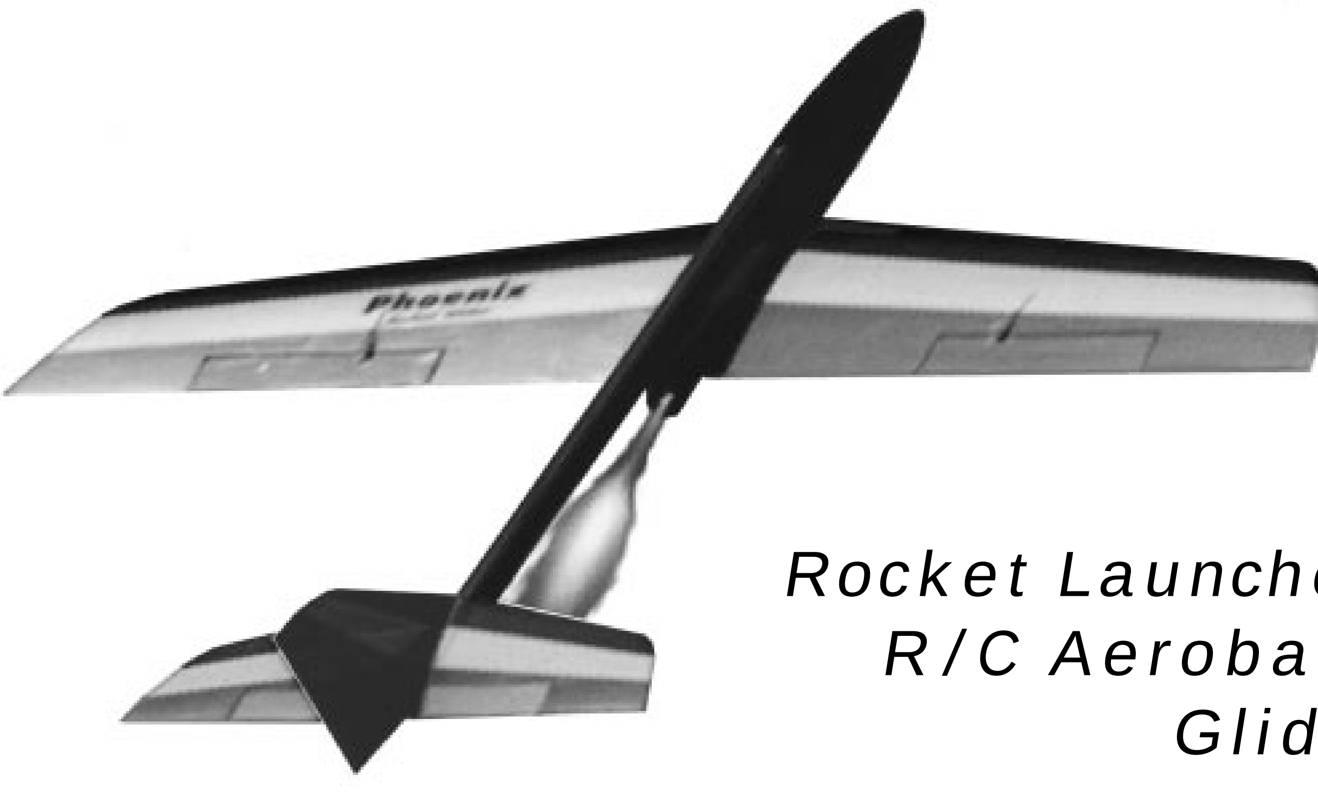
Phoenix™



Rocket Launched
R/C Aerobatic
Glider

Assembly and Operation Manual

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Warning!

Read This Carefully!

The radio controlled model that you will build from this kit and the AeroTech motors and propellants that you will use are not toys!

This model is not intended to be flown by inexperienced pilots.

If incorrectly built, mishandled or misused, they are capable of bodily harm and property damage. Therefore, it is **your** responsibility to correctly build this kit, to install all components carefully and accurately, and to test and fly this product in accordance with all safety standards prescribed by the Academy of Model Aeronautics Safety Code. We strongly suggest that you join the AMA and become fully and properly insured before using these products. If you require technical, construction or flying assistance, contact your local hobby shop or the AMA to locate experienced instructors.

AeroTech certifies that it has exercised reasonable care in the design and manufacture of its products. As we cannot control the storage and use of our products, once sold we cannot assume any responsibility for product storage, transportation or usage. AeroTech shall not be held responsible for any personal injury or property damage resulting from the handling, storage or use of our product. The buyer assumes all risks and liabilities therefrom and accepts and uses AeroTech products on these conditions.

No warranty either expressed or implied is made regarding AeroTech products, except for replacement or repair, at AeroTech 's option, of those products which are proven to be defective in manufacture within one year from the date of original purchase. For repair or replacement under this warranty, please contact AeroTech. Proof of purchase will be required. Note: Your state may provide additional rights not covered by this warranty.

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CONGRATULATIONS! You are now embarking on a new and exciting era in model aviation, high performance rocket gliders! Phoenix is the first of a new generation of rocket gliders from AeroTech and it will provide you with many exciting and satisfying flights. Thank you for choosing Phoenix!

Phoenix is the culmination of many years of flight and design experience with model airplanes, model rockets and with rocket gliders. Designed for the intermediate to advanced level pilot who wants high performance, both in the launch and in the glide phases of flight, Phoenix is a revolutionary design. You'll have a new class of model, exciting and different, unlike anything you currently have in your model airplane hangar.

What do we mean when we describe Phoenix as revolutionary ? By using extensive computer aided design, from the custom airfoils to the overall configuration, Phoenix uses the latest breakthroughs in aerodynamics to achieve these unique design goals:

- smooth, precise handling on launch
- low drag for outstanding launch performance
- ability to withstand the high speed and acceleration of launch
- high L/D and large speed range during glide for easy thermalling
- fully aerobatic during glide
- light weight and ease of construction
- maximum efficiency through an integrated rocket design

You'll be able to experience all of these objectives for yourself as you build and fly Phoenix. We've carefully laid out the plans, detailed the instructions and chosen the wood and other components so that your Phoenix can be as good as ours and you can have as much fun as we have had.

If you are an intermediate level pilot, you'll be able to immediately enjoy the high performance characteristics of Phoenix. By intermediate level, we mean someone who has previously built and successfully flown aileron equipped aerobatic RC models. While Phoenix is not difficult to fly for a pilot who has already flown several other planes, it is not for the novice or beginner pilots.

PHOENIX does not require that you have previous experience with model rockets. You just have to remember to follow some common sense safety rules. Just like it is a good idea to keep your hand out of a spinning prop, Phoenix should be launched only from its launcher, and only with a remote electrical ignition system. Please read the flying and safety sections in this manual for further details..

We ask that you follow the instructions as written, because after many prototypes and much experimentation, we've learned what tools, techniques and components work best. While Phoenix is easy to build because of the work we've put into it, the design is integrated, so that every detail contributes to the overall performance and changing one part of the design will impact the performance in other areas.

