



SIG
SIGRC66



WONDER



BUILDING AND FLYING INSTRUCTIONS

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Introduction by Bruce Tharpe

People often ask me what the inspiration was for the Wonder. Well, did you ever see the Flying Sub from "Voyage to the Bottom of the Sea"? As a kid, I thought that was just about the coolest flying machine ever conceived. No, the Wonder doesn't look exactly like the Flying Sub, but it had to be somewhere in the back of my mind when I was doodling the first Wonder years ago. I suppose there's a bit of old-time control line combat influence in the design as well.

The design presented here actually evolved from many years of "Wonder-Type" designs, starting with 1/2A versions back in the early 1980s. There have been swept wings, straight wings, single tails, twin tails, and tripple tails. The basic idea has never changed, however. I wanted dirt-simple models that featured a shoulder wing (for easy hand launches) with a large stabilizer butted up against the trailing edge. Many people call them flying wings, but technically, they're not. Actually the extended tail simplifies hooking up the ailerons and elevator, and provides a smoother pitch response than most true flying wings.

The main goal was always to create a smooth-flying, aileron-and-elevator-controlled aerobatic ship. The design in this box is definitely the best of the Wonder bunch!

The Sig Wonder kit has been engineered to provide the builder with four optional versions as shown above. The basic structure of each version is identical - the differences are cosmetic. There's no perceptible difference in the flying qualities of one over another, so pick the version that "turns you on" the most.

If you're feeling creative, go ahead and mix fins from one version with ailerons from another and a canopy from a third to create your own, personal version. All of the decals are provided, so you can intermix those as well.

Incidentally, if you get a chance to see a rerun of "Voyage to the Bottom of the Sea", be sure to check it out. Somehow the stories seem dumber than they were so many years ago, but the Flying Sub is still pretty cool.

ENGINES, PROPELLERS, AND MUFFLERS

The recommended engine range for the Wonder is .09 to .19 cu. in. There is a tremendous variety of engines available in this range. Remember that weight is the mortal enemy of small models like this Wonder, and as you go up in power you also wind up increasing the weight. That's not to say that an .09 powered Wonder performs as well as a .19 powered Wonder, but the difference is probably less than you would expect. Most modellers will be completely satisfied with a good .15 in the nose. The real power lovers who enjoy ballistics over aerodynamics will have to install a .19. Anything bigger is not recommended by Sig.

Use only those propellers recommended in the instructions supplied with your engine. And use a muffler! A loud engine may cost you (and possibly your club) the use of your flying field if it annoys a non-flying neighbour. Use the muffler that came with the engine or one of the many after-market mufflers that are available.

RADIO REQUIREMENTS

The Sig Wonder uses only two flight controls: ailerons and elevator (there is no rudder). Throttle control is optional but is highly recommended. Standard size servos can be used (see plan), but do yourself a favour and buy some mini or micro servos that are compatible with your radio system. The smaller servos will be much easier to install in the Wonder and will save some weight, too. A small, flat 225 maH to 300 maH battery pack is a must. Be certain your radio system frequency is approved for use in R/C model aircraft.

GLUES

There are many different glues available today for model construction that it can be confusing to even the experienced modeler. To simplify matters, most glues can be classified as one of four basic types: Fast cyanoacrylate adhesives (abbreviated as CA) such as Sig CA, easy to use water-based wood glues such as Sig-Bond (yellow) and Sig Super-Weld (white), super strong (but heavier) two-part epoxy glues such as Sig Kwik-Set (5 minute cure) and Sig Epoxy (3 hour cure), and traditional solvent-base model cements such as Sig-Ment.

Each of these types has different characteristics and advantages. Often times, the choice of which type to use is strictly a matter of personal preference based on your experience with previous models. CA is recommended as our first choice because of its ability to penetrate an already assembled joint. In other words, parts can be assembled dry (without glue), the alignment checked and adjusted, and then the glue can be applied to the joints. You should also have on hand some epoxy (both 5-minute and slow dry) and Sig-Bond because these glues are called out in several of the steps in these instructions.

Sig CA, like most brands of cyanoacrylates, come in three viscosities- thin, medium, and thick. Odorless CA is generally more expensive, but it is ideal for people who can't tolerate the fumes of normal CA. An accelerator spray and debonder are also available and are described below.

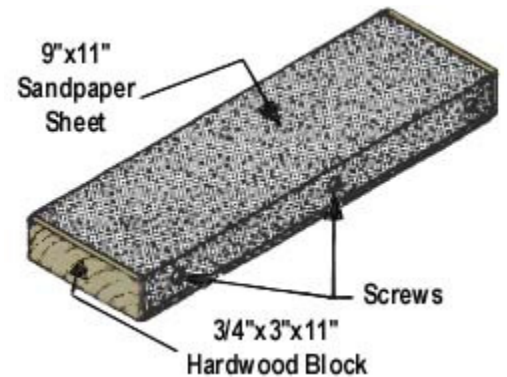
- **Sig CA Thin-** Watery consistency, thin CA should only be used when the two parts to be joined are in perfect contact with zero gap. Capillary action pulls this glue deep into the wood resulting in a very strong bond and it dries in just a few seconds. Thin CA can be used to tack assemblies together, but these joints should be glued again later with medium or thick CA. Thin CA is also necessary for installing Easy Hinges.
- **Sig CA Plus-** Our medium thickness CA is excellent for almost any step during construction. The extra thickness allows the glue to fill small gaps, but it does dry a little slower than a thin CA.
- **Sig CA Slow-** This thickest formula is good for filling large gaps and building up strong fillets at joints requiring extra strength. It also dries slow enough to allow you to apply it to one part and position it on another before it dries. This feature is useful when laminating large sheeted areas like a fuselage side and a fuselage doubler.
- **Sig Kwik-Shot Accelerator-** Spraying accelerator on CA (any thickness) will cure it almost instantly. Although CA is fast, it's sometimes nice to speed it up even more.
- **Debonder-** This can be used to separate parts, but you'll probably use it for unsticking your fingers more than anything else!

CAUTION: Some people have experienced allergic reactions when exposed to epoxy or cyanoacrylate glues. This is very rare. However, it is always important that such glues, and also paints, thinners and solvents, be used with adequate ventilation to carry fumes away.

YOU'LL NEED GOOD SANDING BLOCK

An assortment of different size sanding blocks are indispensable tools for model construction. A good general purpose block can be made by wrapping a 9"x11" sheet of sandpaper around a piece of hardwood or plywood. Use three screws along one edge to hold the overlapped ends of the sandpaper. Put 80-grit paper on the block during general construction. Switch to 220-grit paper for final finish sanding just before covering.

In addition to the large block, there are places where a smaller one is handy. Also, a sandpaper "file" can be made by gluing sandpaper to a flat spruce stick or around a hardwood dowel for working in tight places.



NOTES BEFORE BEGINNING CONSTRUCTION

Any references to right or left refers to your right or left as if you were seated in the cockpit.

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 "door core" from the lumber yard, or whatever - as long as it is perfectly flat and untwisted. Cover the top surface of the building board with a piece of celotex-type wall board or foam board, into which pins can be easily pushed. Don't hesitate to use plenty of pins during assembly to hold drying parts in their correct position.

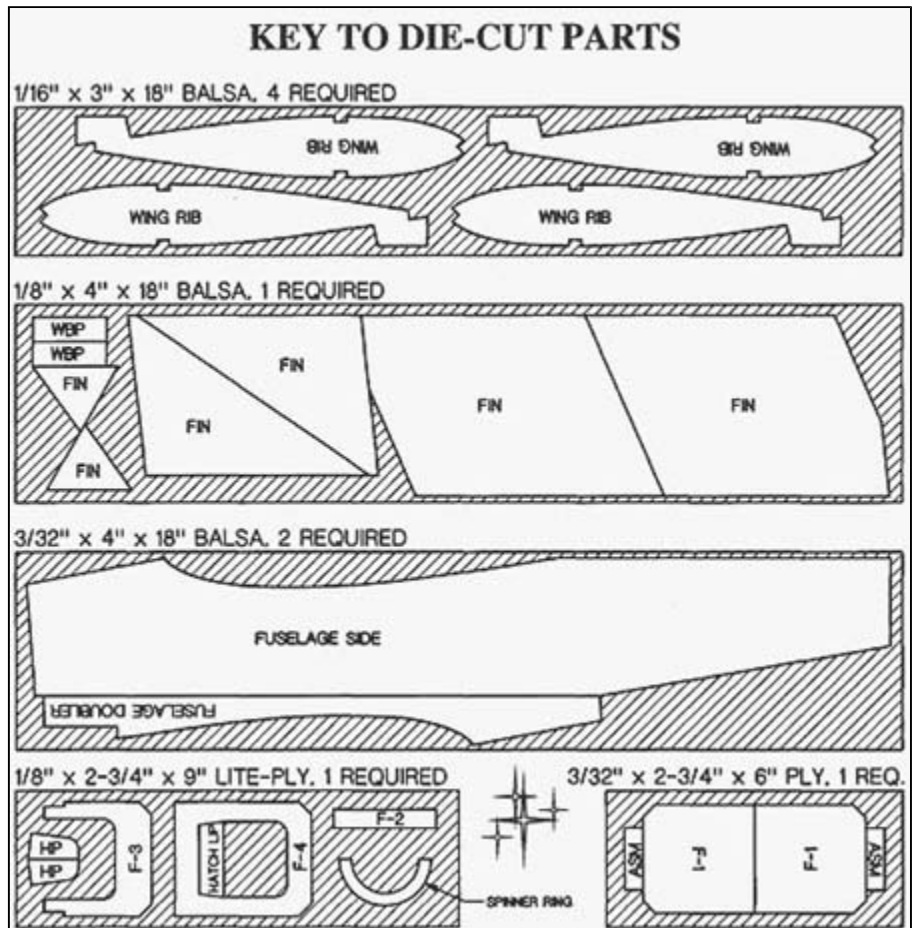
When pinning or gluing parts directly over the full-size plans, cover the plan with wax paper or plastic kitchen wrap to prevent gluing the parts to the plans.

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

Leave all the die-cut parts in the sheets until needed for construction. Then remove pieces from the sheets carefully. If difficulty is encountered, do not force the part from the sheet. Use a modeling knife to cut it free.

The die-cut balsa and plywood can be identified using the plans and the "Key to Die-Cut Parts" below. Mark the identification numbers on the corresponding parts before removing them from the die-cut sheets

All of the other parts can be identified by the "Complete Kit Parts List". Sort the different sizes of sticks and sheets into individual piles to avoid confusion during building.



ABOUT THE BUILDING SEQUENCE

The quickest and most efficient way to complete a model is to work on several pieces at the same time. While the glue is drying on one section, you can start on or proceed with another part. Keep in mind that the number sequence used in these instructions was chosen as the best way to explain the building of each major component and is not intended to be followed exact one-two-three fashion. Start on the wing at No.1 and after doing as many steps as is convenient, flip over to "Fuselage construction" and do a step or two or three, then back to "Wing Construction" and so forth. You will arrive at points where you can go no farther until another component is available.

