TWINSTAR™

RADIO CONTROLLED DUAL ENGINE AIRCRAFT

ARF SERIES

All Wood–Almost Ready To Fly

ASSEMBLY INSTRUCTIONS

HOBBICO

90-Day Limited Warranty

If you, as the original owner of this model, discover defects in parts or workmanship within 90 days of purchase, Hobbico will repair or replace it – at the option of our authorized U.S. repair facility, Hobby Services – without charge. Our liability does not include cost of shipping to us. However, Hobby Services will pay shipping expenses to return your model to you. You must provide proof of purchase, such as your original purchase invoice or receipt, for your model's warranty to be honored. This warranty does not apply to damage or defects caused by misuse or improper assembly, service or shipment. Modifications, alterations or repair by anyone other than Hobby Services voids this warranty. We are sorry, but we cannot be responsible for crash damage and/or resulting loss of kits, engines, accessories, etc.

Repair Service

Your Twinstar must be returned directly to Hobby Services for warranty work. The address is: Hobby Services, Attn: Service Department, 1610 Interstate Drive, Champaign, IL 61821-1067 Phone: (217) 398-0007. Please follow the instructions below when returning your model. This will help our experienced technicians to repair and return it as quickly as possible.

1. ALWAYS return your entire system, including airplane and radio.
2. Disconnect the receiver battery switch harness and make sure that the transmitter is turned off. Disconnect all batteries and drain all fuel.
3. Include a list of all items returned and a THOROUGH, written explanation of the problem and service needed. If you expect the repair to be covered under warranty, also include your proof of purchase.
4. Include your full return address and a phone number where you can be reached during the day.

If your model is past the 90-day warranty period or is excluded from warranty coverage, you can still receive repair service through Hobby Services at a nominal cost. Repair charges and postage may be prepaid or billed COD. Additional postage charges will be applied for non-warranty returns. All repairs shipped outside the United States must be prepaid in U.S. funds only. All pictures, descriptions and specifications found in this instruction manual and on the product package are subject to change without notice. Hobbico maintains no responsibility for inadvertent errors.

Congratulations!

You're about to build in just hours what took aviation pioneers years—a powered machine that flies. Specially created for you and other experienced radio control modelers, Hobbico's Twinstar offers nearly all the excitement of piloting a real airplane...and develops skills that will take you anywhere you want in your hobby.

Know Your Model's Parts

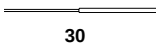
Take a moment now to match the box contents with the items listed below. Following the Twinstar assembly instructions will be quite easy if you identify and organize the parts before you begin.

Landing Gear

Part #		Quantity
15	Main Landing Gear	2
5	Nose Gear	1
4	Steering Arm	1
14	Wheels	3
66	Wheel Collars	5
67	3 x 8mm Screw	1
68	3 x 5mm Screw	5

Tail Assembly

Part #		Quantity
1	Stabilizer and Elevator	1
16	Rudder and Fin	1
28	*Clevises	5
29	*Control Horns	2
31	2mm x 18 mm Machine Screws	4
53	Dorsal Fin	1
53	Dorsal Fin Decal	1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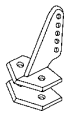
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Wing Assembly

Part #		Quantity
6	Dihedral Brace	3
7	Right Wing Panel	1
8	Left Wing Panel	1
28	*Clevises	2
40	4mm Washers	2
41	4 x 35mm Bolt	2
42	4mm O-ring	2
43	Engine Nacelle (R)	1
44	Engine Nacelle (L)	1
45	Wing Bolt Plate	1
46	Servo Tray (Wing)	3
47	*Aileron Control Horns	2
50	Fuel Tank Brace	2
61	Front Root Ribs	2
62	Rear Root Ribs	2


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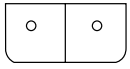
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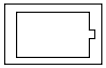
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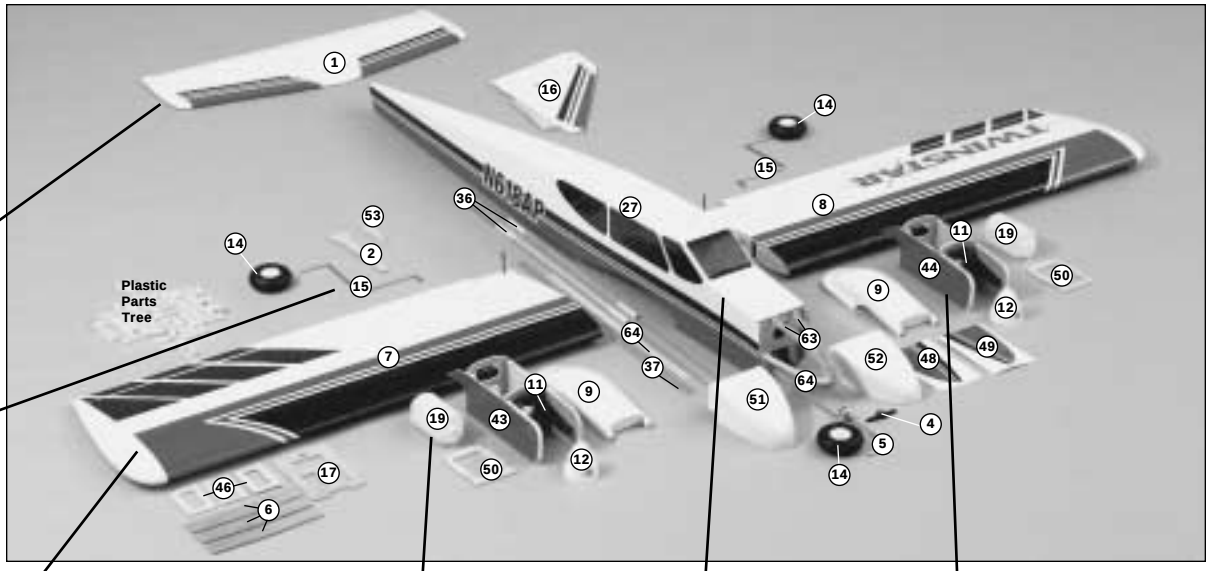
Replacement Parts Available

HCAA3690...Wing Kit	HCAA3694....Landing Gear Set
HCAA3691...Fuselage Kit	HCAA3695....Nacelle Set (L&R)
HCAA3692...Fin Set	HCAA3696....Nacelle Cover
HCAA3693...Spinner	HCAA3697....Nose Cone (2 pcs.)

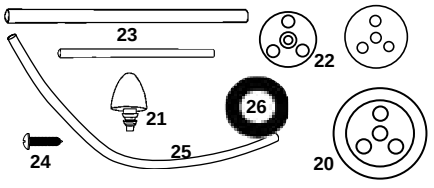
*Parts marked with an asterisk are found on the plastic parts tree.



Fuel Tank & Parts

• Parts Shown Below

Part #		Quantity
19	Fuel Tank	2
20	Rubber Tank Stopper	2
21	Fuel Pick-up Weight (Clunk)	2
22	Plastic Stopper Compression Disks (One Large and One Small)	4
23	Aluminum Fuel Tubing (One Short and One Long)	4
24	3 x 18mm Screw	2
25	Silicone Fuel Line	2
26	Foam Tank Collar	2



Engine Mounting Parts

Part #		Quantity
11	Engine Mount	2
36	Pushrods	2
37	Pushrod Wire	2
65	Pushrod Tubes	2

Fuse Parts

Part #		Quantity
2	Stab Base	1
9	Nacelle Covers	2
12	Spinners	2
17	Servo Tray (Fuse)	1
27	Fuselage	1
48	Nose Decals (R)	1
49	Nose Decals (L)	1
51	Nose Cone (R)	1
52	Nose Cone (L)	1
63	Vertical Front Brace	2
64	Horizontal Front Brace	1

Parts shown smaller than actual size (out of proportion).

Other Items You'll Need:

Glues

Choose 6-minute and 30-minute epoxy, such as Great Planes® Pro™ Epoxy, which has been formulated especially for R/C model building. Pro Epoxies offer a strong bond and a variety of curing times suited for every step of assembly. You'll also need a thin instant-setting CA (cyanoacrylate), a thicker CA+, plus rubbing alcohol for easy epoxy cleanup.

Hardware

Tools and accessories required for assembly include a hobby knife; small and large Phillips screwdrivers; needle nose pliers; drill with 1/16", 1/8", 3/32" 3/16", 5/32" and 5/64" bits; ruler; 2 feet of medium fuel tubing; and 150 to 200-grit sandpaper.

Model Engine

Power your Twinstar with two high-quality, .25 to.32-size model engines. The O.S®. .25 FP, or O.S. .32 F are fine engines for this plane. Look for features such as easy break-in, easy starting, efficient carburetion and low maintenance. Check the manufacturer's recommendations for propellers to use with your engine.

Radio Equipment

In selecting a radio system for your Twinstar, you'll need at least a 4-channel radio system with five standard servos. Many of the 4-channel radios offered include only three servos, so it may be necessary to purchase two extra servos along with your radio system. Unless you are planning to use a computer radio and mix the throttle servos, you will also need a "Y" harness for your Twinstar. The servos and receiver will be mounted on-board your model and need to be cushioned from shock and vibration. One-half inch thick foam rubber sheets (HCAQ1050) are available from your hobby dealer for this purpose.

Getting Ready for Flight

1. While building your Twinstar, make sure to follow the instructions. Do not alter or modify the model, as doing so may result in an unsafe or unflyable model. In a few cases the instructions differ slightly from the photos. In those instances the instructions are correct.
2. You must install all components so the model operates on the ground as well as in the air.
3. You must check the operation of the model before EVERY flight to ensure all equipment is operating, and the model has remained structurally sound. Be sure to check the clevises and other connectors often and replace them if they show signs of wear or fatigue
4. When you are preparing to go and fly your model, make sure to fully charge the radio system according to the manufacturer's instructions the night before. Fully prepare your field box, making sure you have the necessary items for starting your engines. Remember to take along spare propellers and glow plugs, as well as some epoxy and CA glue, just in case. Being prepared at the field will make your flying experience much more enjoyable.

Other General Items Required

Epoxy Brushes (GPMR8062)	Mixing Sticks (GPMR8055)	Clothespins	1/4" Foam Rubber (HCAQ1050)
T-Pins (HCAR5150)	Masking Tape	String	Felt-Tip Pen
Sanding Block	Adjustable Wrench	Paper Towels	Builders Triangle Set (HCAR0480)
Plastic Wrap or Wax Paper	Round Toothpicks	Wire Cutter	Thread Locking Compound
70% Isopropyl Alcohol	Small Hobby Clamps	Razor Saw	

Protect Your Model, Yourself & Others... Follow This Important Safety Precaution

Your Hobbico Twinstar is not a toy, but rather a sophisticated, working model that functions very much like an actual airplane. Because of its realistic performance, the Twinstar, if not assembled and operated correctly, could possibly cause injury to yourself or spectators and damage property.

If this is your first low wing sport model, or if you are uncomfortable in making the initial flight of your Twinstar, it is recommended that you get help from an experienced, knowledgeable modeler with your initial flights.

You may also want to contact the Academy of Model Aeronautics (AMA), which has more than 2,500 chartered clubs across the country. Through the AMA, you should either be able to locate a modeler nearby that can help, or at least be able to phone one that can verbally instruct you for any potential problems that could occur. Contact the AMA at the address or phone number below:

Academy of Model Aeronautics
5151 East Memorial Drive
Muncie, IN 47302
Office: (765) 287-1256
Toll Free: (800) 435-9262
Fax: (765) 741-0057

AMA SINCE 1936
JOIN THE AMA

WARNING! This is not a Toy! Please follow these safety precautions:

Before you fly:

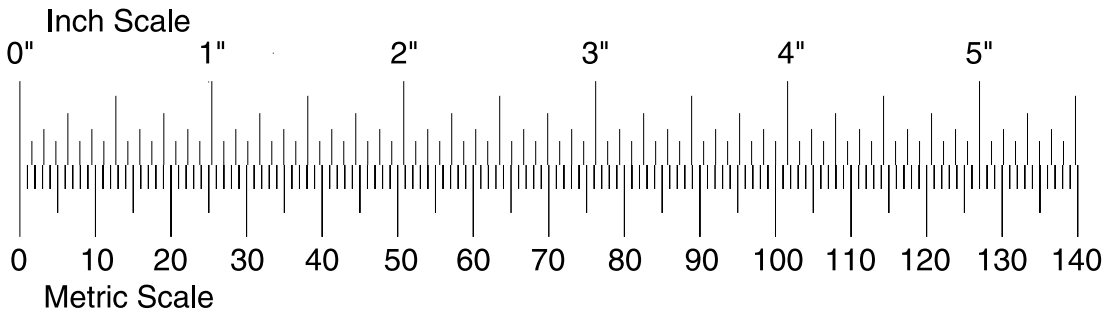
1. Make sure that no other fliers are using your radio frequency.
2. Your radio transmitter must be the FIRST thing you turn ON, and the LAST thing you turn OFF.
3. Double check all control surfaces.
4. Make sure that the transmitter & receiver batteries are fully charged.

Fuel storage and care:

1. Do not smoke near your engine or fuel.
2. Store all engine fuel in a safe, cool, dry place, away from children and pets. Model fuel will evaporate, so make sure that you always store it with the cap secure.

When starting and running your engine:

1. Always wear safety glasses.
2. Make certain that your glow plug clip is securely attached to the glow plug and cannot pop off, possibly falling into the spinning propeller.
3. Use a “chicken stick” or electric starter to start the engine – NOT your fingers.
4. Make sure that the wires from your starter and glow plug clip cannot become tangled with the spinning propeller.
5. Do not stand at the side of the propeller when you start or run the engine. Even at idle speed, the spinning propeller will be nearly invisible.
6. If any engine adjustments are necessary, approach the engine only from behind the spinning propeller.



Special Note:
You should charge your radio system before starting to build. Following the manufacturer's directions, connect your transmitter and receiver batteries to the system's charger. This way the radio will be ready when it is time to install the radio components.

Wing Joiner Assembly

Prepare the Wing Joiners:

❑ 1. Locate the 1/8" (3mm) die-cut plywood wing joiners and separate the three individual joiners from the die-cut plywood sheet using a hobby knife. Arrange the three "V"-shaped joiners in the same orientation as they will be glued together.

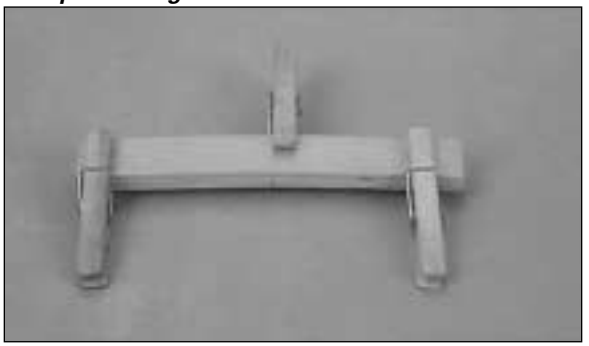
Glue the Wing Joiners:
Note: Please read steps 2 through 4 before gluing.

❑ 2. Mix approximately 1/4 oz. (7.5ml) of 30-minute epoxy. Using a mixing stick or epoxy brush, apply an even coat of epoxy on both sides of one of the wing joiners. Sandwich this coated joiner between the remaining two joiners. Quickly proceed through the following steps (3 and 4) before the epoxy cures.

Remove the Excess Epoxy:

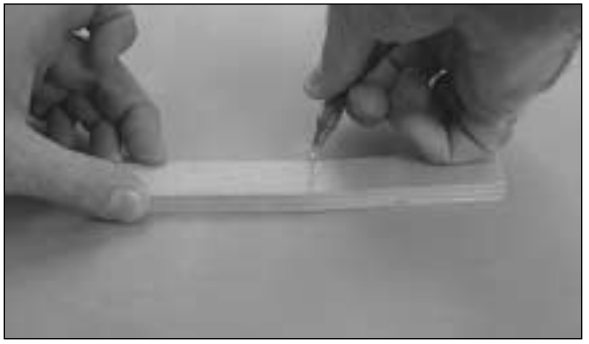
❑ 3. Excess epoxy will squeeze out of the seams between the joiners and must be removed before the epoxy is allowed to cure. Use a paper towel dampened with rubbing alcohol to remove any excess epoxy.

Clamp the Wing Joiner:



❑ 4. Use clothespins to clamp the wing joiners firmly together. If any more epoxy squeezes out, remove it using a paper towel. Make sure that the joiners are evenly lined up with each other.

