



FOUR-STAR 20EP



SIGRC106

INSTRUCTION MANUAL

Sig Mfg. Co., Inc...401-7 South Front Street...PO Box 520....Montezuma, IA 50171-0520

Congratulations on your purchase of the SIG FOUR-STAR 20EP. For many years the SIG Four-Star series of low-wing sport airplanes have proven to be among the most popular and versatile at the flying field. Originally designed for 2-stroke glow engines, Four-Stars have also excelled with 4-stroke, gasoline, and now electric motors. The secret to their popularity is their light flying weight and low wing loading, combined with excellent aerobatic performance. The maneuverability and smooth handling of the Four-Star will make it the sport model you'll want to take to the flying field every time.

The FOUR-STAR 20EP is the first Four-Star kit designed primarily for electric power (although the structure is configured to easily accommodate a glow engine if you wish to go that way). This use of a modern electric power system in the legendary Four-Star has produced a marvelous little R/C ship that is a pure joy to fly. It's small enough to carry around in your vehicle completely assembled and ready to fly almost anywhere, anytime!

Assembly of the FOUR-STAR 20EP is quick and easy, following the detailed instructions in this manual. All parts are CAD-drawn and the majority are laser-cut, so that everything fits the way it should! We strongly suggest that you read through the manual first to get familiar with the various parts and the assembly sequences.

Additional Items Needed

The following items are not supplied in this kit but are needed to complete the airplane. Because of the wide variety of brands available and the influence of local preferences, the final choice of these items is left to you. In most cases, we will list what worked well for us in our prototype models. You should select equivalent items.

- **BRUSHLESS OUTRUNNER ELECTRIC MOTOR**

200-300 watts with a kv specification suitable for turning a 9x6E propeller. Motor should also include prop adapter hardware and a radial-style motor mount.

- **ELECTRONIC SPEED CONTROL (ESC)**

Matched to your motor - typically 35 amp.

* We use and recommend the Maxx Products Co. Combo 19A (www.maxxprod.com), which is a packaged motor system that includes their Himax 3510-1100 Brushless Outrunner Motor, a Castle Creations Thunderbird 36 amp ESC, a radial motor mount, an APC 9x6E propeller, a prop adapter, and mounting screws.

Any other brand of outrunner motor and speed control of equivalent size and specifications would also work.

Himax 3510-1100 Motor specs:

Diameter	35.2mm (1.39")
Length	32.2mm (1.27")
Shaft Diameter	4.0mm
Weight	89g (3.1 oz.) motor only
Max. Power	250W
Kv=1100 Rm=.055 Io=1.2	

- **3S1P LITHIUM-POLYMER BATTERY PACK**

1800-2400 mAh

- **BATTERY CHARGER**

For maximum performance from your battery pack, you **MUST** use a proper battery charger! Make sure your charger is designed for the type of cells in your battery pack. Using the wrong battery charger can be very dangerous! We recommend that you use a quality peak detection lithium-polymer battery charger with cell balancing.

- **SPINNER (if desired)**

2" to 2-1/4" diameter spinner is optional. You could also use an "acorn" style prop nut alone. Your choice.

- **2-1/4" dia. MAIN WHEELS**

- **4-CHANNEL RADIO CONTROL SYSTEM with 4 SERVOS**

"Standard" size radio gear is not recommended for an airplane as small as the Four-Star 20EP. The Four-Star gets its great flight performance from many factors, but two of the most important factors are its light weight and generous wing area. The lighter the final weight is, the better this airplane will fly! The radio equipment you install will have a great effect on the flight performance of your airplane. Maximum performance can only be achieved with light weight components.

RECEIVER a small or micro size receiver should be used in this model. In our flight tests we have used the Hitec Electron 6 (weight: 19 grams) and the FMA M5 (weight: 11 grams). Both are dual conversion receivers.

SERVOS standard size servos, the ones that come with most sport radio systems, are too big and too heavy for the Four-Star 20EP. You will need smaller servos. In our prototypes airplanes, we used Hitec HS-81 Micro Servos, which have a torque rating of 36 oz/in and weigh .58 oz each. Any other brand of servo that is in the same size and torque range will also work just fine.

SERVO CHORDS You will need one Y-Harness chord to connect the two aileron servos together inside the wing. Every radio manufacturer has Y-Harness chords available for their radio systems. If they have an option for a short Y-Harness or a long Y-Harness, you can probably use the short one due to the small size of the airplane. In addition, you will also need a short standard Servo Extension Chord to plug into the receiver and connect to the aileron Y-Harness.

- **COVERING MATERIAL**

Any brand of quality iron-on plastic covering material is suitable for the Four-Star 20EP. If the manufacturer has a "lite" version, use it to save a little weight. The color choice is entirely up to you. It will take approximately 1 to 1-1/2 rolls of covering material to cover the Four-Star 20EP, depending upon how many colors you elect to use.

- **GLUES**

Choice depends a lot on you personal preference. We used Thin, Medium, and Thick SIG CA; CA Accelerator; Fine point CA applicator tips; and SIG Epoxy Glue (5-minute and 30-minute).

- **BASIC MODELING TOOLS**

Screwdrivers, Pliers (regular, needle nose, flat nose), Wire Cutters, Scissors, Ruler, Pencil, Metal Straight Edge, Triangle, Flat Building Board, Hobby Knife with #11 Blades, Single-Edge Razor Blades, Wax Paper, T-Pins, Paper Towels, & Rubbing Alcohol (for cleaning off excess epoxy glue).

- **POWER DRILL with Assorted DRILL BITS**

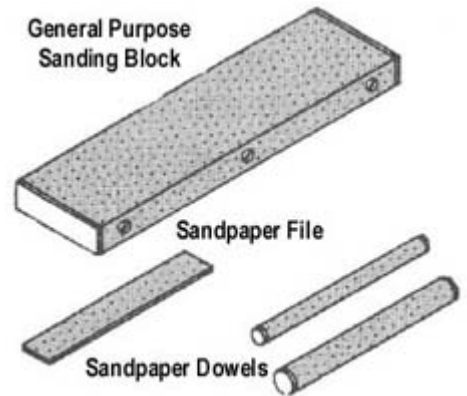
- **SOLDERING IRON and SOLDER**

- **COVERING IRON and TRIM SEAL TOOL**

- **LIGHT WEIGHT WOOD FILLER**

- **SANDPAPER BLOCKS and SANDPAPER**

Use 80-100 grit to rough sand and shape parts; 220-300 grit for finish sanding. A good general purpose sanding block can be made by wrapping a full 9"x11" sheet of sandpaper around a piece of hardwood or plywood. Use screws or thumbtacks along one edge to hold the overlapped ends of the sandpaper in place. In addition to that block, make a small sandpaper "file" by gluing a strip of 80 grit sandpaper onto a scrap plywood stick. Sandpaper glued or taped to different size wood dowels are also handy to have around.



Glow Power Option

The Four-Star 20 can be powered with a 2 or 4-stroke glow engine instead of an electric motor, if you prefer. We recommend glow engines in the .15 to .20 cu.in. range. No major structural modifications are necessary to accommodate a glow engine.

The checklist of changes if using a glow engine is short:

1. Leave the 3 small circles near the bottom of the F-1A and F-1B plywood formers in place. Do not punch them out. Work some glue into the cut lines to keep them permanently in place. The purpose of those 3 holes was to cool the electric motor battery. Obviously not needed in a glow version. In fact, they need to be sealed up so that glow fuel exhaust residue does not enter the nose of the airplane.
2. Do not install the plywood BT (Battery Tray) in the nose. You will need that clear space in the nose for a fuel tank.
3. In addition to the glow engine, you will need to purchase a suitable engine mount and a plastic 4 oz. fuel tank. You will also need to buy a 5th servo for the throttle, and a suitable throttle pushrod.



Notes Before Beginning Construction

Any references to right or left, refer to your right or left as if you were seated in the cockpit of the airplane.

To build good flying models, you need a good straight building board. Crooked models don't fly well! The building board can be a table, a workbench, a reject hollow wood door from the lumber yard, or anything else that is perfectly flat and untwisted. Cover the top surface of the building board with a piece of celotex-type wall board or dense foam board, into which pins can be easily pushed.

When building directly on top of the full-size plans, cover the plan with wax paper to prevent gluing the parts to the plan.

Don't use a ball point pen for making marks on the model during construction. If not sanded off, the ink marks will show through the model's covering. Use a soft pencil instead of a pen.

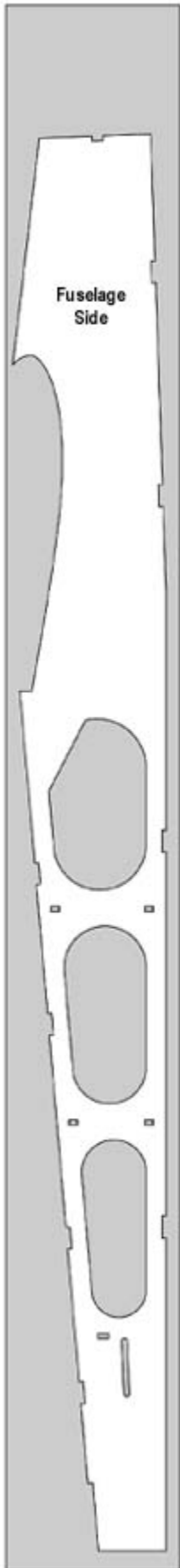
The laser cut balsa and plywood parts can be identified using the "KEY TO LASER CUT PARTS". Mark the identification numbers on the corresponding parts before removing them from the laser cut sheets. Leave all the laser cut parts in the sheets until needed in construction. Then remove the pieces from the sheets carefully. Use a sharp #11 hobby knife to cut through any "tabs" that are holding the parts in the sheets. Lightly sand off any remainder of the tabs, flush with the actual edge of the part.

All of the other parts can be identified by the "KIT INVENTORY LIST" that follows. Sort the different sizes of sticks and sheets into individual piles to avoid confusion during building.

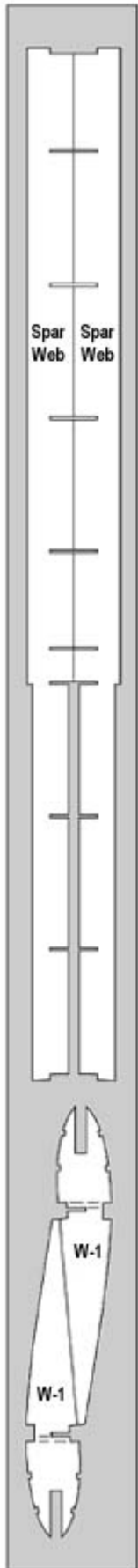
COMPLETE KIT PARTS LIST							
Laser Cut Balsa Wood Parts							
2	1/16"x3"x36" Sheet No.1: wing ribs W-2, W-3, W-4, W-4A	1	3/32"x3"x36" Sheet No.2: Fuselage Top	1	3/32"x3"x36" Sheet No.3: fuselage parts FBT-2, FD-1	1	3/32"x3"x36" Sheet No.4: W-1 wing ribs, Spar Webs
2	3/32"x4"x36" Sheet No.5: Fuselage Sides	1	3/16"x3"x36" Sheet No.6: tail parts Tail Parts; S-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8, S-9, E-1, E-2, E-3, E-4, E-5, E-6, E-7, R-1, R-2, R-3, R-4, R-5, R-6, R-7, R-8, F-1, F-2, F-3, F-4, F-5, F-6, F-7	1	3/16"x3"x36" Sheet No.7: W-1A, Ailerons, Wingtips		
Laser Cut Plywood Parts							
1	1/8"x6"x24" Sheet No.8: APG, F-1A, F-1B, F-2, F-2B, F-3, F-4, F-4T, F-5, F-5T, F-6, F-6T, FBT-1, BT, DB, FHR, HT-1, HT-2, LG-1, LG-2, P-1, P-2, SM-1 (4), T-1, T-2, TWM, WBP	2	1/4" Motor Spacers				
Balsa Wood Sticks							
3	3/32"x3/16"x36" Stringers	1	1/16"x1/4"x18" Capstrips	8	1/8"x1/8"x24" Sub Spars	4	1/8"x3/8"x36" Main Spars, Main Spar Doublers, Servo Bay
4	1/4"x1/4"x24" Leading & Trailing Edges						
Balsa Wood Sheets							
2	1/16"x1-1/4"x24" Trailing Edge Top Sheet	2	1/16"x1-1/2"x24" Trailing Edge Bottom Sheet	2	1/16"x2"x24" Wing Center Section Sheeting	1	3/32"x3"x13" Fuselage Top Sheeting
Hardwood							
2	1/4"x1/4"x2-9/16" Servo Mount Rails	1	1/4" dia.x1-1/2" Birch Dowel				
Music Wire							
1	1/16"x4-3/8" formed Tailwheel Wire	1	1/16"x4-1/4" formed Elevator Joiner	2	1/32"x24" Elevator & Rudder Pushrods		
Plastic Parts							
1	Molded Plastic Canopy	1	Molded Plastic Cowling				
Hardware							
2	2-56x10" Threaded Rods; for aileron pushrods	1	3/4" dia. Tailwheel	4	Nylon RC Links; for rud(1), ail(2), ele(1)	2	Right Nylon Control Horns; for ele(1), left ail(1)
2	Left Nylon Control Horns; for rud(1), right ail(1)	1	Nylon Landing Gear Clip	1	Nylon Tailwheel Bracket	8	#2x3/8" Sheet Metal Screws; for cowling, hatch, tailwheel bracket
8	#2x1/2" Sheet Metal Screws; for control horns	1	2-56x3/8" Bolt; for tailwheel	1	2-56 Hex Nut; for tailwheel	2	4-40 Blind Nuts; for main landing gear
2	4-40x3/8" Bolts; for main landing gear	2	6-32x1-1/2" Bolts; for axles	2	6-32 Lock Nuts; for axles	4	6-32 Hex Nuts; for axles
14	Hinges; for ail(6), ele(4), rud(3), tailwheel (1)	1	10-32x1" Nylon Wing Bolt	1	10-32 Blind Nut; for wing hold down	2	Threaded Couplers; for elevator & rudder pushrods
1	1/16" id Wheel Collar & Set Screw; for tailwheel	1	Hex Key Wrench				
Misc							
1	formed Aluminum Landing Gear	2	.130 oxdx19 Nylon Pushrod Tubes	1	Decal Sheet SIGDKM106A	1	Decal Sheet SIGDKM106B

