glue in the lower spar beam. There is no dihedral on the bottom of this section, so one 1/8 x 1/4 lower spar beam can go right across. Glue the two pieces (a cut is necessary at the center of the wing) of 1/8 x 1/4 that make the upper spar beam to the ribs. Glue **LE-I** to the front of the ribs, taking great care that it is in contact with the building board for its entire length. Lift assembly from plans, and remove front jig tab from the bottom of **W1**. Brace the joint between **W1** and **SUB-I** with four pieces of 1 1/2" long 1/4 tri-stock, as seen in the second photo below. Trim the very front of these braces to match the profile of the rib. These will form a secure "socket" for the wing dowel, later on. If using gear, cut to correct length, cut anchor blocks from leftover stock epoxy 1/2 x 1/4 GROOVED LANDING GEAR BLOCKS with the slot facing down. While you have the epoxy out, also epoxy **DB1** and **DB2** in place. Tri-stock bracing is not shown on the plans. Re-trace all glue joints with medium CYA..



Ribs, **S/W-I** and **SUB-I** assembled



1/8 x 1/4 spar beams and **LE-I** added. Note 1/4 tri-stock bracing of **SUB-I/W1** joint.



Epoxying in gear block and **DB1/DB2**. Note extensive tri-stock bracing of gear block and anchor block.

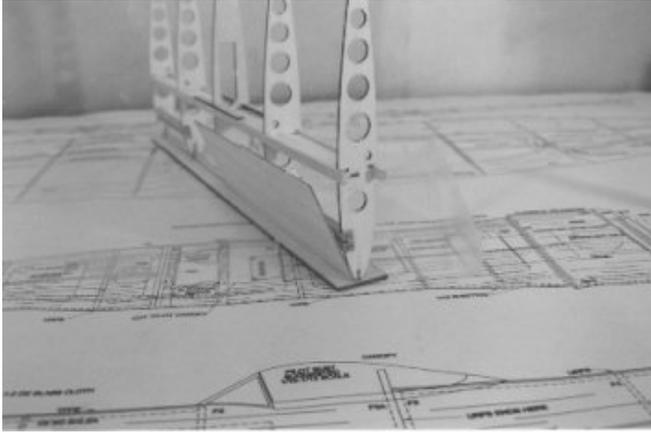
W2) Cut the rest of the jig tabs from the FRONT of the ribs at this time (*DO NOT REMOVE THE REAR ONES YET. YOU WILL NEED THEM LATER!*). Place the wing in a vertical position, standing on **LE-I**. Glue the front of one of the two **BMDS** sheets to **LE-I**. Prior to doing so, identify the front, as the side with no notches cut into it. The notch will be placed towards the middle of the wing, when **BMDS** is glued in place. Use 120 GRT sand paper, laid face up on your bench to sand a slight taper on to the front edge of **BMDS** so that it mates more accurately with **LE-I**. Work cautiously, dry fitting a couple of times to make sure that the fit is accurate. When you are satisfied, glue **BMDS** to **LE-I**, making sure that there are no gaps between **BMDS** and the ribs where **BMDS** meets **LE-I**, and that **BMDS** ends about in the center of **W1**. The rear of **BMDS** will be sticking up, away from the spar beam, at this point. Using a brush, apply some water to the outer surface of **BMDS**, to ease bending, if needed. When this is done, “roll” **BMDS** down on to the ribs and spar, but do not glue yet. Take note of where **BMDS** lands on **W1**, and trim it (if necessary) so that it ends at about the middle of **W1** for the entire distance from **LE-I** to the spar. When satisfied, apply glue to the ribs, allowing it to run down the rib until it meets **LE-I**. Also apply glue to the lower spar beam. If you are using fixed landing gear, you should put glue on the lower surface of the GROOVED LANDING GEAR BLOCK, as well. Working from front to back, and applying pressure evenly, “roll” the sheeting down on to the ribs, and spar (and LG block, if any), and hold it until the glue is set.

Repeat for other half, trimming **BMDS** at **W1**, as necessary.

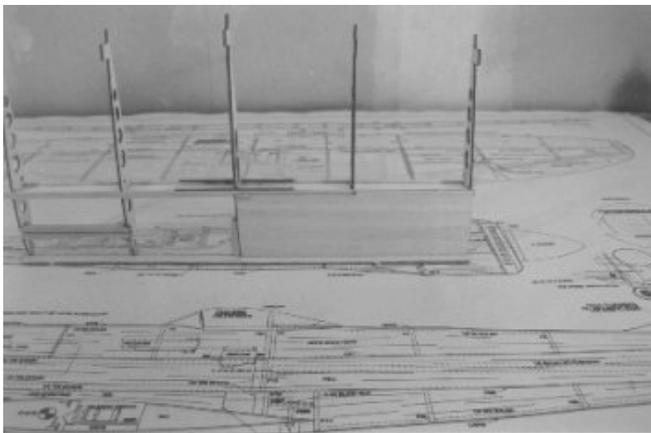
Flip the assembly back to upright, and re-trace all glue joints with medium CYA.

If using fixed gear, drill 1/8” diameter holes down the anchor blocks, and through both the gear block and **BMDS**.

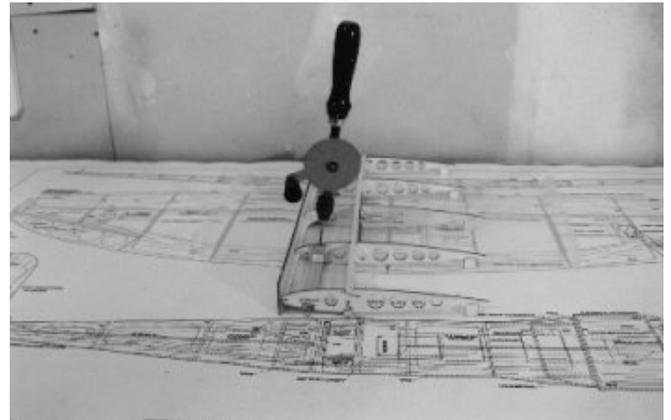
Photos are on next page.



Adding **BMDS**



First **BMDS** glued fully in place

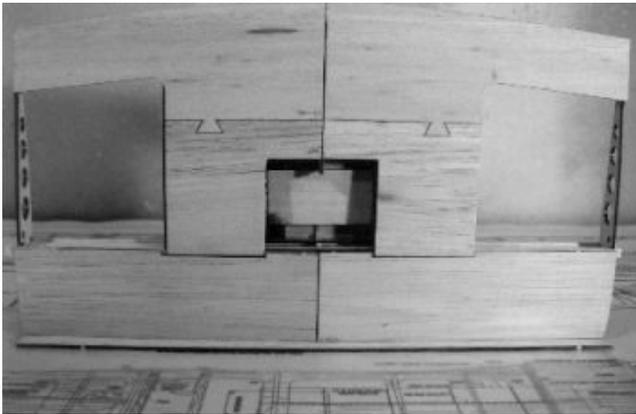


Drilling 1/8 holes for LG wire.

Place the wing section back on the bench. Repeat procedure for upper surface using **TMDS**. Ensure that **LE-I** and rear jig tabs are in firm contact with the building table, while doing so. If you needed to moisten the wood to get it to curve easily down, place weights on the assembly, and allow to dry until the moisture content in the balsa sheeting has returned to its normal level. This last step will keep the wing from developing a warp, while sheeting dries.

W3) Glue **TE-MU** to **CMT**, on a flat surface. Give this assembly a quick, light block sanding at the joint to ensure a flush fit. With the wing on the plans and all ribs aligned well, dry fit this assembly to the top of **W1**, **W2**, **W3**, and the upper spar beam, using the small tabs on top of **W3A** to set the outboard position, and nesting the front of **CMT** into the notch in the rear of **TMDS**. Inboard edge should be aligned with the middle of **W1**. You may have to sand this edge a bit to achieve a perfect fit. When satisfied, glue it in place. Repeat for other half. Double check that **LE-I** and all of the jig tabs are in contact with the building board. If not, use moisture, warping and heat drying until they are.

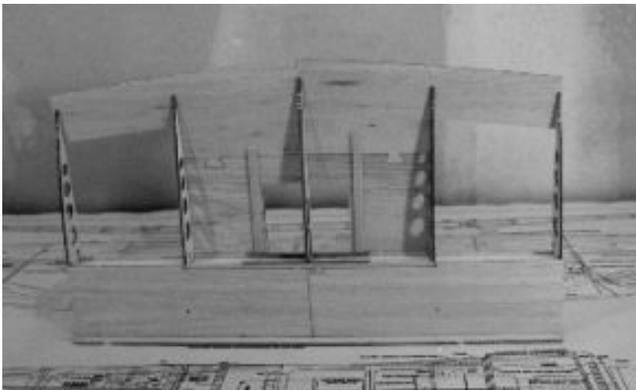
Flip the wing section over, remove remaining jig tabs from bottom of wing ribs. Re-trace all glue joints with medium CYA. Glue 1/8 X 1/4 "scrap" to bottom of CMT/TE-MU to reinforce the servo bay opening, as shown on the plans and in the photo below. Sand a bevel on the lower rear end of the **TE-MUs**. This bevel should be about 1/2" in chord, and, at the trailing edge, **TE-MUs** should be reduced to 1/32 in thickness. Sand a similar bevel on the top rear end of a **TE-ML**, and then test fit it as you did above. When satisfied with the fit, glue it to **TE-MU**, and **W1-W3**, ensuring that they are aligned with each other, and that the resulting joint is straight. Wrap waxed paper around trailing edge, place scrap balsa sheet above and below it, and clamp it as shown until glue is dry. Repeat for other side.



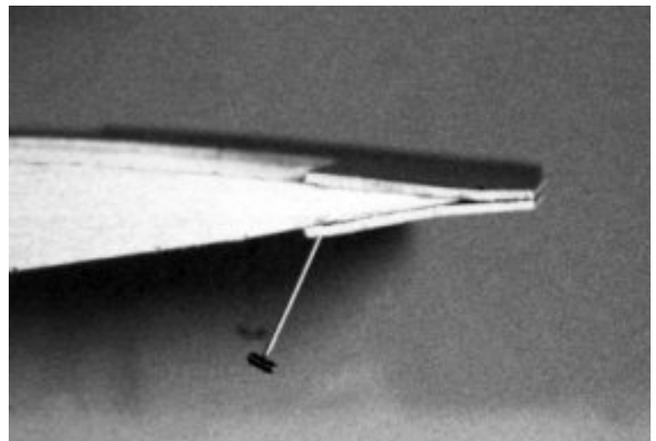
**CMT/TE-MU** in place



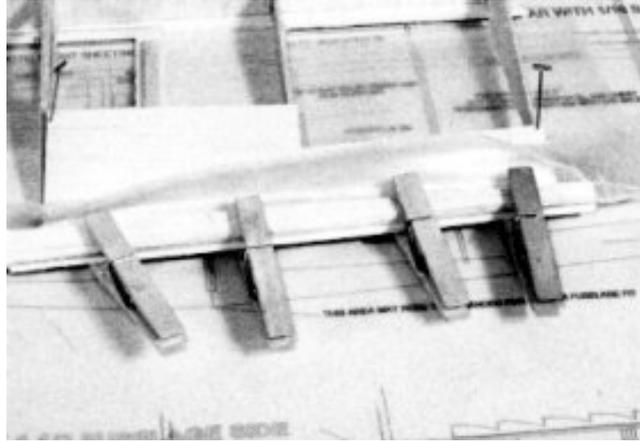
Sanding bevel on underside of **TE-MU**



Note 1/8 x 1/4 reinforcing opening



Resulting trailing edge is straight (does not curve up or down)

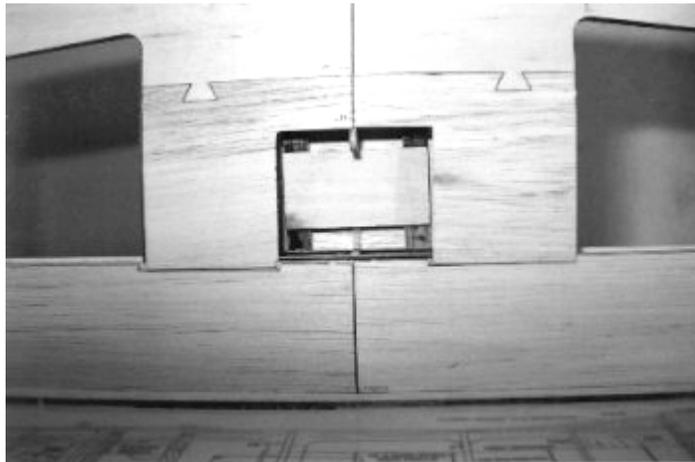


Clamp in place until dry. Note waxed paper and scrap wood to protect trailing edge, and keep it straight.