For maximum performance and safety, you must:

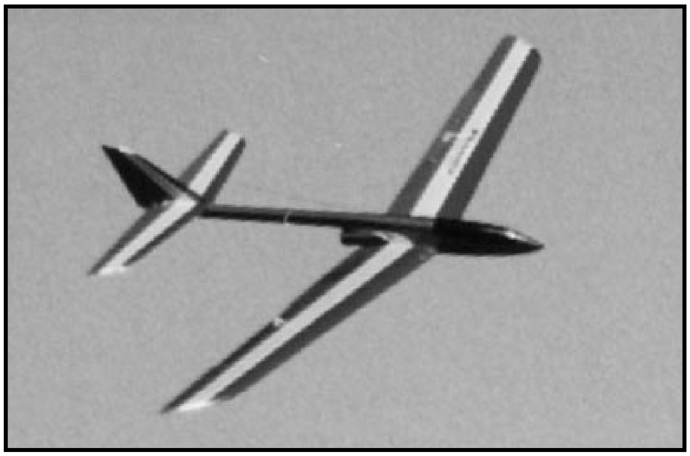
- Build Phoenix as described
- Install a fully working, tested and legal radio system
- Follow the AMA safety code, and the Rocket Glider safety code, as described in this manual
- Always use the recommended rocket motor reloads from AeroTech
- Test fly the Phoenix as described in this manual, and lastly
- Have a great time flying Phoenix!

We know that you'll enjoy your Phoenix Rocket Glider and you will have many exciting flights. We look forward to hearing from you: your comments, suggestions and experiences. Included in this kit is a product registration and evaluation card. We'd appreciate you completing it so we may do a better job in future rocket glider kits. We always look forward to your comments.

Thanks again for choosing Phoenix!

Integrated Rocket Motor

PHOENIX has a carefully integrated rocket motor for both good performance and good behavior on boost. For example, the placement of the rocket thrust line is critical for a stable boost. With Phoenix's high thrust to weight ratio (5:1 for Phoenix versus 1.5 to 1 for a hot power plane), Phoenix's motor thrust line had to pass through the CG or the model would try to loop violently on launch. Phoenix's motor is located as close as possible to the model's CG to reduce the amount of CG movement as fuel is burned. Finally, the motor mount angle on Phoenix was carefully tested with over 100 flights to minimize drag while providing easy access to the motor for reloading.



Computer Designed Airfoil

PHOENIX uses a custom computer designed airfoil, the BP4d™, for maximum boost and glide performance. To achieve the best overall results, the main design goal for the airfoil was a significant reduction in drag. The BP4d design did this, and is a significant improvement over sections such as the S3021, a common RC sailplane airfoil. When compared with the S3021, the BP4d has 33% lower drag at launch speeds and 5 to 15% lower drag during typical gliding flight, with only a slight decrease in maximum lift. As a result , Phoenix has a very wide speed range in glide, and retains a good glide ratio at high cruising speeds. Also, the Phoenix airfoil is slightly thicker, for better strength and for adequate room for aileron servos. With its substantially thicker aft section, the ailerons are thicker, reducing the possibility of flutter at high flight speeds.

Two Aileron Servos

PHOENIX has an aileron servo installed in each wing panel for several important reasons. First, by locating the servos away from the center section of the wing, where the flight loads are the greatest, less structural reinforcement is required to maintain the designed strength of the overall wing. The wing is stronger and actually lighter by having two servos outboard in the wing instead of one in the center surrounded by extensive reinforcements! Second, by moving the servos into the wings, closer to the ailerons, the result is stiffer linkages which are much less prone to flutter at high speeds, such as during launch. Finally, a dedicated servo for each aileron gives more accurate control for precise roll authority, as expected by experienced pattern flyers. While this is not essential for a sport plane such as Phoenix, once we started using the two ailerons and enjoyed the roll response, we couldn't give it up.

Offset Vertical Tail

ONE unique feature of Phoenix is its offset vertical tail. If you haven't already noticed, the tail is not on the centerline of the fuselage, it is offset to one side! This is intentional because it provides several distinct advantages for Phoenix. First, it allows for the pushrods to the elevator and rudder to be perfectly straight, for better stiffness and minimum weight. Second, the linkages and horns are shielded from the hot rocket exhaust, so they won't be damaged. Third, the larger fuselage cross section gives a stiffer tailboom for consistent and precise rudder and elevator response. Even though the back of the fuselage is larger than normal, the linkages are hidden, so the drag is less than or equal to the total drag of a conventional design. Finally, this design is stronger because the tail is glued directly to the side of the boom.

Although the plans show the vertical tail mounted on the left side of the boom, you can put it on the right side if you wish. You might avoid having to reverse a servo, if you have a radio without servo reversing switches.

If you never read the instructions:

Phoenix is a new and exciting category in model aviation, and you have probably never built and flown anything quite like it before. We really want you to be successful with your Phoenix, so:

Please:

- ***Build strong, light and true!***
- ***Read the flying instructions!***
- ***Follow the safety code!***
- ***Read the flying instructions!***
- ***Enjoy your Phoenix!***

PHOENIX has several critical construction requirements. First, it must be strong enough to withstand high speed launches and aerobatic maneuvers. Second, the wing must be built precisely as designed, with an accurate airfoil, to give good overall performance. Most importantly, the model must be light to obtain good launch performance. Strong, accurate but light - are your construction goals!

Why is weight so critical for Phoenix? **Each additional ounce of weight will result in approximately a 10% decrease in still air glide times!** Most of this reduction comes from lower launch altitudes. In designing Phoenix, we have taken lightweight building issues to heart and have selected components and techniques to make it easier for you to be successful. As you sort the wood in your Phoenix kit notice how the critical pieces (such as for the tail) are light weight balsa wood, carefully specified and selected for optimal strength to weight ratios. At first you may have wondered about some of these pieces - they are "fuzzy" or have "threads" on the edges. These are characteristics of lightweight, premium balsa wood - selected especially for Phoenix.

All of our Phoenix prototypes weighted between 23 to 24 ounces without the rocket motor. This is readily achievable with the components in this kit if you take reasonable care in building. So build it strong but light!

Vacuum Bagged Wings

THE best way to make strong, accurate and light wings on a model this size is to use medium weight balsa wood skins epoxied to foam cores, with fiberglass reinforcements where required. A vacuum bag is used to hold the skins firmly in contact with the core while the epoxy cures.

If you are not familiar with the vacuum bagging process, it really is quite simple. First we apply the epoxy resin and fiberglass resin to the balsa skins. The skins are positioned on the cores, and the assembly is placed in an airtight plastic bag. A vacuum pump with a regulator, or else a low power pump designed for vacuum bagging model foam wings, is connected to the plastic bag. A low pressure setting (3 psi or approximately 6 inches of mercury) is used. This pressure is maintained until the epoxy has cured. That's all there is to it!

You may now be wondering if this is sufficient pressure to guarantee a good, lightweight and strong bond. If we pump all of the air out of the bag, the surrounding atmosphere will apply a pressure of about 15 pounds per square inch at sea level. This will actually crush the lightweight foam cores used on Phoenix. So we need to pull only a partial vacuum in the bag. A pressure of 3 psi may not seem like a lot of pressure, but it is equivalent to putting a one foot thick steel plate on top of the wing cores! More than enough to guarantee a strong bond, but not so much as to crush the cores!

You may not have tried making vacuum bagged wings before, but the resulting wings are much stronger and lighter than with any other method. Once you try it, we doubt you will ever go back to the old methods again. Ready to use, low cost, vacuum bagging kits are available from several suppliers (See Appendix F). While you can improvise most of a bagging system, the commercial units use professional materials that are much easier to use, less likely to have an air leak, and not much more expensive. You might also want to get together with some of your flying buddies to share the cost of a system. Just remember that you only need a vacuum of about 3 psi for the Phoenix wings.

If you really do not want to vacuum bag the wings, the next best alternative is to hold the skins in place with weights while the epoxy cures. To equal the pressure of the vacuum bag, you need about 500 pounds on each wing half. The big problem is that it is almost impossible to get that much weight stacked up on that little wing! One hundred pounds per side is a good, practical weight to aim for. You should plan on using a bit more epoxy to get a good bond since you won't have as much pressure as the vacuum bag. We have used such weights as milk cartons filled with water, magazines, stereo speakers and scrap metal. It really depends on what you have available. It isn’t worthwhile to buy weights, since you could get a vacuum bag system for about the same price.