KEY TO LASER-CUT BALSA PARTS

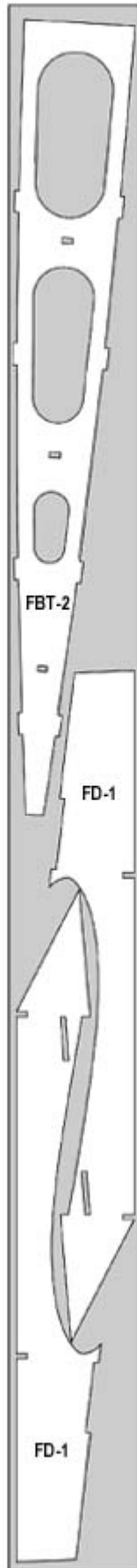
Sheet 5 (2 Req)



Sheet 4 (1 Req)



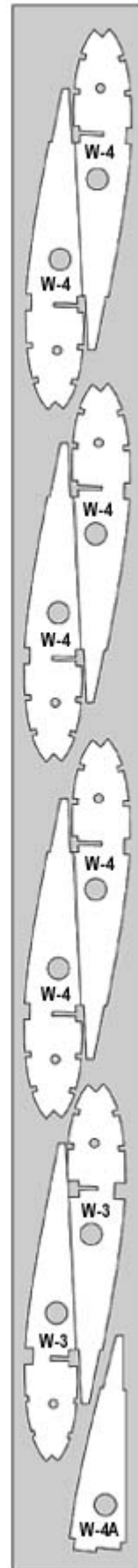
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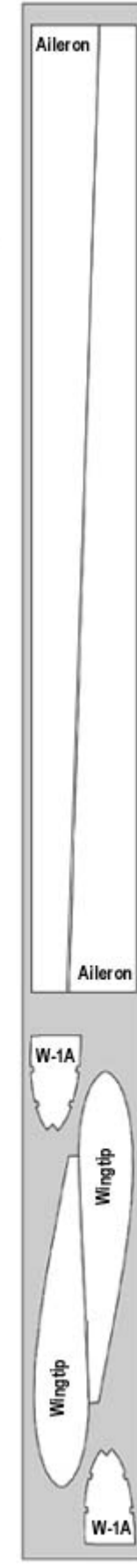
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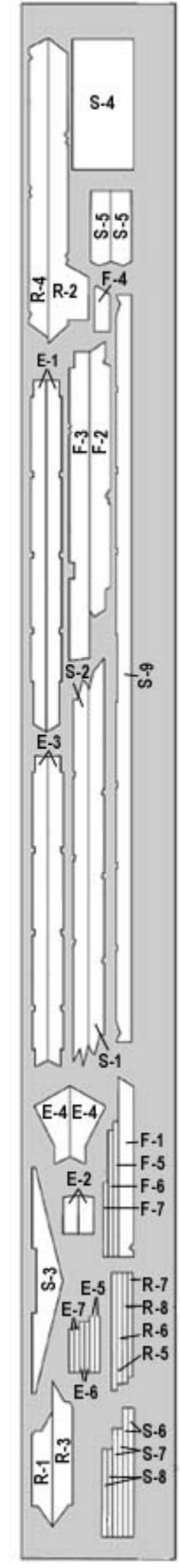
Sheet 1 (1 Req)



Sheet 7 (1 Req)

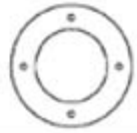


Sheet 8 (1 Req)

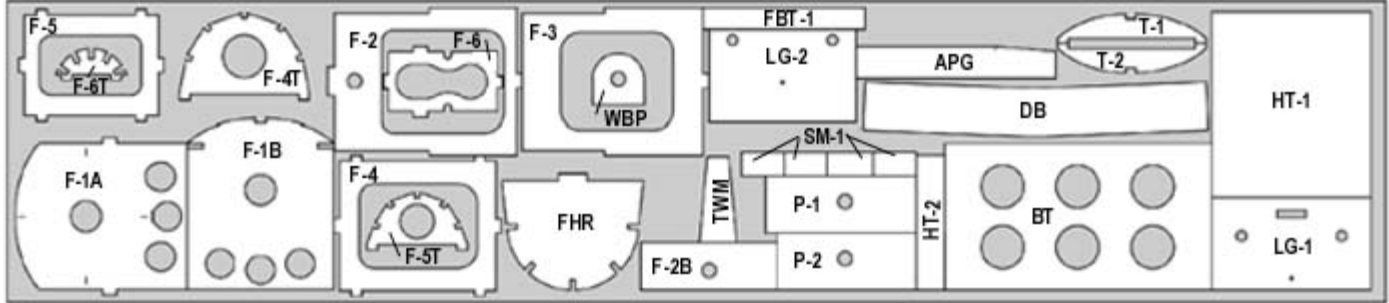


KEY TO LASER-CUT PLYWOOD PARTS

1/4" Plywood
Motor Spacers
(2 Req)



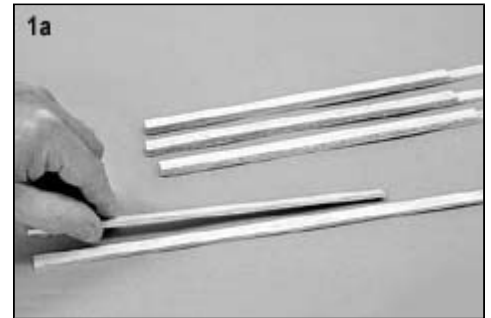
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WING PANEL CONSTRUCTION

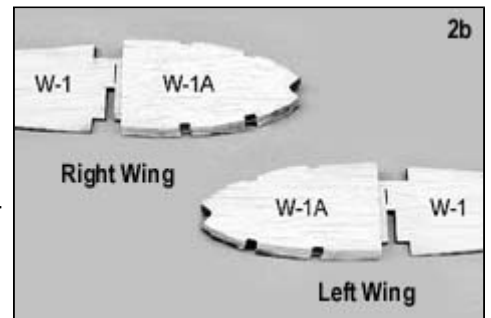
We will build the wing in separate right and left wing panels, and then join the panels together after they are assembled. Let's start with the **LEFT WING PANEL**. To get started, tape or pin the wing plan to your building board. Cover the plan with a layer of waxed paper to keep glue from sticking to the plan.

1a. Cut four 1/8"x3/8"x36" balsa sticks down to 24" long for the Main Spars. Cut the four pieces of leftover stick to 9" long. These will be the Spar Doublers. Glue one Spar Doubler to one end of each Main Spar. Let dry.



b. Pin one of the main spar assemblies in place on the plan. Align the center end of the spar assembly (the end with the doubler on it) exactly with the line on the plan that indicates the center of the wing. Let the excess spar length extend past the wing tip.

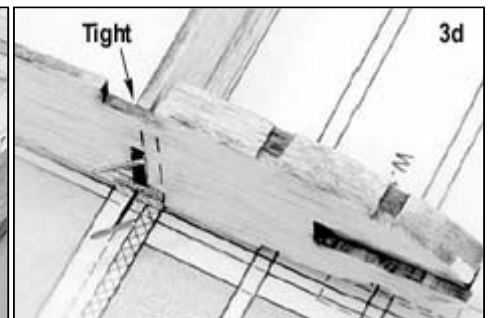
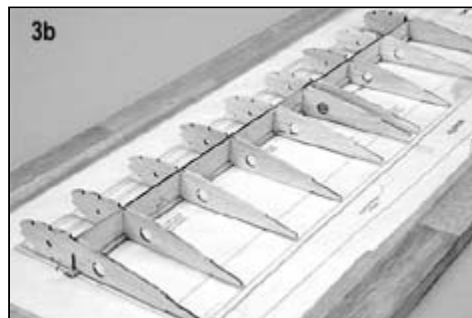
2a. Remove all the balsa wing ribs from laser-cut sheets no. 1, 4, and 7. Make sure you have correctly marked the ribs with their part numbers according to the KEY TO LASER-CUT PARTS diagrams. You should have: (2) W-1 ribs, (2) W-1A, (2) W-2, (2) W-3, (12) W-4, (2) W-4A, and (2) Wingtips.



b. Glue W-1A to the front of each W-1 rib, being very careful to get the edges exactly aligned. Be sure to make a right and left W-1 rib assembly.

3a. Carefully remove one of the Spar Webs from laser cut sheet no. 4. Hold the Spar Web against the plan and familiarize yourself with its exact orientation. Note that the open rib notches should be along the top of the Spar Web when it's installed in the wing, not on the bottom.

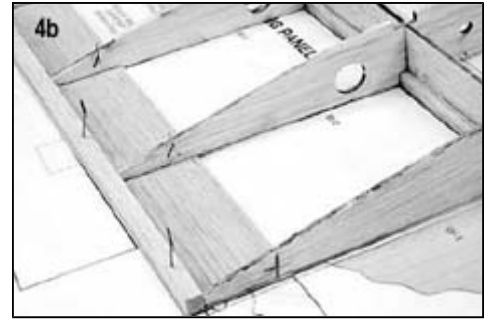
b. Slide ribs W-2, W-3, and W-4 into their notches in the Spar Web. Pin this assembly in place on top of the Main Spar. Pin down only the Spar Web at this time, not the ribs - the ribs must remain loose until the trailing edge pieces are added in a few minutes.



c. Add rib W-4A.

d. Add the W-1/W-1A rib assembly, pinning it in place on the end of the Spar Web. Note that W-1 will not sit perfectly vertical - it should be tipped very slightly with the top edge towards the wingtip to account for the wing's dihedral angle. The correct angle is pre-cut into the end of the Spar Web. Just make sure you pin W-1 firmly against the end angle of the Spar Web - that will insure that you are within tolerance for the dihedral angle later.

4a. Slip the 1/16"x1-1/2"x24" Balsa Trailing Edge Bottom Sheet in place under the back ends of the wing ribs. Slide it forward against the notches in the bottom of the ribs. Now pin the ends of all the wing ribs to the Trailing Edge Bottom Sheet and firmly to the plan.