Complete the sheeting of the bottom of the mid-section (under **CMT**), using some of the 1/16 x 4 balsa sheeting provided in the kit. There is no need to do this in left and right halves, as the wing is flat across the bottom of this section. You can simply sheet right from one **W2** to the other.

Rough trim **LE-I**, using a sharp blade, and cutting about 1/16 away from the D-tube sheeting on the first cut. Save this 1/8 scrap, as you will need it in the aileron bays later on.

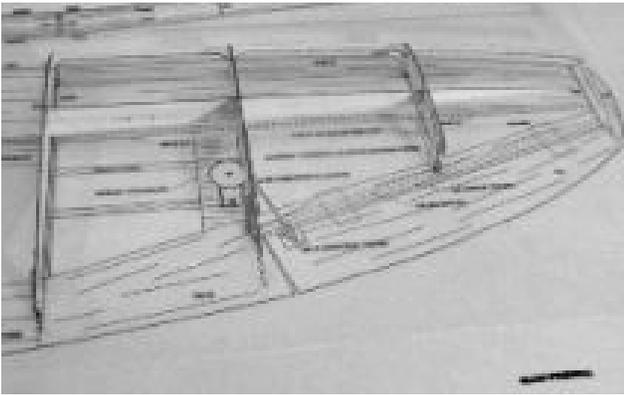
W4) For the sport kit, trim the top of **W1** where it crosses the opening in the top of the center section. Make provisions for securing the servo to **SSP**, and then glue **SSP** to the top of the two **SSPS** pieces. Then epoxy this assembly to the bottom wing sheeting and **W1**, in the place shown on the plans, and the photo below.



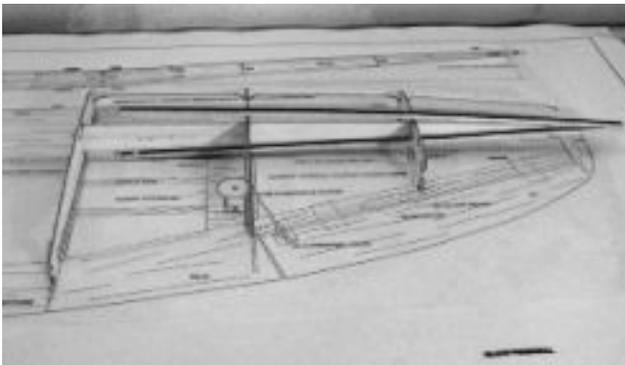
*Note that there is no provisions for the servo mount in this shot, as parts are just dry-fitted*

For the combat kit, roll some scrap paper around a 12 mm or 1/2" diameter dowel to make a servo wire conduit. Use a bit of tape over the seam to make sure it doesn't unravel. Slide it into place in the provided holes, and glue in place.

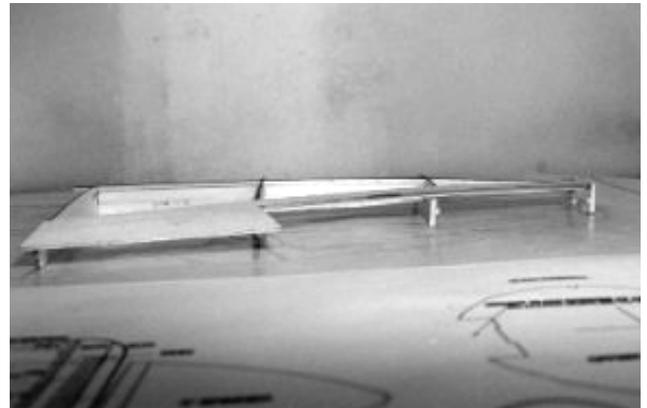
W5) Proceed to the outer wing panels at this time. Start by dry-fitting **W3B**, **W4** and **W5** to **S/W-O**, and then sliding **SUB-O** into place. Place this on to the plans, and align it. Then, using thin CYA, glue all of the joints, making sure that **W3B** is pressed firmly against the end of **S/W-O**. Sliding it on from the outer end of **S/W-O**, glue **OWS** to the ribs and **S/W-O**. Once **OWS** is in place, dry-fit **W6** to the outer end of **S/W-O**, as well as **SUB-O**. Due to production variances, it may be necessary to either shim or trim the end of **OWS** slightly to ensure that **W6** is lined up with the plan when it is fitted. When satisfied, glue **W6** in place, making sure that all jig tabs remain in contact with the building table while gluing **W-6**. On the combat version, where **SUB-O** is made from stiff 1/16 A/C ply, it may be helpful to wet and pre-twist **SUB-O** prior to doing this sub-step to relieve strains caused by the wing wash-out. Carefully sand outer ends of the top and bottom of **OWS** until it is flush with the top and bottom of **W6**. It won't take much, so work gently. Glue top 1/8 sq. aileron spar in place, after tapering the bottom over the last 1 1/2" or so, so that it is about 1/2 the height of **W6** where it meets with it. Install upper **TE-O**, using the tab on **W3B** to locate the inboard end, and lining up the front of **TE-O** with the front of the 1/8 sq. aileron spar at the outer end.



Ribs, **SW/O**, **LE-O** assembled

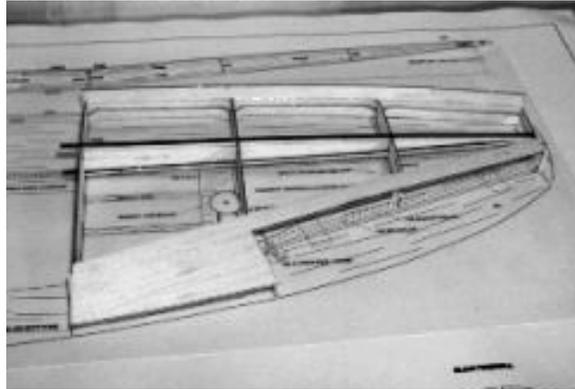


Sliding **OWS** into place



**TE-O** installed - will help hold shape of wing section when **LE-O** is put in place.

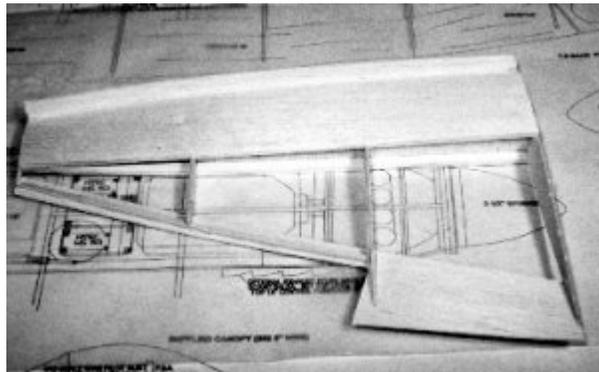
W6)Wet **LE-O**, and pre-curve it to very nearly match the curvature of **SUB-O**, This will ensure that **SUB-O** is not pulled out of shape by **LE-O**, when it is glued in place. You may find it helpful to wet the piece, warp it, and then dry it with a heat gun, holding the warp in it as you do so. Glue it to the front of the wing ribs, and **SUB-O**, making sure that **LE-O**, and all of the rib jig tabs are in contact with the building table. Lift assembly from board, and sheet bottom of wing from spar forward, using **ODS**, and the exact same technique used in the wing center section.



**LE-O** installed. Ready for **ODS** installation.

W7)Place back upright on the plans, and, with the wing weighed down on the jig tabs, and ribs aligned with plans, install upper **ODS**, using the same techniques used for the center section. Check and/or correct for warpage, as done for the center section.

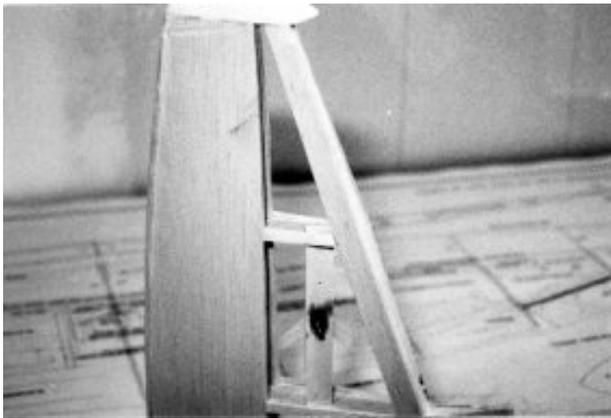
W8)Remove from plans and invert. Cut rear jig tabs off of the bottom of the ribs. Install lower 1/8 square aileron spar, using the same method used for the upper one. Glue 1/8 scrap balsa (from **LE-I**) behind 1/8 sq. aileron spars, and trim it to fit. Install bottom **TE-O**, lining it up as **TE-ML** was lined up on the center section. Fill open end between top and bottom **TE-O**'s at the inboard side of the aileron bay with light scrap. Trim leading edge to rough shape.



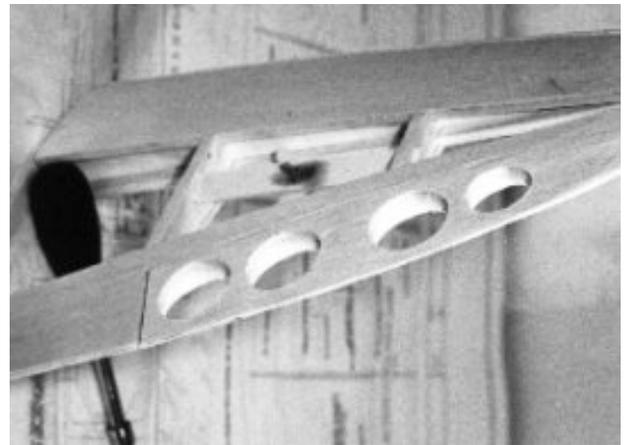
Ready to fit lower aileron spar

W9) Install **BSP** and the bellcrank assembly. Glue **TIP** in place and sand to shape. *Round rear tip of this part a bit, to prevent hangar rash.* Tack glue **AIL** in place. Use a flexible straight-edge to mark a straight line from the trailing edge of the inboard portion of the aileron bay at **TE-O** to the rear tip of **TIP**. Sand **AIL** to shape. I find marking the sections that need to be removed, and then removing **AIL** from the wing section to do the actual carving/sanding to be helpful to this process. Remove **AIL** from wing and fit hinges. Chamfer leading edge of aileron. Photos show rib caps in place, but they should not be, at this point. Repeat steps W5 to W9 for other outer wing panel.

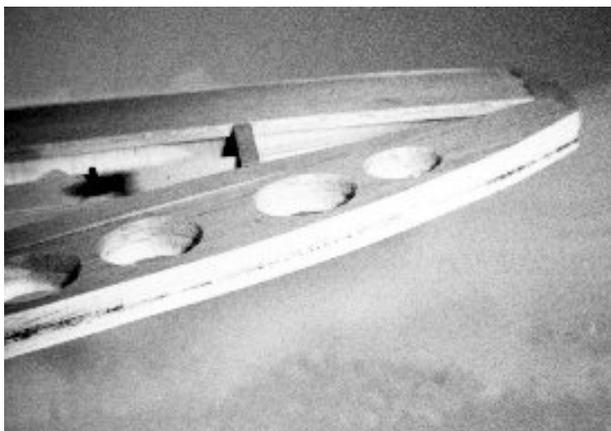
*For combat version, ignore instructions about bellcrank, and wait until wing panels have been mated to install wing servo rails.*



**BSP**, bellcrank and **TIP** in place



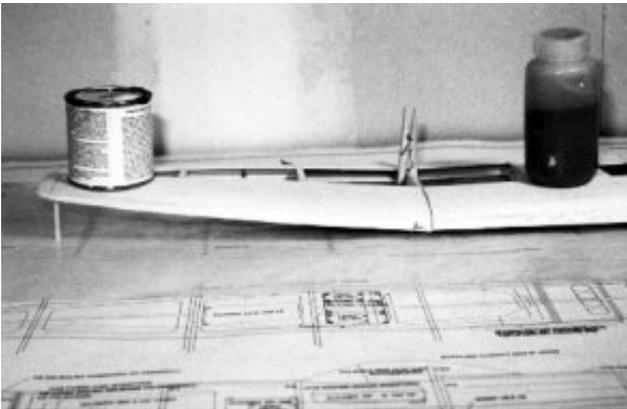
**AIL** shaped, and ready for chamfering of leading edge



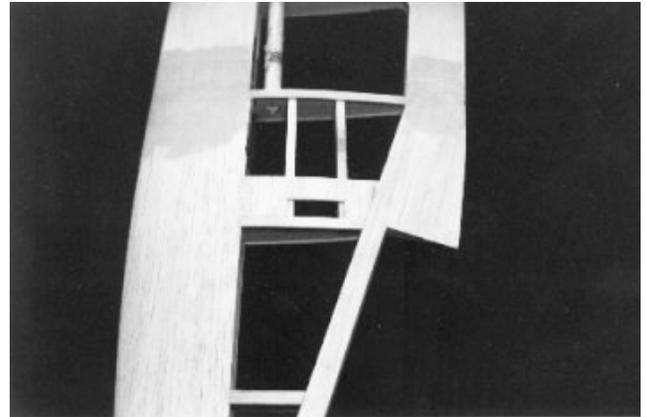
Rear of **AIL** marked and ready for shaping.