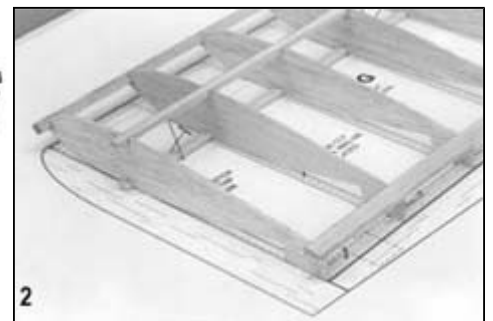
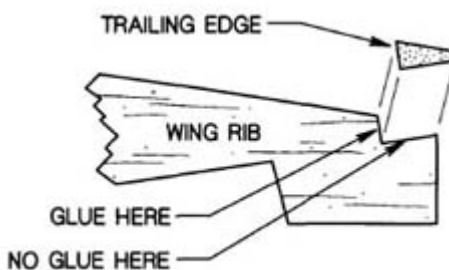
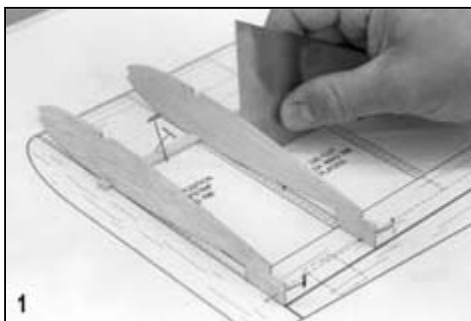
Plan ahead! Read the instructions completely and study the full size plans before beginning construction.

COMPLETE KIT PARTS LIST						
Die-Cut Balsa						
4	1/16"x3"x18" Wing Ribs	2	3/32"x4"x18" Fuselage Side, Fuselage Doublers	1	1/8"x4"x18" fins, Wing Block Pads (WBP)	
Printed Balsa						
1	1/4"x2"x12" Canopy, Wing Dowel Supports (WDS)					
Sheet Balsa						
2	1/16"x1"x36" Trailing Edge Sheeting	1	1/16"x3"x18" Wing Center Sheeting	2	1/16"x3"x36" Leading Edge Sheeting	
2	1/8"x4"x10" Sheets for Optional Fins	2	3/16"x4"x12" Stabilizer and Elevator	2	1/4"x3"x3" Fuselage Top, Cowl Bottom	
Stick Balsa						
3	1/16"x1/4"x36" Capstrips	1	1/4"x1/4"x36" Leading Edge	5	1/4" Traingle x12" Corner Braces, Skid Sides	
				1	1/2" Triangle x6" Cowl Filler	
Block Balsa						
2	1"x1-1/2"x9" Wingtips					
Special Cut Balsa						
1	3/16"x3/8"x36" Tapered Trailing Edge	2	3/16"x1-1/4"x12" Tapered Ailerons	4	3/16"x1"x3" Cowl Sides	
Pre-Cut Plywood						
1	3/32"x2-3/4"x6" Birch Ply F-1, Aileron Servo Mounts (ASM)	1	1/8"x2-3/4"x9" Lite-Ply Formers, HP, Hatch Lip, Spinner Ring			
Sawn Plywood						
1	1/16"x7/8"x2-1/2" Birch Ply Wing Hold-Down Plate					
Hardwood						
1	1/8"x1/8"x9" Spruce Fin Stiffener	2	1/8"x1/4"x36" Spruce Wing Spars	1	1/8"x5/16"x12" Spruce Skid	
2	1/4"x1/2"x1-1/2" Basswood Wing Hold-Down Blocks			2	3/16" dia. x1-1/2" Birch Wing Dowels	
Formed Wire Parts						
1	4-40x8" L.H. Aileron Torque Rod (with brass bearing)	1	4-40x8" R.H. Aileron Torque Rod (with brass bearing)			
Miscellaneous						
1	4"x20" Decal DKM-266A (for Standard Version)	1	4"x20" Decal DKM-266B (for Russian Version)	1	4"x20" Decal DKM-266C (for Angel Version)	
1	38"x50" Full-Size Printed Plan	1	20 pg. Photo Illustrated Instruction Book		1	4"x20" Decal DKM-266D (for Patriot Version)
Hardware						
2	Small Glass-Filled Engine Mounts	2	#2x3/8" Flat Head Wood Screws (for hatch)	2	#2x1/2" Sheet Metal Screws (for control horn)	
2	10-32x1" Nylon Wing Bolts	4	6-32 Blind Nuts (for engine mounts)	1	2-56 Solder Link (for throttle)	
3	2-56x10" Threaded Rods (2/aileron, 1/elevator)	2	4-40 Nylon Aileron Connectors	1	Nylon Control Horn (for elevator)	
1	1/16" dia.x12" Steel Cable (for throttle pushrod)	7	3/4"x1" Easy Hinges	1	Pushrod Connector Package	
				4	6-32x5/8" Socket Head Mounting Blocks (for engine mounts)	
				3	2-56 Nylon RC Links (2/aileron, 1/elevator)	
				1	130" o.d.x12" Nylon Tubing (for throttle pushrod)	

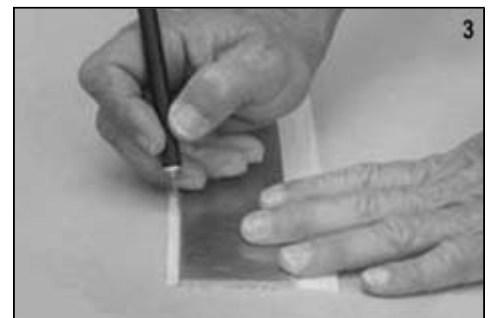
WING CONSTRUCTION

The Wonder wing is designed to be built in one piece, flat on the building board (no dihedral or washout). Pin or tape the wing plan to your building board and protect the plan by covering it with wax paper or plastic wrap.

1.
 - a. Pin the 1/8"x1/4"x36" spruce lower wing spar over the plans. Instead of pushing pins right through the spruce (which could cause it to split), cross two pins over the spar to hold it in place.
 - b. Glue the 16 die-cut balsa wing ribs to the lower wing spar. Each wing rib should be vertical and the alignment tab at the trailing edge should be pinned firmly to the building board.
2.
 - a. Glue the 1/8"x1/4"x36" spruce upper wing spar to the wing ribs.
 - b. Find the 3/16"x3/8"x36" special-cut balsa trailing edge. By looking at its ends you will see that it is not symmetrical. Rather, it is a 3/16"x3/8" balsa stick that has been tapered on its top surface from 3/16" at the front to 1/6" at the rear. For the best fit, make sure the trailing edge is positioned properly in the wing rib notches as shown in the diagram. Glue the trailing edge to the wing ribs being careful not to glue the trailing edge to the alignment tabs.
 - c. Add the 1/4"sq.x36" balsa leading edge to the front of the ribs.



3. The leading edge sheeting must be cut to its correct 2-3/4" width from the 1/16"x3"x36" sheets provided in the kit. Use a long straightedge and a sharp modelling knife to trim the sheets. To help make the sheeting fit against the leading edge, hold the knife at a 15 or 20 degree angle while cutting the front edge of the sheeting, as shown in the photo.
4. Glue the leading edge sheeting to the leading edge using a bottle of thin CA with a long applicator tube. Apply slow CA to the tops of the wing ribs and the upper spar, then push the sheeting into place with your hands. You may have to use accelerator spray on small sections at a time until the sheeting is completely glued in place.



NOTE: Harder sheeting may need to be wetted before bending it into place, to prevent cracking. Warm water sponged onto the outer surface will cause the sheeting to swell, allowing it to conform easily to the rib contour.



WONDER WHY...

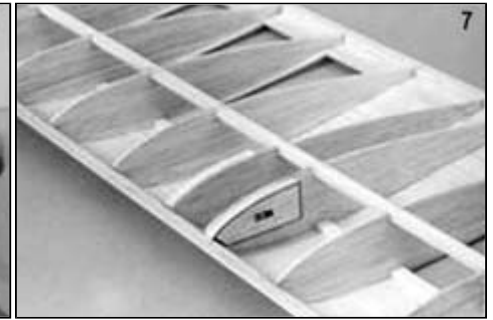
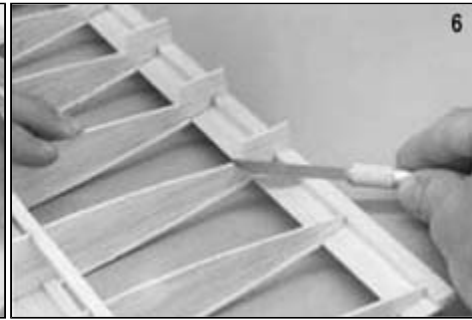
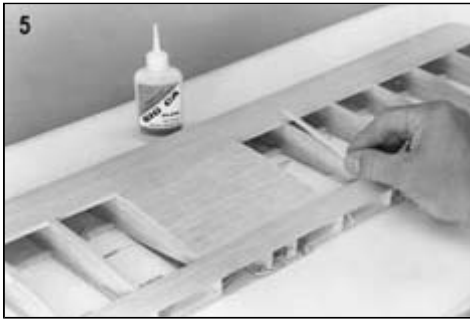
...we don't just give you 2-3/4" sheeting in the kit?

Answer:

Internal stresses can cause a sheet of balsa to bow, even when cut from a perfectly straight plank. Experienced modelers know that the only way to ensure a straight sheet of balsa is to cut the edges themselves, just before gluing it in place on the model. Trimming the edges is an easy step that will help you build a true wing.

5.
 - a. Add the 1/16"x1"x36" balsa trailing edge sheeting.
 - b. Sheet the upper center section of the wing using pieces cut from the 1/16"x3"x18" balsa provided in the kit. Sig-Bond (yellow wood glue) is recommended for the edges of the sheeting because it's easier to sand than CA.
 - c. Glue the 1/16"x1/4" balsa capstrips to the upper edge of the remaining wing ribs and allow to dry.

6. Unpin the wing from the building board. Carefully cut away the alignment tabs on all of the wing ribs.
7.
 - a. Use a jigsaw or a sharp modeling knife to cut the two wing dowel supports (WDS) from the 1/4" printed balsa sheet. Saw just outside the lines, then true up the edges with a sanding block, leaving the complete black line on the parts.
 - b. Glue the wing dowel supports to the two center ribs as shown on the plans.



8.
 - a. Turn the wing over and pin it to your building board. The wing is now rightside up. Mark the top of the wing for identification in latter steps. Use a piece of scrap stick wood to support the trailing edge. It's very important to keep the support stick straight and aligned with the trailing edge - you don't want to build in any warps now. Pin the support stick to the board and pin the wing to the support stick to hold everything firmly in place.
 - b. Glue on the bottom leading edge sheeting, the bottom trailing edge sheeting, and the bottom capstrips. Hold off on the bottom center sheeting; it will be installed later.
9. When dry, unpin the wing from the building board. If you have been using thin or medium CA glue during construction, now is the time to go back over every joint with medium or thick CA. Don't be stingy here - the integrity of your wing depends upon strong glue joints. Glue each side of each joint. A long applicator tube will help you reach inside the leading edge sheeting.



10. Now you can glue on the 1/16" balsa bottom center sheeting.

11.
 - a. Carve and sand the wing leading edge to shape. For best stall characteristics, you want a nicely rounded leading edge as shown on the plans. Use a long sanding block to make certain the curvature is consistent along the entire length of the wing.
 - b. If necessary, touch up the trailing edge with a sanding block so that it's flat and straight.
 - c. Cut off and sand the spars, leading edge, trailing edge and sheeting at both ends of the wing flush with the end ribs
 - d. Give the wing a final sanding over it's entire surface with a long sanding block. Sand just enough to remove any prominent high spots or bumps. Be careful! Excessive sanding may disturb the airfoil shape.



12. Decide now which type of wingtip you plan to use, then cut or trace the top view of the wingtip from the plan. Transfer the shape of the wingtip to the tops of the 1"x1-1/2"x9" balsa block wingtips using the paper outline as a guide. Rough cut the blocks to shape with a bandsaw or a jigsaw.
13.
 - a. Glue the wingtips to the end ribs. If one of the blocks happens to be heavier than the other, glue the heavy one to the left end of the wing to help offset the weight of the engine's muffler, which is generally on the right side. Sig-Bond is again recommended for easy sanding.
 - b. When dry, carve and sand the wingtips to shape. If you are building the "Standard" Wonder, see the separate instructions for "Carving Vortex Wingtips". If you are building another version, start by carving and sanding the blocks to match the airfoil contour, then round off the corners.
 - c. Reinforce the thin trailing edge of each wingtip by soaking it with several drops of thin CA.