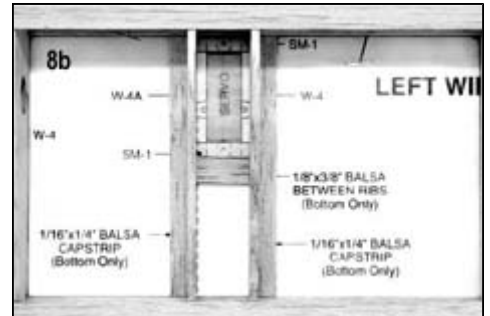
b. Pin the 1/14"x1/4"x24" Balsa Trailing Edge in place on top of the Trailing Edge Bottom Sheet and up against the ends of the wing ribs.

5. Check one more time that all the wing parts are properly aligned and pinned together and pinned down to the building board. Then glue all the joints with Thin CA adhesive. Let dry.

6. Fit one of the Main Spar assemblies (from step 1 a.) in place in the notches in top of all the ribs. Glue securely and let dry.

7. Glue the 1/16"x1-1/4"x24" Balsa Trailing Edge Top Sheet in place.

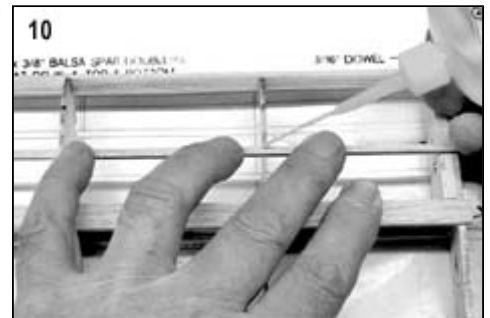
8a. Cut a piece of 1/8"x3/8" balsa stick to fit between ribs W-4 and W-4A, where shown on the plan at the rear of the aileron servo bay. Glue it in flush with the bottom of the ribs.



b. Cut two pieces of 1/16"x1/4" balsa stick for the Capstrips that go along the sides of the W-4 and W-4A ribs, as shown on the plan. Glue the capstrips in place flush with the bottom of the ribs.

9. Glue the 1/4"x1/4"x24" Balsa Leading Edge in place.

10. Glue two 1/8"x1/8"x24" Balsa Sub Spars in place in the top rib notches.



11a. 1/16"x2"x24" balsa is provided for sheeting the center section of the wing. Start by cutting the stock into seven 3-1/4" long pieces.

b. Glue one of the 3-1/4" long pieces in place up against the trailing edge top sheet. Trim the width of another 3-1/4" long piece of sheeting stock to fit between the first piece and the back of the top main spar. Glue in place.

c. Trim more pieces of the sheeting stock to fit between the top Sub Spars, as shown. Glue in place and let dry.



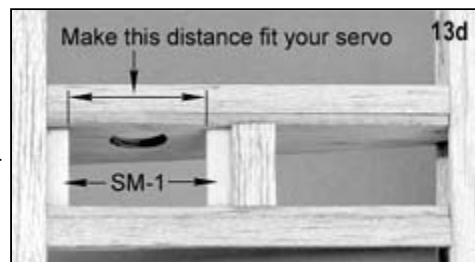
12a. When all the glue joints are dry, take out all the pins and remove the wing panel from the building board.

b. Glue two 1/8"x1/8"x24" Balsa Sub Spars in place in the bottom rib notches.

Note: Do not install any 1/16" balsa sheeting to the bottom of the center section at this time.

13a. Now is a good time to fit your aileron servo in the wing. Remove two SM-1 pieces from the laser-cut plywood sheet. Be sure to sand off any excess part of the "tabs" that held the parts in the big sheet (the fit of SM-1 between the W-4 wing ribs is tight).

b. Glue the front SM-1 part in place.

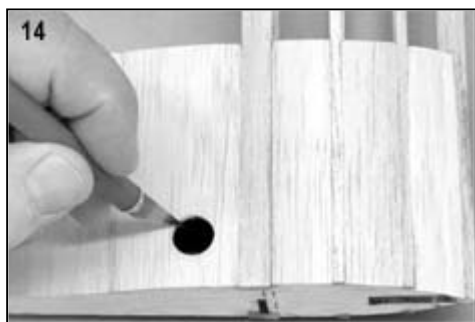


c. Measure the length of your servo case to determine exactly where the rear SM-1 part should be located. Then glue it in place.



d. Drill pilot holes for your servo mounting screws and then mount the servo. When done, remove the servo and set aside.

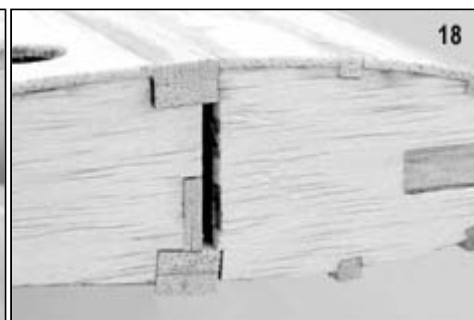
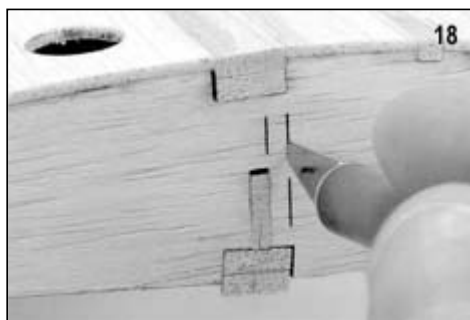
14. Cut a 1/2" dia. hole in the top sheeting just behind the main spar. This is for the aileron servo chord to exit the wing panel.
15. Use a large sanding block to sand any excess spar ends and sheeting flush with the W-1 rib. Use a sanding block large enough to sand the entire part at the same time. Work slowly to insure that the end rib remains flat and straight.
- 16a. Use a large sanding block to sand any excess spar ends or sheeting flush with the last W-4 tip rib.
- b. Glue the 3/16" balsa Wingtip in place on the end of the wing panel. Make sure to match up the edges perfectly with rib W-4.
17. Wrap a small piece of 80 or 100 grit sandpaper around the 1/4" hardwood dowel provided. Use this to sand a groove in the end of the 1/4" balsa leading edge where the dowel will be installed later.



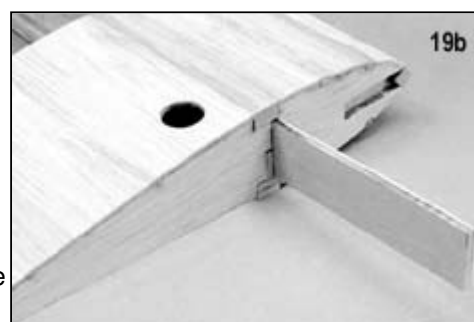
The LEFT WING PANEL is now basically done. Repeat steps 1 through 17 to build a RIGHT WING PANEL.

Joining The Wing Panels

18. Note the dashed lines that are cut into the W-1 end ribs to indicate the location for the laser-cut plywood DB Dihedral Brace. Use a sharp #11 hobby knife to cut through the rib between the dashes to create an opening for the Dihedral Brace. Do the same for both the W-1 end ribs of BOTH wing panels.



- 19a. Trial fit both wing panels together with the Dihedral Brace installed. Make sure the panels come together tightly with no gaps. Then take the wings back apart.



- b. Glue the DB Dihedral Brace halfway into one of the wing panels. Epoxy glue is recommended.
- c. Coat the end rib and the Dihedral Brace with glue and then slide the other wing panel in place. Push the panels together tight! Match up the edges of the wing panels perfectly. Use pins or clamps to hold the wing panels tight together until the glue dries.
20. Install 1/16" balsa center section sheeting to the bottom of the wing panels, just as you did in step 11 for the top of the wing.
21. Sand the wing to final shape. Round the 1/4" sq. balsa leading edge as shown in the cross-section drawings on the plan. Trim and sand down the top surface of the 1/4" sq. balsa trailing edge to blend with the shape of the wing.

22. Drill the center of the leading edge with a 1/4" dia. drill bit until the 1/4"x1-1/2" hardwood dowel can be slid into place in the notches in the W-1 ribs. The dowel should end up protruding about 5/16" out front of the leading edge. When satisfied with the fit, glue the dowel in place.
- 23a. Locate the laser-cut plywood WBP Wing Bolt Plate. Glue it in position on the bottom of the wing. Make sure it is centered over the joint of the wing panels, and that the back edge of WBP is flush with the back edge of the wing.
- b. Use a 3/16" dia. drill bit to drill completely through the wing in the center of WBP. Be sure to use a "backing block" of some kind to support the top wing sheeting as you drill through. Cosmetic Note: for better final appearance, and to make it a little easier to apply the covering material, we like to bevel the edges of WBP as shown here. Bevel the edges before gluing WBP on the wing.

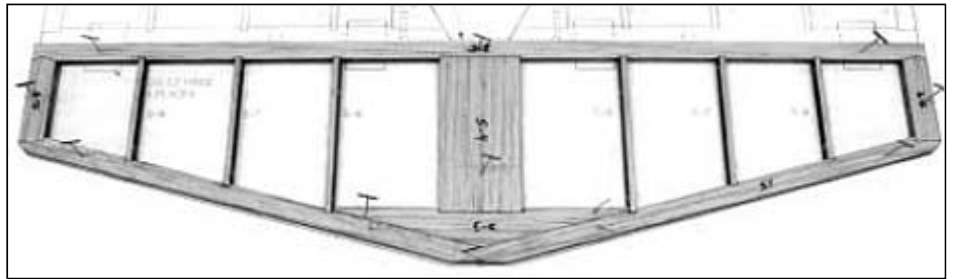


24. Remove the 3/16" balsa Ailerons from laser-cut sheet no. 7. Shape the leading and trailing edges of the Ailerons to the shape shown on the CROSS-SECTION AT W-4 drawing on the plan - round the trailing edges, and "v" shape the leading edges. When finished sanding, set the Ailerons aside for now. We will hinge them to the back of the wing after all the parts are covered.

TAIL SURFACES

Begin by taping or pinning the Stabilizer and Elevator plan to your building board. Cover the plan with a layer of waxed paper to keep glue from sticking to the plan.

- 25a. Assemble stabilizer parts S-1, S-2, S-3, S-4, S-5, and S-9 together over the plan. Glue the parts together where they join.
- b. Add the stabilizer ribs S-6, S-7, and S-8.
- c. When dry, unpin the stabilizer from plan and sand it to final shape. Round the leading edges. Leave the trailing edge and the tips square.

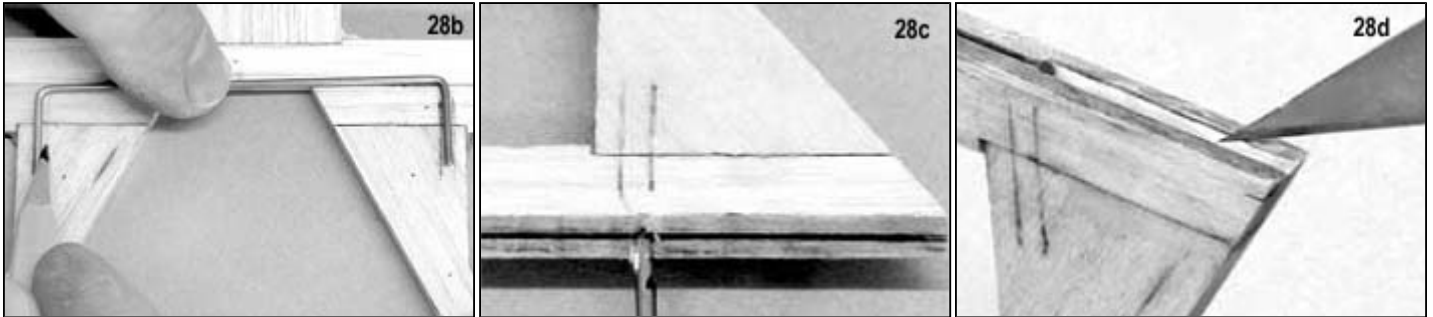


- 27a. Assemble and glue the elevator parts together over the plan, just like you did the stabilizer.
- b. When dry, remove the elevators from the plan and make a couple light passes on the top and bottom surfaces with your large sanding block to smooth them out.
- c. Sand the trailing edges of both elevators round, as shown in the cross-section drawing of the elevator on the fuselage side view plan. Leave the tips of the elevators square.