Airfoil accuracy

BUILDING the wing airfoil accurately is always going to require careful craftsmanship. We have found that the effort is really worthwhile to obtain the best possible performance from the model. On one of the prototype models, we were in a hurry and got sloppy on the airfoil shape. The resulting performance loss was very noticeable, possibly over 25%! We have tried to make building an accurate wing as easy as possible.

No wing shape is going to be perfect, but some errors are less critical than others. The most important thing is that the airfoil be a smooth shape with no wrinkles or bumps. It is actually very difficult to make the wing chord match the plans. A small error in thickness at the trailing edge will make a big error in the chord. Fortunately, this is not critical. Just make sure that both wing halves are the same. A small difference in trailing edge thickness is not important. The leading edge requires very careful shaping, so we have included precision die cut templates to make the job easier.

Adhesives

EVERYONE has their own preferences about which glue to use for which job. Throughout the instructions, we make suggestions based on the glues we prefer for a given job, based on our experience with the Phoenix prototypes.

For applying the wing skins, there really isn’t any choice but a good epoxy resin. We have used the PIC, Z-poxy and Bob Smith finishing resins with good results. These resins have a low viscosity and are easy to spread in a thin layer, but all have a “pot life” of only 10 to 20 minutes. Once the epoxy is spread into a thin layer, the cure time is greatly extended. If you pour some resin on each of the skins as soon as it is mixed, spread it around a bit, and then go back to do the final spreading, you should have plenty of time.

We routinely will skin a pair of Phoenix wing panels with one batch of 9 minute pot life epoxy. If you have never done vacuum bagging before, you might want to either do one wing panel at a time or use a slower setting resin. Resins such as EZ-Lam, West System and Safe-T-Poxy are all low viscosity with a 30 to 60 minute pot life. Do not try to apply the skins with a standard epoxy glue because it will be difficult to keep the weight down. We use about one fluid ounce of resin total to bond all four wing skins to the cores.

For the remainder of the construction, we use 5 and 30 minute epoxies, thin and thick CA as well as aliphatic resin glues. The instructions will mention any areas where a specific glue is required. For most of the construction, use either aliphatic resin glue (Titebond, PIC Rigid White Glue etc.) or CA. The CA glues have the obvious advantage of a fast cure time, but we find the aliphatics easier to sand, not all that much slower to use and non-toxic. Do not use standard CA glue near the foam cores! Take your pick. In any case, be sure to use a good quality, fresh glue to build your Phoenix.

Radio System

TO get good performance, you should use a moderately light weight radio system in Phoenix. For the aileron servos, only micro servos will fit in the wing. We have used Futaba S-133's in the prototypes with good results. Avoid servos with less than 20 inch-ounces of torque. We have also used S-133's for the elevator and rudder, although there is room for a slightly larger servo. Extra room for a standard servo can be made by deleting the rudder servo and only using a servo for the elevator. This does not greatly impact the maneuverability of Phoenix, but using properly coordinated rudder and aileron controls does make a significant improvement in thermalling performance. Therefore, we do recommend a servo for both rudder and elevator.

For the remainder of the radio gear, we have used either a standard receiver and a 150 mAh battery or a small receiver and a 275 mAh battery. Both combinations weigh about the same. The prototypes would balance properly with either of these radio options, without any additional nose weight. If your Phoenix comes out nose heavy, try not to add weight to the tail, but put in a lighter radio and enjoy the extra performance.

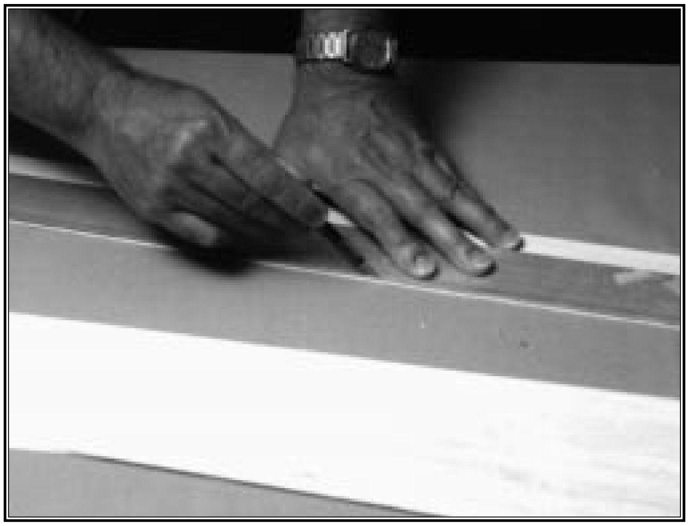
Finishing

PHOENIX is not the airplane to try out your latest 57 coat, hand-rubbed super finish! Remember that each extra ounce is going to cost you 10% in performance! All of the prototypes were covered with iron-on film coverings. We have found that the different coverings have different characteristics. A high temperature covering, such as MonoKote™ or Ultracote™ should be used on the bottom of the tail since it is close to the rocket exhaust. Lower temperature coverings can become loose or bubble due to the high heat in this area.

Regardless of the covering used on the wings, make sure that there aren't any wrinkles or bubbles, because they cause an increase in boost drag. Be especially careful to avoid wrinkles near the leading edge.

Finally, applying striping tape to the wing can also hurt the performance. If you really have to put on the striping, try flying your model first. If you notice a loss of performance when you put the tape on, then you have to decide if you want the performance or the looks.

Since Phoenix can be launched to high altitudes, good visibility is important. We have found that very dark colors are best for the bottom of the wing. We also put a fluorescent yellow stripe on the bottom for contrast. The upper surface can be any colors you want, but should be different from the bottom of the airplane.



Trim wing skins

- ❑ Trim edges of skins
- ❑ Don't trim your fingers
- ❑ Check that the sheets fit

BEGIN construction with the wing. We prefer to build both wings at the same time, however, you can build them individually if you wish.

Locate the 10 pieces of 1/16" x 3" x 24" balsa for the wing skins. Trim the edges using a straightedge and a sharp knife blade. Make sure that you hold the knife so the cut edges are vertical. We find it best to make several light cuts. Also, be careful how you hold the straightedge so you don't trim your fingers!

The skin splicing layout is shown on the plans. Note that you need to splice together two sets of 5 sheets each. Check the sheets to verify that they fit together with no gaps. If there is a minor problem with the fit, clean it up with a sanding block. The other option is to re-trim that edge.

Select the stiffest C-grain sheets for use on the trailing edges of the wing. Use the more flexible A-grain wood for the leading edges.

Glue wing skins

- ❑ Glue skins together
- ❑ Don't use too much glue

WE use one of two different ways of splicing wing skins. The CA method is a bit quicker, but the aliphatic glue method generally needs less sanding later, so use the one you prefer.

To use a thin CA glue, lay a piece of wax paper on your workbench. Then lay 2 sheets of wood down, hold the seam closed with one hand, and apply the thin CA. Use the minimum possible amount of glue, as it is difficult to sand off the excess later.

To use an aliphatic resin glue, lay the sheets flat on the bench and apply a strip of masking tape along the length of the seam. Make sure that there is no gap between the sheets. When you have all of the sheets taped together, turn them over and apply glue in the seams as shown. Lay the sheets flat on the bench and wipe off the excess glue with a damp paper towel. A few strips of masking tape will help hold the seam closed while the glue dries. If you have a good gap-free fit between the skins, try thinning the glue about 20% with water and applying it with a small paint brush. This will make it easier to sand.