Mark the Centerline on the Joiner:

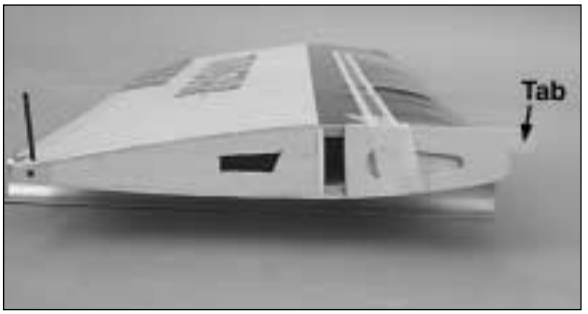


❑ 5. After the epoxy has cured and the clothespins have been removed, draw a centerline on both sides of the plywood wing joiner.

Even the Edges:

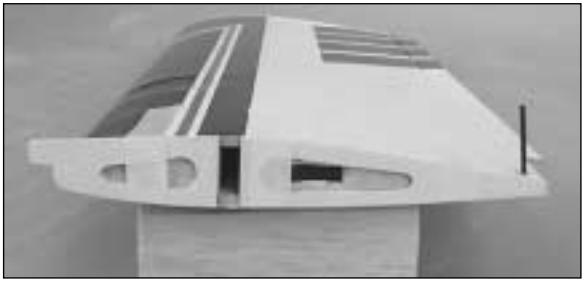
❑ 6. Using a flat sanding block or similar tool, lightly sand the wing roots to remove any irregularities. Do not sand off too much as the dihedral angle could be altered.

Install the Front Root Ribs:



❑ 7. Locate the two 1/8" (3mm) front root ribs. Position the rib so the tab is on the top of the wing. The aileron torque rod is also located on the top of the wing, which can be used as a reference. Align the rear edge of the rib flush with the front edge of the joiner pocket. It should also follow the contour of the bottom of the wing. Use 1/4 oz. (7.5ml) of 6-minute epoxy to glue the rib in position. Use masking tape to hold the rib securely to the wing until the epoxy has fully cured.

Install the Rear Root Ribs:



❑ 8. Locate the two 1/8" (3mm) rear root ribs. Position the rib with the front edge flush with the aft edge of the joiner pocket. The rib should follow the contour of the wing airfoil when positioned correctly. Once satisfied with the fit, use 6-minute epoxy to attach the rib to the wing. Use masking tape to hold the rib securely to the wing until the epoxy has fully cured.

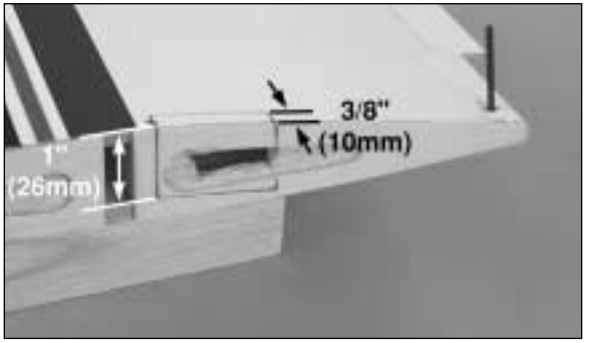
Mark the Wing Joiner Pocket:

❑ 9. Lay the wing halves on the work surface with the aileron torque rods facing upwards. Place a mark at the aft edge of the wing joiner pocket using a felt-tip pen. This line will aid in positioning the aileron servo tray.

Position the Aileron Servo Tray:

❑ 10. Locate one of the 1/8" (3mm) plywood servo trays. Position the servo tray so the front edge rests at the line drawn locating the aft edge of the joiner pocket. Using a felt-tip marker, mark the position for the front and rear of the opening in the servo tray.

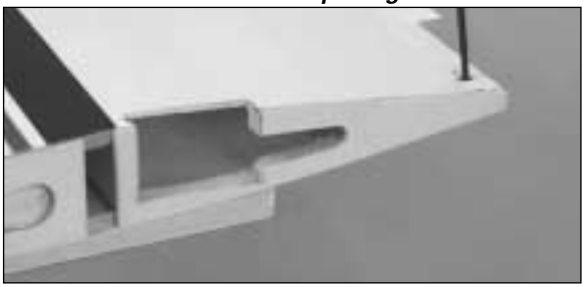
Mark the Aileron Servo Location:



❑ 11. Measure in 3/8" (10mm) from the edge of the root ribs and draw a line connecting the front and rear lines

drawn for the opening. Measure down 1" (26mm) from the top of the wing at the front and rear edges of the servo opening. Connect the lines as shown in the photo.

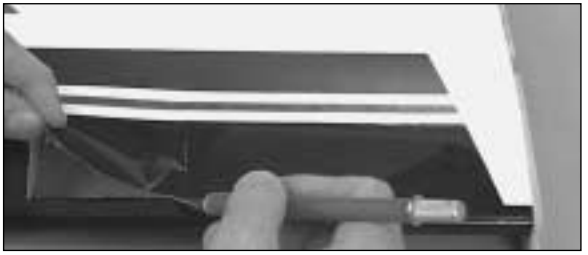
Cut Out the Aileron Servo Opening:



❏ 12. Using a sharp hobby knife or razor saw, cut out the opening for the aileron servo. Use care not to cut outside of the lines. Using a sharp hobby knife, remove the material from the inside of the aft root rib. **Caution: Be very careful not to cut into the main spars or the shear webs.**

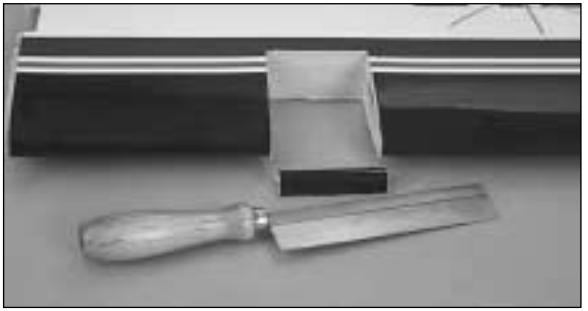
Engine Nacelle Installation

Prepare the Wing for the Engine Nacelles:



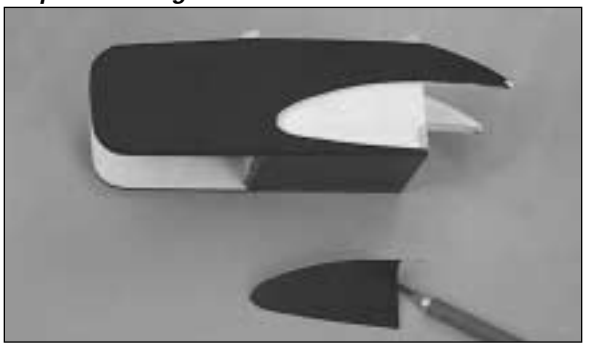
❏ 1. Measure from the root of the wing 7" (177mm) along the leading edge of the wing. This will roughly locate the **center** of the engine nacelle's location on the wing. Using a sharp hobby knife, carefully remove the covering from the wing in this area.

Remove the Leading Edge:



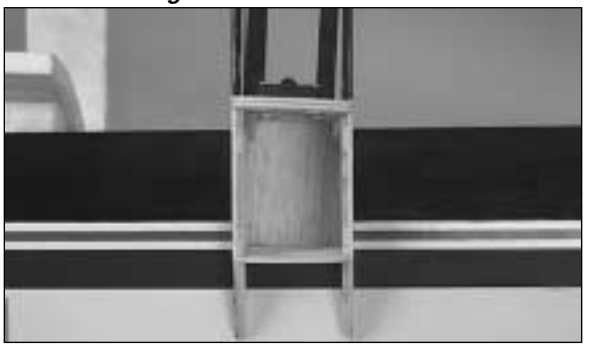
❏ 2. Using a razor saw, remove the section of leading edge necessary to fit the engine nacelles into place. Lightly sand the leading edge flush with the ribs on both sides of the nacelle opening. Sand the wing sheeting at the rear of the opening flush with the balsa shear web.

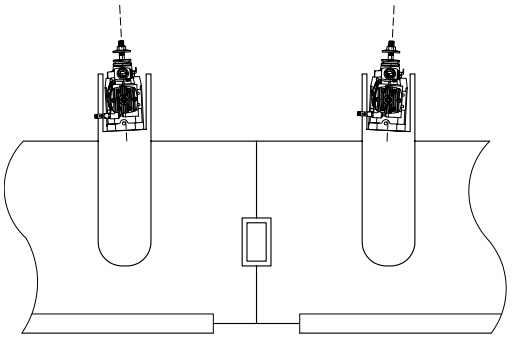
Prepare the Engine Nacelles



❏ 3. Locate the two engine nacelles. Using a sharp hobby knife, carefully remove the covering from the nacelles in the location necessary to fit them to the airfoil of the wing.

Test Fit the Engine Nacelle:

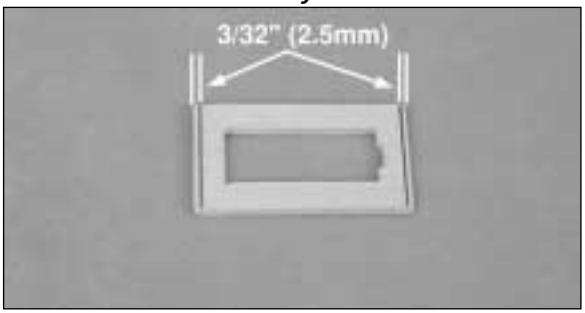




❏ 4. Use the photo and sketch to properly position the nacelles to the wing. There is a right and left nacelle, which can be easily distinguished by the angle of the firewall. When installed correctly, the engines will have outward thrust, which helps in controlling the aircraft in an engine out situation. The nacelles should slide fully against the balsa shear web. When satisfied with the fit of the nacelle, use 30-minute epoxy to secure the

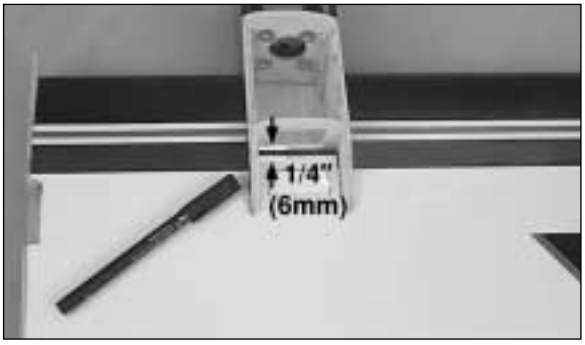
nacelle to the wing. Use masking tape to hold the nacelle in position until the epoxy has fully cured. (The photo shows the installation of the right nacelle.)

Trim the Throttle Servo Trays:



❑ 5. Locate two of the 1/8" (3mm) plywood servo trays. Carefully measure in 3/32" (2.5mm) on each side of the tray. Using a razor saw or hobby knife, trim the trays to this line.

Cut Out the Throttle Servo Hole:



❑ 6. Temporarily install the throttle servo tray so it is positioned 1/4" (6mm) from the rear nacelle former as shown in the photo. Using a felt-tip marker, trace the inside edge of the tray onto the wing. Both servo trays face the same direction.

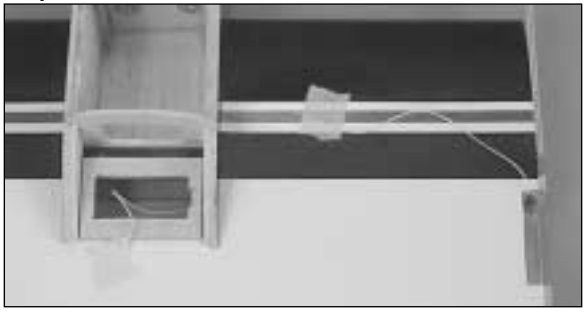
Remove the Covering for the Servo Tray:

❑ 7. Use a sharp hobby knife to carefully cut out the opening in the wing for the throttle servo. If necessary, trim the wing sheeting forward to the wing spar, being careful not to cut into the spar itself. Holding the servo tray in position, trace the outside edges of the tray. Remove the covering, being careful not the cut into the balsa sheeting of the wing.

Install the Throttle Servo Trays:

❑ 8. Use medium CA to glue the servo trays into position.

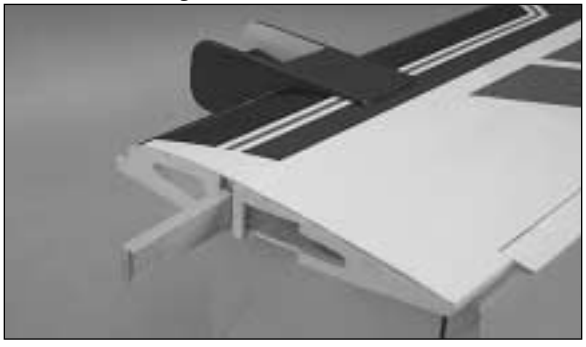
Prepare for the Servo Leads:



❑ 9. Tie a wheel collar onto one end of a 16" (410mm) piece of string. Drop the string into the opening for the throttle servo. Hold the wing so the root is towards the ground and allow the wheel collar to fall out at the root. Tape the string at the root, and at the servo opening. Cut the wheel collar from the string and repeat the process on the other wing panel. (Remember to return the wheel collar back into its original packaging for later use.) The strings will be used to pull the servo wires through the wing once the throttle servos are installed.

Join the Wing Panels

Test Fit the Wing Joiner:



❑ 1. Test fit the wing joiner into both wing panels by sliding the joiner into the joiner pocket in the panels. The joiner should slide in with little resistance up to the centerline on the joiner. Test fit the two wing panels together, making sure that they fit together flush without any gaps.

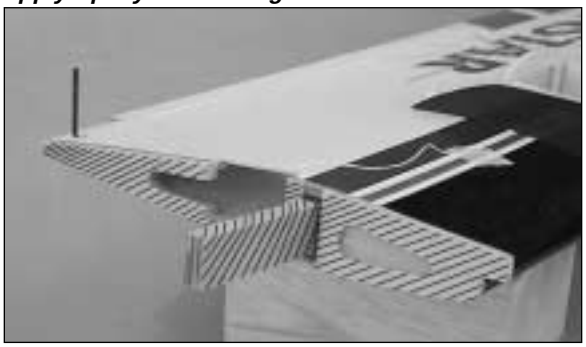
Sand the Joiner:

❑ 2. If the wing joiner will not fit in the pocket, lightly sand any excess epoxy and uneven surfaces from the joiner edges, sides and ends. **Caution:** A snug fit is desirable between the joiner and the wing pocket. Do not sand an excessive amount of material from the wing joiner.

Glue the Wing Joiner into the Wing:

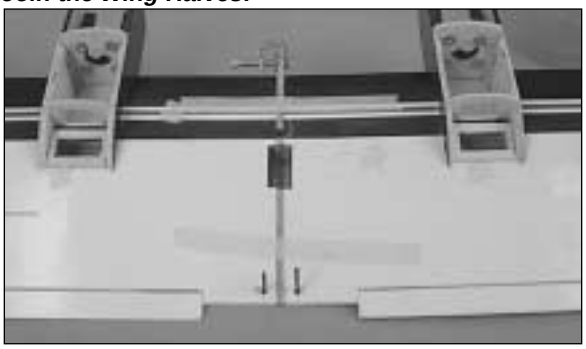
❑ 3. Mix 1/2oz (15ml) of 30-minute epoxy to glue the joiner into one wing half. Use a mixing stick or epoxy brush to apply an even coating of epoxy to all four sides of the joiner pocket. Apply a liberal coating of epoxy onto the joiner half being inserted into the wing. There should be enough epoxy applied to fill any gaps between the joiner and joiner pocket. Insert the joiner into the pocket up to the centerline marked on the joiner. Be sure the joiner is in the correct orientation to the wing to provide the proper dihedral angle. Clean the excess epoxy from the wing root rib using a paper towel dampened with rubbing alcohol. You must be sure all the excess glue is removed from the wing root ribs or the wings will not fit together correctly. Allow enough time for the epoxy to fully cure before proceeding.

Apply Epoxy to the Wing Root:



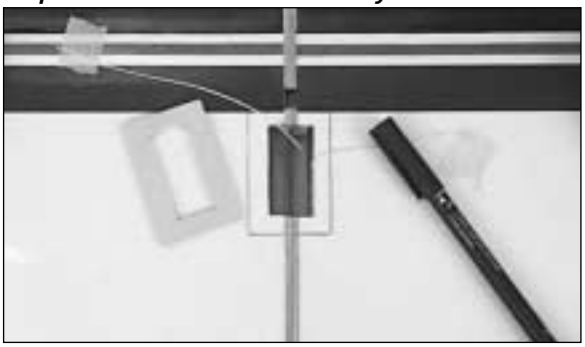
❑ 4. Mix 3/4 oz. (25ml) of 30-minute epoxy and apply an even coat to the wing root ribs of both panels. Apply an even coating of epoxy into the joiner pocket of the opposite wing panel, making sure that all the walls are evenly coated. Also, liberally apply epoxy to the exposed wing joiner.