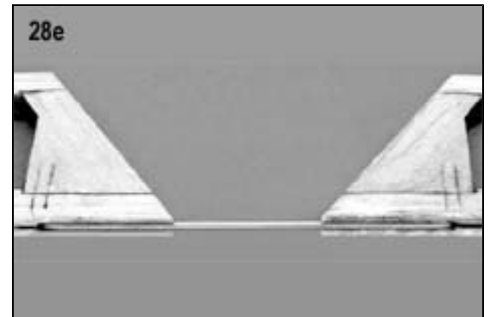


- 28a. Draw a hinge line all the way down the middle of the leading edge of each elevator. Make sure it is centered.
- b. Lay the elevators in position up against the trailing edge of the stabilizer, making sure to have the tips lined up. Then lay the 1/16" Wire Joiner in position and mark its location on the elevators.
- c. Use a 1/16" dia. drill bit to drill a hole in the leading edge of the elevators to accept the leg of the Wire Joiner.

d. Use a sharp #11 hobby knife to cut a groove in the leading edge to accept the Wire Joiner.



e. Wipe the Wire Joiner clean with some type of solvent (paint thinner, mineral spirits, rubbing alcohol, etc.), and then glue it into the elevators with epoxy. Be sure to keep the leading edges of the two elevators aligned straight while the glue dries.



f. Use a sanding block to bevel the leading edge of the elevators to a "v" shape, using the hinge line as a guide. Refer to the cross-section drawing of the elevator on the plan.

29. Assemble all the fin and rudder parts over the plan. When dry, remove them from the plan and sand them to final shape. Fin - round the leading edge, leave the trailing edge square. Rudder - round the trailing edge, "v" shape the leading edge.

30. Temporarily tape the elevators to the back of the stabilizer. Then use a sanding block to sand the ends of both pieces together until they match perfectly. The tips can be left square or sanded round if you prefer.

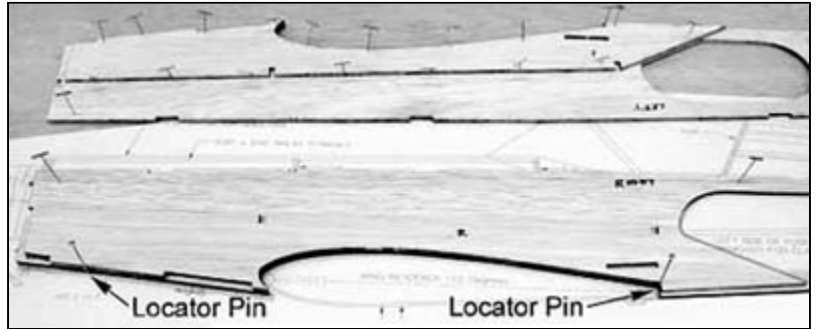


The tail surfaces are now complete and can be set aside until covering is done. They will be hinged after covering is done.



FUSELAGE CONSTRUCTION

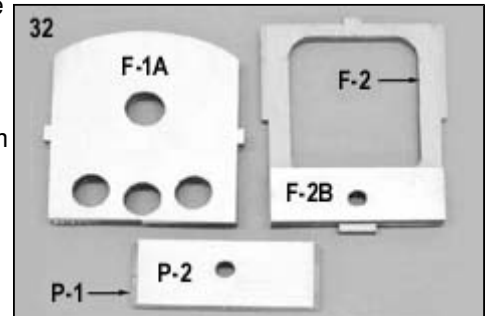
31. Remove the balsa Fuselage Sides from laser-cut sheet no. 5 and the FD-1 Doublers from sheet no. 3. Use slow drying glue to laminate one doubler to each fuselage side, making sure to make a LEFT and RIGHT assembly. Also make sure that you have the doublers properly positioned on the fuselage sides - 2 points to pay particular attention to are the wing saddle and the bottom of the nose - those edges should match up perfectly. (Notice in the picture the two "locator pins" that we used to aid in the alignment.) Let dry.



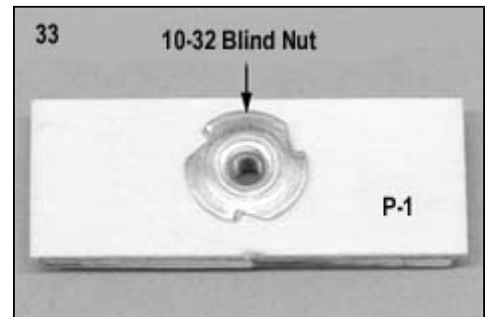
- 32a. Laminate laser-cut plywood parts F-1A and F-1B together, making sure to get the edges exactly aligned. Use clamps or pins to hold the parts in alignment while drying.

- b. Laminate laser-cut plywood parts F-2 and F-2B together, making sure to get them properly aligned. Use clamps or pins to hold the parts in alignment while drying.

- c. Laminate laser-cut plywood parts P-1 and P-2 together, making sure to get them properly aligned. Use clamps or pins to hold the parts in alignment while drying.



33. Install the 10-32 Blind Nut into the P-1 side of the P-1/P-2 lamination. Double check to make sure you are gluing into the P-1 side, which is the longer piece - see CROSS-SECTION AT F-3 drawing on the plan. Glue in place with epoxy glue. Be careful not to get any glue in the threads.



- 34a. Remove the balsa Fuselage Top from laser-cut sheet no. 2. Notice the series of dashed lines cutting across the Fuselage Top in the location where top former T-2 will eventually go (near the front of the canopy). Very carefully bend the Fuselage Top just slightly across the dashed lines, cracking the wood but not breaking it. You are doing this because the top of the fuselage is not a perfectly straight line - it changes direction just slightly at T-2. The change in direction is only a couple degrees, so don't get carried away and overbend and break it.

- b. Now pin the Fuselage Top in place flat on the plan.

- c. Glue formers F-3, F-4, F-5, and F-6 in place on the fuselage top, being careful to get them perpendicular to the board.

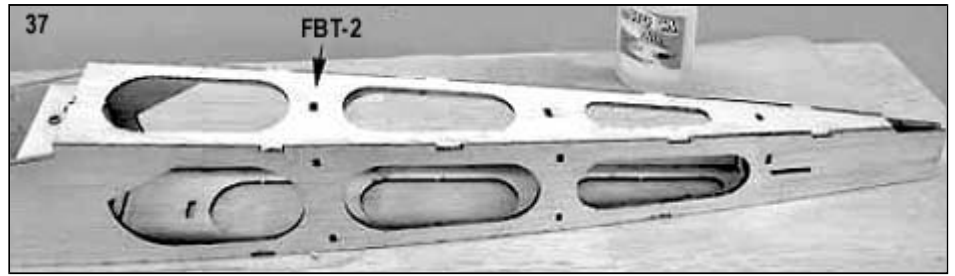


35. Install the left Fuselage Side, gluing it to the sides of the four formers and to the fuselage top. NOTE: Glue the side to the top ONLY from the dashed lines back to the tail. Do not glue it to the front portion of the fuselage top at this time.

36. Add the right Fuselage Side while at the same time installing the P-1/P-2 assembly, which keys into cutouts in the doublers.



37. Install the balsa fuselage bottom piece FBT-2, gluing it to all its mating parts.



38. Install the plywood TWM tailwheel mount.

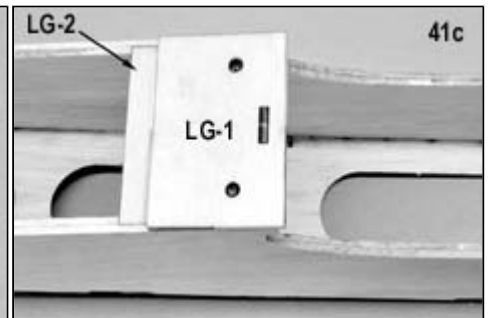
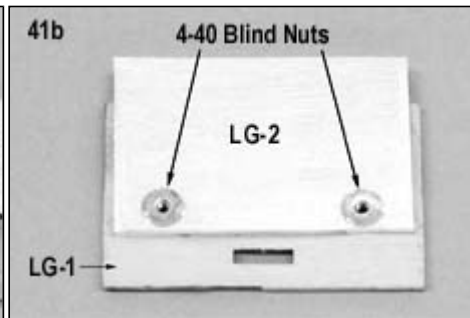
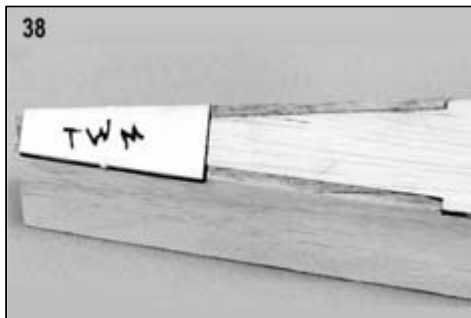
39. At the front of the fuselage, carefully lift the front portion of the fuselage top up to fit between the fuselage sides. Remember back in step 34 you cracked the top slightly along the dashed cut lines so it can make this bend. When you have it fitting well between the side, glue together with a few drops of thin CA glue.

40. Insert former F-2/F-2A former assembly in place, gluing it to the fuselage sides and top.

41a. Laminate plywood parts LG-1 and LG-2 together. There are 3 common holes in both parts. Use the holes to get the parts in correct alignment with each other.

b. Install two 4-40 Blind Nuts in the top of LG-2. Glue them in place - don't get any glue in the threads of the blind nuts!

c. Glue the LG-1/LG-2 assembly in place in the fuselage.



42. Glue plywood part BT Battery Tray in place. It rests on the edges of the fuselage doublers and up against the front of former F-2.

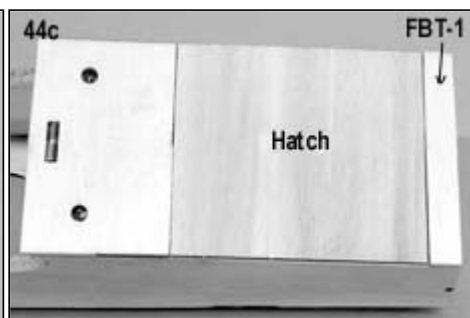
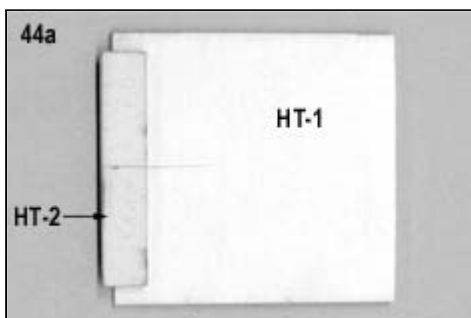
43. Fit the plywood F-1A/F-1B firewall assembly in place in the fuselage. Note that F-1B is the side of the firewall with two notches to accept the ends of the fuselage top sheeting. Glue the firewall assembly securely in the structure.

44a. Assemble the Hatch by gluing plywood part HT-2 in place on HT-1. Measure the plan for the correct amount of overhang.

b. Put the Hatch in place on the fuselage. If HT-2 doesn't fit between the doublers, sand a tiny bit off the edges until it does. You want the Hatch to come off and on easily.

c. With the Hatch in place to provide the proper spacing, glue plywood FBT-1 onto the bottom of the firewall.

45. Glue on plywood fuselage top formers F-4T, F-5T, and F-6T. Use a square to make them perpendicular to the fuselage top.



46. Glue on plywood top former FHR. Note on the plan that FHR tilts back towards the rear of the fuselage. There should be approx. 2-3/8" between the top of FHR and the top of former F-4T.
47. From 36" long balsa stock, cut to length and glue in place the five 3/32"x3/16" stringers for the top rear of the fuselage. When glue is dry, sand the ends of the stringers flush with the front of former FHR and the rear of former F-6T.
48. Glue in place the plywood fuselage top formers T-1 and T-2. They should be perpendicular to the fuselage top.
49. Cut to length and glue in place a 3/32"x3/16" top stringer for the front of the fuselage, running from the firewall F-1 back to T-2.