Sand wing skins

- ❑ **Mark the inside of the skins**
- ❑ **Sand off excess glue**
- ❑ **Sand smooth**
- ❑ **Clean off balsa dust**
- ❑ **Trim to size**

WHEN the glue is dry, examine the wing skins. Generally, you will find that one side is smoother and more even than the other. This will be the outside of the skin. Mark the inside with a felt tip pen so you won't get it mixed up later. Use a good flat sanding block (we prefer the aluminum "T" bar as shown) and 120 grit sandpaper to remove any excess glue. Finish sand with 320 grit. For best results, clean off all of the balsa dust with a brush attachment on a vacuum cleaner. We also wipe the skins with a painters tack rag.

When the skins are smooth, trim them to shape as shown on the plans. The dimensions shown are slightly oversize to allow for trimming later. Mark the skins "upper right", "lower left" etc. on the inside of the skins

Clean up foam cores

- ❑ **Remove "threads"**
- ❑ **Trim trailing edge**

THE foam cutting process leaves some very fine "threads" on the surface of the core. In most cases, they can be removed by rubbing the cores with your fingers. In some cases, you might need to **very lightly** sand the core with a fresh piece of 400 grit sandpaper. **Be careful not to change the shape of the core or gouge the wing.** You do not need to remove any of the foam itself, just the threads. It is a good idea to support the wing in its foam "cradle" anytime you are working on it.

You may want to remove the threads from the surface of the foam cradles so they don't accidentally end up in some glue joint later.

Next, using a sharp knife, trim off the ragged trailing edge of the core. The trailing edge should be about $\frac{1}{32}$" thick when you are done.

Prepare fiberglass tape

- ❑ Mark location of glass tape
- ❑ Color trailing edge of skins
- ❑ Cut glass tape to length
- ❑ Prepare vacuum bag

USING a felt tip pen, layout the position of the ½" fiberglass reinforcing tape on the inside of the wing skins. The location of the tape is shown on the plans. The exact position is not too critical.

Cut the glass tape to the lengths marked on the wing skins. Leave a half inch extra at the wing root. Be careful when cutting the tape since it will unravel **very** easily. Remember that you only need 2 pieces of tape for the trailing edge(left and right), while there are 4 pieces of each length (upper and lower, left and right) for the other two lengths

It is a good idea to color the aft ¾" of each wing skin trailing edge with a dark color marker as shown in the photo. This will make it easier to find the trailing edge center line when you are sanding it later.

If you are using a vacuum bag, now is the time to get it ready. If you are skinning both wing halves at the same time, make the bag at least 5 feet long. Re-read the manufacturers instructions one more time. Otherwise, make sure that you have at least 100 pounds of weights, and practice stacking them on an area the size of the wing cradles. Once you mix the epoxy, it will be too late…

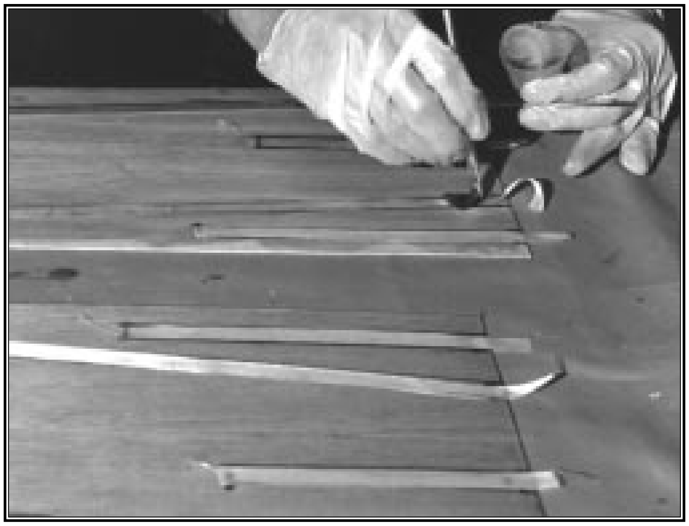
Apply epoxy to wing skins

- ❑ Mix the epoxy carefully
- ❑ Spread epoxy on skins
- ❑ Wear gloves
- ❑ Don't use too much glue

THERE are several types of epoxy suitable for applying skins. To keep the weight down, we need to use the minimum amount of epoxy possible. This is easiest with the low viscosity finishing resins. Most resins of this type tend to have working times under 30 minutes. If you are familiar with vacuum bagging, then this is not a problem. If this is your first time, then you might want to obtain a "laminating epoxy" with an hour or more of working time. These are available from most of the vacuum pump suppliers. Do **not** dilute the epoxy with any type of solvent.

Mix the epoxy according to the directions. We use about 1 ounce to do an entire set of wings. If you are using weights instead of a vacuum bag, you might want to use about 1 ½ ounces of epoxy. If you are using a fast setting resin, it helps to pour most of it out on the skins as soon as it is mixed. This will extend the working time.

Now spread the epoxy on the skins using a couple of old playing cards as a squeegee. You should have some resin left for the next step. Remember, the skin to foam glue joint does not have to be any stronger than the foam core itself!



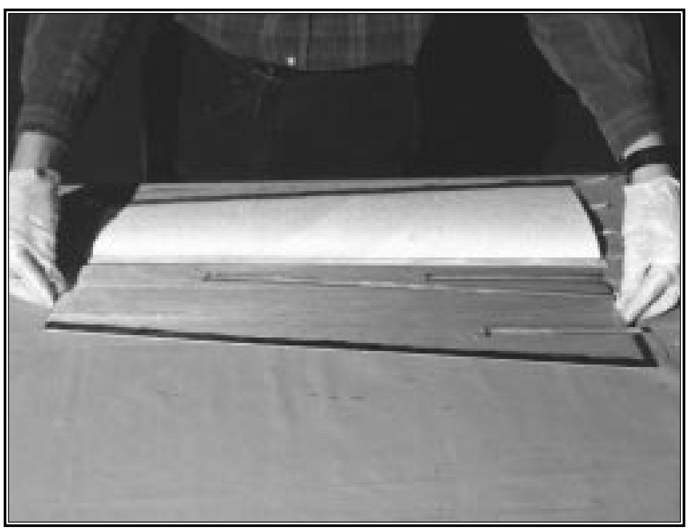
POSITION the fiberglass tape on the skins in the wet resin. Make sure that you apply the trailing edge tape to the lower left skin and to the lower right skin. The aft edge of the trailing edge tape should be even with the edge of the skin. Again, be careful to avoid unravelling the ends of the tape. If you used the right amount of epoxy on the skins, the tape should soak up enough turn partially clear about a minute after you lay it in place. If the tape turns completely clear, you used too much resin and your wing will be heavier than it needs to be. If it does not change color at all, then you did not use enough resin on the skins. You can go back and add some more resin or try to squeegee some more off, as required.

Apply fiberglass tape

- ❑ **Lay the tape in place**
- ❑ **Saturate with resin**

Finally, use the remaining resin and a disposable brush to fully wet out the tape. The tape will turn clear when it is properly wetted out. Use the minimum amount of resin to make the tape turn clear..

Now it is time to put the wings together.



PLACE a foam core on the lower skin. The trailing edge of the foam should be about 1⁄16" ahead of the front edge of the trailing edge tape as shown on the plans. Lay the upper skin in place so that both the upper and lower skins trailing edges are aligned. Apply several pieces of masking tape to keep the skins and core aligned.