14. Locate the 1/16"x7/8"x2-1/2" plywood wing hold-down plate, then round off the top edges and the corners with a sanding block. Glue the wing hold-down plate to the top of the wing so that it's centered left to right and overhangs the trailing edge 3/16".



WONDER WHY...

...there's no dihedral brace or sheer webs in the wing?

Answer:

All of the spars and sheeting in the Wonder wing run the full span of the wing, from tip to tip. Since there is no center wing joint, there's no need for a dihedral brace or reinforcing fiberglass tape. The center sheeting is more than adequate to absorb the aerodynamic loads at the center of the wing.

None of the Wonder prototypes ever used, or needed, sheer webbing. The low-aspect-ratio, 15%-thick wing simply doesn't need the extra strength or weight of sheer webs, and you don't need the extra work of installing them!

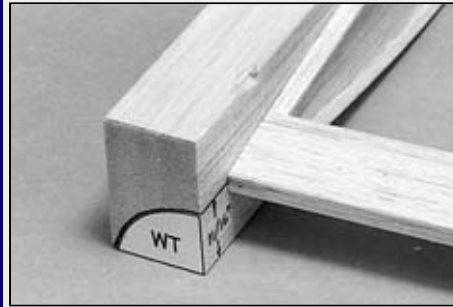
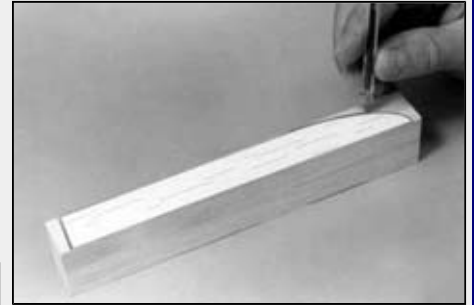
- 15.
- Draw a line on the trailing edge at the exact center of the wing, then two more lines spaced 1/2" on either side of the center. The second two lines indicate where to position the inner end of the torque rod brass bearings, which should now be glued in place. Make certain the torque rod assemblies are centered vertically on the wing trailing edge and be careful not to get any glue in the bearings.
 - When dry, fill the small gaps above and below the torque rods with more glue or balsa filler and sand it smooth.
 - Cut clearance notches in the wing trailing edge for the inner end of the torque rods.

Carving Vortex Wingtips

The down-turned vortex wingtips used on the Standard version of the Wonder were chosen more for their looks than any kind of aerodynamic reason. Theoretically this type of wingtip is very efficient, but on a model of this size it really makes little difference.

They are easier to carve and sand than they appear, so give 'em a try!

1. Cut out the top view of the wing tips (see step 12 above). Draw a line on the inside surface of each tip, 11/16" from the bottom.



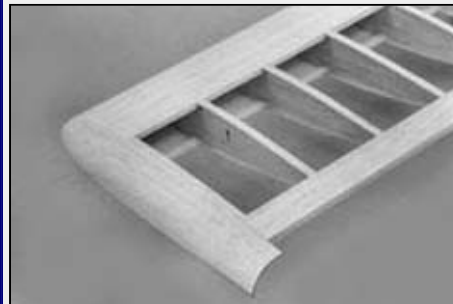
2. Glue the wingtip to the end rib so that it's flush with the bottom of the airfoil and the drawn line passes through the exact center of the trailing edge. When dry, use the WT wingtip plate (cut from plans) to mark the shape of the trailing edge on each wingtip.

3. Carve and sand the wingtip blocks to match the contour of the entire upper surface and back to the spar on the lower surface.



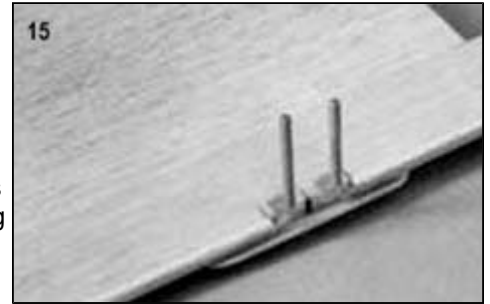
4. Rough carve the concave portion of the tips using an X-Acto #162 router blade.

5. Finish sand the concave portion with a large dowel wrapped with 80-grit sandpaper.



6. The rest of the block can now be carved and sanded pretty much like a normal, rounded wingtip. Be sure to strengthen the trailing edge area of each wingtip by soaking then with thin CA. Smooth things up with a hand-held piece of 150-grit sandpaper.

16. a. Two pieces of 3/16"x1-1/4"x12" tapered balsa are provided for making the ailerons. Choose an aileron pattern, cut it from the plans, trace the outline onto both pieces of tapered balsa, then cut the ailerons to shape.
- b. Carefully block sand the top and bottom surface of each aileron equally so that the leading edge remains 3/16" thick and the trailing edge is a constant 1/16" or less. You'll need to steepen the angle of the sanding block as you approach the aileron tip to make the trailing edge a constant thickness. This sounds tricky, but it won't take more than a few passes of an 80-grit sanding block.



17. a. Draw a hinge line centered on the leading edge of each aileron. Use a sanding block to bevel the front of the ailerons using the hinge line as a guide.
- b. Position the ailerons on the back of the wing, leaving a 1/32" gap between the ends of the aileron and the wingtips. Mark the locations for the torque rods, then slot and drill the ailerons to receive the torque rod wires.



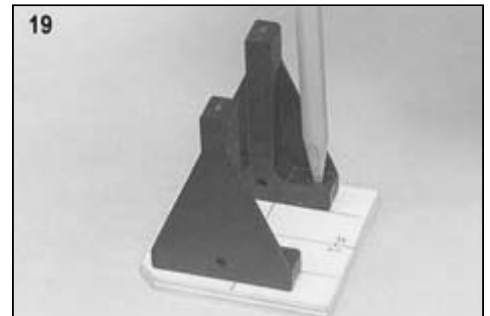
18. Trial fit the ailerons to the torque rods. Once they fit, temporarily tape the ailerons in place and sand the wingtips and ailerons in place and sand the wingtips and ailerons as necessary to blend smoothly together.



FUSELAGE CONSTRUCTION

Basic Fuselage Assembly

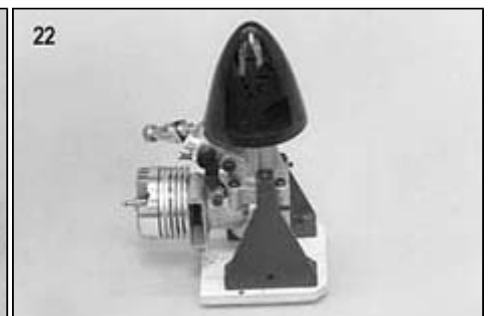
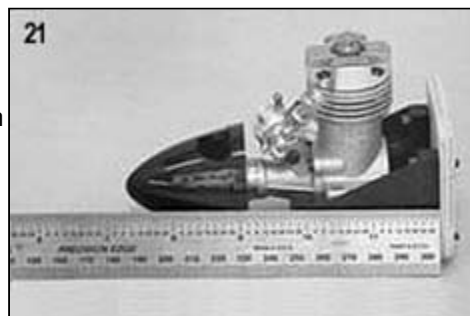
19. a. Glue together the two die-cut 3/32" plywood F-1 pieces using Kwik-Set epoxy or slow CA. Use a heavy weight of some kind to hold the two pieces perfectly flat while drying.
- b. Mark the vertical centerline and thrust line on the F-1 assembly using the cross-section on the plan as a guide.
- c. Determine the spacing that will be necessary between the two glass-filled engine mounts to fit your engine, then position the mounts on F-1 accordingly. Mark the location of the four mounting holes and drill them out with a 3/16" drill bit.



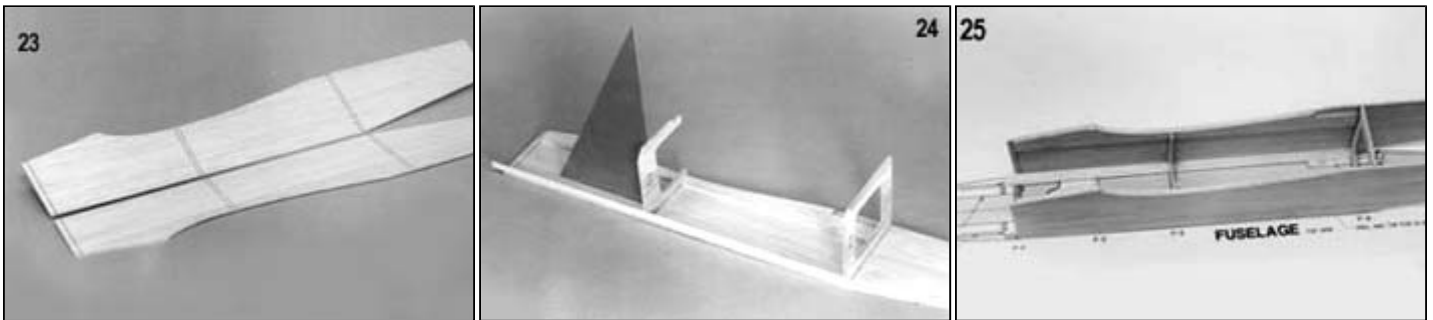
20. Lightly hammer four 6-32 blind nuts into the back of F-1. Bolt the engine mounts to the front of F-1, using 6-32x5/8" socket-head bolts to align the blind nuts (see note below). Apply medium or slow CA around the edges of the blind nuts to hold them in place.

NOTE: The shank of the 6-32 blind nuts may extend too far through F-1 and interfere with the back of the engine mounts. To avoid any interference, drill a 3/16" dia. relief partially through the back of the mounts at each hole.

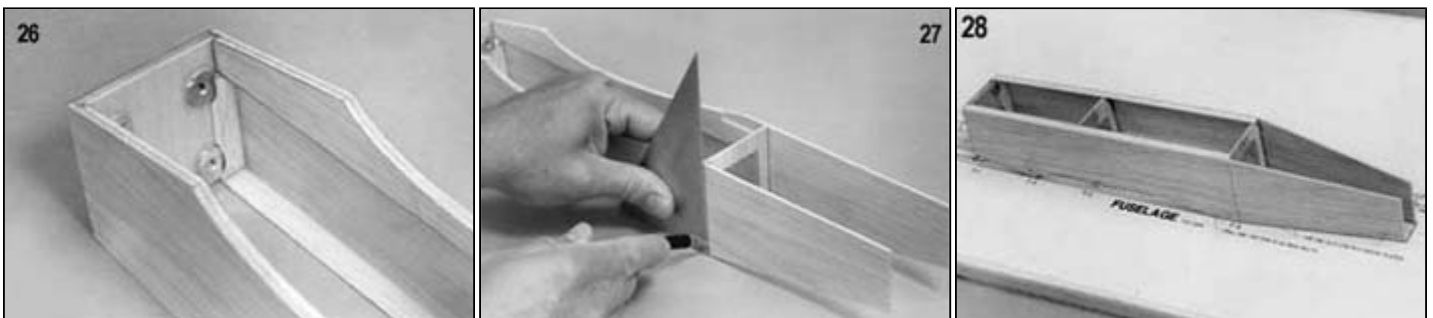
21. a. Position your engine on the mounts so that the rear face of the spinner backplate is between 2-3/4" and 3" from F-1. Mark through the engine mounting holes with a pencil, then remove the mounts from F-1.
- b. Drill and tap the mounts for the engine bolts (not included).