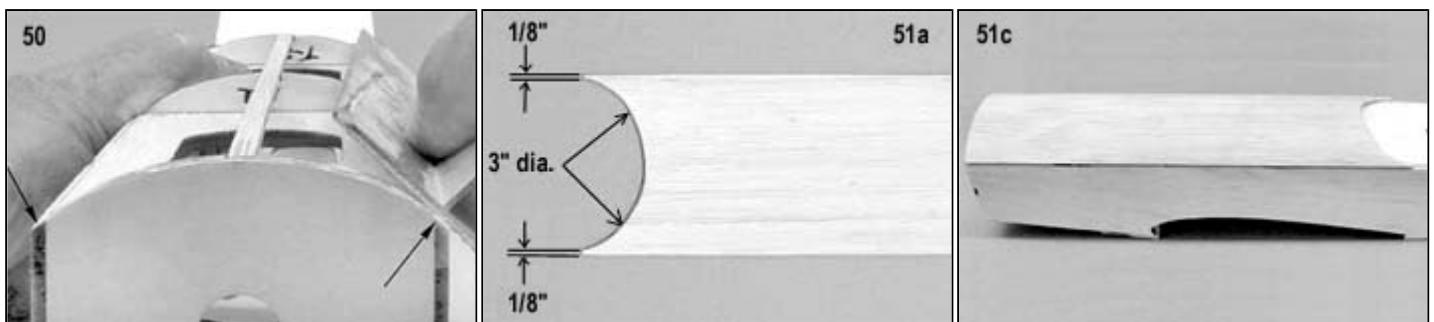


50. Use a flat sanding block to bevel the top edge of the fuselage sides to blend into the curve of F-1, T-1, and T-2, as shown. Continue this bevel from F-1 back to former F-3.

- 51a. A piece of 3/32"x3"x13" piece of sheet balsa is provided for sheeting over the top front of the fuselage. On one end of the sheet cut out a semi-circle approximately 3" diameter to form the edge of the cockpit. Exact diameter and shape is not critical (an empty yogurt container is about the right size).

- b. Trial fit the balsa sheet over the top of formers F-1, T-1, and T-2. Dampen the outside, or top, of the sheet to help bend over the top formers. When ready, glue the sheet in place to the formers, top stringer, and fuselage sides. Use tape and/or pins to hold the sheet in place until the glue dries.

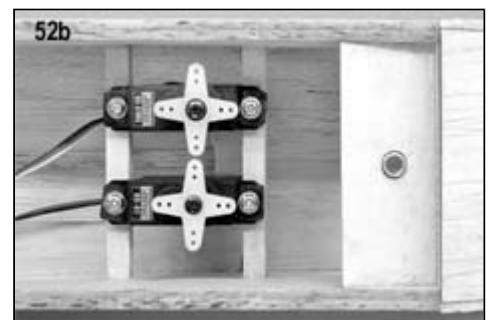
- c. When glue is dry, sand the edges of the top sheeting to blend with the fuselage sides.



- 52a. Glue the two 1/4" square x 2-9/16" long hardwood Servo Mount Rails in place in the fuselage. Refer to the plan for the approximate location. Be sure to check the length of your particular servos to make sure you put enough space between the rails to fit your servos.

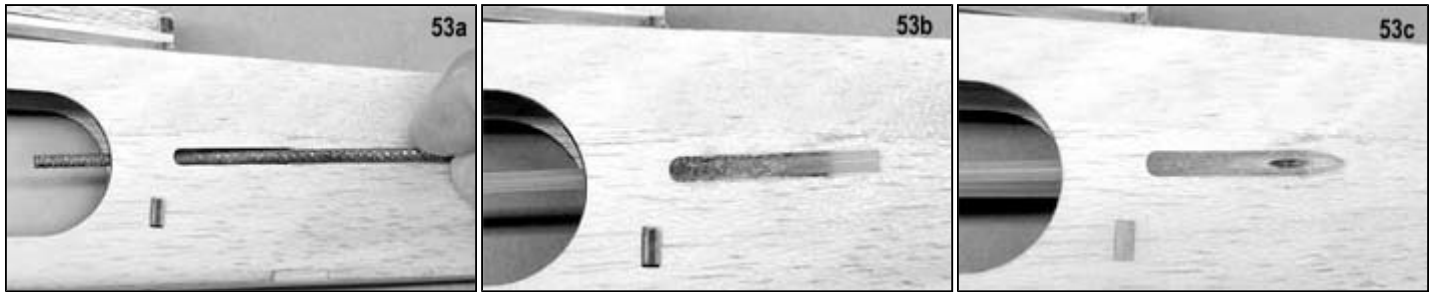
- b. Mount your elevator and rudder servos onto the servo rails, using the hardware that came with the servos.

- 53a. Use a small round file, or rolled up piece of sandpaper, to give the rear edge of the pushrod exit slot a slight bevel. This will increase the gluing area for the pushrod tube. Do this to the exit slots on both sides of the fuselage.



- b. Slide a 19" long Nylon Pushrod Tube into the pushrod exit slot, as shown. Glue securely the tube to the slot with CA adhesive. Repeat for the second tube on the other side of the fuselage.

c. When glue is dry, sand the protruding ends of the pushrod tubes flush with the fuselage sides.



54. Test fit the wing onto the fuselage, using the 10-32 x1" long Nylon Wing Bolt provided. It should go on easily without binding. Adjust the dowel hole in former F-2 and/or the wing saddle slightly if necessary to achieve a proper fit.
55. Finish sand the entire fuselage. Be sure to test fit the cowling over the nose to make sure you have rounded the bottom corners enough to allow the cowling to slip over the firewall.

COVERING

Any brand of quality iron-on plastic covering material is suitable for the Four-Star 20EP. If the manufacturer has a "lite" version, use it to save a little weight. The color choice and final color scheme is entirely up to your imagination. It will take approximately 1 to 1-1/2 rolls of covering material to cover the Four-Star 20EP, depending upon how many colors you elect to use.

We recommend that you cover the wing, ailerons, fuselage, and tail surfaces separately before hinging and final assembly. This way the parts are much easier to handle, which produces a better covering job.

The following notes provide advice and procedures specific to covering the Four-Star. Be certain to also read and follow the instructions the come with your covering material.



Surface Preparation

A good covering job starts with good surface preparation. Regardless of what brand of covering you choose, it won't hide poor workmanship. Fill any small surface gaps with a light-weight filler or spackling putty. Sand the entire model with 220 grit sandpaper, and then again with 360 or 400 grit.

Covering The Wing

Begin the wing by covering the wingtips with separate pieces of covering material. Trim the covering material about 1/8" larger than the wingtips. Work the extra 1/8" around and seal down onto the top and bottom surfaces of the wing. Later, when the main top and bottom wing covering pieces are put on, they will overlap the wingtip covering and can be trimmed at the wingtip corners, leaving a virtually invisible seam.

Cover the main surfaces of the wing with four separate pieces of covering material - one piece for the bottom right wing panel, one for the bottom left wing panel, one for the top right panel, and one for the top left panel. Make sure to use generous overlaps of all these pieces with each other.

Wait until all the top and bottom pieces of covering material have been sealed down completely around their edges before shrinking the large open areas between the ribs. A covering "heat gun" works best for the major shrinking, but an iron will also work. Alternate between the top and bottom surface to avoid uneven shrinking, which could cause a warp. Keep the heat gun moving at all times, or you may burn a hole in the covering. If you notice the covering material ballooning up, put a small pin hole in the bottom of each rib bay to allow expanding air to escape.

To maximize the torsional stiffness of the wing, be sure to firmly bond the covering material to all of the spars and ribs by going over them again with your sealing iron.

Covering The Fuselage

The fuselage should be covered with 7 separate pieces of covering material, in the order described here:

- Fuselage Bottom - 2 pieces, front and rear
- Fuselage Sides - 2 pieces, left and right
- Fuselage Top - 2 pieces, front and rear
- Hatch - 1 piece

All seams should overlap at least 3/16". When covering solid wood surfaces like the front of the fuselage sides, better results can be obtained by starting at the center and working toward the outer edges, allowing air to escape as you iron.

The trickiest area of the fuselage to cover is the stringer area of the top rear. Start by applying one edge of the covering to one of the fuselage sides, overlapping 3/16" onto the side covering. Drape the material over the stringers, pulling out any major wrinkles. Carefully tack the material down to the other fuselage side, then trim off the excess, again leaving a 3/16" overlap. To avoid slicing into the material underneath, slide a piece of thin cardboard under the excess stringer covering before cutting it with a knife. Use a straight edge to make a nice straight cut.

Go back over the side seams with the iron. Then seal front edge of the material to the edge of FHR. Seal the back edge to former F-6T. Trim the excess at each end leaving an overhang of about 1/8" to iron around the corners. Seal down the 1/8" overhang to the front of FHR, and to the back of F-6T. Making slits in the overhang covering every 1/4" or so will help during this step. Once the edges are all firmly adhered, shrink the rest of the material over the stringers.

Optional: For a nice "finished" look, use more covering material, or some colored construction paper, to cover the cockpit floor and front of FHR. Or you can paint those areas.

Covering The Tail Surfaces And Ailerons

The stabilizer, elevators, fin, rudder, and ailerons should each be covered with two pieces of material - cover the bottom first, then the top. Note: Do not cover the bottom of the fin trailing edge - it gets glued into the fuselage.

Decal Application

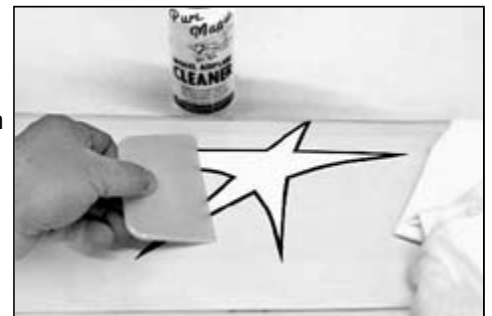
You may want to apply your decals now before the model is completely assembled. It's easier to do now, while the parts are easy to handle.

The decals supplied with the Four-Star 20EP are sticky-back Mylar® stickers with a very aggressive adhesive. They are NOT water slide decals. Also, these decals are not die-cut and must be cut from the sheet with a sharp #11 hobby knife or scissors. A straight edge makes this easier when straight lines are involved. Trim as close to the image as possible.

Putting sticky-back decals on a model can be tricky, especially medium to large size ones like some of those in this kit. If you don't do it right you will end up with unsightly air bubble trapped underneath the decal. The best method is to put large decals on wet. This technique involves using a "soapy water" mixture to float the decal on the surface of the model until you get it in correct position, and then use a squeegee to press the decal permanently in place.

The soapy water mixture can simply be water mixed with a small amount of dish soap, or SIG Pure Magic Model Airplane Cleaner, or Fantastic®, or Windex®, or 409® type household cleaners, they all work. For a squeegee, we recommend the SIG 4" Spreader SIGSH678 or simply use some scraps of sheet balsa. You will also want to have some soft paper towels or clean soft cloths (old tee shirts are great) handy. We also suggest that you have some narrow (1/8" width or less) trim tape handy for making temporary guidelines to help in aligning the decals.

First spray the surface of the model where the decal is to be placed with a soapy water mixture. Then carefully peel the decal completely off the backing sheet, being careful not to let the sticky side double over and adhere to itself. Then spray the adhesive side of the decal as well. Lightly position the decal in place on the wet surface of the model. Do not push down! The liquid allows you to slide the decal into the desired final position, as long as you don't press down on it. Once you have it in position, gently squeegee the excess liquid out from under the decal, starting from the middle and working out towards the edges. Mop up the liquid with dry cloth. Squeegee repeatedly to get as much of the water out from under the decal as possible.



Allow the decals to set overnight to finish drying. Once dry, they will be solidly adhered to the model. When completely dry, wash off any soapy smears with a soft clean wet rag.

Hinging The Control Surfaces

The hinges in this kit are designed to be installed with Thin CA glue. Thin CA (any brand) is the **ONLY** type of glue that can be used on the hinges - do not use epoxy or any other type of glue!

56. Let's start with hinging the elevators to the stabilizer.

a. Begin by marking the location for the four hinges on the trailing edge of the stabilizer and the leading edges of the elevators, according to the plan. A fine-line felt tip pen works best for this.

b. Using a #11 hobby knife, cut a slot approximately 1/2" in depth for each hinge. Start by cutting a very shallow slit at the hinge location. This first slit should be very shallow so you can better control the direction of the knife. It's main purpose is to establish your hinge slot in the right place, so concentrate on staying on the hinge line and don't try to cut too deep. Now make 3 or 4 more cuts in the exact same line, going slightly deeper each time. As you make these additional cuts, concentrate on staying in the slit and keeping the blade headed straight into the center of the wood so that it won't come out the side of the part. You will find that as the blade gets deeper into the wood, it will become harder to move it along the slot.