Assemble wing

- ❑ **Position core on lower skin**
- ❑ **Lay upper skin on core**
- ❑ **Align trailing edges**
- ❑ **Tape together**

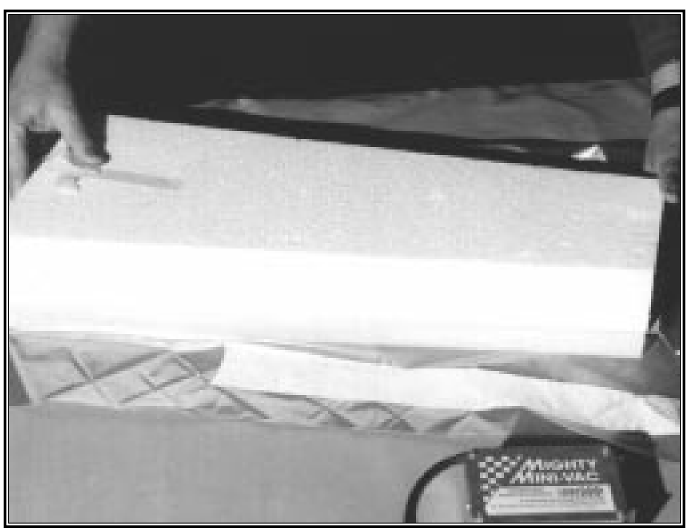
Vacuum bag the wing

- ❑ **Put wing in vacuum bag**
- ❑ **Seal the bag**
- ❑ **Pump out the air**
- ❑ **Make sure wing is straight**
- ❑ **Check for leaks**

NOW, apply pressure to the wing to hold everything together while the epoxy cures. If you are using a vacuum bag, insert the wings and finish sealing the bag. Set the entire bag assembly on the appropriate foam cradles, and align the wings in the cradles. Start the pump. As the air is removed, hold the wings flat in the cradle as shown to avoid warps.

If you have a vacuum gauge and regulator, set the system for about 3 psi (6 inches of mercury). Pumps like the one in the photo are preset for this value. Make sure that the wing is still straight. If not, shut off the pump, bleed some air into the bag, straighten it out and try again.

If your pump does not use a “bleed valve” to control the vacuum, you should shut off the pump and check for air leaks. Watch the bag carefully, if it “relaxes” noticeably within a few minutes, you have a leak. Check all of the seams and plumbing until you fix the problem. Sometimes you can even hear the leak. With some experience, you will be able to judge the pressure pretty accurately by the look and feel of the bag.



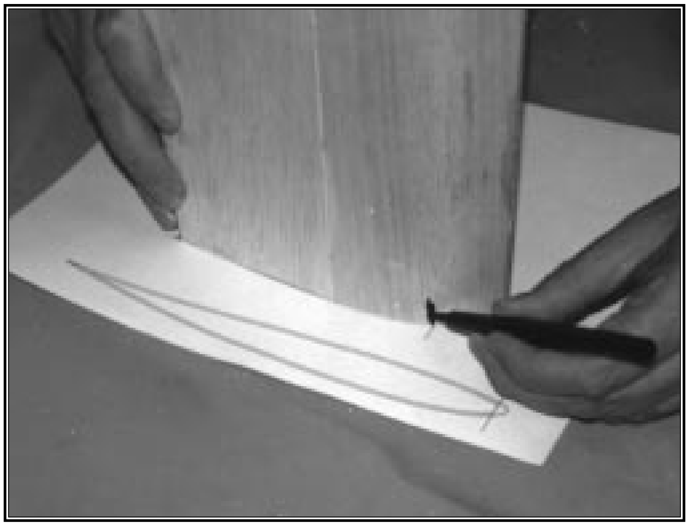
Allow wing to cure

- ❑ **Stack weights on wing**
- ❑ **Make sure it is straight**
- ❑ **Wait until epoxy cures**

IF you are using weights, place the core and skins in the cradle and set the upper cradle in place. Make sure everything is aligned properly, and use masking tape to hold the stack together. (A good place to check it is at the leading edge.) Carefully set weights on top, until you have at least 50 pounds, and preferably over 100 pounds. Remember, the vacuum bag is equivalent to about 500 pounds per wing panel.

Be careful, since many workbenches will bend noticeably with this kind of weight on them, resulting in a warped wing. The best place to do the wing assembly is on a flat concrete floor(check it first!). If you have to set up the wing on a workbench or wood floor, we suggest that you get a couple of flat 2" x 10" boards at least 30" long to set everything on. This will help keep the wing straight.

Regardless of the technique you use to hold everything together, wait until the epoxy is fully cured before proceeding. We prefer to wait about 50% longer than the epoxy manufacturer suggests, just to be safe. Remember, epoxy can take a very long time to cure at low temperatures.



Mark LE trim line

- ❑ **Trim balsa flush with foam**
- ❑ **Mark LE trim line**
- ❑ **Match wing panels**

NOW THAT you have this nice straight, strong piece of balsa and foam, we need to turn it into a wing.

First, trim the balsa skins flush with the root and tip ends of the foam cores. This does not have to be a particularly neat job, since we will be trimming them again later. The approximate trim lines are shown on the plans.

Set the wing on the appropriate wing end airfoil section drawing, and mark the location of the leading edge trim line on both the root and the tip of the wing. You will probably have to move the wing around a bit to get the best match possible with the drawing. You want to match up the shapes over as much of the airfoil as possible. The fit will probably not be perfect, but do the best you can. Repeat this process until both ends of each panel are marked. It is a good idea to check the two panels against each other to make sure they match.

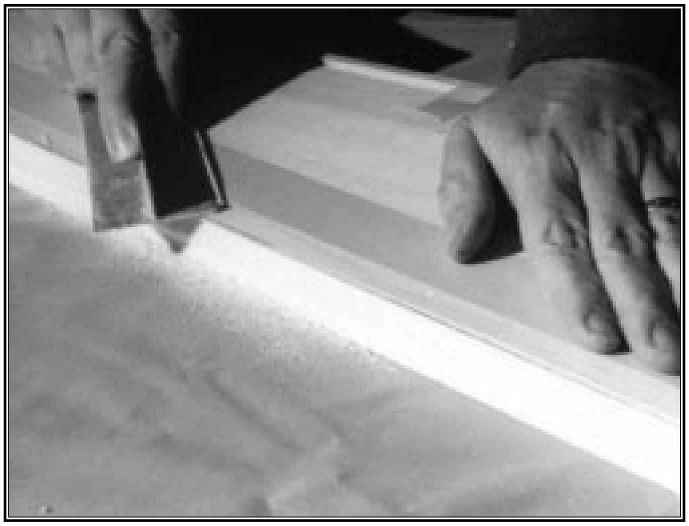
Attach leading edge

- ❑ **Trim wing panel**
- ❑ **Glue on leading edge**

SET THE WING panel in its cradle. Using a straightedge and a sharp knife, trim the leading edge on the lines you marked in the last step. Try to keep the cut vertical. Clean up the cut with a sanding block if required.

Glue the 3⁄16" x 3⁄8" x 24" balsa leading edge strip in place. We prefer to use aliphatic glue for this step. Apply the glue to the wood and spread it into a thin layer. Hold the balsa in place with masking tape while the glue dries.

If you want to use CA glue, make sure it is one of the styrofoam compatible types. Do not use epoxy, since it is very difficult to sand cleanly.



Shape trailing edge

- ❑ **Protect the wing with tape**
- ❑ **Sand the TE to shape**

NOW SHAPE the leading and trailing edges. This has to be done without modifying the contour anywhere else. The best way is to protect the remainder of the wing with masking tape while you are working. See the trailing edge sketches on the plans

On the trailing edge, you need to remove the excess balsa until you get to the fiberglass tape. Lay a piece of masking tape on the wing with its aft edge aligned with the aft edge of the foam core. Add additional strips of tape adjacent to the first one until you have at least 2" covered. Using a straight sanding block, sand the trailing edge to the shape on the plans. Support the wing in its cradle while sanding.