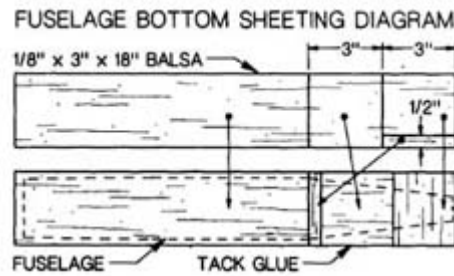
22. Re-install the engine mounts, bolt the engine in place, then install the pushrod connector (included in your kit) on your engine's carburettor control arm. Locate and mark the best spot on the firewall for the throttle pushrod to exit and line up with the pushrod connector. Now you can remove the engine and mounts, and drill at the mark with a 9/64" drill bit.
23.
 - a. Hold the two 3/32" die-cut balsa fuselage sides together and sand the edges lightly until they are a perfect match.
 - b. Mark the positions of the three formers on the fuselage-sides. Marking the right-hand fuselage side is easy. Place it over the "Typical Radio and Engine Installation" drawing on the plan and use the small guidelines to mark the balsa. Now you can use the right-hand fuselage side to transfer identical markings to the inner surface of the left-hand fuselage sides.
24.
 - a. Glue the 3/32" die-cut balsa fuselage doublers to the fuselage sides.
 - b. Glue a piece of 1/4" balsa triangle along the bottom of each fuselage side. Notice that the aft end of the triangle piece should end at the rear face of former F-4.
 - c. Tack glue the 1/8" die-cut lite-ply formers F-3 and F-4 in place on one of the fuselage sides using a triangle to make certain they are square with the side.
25. While holding the second fuselage side in place on the formers, check the alignment of the fuselage over the top view on the plan. When satisfied, glue both fuselage sides firmly to F-3 and F-4.



26.
 - a. Tape former F-1 in place on the front of the fuselage, and again check the alignment over the top view on the plans. Notice that the correct amount of downthrust (4 deg.) is built in automatically by lining up the front face of F-1 with the front edge of the fuselage sides. There should be no side thrust when viewed from above. When satisfied, glue F-1 to the fuselage sides from the front and back with thin CA.
 - b. Trim the 1/4" triangle stock flush with the front of F-1.
 - c. Cut two braces for F-1 from 1/4" balsa triangle stock and notch them as necessary to clear the blind nuts on the back of F-1. Apply slow CA to the braces and press them firmly in place.
 - d. It may be necessary to redrill the hole for the throttle pushrod through a triangle brace that was installed. Use a 9/64" drill bit.
27. Carefully position a straightedge so that it's lined up with the rear face of F-4 on the outside of the fuselage. Use a sharp knife to cut through about half the thickness of each fuselage side. Now the back end of the fuselage can be literally "cracked" into position. If it happens to snap off completely, that's okay; it can be re-attached in the next step.
28. Firmly pin the fuselage upside down over the top view on the plan so that it can't move. Now you can hit the cracked joint on each side with a bit of CA to hold the rear fuselage in alignment.



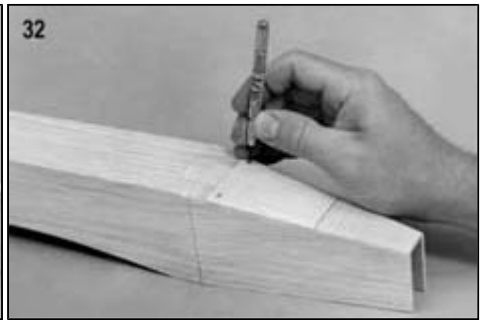
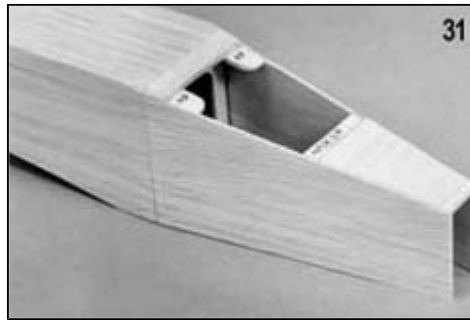
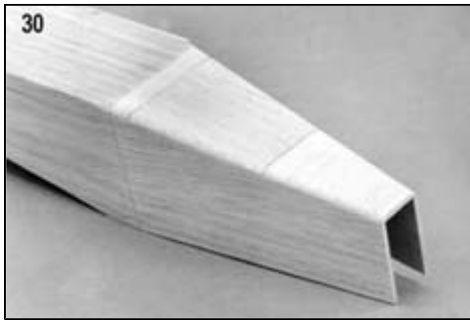
29. Cut the 1/8"x3"x18" balsa fuselage bottom into four pieces as shown in the diagram. With the fuselage still pinned to the plan, glue on the bottom pieces in the order shown. Notice the grain direction of each piece, and be sure to just tack glue to the hatch - it will be removed later.



WONDER WHY...
...there's a hatch way be there?

Answer:
If you've looked ahead in these instructions or at the plans, you have already seen that a servo will probably have to be located in this area and possibly the battery and switch too.

30. Remove the fuselage from the building board and fill the scored areas on the fuselage sides with medium or slow CA. Trim and sand all of the bottom pieces flush with the fuselage sides. Use a long sanding block to round off the bottom corners of the fuselage aft of F-4.
31. a. Remove the hatch and glue in two die-cut 1/8" lite-ply hatch plates (HP).
b. Slide the die-cut 1/8" lite-ply hatch lip (HL) into place on the fuselage bottom. Put a drop or two of slow CA on the exposed part of the hatch lip, then put the balsa hatch back into place. The idea here is to glue the hatch lip only to the balsa hatch.
32. a. With the hatch still in place, use the plans as a guide to carefully mark the location of the two hold-down screws. Drill completely through the hatch and the hatch plates at the marks with a 1/16" drill bit.
b. Remove the hatch, then redrill the hatch holes with a 3/32" drill bit. The holes can be countersunk for the flat-head wood screws using a sharp 1/4" drill bit. Strengthen the countersunk area with a few drops of thin CA.
c. Re-glue the hatch lip firmly to the hatch.



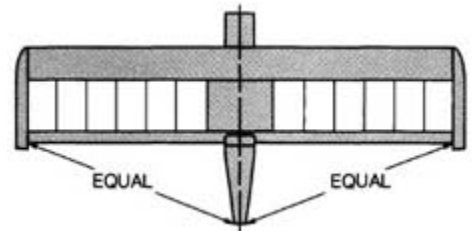
33. a. Carefully drill at the two dimples in F-2 with a 1/8" drill bit, followed by a 3/16" drill bit. Use a chunk of hardwood behind the former to keep the wood from splintering as you drill through.
b. Glue F-2 into position as shown on the plans.



Mounting the Wing to the Fuselage

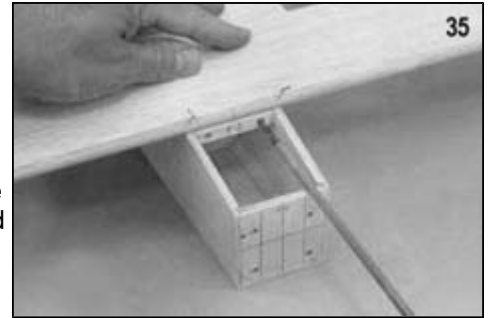
NOTE: The wing must be finished through step 14 before proceeding.

34. Position the wing on the fuselage and check its alignment as shown in the diagram. When staisified, firmly tape and pin the wing in place.

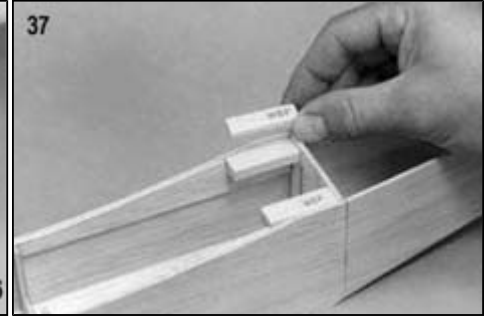


35. Drill two holes into the wing for the wing dowels. The easiest way to do this is to run a long 3/16" drill bit along the top edge of F-1, through the holes in F-2, and into the wing. If you don't have a long drill bit, you can turn a shorter one by hand to get the holes started then finish off the holes after removing the wing.

36. a. Remove the wing and insert the two 3/16" dia. x 1-1/2" wing dowels into F-2 from the aft side so that they extend in front of F-2 about 1/16". Slide the wing into place to check that it seats properly on the fuselage. If not, slowly enlarge the holes in the wing until it does seat properly. Again remove the wing, leaving the dowels in place in F-2.
- b. Apply several drops of Kwik-Set epoxy to the holes in the wing. Slide the wing back into its proper position on the fuselage until the epoxy is dry. Be careful not to glue the wing dowels to F-2. When dry, remove the wing and fill any gaps around the dowels with another application glue.

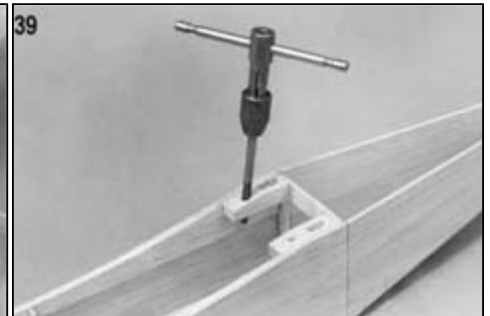


37. a. Glue the two 1/4"x1/2"x1-1/2" basswood wing hold-down blocks into the notches in the fuselage doublers.
- b. Add the die-cut 1/8" balsa wing block pads (WBP) to the top of the basswood blocks.
- c. Carefully sand the balsa wing block pads to match the contour of the wing saddle area.



38. a. Fit the wing in place on the fuselage and check its alignment one last time. When you are satisfied that it's aligned correctly, tape or pin the wing so that it can't move.
- b. Carefully mark the drill locations for the wing bolts using the plan as a guide. Drill through the wing and the wing hold-down blocks at the same time with a 5/32" dia. drill bit. Keep the drill perpendicular to the top surface of the wing so the heads of the nylon bolts will seat flush against the plywood plate.

39. a. Remove the wing and tap the wing hold-down blocks with a 10-32 tap. You can apply a few drops of thin CA to the holes to strengthen the threads.
- b. Redrill the holes in the wing with a 3/16" drill bit to pass the nylon wing bolts.



Finishing The Fuselage

40. Now is a good time to prepare your fuel tank for installation. The 4oz slant tank from Sullivan (not included) fits well and should sit as high in the fuselage as possible. The fuel lines from this tank exit the fuselage at the joint between F-1 and the balsa top. You can prepare F-1 for the fuel lines by sanding or filing semi-circles into the top edge. If you plan on using a different type of fuel tank, drill holes in F-1 as necessary for the routing of the lines.

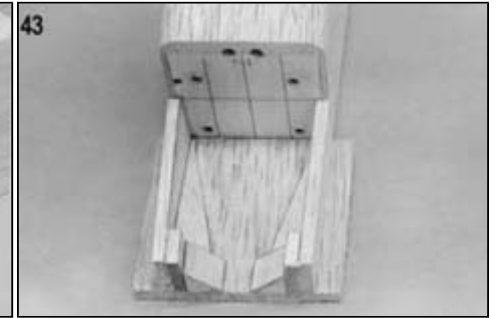
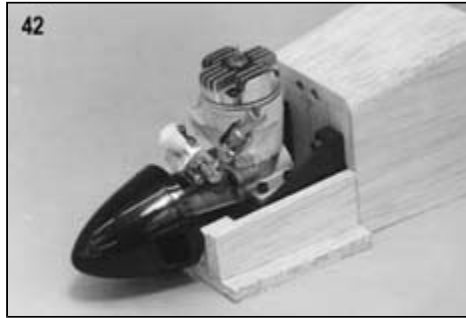


41. a. The 1/4"x3"x3" balsa fuselage top can be shaped at the aft end to match the contour of the wing leading edge. Glue the fuselage top in place so that the aft end fits snugly against the wing.
- b. Trim and sand the fuselage top flush with the sides and F-1, then round off the side corners with a sanding block.
- c. Finish drilling the fuel line holes through the balsa.