W10) Install outer pushrod housing into inner and outer wing panel, as you epoxy **W3A and W3B** together, with the wing tip blocked up 1 3/4" at the inboard end of **TIP**. The leading and trailing edges should be aligned, and the center section weighed down on the building board. Install **DB3**, using epoxy. Allow to cure. Invert and install **DB4**. Repeat for other side. Complete installation of pushrods, making sure that the servo attachment is centered well. Though no pushrod is included for this in the kit, I personally use a stiff 2-56 tube-in-tube type pushrod (such as a "nyrod") with a Du-Bro 183 aileron connector hooking it to the servo. I like to use metal clevises with retention clips at the bellcranks. This area is not accessible after it is covered, and I want 100% reliability, in that case. Install **APX**, on both sides, notching **ODS**, and **TE-O** slightly to allow it to sit flush.

If building the combat version, epoxy the aileron servo rails in place, and install a suitable scrap 1/16 covering support at this time.

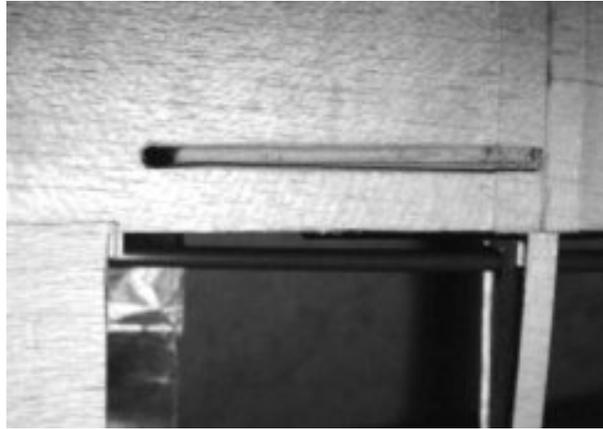


Joining outer wing panel to center section. Note weights



Combat servo rails and scrap 1/16 covering support

W11) Sand leading edges down to final shape. Fit and install 1/16 x 1/4 rib caps. Sand entire wing with 220 GRT sandpaper, using an appropriate sanding block. Sand trailing edge down to about 1/16". If the plane is to be hand launched, soak the trailing edge, just outboard of the fuselage with thin CYA to prevent a hand slip from damaging the trailing edge. Laminate about 1-2" of light glass cloth (1" cloth included with sport kit) over the dihedral breaks, using thin CYA, or epoxy finishing resin to bond it. Fill the grain of the cloth with a light weight filler and sand smooth. If using landing gear, cut open landing gear slots, and make provisions for the straps. Angle the straps so that the screw heads are near to the actual slots.



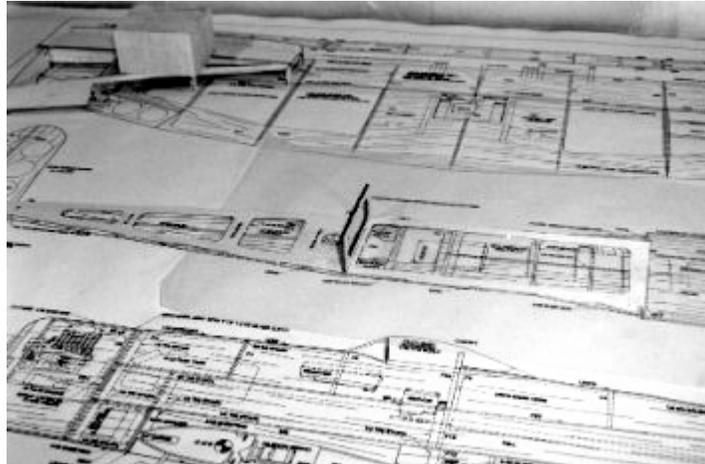
Slot for fixed landing gear prior to addition of cut-outs for straps

## Fuselage

F1) *This step is unnecessary for **electric** use, if gearbox lugs are to be used to mount motor.* Drill your engine mount such that your spinner is positioned the distance from **FW** shown on the plans. Bolt your mount to the **FW**. Make holes in the firewall for fuel tubing. Make a hole in the appropriate spot for the throttle cable. Keep in mind the location of the tank when locating this hole. **The offset shown on the firewall is necessary due to the right thrust.** Right thrust is optimized for a 9 or 10 " diameter propeller, and a larger propeller may require a bit more. Note 45° mounting of engines. This allows the stock muffler to be used.

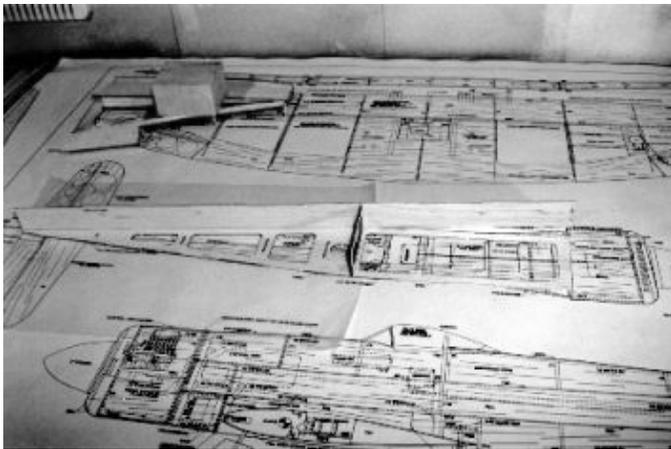


F2) Lay **FBB** of the fuselage box over the plans, on waxed paper. Side with etched letters should face up. Note that the thrust offset is *same* as the plans. Glue **F13** in place, making sure that it is 90° to the surface. The tab without the notch in it goes down. It will fit exactly into the slot in **FBB**. If it doesn't, it is the wrong slot.

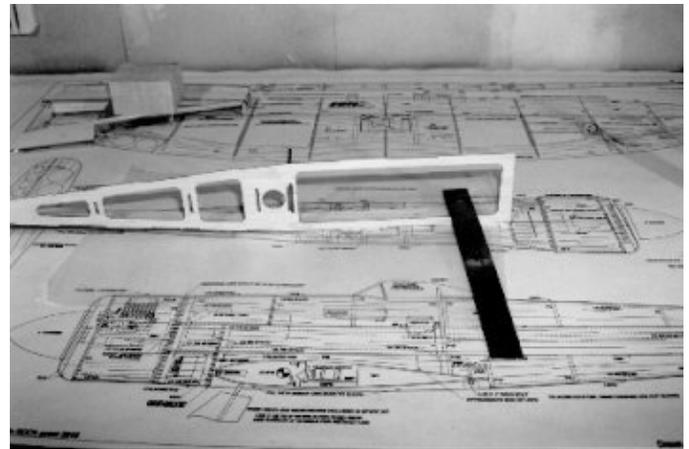


**F13** glued in place. Note right thrust on **FBB**. Etching on **FBB** faces up.

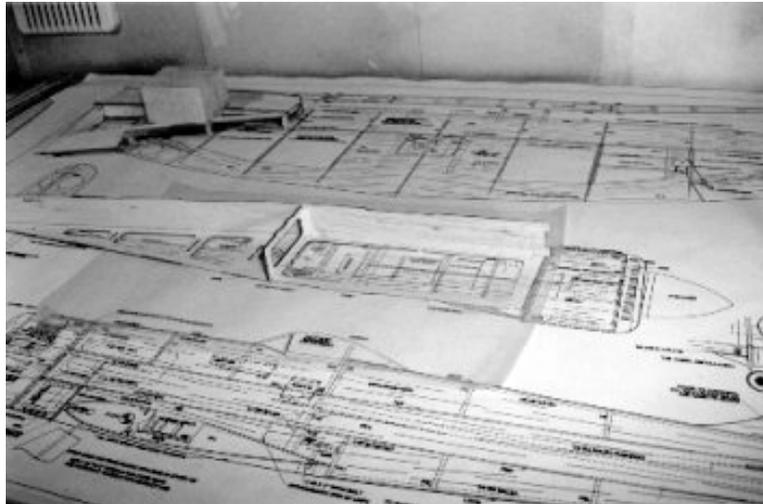
F3) Glue **FSL** to the tapered section at the back of **FBB**. Be sure that you've put **FSL** on the left side, as the two sides are different lengths due to the right thrust. When the glue has cured, glue it to **F13**, as well as the front section of **FBB**. It may help you to lift the assembly, lay a side flat on the table, and push down on **FBB** to get a good mating of the parts just ahead of **F13**. Make sure that you put the left side on the left, and vice versa, as they are not quite the same. The interlocking notches will fit very tightly ahead of **F13**, so dry-fit first. Place 1/4 tri stock bracing in the places seen in the third picture below. Repeat for right hand side, using **FSR**.



**FSL** is glued to the rear section of **FBB**. It is ready to glue to **F13**, and the front section of **FBB**.



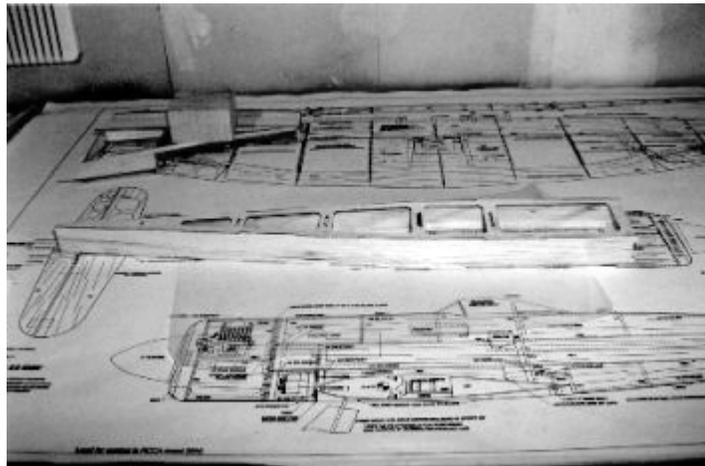
It may be helpful to place the parts in this position when gluing the front section.



**FSL** is completely glued to **FBB** and **F13**. 1/4 tri-stock bracing is used between **FBB** and **FSL**, as well as between **F13** and **FSL**. It is not used aft of **F13**. Be sure to end the piece between **FSL** and **FBB** at least 1/4" back from the front of **FBB**.

F4)Join the two sides at the rear using a 1/8 x 1/4 scrap balsa for a tail post. Use a square to make sure that the tail post is vertical.

F5)Glue **FBT** in place, again, gluing the back section first, and then the front section. If you need to, turn the part on its side, as you did in step F3, to get a good glue joint just in front of **F13**. When glue has dried, reinforce the joint between **FSL/FSR** and **FBT**, forward of **F13**, with 1/4 balsa tri-stock, as you did in step F3.

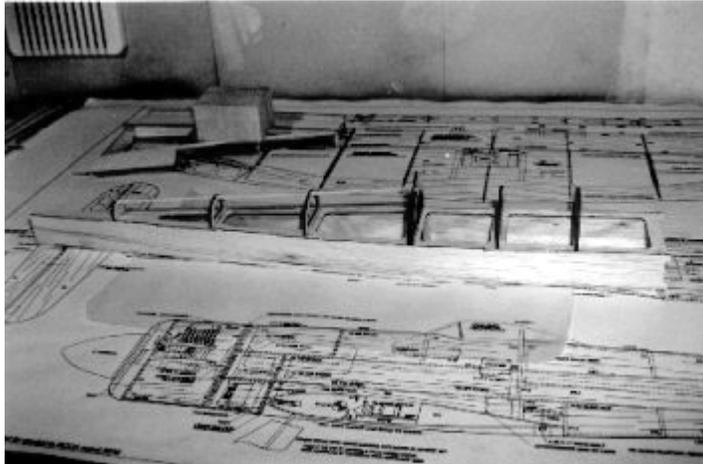


**FBT** in place, and "central fuselage box" complete

*Note: if the cross pieces in **FBB** or **FBT** get cracked along their grains during the preceding steps, don't worry. You can either just butt-glue them back together, or add a small piece of reinforcement, cross-grain to them, on the side facing the middle of the box. When the formers are added, they will be plenty strong.*

F6) This step not required for Tempest Mk II.

F7) Laminate **F3** to **F3A**, making sure that they are aligned well. Install all of the upper fuselage formers, making sure that they are vertical. Each former tab, will fit properly in the correct slot only, so the marking of the parts on the sport model is only needed as a back-up. Add 1/8 sq. top rear longeron, as well as 1/8 sq. longeron between **F2** and 1/2 way across **F1**.