Join the Wing Halves:



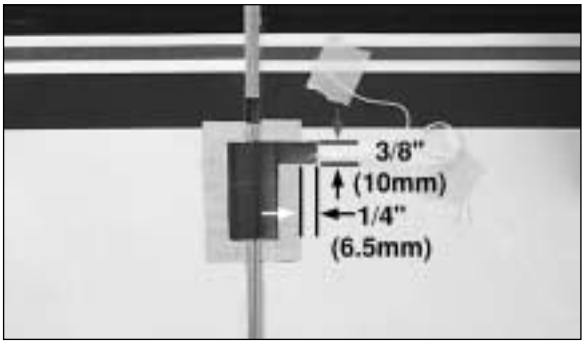
❑ 5. Assemble the two wing halves with the tightest seam possible. No gaps should be showing between the two wing panels. Clean the excess epoxy from the outside of the wing using a paper towel dampened with rubbing alcohol. Hold the wing halves in alignment while the epoxy is curing. Use several strips of masking tape on both sides of the wing to hold the panels securely together. Clamp the wing together using the tabs on the front root ribs. Allow the epoxy to fully cure before proceeding with the assembly.

Prepare for the Aileron Servo Tray:



❑ 6. Position the aileron servo tray so it is centered over the opening made in the wing. Using a felt-tip marker, trace the outside of the tray onto the wing. Use a sharp hobby knife to remove the covering for the servo tray. Use care not to cut into the underlying balsa of the wing, as this may weaken the wing.

Provide Access for the Throttle Servo Leads:

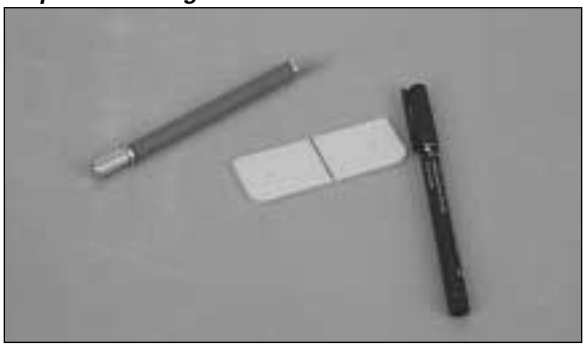


❑ 7. At this time, you will need to decide on using transmitter “mixing” or a “Y” harness to operate your throttle servos. Cut a 1/4" x 3/8" (6mm x 10mm) notch, positioned so it will be on the outside edge of the aileron servo tray. (If you are planning on mixing the throttle servos, two notches will need to be cut, positioned on either side of the aileron servo tray.) Move the guide strings to the notch before attaching the aileron servo tray.

Attach the Aileron Servo Tray:

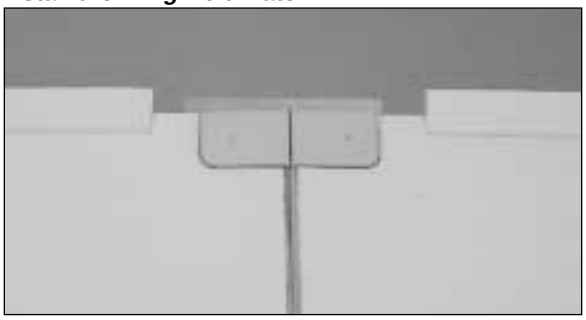
❑ 8. Use medium CA to glue the servo tray to the top side of the wing. Make sure not to glue the throttle guide strings accidentally.

Prepare the Wing Bolt Plate:



❑ 9. Lay the wing bolt plate on a table with the punch marks facing upwards. Draw a centerline across the wing bolt plate. Using a hobby knife, gently score the plate along this line. This score line is necessary to allow the wing bolt plate to be easily bent to the dihedral angle of the wing and should not be cut completely through the plate.

Install the Wing Bolt Plate:

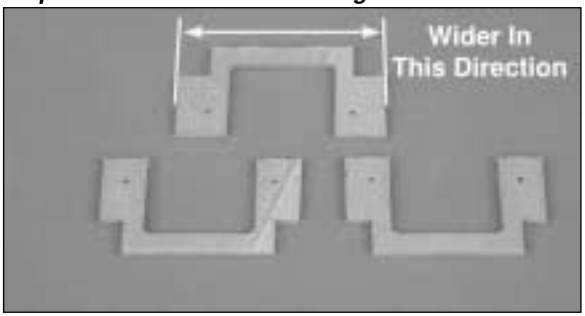


❑ 10. Center the plate at the trailing edge on the **bottom** of the wing. Use the centerline to assist in the alignment of the plate. Using a felt-tip marker, draw a line around the plate. Carefully remove the covering with a hobby knife. Be careful not to cut into the underlying balsa. With the punch marks facing upwards, glue the plate in position using medium CA. Be careful not to get CA into the holes at the aileron torque rods. Wick thin CA along the score line of the wing bolt plate. Locate the 2" x 4" (50mm x 100mm) piece of adhesive backed covering in the kit. Remove the backing, and apply the covering to the plate. Apply the covering for the center wing ribs. (See the photo at **Install the Wing Bolts** for clarification.)

Mounting the Wing

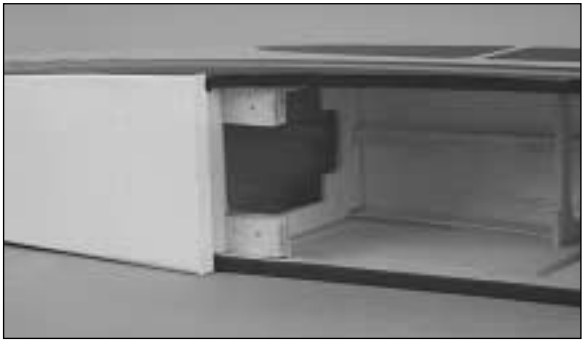
Note: The following step is similar to that of preparing the wing joiners. Read through the step to familiarize yourself with the procedure before actually performing the step.

Prepare and Assemble the Wing Hold-Down Plate:



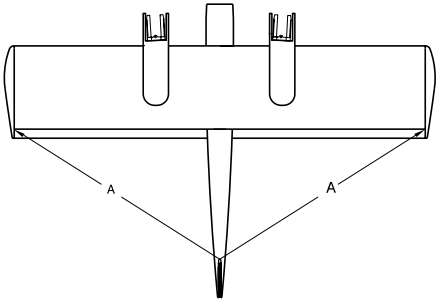
❑ 1. Locate and separate the three 1/8" (3mm) plywood wing hold-down plates from each other using a razor saw or hobby knife. Lightly sand the plates to remove any rough edges. Measure and mark the wider plate so that it can be positioned correctly during this step. Mix approximately 1/4oz. (7.5ml) of 6-minute epoxy. Using a mixing stick or epoxy brush, apply an even coat of epoxy on both sides of one of the smaller wing hold-down plates. Sandwich this coated joiner between the remaining two plates. Excess epoxy will squeeze out of the seams between the plates and must be removed before the epoxy is allowed to cure. Use a paper towel dampened with rubbing alcohol to remove any excess epoxy. Use clothespins to clamp the plates firmly together. If any more epoxy squeezes out, remove it using a paper towel. Make sure that the plates are evenly lined up with each other. Allow the epoxy to fully cure before proceeding to the next step.

Install the Hold-Down Plates:



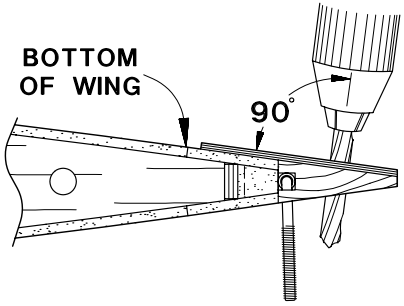
❑ 2. Test fit the assembled wing hold-down plates into the fuselage. The wider plate will enter the fuselage first, and locks into the fuselage sides. Sand or trim the plate to achieve the best fit. Remove the plate and glue it into position using 6-minute epoxy. Allow the epoxy to fully cure before proceeding to the next step.

Aligning the Wing:



❑ 3. Position the wing on the fuselage with the centerline of the wing along the centerline of the fuselage. Hold a string (with one end attached to a pin centered at the aft end of the fuselage), out to a wing tip. Put a piece of tape on the string to mark the intersection of the string and the wing tip. Swing the string over to the opposite wing tip and check to see if the distances are the same. Make slight adjustments to the angle of the wing until the distances from the tail to each wing tip are equal.

Drill for the Wing Bolts:

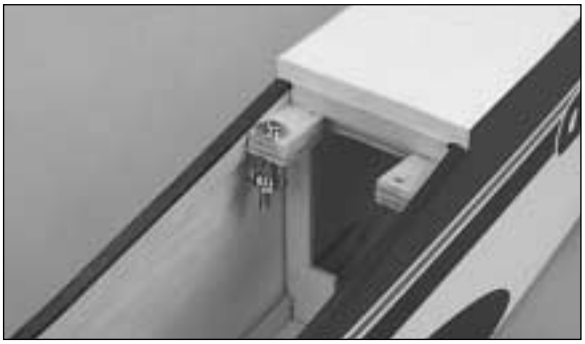


❑ 4. With the wing in place and aligned to the fuselage, use a 5/32" (4mm) drill bit to drill through both the wing bolt plate and the wing hold-down plate of the fuselage. **Note:** Make sure that the drill bit remains square to the wing bolt plate while drilling.

Prepare for the Blind Nut Installation:

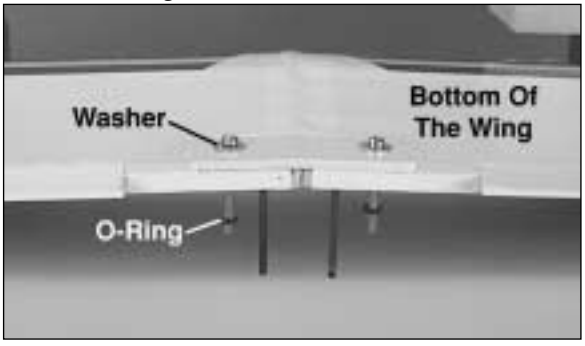
❑ 5. Enlarge the holes in the wing hold-down plate to 3/16" (5mm). A prop reamer or drill bit may be used for this operation.

Install the Blind Nuts:



❑ 6. Slide a 4mm washer onto one of the 4mm wing bolts. Slide the bolt through the wing hold-down plate. Thread a 4mm blind nut with the “pronged” side up partially onto the wing bolt from the underside of the plate. Put a small amount of 6-minute epoxy onto the prongs, then draw it up into the plate by tightening the bolt. Repeat this process for the other blind nut. Be careful not to get any epoxy onto the threads of either the nut or bolt during this procedure. Remove the bolts.

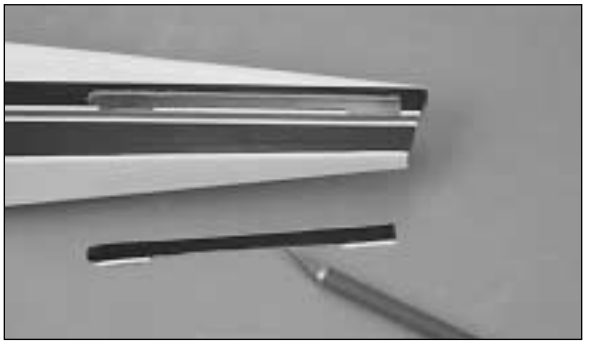
Install the Wing Bolts:



❑ 7. Slide the bolt/washer combination from the last step through the wing from the bottom. Slide a 4mm rubber O-Ring onto the bolt from the top of the wing. The O-Ring will keep the bolt from falling out of the wing during transport.

Install the Elevator and Rudder

Locate the Stabilizer Slot:

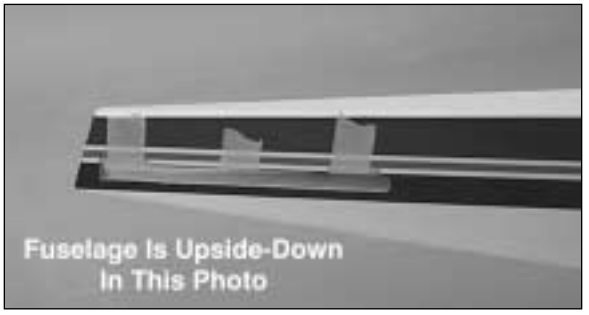


❑ 1. Locate the horizontal stabilizer slot under the covering on the tail section of the fuselage by pressing lightly with your finger. The slot will be located on both sides of the fuselage. Using a sharp hobby knife, carefully remove the covering, exposing the slots. **Note:** Do not cut into the wood around the slot.

Install the Stabilizer Mount:

❑ 2. Locate the 1/8" (3mm) stabilizer mounting plate and trial fit it into the bottom of the horizontal stabilizer slot. Lightly sand the plate if necessary to obtain a good fit.

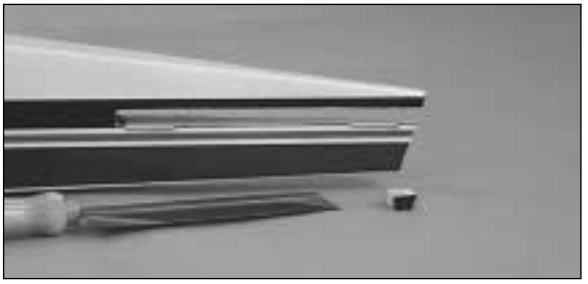
Glue the Mount into Position:



❑ 3. Mix 1/8oz (3.5ml) of 30-minute epoxy. Using a mixing stick, apply a generous amount of glue into the slot and position the mounting plate, pressing it firmly

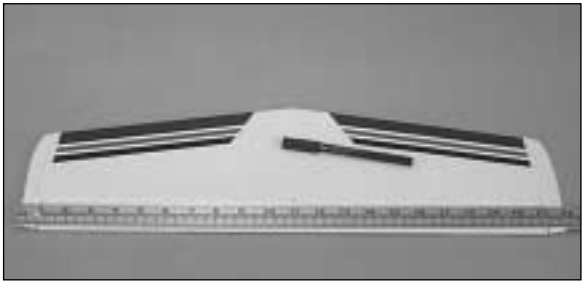
into position. Remove any excess epoxy from the fuselage sides and the exposed portion of the stabilizer mount using a paper towel dampened with rubbing alcohol. Use masking tape to hold the plate securely in position. Turn the fuselage over on your work bench, resting it on its top. This will allow the epoxy to remain in the joint between the fuselage and plate and provide for a secure bond between both items. Allow the epoxy to fully cure before proceeding.

Remove the Tail Post:



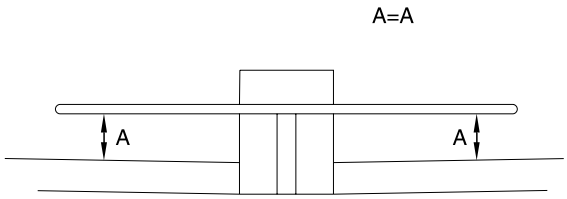
❑ 4. Located at the rear of the fuselage, behind the horizontal stabilizer slot, is the balsa tail post. The post is necessary for alignment during the manufacture of the kit. The post must be removed in order to install the horizontal stabilizer. Using a razor saw, cut the post even with the slot as shown in the photo. Lightly sand the area where the post was removed to even it up with the stabilizer slot.

Mark the Centerline of the Stabilizer:



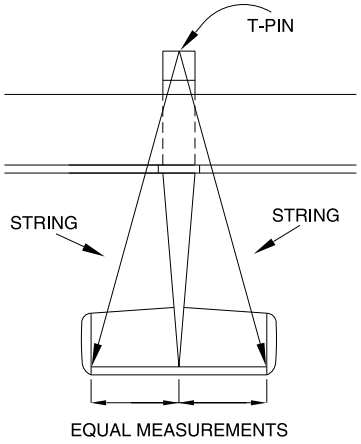
❑ 5. Locate the horizontal stabilizer. Measure and mark the exact center on the top of the trailing edge, in the elevator gap, as shown.

Align the Stabilizer with the Wing:



❑ 6. Insert the stabilizer into the horizontal stabilizer slot, using the mark made in the previous step to center the stabilizer. Attach the wing to the fuselage and view the plane from the rear at a distance of around 6'-8' (2m-2.5m). The stab should be positioned parallel with the wing. If it is not, remove the stabilizer and lightly sand the stabilizer mount on the side that was positioned higher. Only a small amount of sanding is necessary to make large adjustments. Insert the stab and re-check the alignment. Continue sanding and checking until the stab and wing are parallel.