- 42.
- The balsa cowl is made of several parts that are basically built up around the engine. Install the engine mounts and your engine with the spinner that you intend to use. Cover any openings in the engine (carb, exhaust) with tape to protect it from dust.
 - Begin the cowl construction by gluing the 1/4"x3"x3" balsa cowl bottom to the front of F-1 so that it's flush with the fuselage bottom. Sig-Bond is recommended for all of the cowl parts because it will be easier to sand later.
 - Add two of the 3/16" pre-cut balsa cowl sides leaving about 1/16" between them and the engine mounts. Depending on the width of your engine, the cowl sides may or may not blend into the spinner backplate. If not, cut off the front end of the two remaining cowl sides and glue them in front of the engine mounts.

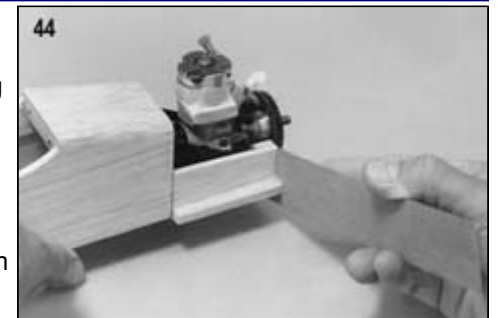
43. Remove the engine and the mounts, then fill the bottom inside corners of the cowling with pieces of 1/2" or 1/4" balsa triangular stock. Taper the triangular stock towards the rear so it doesn't interfere with the engine mounts.



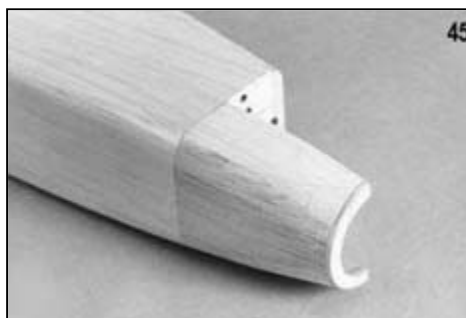
44. Bolt the engine back in place and carefully sand the front edge of the cowl with a narrow sanding stick. Sand until the gap between the cowl and the spinner backplate is about 5/32".

<p>WONDER WHY... ...the Wonder cowl is made of balsa instead of plastic?</p>
<p>Answer: Flexibility. The Wonder uses lots of different engines which all have different lengths, which all require something of a custom cowl. Besides, a balsa cowl allows you to cover the fuselage right up to the spinner ring with no seams. Actually, you can leave the cowl off with no adverse effects on flight performance - it just won't look as good!</p>

- 45.
- Glue the die-cut 1/8" lite-ply spinner ring to the front of the cowl, making certain it is aligned with the spinner backplate. Notice that the spinner ring is cut oversize to allow for a bit of sanding.
 - Prepare the spinner backplate for the cowl sanding process by protecting the edge with tape.
 - Carve and sand the cowl to blend in smoothly with the spinner at the front and the fuselage at the rear. Now's a good time to round off the bottom corners of the fuselage (forward of F-4) as well. Do the rough sanding with 80-grit sandpaper, then smooth it down with some 150-grit.



46. The landing skid is constructed by gluing two 1/2" lengths of 1/4" balsa triangle stock to the sides of the 1/8"x5/16"x12" spruce skid. Sand the spruce round on the bottom and shape the ends as shown on the plans.

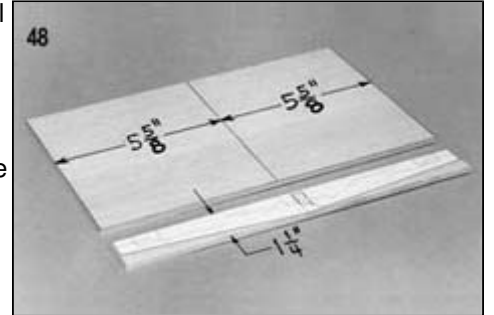


<p>WONDER WHY... ...there's no landing gear on this design?</p>
<p>Answer: Well, let's look at the pros and cons of going with a skid instead of wheels on the Wonder. On the positive side, without landing gear the Wonder is lighter, simpler, costs less, flies faster, performs better, and simply looks sleeker. The negative is you can't land on concrete (technically you can, but it's certainly not recommended!). Even if it had wheels, the Wonder would still require a hand launch because there's no ground steering without a rudder. So find a field and have at it!</p>

TAIL SURFACES

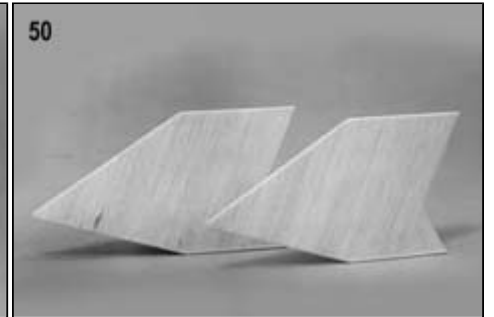
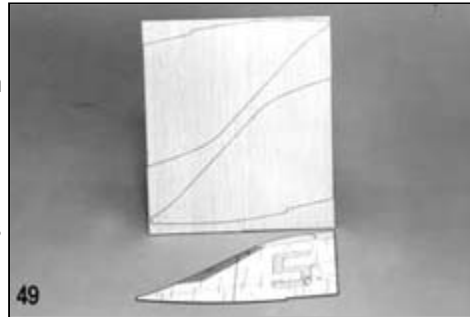
47. a. Make the stabilizer by edge gluing two 3/16"x4"x12" balsa sheets (Sig-Bond is recommended). When dry, block sand the joint until it's smooth.
b. The stabilizer must be accurately cut to it's proper width of 11-1/4". Start by drawing a centerline and two edge lines, each spaced 5-5/8" from the centerline. If you don't have an accurate 90 deg. square, you can use the plans as a guide. Use a sharp knife to make the cuts on each edge.

48. Cut the elevator from the stabilizer using the elevator shape of your choice. Bevel the leading edge of the elevator, sand the trailing edge round, and trim each tip about 1/16" to clear the fins.



49. If you are building the Russian, the Angel, or the Patriot, you need to hand cut the fins from the two sheets of 1/8"x4"x10" balsa. Edge glue the sheets, then cut the fins out using the pattern of your choice. Add the 1/8" sq. spruce stiffeners, sand the sides smooth, and round all the edges.

50. a. To make the two fins for the Standard version, simply glue together the die-cut 1/8" balsa fin pieces together as shown on the plan.
b. Add a piece of 1/8" sq. spruce to the bottom of each fin to act as a stiffener. When dry, sand the fins smooth on each side and round all of the edges.



General Instructions

All of the Wonder prototypes were covered with Sig Supercoat Iron-On Plastic Covering. Supercoat is ideal for sport models because it's lightweight and easy to apply. One roll is plenty for a Wonder, but most modelers will want two or more colors.

Details about colors and decal placement for specific versions of the Wonder follow. All four versions have different colors or markings to help distinguish the top of the model from the bottom. This is very important for visibility in flight, especially with small, fast models like the Wonder. Keep this in mind if you plan your own custom color scheme.

We recommend that you cover the wing, fuselage, tail surfaces, control surfaces, and skid all separately before hinging and final assembly. This way the parts are much easier to handle.

The following instructions provide advice and procedures specific to the Wonder. Be sure to read the two pages of step-by-step, photo illustrated instructions included with each roll of Supercoat. If you choose another brand of covering material, be sure to read the manufacturer's directions (supplied with the covering) and follow them carefully.

Surface Preparation

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

Since it's too difficult to apply covering material to F-1 and the inside of the cowl, they must be fuel-proofed using several coats of clear dope or two coats of polyester (glass) resin, sanded between coats. Finish off the engine area with a few coats of colored Sig Supercoat Dope. (Most of the Sig Supercoat Plastic Covering colors have a matching Sig Supcoat Dope color.)

Covering The Fuselage

The fuselage should be covered with four pieces of material, starting with the bottom, followed by the two sides, and ending with the top. If you're using more than one color, it may take more pieces of material. All seams should overlap about 1/8". When covering solid wood surfaces like 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.

Experienced modelers know that oily engine exhaust likes to creep into every crack it can find, which means special care must be taken to keep the hatch area as fuel-proof as possible. When you cover the hatch, be sure to cover the front and rear edges, and wrap the material around both sides about 1/4". The covering material on the fuselage sides should wrap around the bottom in the hatch area as well as the wing saddle area.

Covering The Wing

Begin the wing by covering the wingtips and plywood hold down plate. Cover each wingtip with two pieces of material, first the bottom and then the top. Seal each piece securely to the capstrip and sheeting for the end rib. Later, when the main top and bottom covering pieces are applied, they will overlap the wingtip covering on the end rib. Cover the hold-down plate with a single piece of material, extending it about 1/8" past the outside edges of the plate to provide an area for overlap. Cover the main portion of the wing starting with the bottom and then the top so that the seams will be on the bottom where they will be less visible. The top covering should overlap the full width of the leading edge and trailing edge.

Wait until both the top and bottom pieces of covering material have been sealed completely around the edges before shrinking the large open areas between the ribs. Alternate between the top and bottom surface to avoid uneven shrinking which could cause warp. Your sealing iron or a special heat gun can be used (household blow dryers don't provide enough heat). 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 the expending air to escape.

Covering The Sheet Balsa Parts

The stabilizer, elevator, fins, ailerons, and canopy pieces should each be covered with two pieces of material - bottom first, then top. Iron the material from the center out to avoid trapping air bubbles.

Don't be alarmed if these small parts bow slightly after covering just one side. This is a common condition that should correct itself after covering the second side.

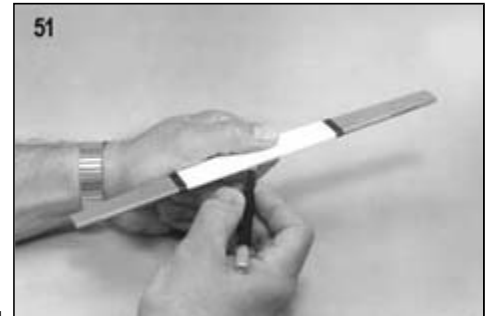
Applying The Decals

Cut out the decals with sharp scissors, leaving about 1/32" to 1/16" of clear at all edges and rounding the corners as you cut. Wet the surface on which the decal will be placed with soapy water (use dishwashing detergent). Place the decal on the model and squeegee the water from underneath with a balsa paddle. This procedure allows time for repositioning and prevents air from being trapped under the decal. Allow several hours to dry.

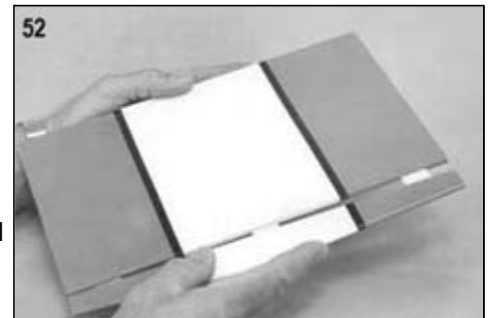
INSTALLING EASY HINGES

Sig's famous Easy Hinges have been included with your kit to hinge all of the control surfaces. Each ultra-thin hinge is actually a three-part laminate - a tough plastic inner core sandwiched by an absorbant wicking material. They have been chemically treated to slow down the reaction of thin CA (which is normally instant), to allow the glue time to soak all the way to the ends of the hinge and into the wood surrounding it. Once the glue has dried, the hinge cannot be pulled from the structure without tearing the wood out with it! We recommend that all surfaces be covered before hinging.