The black marks on the inside of the skin will help you judge the progress of the sanding. We sand the edge until it is sharp, and then trim it back slightly to blunt it. Yes, you can cut your finger on one of these trailing edges!

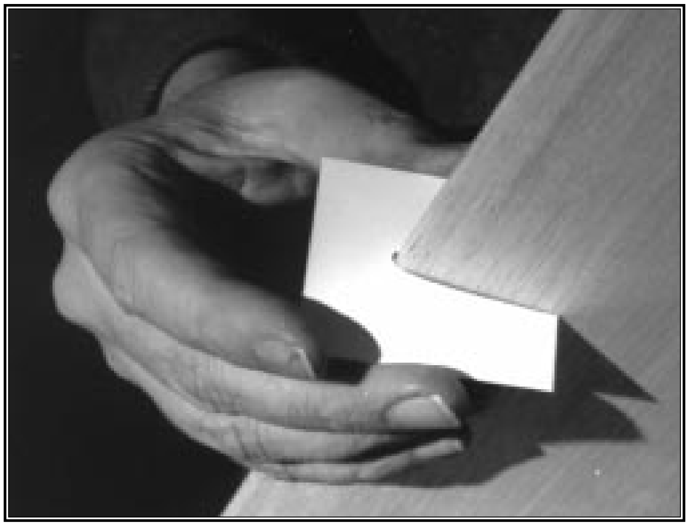
It is hard to make the trailing edge the right shape while maintaining the proper wing chord. We prefer to get the airfoil right, and then make the chords of the wing panels match. It is not critical if the chord does not match the plans exactly.

Carve leading edge

- ❑ **Protect wing with tape**
- ❑ **Start shaping the LE**

THE LEADING edge is probably the most critical part of the Phoenix wing shape. The leading edge shape was designed to give the best balance of low drag on launch and good glide performance. This is the place to put in that extra bit of effort to get things really right.

Start out by protecting the wing with masking tape, the same as you did for the trailing edge. Use a razor plane and sanding block to Rough out the leading edge. At this stage, you just want get the shape close, without taking off too much. Again, resting the wing in its cradle will help.



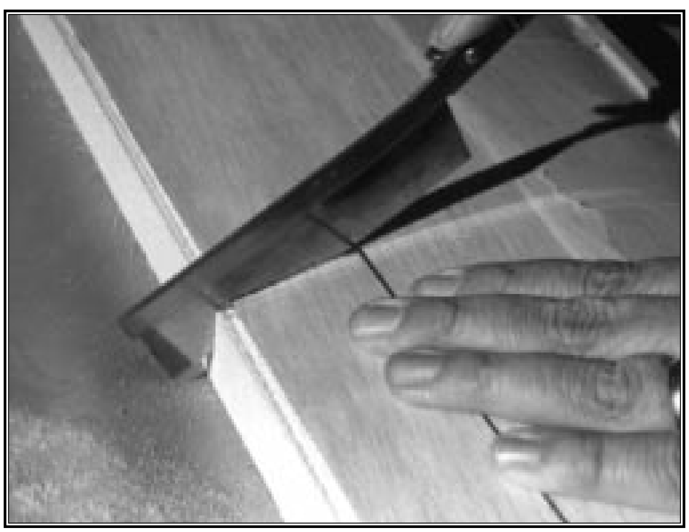
Shape airfoil

- ❑ Check LE with templates
- ❑ Sand carefully
- ❑ Check LE with template
- ❑ Sand carefully
- ❑ Repeat until finished

ONCE THE leading edge shape is close, start checking things with the die cut templates. The exact locations of the templates are shown on the plans; however, they will still give you a good idea of the proper shape for several inches each side of the proper location. While it probably is not possible to get the shape exact using lightweight balsa construction, you want to get it as close as possible. Remove the masking tape for the final shaping, and sand very carefully with fine sandpaper to avoid changing the main wing airfoil.

The most important thing is to keep the shape smooth. The lower surface is especially critical for launch performance.

If things get really messed up, it is best to cut off the entire leading edge strip and start over.



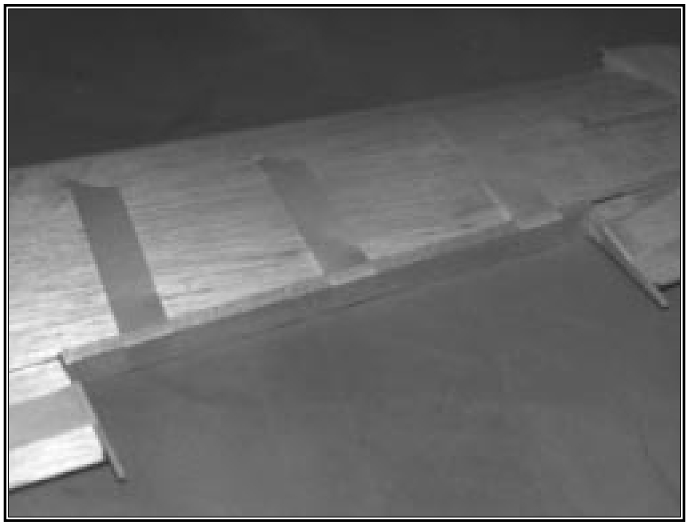
Cut out ailerons and tip

- ❑ Layout cut lines
- ❑ Trim wing tips
- ❑ Glue on tip blocks
- ❑ Cut out ailerons

MARK the aileron cutout and tip trim line as shown on the plans. Use a fine marking pen.

Trim the tip of the wing to size with a fine razor saw. Clean up the cut with a sanding block and glue the tip block in place using the same technique you used for the leading edge.

Cut out the ailerons as shown. We make the spanwise cut with a knife and straightedge, similar to the way you trimmed the leading edge. You might find it helpful to remove the razor saw blade from its stiffening spine for making the final chordwise cuts. Clean up the cut with a sanding block.



Install aileron framing

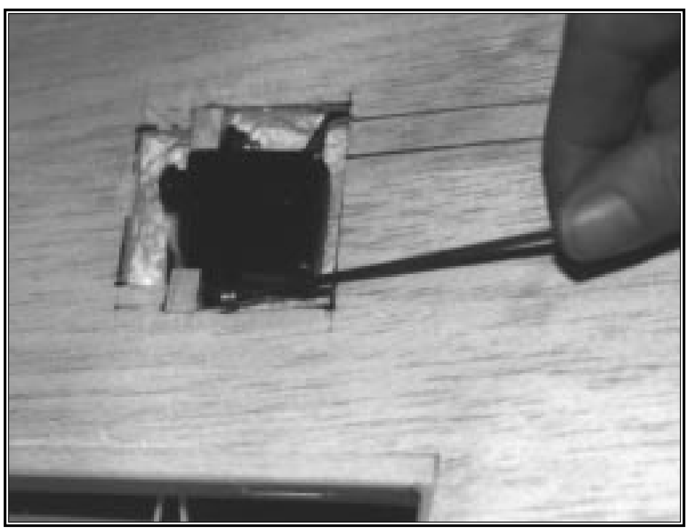
- ❑ Glue cutout framing in place
- ❑ Trim ailerons to fit
- ❑ Glue aileron LE in place
- ❑ Glue W-1 parts in place
- ❑ Sand flush with wing

TRIM the two 3⁄16" x 3⁄8" x 9" balsa strips to fit in the aileron cutout as shown. Glue in place. Glue one of the die cut W-1 pieces on each end of the cutout as shown.

Cut about 1⁄4" from the end of each aileron so it will fit back in the opening. Trim the leading edge of the aileron to allow for the thickness of both the wing trailing edge strip and the 3⁄16" thick aileron leading edge strip. Glue the aileron leading edge strip in place. The aileron trailing edge should match up with the wing trailing edge with both strips in place when you are done.