Align the Stabilizer with the Fuselage:

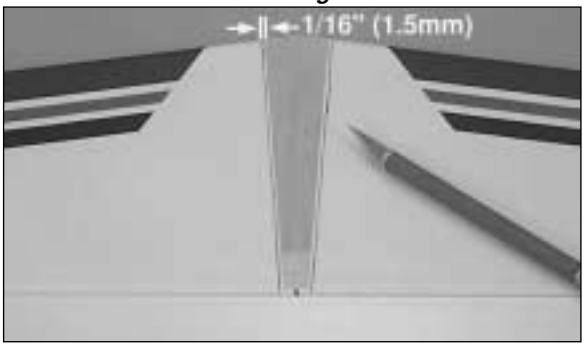


❑ 7. Attach a piece of string with a pin to the center of the fuselage as shown. Hold the string out to a stab tip. Put a piece of tape on the string to mark the intersection of the string and the tip. Swing the string over to the opposite tip and check to see if the distances are the same. If the distances are not equal, make slight adjustments to the angle of the stab until the distances from the tail to each tip are equal.

Mark the Stab Location:

❑ 8. Using a felt-tip pen, trace a line around the tail of the fuselage on the top and bottom of the stabilizer. Be careful not to change the alignment of the stab during this step.

Remove the Center Covering:

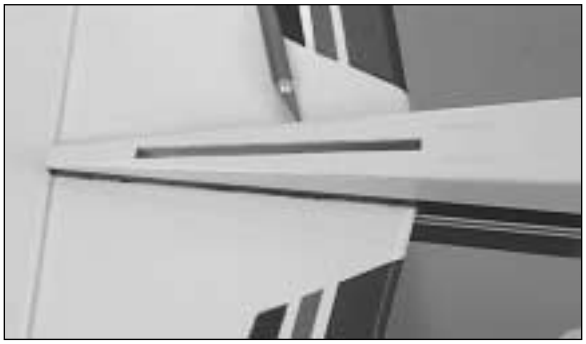


❑ 9. Remove the stab and draw two additional lines, on the top and bottom, 1/16" (2mm) inside the lines drawn in the previous step. Next, using a hobby knife and a **new #11 blade,** carefully cut through the covering at the inside lines and remove the covering from the center. **Do not cut the wood under the covering! This would seriously weaken the stab and could easily cause the stab to break in flight. If the stab breaks the plane may crash, so be be very careful when making this cut.**

Install the Stabilizer:

❑ 10. Mix 1/4oz (7.5ml) of 30-minute epoxy. Using a mixing stick, place glue inside the horizontal stabilizer slot on all sides including the horizontal stabilizer mount. Insert the stabilizer from the rear, and adjust the alignment. Wipe off any excess epoxy that may squeeze out using a paper towel dampened with rubbing alcohol. Check the alignment of the stabilizer to the fuselage and wing before the epoxy has had a chance to cure. Periodically check the stabilizer alignment while the epoxy is allowed to fully cure.

Locate the Vertical Fin Slot:

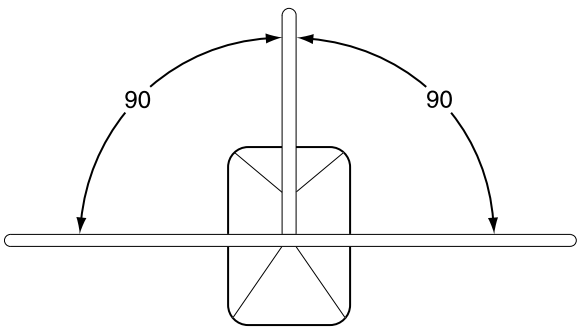


❑ 11. Using your finger, locate the vertical fin slot on the top of the fuselage. Remove the covering with a hobby knife.

Prepare the Vertical Fin:

❑ 12. Test fit the fin into the slot in the top of the fuselage. Using a felt-tip pen, trace a line around the front of the fin onto the fuselage. Remove the fin. Use a hobby knife to carefully remove the covering from the fuselage. Be careful not to cut into the underlying balsa directly under the fin in front of, and behind the slot.

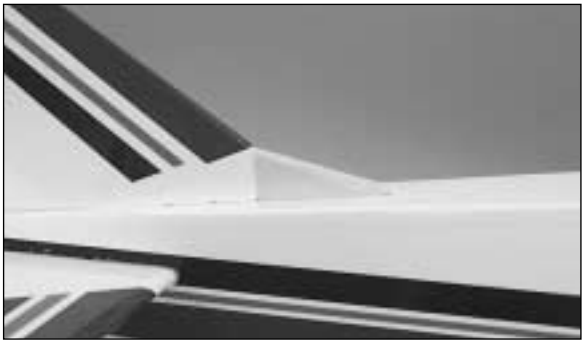
Secure the Vertical Fin:



❑ 13. Mix 1/4oz (7.5 ml) of 30-minute epoxy. Using a mixing stick, apply epoxy to the top of the horizontal stabilizer through the slot for the vertical fin. Apply epoxy to the sides and bottom surfaces of the vertical fin that have balsa wood exposed. Insert the fin into the

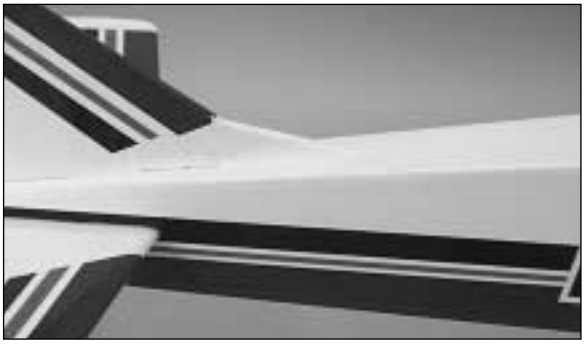
slot, making sure the fin base is seated firmly on the horizontal stabilizer. Check for a perpendicular angle between the fin and the horizontal stabilizer when viewing from the rear. Check this alignment several times as the epoxy cures. Masking tape can be used to help hold the fin in alignment while the epoxy cures.

Attach the Dorsal Fin:



❑ 14. Locate the 1/4" (6mm) balsa dorsal fin. Test fit the placement of the dorsal fin, and sand if necessary to fit the dorsal fin to the vertical fin and fuselage. Use a felt-tip marker to trace around the dorsal fin onto the fuselage. Trim the covering from the fuselage using a sharp hobby knife. Using medium CA, glue the dorsal fin into position.

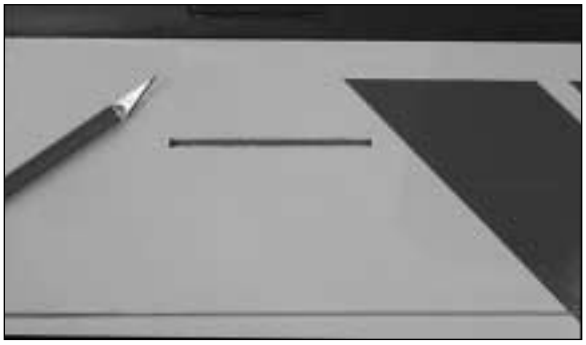
Cover the Dorsal Fin:



❑ 15. Once the CA has cured, apply the covering material over the dorsal fin, starting at the top and working the covering down either side of the fin. It may be necessary to trim the material to allow it to form to the dorsal fin and fuselage.

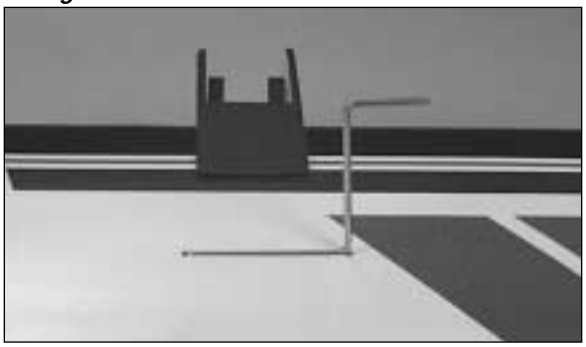
Install the Landing Gear

Locate the Main Gear Channel:



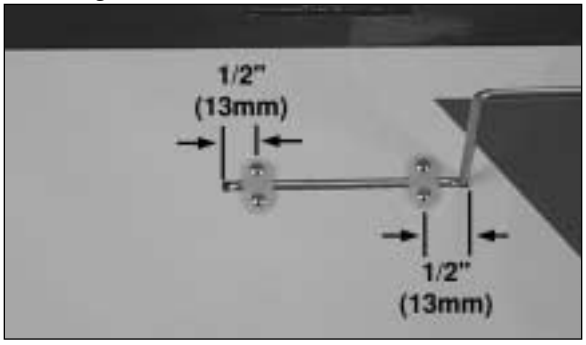
❑ 1. On the bottom of the wing, there are channels for installing the main gear. These can be located by running your finger over the covering on the bottom of the wing. Trim the covering from the channels using a sharp hobby knife.

Fitting the Gear:



❑ 2. Test fit the main landing gear wires into the channels of the wing. If the wire does not go in easily, drill out the two holes using a 5/32" (4mm) drill bit. Be careful not to drill through the top of the wing.

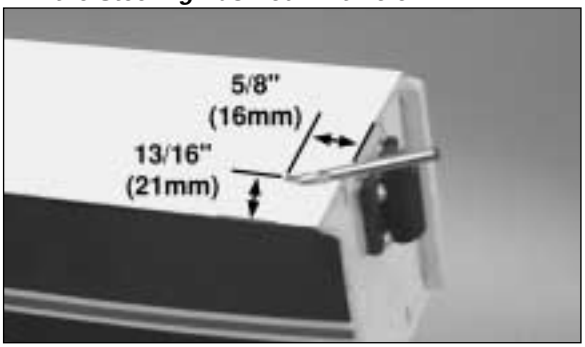
Mounting the Main Gear Wires:



❑ 3. Measure approximately 1/2" (13mm) from each end of the wire and mark this location on the wing.

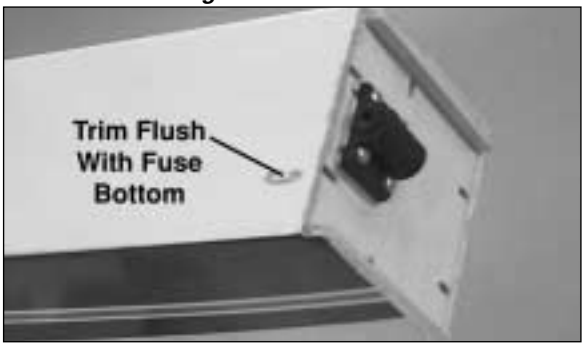
Position the nylon landing gear straps so they are centered over the wire and on the marks. Drill pilot holes using a 1/16" (1.5mm) drill bit. Using four 2.5mm x 10mm self-tapping screws, fasten the landing gear straps to the bottom of the wing over the struts.

Drill the Steering Pushrod Exit Hole:



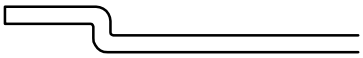
❑ 4. Make a mark on the bottom of the fuselage 5/8" (16mm) back from the front former as shown in the photo and 13/16" (21mm) from the side of the fuselage. Drill a 5/32" (4mm) hole at a 70 degree angle at the mark towards the rear of the fuselage. **Note:** The angle of the hole must be shallow to prevent binding of the pushrod wire.

Install the Steering Guide Tube:



❑ 5. Locate one of the 13-7/8" x 1/8" (352mm x 3mm) pushrod tubes. Roughen the outside of the tube and clean it using a paper towel and rubbing alcohol. This is necessary to help the glue to adhere to the tube. Insert the tube into the hole made in the fuselage. Use medium CA to glue the tube into position. Trim the tube flush with the bottom of the fuselage.

Prepare the Steering Pushrod Wire:

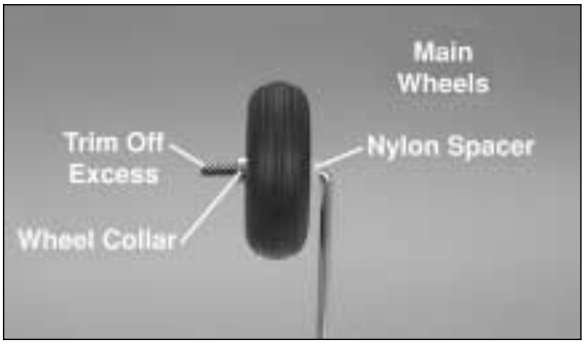


❑ 6. Make a “Z” bend at one end of a 17-3/4" x 1/16" (1.5mm x 450mm) pushrod wire. **Note:** Hobbico offers pliers that easily make perfect “Z” bends (HCAR2000).

Install the Nose Gear Strut:

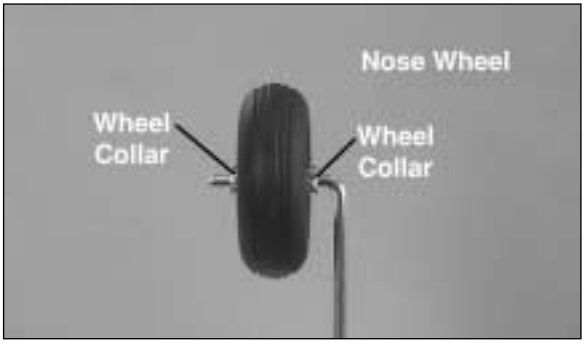
❑ 7. Attach the “Z” bend to to the steering arm in the hole farthest from the center of the arm. Slide the wire into the the pushrod tube so that the steering arm is positioned with the screw hole facing forward. Trim one of the 5/32" x 3/8" (4mm x 9.5mm) nylon wheel spacers from the nylon parts tree. Install the nose gear strut through the steering arm with the arm positioned away from the coil. Next, slide the nylon spacer onto the strut. Pass the strut through the pre-installed nylon steering bearing located on the former. Slide a wheel collar onto the strut from the top side. Install a 3mm x 5mm screw into the wheel collar, and secure the collar flush with the top of the strut, tightening the screw onto the flat on the nose gear strut. Slide the steering arm up so the nylon spacer is tight against the nose gear bearing. Install a 3mm x 8mm screw into the steering arm and tighten the screw onto the flat on the nose gear strut. When properly installed, the collar and steering arm will prevent the nose gear wire from moving up or down in the nose gear bearing.

Install the Main Wheels:



❏ 8. Trim the two remaining 5/52" x 3/8" (4mm x 9.5mm) nylon wheel spacers from the nylon parts tree. Slide the spacers onto the **main** gear struts. Next, slide the wheel onto the strut. Make sure that the wheel can rotate freely on the axle. If it does not, drill the opening in the wheel using a 5/32" (4mm) drill bit. Prepare a wheel collar by partially installing a 3mm x 5mm screw into the collar, and slide it onto the gear wire. Slide the collar next to the wheel, but not as to cause binding of the wheel. Secure the position of the collar by tightening the screw.

Install the Nose Wheel:

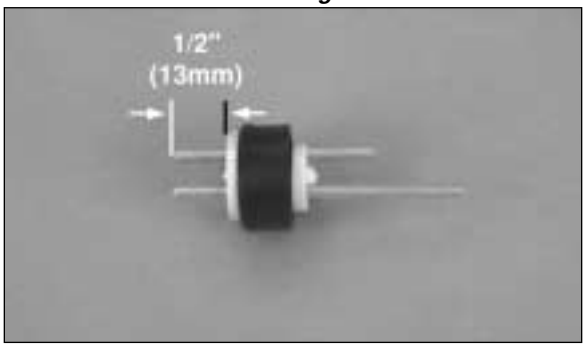


❏ 9. Using the same basic technique as the main wheels, attach the nose wheel to the nose gear strut. The difference is wheel collars are on both sides of the nose wheel. Center the nose wheel on the axle and tighten the screws in the collars to secure the position of the wheel.

At this time, you can elect to cut off any excess gear wire that extends beyond the wheel collars. The performance of the aircraft won't be affected much, but it will look better if the wires are trimmed.