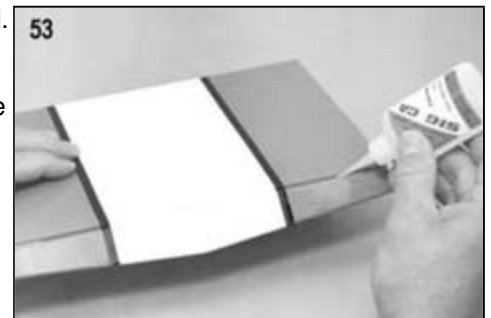
51. Using a No.11 X-Acto blade (or similar), cut slots approximately 1/2" in depth and slightly wider than the hinges. Cut three slots in the stabilizer and three matching slots in the elevators at the locations shown on the plans.



52. After all of the slots have been cut, insert Easy Hinges halfway into the stabilizer slots. Do not glue the hinges yet! Next, carefully slide the elevator onto the hinges. You'll find it easiest to slide the elevator onto the hinges at an angle, one at a time, instead of trying to push it straight onto all of the hinges at once. Don't be concerned if the hinges aren't perfectly straight or centered in the slots - they'll work fine regardless of their final position.



- 53.
- To set the hinge gap, deflect the elevator to the maximum amount needed. For best control response, the gap should be as small as possible but big enough to allow full movement of the control surface without binding.
 - Easy Hinges were designed to use Thin CA (any brand) for maximum glue penetration. Place three or four large drops of thin CA directly onto the hinges in the gap. The glue will wick into the slot as it penetrates both the wood and the hinge. Continue this process, gluing the same side of all the hinges, then turn the stabilizer over and repeat the gluing process on the other side of each hinge.

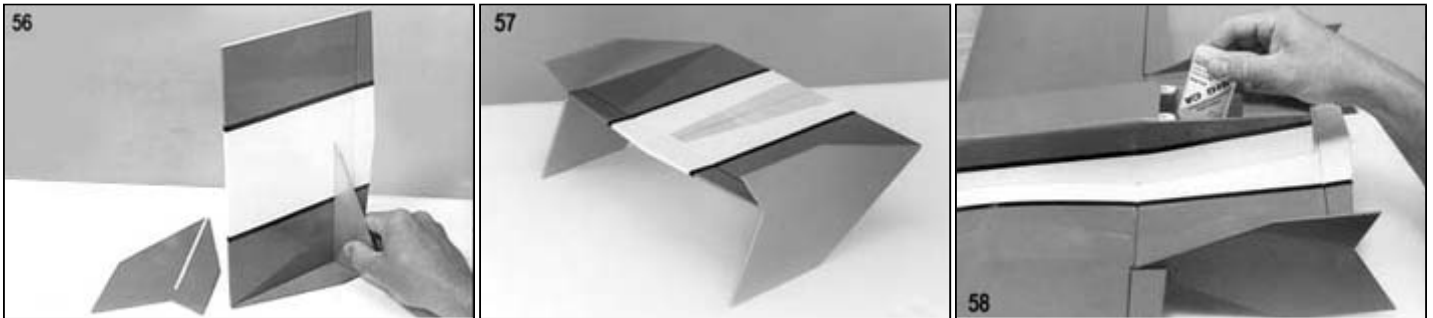


54. After the glue has cured (3 to 5 minutes) the joint should be flexed to full deflection in each direction a couple of dozen times to reduce the stiffness. Don't worry about shortening the life of the hinges as they are almost indestructible.
- 55.
- The ailerons are hinged like the elevator, but the torque rods must be glued as well. Start by cutting the slots in the wing and the ailerons (two per aileron) and slide the hinges into the ailerons.
 - Slide a small piece of wax paper between the torque rods and the wing. Working with one aileron at a time, apply Kwik-Set epoxy to the slot and hole in the aileron leading edge and slide it onto the torque rod, working the Easy Hinges into the wing slots at the same time. Before the glue sets, be sure to deflect the aileron back and forth to set the proper hinge gap.
 - Once the epoxy has cured, remove the wax paper and apply thin CA to the hinges as you did earlier.

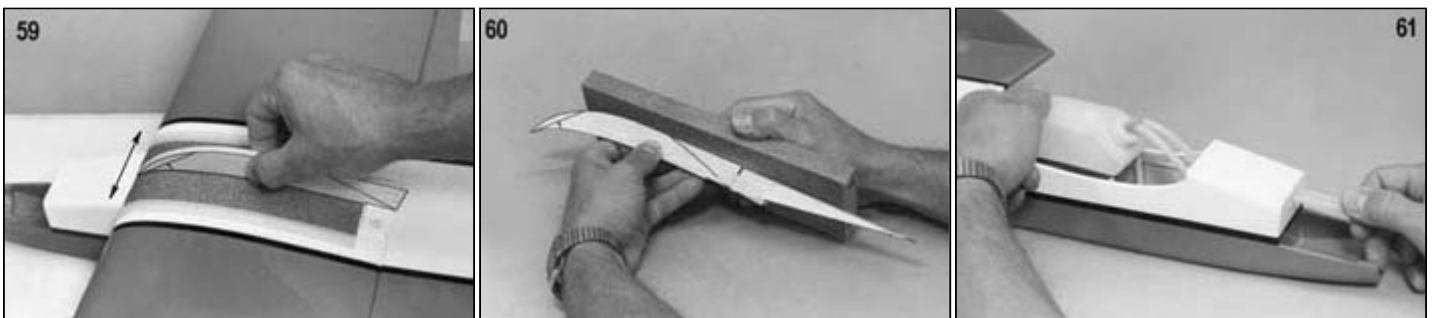
FINAL ASSEMBLY

56. Use a sharp knife to carefully cut away the covering material on the fins where they contact the stabilizer. Glue the fins to the stabilizer using a triangle to check their alignment.

57.
 - a. With the wing bolted in place on the fuselage, trial fit the stabilizer/fin assembly. The stabilizer should sit against the back of the wing with no gap. If the stabilizer seems tilted slightly, you should trim the top of one of the fuselage sides until the stabilizer sits level with the wing.
 - b. When satisfied with the alignment, draw cut lines on the bottom of the stabilizer at the fuselage sides. Remove the stabilizer and use a sharp knife to cut away the covering on the bottom where it will be glued to the fuselage.
58.
 - a. Hold the stabilizer/fin assembly in place on the fuselage, then glue it firmly with CA working through the hatch opening.
 - b. Install the nylon control horn on the elevator so that it's centered in the opening at the back of the fuselage. Use two #2x1/2" sheet metal screws to install the horn, then clip or grind off the pointy ends of the screws.



59. Cut out the canopy of your choice from the printed 1/4" balsa sheet, again leaving the entire black line on the parts. Match the bottom edge of the canopy to your wing by taping sandpaper to the wing's upper surface and gently pushing the canopy from side to side.
60. If you chose the one-piece Angel canopy, go ahead and round off the upper edge, cover it, and glue it to the top of the wing (after removing a strip of covering material to provide a wood-to-wood joint, of course). The other Wonder versions feature a two-piece canopy with the front portion glued to the wing and the rear portion glued to the stabilizer. Temporarily pin the canopy parts in their proper position on the assembled model, then attach the front and rear canopy parts to each other with a piece of tape on each side. Now the canopy parts can be lifted from the model and their top edges sanded round at the same time so they will match perfectly when installed. Remove the tape, cover the canopy parts, and glue them in place.
61. Install your fuel tank, engine and muffler. The easiest way to install the fuel tank (which was prepared in step 40) is to run extra-long fuel lines through F-1, attach them to the tank, then slide the tank into place while gently pulling the fuel lines back through F-1. Now you can bolt your engine mounts to F-1, bolt your engine to the mounts, bolt the muffler to your engine, and cut the fuel lines to their final length. The propeller should be mounted so that it's level with the wing when it comes up against the engine compression, to minimize the chance of breaking it during landings. Attach your spinner cone and the engine installation is complete.
62. Glue the skid to the bottom of the fuselage.



RADIO INSTALLATION

Different radio installations using different size servos and receivers are described under specific versions of the Wonder following. One thing that's common to all of them is that they're stuffed into one tight little fuselage! Every radio installation is unique and must be planned carefully to make certain that the servo arms and control linkages have clear room to operate. The following guidelines are meant to provide general information on stuffing a Wonder with radio gear.

Start your radio installation with the receiver. All of our prototypes had the receiver installed just behind the fuel tank in the opening in F-3. Wrap the receiver in 1/4" foam rubber for protection.

With the receiver in place, now you can install the aileron servo. Measure carefully for the cutout in the wing so that the aileron servo will clear the receiver. Glue the two die-cut 3/32" plywood aileron servo mounts (ASM) to the balsa sheeting, and screw the servo in place. Make the aileron pushrods from threaded rod and nylon clevises then hook them up to the nylon aileron connectors (which should be threaded onto the torque rods). You can use an extension wire from the receiver to the servo, but we typically plug the aileron servo wire directly into the receiver just before bolting on the wing. This saves weight and keeps loose wires to a minimum. You may have to make a small notch in the stabilizer leading edge to clear the torque rods during wing installation.

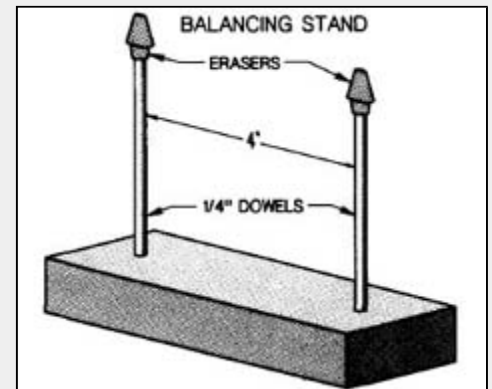
Now you need to do some decision making. The battery, switch, and remaining servos should be positioned as necessary to achieve the proper balance point on the finished model without having to add weight to the nose or tail. If you're using a very lightweight engine, the battery will probably need to go under the fuel tank and receiver. Heavier engines will dictate a more rearward battery position, possibly behind F-4. Assemble the Wonder, place it on a balancing stand, then shift the components around on the outside of the model until you find the best arrangement.

BALANCING

IMPORTANT: It is vitally important that your Wonder is balanced properly. The correct balance point for first flights is 2-3/8" (plus or minus 1/16") behind the wing leading edge. This is a short-coupled airplane and the balance range is very small. Our prototypes all flew well with the balance point between 2-5/16" and 2-7/16" behind the leading edge. If the balance point is too far forward, the Wonder flies well under power but you can run out of "up" elevator during the landing flare. If the balance is too far back, the plane can become unstable and eventually, uncontrollable.

Oh, and don't use your fingertips for balancing! Build yourself a quick and dirty balancing stand like the one shown in the diagram. Mark the balance point on the bottom of the wing with tiny lengths of striping tape. Shift the radio gear or add weight as necessary to bring the balance point into the proper range. Trying to fly with the balance point too far forward or too far aft is much more dangerous than the slight increase in wing loading caused by adding nose or tail weight. Always balance the model with an empty fuel tank so that it sits level on the balancing stand.

In addition to the fore/aft balance, it's important that you balance the model spanwise. A "heavy wing" on one side can result in poor loop tracking. To check for this, pick up the assembled model by the spinner at the front and under the center of the stabilizer at the rear. Insert weight (small finishing nails work well) into the lighter wingtip until the model is balanced.



The battery should be wrapped in foam rubber and secured inside the fuselage with balsa sticks to keep it from moving. The sticks can be broken away later when you need to remove the battery from the plane.