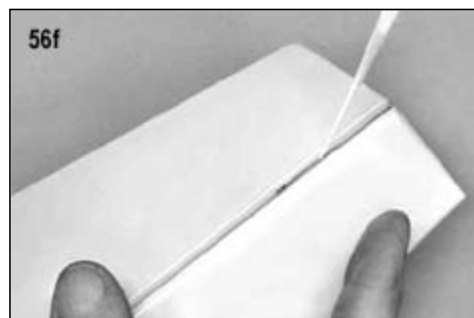
Try "wiggling" the knife handle in the slot to make it cut, instead of trying to "slice" the blade along in one continuous motion. Continue making additional cuts until the slot is approximately 1/2" deep. **CAUTION:** You must use extreme care to avoid cutting yourself while cutting the hinge slots. If the balsa wood breaks while you are pushing on the knife, the blade could go into your hand before you can stop it. A good precaution is to wear a leather glove on the hand that is holding the model part while you are cutting the slots.

c. After all the slots have been cut, insert a single hinge halfway into each hinge slot in the stabilizer. If the hinge is difficult to push in, re-insert the knife and move it back and forth in the slot a few more times and then try again. **DO NOT GLUE THE HINGES IN AT THIS TIME!**

d. Now carefully slide the elevator onto the exposed half of the hinges. You will find it easiest to slide the part onto the hinges at angle, one hinge at a time, instead of trying to push it straight onto all the hinges at once. Don't be overly concerned if the hinges don't end up perfectly straight or centered in the slots - they do not have a center line. **ONCE AGAIN, DO NOT GLUE THE HINGES IN AT THIS TIME!**



e. To set the proper amount of gap between the model parts, simply deflect the control surface to the maximum amount of travel needed. This will automatically set the proper hinge gap! Keep in mind that for best control response the gap should be kept as small as possible, but big enough to allow full movement of the control surface. Make sure everything is functioning properly before proceeding to the next step.



f. With a fine applicator tip on your glue bottle, carefully place 2-3 drops of Thin CA glue directly onto the hinge in the gap. You will notice that the glue wicks into the wood and the hinge. Quickly turn the part over and apply 2-3 drops of glue to the other side of the hinge. Continue this process until you have glued both sides of all the hinges. Keep a rag handy to wipe off any excess Thin CA glue. (If you get some glue smears on the plastic covering, don't worry about them right now. Once all the hinges are glued, you can go back to clean the smears off with a little CA Debonder on a rag.

g. Let the glue dry a minimum of 10 minutes before flexing the elevators. At first you might notice a little stiffness in the joint. This will go away after the hinges have been flexed a few times.

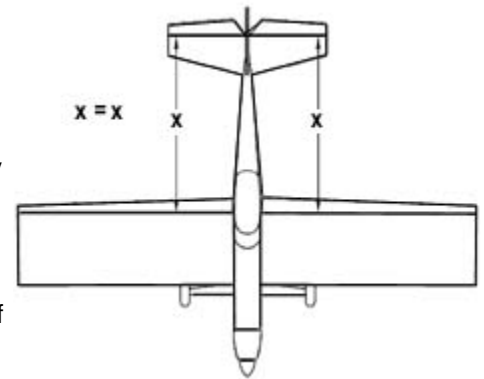
h. Repeat steps a thru g hinge the ailerons to the wing.

- i. The rudder is hinged in the same manner as the other parts, but it is easier to install AFTER the fin has been glued onto the fuselage. For now, go ahead and cut the slots for the hinges in the fin and rudder, but do not glue them. Set them aside until later.

VERY IMPORTANT: It's critical that you only make one application of glue to each side of the hinges. If you apply additional glue to the hinge after the first application of glue is already dry, the second application of glue will merely puddle in the hinge gap and make the hinge too stiff to operate properly. The excess glue can also weaken the hinge! When properly glued, the portion of the hinge that you see in the hinge gap should have a dry appearance, not wet. A dry appearance indicates that almost all of the glue has properly soaked into the hinge and wood. A wet appearance indicates that excess glue is puddled in the hinge gap. Excess glue can become brittle with age and cut the hinge. Also, NEVER USE CA ACCELERATOR (KICKER) ON CA HINGES!

FINAL ASSEMBLY

57a. Install the wing on the fuselage.

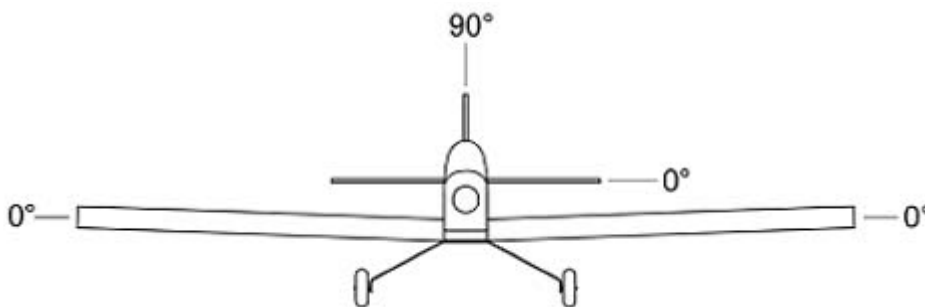


- b. Mark a centerline on top of the stabilizer, making sure that the centerline is perpendicular to the trailing edge of the stabilizer. Then pin the stabilizer in place on the fuselage. Carefully measure from the trailing edge of the wing to the trailing edge of stabilizer. Both measurements should be the same. If there is any difference rotate the stabilizer until the measurements are identical.

- c. Also check the alignment of the stabilizer to the wing in the front view. The stabilizer should be level with the wing. If it is not, alter the stab mount platform of the fuselage as needed.

- d. When satisfied with the alignment, use a fine-line felt-tip pen to draw lines on the bottom of the stabilizer along the fuselage sides. Then remove the stabilizer from the fuselage and cut away the covering material between the lines, where the stabilizer will be glued to the fuselage, exposing the bare wood underneath.

Cut just inside the marked lines with a sharp knife. Try not to cut into the balsa wood.



- e. Glue the stabilizer permanently onto the fuselage. Recheck the alignment and adjust as necessary before the glue dries.

58a. Test fit the fin in place on top of the fuselage, inserting the bottom of the fin trailing edge between the fuselage sides. Use a felt tip pen to mark the position of the fin on top of the stabilizer.



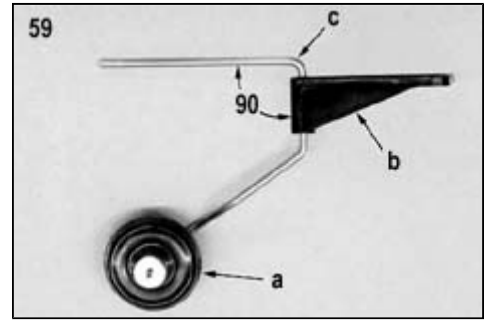
- b. Carefully remove the covering material from the the top of the stabilizer where the fin will attach. The covering should be trimmed away 1/16" inside the drawn lines. It is extremely important that you cut the covering only and not the balsa underneath. Do not cut into the balsa.

- c. Permanently glue the fin in place. Use a triangle to check that the fin is square with the top of the stabilizer. Let dry.

59a. Install the 3/4" dia. Tailwheel on the axle of the formed Tailwheel Wire, using the 1/16" id Wheel Collar provided.

b. Slide the plastic Tailwheel Bracket onto the shank of the tailwheel wire. Be certain that you have the bracket on right side up.

c. Using a needle nose pliers, bend the top of the tailwheel wire back 90 degrees, as shown on the plan.



60a. Hold the tailwheel assembly in place on the bottom of the fuselage, familiarizing yourself with the installation - see plan. After determining the exact position for the assembly, mark the bracket's three mounting holes on the fuselage.

b. Drill small pilot holes for the three #2 x3/8" Sheet Metal Screws provided. Then screw the tailwheel assembly in place.

c. Clamp the upper arm of the tailwheel wire to the bottom of the rudder with a folded hinge, held in place with a 2-56 x3/8" Bolt and Hex Nut.



61a. Slip a 2-1/4" dia. Main Wheel onto one of the 6-32 x1-1/2" Axle Bolts.

b. Thread a 6-32 Hex Nut onto the axle bolt and run it up near, but not touching, the wheel. Be sure to leave a little room for the wheel to turn freely.

c. Thread a second 6-32 Hex Nut onto the axle and tighten it against the first nut. We recommend that you put a small drop of Lock-Tite® thread locker (or a small drop of epoxy glue) between the two hex nuts as you tighten them against each other. After tightening the nuts, double check that the wheel still turns freely. d. Repeat steps a, b, and c to install the other wheel on the other 6-32 axle bolt.

62. Insert the axle bolt into the hole at the bottom of one of the legs of the Aluminum Landing Gear. Thread a 6-32 Lock Nut onto the axle bolt and tighten securely. Repeat to install the other wheel on the other landing gear leg.

63. Mount the main landing gear assembly on the bottom of the fuselage using the two 4-40 x3/8" Bolts provided.

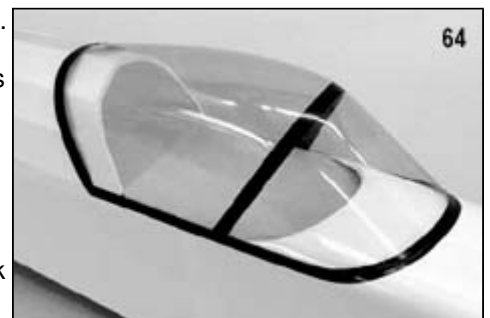


64a. If you wish to install a dummy pilot, or otherwise dress up the cockpit area, now is the time to do it. If you install a pilot, be sure to mount him securely so he doesn't come loose in flight.

b. Cut the excess plastic away from the Canopy using a scissors. Test fit the canopy on the fuselage, positioning it in the location shown on the plan. Trim the edges as necessary for a good fit.

c. We like to attach the Canopy to the fuselage with a combination of glue and tape. First tack glue the Canopy to the fuselage with 3-4 small drops of CA glue (or special "canopy glue" available at some hobby shops). When dry, tape the edges of the canopy to the fuselage with 1/4" wide black striping tape - with the tape half on the canopy and half on the fuselage. The combination of the glue and the taping usually keeps the canopy securely in place.

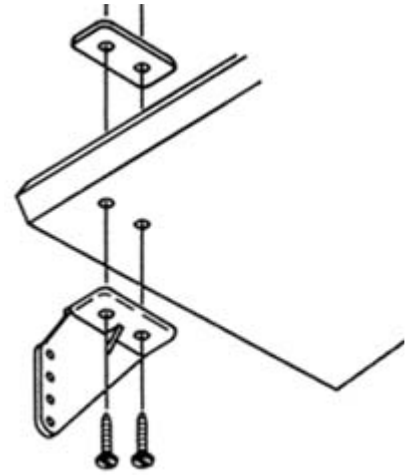
d. Finish off the Canopy with 1/4" wide black striping tape run along the back edge, and another piece to simulate the joint between the front windshield and the back of the canopy (shown on the plan).



Radio Installation

65. Mount a Nylon Control Horn on the bottom of the left elevator using two #2 x1/2" Sheet Metal Screws provided, as follows.

- Note that there are right and left Nylon Control Horns. Study the plans and photos carefully to identify which type you should use on each control surface. Use a right control horn for the elevator.
- Cut the Control Horn and the Retainer Plate apart. Hold the Control Horn in exact position (see plan) on the bottom of the elevator and mark the location of the two mounting holes. Drill pilot holes through the elevator with a 1/16" dia. drill bit (turn the bit with your fingers, a drill is not necessary).
- Mount the control horn onto the elevator with the Sheet Metal Screws and Retainer Plate. Turn the screws down until both the control horn and retainer plate first make contact with the balsa elevator. Then turn each screw in 1/2 turn further. Do not tighten further! By tightening the screws in this manner, the control horn will not crush the balsa.