Sand one end of the aileron smooth. Glue a W-1 in place. Trim the other end to allow for the thickness of the other W-1, plus about 1⁄16" extra clearance as shown on the plans. Glue the final W-1's in place.

When the glue is dry, sand all of the framing pieces flush with the wing skin. Remember to protect the wing surface with masking tape while sanding.



Install aileron servos

- ❑ Attach servo to mounts
- ❑ Layout and cut hole
- ❑ Epoxy mounts in place

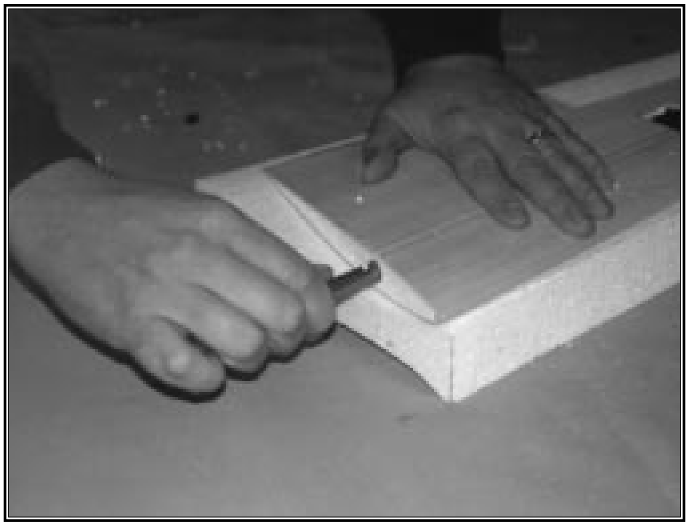
CUT 4 aileron servo mounts from the 1⁄4" x 3⁄8" x 6" basswood strip. The lengths are shown on the plans. Note that the aft mount is shorter than the front mount.

Drill 1⁄16" diameter holes in the mounts to match your servos. The servo is attached to the bottom of the mounts, as shown. Use the special #2 Allen head sheet metal screws and wrench from the hardware package to mount the servos. Remember to reverse the eyelets that came with your servo to allow for this "upside-down" mounting.

Lay the servo and mounts on the **bottom** of the wing, and mark the area for the cutout. Cut out the skin with a knife. Use a knife or Dremel tool to remove the foam. Be careful not to cut into the upper wing skin.

Trim the top of the mounts until the servo is flush with the lower wing surface. Epoxy the servo mounts in place. The mounts should be glued to the upper skin and the edge of the lower skin.

Remove the servo. The enclosed "ball end" Allen wrench allows easy removal of the servo screws.



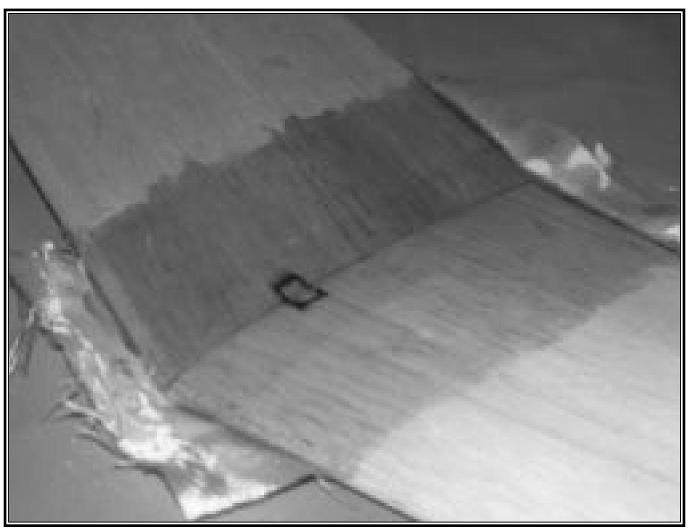
Cut aileron lead tunnel

- ❑ **Sharpen tube**
- ❑ **Cut tunnel**

CUT a “tunnel” for the aileron cable. Find a 12" long piece of brass tubing of a diameter large enough to clear your servo connectors (but not more than ½"). Sharpen one end with a knife or file.

Very carefully, use the tubing to cut out the foam as shown. We generally cut about an inch or two, remove the tubing, push the “plug”of foam out of the brass tube with a balsa stick and then continue. You should be able to feel the progress of the tubing with your other hand right through the wood skins. Do not let the tubing cut through the skins. Try to aim the tubing at the servo cutout. You might want to draw some reference lines to help guide the cut. Make sure the holes on each panel line up at the root.

It might have been easier to cut the tunnel before skinning the wings, however the pressure from the vacuum bag would have crushed the wing!



Join wing halves

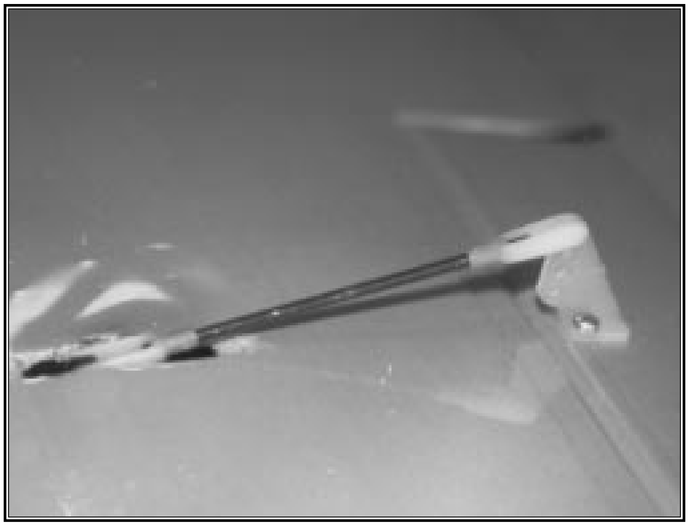
- ❑ **Trim the wing roots**
- ❑ **Sand the dihedral angle**
- ❑ **Glue the wings together**
- ❑ **Get the dihedral right!**
- ❑ **Glass the wing center**

TRIM the wing root to the sweep angle shown on the plans. Clean up the cut, and sand the dihedral angle. We prop each wing tip up 1 ¾" with the root at the edge of the workbench and use the edge of the bench to guide the sanding block. Take your time and get the angle right. Mark the location of the aileron cable tunnel on top of the wing as shown.

Glue the wing halves together with 5 minute epoxy. Wipe off any excess glue before it cures. It is very important make the dihedral angle as shown on the plans. An error in the dihedral will change the vertical location of the CG. The resulting offset between the thrust line and the CG will cause Phoenix to loop as it leaves the launcher. If you change the dihedral, you will have to change the thrust line to compensate. This will take a lot of trial and error before you get it right again!

Glass the joint top and bottom with the 6" wide cloth and epoxy.

When the resin is cured, trim the cloth at the leading and trailing edges.



CUT the hinge slots. We like to start the slot with a knife, and then enlarge it with an X-acto #26 saw blade. Sand the aileron leading edge to the "V" shape shown on the plans **after** the slots are cut. We cover the ailerons before gluing in the hinges.