The throttle servo and the elevator servo on most of our prototypes were installed using servo tape, which works very well on a small model like the Wonder. Here are a few tips for using servo tape:

- Coat the area of the fuselage where you plan to install the servo with glue, either epoxy or CA, and allow it to dry. The tape will stick much better to this than it will to bare balsa.
- Clean the servo with alcohol before applying the tape.
- Cover the entire side of the servo with tape. You want as much bonding as possible.
- Make certain the servo arm and screw are installed before taping the the throttle servo in position. You won't be able to get at the screw once the servo is taped in place!

The throttle pushrod is a 1/16" steel cable which moves inside a nylon tube. The hole in F-1 has already been drilled for the tubing, but you need another hole in F-3 to route the tubing so that it's pointed directly at the servo arm. Solder the clevis (included in the kit) to the steel cable, route the cable through the nylon tube and into the pushrod connector located on the engine's throttle control arm. Snap the solder clevis on the servo arm and adjust the cable at the pushrod connector end.

The elevator servo is very easy to install through the hatch. Bend a pushrod to suit from a 2-56 threaded rod. At the field, adjustments to the clevis can be made at the rear fuselage opening, if necessary.

The switch should be mounted on the fuselage side opposite the engine exhaust and where it can't be accidentally bumped during launch. High in the fuselage behind F-4 works well. Route the antenna through the inside of the fuselage, away from all the other wires, and out the rear opening. On very short models like the Wonder, all you can do is let the excess antenna wire dangle behind the airplane. Under no circumstances should the antenna be shortened, folded or bundled.

PRE-FLIGHT CHECKOUT

Range check your radio equipment according to the manufacturer's instructions before attempting test flights. A lot of problems can also be avoided if your engine has been well broken in and the idle adjustment perfected on a test block or in another airplane before installation in the new model.

Adjust all of your pushrod linkages so that the control surfaces are in their neutral position when the transmitter sticks and trim levers are centered. The control surface movements listed below are recommended for the first flight of your Wonder. These movements will provide the model with a fair degree of aerobatic capability if it's balanced correctly. Test flights may indicate a need for slightly more or less movement, depending on individual model performance and personal preference.

RECOMMENDED CONTROL SURFACE MOVEMENTS For test flying, the following are suggested:	ELEVATOR	1/4" UP and 1/4" DOWN
	AILERONS	5/16" UP and 5/16" DOWN
	Measured at the widest point of each control surface	

"STANDARD" VERSION



The Standard Wonder is probably the most generic-looking version, but it was the original. All of the other versions were an offshoot of the Standard. Its most distinctive feature has to be the down-turned vortex wingtips. The wingtips probably don't do much aerodynamically for a model of this size, but they do look good and generate lots of comments from fellow modelers.



Covering the "Standard"

The Standard color scheme is easy to see in the air thanks to the bold white stripes on the top of the wing. The black striping tape helps to hide any imperfections where the blue and white coverings overlap. You will need the following materials to finish the Standard version:

- **Medium Blue Supercoat Covering**- Wing, bottom half of fuselage, stabilizer, and fins.
- **White Supercoat Covering**- Wing and stabilizer stripes and top half of fuselage.
- **Black Supercoat Covering**- Front canopy piece.
- **1/4" Black SuperStripe Tape**- Stripes between white and blue.
- **Decal Sheet**- SIGDKM266A

Begin the wing by ironing on the white stripes. The center stripe should be cut 5" wide, and the outboard stripes should be 2-5/8". Notice the outside stripes wrap around the leading edge, but only extend about 3/4" back on the lower surface. The center stripe is used on both the top and the bottom.

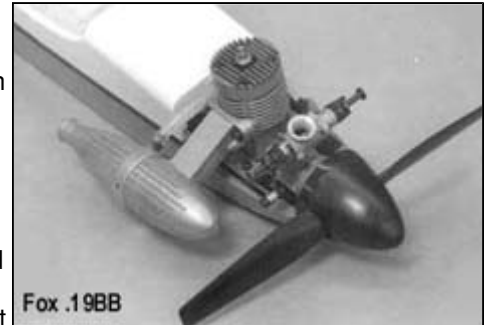
The blue is applied in lots of places, starting with the wingtips. Cover each tip with two pieces of material, first the bottom, then the top. Use the edge of your iron to apply the covering to the concave (bottom) portion of the vortex tips. Finish the bottom of the wing with two more pieces, carefully cut to overlap the wingtip covering on the outer end and the white center stripe on the inner end. The upper wing surface will need four pieces of blue covering material. Make all of your overlaps about 1/4".

Use the same procedure when covering the fuselage, stabilizer, and ailerons. Start with white and finish with blue, again overlapping 1/4".

Engine Installation

The engine shown on the Standard is a Fox .19BB. With schneurle porting and ball bearings, its power is hard to beat. Unfortunately, it's also hard to find because this engine is no longer in production. We've shown it here to give you an idea of how a big, .19-size engine looks on the nose.

The performance with a hot .19 is, well, phenomenal! Expect blistering level flight speeds and vertical climbs that won't stop until you want them to. As great as it sounds, this kind of power isn't for everybody. It takes a lot of flying experience to safely handle fast model airplanes of any type. A pilot needs to be one step ahead of his machine at all times, which can be difficult with a small hot rod like the Wonder. Yes, with a throttle you can slow it down, but the temptation is to just let it rip! Remember, the faster a plane flies, the more sensitive it is to control inputs. Be smooth on the sticks!

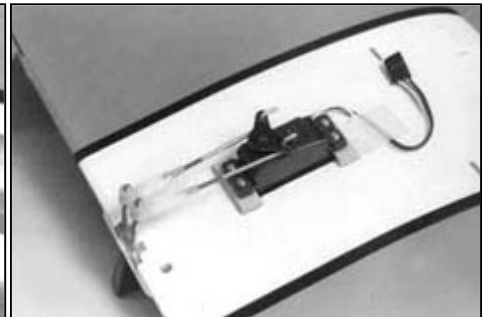
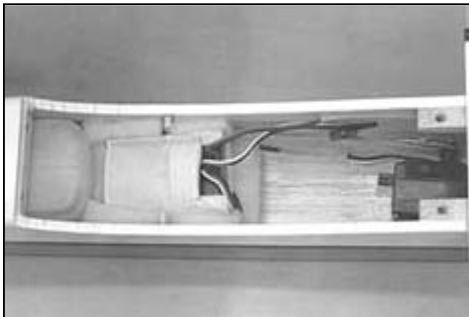


Radio Installation

Like all of our Wonders, the receiver is installed behind the fuel tank in the opening in F-3. This Futaba R114H receiver is pretty small, so it has lots of padding around it. Notice that the servo connection area is left exposed so that the aileron servo can be plugged in easily when installing the wing.

Size-wise, the S132 servos aren't as big as standard servos, but they're bigger than micros. The throttle and elevator servos are both attached with servo tape. The 250 maH battery had to be installed next to the elevator servo under the hatch to offset the weight of the big engine. It's held in place by the servo on one side and a scrap balsa stick.

The aileron servo is mounted to the plywood aileron servo mounts (ASM). Notice the servo arm uses two offset spokes of a six-spoke servo arm (the other four are cut off). This was done to counteract the slight amount of negative differential that you naturally get from the swept-forward torque rods. Without getting too technical, what you're looking for is equal up and down movement of the ailerons. If a straight servo arm doesn't give you equal movement, you can try an offset arm like the one shown in the photo.



"RUSSIAN" VERSION



This version was styled like Soviet jet fighters, which typically feature sharp angular lines. The control surfaces on the Russian are bigger than the other versions, but it seems to fly about the same. All of the Wonders roll and loop plenty fast!



Covering the "Russian"

The color scheme for this version was loosely translated from a picture that we found of an aerobatic Russian Jet. The contrasting red and silver makes it easy to tell the top from the bottom during flight. The Soviets were never too interested in decorating their airplanes, so the markings on this version were kept pretty simple.

To duplicate the color scheme of the Russian, you will need the following materials:

- **Fokker Red Supercoat Covering**- Top of wing and stabilizer, top half of fuselage and fins.
- **Silver Supercoat Covering**- Bottom of wing and stabilizer, bottom half of fuselage and fins.
- **Black Supercoat Covering**- Front canopy piece.
- **1/16" Black SuperStripe Tape**- Rudder outlines on fins.
- **Decal Sheet**- SIGDKM266B

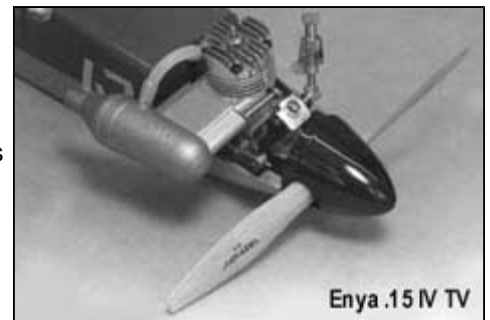
In general, cover with silver first followed by red. The red should overlap the silver about 1/8". To keep the edges of the red covering from "squirming" around, try touching the overlap areas with the iron first. Avoid overheating the plastic covering, which can pull the edges. The covering on the wingtips has to be cut very carefully to look good. Instead of pushing a knife or razor blade through the covering, try holding the blade against the cut line while pulling on the excess covering. Take your time!

The fake rudder outlines on the fins are made with striping tape. You can cut out the pattern from the plans to help keep them equal in size.

Engine Installation

The Russian flew extremely well with an Enya .15 IV TV. This is a crossflow, plain bearing engine that's ideal for sport models like the Wonder. It's not the most powerful .15 on the market, but it's built well, starts easy, and runs reliably flight after flight. Its best feature is the angled needle valve that helps keep your fingers away from the propeller while adjusting the mixture.

The wood propeller shown in the photo was something of an experiment. It actually held up very well through several landings, but eventually broke. Stick with reinforced nylon props and check them carefully after every flight.



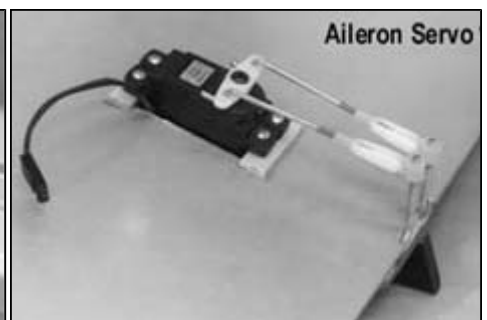
Radio Installation

The radio installation in our Russian prototype is just like the "Typical Engine and Radio Installation" drawing on the plan. The photos show a standard size Airtronics FM receiver and three standard size Airtronic servos. The 270 mAh battery pack is wrapped in foam below the fuel tank.

The throttle servo is taped to the bottom of the fuselage, but the elevator servo is bolted to hardwood blocks which were glued to the fuselage side.

Notice the switch is mounted way in the back, under the hatch. On this particular model, the charging jack was routed out the rear fuselage opening.

The aileron servo on this model used a standard straight-across servo arm, which worked just fine. Most of the servo wire is still inside the wing, out of harms way.



"ANGEL" VERSION



The Navy's flight demonstration team, the Blue Angels, was the obvious inspiration for this Wonder version. Even though it's not jet-powered, the Angel Wonder can do a pretty impressive aerobatic routine itself! The big canopy on the Angel is easier to install than the others because it doesn't have to match up with another piece glued to the stabilizer. You might also notice that the very aft end of the fuselage is cut off at an angle to match the fins - it just seemed to look better that way!