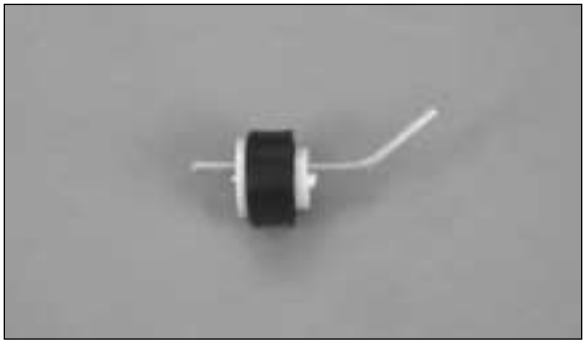
Fuel Tank Installation

Assemble the Fuel Tank Plugs:



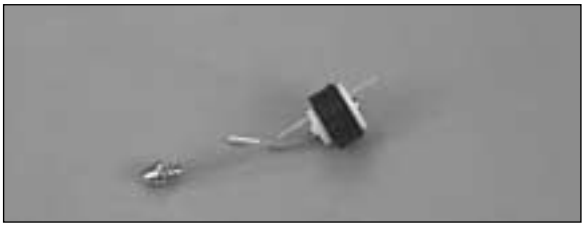
❏ ❏ 1. Push one long and one short aluminum tube through the black rubber stopper. It may be helpful to lubricate the tubes with a thin film of oil. (The third aluminum tube will not be used, nor will the remaining hole in the stopper.) Place the two white plastic disks over the tubes. The larger disc is placed towards the front of the stopper, which will be on the outside of the tank. The small protrusion of the small disc should face away from the stopper. Insert the 3mm x 18mm self tapping screw through the larger disc, rubber plug and then into the smaller disc. Do not tighten the screw at this time. Position the aluminum tubes so they extend 1/2" (13mm) in front of the larger disc.

Bend the Vent Tube:



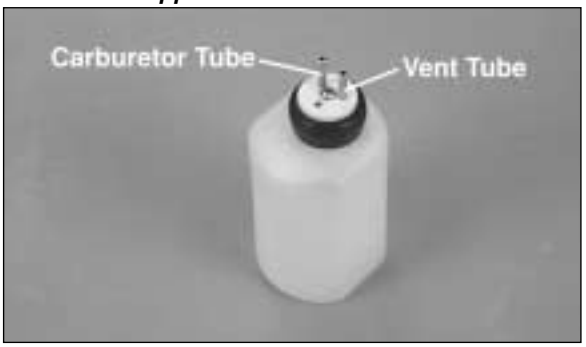
❏ ❏ 2. Bend the longer tube upwards as shown so that it will come within 1/16" (1.5mm) from touching the top of the tank when installed. Use your fingers to bend the tube, but be careful not to kink the tube during this process.

Install the Clunk:



❑❑ 3. Locate the metal fuel pick-up weight (referred to as the “clunk”) and the fuel tubing. Cut the fuel tubing so it is only 2-1/4" (57mm) long. Attach the fuel tubing to the shorter, unbent tube and to the clunk.

Install the Stopper:



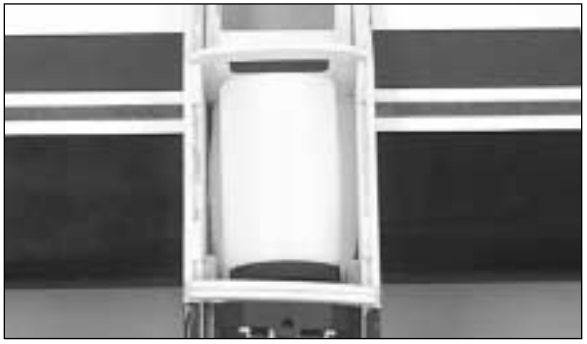
❑❑ 4. The stopper assembly can now be inserted into the tank. The vent tube should be adjusted so the tube is pointed upward just under the top of the tank. The rubber stopper must seat over the lip of the tank. Make sure that the tubes are positioned side to side. Tighten the stopper by turning the self tapping screw. Do not over-tighten the screw or you may strip out the plastic disc. It is suggested you mark the vent and carburetor lines on the plastic disc before proceeding. This will help when attaching the fuel lines to the engine in later steps.

Install the Foam Collar:

❑❑ 5. Locate the foam collar. Remove the inner foam circle and place the foam collar around the neck of the fuel tank.

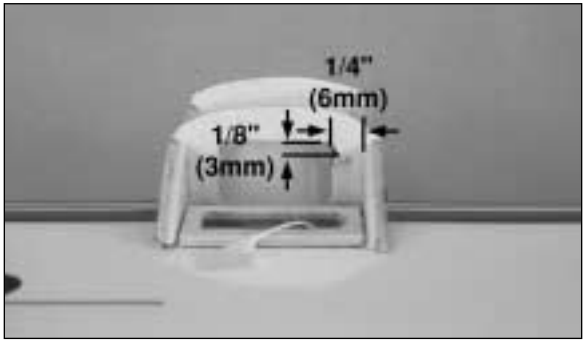
Now would probably be the best time to fuelproof the engine and fuel tank compartments. Use your favorite method for this process. We recommend using 30-minute epoxy thinned with isopropyl alcohol, then just brush the mixture onto the surface you want to fuelproof. It is necessary to remove the engine mounts to fully fuelproof the firewall. Be careful not to get any of the mixture into the blind nuts installed in the firewall. Once the mixture has cured, re-attach the engine mounts to the firewall. We recommend using a thread locking compound on the bolts.

Install the Tanks:



❑❑ 6. Place a 1/4" (6.5mm) piece of foam in the bottom of the fuel tank compartment. With the vent tube (inside the tank) pointing upwards, insert the fuel tank into the engine nacelle.

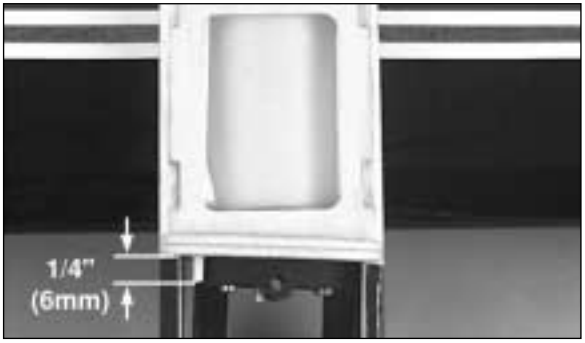
Install the Throttle Pushrod Tubes:



❑❑ 7. Locate one of the 13-3/4" (350mm) pushrod tubes, and cut off two 4" (100mm) pieces. Cut a 5/32" (4mm) notch in the rear nacelle former as shown in the photo. Pass a 4" tube through the hole in the firewall, and out towards the rear of the nacelle so it rests along the side of the fuel tank. Position the tube so 1/4" (6mm) of the tube is exposed in front of the firewall. (The following photo illustrates the position of the pushrod tube.) Use medium CA to glue only the front of the tube in position. Once the tube is secured, use 1/4" (6mm) foam to pad

the sides and rear of the tank to prevent fuel foaming caused by engine vibration. Do not glue the tube at the rear former. It will be glued into position after the throttle servos are installed.

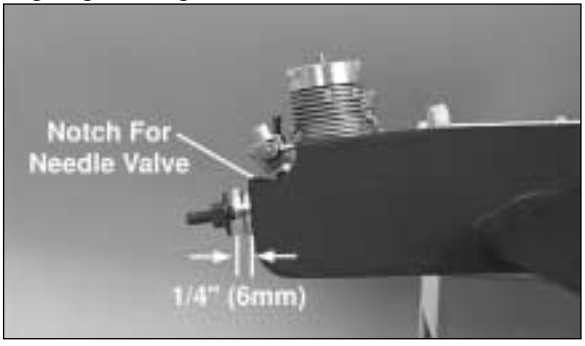
Install the Tank Braces:



❑ 8. Locate two 1/8" (3mm) plywood fuel tank braces. Test fit the braces into position, paying attention to the angled front that matches the firewall angle. It may be necessary to lightly sand the braces to achieve a proper fit. Once satisfied with the fit, glue the braces into position using medium CA.

Install the Engines

Aligning the Engine:

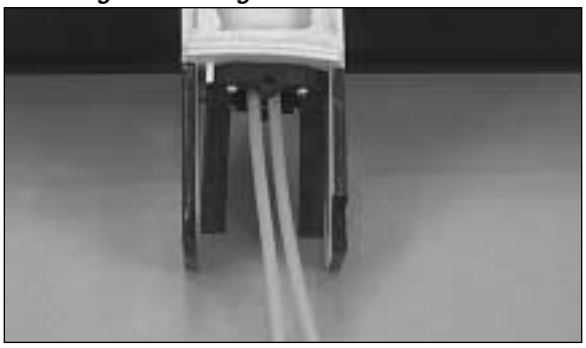


❑ 1. Position the engine on the mount so that the face of the engine thrust washer is at least 1/4" (6mm) forward of the nacelle sides. Depending on your engine selection, it may be necessary to lightly trim the engine nacelle to allow for needle valve clearance. Align the engine so that the crankshaft is parallel with the engine mount rails. Mark the engine mount rails at the four mounting hole locations on the engine using a 3/32" (2.5mm) drill bit to scribe a mark.

Drill the Mounting Holes:

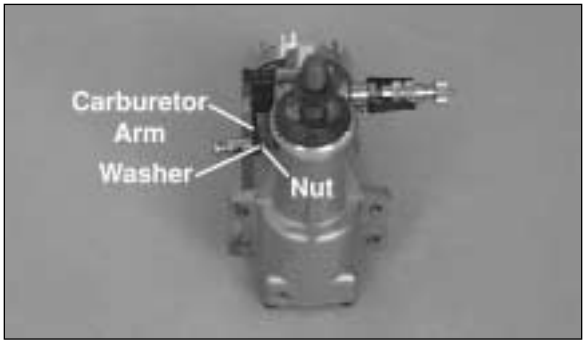
❑ 2. Remove the engine from the mount and drill four 3/32" (2.5mm) holes at the marks you just made. Make sure to keep the drill perpendicular to the mount while drilling. If a drill press is accessible, using it for this process is recommended.

Attaching Fuel Tubing:



❑ 3. Cut two 6" (150mm) lengths of medium fuel tubing (not included). Attach one piece of fuel tubing to each of the aluminum tubes coming from the fuel tank.

Install the Pushrod Connector:



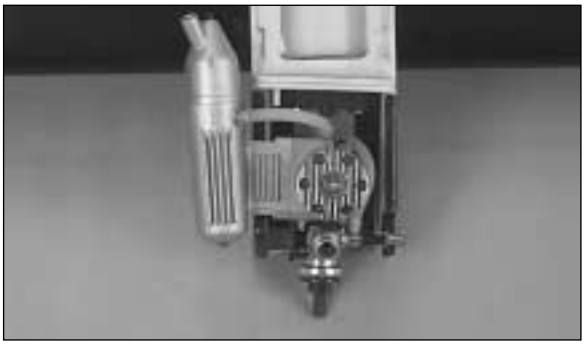
❑ 4. Locate a pushrod connector, 2mm nut, 2mm washer and 3mm x 5mm machine screw. Install the connector into the throttle arm of your engine in the hole located farthest away from the center of the arm. Apply screw locking compound to the 2mm nut and secure the connector to the arm. Make sure not to overtighten the nut which could prevent the connector from rotating. Temporarily attach the 3mm x 5mm screw to the connector.

Note: If you are using an engine other than the O.S. .25 FP, it may be necessary to purchase a set of Great Planes Screw-Lock Pushrod connectors (GPMQ3870) and two 4-40 set screws. This is to allow for clearance between the connector and fuselage side with larger sized engines.

Install the Engines:

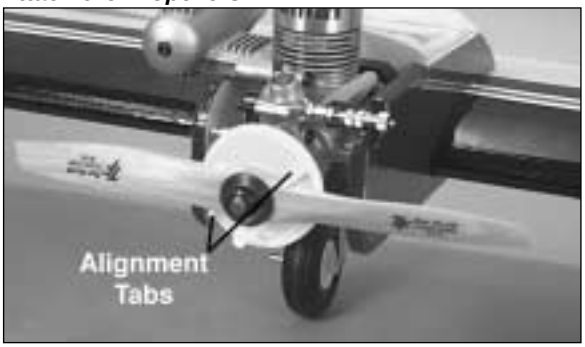
❑ ❑ 5. Place the engine on the mount, and secure it using four 3mm x 18mm self-tapping screws.

Install the Mufflers:



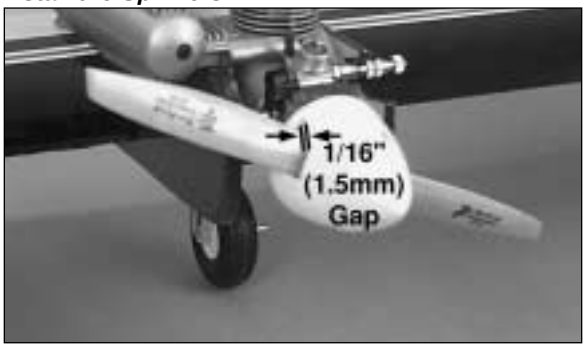
❑ ❑ 6. Install the muffler onto the engine using the screws that were provided with your engine. It may be necessary to slightly trim the engine nacelle to provide a 1/4" (6mm) gap between the muffler and the engine nacelle side. Attach the fuel tubing from the "vent" in the fuel tank to the muffler pressure tap. Attach the tubing from the "clunk" in the fuel tank to the carburetor. **Note:** You may need to shorten the fuel lines for a more direct routing. Make sure that the lines are not kinked during the routing, as this will restrict fuel flow and will reduce engine performance significantly.

Attach the Propellers:



❑ ❑ 7. If necessary, enlarge the hole in the spinner backplate to fit onto your particular engine. It is best to use a prop reamer for this procedure. Install the spinner backplate, propeller, propeller washer and propeller nut onto the engine. Position the propeller so it is horizontal when the engine is against compression (the point at which resistance is felt as the engine is rotated counter-clockwise). This is a good practice to follow, because if the engine were to stop running during flight, the propeller will stop in this position, and the chances of propeller breakage during landing will be greatly reduced. The spinner backplate is properly positioned when the propeller is almost touching the alignment tabs on the spinner backplate. Use an adjustable wrench (not a pliers) to fully tighten the propeller nut.

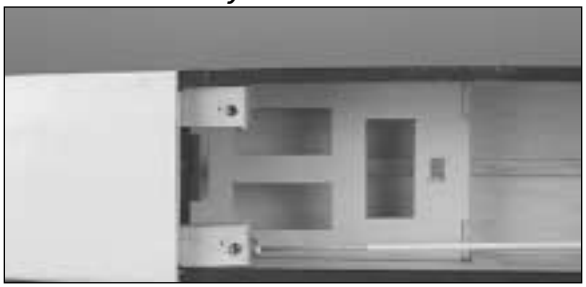
Install the Spinners:



❑ ❑ 8. Test fit the spinner cone onto the spinner backplate. Check to make sure that there is at least a 1/16" (1.5mm) gap between the openings for the propeller in the spinner cone and the propeller. If not, trim the spinner to provide the 1/16" (1.5mm) clearance necessary. Once satisfied with the fit of the spinner cone, attach the cone using the 2.5mm x 12mm self-tapping screws provided with the spinner. Be careful not to over-tighten these screws. They are threaded into plastic which can strip out if they are over-tightened. Repeat steps 4-8 for the other engine.

Radio Installation

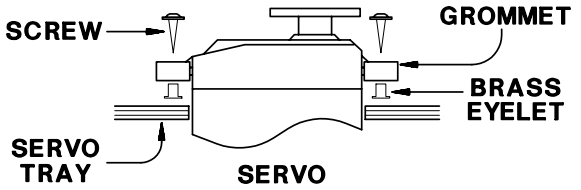
Install the Servo Tray:



❑ 1. Locate the 1/8" (3mm) plywood servo tray. Test fit the tray into position in the fuselage. Make sure it rests

against both the former at the rear and the tray support at the front. Sand the tray if necessary to provide a snug fit of the tray into the fuselage. Once satisfied with the fit, glue the tray into position using 6-minute epoxy. Save the excess plywood from the servo cut-outs for use later.

Install the Servos:



❑ 2. Use the following sequence for mounting the servos into the servo tray:

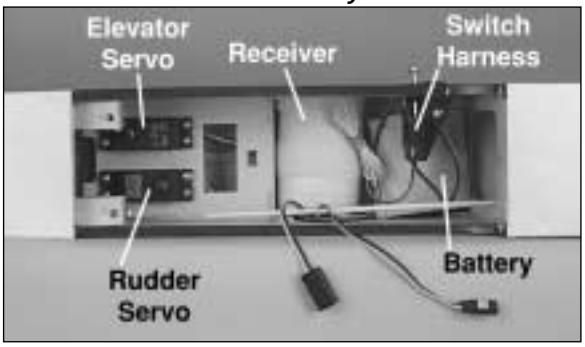
A. Install the rubber grommets and brass eyelets in the servos using the illustration as a guide.