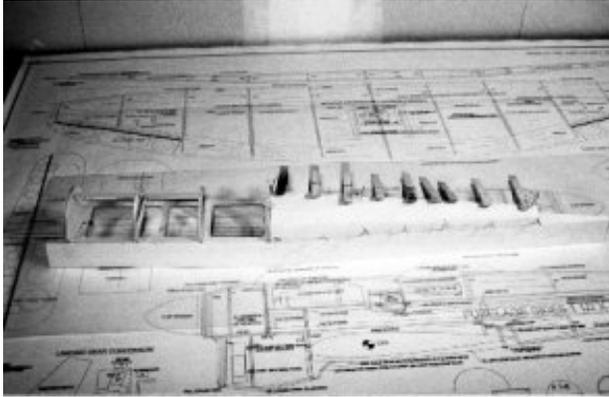


All top formers in place, as well as rear 1/8 square longeron

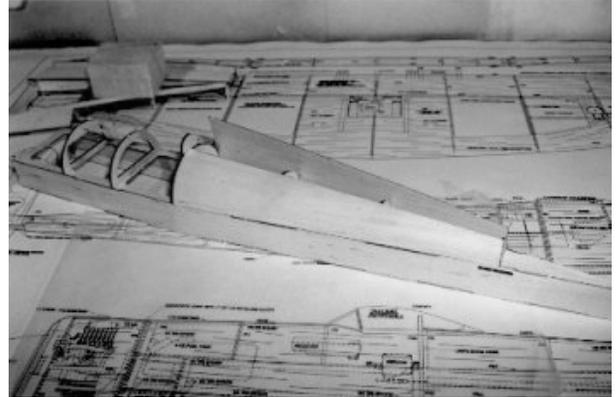
F8) Glue one of the two **URFS** pieces along the edge of the central fuselage box, as seen in the photo. Other than this one edge, the part should be "free". Dampen **URFS** with water, ammonia or vinegar. Make sure that the area around **F6** is especially well-wetted. Gently roll **URFS** down into position. It should go into position without rubbing on the headrest of **F3A**, and stop 1/2 way across the 1/8 top rear longeron. Very minor trimming may be necessary. When satisfied with the fit, glue permanently to **F3-F6**, as well as the longeron, using pins and/or clamps to hold it until the glue dries. Repeat for other side.



**URFS** glued along top edge of central fuselage box



Clamping first **URFS** to longeron



Beginning process for other **URFS**

Repeat these steps once more for **TFFS**. **TFFS** extends from the joint of **F3/F3A** to the middle of **F1**.

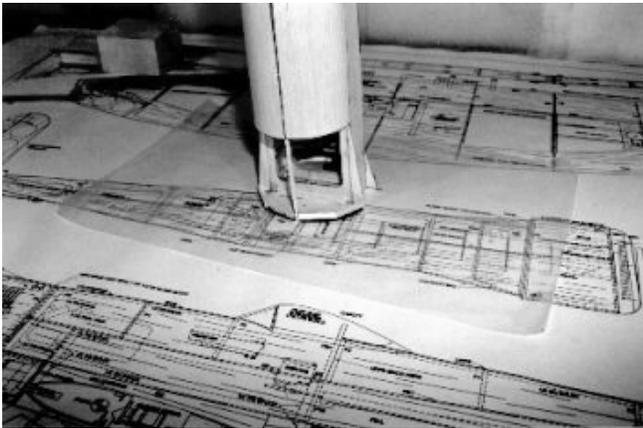
F9) Test fit **HSLs** (horizontal stab locators), trimming as necessary to allow the rear ends to fit flush with the fuselage..  
When satisfied, glue them in place.

F10) Install **FW** ( For electric use, using gearbox lugs as mount, use **FW-E**), ensuring that cut-out for 1/8 square longeron is on the top. Install the 1/8 square longeron between **F1** and **FW**. It runs from the middle of **F1** to the front of **FW**. Use a square to ensure that **FW** is set at 90° to the fuselage datum line. Right thrust will be set by **FBT** and **FBB**. Vertical position will be set by the interlocking tabs on **FW**. Because **FW** extends below **FBB**, it will be necessary to perform this step, as well as the remainder of the upper fuselage sheeting steps, with the front of the fuselage overhanging the end of your workbench somewhat.

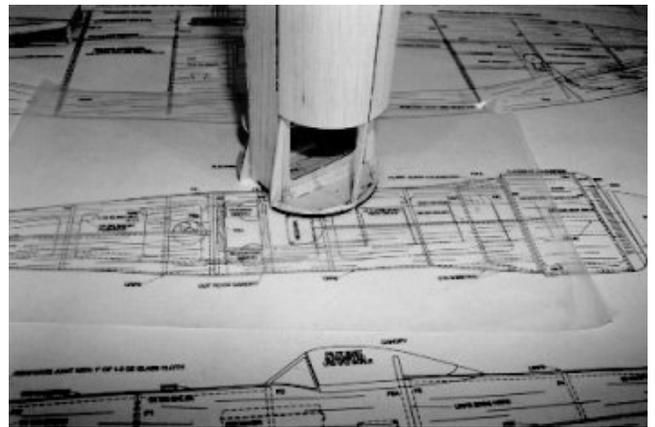


Installing **FW**

F11) Fit scrap 1/16 balsa "fuselage flares" to the top of the **FBT** as shown in the photo. You can leave them a bit oversized, and trim them in place, or pre-trim, them as you wish. Install 1/4 tri-stock along the front edge of the **FBT**, **FBB**, and **FSL/FSR** where they meet **FW**. Don't add the 1/4 tri-stock the *underside* of **FBB**. If you want to place your receiver pack between **WM1** and **FW**, cut an appropriate hole in **WM1-SPACER** (**WM1-LOC** is etched on to this part), prior to gluing it in place. Glue **WM1-SPACER** to the bottom of the **FBB**, butted up against the back of **FW**, such that it matches the angle of the right thrust, and centered left to right to leave room for the bottom fuselage flares. Using **WM1-SPACER** to set the location, install **WM1**, making sure that it is set at 90° to the fuselage datum. Brace the upper "forks" of **WM1** to the sides of the fuselage box with 1/4" tri-stock. Add 1/16 scrap balsa fuselage flares between **FW** and the bottom of **FBB**. Trim the 1/16 scrap balsa in a straight line between **FW** to **F1** (top) **WM1** (bottom), if not already done. Add 1/4 sq. stick between **FW** and **WM1**. Epoxy 1/4" tri stock to the back of **FW** ( or **FW-E**), such that it fits flush to, or overhangs the outer curve of **FW**. When it is cured, sand any overhangs flush. Complete top sheeting from **F1** to the front of **FW**. This is done using scrap 4" sheeting, working from the middle of the top longeron, and rolling it down to the fuselage flare, trimming as necessary. Sheet lower section, between **FW** and **WM1**, at this time, as well.



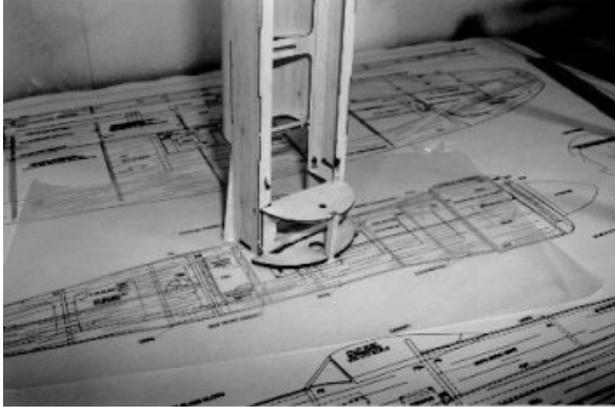
Top fuselage flares in place. Note 1/4 tri-stock fillets (not yet sanded to contour)



1/4 tri-stock now sanded to match contour of **FW**



Sheeting between **F1**, **FW** and fuselage flare

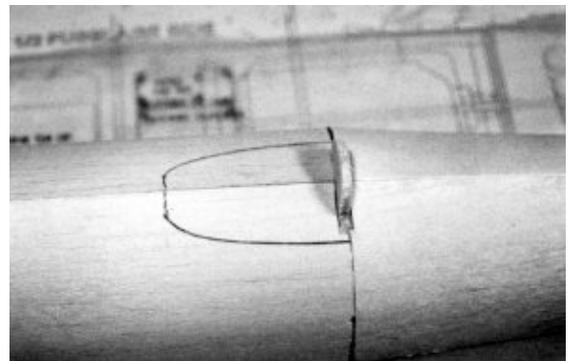


**WM1-SPACER** and **WM1** installed

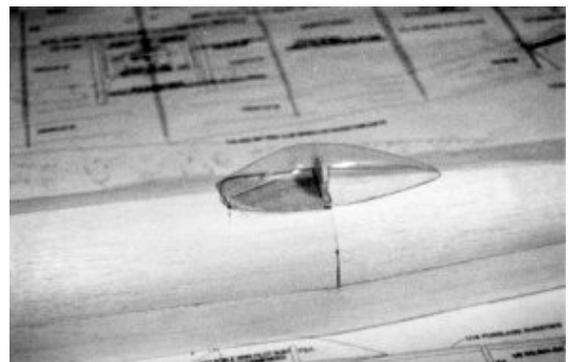
F12) Test fit **CANOPY**, cutting it back carefully until it fits the fuselage contour, and draw a line around it on the fuselage. Cut an opening in the fuselage following this shape (forward of **F3A** only). You may sheet across this opening, or leave it open, depending on your wishes for scale detailing of cockpit. Note that canopy has been upgraded since photos were taken.



Trim canopy and trace outline.



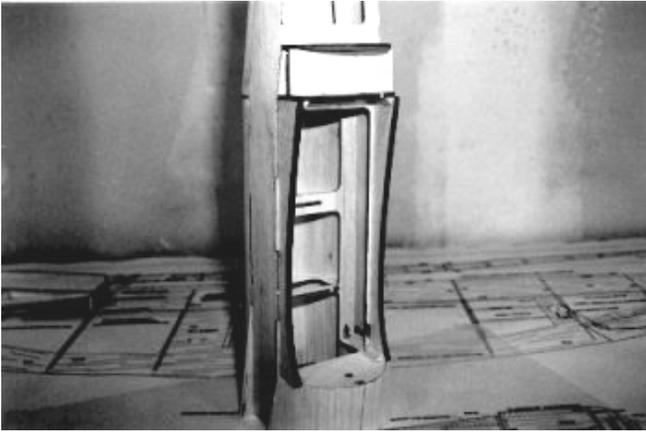
Cut along line



Done

F13) Install **WS**'s (wing saddles) along **FBB**, aligning their outside edges with this part NOT THE SIDE SHEETING - the sheeting on the outside of the wing saddles will be flush with this, when installed. Contour the front of **WS** to match that of **WM1**, so that later, when it is sheeted with 1/16 balsa, the sheeting will be flush with the sheeting that runs from **WM1** to **FW**.

F14) Fit **F12**, **WBP** and **F-11**, in that order. Fill area between **F12**, **F11**, and **WBP** with **WBB**, as shown on plans. . Sand **WS** and **WBB** between **F-11**, and **F-12** to meet contour of the surrounding formers. Sand **WBB** to continue the airfoil outline of **WS**.