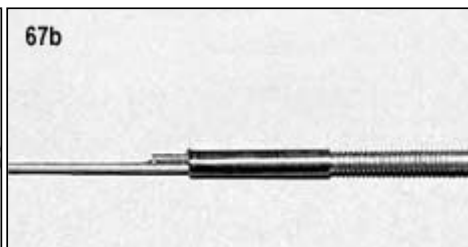
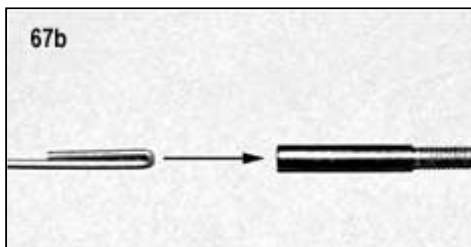
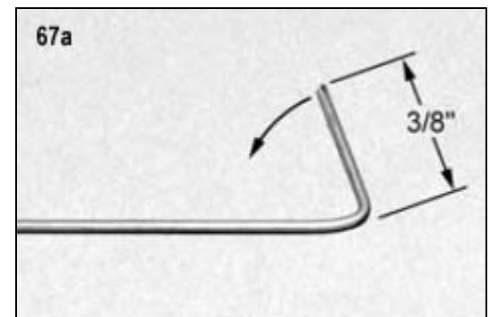


66. Repeat step 65 to mount a control horn on the right side of the rudder. Check the exact location on the plan.

Elevator Pushrod

67. A piece of 1/32" dia. x24" long straight music wire is provided for the elevator pushrod.

- Bend the last 3/8" of one end of the pushrod wire all the way back against itself. Mash the bend flat against the pushrod.
- Push the mashed end inside the open end of a Threaded Coupler. If you can't get it in, you haven't mashed the wire flat enough yet. The wire diameter is 1/32" and the id of the threaded coupler is 1/16"+, so it will go if mashed flat enough. You want a tight fit.
- Once you have the wire inside the threaded coupler, solder them permanently together with rosin core solder - it won't take much. When cool, clean up the solder joint.
- Screw an RC Link half way onto the threaded coupler.



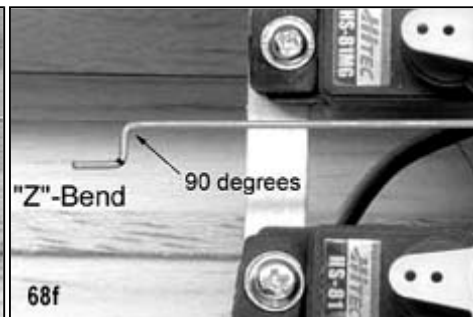
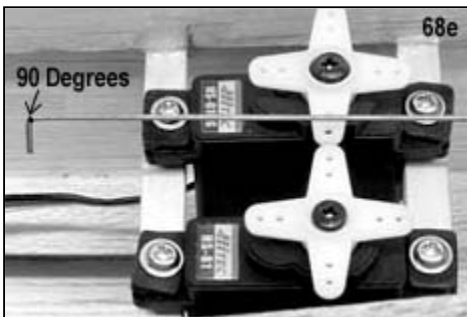
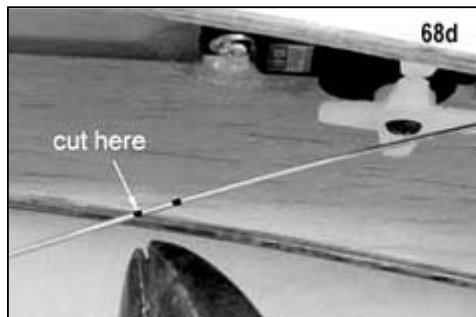
68a. At the tail, slide the plain end of the elevator pushrod wire inside the nylon pushrod tube on the left side of the airplane. Slide it in until you can hook the RC Link into the elevator control horn.

- At the servo end, make sure the elevator servo is in neutral position. Line the pushrod wire up with the outermost hole in the servo arm, and then make a mark on the wire just past the hole in the servo arm - a strong 1/16" past - about in line with the front edge of the servo arm.

c. Then make a second mark 3/16" past the first mark.



- d. Unhook the rear of the elevator pushrod from the control horn and slide the pushrod as far forward as possible. Cut off the servo end of the pushrod wire at the longest mark.
- e. Bend the end of the pushrod wire over 90 degrees at the remaining mark (the first mark you made back in step b.) Make the bend as sharp as possible.
- f. With a needle nose pliers, make another 90 degree bend back the other way, on the servo side of the mark - forming a "Z" bend. Make the bend as sharp as possible.



- g. Unscrew the servo arm from your servo and install it on the "Z" bend of the pushrod. Reinstall the servo arm.
- h. Plug the elevator servo into your radio system, make sure the elevator trim is neutral, and then adjust the RC Link to get the elevator in neutral position.



Rudder Pushrod

- 69. Repeat steps 67 and 68 to make and install the rudder pushrod wire.
- 70. You need to support the front end of the outer nylon pushrod tubes to keep them from flexing. Cut a 2-1/4" long piece of leftover 1/8"x3/8" balsa main spar stock to make a suitable support. Hold the balsa support against the front of former F-3 and up against the bottom of the pushrod tubes. Mark the positions of both tubes on the support. Take the support back out and make a small notch in the support for each tube. Then put the support back in position and glue it to the back of F-3. Also glue the pushrod tubes securely in the notches.



- 71. Install your aileron servos in the wing using the hardware that came with the servo.

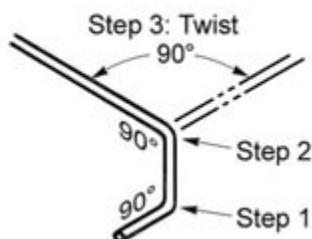
Aileron Pushrods

- 72. Two 2-56 x 10" long Threaded Rods are provided for the aileron pushrods.

- a. Thread a RC Link halfway onto the end of each rod.
- b. Mount a Nylon Control Horn on the bottom of each aileron. Check the exact location on the plan.
- c. Make a "Z"-Bend in the servo end of each aileron pushrod.

Note: This wire is heavier than the wire used for the elevator and rudder pushrods. Trying to make the z-bend with a needle nose pliers will be difficult. This illustration shows a traditional method for making z-bends with a standard pliers.

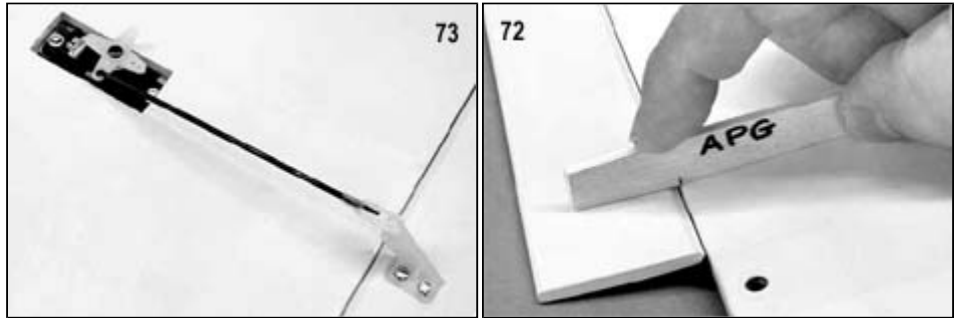
MAKING A Z-BEND



1. Make the first 90 degree bend in the end of the wire.
2. Make a second 90 degree bend, perpendicular to the first.
3. Clamp the bent end with pliers or a vise, and twist it to line up with the main wire.

- d. Install the z-bend end of the finished aileron pushrods in the servo arms. Snap the RC Links to the aileron control horns.
- e. Plug both aileron servos into your radio system using a Y-Harness chord. Make sure the aileron trim is neutral, and then adjust the RC Links to align the ailerons in neutral position.

Note: Your kit includes a plywood piece called APG, which stands for Aileron Positioning Guide. The Four-Star airfoil has a unique shape (semi-symmetrical with a flat bottom aft of the main spar), and the APG gives you a precise method for determining aileron neutral position. As shown, simply hold the APG up against the bottom of the wing. The aileron pushrod is then adjusted to align the aileron flat against the back of the APG.



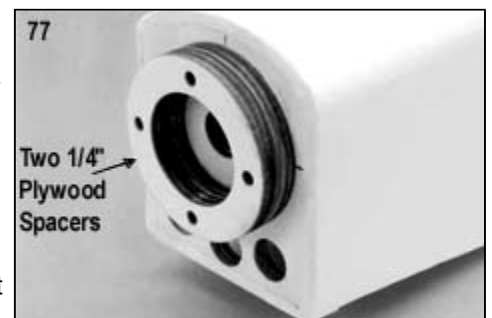
73. If your ESC includes an on/off switch (some do, some don't) this is typically mounted in the fuselage side. Use the switch cover plate as a guide to mark the location and size of the opening for the switch lever, and to mark the two holes for the mounting bolts. Cut the opening with a sharp #11 hobby knife, drill the two mounting holes, and then mount the switch with the bolts that came with it. CAUTION: Make sure the opening you cut for the switch is just slightly bigger than the switch lever, so that the switch will operate safely, without catching or binding on the wood.
74. Plug the elevator and rudder servos, and the aileron Y-harness chord into the receiver. Mount the receiver in the fuselage, between the servos and the back of former F-2 - exact location is not critical and may depend on the final fore-and-aft balancing of the model. Common ways of securing the receiver from moving around are:
 1. scrap sticks of balsa wood glued to the fuselage sides;
 2. Velcro® on the receiver with the mating piece mounted on a scrap balsa or plywood platform you glue into the fuselage; or
 3. a plastic tie (cinch) strap secured to the fuselage structure.
75. Route the receiver antenna to the outside of the fuselage and extend it back to tail end of the fuselage. We drilled a small hole through the fuselage bottom, just behind the trailing edge of the wing, and pushed the antenna through the hole. To hold the antenna at the rear of the fuselage, tie a small rubber band on the end of the antenna, and then loop the rubber band over the tailwheel wire to keep the antenna taught.

Motor Installation

This section presumes you are installing an electric power system in your Four-Star 20EP. We will show details of our installation of the Maxx Products Himax 3510-1100kv Brushless Outrunner Motor and Motor Mount, along with a 36 amp ESC, and a 3S1P Lipo 1800 mAh Battery Pack. Other similar products may have differences. Plan your installation accordingly.

76. Notice the four small nicks laser-cut into firewall F-1A to indicate the location of the horizontal and vertical thrust lines. Draw the full thrust lines all the way across the front of F-1A, connecting the small nicks. This will create a target for locating your motor.
77. For the cowling to fit properly, the distance needed between the front of the firewall to the front of the motor's thrust washer (back of the spinner if used) is 2-5/8", as shown on the plan. This distance was established in the design of the Four-Star 20EP to accommodate both electric and glow motor installations. With most electric motors appropriate for this airframe, this distance is longer than needed.

For instance, our Himax-3510 Motor with Himax Mount is 2-1/8" long. We installed a 1/2" thick spacer behind the motor mount, with the spacer glued permanently to the front of the firewall. Note that two 1/4" thick plywood laser-cut spacers are provided in this kit for the Himax installation. These spacers, or similar ones that you fabricate, may be needed for other brands of electric motors and mounts. If your brand motor is too short to reach 2-5/8" in front of the firewall, you will need to alter the ones included in the kit, or create your own. Install whatever thickness spacers are needed to achieve a distance of 2-5/8" between the front of the firewall to the front of the motor's thrust washer.



78a. Mount your motor on the firewall with appropriate screws. Be sure to locate the centerline of your motor with the thrust line.



b. The motor wires can be fed back through any of the holes in the firewall - whichever one is most convenient for your motor configuration. Leave all of the holes in the firewall open. They provide cooling air to the battery pack.

79. Connect your ESC to the motor wires, being very careful to get the polarity correct (red to red, black to black). Also plug the ESC into the receiver. Stuff the bulk of the ESC into the space above the battery compartment. The ESC does not need to be fastened down, it can simply float free in the nose. DO NOT wrap the ESC in foam or plastic. It must be left fully exposed to allow it to stay cool.
80. When you are ready to fly, the battery pack is inserted through the bottom opening of the fuselage. We recommend that you use Velcro® to secure your Battery Pack to the BT battery tray. The use of Velcro® makes the battery pack easy to remove for re-charging between flights.

SAFETY WARNING: It is very important that you always remain aware of the position of the throttle stick on your transmitter whenever there is a battery plugged into the airborne system. The motor/geardrive unit used in this model is powerful enough to cause damage to people or property if it is activated prematurely, accidentally, or unexpectedly. With an electric airplane, we recommended that you get in the habit of always keeping the throttle stick in the "low throttle" position, even when the transmitter is in storage. Be sure to recheck the throttle stick position before plugging in the airborne battery pack, and also before turning on the airborne on/off switch. Under no circumstances should you hold this model by the nose when the battery is plugged in or the radio system is turned on. Never plug in your flight battery until you are on the flight line, ready to fly.