Covering the "Angel"

The Angel is the simplest Wonder to cover because it's basically all one color. The top of the plane is distinguished with some large decals and bright yellow stripes. To duplicate the Angel color scheme, you'll need the following materials:

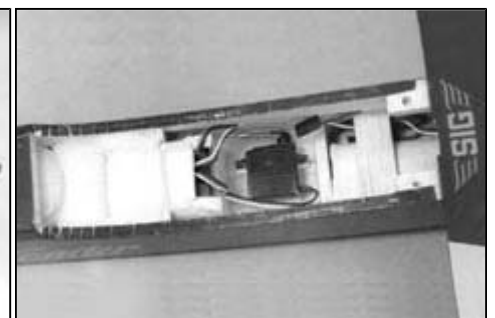
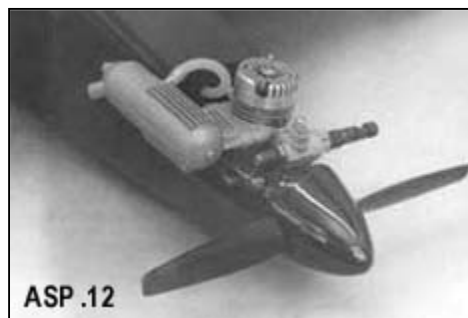
- **Dark Blue Supercoat Covering-** Entire airframe.
- **Cub Yellow Supercoat Covering-** Wing tips, fin tips.
- **Silver Supercoat Covering-** Canopy.
- **Cub Yellow SuperTrim-** Stripes on top of wing and stabilizer.
- **Silver SuperTrim-** Wing and fin leading edges.
- **Decal Sheet-** SIGDKM266C



Cover the wingtips and fin tips with yellow first, then cover the rest of the airframe with dark blue. The yellow stripes should be cut in one piece, applied to the assembled airplane, then cut at the junction of the wing and stabilizer. The silver leading edges are 1"x16-1/2" strips of trim material. Center the strips on the leading edge so that there is an equal amount on the top and bottom wing surface. The outboard end of the silver stripes should end at the yellow wingtip. The silver leading edge pieces for the fins are cut from trim material using the pattern shown on the plan.

Engine Installation

The ASP .12 engine that's bolted to the front of the Angel is a true winner. It's powerful, idles well, and is very economical on fuel. We used a two ounce tank in our prototype, and still had more flight duration than we really needed. The performance with this size of engine is still pretty hot, you just can't go up, up out of sight.



Radio Installation

Again the Futaba R114H receiver was installed in the F-3 opening. The 250 maH battery on this particular model needed to be located at the aft end of the wing opening, just ahead of F-4. It's held in position with some scrap pieces of balsa which can be broken away easily when the time comes to remove the battery.

There was still plenty of room left between the receiver and battery for the throttle servo to be taped in place. The elevator servo was mounted in its familiar position behind F-4. We used three Futaba S133 micro servos in this prototype. The weight savings of three micro servos over standard servos is nearly 3 ounces. That's a lot for a model of this size!

"PATRIOT" VERSION



The Patriot Wonder is a great way to fly the colors! The elegantly curved ailerons and elevator, as well as the nicely rounded wingtips and fin tips give the Patriot a style all of its own. At 26 ounces, this was our lightest Wonder prototype. It was achieved by using a very lightweight engine, a two ounce fuel tank, a very light radio system, and only two channels.

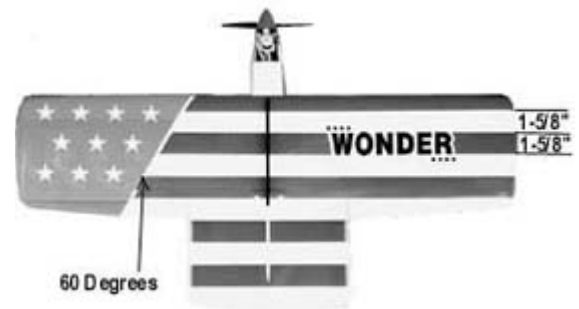


By going without a throttle, you save the weight of a servo and the linkage to the engine. The downside of this is that you have to fly wide open all the time, and you can't control when and where the engine quits. The upside is the tremendous glide! All of the Wonders glide well, but at this weight it's almost a floater.

Covering the "Patriot"

This is by far the most difficult Wonder version to cover. If you like how it looks however, it's definitely worth the effort. You will need the following materials to duplicate the Patriot color scheme:

- **White Supercoat Covering**- Entire airframe except blue field on the wing.
- **Medium Blue Supercoat Covering**- Blue field on the wing, top and bottom.
- **Black Supercoat Covering**- Front canopy piece.
- **Medium Blue SuperTrim**- Blue fields on fins.
- **Waco Red SuperTrim**- Red stripes on wing, stabilizer and fins. Wing and fin leading edges.
- **1/4" Medium Blue and Red SuperStripe**- Stripes on fuselage.
- **Decal Sheet**- SIGDKM266D

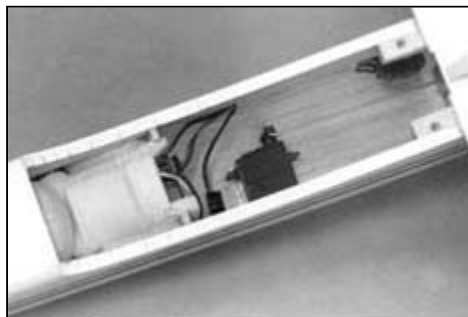


The blue and white covering pieces for the wing must be joined before you actually iron them onto the structure. Cut them out carefully, then overlap the blue onto the white about 1/4" over a glass plate. Iron just the seam with the edge of your iron, which should be set at a fairly low temperature. Lift the joined pieces from the glass and iron it onto the wing like it was one piece of covering material. The rest of the model is covered with white supercoat.

Now for the fun part! Cut 1-5/8" wide stripes of red trim material and adhere them over the white as shown in the photo. The center red stripe on the wing will have to be cut to leave room for the black "Wonder" decal. It would probably be best to do this before you apply it to the model. Sig SuperTrim Self-Adhesive Trim Sheets come with complete instructions on how to apply it using the wet method (soapy water). You will also need to cut some blue and red trim pieces for each of the fins. Use the pattern on the plans to cut the fin trim pieces.

Radio Installation

All of the radio gear in the Patriot Wonder is installed as far forward as possible to help with balance. The servo that you see in the fuselage (S133 micro) is for the elevator- there is no throttle. The 250 maH battery is under the fuel tank.



Engine Installation

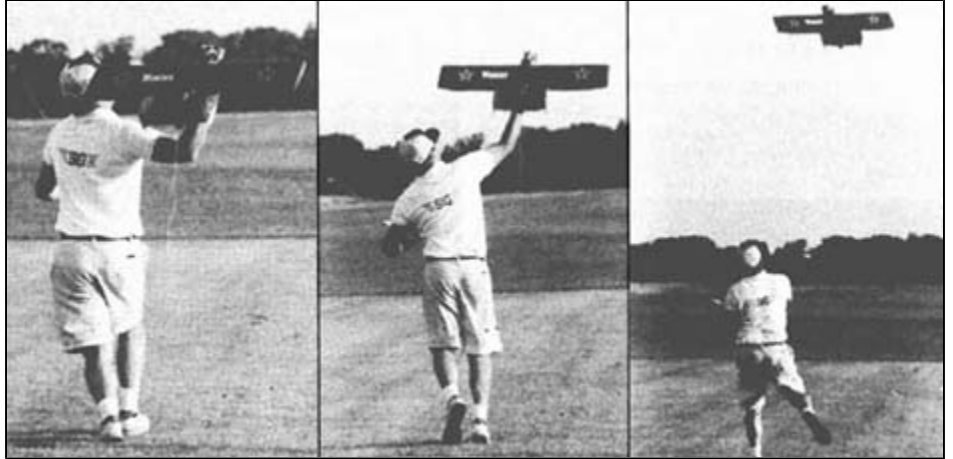
The Cox Tee Dee .09 shown installed on the Patriot is the smallest engine we recommend for the Wonder. That doesn't mean it's a slouch. At this light weight, the performance difference between the Patriot and the Standard Wonder (with a .19) is not as great as you might think. One caution- without a muffler the .09 is pretty loud, so stay away from noise-sensitive flying sites.

Notice that for balance reasons the engine is placed well forward on the mounts. A small length of fuel tubing has been forced over the needle valve to prevent air leaks around the threads.

FLYING

The Wonder was designed for experienced R/C pilots who can keep up with fast, highly aerobatic models. If you have any doubts about your ability, by all means play it safe by seeking out a more experienced pilot for the first round of test flights. You'll also need to seek out a nice, soft, grassy field for landing. Your local football field isn't nearly big enough. This is a small plane, but it eats up chunks of sky in a big hurry. Contact your local club or ask your hobby dealer for the names of good fliers in your area and a suitable location for flying.

We recommend that you find a helper to hand launch the Wonder for the first few flights. This way, you can be ready on the transmitter for immediate corrections, if necessary. After getting a feel for the plane, you can launch it yourself while holding the transmitter in your free hand. Get in the habit of checking your controls before starting the engine and again just before launch. Set the engine on the rich side because it will most likely lean out in flight. Go to full throttle, check that your transmitter antenna is fully extended, and give your helper a nod of the head when you're ready to fly. Hand



launching the Wonder is easy, thanks to the shoulder wing and light wing loading. Take a few quick steps and toss the model smoothly with the nose up slightly. The engine and wing should do the rest! Avoid throwing the model sharply - a real hard throw may cause the engine to sag or quit at the worst possible moment. Once the model has been released, allow it to level out and gain some airspeed before pulling into a gentle climb.

Grasp a quick breath, then bank your Wonder into a gentle turn before it gets too small to see (which can happen fast!). At altitude, make a few passes, trimming as necessary for level flight. Now it's time to try some loops and rolls. The Wonder reacts instantly to any control input, so go gentle on the sticks. If you find yourself struggling to keep up with the airplane, maybe it's time to throttle back and explore its mild-mannered slow-speed characteristics!

One of the Wonder's unique flying traits is something we call "Wonder-Bob". Gain some altitude, bring the engine to idle, then slowly feed in "up" elevator until you have the stick all the way back and hold it. Even at this low airspeed, you should have enough aileron control to keep the wing level. If you've done it right, the Wonder will begin to rapidly bob its nose up and down. What you're seeing is the airplane go through a mild stall, drop its nose a few degrees, pick up a tiny bit of airspeed, stall again, and repeat the process, all in a fraction of a second! This is not a violent maneuver, but it's fun to watch and you can fly out of it at any time by releasing the up elevator.

It's nice to have your engine set up so that you can kill it intentionally by bringing the throttle stick and trim lever all the way down. Since the Wonder must be glided in dead-stick to land. It's always better to shut the engine off when you want to, rather than waiting for it to run out of gas at some random time during the flight.

The Wonder glides beautifully, but it's no sailplane! Try to keep your control inputs smooth during the glide. Rapid maneuvering can bleed off precious airspeed, drastically reducing the gliding range. Shut the engine off with plenty of altitude so you can get a feel for the glide before bringing it in for the final approach. Hold the model off as long as possible before letting it settle into the grass. Like any design, the actual landing speed of the Wonder will vary as a function of your model's final weight and the amount of headwind.

Go ahead and take another breath! Be sure to wipe off the oily exhaust on the fuselage before attempting another hand launch. Also, check your propeller for damage after every landing.

The Wonder was designed for fun and we sincerely hope that it gets your adrenaline flowing flight after flight. If you have any questions, comments, or problems with this kit or any other Sig product, please call us.

SIG MODELER'S HOTLINE
641-623-0215
Weekdays, 7:00am - 4:30pm Central

WARNING - DANGER Important! Read these Warnings:

A model airplane motor gets very hot and can cause serious burns. Do not touch the motor during or after operation. Keep clear of the propeller, it can cut off a finger or put out an eye. Make sure the propeller is securely fastened in place and is not cracked. Model airplane fuel is flammable and poisonous. Take the same precautions while transporting and using it that you would with a can of gasoline or a bottle of poison.

Remember that it is possible to lose control of a model airplane. Do not fly in locations where the model may hit people or damage property if loss of control occurs. Check your model and equipment regularly to insure it is in safe operating condition.

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