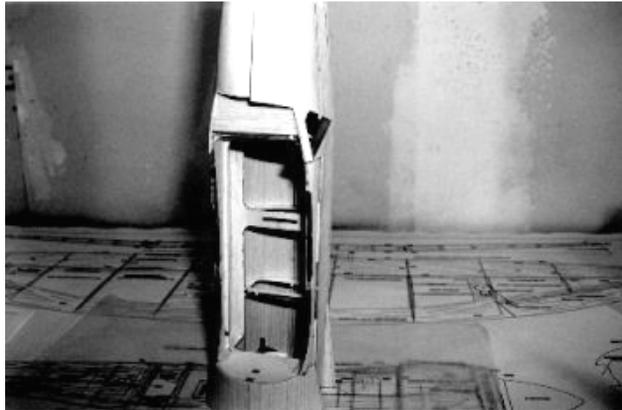


Parts in place, but not yet contoured

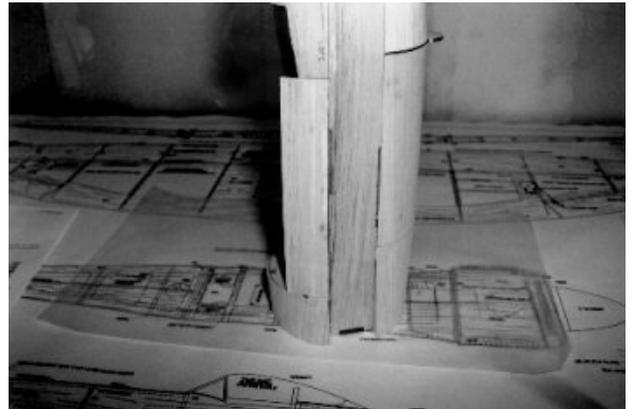


**WS, WBP, and WBB** contoured

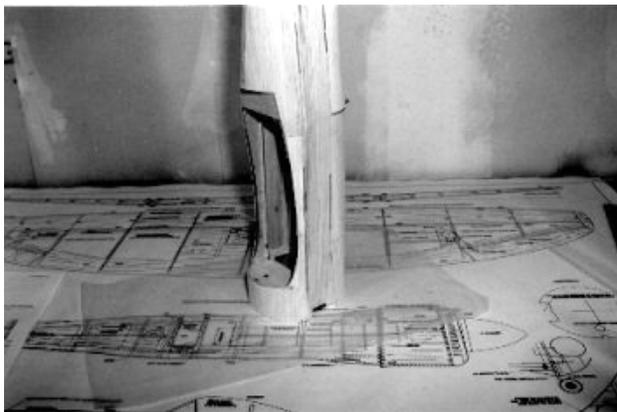
F15) Glue **F4L**, **F5L**, and **F6L**, in place, and add 1/8" square balsa longeron. Sheet the bottom of the fuselage, using the techniques from earlier steps. Be sure to overlap the sheeting extending to the rear of the fuselage at least 1" on to the wing saddle before making a butt-joint to a 1/16 scrap piece used to cover the wing saddle. Trim sheeting in front of **F11**, and around **WS**.



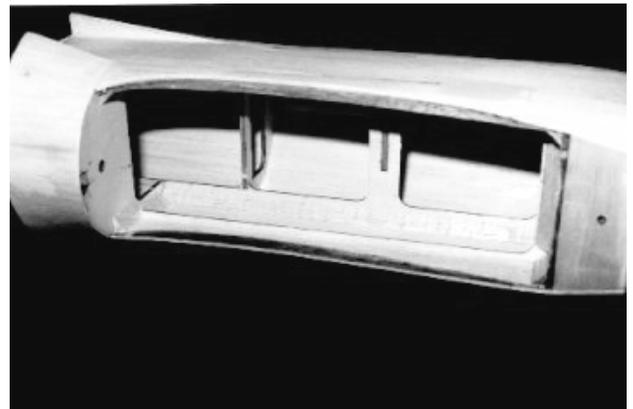
Trimming **LRFS**



Scrap sheeting over remainder of **WS**



**LRFS** trimmed



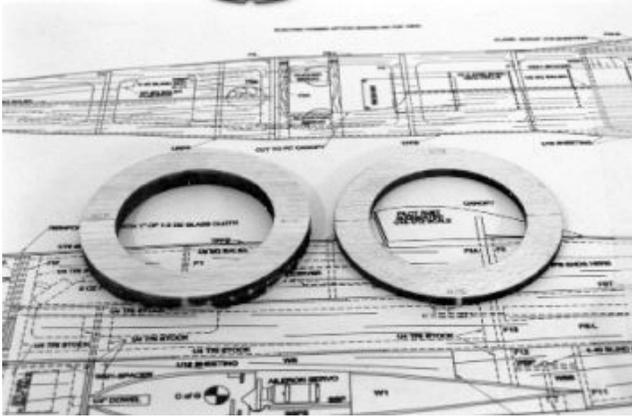
Sheeting complete and trimmed

## **Cowling**

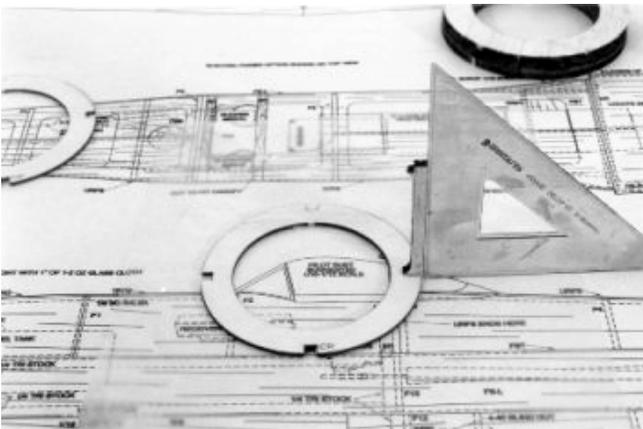
C1) Glue the half-rings that make up the 1/4" thick and 1/2" thick **BCR**'s together. Laminate the two completed rings together, rotating 90° between layers. Set aside, for now.

Assemble the cowling frame using the **CR** pieces, as well as **CS-R**, **CS-L** and **CS-U/L**. **CS-U/L**'s should be opposite to one another. Lay one of the **CR**'s flat on the table, and use a square to ensure that the **CS** pieces are 90° to this **CR**. When this assembly has dried., use the supplied 4" 1/16 sheeting to sheet it. Grain will run from one **CR** to the other. 4 pieces will completely enclose the structure, if you go from the middle of one **CS** piece to the middle of the next. Gluing it to the **CS**, and then rolling the assembly to press it down to the next **CS** works well. You can leave the sheeting overhanging in front and behind the assembly, for now. When it is fully sheathed, laminate a second layer of 1/16 balsa sheet on top of the first. Ensure that the "seams" are not aligned with those of the first layer, for maximum strength.

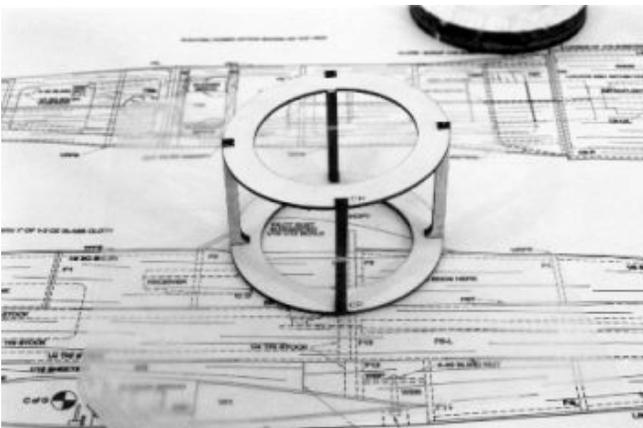
25/05 sized Hawker Tempest Mk II



**BCR's**

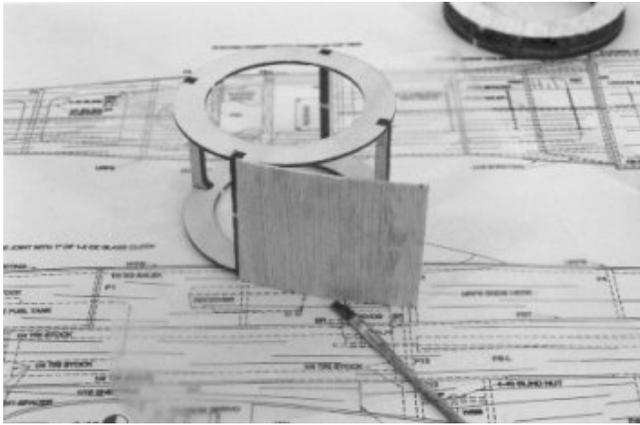


First cowl support piece glued to **CR**

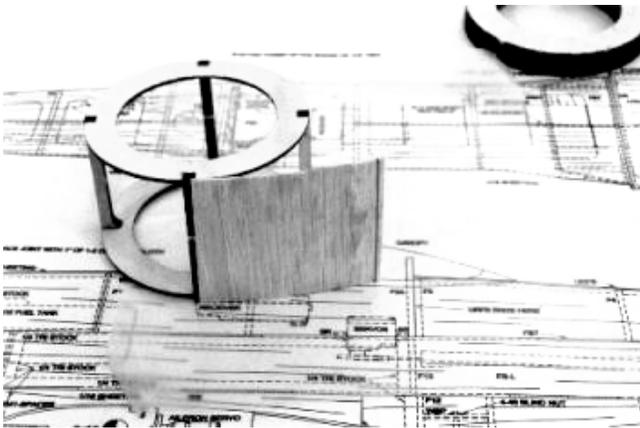


Cowling sub-frame complete

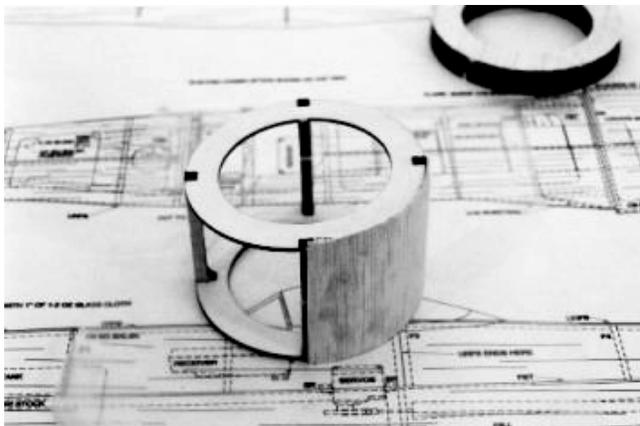
25/05 sized Hawker Tempest Mk II



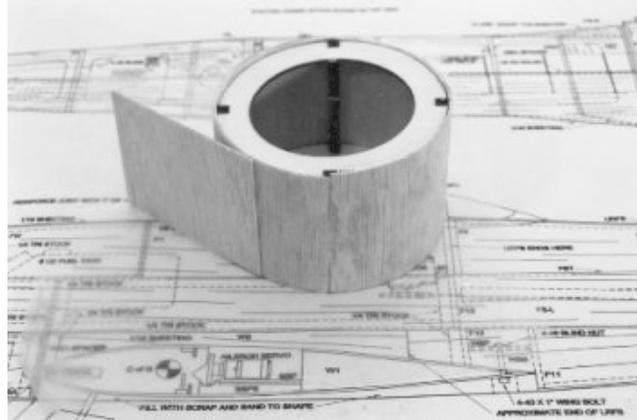
Sheeting begins. Note that it is wetted



Note trim line drawn on sheet

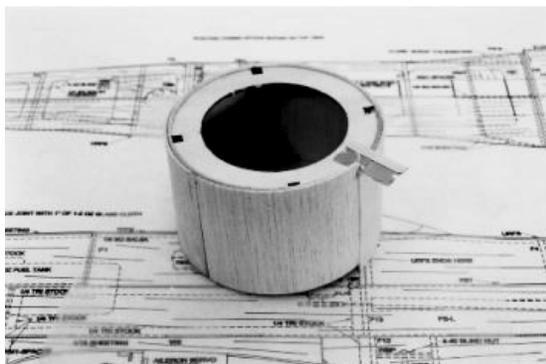


First sheet in place

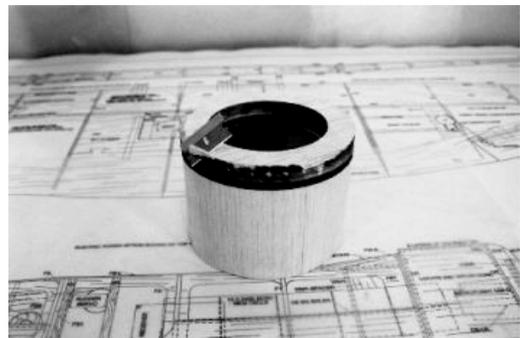


Starting second layer of 1/16 sheeting

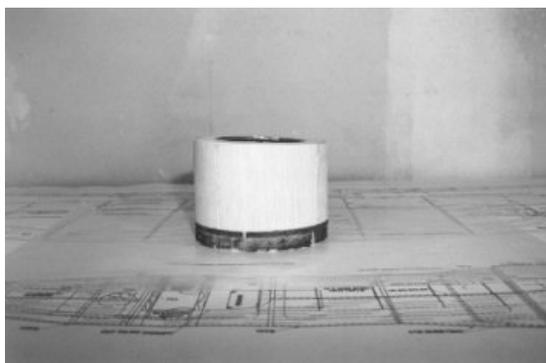
C2) Trim the sheeting that extends beyond the **CR**'s. Now glue the 3/4" thick front ring assembly to the front of this assembly. Sand the cowling, rounding the front to match the shape shown on the plans. The inside of the cowl opening is not rounded. Test fit cowl on the fuselage. Make any cut-outs necessary to clear the muffler and carburetor of your glow engine ( you will very likely have to trim away a portion of **T2-CR** on the muffler side), and allow fueling, carb adjustments, and glow plug access. Install complete engine in fuselage, and re-test-fit cowl, making alignment marks between cowl and fuselage. Remove engine.