B. Test fit the servos into the servo tray. Enlarge the openings if needed to provide a 1/32" (1mm) gap between the servo and the servo tray on all sides of the servo.

C. Mark the mounting hole locations on the tray, then drill a 1/16" (1.5mm) pilot hole at each mark.

D. Mount the servos to the servo tray using the hardware provided with the radio system.

Install the Receiver and Battery:



❑ 3. Wrap the receiver and battery pack with 1/4" (6mm) foam (not included). Use rubber bands or masking tape to hold the foam in position. Install the battery and receiver as shown in the photo. **Note:** It may be necessary to change the locations of these items, so don't secure them permanently at this time.

Connect the Rudder and Elevator Servos:

❑ 4. Following the manufacturer's recommendations, connect the rudder and elevator servos to the receiver. Plug in the extensions necessary for the aileron and throttle(s) at this time. Plug the battery into the switch harness, and the harness into the receiver. Mount the switch harness to the side of the fuselage as shown. We added a Great Planes Switch Mount & Charge Jack (GPMM1000, not included) for convenience and ease of use at the field. Center the rudder and elevator trims on the transmitter. Turn on the radio (transmitter first) and center the servo horns on the rudder and elevator servos. Turn the radio system off (receiver first) after the servo horns are re-installed onto the servos.

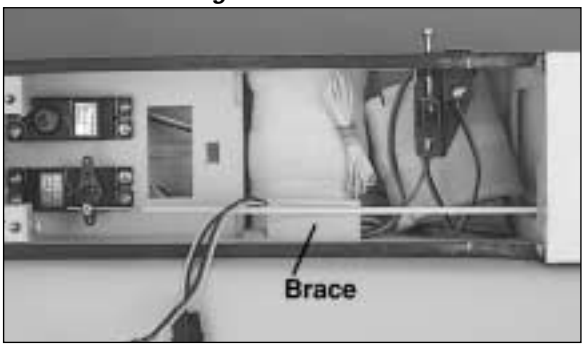
Attach the Steering Connector:

❑ 5. Install the remaining pushrod connector to the rudder servo horn using the same technique used for the connectors on the throttle arm. Use the hole closest to the center of the servo horn for attachment. The preferred arm is the one that is nearest to the fuselage side. (*See the following photo for the proper positioning of the connector.)*

Connect the Steering Linkage:

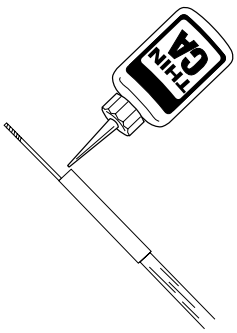
❑ 6. Pass the steering pushrod wire through the connector on the servo. After making sure that the horn is centered and the wheel is set to provide straight tracking, tighten the screw to secure the wire. Trim the excess wire that extends behind the connector using wire cutters or a Dremel® Moto-Tool® and a cut-off wheel.

Secure the Steering Pushrod Tube:



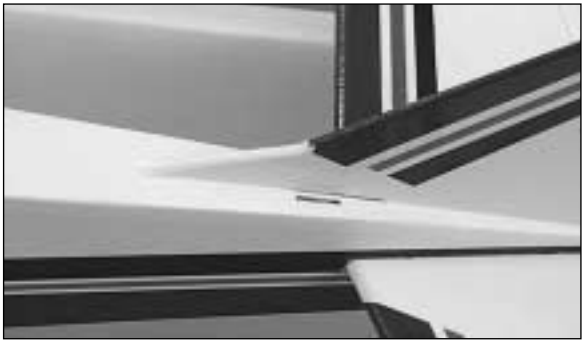
❏ 7. Using the scrap plywood from the servo tray, install a brace for the steering pushrod tube. Use medium CA to attach the brace to the fuselage side. Medium CA is also used to attach the tube to the brace.

Prepare the Pushrods:



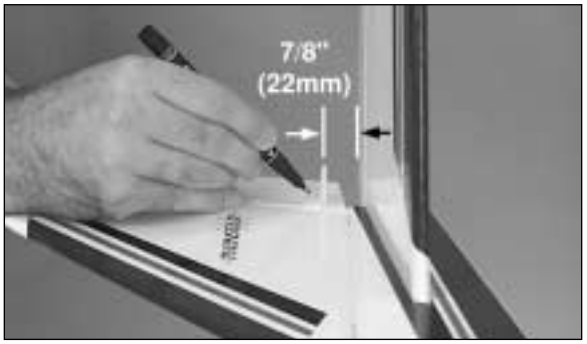
❏ 8. Locate the two wooden dowel pushrods and apply thin CA to the ends of the shrink tubing on both rods.

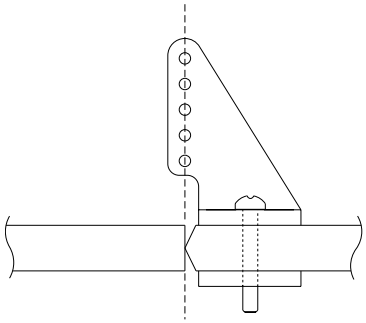
Locate the Rudder Exit:



❏ 9. The rudder pushrod exit is located on the top of the fuselage on the left side of the fin. Carefully remove the covering from the opening using a sharp hobby knife.

Position the Rudder Control Horn:





❏ 10. Carefully remove one of the nylon control horns from the nylon parts tree. Position the horn so it is 7/8" (22mm) above the elevator and on the same side as the pushrod exit. Using the illustration, position the horn so the holes align along the hinge line of the rudder and fin. Mark the positions of the holes on the rudder using a felt-tip marker.

Attach the Rudder Control Horn:

❏ 11. Drill the locations marked in the previous step using a 3/32" (2.5mm) drill bit. Place two 2mm x 16mm machine screws into the control horn, and slide the horn and screws into the holes. Remove a control horn backing plate from the nylon parts tree, and thread the screws into the plate on the opposite side of the rudder. Tighten the screws, but not so much that you crush the balsa. Cut-off the excess screws extending past the backing plate.

Install the Rudder Pushrod:

❑ 12. Insert the pushrod, threaded end first, into the fuselage. Pass the pushrod out through the exit.

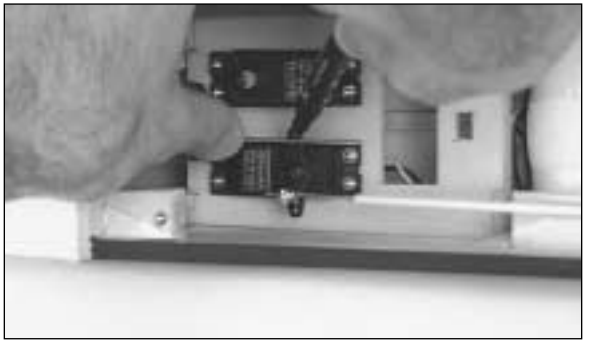
Install the Clevis:

❑ 13. Remove one of the nylon clevises from the parts tree. Locate the piece of 2-1/2" (65mm) clear tubing and cut a 1/4" (6mm) length from the tubing. Slide the tubing over the wire, then thread the clevis onto the wire. Thread the clevis until the threads are even with the opening between the forks of the clevis. This is done to make sure the clevis is securely attached to the pushrod wire.

Attach the Rudder Pushrod:

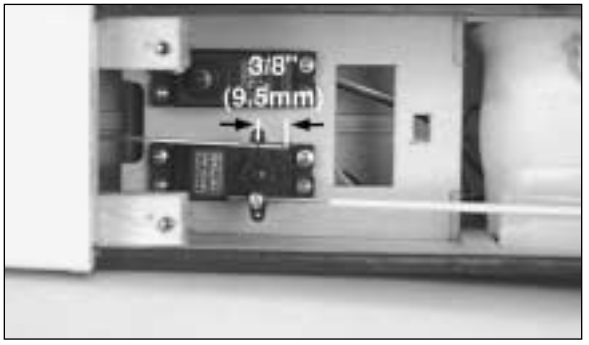
❑ 14. Attach the rudder pushrod clevis to the control horn as shown in the photo. Use the center hole in the horn as the attachment point. Enlarge the opening slightly, if needed, to prevent binding.

Mark the Rudder Pushrod:



❑ 15. After checking to make sure the servo arm is centered, check that the rudder is aligned with the fin. While making sure the rudder and servo are in their neutral positions, mark the pushrod wire. This mark should be located at a hole that is 1/2" (13mm) from the center of the servo arm, opposite from the steering pushrod connector.

Cut the Rudder Pushrod:



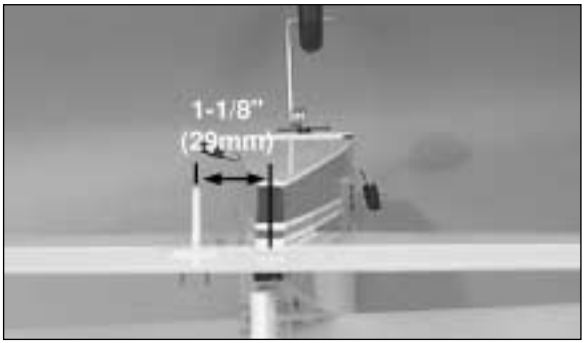
❑ 16. After marking the pushrod, measure 3/8" (9.5mm) forward and cut off the excess rod.

Attach the Pushrod to the Servo:

❑ 17. Bend the wire upwards at a 90 degree angle at the mark made in step 15. (It will be easier to detach the clevis at the rudder and pull the pushrod forward out of the fuselage before bending the wire.) Enlarge the hole

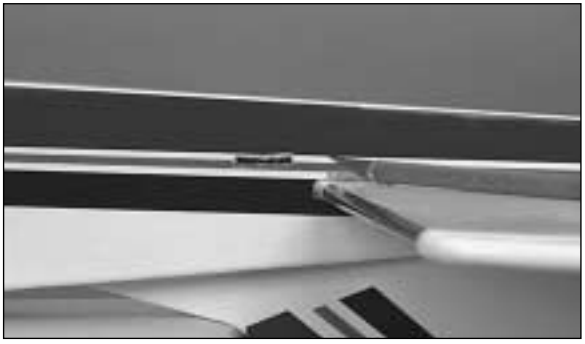
in the servo arm located at the 1/2" (13mm) position using a 5/64" (2mm) drill bit. Pass the wire through the hole in the arm. (The arm may need to be removed from the servo to install the wire.) Use a nylon pushrod connector from the nylon parts tree to secure the wire to the horn. Re-attach the clevis to the rudder horn, and slide the clear tubing over the clevis to prevent it from releasing during flight. (Use the photo at Attach the Elevator Pushrod for clarification of the attachment of the nylon pushrod connector.)

Install the Elevator Control Horn:



❏ 18. Position the elevator control horn so it is 1-1/8" (29mm) to the right of the centerline of the fuselage. Make sure that the holes are aligned with the elevator hinge line. Mark and drill the hole locations using a 3/32" (2.5mm) drill bit. Secure the horn in position using two 2mm x 16mm machine screws and a control horn backing plate. Remember to cut off the excess screws before moving on to the next step.

Locate the Elevator Pushrod Exit:



❏ 19. The elevator pushrod exit is located on the right side of the fuselage in front of the leading edge of the stabilizer. Carefully remove the covering from the opening using a sharp hobby knife.

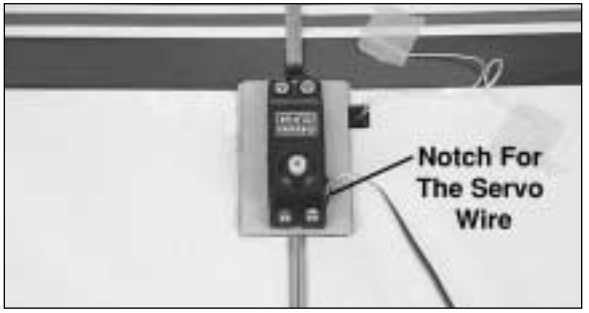
Install the Elevator Pushrod:

❏ 20. Using the same technique used for the rudder pushrod, install the elevator pushrod into the fuselage. Attach a clevis and a piece of clear tubing to the pushrod wire, and attach the clevis to the control horn in the farthest hole from the control surface. Enlarge the opening slightly, if needed, to prevent binding.

Attach the Elevator Pushrod to the Servo Arm:

❏ 21. After aligning the elevator in the neutral position, and checking the servo arm to make sure it is centered, mark the pushrod where it crosses the servo arm. Mark and trim the wire 3/8" (9.5mm) in front of the mark, and bend the pushrod wire upwards at a 90 degree angle. Use a 5/64" (2mm) bit to enlarge the hole in the servo arm approximately 3/8" (9.5mm) from the center of the arm. Pass the pushrod wire through the hole and secure it into position using a nylon pushrod connector.

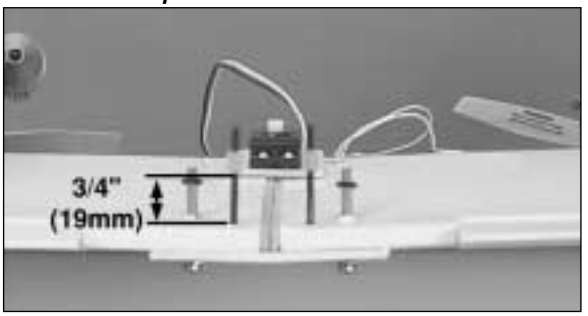
Install the Aileron Servo:



❏ 22. Prepare the aileron servo by installing the grommets and brass eyelets as described earlier in this section. Cut a notch into the aileron servo tray to allow

the servo wire to pass through. Test fit the aileron servo into the tray with the output of the servo facing the trailing edge of the wing. Secure the aileron servo to the tray.

Install the Torque Rod Horns:

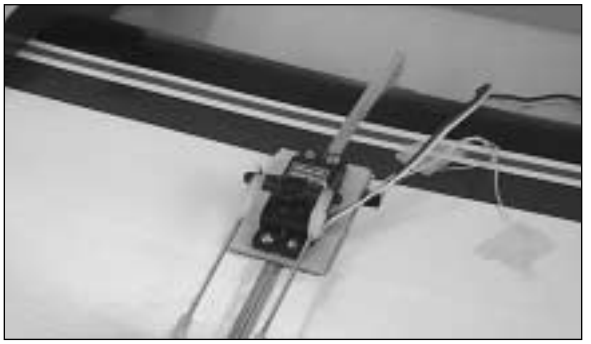


❑ 23. Locate the torque rod horns on the nylon parts tree. Since there are four horns on the tree, make sure to use the two that have the larger inner diameter hole. Thread the horns onto the aileron torque rods until there is 3/4" (19mm) of torque rod between the wing and the control horn.

Assemble the Aileron Pushrods:

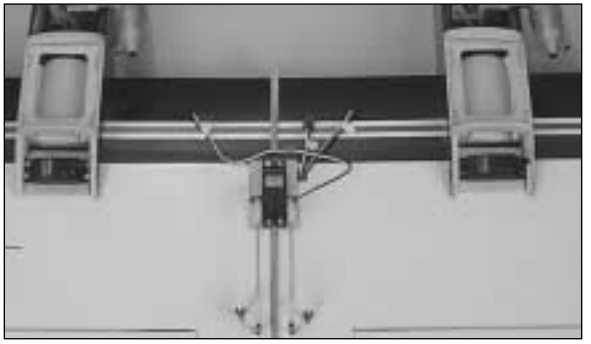
❑ 24. Prepare the aileron pushrods using the two 7-7/8" (200mm) pushrod wires. Thread nylon clevises onto the wires, and attach 1/4" (6mm) pieces of the clear plastic tubing onto the clevises. Attach the clevises onto the torque rod horns.

Connect the Aileron Pushrods:



❑ 25. While holding the ailerons in neutral, and after making sure the servo horn and servo are also neutralized, mark the pushrods where they cross the servo arm. Trim the wires off 3/8" (9.5mm) beyond the marks made, and bend the wires upward at a 90 degree angle. Enlarge the holes in the servo arm that are 1/2" (13mm) from the center of the arm using a 5/64" (2mm) drill bit. Pass the wires into the holes and secure them using nylon pushrod connectors.