81. Open up the front of the Cowling. A Dremel® tool works great for this. If you don't have one, another good method is to first drill a series of 1/4" dia. holes near the perimeter of the area to be cut out. Then cut between the holes with a #11 hobby knife. Finish trimming with the knife, and then sand the edge smooth.



82a. The Cowling is ABS plastic and can be painted with any common modeling paint - dope, enamel, or epoxy.

b. Test fit the Cowling over the motor and onto the fuselage. Once you can get the cowling in proper position, mount your spinner backplate and propeller on the prop shaft. Check to see that you have a 1/16" to 1/8" gap between the back of the spinner backplate and the front of the cowling (we use a little larger gap than on a glow engine airplane, to allow a little more cooling air to the inside of the cowling). Adjust the location of the cowling, making sure that the spinner backplate is centered at the front and that the back edges of the cowl are tight against the fuselage. Use masking tape to hold the cowling securely in position on the fuselage.

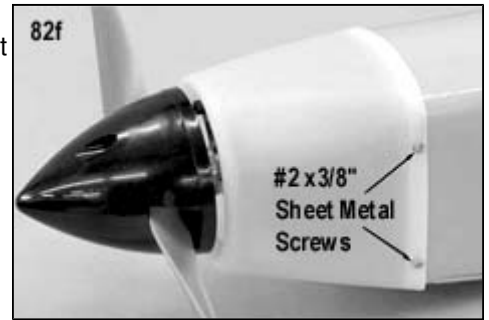
c. Four #2 x3/8" Sheet Metal Screws are provided for fastening the cowling to the fuselage. Use two screws on each side - see plan for locations. Mark the screw locations on the cowling. The idea is for the cowl mounting screws to go into the center of the edge of the F-1A/F-1B firewall.

d. Drill a 1/16" dia. pilot hole thru the cowling and into the fuselage at each screw location. Drill as straight as possible. As you finish drilling each hole, thread a mounting screw into the pilot hole. When finished, remove the tape that was holding the cowl.

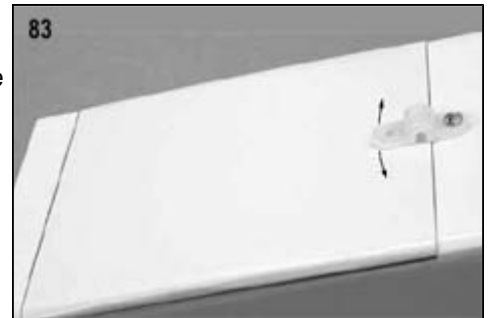


e. Remove the cowling from the fuselage. Open up the four holes in the cowling to allow the mounting screws to pass cleanly through the plastic (a #45 .082" drill bit is perfect).

f. On the fuselage, run the mounting screws in and back out of the holes a couple times to create good threads in the wood. Note: If the screws ever get to loose in the wood, take the screws out and place a small drop of Thin CA glue in each hole. Let dry thoroughly. Then run the mounting screws in and out a few times again. The CA hardens the threads in the wood, making them tough and durable enough to hold up to dozens of cowl removals and installations.



83. A Nylon Landing Gear Clip and #2 x 3/8" Sheet Metal Screw are provided to make a simple latch to hold the Battery Hatch in place. Use the screw to mount the clip near the front edge of the LG-1 landing gear plate. Half the clip should be mounted on LG-1 and the other half overhangs and captures the Hatch. There is already a small pilot hole in LG-1 for the screw - look closely for an indication of the hole underneath the covering material - if you have trouble finding it, you can stick a pin down through the hole from the inside. Assemble as shown, leaving the screw loose enough that you can rotate the clip out of the way with your fingers when you want to take off the Hatch.



84. Remove the covering material over the rearmost hole in the fuselage bottom in front of the tailwheel, to allow the cooling air that is going into the front of the cowling a place to exit the fuselage. This will help keep your motor, battery, ESC, and radio equipment running cool.



System Tests

85. The completed radio and motor systems can now be powered up and tested for proper operation.

a. Make sure your transmitter aileron, elevator, and rudder trim levers are in neutral position, and that the throttle stick is in the full "low throttle" position. Then turn on your transmitter.

b. Install a charged battery pack inside the fuselage. Making very sure of the correct polarity of the connectors, plug the battery pack into the ESC.

86. The elevator and rudder servos should now be working.

a. Move the transmitter sticks and check for correct direction of servo movement. Use the servo-reversing feature of your transmitter, if needed, to make the servos move in the correct direction.

b. If necessary reposition the servo output arms on the elevator and rudder servos as close to 90° to the servo case as possible. Be sure to reinstall the output arm retaining screws after making the adjustment.

c. With the radio still on and the servo arms squared up, note the exact positions of the elevator and rudder. Adjust the RC Links if necessary to get the control surfaces properly centered.

87. Set the wing in place on the fuselage, plugging the aileron servo chords into the Y-harness in the fuselage.

a. Move the transmitter aileron stick and check for correct direction of movement. Use the servo-reversing feature of your transmitter, if needed, to make the ailerons move in the correct direction.

b. If necessary reposition the output arms on the aileron servos as close to 90 deg. to the servo case as possible. Be sure to reinstall the output arm retaining screws after making the adjustment.

c. With the radio still on and the servo arms squared up, note the exact positions of the ailerons. Adjust the RC Links if necessary to get the ailerons properly centered.

88. The propeller and spinner should NOT be installed on the motor for this initial test - for safety!

- a. Slowly advance the throttle stick on the transmitter. The motor should start turning. If not, your throttle channel needs to be reversed on the transmitter.
- b. Now make sure the motor shaft is moving in the correct direction. When viewing the fuselage from the rear to the front - as if you were sitting in the cockpit - the motor shaft should turn clockwise when throttle is applied. If not, you've most likely got the polarity of the motor-to-esc or esc-to-battery wiring reversed.

Modeler's Tip - When trying to tighten the prop nut, you may find that the spinner backplate keeps slipping against the motor's prop flange, allowing the propeller to slip out of position. If this happens, remove the prop nut, propeller, and spinner backplate, and then glue a small disk of coarse sandpaper (50-100 grit) onto the front of the motor's prop flange. When dry, reassemble the parts and tighten securely.

Control Throws

The maximum distance that a control surface moves when you move the transmitter stick to full deflection is normally called the "control throw" or "control travel". Most modern radio systems allow you to adjust the control throw of the servos directly from the transmitter. This radio feature is usually referred to as EPA, or end point adjustment. Use this feature to adjust the control movements for the ailerons, elevator, and rudder of your Four-Star 20. The following control movements are recommended for your initial test flight. Some pilots may prefer "snappier" performance. After the initial test flights you can adjust the control throws to suit yourself and the way you like to fly.

RECOMMENDED INITIAL CONTROL THROWS

Ailerons: 5/16" up 5/16" down
Elevator: 7/16" up, 7/16" down
Rudder: 7/8" right, 7/8" left

Note: These measurements are always taken at the widest part of the control surface, at their trailing edges.

Balance Your Airplane

Important: An R/C model should always be balanced with everything on board, ready for flight. The flight battery must be installed in the fuselage, and the propeller and spinner must be mounted in place when balancing the model.

RECOMMENDED BALANCE POINT 2-3/8" (26%) to 2-3/4" (30%) Behind The Leading Edge Of The Wing

The main wing spar of the Four-Star 20EP is located precisely in the middle of this balance range. This means that the simplest way to check the balance of your Four-Star 20EP is to pick up the airplane with a fingertip under the each wingtip at the main spar location. Slowly lift the airplane off the work table and note the attitude of the fuselage. The airplane should balance on your fingertips in level position - not nose up or nose down. If the nose hangs low, the model is "nose heavy". If the tail hangs low, this means that the model is "tail heavy". If either of these conditions exists, you must make adjustments to correct the problem. Never attempt to fly a model that is out of balance! Since the flight battery pack is the single heaviest component in the airplane, it can be used to adjust almost any tail heavy or nose heavy condition. This is simply done by moving the battery forwards or backwards inside the airplane.

FLYING YOUR FOUR-STAR 20EP

The Four-Star appeals to R/C fliers of all experience levels, from beginners to expert pilots. Assuming that expert pilots will not need much guidance, these notes are written for the newcomer.

Pre-Flight

Be sure your flight battery pack is fully charged. Also be sure your transmitter is fully charged. We highly recommend that you perform a standard range check on your radio system - with and without the motor running. Make sure your propeller is balanced and has no nicks or cracks - never fly with a faulty propeller! Finally, take a few minutes to give your model a thorough pre-flight inspection. Make sure everything is secure and tight and operating properly, before attempting to fly the model. Any problems you have will not magically disappear at the field - they will get worse!

First Test Flight

The Four-Star 20 is a fun airplane to fly, but it is not a basic trainer. If you have no previous R/C flying experience, we suggest that you not attempt to fly this model without the assistance of an experienced R/C pilot. Contact your local R/C club or ask your hobby dealer for the names of good fliers in your area and a suitable location for flying.

Choose a calm day with little or no wind for the Four-Star 20's first test flight. This is important in getting the model properly trimmed. If there is too much wind, you won't get a true reading on what the model is doing in the air.

The Four-Star 20 is capable of taking off from any smooth surface runway or a closely cut grass field. The Four-Star 20 can also be easily hand-launched if the grass is too long at your flying field. When hand launching, the airplane must be launched straight and level directly into the wind, with the nose aimed at a point on the ground about 75' in front of you. Never launch the model with the nose pointed up or the wings tipped to one side or the other. The launch should be firm enough to achieve flight speed but yet not overly hard.

You will find the Four-Star 20 capable of almost any trick "in the book". Experiment with different control throws and balance points until the model flies exactly the way you want. Make any changes, especially to the balance point, gradually. We recommend that you shift the balance point no more than 1/8" at a time. In general, moving the balance point forward will make the model more stable, slowing down the snap rolls and spins. Moving the balance point rearward increases its sensitivity to control inputs; but if carried too far the model can become completely unstable and uncontrollable. The balance range shown on the plan is a safe area to use for test flights. Don't exceed the rearward limit unless you are a very experienced pilot.

Caution: Never land your airplane in tall grass or weeds with the electric motor running. Always throttle back completely if you land in such terrain, or if you nose over after landing. Tall grass or a nose over will stall the motor if it is running. A stalled motor can overheat the ESC and batteries, causing them to fail.

Join The Club

Although the Four-Star 20 is small and can be flown in fairly confined spaces by accomplished pilots, it should never be flown within five miles of an organized R/C aircraft flying site. This one simple precaution can prevent the loss of your model from radio interference. Do yourself a favor and join your local R/C club - you'll almost always get assistance and good advice, and you will even make a friend or two!

GOOD LUCK AND HAPPY LANDINGS!

WARNING! THIS IS NOT A TOY!

Flying machines of any form, either model-size or full-size, are not toys! Because of the speeds that airplanes must achieve in order to fly, they are capable of causing serious bodily harm and property damage if they crash. IT IS YOUR RESPONSIBILITY AND YOURS ALONE to assemble this model airplane correctly according to the plans and instructions, to ground test the finished model before each flight to make sure it is completely airworthy, and to always fly your model in a safe location and in a safe manner. The first test flights should only be made by an experienced R/C flyer, familiar with high performance R/C aircraft.

The governing body for radio-control model airplanes in the United States is the ACADEMY OF MODEL AERONAUTICS, commonly called the AMA. The AMA SAFETY CODE provides guidelines for the safe operation of R/C model airplanes. While AMA membership is not necessarily mandatory, it is required by most R/C flying clubs in the U.S. and provides you with important liability insurance in case your R/C model should ever cause serious property damage or personal injury to someone else. For more information, contact:

ACADEMY OF MODEL AERONAUTICS
5151 East Memorial Drive
Muncie, IN 47302
Telephone: (317) 287-1256



Customer Service

SIG MFG CO. is totally committed to your success in both building and flying the FOUR-STAR 20EP design. Should you encounter any problem building this kit, or discover any missing or damaged parts, please feel free to contact us by mail or telephone.

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