Trimming sheeting



Rough-trimming of **BCR**'s



**BCR**'s attached to front - angle is on back side



Final sanded **BCR**'s

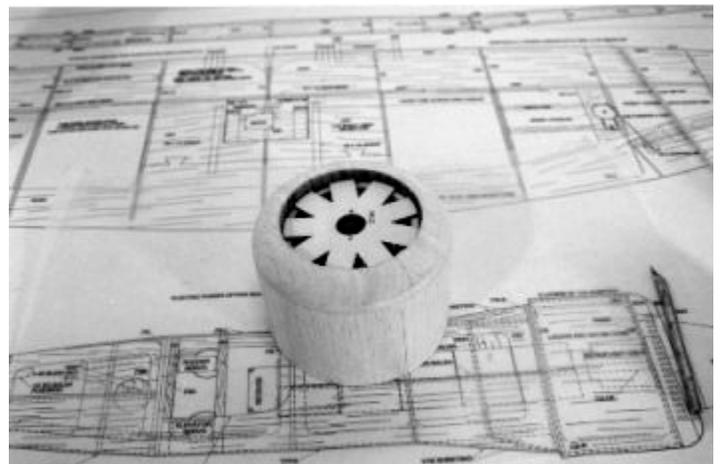


Cowl trimmed to clear engine and muffler, as well as allow air to exit either side. Earlier version shown here.

C3) If using the gearbox lugs of your Astro gearbox to mount your electric motor, you can bolt it directly to **EMM**, with this step setting your right thrust for you (there is no down thrust). Begin by laying **EMMS** flat on the building table. Glue the L-shaped 1/8 lite-ply pieces labeled as **T/B** to it, 180° apart from one another. The etched part names should be on the arm of the part *not* glued to **EMMS**. This arm should extend away from the center of the assembly. Then glue **LTR** 1/2 way between the two **T/B** pieces, and finally **RTR**, 180° from it. The etching on **LTR** and **RTR** will go *towards* **EMMS**. You can now lower the assembly into the front opening of the cowl, as shown in the photo. Rotate it until **LTR** (the longest of the L-shaped jig pieces) is in line with **CS-R** (the longest side of the cowl). Epoxy **EMMS** in place, and remove the L-shaped jigs from it when the epoxy has cured. When you are ready, you can install the motor by bolting it to **EMM**, and then gluing **EMM** to **EMMS** and the cowling as demonstrated in the photo below. It is likely best to do this after the model is fully assembled, covered, and painted.



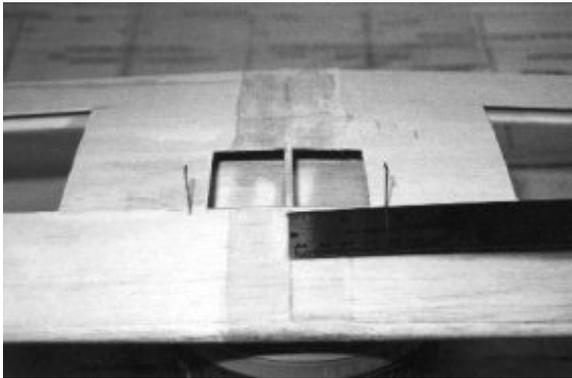
**EMMS** being installed. Jigs set thrust angle



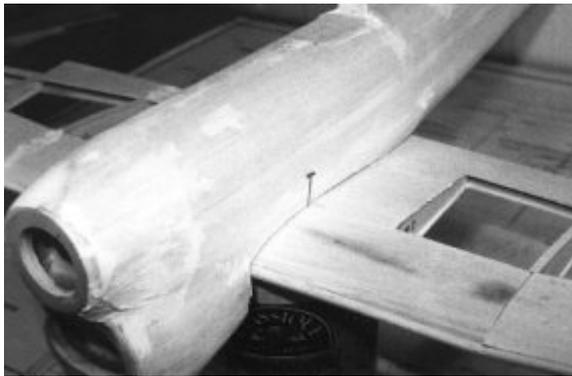
**EMM** simply rests on **EMMS** to find its position

## Wing installation and alignment

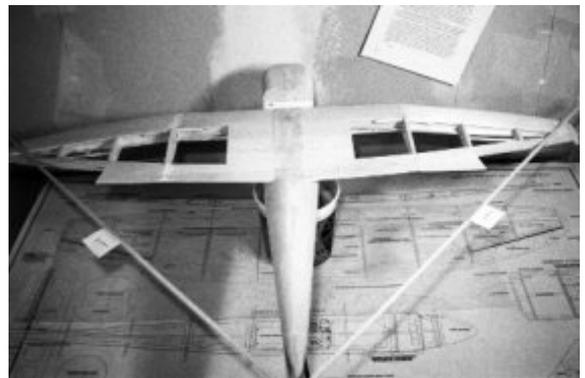
WA1) Tempest Mk V is shown, but steps are identical for Mk II. With the wing upright, measure from each wing-tip  $22\frac{9}{16}$ " towards center of wing, along the spar, and make a mark for each measurement. Make a mark half-way between these two points. Measure the width of the fuselage at the wing saddle, above the spar location. Divide this value by 2, and make marks *this* distance away from the point marked earlier. Insert pins at these points. Place the fuselage between these pins, as shown. Invert the fuselage and wing, and place on an appropriate saddle. Push a pin through two pieces of stick balsa, continuing into the center of the tail post. Measure along each of these sticks to the point where the leading edge meets the wing-tip. When these measurements are the same as one another, pin the sticks to the wing (through the sheeting and into the spar).



Centering pins in place

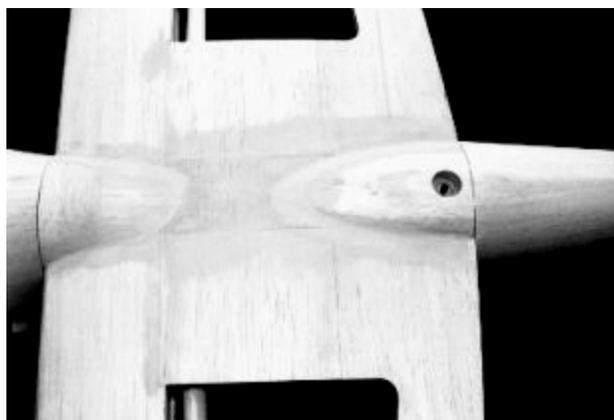


Fuselage in place between pins



Measuring tail to tip distance, and pinning braces in place when wing aligned

WA2) Using the plans, **F12A**, and **WM1** as guides, fill the bottom of the center section of the wing with scrap and carve/sand to give the illusion of the fuselage continuing beneath the wing. Leave a 1/2" diameter hole, where the wing bolt will be, as seen on the side view in the plans. Reach through the holes in **FW**, using a sharpened 1/4" tube, and drill into the leading edge of the wing, using the hole in **WM1** as a guide. Push, but do not glue, a 1/4" dowel into this hole to secure the wing. Drill a 1/8" hole through the center of the wing, about 3/4" forward of the trailing edge, down through **WBP**. Remove the wing, and enlarge the hole in **WBP** to accommodate a 4-40 blind nut. Install the blind nut through the hole left in **FBB** for this purpose. It can be helpful to tape the blind nut to your finger with double-sided tape, and then thread a 4-40 bolt into it to pull it into position. Saturate the area of the bolt hole in the wing with thin CYA to reinforce. Remove the wing once more and epoxy the dowel in place, leaving 1/4" exposed. Cover access hole in firewall with scrap 1/16" balsa.



## Finishing touches

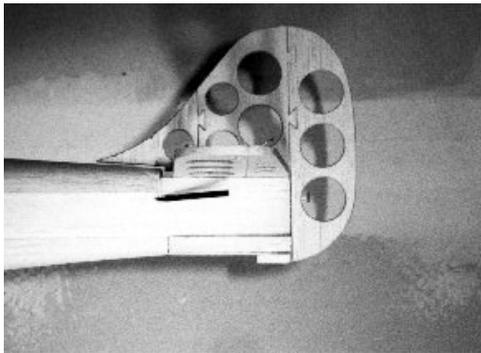
FT1) Laminate 4 **TB**'s together to form the tail block. Rough-trim to shape, leaving the part a little big of final size. Glue this assembly in place behind **F6L**, and beneath **FBB**. Test-fit tail group to help determine final shape of this part. If using a tail wheel, epoxy scrap 1/8" to 1/4" aircraft ply to this section, as shown in the pictures, and on the plan. Remember to reinforce this joint with glass cloth. The lower tip of the rudder will need to be notched to allow for steering, if a tail wheel is used. If not using wheels at all, carve this area as shown on the plans and in the pictures. Test fit TAIL GROUP, including making and installing the necessary fillets, and gluing them to the fuselage, but not the TAIL GROUP. Ensure that **HS** is level with respect to the wing. Ensure that the **VS** is aligned along the axis of the fuselage by taping two 1/4" sq. (or larger) 36" long sticks together, spaced apart by 1/4" scrap. Slide **VS** into the slot formed by these pieces, near one end. Align the rear of **VS** with the tail post, and the front of the jig you just made with a spot in the center of the fuselage near the front. Pin or tack-glue the TAIL GROUP into position. Mark where the **HS** makes contact with **HSL**. Remove the TAIL GROUP. Sand the scrap filler pieces to contour. Note that neither a tail wheel bracket nor a tail skid wire is included with either version of the kit..



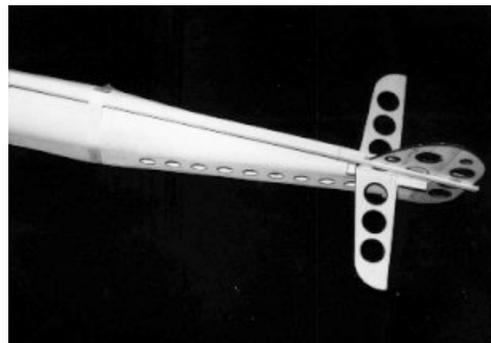
TB's stacked and glued



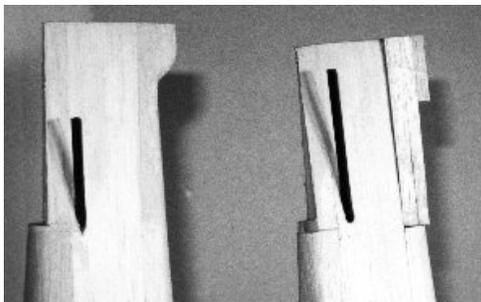
Tail wheel - note notch in **RUD**



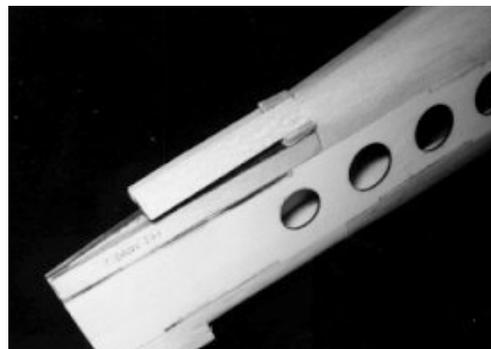
Rough trimmed



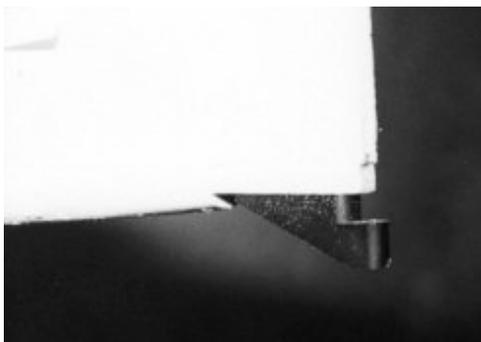
Aligning **VS** using the "two sticks" method



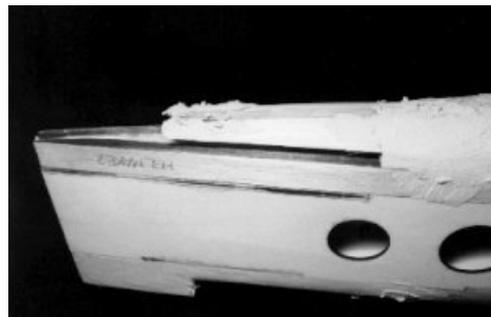
Rough and final shapes



Scrap fill at **VS/HS** joint



Tail wheel bracket installed



During sanding/filling process

FT2) Reinforce all sheeting butt-joints where the joint line is perpendicular to the grain of the sheeting. Do so by overlapping these joints with a small strip or .75 to 2 oz glass cloth. Also reinforce the sheeting surrounding **WBP** and **WBB**, as well as the joint between **WS** and **WM1**.