Install the Throttle Servos:



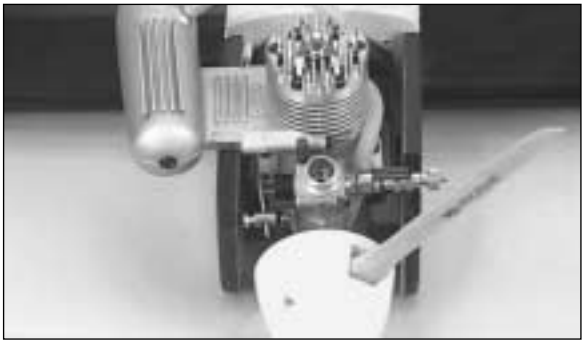
❑ 26. Prepare the throttle servos by installing the grommets and brass eyelets. Test fit the servos into position, and trim the servo trays if necessary. (Note the position of the servos in the tray.) Tie the guide strings onto the ends of the servo wires, and pull the wires through the wing. Secure the throttle servos using the hardware included with the radio system. It may be necessary to temporarily remove the aileron servo in order to pass the wires through for the throttle servo.

Prepare the Throttle Pushrod Wires:

❑ 27. Locate the remaining 17-3/4" (450mm) pushrod wire, and cut it into two 8-7/8" (225mm) pieces. Make a “Z” bend on one end of each wire.

Note: Perform the following steps for one of the engines, then copy the set-up for the other engine. This will make the second linkage much easier to install, and save quite a bit of time.

Install the Throttle Pushrod Wires:



❑ 28. Remove the servo horns, and attach the "Z" bends from the bottom of the horn 3/8" (9.5mm) from the center of the arm. With the transmitter and receiver on, check the relationship of the stick movement and the servo to make sure when the stick is fully forward (full throttle), the servo is moving in the direction necessary to open the throttle. Center the throttle stick and trim. Pass the pushrod wire into the pushrod tube. The wire then must pass into the pushrod connector on the carburetor arm. Cut the wire so it doesn't hit the spinner when installed. Attach the servo horn to the servo so it is positioned parallel to the centerline of the servo. This is necessary to make sure the throttles operate as equally as possible. It may be necessary to put a slight bend in the wire near the servo or carburetor arm to allow the linkage to move freely.

Adjust the Throttle Servo Operation:

❑ 29. Using the transmitter, move the stick to the fully open position. Manually move the throttle arm to open the carburetor to full throttle. Tighten the screw to secure the pushrod wire to the connector. Move the stick and trim lever to the fully closed position. Make sure that the carburetor closes completely, and that the servo does not bind. (If it closes too far and the servo is binding, your receiver battery pack could prematurely run down, and you could lose your aircraft. Remember, there will be two stalled servos, if all is set-up equally!) If there is binding, or the throttle does not close, change the position of the pushrod wire at the servo or carburetor arm. Glue the pushrod tubes at the rear of the nacelles at this time. Once you are satisfied with the operation of the first installation, repeat this set-up for the other linkage.

Some hints about using a computer radio: When using a computer radio for throttle operation you will need a radio that allows mixing of one channel to another. In most cases this would be throttle-to-an auxiliary channel. The other important factor when establishing these mixes is that the radio allows "Trim include". This is a feature that basically makes any change of the trim of the Throttle Channel (master) makes the same change to the Auxiliary Channel (slave). One last thought, if your radio allows change of the rate of mixture, you will want to select linear. This is important because you will want both servo positions to mimic each other.

Final Assembly

Install the Nacelle Covers:

❑ 1. Locate the plastic nacelle covers and test fit them into position. Make sure the lip at the front of the cover is against the firewall. Drill two 1/16" (1.5mm) holes forward of the firewall, and two aft of the fuel tank. Be careful on the location of the holes, as drilling into the tank would not be a good thing. Also make sure the location of the rear screws does not interfere with the operation of the throttle servos. Remove the cover and enlarge the holes in the cover using a 1/8" (3mm) drill bit. Replace the cover, and secure it into position using the 2.5mm x 10mm sheet metal screws.

Install the Front Bracing:

❑ 2. Locate the two 1/8" (3mm) plywood vertical nose braces and the 1/8" (3mm) plywood horizontal nose

brace. Test fit the braces in position, starting with the vertical braces. The vertical braces should have a downward angle when installed. Once the braces are fitted, use medium CA to glue the braces into position.

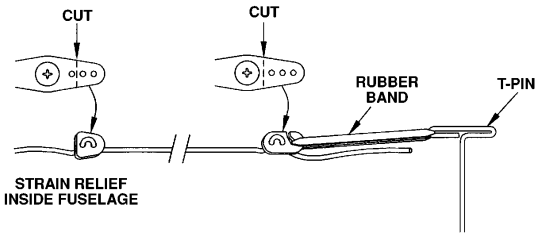
Install the Nose Cone:

❑ 3. Locate the left and right sections of the nose cone. Test the halves and trim if necessary to provide clearance for the nose gear strut and steering arm. Wick thin CA into the seam between the two halves while they are positioned on the fuselage. Do not use CA accelerator, as it may damage the plastic. Drill four 1/16" (3mm) holes at the locations shown in the following photo. Remove the nose cone and enlarge the holes in the plastic only, using a 1/8" (3mm) drill bit. Replace the nose cone, and secure it into position using four 2.5mm x 10mm sheet metal screws. (See the following photo for screw locations.)

Install the Nose Cone Decals:

❑ 4. Using a sharp hobby knife. trim out the decals for the nose cone. Apply the decals as shown in the photo.

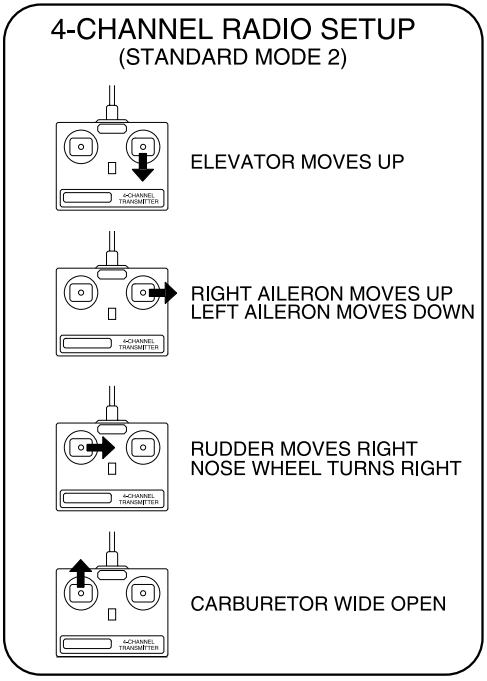
Route the Antenna Wire:



❑ 5. Drill a hole in the side of the fuselage near where the antenna exits the receiver. Route the antenna away from the servos and out through the hole in the fuselage. Use a trimmed servo arm and rubber band at the end of the antenna and secure it to a T-pin secured at the aft of the fuselage. Use the drawing to assist in routing the antenna properly. Remember not to cut the antenna, or tie it into a knot, as this will greatly reduce the range of your radio system.

Radio System Set-Up

❑ 1. Turn on the transmitter and then the receiver. Standing behind the plane, make the following movements with the transmitter and observe the movement of the control surfaces:



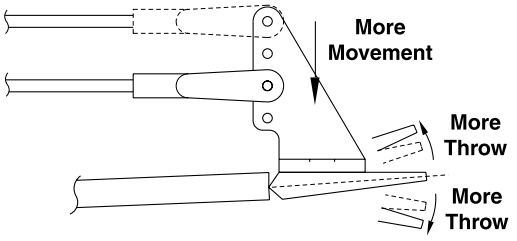
If any of the servo movements are opposite, reverse the servo direction with the servo reversing switches on the transmitter.

❑ 2. Check the movement of the control surfaces. Use a ruler to match our measurements listed below. If your radio features dual rates, set up both the high and low rates following the radio system's instructions. If your radio does not have dual rates, set up the throws at the low rate first, and gradually increase the throws as you get familiar with your new aircraft.

	Low Rate	**High Rate**
Aileron	1/4" up	3/8" up
	1/4" down	3/8" down
Elevator	1/4" up	3/8" up
	1/4" down	3/8" down
Rudder	1" right	same as low rate
	1" left	same as low rate

These are the suggested control throws from neutral.

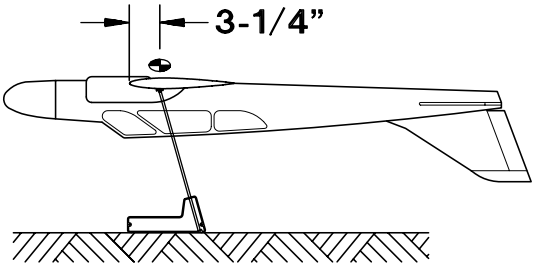
If you need more movement, you should move the clevis to a hole closer to the surface or you can move the linkage further away from the center on the servo arm. If you have too much movement, do the opposite at either the control horn or servo arm. See the sketch below to further illustrate increasing and decreasing control throws mechanically:



Moving the clevis towards the control surface results in more throw.

Balancing Your Model

Note: This section is VERY important and must NOT be omitted! A model that is not properly balanced will be unstable and possibly unflyable.



❑ 1. Accurately mark the balance point on the top of the wing on both sides of the fuselage. The balance point is located 3-1/4" (82.5mm) back from the leading edge. This is the balance point at which your model should balance for your first flights. Later, you may wish to experiment by shifting the balance up to 3/16" (5mm) forward or back to change the flying characteristics. Moving the balance forward may improve the smoothness and arrow-like tracking, but it may then require more speed for takeoff and make it more difficult to slow down for landing. Moving the balance aft makes the model more agile with a lighter and snappier "feel". In any case, please start at the location we recommend and do not at any time balance your model outside the recommended range.

❑ 2. With the wing attached to the fuselage, all parts of the model installed (ready to fly), and empty fuel tanks, hold the model at the marked balance point with the stabilizer level.

❑ 3. Lift the model. If the tail drops when you lift, the model is "tail heavy" and you must add weight* to the nose. If the nose drops, it is "nose heavy" and you must add weight* to the tail to balance. **Note:** Nose weight may be easily installed by using Great Planes (GPMQ4485) "stick-on" lead weights.

*If possible, first attempt to balance the model by changing the position of the receiver battery and receiver. If you are unable to obtain good balance by doing so, then it will be necessary to add weight to the nose or tail to achieve the proper balance point.

Balance The Airplane Laterally

Special Note: Do not confuse this procedure with "checking the C.G." or "balancing the airplane fore and aft."

Now that you have the airframe nearly completed, this is a good time to balance the airplane laterally (side-to-side). Here is how to do it:

❑ 1. Attach the wing to the fuselage.

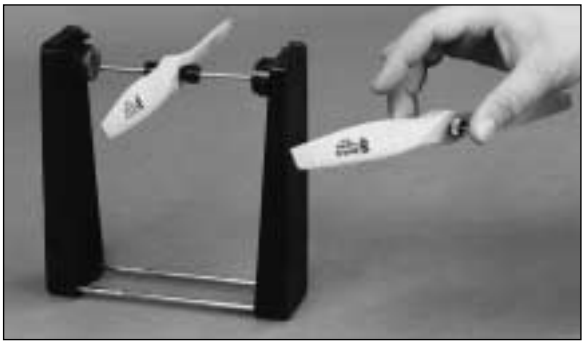
❑ 2. With the wing level, lift the model by the nose gear and the fin post (this may require two people). Do this several times.

❑ 3. If one wing always drops when you lift the model, it means that side is heavy. Balance the airplane by gluing weight to the other wing tip. **Note:** An airplane that has been laterally balanced will track better in loops and other maneuvers.

Pre-Flight

Charge the Batteries:
Follow the battery charging procedures in your radio instruction manual. You should always charge your transmitter and receiver batteries the night before you go flying, and at other times as recommended by the radio manufacturer.

Balance the Propeller:
Balance your propellers carefully before flying. An unbalanced prop is the single most significant cause of damaging vibration. Not only will engine mounting screws and bolts vibrate out, possibly with disastrous effect, but vibration will also damage your radio receiver and battery. Vibration will cause your fuel to foam, which will, in turn, cause your engine to run rough or quit.



We use a Top Flite Precision Magnetic Prop Balancer (TOPQ5700) in the workshop and keep a Great Planes Fingertip Balancer (GPMQ5000) in our flight box.

Find a Safe Place to Fly:
The best place to fly your R/C model is an AMA (Academy of Model Aeronautics) chartered club field. Ask your hobby shop dealer if there is such a club in your area and join. Club fields are set up for R/C flying and that makes your outing safer and more enjoyable. The AMA also can tell you the name of a club in your area. We recommend that you join AMA and a local club so you can have a safe place to fly and have insurance to cover you in case of a flying accident. (The AMA address is listed on page 5 of this instruction book)

If a club and its flying site are not available, you need to find a large, grassy area at least 6 miles away from any other R/C radio operation like R/C boats and R/C cars and away from houses, buildings and streets. A schoolyard may look inviting but it is too close to people, power lines and possible radio interference.

Ground Check the Model:
If you are not thoroughly familiar with the operation of R/C models, ask an experienced modeler to check to see that you have the radio installed correctly and that all the control surfaces do what they are supposed to. The engine operation also must be checked and the engine "broken-in" on the ground by running the engine for at least two tanks of fuel. Follow the engine manufacturer's recommendations for break-in. Check to make sure all screws remain tight, that the hinges are secure and that the prop is on tight.

Range Check Your Radio:
Wherever you do fly, you need to check the operation of the radio before every time you fly. First, make sure no one else is on your frequency (channel). With the transmitter antenna collapsed and the receiver and transmitter on, you should be able to walk at least 100 feet away from the model and still have control. Have someone help you. Have them stand by your model and, while you work the controls, tell you what the various control surfaces are doing.

Repeat this test with the engine running at various speeds with an assistant holding the model. If the control surfaces are not always acting correctly, do not fly! Find and correct the problem first.

Engine Safety Precautions

Note: Failure to follow these safety precautions may result in severe injury to yourself and others.

Keep all engine fuel in a safe place, away from high heat, sparks or flames, as fuel is very flammable. Do not smoke near the engine or fuel; and remember that the engine exhaust gives off a great deal of deadly carbon monoxide. Therefore do not run the engine in a closed room or garage.

Get help from an experienced pilot when learning to operate engines.

Use safety glasses when starting or running engines.

Do not run the engine in an area of loose gravel or sand, as the propeller may throw such material in your face or eyes.

Keep your face and body as well as all spectators away from the plane of rotation of the propeller as you start and run the engine.

Keep items such as these away from the prop: loose clothing, shirt sleeves, ties, scarfs, long hair or loose objects (pencils, screwdrivers) that may fall out of shirt or jacket pockets into the prop.

Use a "chicken stick" device or electric starter; follow instructions supplied with the starter or stick. Make certain the glow plug clip or connector is secure so it will not pop off or otherwise get into the running propeller.

Make all engine adjustments from behind the rotating propeller.

The engine gets hot! Do not touch it during or after operation. Make sure fuel lines are in good condition so fuel will not leak onto a hot engine, causing a fire.

To stop the engine, cut off the fuel supply by closing off the fuel line or follow the engine manufacturer's recommendations. Do not use hands, fingers or any body part to try to stop the engine. Do not throw anything into the prop of a running engine.

A Special Note Regarding Your Twinstar

A pilot's biggest fear when flying a twin is the loss of one engine during flight. Although the Twinstar handles this situation very well, you should take the following precautions to lessen the chance of losing an engine unexpectedly:

1. Make sure both fuel tanks are full before beginning your flight.

2. Make sure both engines are well broken-in and running reliably. Follow the manufacturer's guidelines for break-in procedures.

3. Run and adjust each engine separately. It may take a little more time, but it's well worth the effort. By only running one engine, you can hear it much better, and can tell if it isn't transitioning well, if it is too lean or rich, or needs a new glow plug. It is important that the engines run reliably and transition similarly from low to high throttle. With the Twinstar it is less important that the engines are running at exactly the same RPM. For other twins you may fly in the future, you may have to use a tachometer to closely match the RPM of both engines.

4. With only one engine running at full throttle, have a helper hold the your Twinstar, and point the nose upward. If the engine slows (sags), it is probably adjusted too lean, and it is likely to quit during the flight. As the fuel drops in the tank, the engine will run even leaner, so you must never begin a flight with the engines running lean. Back out the needle a few clicks to be on the safe side. Repeat this test with the other engine, then with both engines running.

5. Make sure all fuel lines are secure and in good shape. A detached pressure line will cause that engine to run differently from the other.

If you have spent the time adjusting your engines, you should not experience an in-flight engine loss very often; but if you do, here are some tips on how to handle the situation.

We have spent many hours flying and testing the Twinstar under engine-out situations. It's actually a lot of fun once you get over that fear, and gain confidence with this airplane! The Twinstar has been especially designed to minimize the effects of an engine-out.