FT3) If installing optional wing fairings, do so at this time. Wrap the centre of the wing with cellophane or waxed paper, and bolt it to the fuselage. Butt-glue the 1/32 ply **LFWF** piece of the wing fairing to the side of the fuselage, lining up its trailing edge with that of the wing. Use epoxy for this, and leave a small fillet. Glue the 1/4 balsa rear formers (**FS**) between this piece and the fuselage (use a short length of 1/4 tri-stock as a front former), ensuring that **FS** overhangs the wing trailing edge by 1/8". Glue **URWF** (1/64 ply) into place. Glue the **UFWF** (1/64 ply) into place, trimming, if necessary. Glue **LRWF** (1/32 ply) into place, trimming if necessary. Make a triangular (not concave) fillet continuing the contour of this fairing (forward of the front former) out of resin/micro-balloons. Blend this into the fuselage at the leading edge of the wing. Make provisions to attach your covering more securely to this fillet than elsewhere. There is a strong tendency to detach from concave areas during shrinking.



**LFWF, FS and URWF** in place

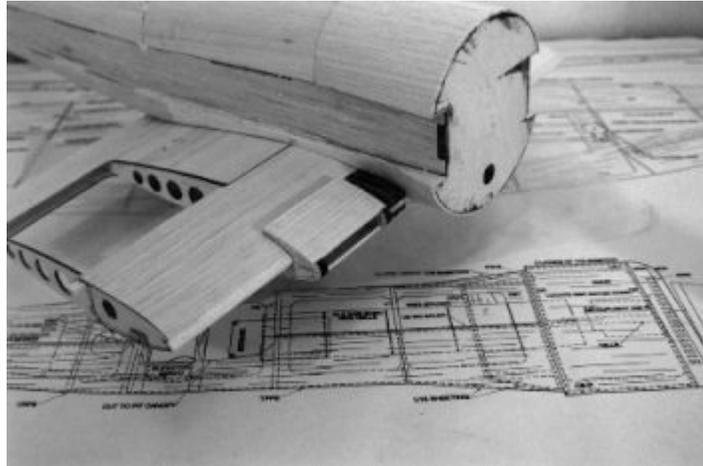


Fairing complete



**LRWF** installed

FT4)If installing optional wing radiators and air intakes, assemble them and test-fit them at this point (permanently install after covering). Make sure all etched part names are right side up, as the wing is not quite symmetrical, and the parts won't fit right if they are upside-down. A small piece of aluminum screen inside the radiator assembly adds to the scale look. Cover these parts before gluing on to airframe.



Test fitting of wing radiator/air intake (done much earlier, in this photo)

FT5)Either glue cowl (recommended) in place by epoxying **CR** to **FW**, or install four 2-56 blind nuts into **FW**, and use the rear **CR** as a bolting flange. If gluing, reinforce joint with F/G tape. Make sure that you've aligned the cowl so that the angle of **FW** matches the angle of **CR** and the front of the cowl is 90° to the aircraft datum.

FT6)Cover entire airframe with your chosen scheme. Cover ailerons, radiator fairing, fin, horizontal stab and elevators, and glue all parts into place, removing what covering is necessary to get wood-wood joints. Fit any scale details, as well as the canopy and optional pilot bust. When painting the "frames" on the canopy, be sure that all other parts of the canopy are completely masked against overspray. Electric fliers should paint **EMM** flat black. Install canopy. An open canopy makes a good cooling air exit for an electric.

FT7)Install your fuel tank, engine, wheels, and radio gear, or if flying electric, **EMM**, motor/gearbox, **ESC**, and battery pack supports. Set control surface travels. Elevator 3/8 + up-5/16 + down, aileron 1/2 up-7/16 down ( 1/2, 3/8 if not using a rudder), rudder 1 left & right (if used). This gives very quick control response. Exponential is strongly recommended! (ailerons -100%, elevator -60%, rudder 0%) Differential aileron travel can be set by moving the aileron horns back from the pivot point. The further back they are, the more differential you will get. Experiment by tack-gluing them in several positions.

FT8)Check that fore/aft C/G is where it is shown on the plans. This is a fairly conservative setting, and a good starting point. Also balance the airplane from left to right.

FT9)Double check operation of servos for smoothness, surface flex, and direction. Check operation of electric motor. Range check radio with and without engine/motor running.

## **Flying**

The Tempest is rock steady, and quite easy to fly. While gross application of control will result in very quick response, if flown with a moderate touch, it is very easy to get large, smooth, very scale-like maneuvers.

There is just the right amount of positive roll-yaw coupling, and there is very little yaw-roll coupling. Rolls are axial, with no corrections required, and a rate of greater than 1 per second is available when required. If you feel that the Tempest does not turn enough for your tastes on aileron alone, simply increase the ratio of up to down travel in your aileron differential. I prefer it more neutral than most.

Strafing runs are too easy. Be careful of ground obstacles when flying as low as this airplane will tempt you to.

The Tempest is not intended for unlimited style aerobatics, as high *negative* "g's" can result in a violent snap-roll (makes for a nice avalanche, though). Upright, however, you will find the stall envelope to be very forgiving, with an on-power stall being preceded by a slight pull to the left at the top of an extended part-throttle climb..

Hand-launch is uneventful, and a strong level toss at full throttle will have the Tempest at flying speed quickly. If you get a poor toss, simply roll with wings level, gently hold a bit of back stick and wait. It will either get flying speed, and start to climb, or it will simply sag gently on to the ground. When taking off of wheels, allow it to build a bit of speed prior to climb-out, rather than rotating quickly to a steep climb. The problem is not stall, but rather gyroscopic torque reaction. If you make an error at this time, and the airplane pulls strongly to the left, simply apply right rudder, and gradually release as the airplane build speed, and stops pulling left.

Landing requires a fairly shallow approach, as this is a very slick airplane, and it likes to float in ground effect. Fly it in so that you are at about 3' up at the threshold, and just cut the engine and let it gently settle in. For your efforts, you will be rewarded with a beautiful 3-point landing. With landing gear, the approach can be a bit steeper than without it.

Take the airplane up on a fairly still day and trim it for straight and level flight at full throttle. Chop the throttle quickly. If the airplane yaws to the right, more right thrust is needed. If to the left, less right thrust. If it balloons, a bit of "up" thrust in the engine is needed. If it drops the nose beyond settling into a gentle glide, down-thrust is needed. When this is complete, perform a series of full throttle 45° dives (obviously from a significant altitude). If you need to push down elevator to maintain the dive, the centre of gravity can be moved back. If you need to pull up elevator to keep the dive from getting steeper, the C/G is too far back. At full speed, bank the aircraft 90°, and smoothly pull full elevator. Do this at a safe height. If the airplane enters a high speed snap, decrease your elevator throw until this can be done without this occurring. Typical values are greater than 3/8" of throw.

Enjoy your Tempest!

## LASER CUT PARTS FOR TEMPEST MK II

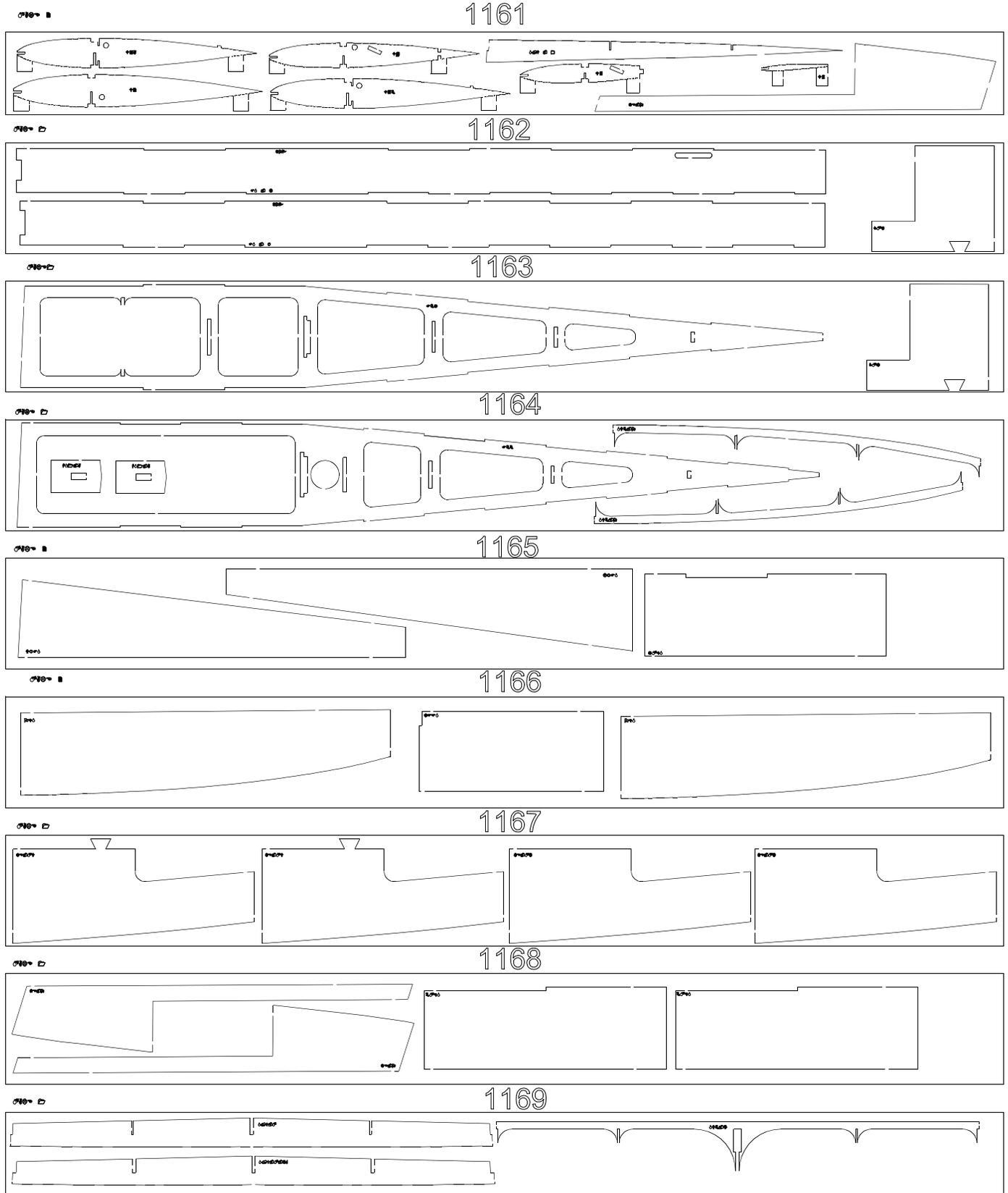
Parts are in order of appearance in manual.

NAME	EXPLANATION	LOCATION
VS1	VERTICAL STABILIZER, FRONT	142
VS2	VERTICAL STABILIZER, MAIN	142
RUD	RUDDER	142
EL	ELEVATOR	141
HS	HORIZONTAL STABILIZER	141
HS1	HORIZONTAL STAB REAR EXTENSION (CORE)	182
HS1-A	HORIZONTAL STAB EXTENSION (SHEETING)	1164
SUB-I	SUB-LEADING EDGE, INBOARD	1169
SUB-O	SUB-LEADING EDGE, OUTBOARD	1164
W1	CENTER WING RIB	181
W2	WING RIB	1161
W3A	OUTER RIB OF CENTER SECTION	1161
S/W-I	SHEAR WEB, INBOARD	1169
W2-LG	ALTERNATE W2, FOR USE WITH FIXED GEAR	1/8 LITE-PLY
W3A-LG	ALTERNATE W3A, FOR USE WITH FIXED GEAR	1/8 LITE-PLY
S/W-I-LG	ALTERANTE S/W-I FOR USE WITH FIXED GEAR	1169
SUB-I-LG	ALTERNATE INBOARD SUB-LEADING EDGE, FOR USE WITH FIXED GEAR	1169
LE-I	LEADING EDGE, INBOARD	182
DB1	CENTER DIHEDRAL BRACE, UPPER	1/16 AIRCRAFT PLY PARTS
DB2	CENTER DIHEDRAL BRACE, LOWER	1/16 AIRCRAFT PLY PARTS
BMDS	BOTTOM, MIDDLE, D-TUBE SHEETING	1168
TMDS	TOP, MIDDLE, D-TUBE SHEETING	1166
TE-MU	TRAILING EDGE, MIDDLE, UPPER	1167
CMT	CENTER, MIDDLE TOP SHEETING	1162,1163
TE-ML	TRAILING EDGE, MIDDLE, LOWER	1167
SSP	SERVO SUPPORT PLATE	1/8 LITE-PLY PARTS
SSPS	SERVO SUPPORT PLATE SUPPORT	121
W3B	MOST INBOARD WING RIB OF OUTER PANEL	1161
W4	WING RIB	1161
W5	WING RIB	1161
S/W-O	SHEAR WEB, OUTBOARD	1161
SUB-O	SUB-LEADING EDGE, OUTBOARD	1164
OWS	OUTER WING SPAR	142
W6	WING TIP RIB	1161
TE-O	TRAILING EDGE, OUTBOARD	1161, 1168
LE-O	LEADING EDGE, OUTBOARD	182
ODS	OUTBARD D-TUBE SHEETING	1166
BSP	BELLCRANK SUPPORT PLATE	1/8 LITE-PLY PARTS
TIP	WING TIP BLOCK	121
AIL	AILERON	121
DB3	DIHEDRAL BRACE, DIHEDRAL BREAK, UPPER	1/16 AIRCRAFT PLY PARTS
DB4	DIHEDRAL BRACE, DIHEDRAL BREAK, LOWER	1/16 AIRCRAFT

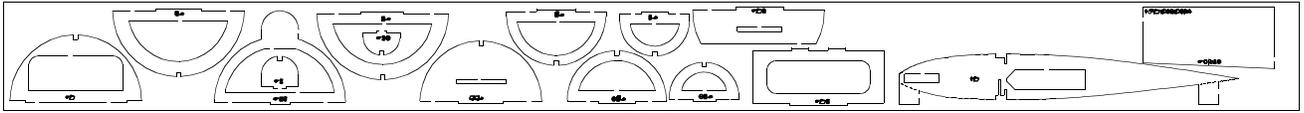
		PLY PARTS
APX	AILERON PUSHROD EXIT	1/64 AIRCRAFT PLY PARTS
FW	FIREWALL (3 LAMINATIONS)	1/16 AIRCRAFT PLY
FBB	FUSELAGE BOX, BOTTOM	1164
F13	RECTANGULAR FUSELAGE FORMER (A.K.A. W13 - TYPOGRAPHICAL ERROR)	181
FSL	FUSELAGE SIDE, LEFT	1162
FSR	FUSELAGE SIDE, RIGHT	1162
FBT	FUSELAGE BOX TOP	1163
F3	UPPER FUSELAGE FORMER AT REAR OF COCKPIT	181
F3A	LIKE F3, BUT WITH "HEADREST"	181
F2	UPPER FUSELAGE FORMER, FRONT OF COCKPIT	181
F1	1ST UPPER FUSELAGE FORMER AFT OF FIREWALL	181
URFS	UPPER REARE FUSELAGE SHEETING	1165
F4-6	UPPER REAR TURTLE DECK FORMERS	181
TFFS	TOP FRONT FUSELAGE SHEETING	1165
HSL	HORIZONTAL STAB LOCATOR	141
FW-E	FORMER TO REPLACE FIREWALL IF USING GEARBOX MOUNTED ELECTRIC MOTOR	1/8 LITE-PY PARTS
WM1-SPACER	1/8 Balsa piece that sets the location of WM1, using the rear of the firewall as a guide	181
WM1	WING MOUNT, FRONT	1/8 LITE-PLY PARTS
CANOPY	VACUUM FORMED CANOPY	
WS	WING SADDLE	141
F12	LOWER FUSELAGE FORMER, AT REAR OF WING SADDLES	181
WBP	WING BOLT PLATE	1/8 LITE-PLY PARTS
F11	LOWER FUSELAGE FORMER, AT REAR OF WBP	181
WBB	WING BOLT BLOCK	121
F4-6L	LOWER REAR FUSELAGE FORMERS	181
BCR	BALSA COWL RINGS	121, 142
CR	COWL RING	1/8 LITE-PLY PARTS
CS/R	COWL SUPPORT, RIGHT HAND	141
CS/L	COWL SUPPORT, LEFT HAND	141
CSU/L	COWL SUPPORT, UPPER/LOWER	141
T2-CR	TYPO - SAME AS CR	
EMMS	ELECTRIC MOTOR MOUNT SUPPORT	1/8 LITE-PLY PARTS
EMM	ELECTRIC MOTOR MOUNT	1/8 LITE-PLY PARTS
T/B	TOP/BOTTOM EMMS JIGS	1/8 LITE-PLY PARTS
LTR	LEFT EMMS JIG	1/8 LITE-PLY PARTS
RTR	RIGHT EMMS JIG	1/8 LITE-PLY PARTS
TB	TAIL BLOCK	142
VS	VERTICAL STABILIZER (ASSEMBLY)	
LFWF	LOWER FRONT WING FAIRING	1/32 AIRCRAFT PLY

25/05 sized Hawker Tempest Mk II

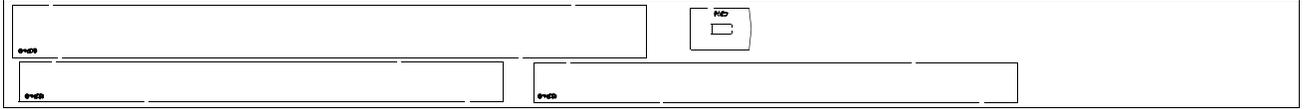
FS	REAR FORMER OF WING FAIRING	142
URWF	UPPER REAR WING FAIRING	1/64 AIRCRAFT PLY
UFWF	UPPER FRONT WING FAIRING	1/64 AIRCRAFT PLY
LRWF	LOWER REAR WING FAIRING	1/32 AIRCRAFT PLY
WRP	WING RADIATOR END PLATE	142
AI	AIR INTAKE	141,142
SR	SERVO RAIL	1/8 LITE-PLY PARTS



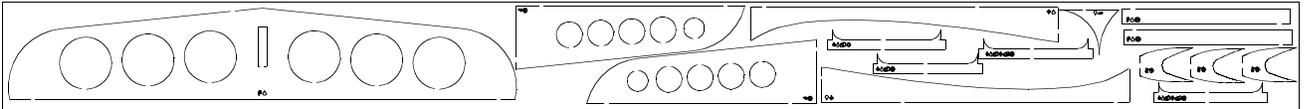
181



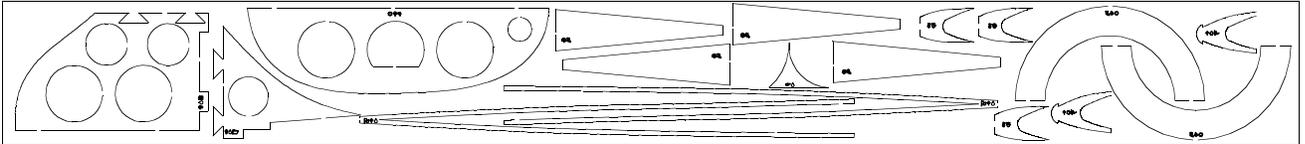
182



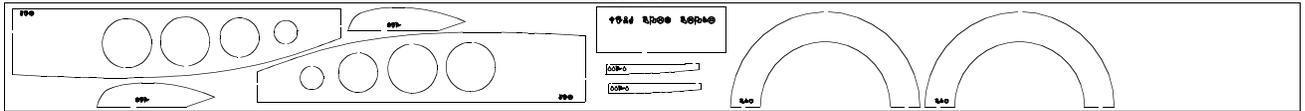
141



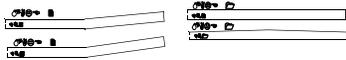
142



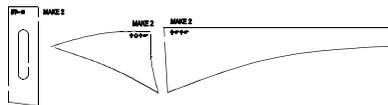
121



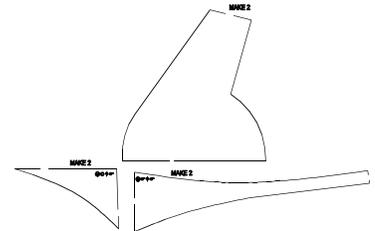
1/16 AC PLY PARTS



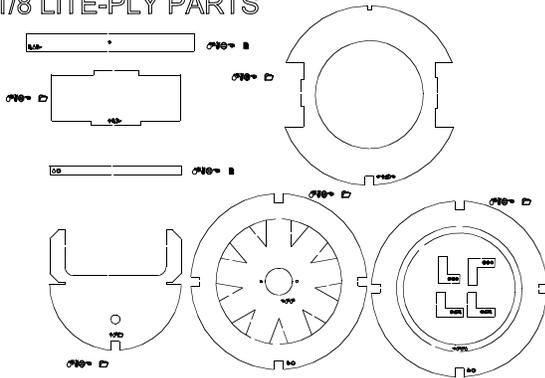
1/64 AC PLY PARTS



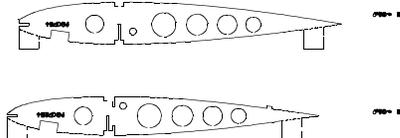
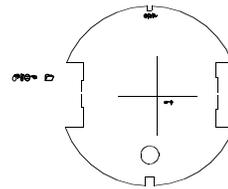
1/32 AC PLY PARTS



1/8 LITE-PLY PARTS



3/16 AC PLY PARTS



## Appendix: Installing Spring-Air #603 Retracts in Your Hawker

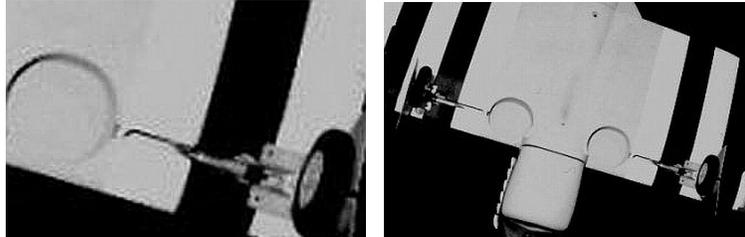
Frame up the center section of the wing, but do not sheet it yet. Cut, and dry-fit the 3/8" sq poplar landing gear rails. Fit your retract mechanism in place (just inboard of W3-RG. Drill mounting holes and attach gear to rails (I used 2-56 bolts and blind nuts).

Now, epoxy rails in place, bracing all joints that are accessible (between rails at W3-RG won't be, as it would hit the retract mechanism) with 1/4" tri-stock. Drill holes needed and install air lines. Cover ends with tape to prevent dust from getting in. After epoxy cures, remove retracts, and complete wing construction as per manual.

After wing is complete, and glass tape is applied to dihedral breaks, cut out the area needed for the mounting of the retract mechanism. Install the mechanism, with the gear in the down position. Working slowly, manually cycle the gear up and down, and cut a slot in the sheeting about twice the width of the gear leg to allow the leg up into the wing. You will need to file a notch in W2-RG to allow the gear leg to get right up.

Now bend the leg (or fit the axle, if 2-piece) such that the axle is 6 7/8" in from W3-RG. This will place the wheel about 1/2" inboard of the half-way point between W2 and W3. This is needed to allow the wheel to clear W2-RG when it arcs into the well. Further, and the well will intrude on the cowling extension under the wing. The axle can be no more than 7/8" from the back of the gear leg to the tip of the axle, or it will hit the upper sheeting.

Draw a circle of 2 5/8" diameter on the bottom sheeting, with the center where the axle rests when retracted (you can turn the axle 180° and retract the gear slowly to find this point). Cut the sheeting along this line, and remove the circle of balsa. Trim the front of this circle a little oblong to allow clearance, should you need to change the angle that the gear retracts on, if the model wants to nose over. Install the gear legs properly, and retract them manually, slowly into the wells, without wheels, making sure that everything lines up, and that the axle does not hit the upper wing sheeting. When satisfied, fit the wheels and try again, making sure that you have at least 1/4" clearance at all times. Make the walls of your wheel well with 1/16 balsa. You will be left with a 2 1/2" wheel well, which will accommodate a thin, 2" wheel. I used Dave Brown treaded foam wheels.



For a tail wheel, a skid made out of 1/16 music wire, and fit into the bottom of the rudder is fine, if you fly from hard smooth grass, or dirt. If you fly off asphalt, use a very light foam 1/2" wheel, and bend a mounting wire out of 1/16 music wire, again fit into the bottom of the rudder.

Make sure that all wheels, especially the mains, roll very easily. Adjust CG with wheels in the up position.

When it comes time to test the plane, take it to a hard, non-abrasive surface, like clay, or very short, hard grass, and taxi test it. If it wants to nose over, you can place a 1/16 ply shim under the rear retract mount flange to angle the gear forward. Ensure that the wheel still retracts without hitting the sheeting.

You will need a lot of up elevator, as the low Reynolds numbers of this plane don't give the stabilizer much force at taxi, and take-off run speeds (note, 2004 and later Tempests have a larger stabilizer, which may help, in this regard). Use 1/2" throw on the elevator, and hold full up until plane is beginning to feel light. Then relax up elevator slowly. Plane will lift off during this period. Relax elevator to allow for about a 10° climb. Raise gear when 2-3 feet up. Allow speed to build, then pull up to normal climb, and enjoy your flight. Resist the temptation to pull straight up as soon as the wheels break ground. There can be a strong torque reaction if this is done at too low an airspeed.

For landing, hold the plane off at idle about 6"-1' up. Keep adding elevator slowly until the plane settles down in a 3 point attitude. On smooth pavement it has no tendency to flip, with wheels that roll easily.