If an engine does "flame-out" during flight, you will notice that the airplane slows and becomes rather sluggish, and it will have a tendency to roll in one direction or the other. The big question you want to answer is, "which engine is out?". If the airplane wants to roll and yaw to the right, that means the right engine has quit or is sagging badly. (Left engine out results in left roll and yaw). Now, what to do? Above all, remain calm. If the airplane is low and you are in a good position for starting a landing approach, throttle back and glide in for a landing. With both engines off, or one off and one idling, the plane will handle normally. If the plane has good altitude, you can confidently continue your flight, setting up for a normal landing approach, but making all turns gradually and smoothly. The airplane will fly as if it is slightly out-of-trim. It is the practice of full-size pilots to avoid "turning into the dead engine," as this can result in a stall. While this is good advice, the Twinstar will usually permit doing so unless its airspeed is low. Here is the bottom line: Don't panic. Make turns and throttle changes smoothly. If the airplane stalls,

spins or rolls, cut the throttle to recover, then advance the throttle gradually.

Because of the docile nature of the Twinstar in an engine-out situation, it makes a great trainer to prepare for other twins that maybe less forgiving. By using a computer radio, the throttles can be set to bring one engine to idle on command. This makes for great practice to experience engine-out flight.

A final note of confidence for those that fear engine out situations. Many different pilots at different experience levels flew the Twinstar prototype. The majority of them had no experience with twins, and were apprehensive to fly it, fearing an engine out. All the pilots got to experience the complete loss of an engine. The basic comment made when one engine "flamed out" was that the Twinstar seemed slower in speed, and the controls became slow and mushy. All the pilots brought the aircraft in for good landings. The Twinstar is not an airplane to fear if an engine fails. In fact, some pilots continued to fly, performing simple aerobatics (one O.S. .25 FP is not a lot of power for this size airplane to perform complex maneuvers) on only one engine!

TAKEOFF

If you have dual rates on your transmitter, set the switches to "high rate" for takeoff, especially when taking off in a crosswind. Although this model has good low speed characteristics, you should always build up as much speed as your runway will permit before lifting off, as this will give you a safety margin in case of a "flame-out." When the plane has sufficient flying speed, lift off by smoothly applying up elevator (don't force it off into a steep climb!), and climb out gradually. If an engine sags or quits on the takeoff roll, it is best to abort the takeoff. Never leave the ground if both engines are not performing at full power.

FLYING

The Twinstar flies just like any other sport airplane you may have flown with the exception that it has a sound that will turn heads and always has an extra engine to "get you home". It is fully capable of all aerobatics and if you have a computer radio, to mix throttle-to-rudder, some you may never have seen before.

We recommend you take it easy with your model for the first several flights, gradually "getting acquainted" with your Twinstar as your engines get fully broken-in. Add and practice one maneuver at a time, learning how it behaves in each. You may be amazed at the Twinstar's aerobatic capabilities. For ultra-smooth flying and normal maneuvers, we recommend using the "low rate" settings as listed on page 29. "High rate" elevator may be required for snap rolls and spins.

CAUTION (THIS APPLIES TO ALL R/C AIRPLANES): If, while flying, you notice any unusual sounds, such as a low-pitched "buzz," this may be an indication of control surface "flutter." Because flutter can quickly destroy components of your airplane, any time you detect flutter you must immediately cut the throttle and land the airplane! Check all servo grommets for deterioration (this will indicate which surface fluttered), and make sure all pushrod linkages are slop-free. If it fluttered once, it probably will flutter again under similar circumstances unless you can eliminate the slop or flexing in the linkages. Here are some things which can result in flutter: excessive hinge gap; not mounting control horns solidly; sloppy fit of clevis pin in horn; elasticity present in flexible plastic pushrods; side-play of pushrod in guide tube caused by tight bends; sloppy fit of Z-bend in servo arm; insufficient glue used when gluing in the elevator joiner wire or aileron torque rod; excessive flexing of aileron, caused by using too soft balsa aileron; excessive "play" or "backlash" in servo gears; and insecure servo mounting.

LANDING

The Twinstar lands just like any other sport airplane also. Set up your downwind leg where you would normally for an airplane of this size and moderate speed. Reduce the throttle to about 1/4 power at the runway center on your downwind leg. Make your turn to base as you would with any other sport plane. Turn to final maintaining your speed with the use of elevator. If you see you are coming up short of the runway, smoothly apply power. It is important that you watch to make sure both engines are running on final. If one has stopped don't panic. It just means you need to be very careful with the application of power. (See engine out procedures.) As the airplane crosses the end of the runway reduce the power and allow the model to settle to the runway. You will find with a little bit of power you can drag the Twinstar all the way across the field in a nose high attitude. It is a very easy airplane to land.

AMA Safety Code (excerpt)

Read and abide by the following Academy of Model Aeronautics Official Safety Code:

General

1. I will not fly my model aircraft in sanctioned events, air shows, or model flying demonstrations until it has been

proven to be airworthy by having been previously successfully flight tested.

2. I will not fly my model aircraft higher than approximately 400 feet within 3 miles of an airport without notifying the airport operator. I will give right of way to, and avoid flying in the proximity of, full scale aircraft. Where necessary an observer shall be used to supervise flying to avoid having models fly in the proximity of full scale aircraft.

3. Where established, I will abide by the safety rules for the flying site I use, and I will not willfully and deliberately fly my models in a careless, reckless and/or dangerous manner.

7. I will not fly my model unless it is identified with my name and address or AMA number, on or in the model.

9. I will not operate models with pyrotechnics (any device that explodes, burns, or propels a projectile of any kind).

Radio Control

1. I will have completed a successful radio equipment ground check before the first flight of a new or repaired model aircraft.

2. I will not fly my model aircraft in the presence of spectators until I become a qualified flier, unless assisted by an experienced helper.

3. I will perform my initial turn after takeoff away from the pit or spectator areas, and I will not thereafter fly over pit or spectator areas, unless beyond my control.

4. I will operate my model using only the radio control frequencies currently allowed by the Federal Communications Commission (FCC).

Good luck and have fun flying your Twinstar, but always stay in control and fly in a safe manner.

Additional Items Available From Great Planes

Hobbico's true-scale, 58.25" span, all-wood **Extra 300S AWARF-Plus** features control linkages engineered for demanding aerobatics, with two aileron servos, pull/pull rudder cables and dual elevator pushrods. Its turtledeck and rounded fuselage bottom are made of split-resistant, laminated balsa, and the preapplied covering looks nearly seamless. Includes hardware, formed aluminum gear, photo-illustrated instructions and full-size plans. Requires a 2-stroke .46 to .61-size or 4-stroke .60 to .91-size engine & 4-channel radio with 5 servos. **HCAA2080**

One leading cause of crashes is flying an airplane with its control throws set differently from those recommended in the instructions. The **Great Planes® AccuThrow™** lets you quickly and easily measure actual throws first, so you can make necessary corrections before you fly. Large, no-slip rubber feet provide a firm grip on covered surfaces without denting or marring the finish. Spring tension holds AccuThrow's plastic ruler steady by each control surface. Curved to match control motions, the ruler provides exact readings in both standard or metric measurements. **GPMR2405**

BUILDING NOTES

Kit Purchased Date _____

Where Purchased _____

Date Construction Started _____

Date Construction Finished _____

Finished Weight _____

Date of First Flight _____

FLIGHT LOG

APPENDIX

FLIGHT TRIMMING

Note: *The following article has been reprinted in part for future reference and also as a guide for your flight instructor or experienced flying partner to help you with trimming your model. If further information is required, please contact your local hobby dealer, local flying club or call Great Planes at (217) 398-8970*

A model is not a static object. Unlike a car, which you can only hunt left or right on the road (technically, a car does yaw in corners, and pitches when the brakes are applied), a plane moves through that fluid we call air in all directions simultaneously. The plane may look like it's going forward, but it could also be yawing slightly, slipping a little and simultaneously climbing or diving a bit! The controls interact. Yaw can be a rudder problem, a lateral balance problem or an aileron rigging problem. We must make many flights, with minor changes between each, to isolate and finally correct the problem.

The chart accompanying this article is intended to serve as a handy field reference when trimming your model. Laminate it in plastic and keep it in you flight box. You just might have need to consult it at the next contest! The chart is somewhat self-explanatory, but we will briefly run through the salient points.

First, we are assuming that the model has been C.G. balanced according to the manufacturer's directions. There's nothing sacred about that spot — frankly, it only reflects the balance point where a prototype model handled the way the guy who designed it thought it should. If your model's wing has a degree more or less of incidence, then the whole balance formula is incorrect for you. But, it's a good ballpark place to start.

The second assumption is that the model has been balanced laterally. Wrap a strong string or monofilament around the prop shaft behind the spinner, then tie the other end to the tail wheel or to a screw driven into the bottom of the aft fuse. Make the string into a bridle harness and suspend the entire model inverted (yes, with the wing on!). If the right wing always drops, sink some screws or lead into the left wing tip, etc. You may be surprised to find out how much lead is needed.

At this point the model is statically trimmed. It's only a starting point, so don't be surprised if you wind up changing it all. One other critical feature is that the ailerons must have their hinge gap sealed. If shoving some Scotch tape or Monokote into the hinge gap to prevent the air from slipping from the top of the wing to the bottom, and vice-versa, bothers you, then don't do it.

To achieve the maximum lateral trim on the model, the hinge gap on the ailerons should be sealed. The easiest way to do this is to disconnect the aileron linkages, and fold the ailerons as far over the top of the wing as possible (assuming they are top or center hinged). Apply a strip of clear tape along the joint line. When the aileron is returned to neutral, the tape will be invisible, and the gap will be effectively sealed. Depending on how big the ailerons are, and how large a gaping gap you normally leave when you install hinges, you could experience a 20 percent increase in aileron control response just by this simple measure.

Your first flights should be to as certain control centering and control feel. Does the elevator always come back to neutral after a 180° turn or Split-S? Do the ailerons tend to hunt a little after a rolling maneuver? Put the plane through its paces. Control centering is either a mechanical thing (binding servos, stiff linkages, etc.), an electronic thing (bad servo resolution or dead band in the radio system), or C.G. (aft Center of Gravity will make the plane wander a bit). The last possibility will be obvious, but don't continue the testing until you have isolated the problem and corrected it.

Let's get down to the task of trimming the model. Use the tachometer every time you start the engine, to insure consistent results. These trim flights must be done in calm weather. Any wind will only make the model weather vane. Each "maneuver" on the list assumes that you will enter it dead straight-and-level. The wings must be perfectly flat, or else the maneuver will not be correct and you'll get a wrong interpretation. That's where your observer comes in. Instruct him to be especially watchful of the wings as you enter the maneuvers.

Do all maneuvers at full throttle. The only deviation from this is if the plane will routinely be flown through maneuvers at a different power setting.

Let's commence with the "engine thrust angle" on the chart. Note that the observations you make can also be caused by the C.G., so be prepared to change both to see which gives the desired result. Set up a straight-and-level pass. The model should be almost hands-off. Without touching any other control on the transmitter, suddenly chop the throttle. Did the nose drop? When you add power again, did the nose pitch up a bit? If so, you need some down thrust, or nose weight. When the thrust is correct, the model should continue along the same flight path for at least a dozen plane lengths before gravity starts to naturally bring it down.

Do each maneuver several times, to make sure that you are getting a proper diagnosis. Often, a gust, an accidental nudge on the controls, or just a poor maneuver entry can mislead you. The thrust adjustments are a real pain to make. On most models, it means taking the engine out, adding shims, then reassembling the whole thing. Don't take shortcuts.

Don't try to proceed with the other adjustments until you have the thrust line and/or C.G. correct. They are the basis upon which all other trim settings are made.

Also, while you have landed, take the time to crank the clevises until the transmitter trims are at neutral. Don't leave the airplane so that the transmitter has some odd-ball combination of trim settings. One bump of the transmitter and you have lost everything. The trim must be repeatable, and the only sure way to do this is to always start with the transmitter control trims at the middle.

The next maneuver is somewhat more tricky than it looks. To verify C.G., we roll the model up to a 45° bank, then take our hands off the controls. The model should go a reasonable distance with the fuse at an even keel. If the nose pitches down, remove some nose weight, and the opposite if the nose pitches up. The trick is to use only the ailerons to get the model up at a 45° degree bank. We almost automatically start feeding in elevator, but that's a no-no. Do the bank in both directions, just to make sure that you are getting an accurate reading of the longitudinal balance.

We now want to test the correct alignment of both sides of the elevator (even if they aren't split, like a Pattern ship's, they can still be warped or twisted). Yaw and lateral balance will also come into play here, so be patient and eliminate the variables, one-by-one. The maneuver is a simple loop, but it must be entered with the wings perfectly level. Position the maneuver so that your assistant can observe it end-on. Always loop into the wind. Do several loops, and see if the same symptom persists. Note if the model loses heading on the front or back side of the loop. If you lose it on the way up, it's probably an aileron problem, while a lose of heading on the way back down is most likely a rudder situation.

Note that the Yaw test is the same looping sequences. Here, however, we are altering rudder and ailerons, instead of the elevator halves. We must repeat that many airplanes just will not achieve adequate lateral trim without sealing the hinge gaps shut. The larger you make the loops (to a point), the more discernable the errors will be.

The Lateral Balance test has us pulling those loops very tightly. Pull straight up into a vertical and watch which wing drops. A true vertical is hard to do, so make sure that your assistant is observing from another vantage point. Note that the engine torque will affect the vertical fall off, as will rudder errors. Even though we balance the wing statically before leaving for the field, we are now trimming it dynamically.

The Aileron Coupling (or rigging), is also tested by doing Hammerheads Stalls. This time, however, we want to observe the side view of the model. Does the plane want to tuck under a bit? If so, then try trimming the ailerons down a small bit, so that they will act as flaps. If the model tends to want to go over into a loop, then rig both ailerons up a few turns on the clevises. Note that drooping the ailerons will tend to cancel any washout you have in the wing. On some models, the lack of washout can lead to some nasty characteristics at low speeds.

Again, we reiterate that all of these controls are interactive. When you change the wing incidence, it will influence the way the elevator trim is at a given C.G. Re-trimming the wing will also change the rigging on the ailerons, in effect, and they may have to be readjusted accordingly.

The whole process isn't hard. As a matter of fact it's rather fun — but very time consuming. It's amazing what you will learn about why a plane flies the way it does, and you'll be a better pilot for it. One thing we almost guarantee, is that your planes will be more reliable and predictable when they are properly trimmed out. They will fly more efficiently, and be less prone to doing radical and surprising things. Your contest scores should improve, too.

We wish to acknowledge the Orlando, Florida, club newsletter, from which the basics of the chart presented here were gleaned.

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See the Flight Trimming Chart on Page 36.

TRIM FEATURE	MANEUVERS	OBSERVATIONS	CORRECTIONS
CONTROL CENTERING	Fly general circles and random maneuvers.	Try for hands off straight and level flight.	Readjust linkages so that Tx trims are centered.
CONTROL THROWS	Random maneuvers	A. Too sensitive, jerky controls. B. Not sufficient control.	If A, change linkages to reduce throws. If B, increase throws.
ENGINE THRUST ANGLE[1]	From straight flight, chop throttle quickly.	A. Aircraft continues level path for short distance. B. Plane pitches nose up. C. Plane pitches nose down.	If A, trim is okay. If B, decrease downthrust. If C, increase downthrust.
CENTER OF GRAVITY LONGITUDINAL BALANCE	From level flight roll to 45-degree bank and neutralize controls.	A. Continues in bank for moderate distance. B. Nose pitches up. C. Nose drops.	If A, trim is good. If B, add nose weight. If C, remove nose weight.
YAW[2]	Into wind, do open loops, using only elevator. Repeat tests doing outside loops from inverted entry.	A. Wings are level throughout. B. Yaws to right in both inside and outside loops. C. Yaws to left in both inside and outside loops. D. Yaws right on insides, and left on outside loops. E. Yaws left in insides, and right on outside loops.	If A, trim is correct. If B, add left rudder trim. If C, add right rudder trim. If D, add left aileron trim. If E, add right aileron trim.
LATERAL BALANCE	Into wind, do tight inside loops.	A. Wings are level and plane falls to either side randomly. B. Falls off to left in loops. Worsens as loops tighten. C. Falls off to right in loops. Worsens as loops tighten.	If A, trim is correct. If B, add weight to right wing tip. If C, add weight to left wing tip.
AILERON RIGGING	With wings level, pull to vertical climb and neutralize controls.	A. Climb continues along same path. B. Nose tends to go to inside loop. C. Nose tends to go to outside loop.	If A, trim is correct. If B, raise both ailerons very slightly. If C, lower both ailerons very slightly.

1. Engine thrust angle and C.G. interact. Check both.
2. Yaw and lateral balance produce similar symptoms. Note that fin may be crooked. Right and left references are from the plane's vantage point.