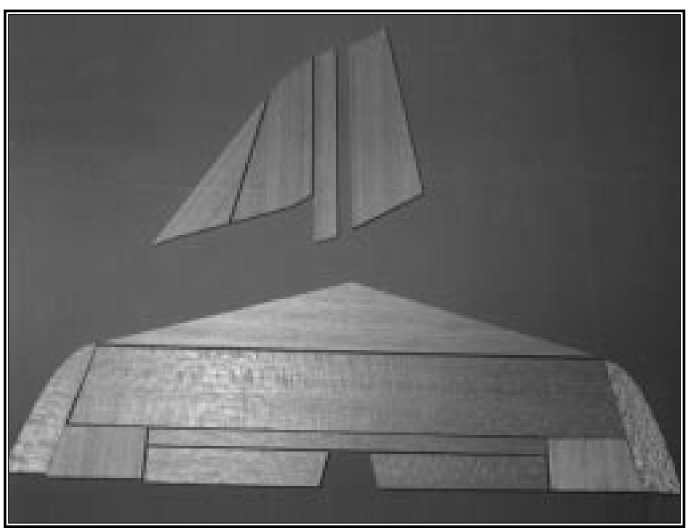
The enclosed hinges are the best we have used. Roughen the surface with 80 grit sandpaper. Flex the hinges 180° a few times for "break-in". Coat the hinge with 30 minute epoxy and force some epoxy into the hinge slot. Insert the hinge into the slot. Wipe off any excess glue. Pinning the hinges is not required. We glue the hinges into the control surface, let the glue cure and then attach the control surface to the wing.

Install aileron linkages

- ❏ **Hinge ailerons**
- ❏ **Cut slot to clear linkage**
- ❏ **Install control horns**
- ❏ **Make and adjust linkage**

Trim the servo arm to the shortest length that will allow full movement without the clevis interfering with the servo arm hub. Cut a slot in the upper surface of the wing to clear the linkage. Mount the aileron horn, and adjust everything for the correct throw and centering.

In case you are wondering, the aileron horn is on top to keep it from dragging on the ground during landing and damaging the servo gears.



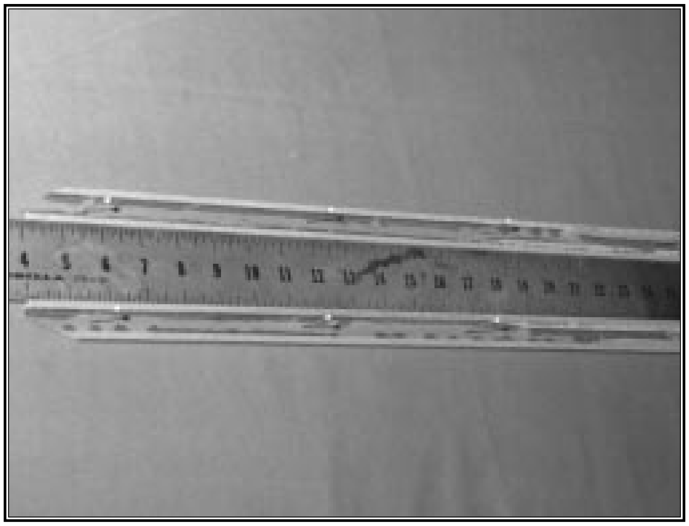
CUT the vertical and horizontal stabilizer parts from the 3/16" x 3" balsa sheets using a **sharp** knife or razor blade. Use the die cut templates as guides. Note the grain direction on all parts, especially the S-3's. Square up the edges of the parts with a sanding block. We feel that cutting these parts out using a template is easier than cleaning up die cut parts. (Light balsa die cuts very poorly.)

Glue the parts together as shown on the plans. Use either a thick CA or an aliphatic resin glue. Both types are relatively easy to sand when cured. Be careful when gluing the end grain edges, since they will tend to soak up some glue. It is best to apply the glue, wait a few moments for it to soak in, apply some more glue and then assemble the parts.

Assemble tail surfaces

- ❏ **Cut out parts**
- ❏ **Clean up edges**
- ❏ **Glue parts together**
- ❏ **Sand and shape**
- ❏ **Cut hinge slots**

Sand both surfaces smooth. The leading and trailing edges should be shaped as shown on the plans. Note that the trailing edge is about 3/32" thick. This provides better control response as well as keeping the control surfaces stronger. Do **not** round off the corners on the trailing edge! Cut the hinge slots the same as you did on the ailerons. Shape the "V" on the rudder and elevator leading edges.



Frame tailboom sides

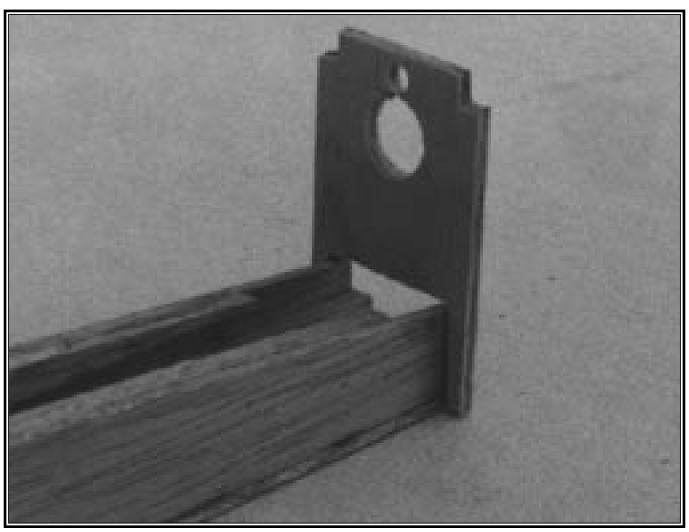
- ❑ Sort stringers
- ❑ Pin sides on workbench
- ❑ Make a right and a left
- ❑ Check for straightness
- ❑ Glue on stringers

THERE are 8 pieces of 3⁄16" square by 30" balsa in the kit. Pick out the two straightest and stiffest ones and save them for use as pushrods.

Remove the F-5 pod sides from the die cut plywood sheet. Typically, the surface finish on one side of the plywood is better than on the other. Make sure to use the good side of each part on the outside of the model. Pin the F-5's to the board with the good side down. Make sure you build both a **right** side and a **left** side. Select the softest 3⁄16" square stringer. Cut and glue it to the bottom edge of each F-5 as shown on the plans. Use the nose block to determine the location of the front of the stringer.

Remove the F-1 tailboom sides from the die cut sheets. Pin the two F-1's to a building board as shown. It might be necessary to bend the parts slightly to keep the edges straight as you pin them down. Glue the stringers in place. Note the position, trim angle and length of the extra stringers near the front.

Clean up the edges after the glue dries.



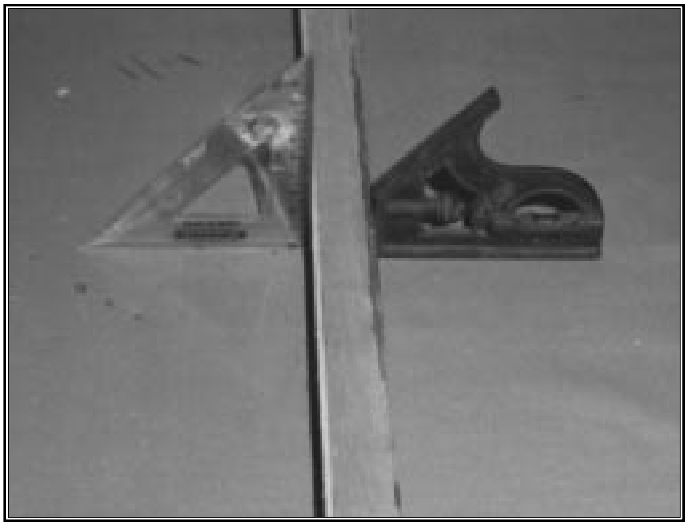
Glue sides on tail boom

- ❑ Pin bottom on board
- ❑ Check for straightness
- ❑ Glue sides in place
- ❑ Check spacing at front
- ❑ Check that sides are vertical

THE tailboom is too small in cross section to be built with internal bulkheads, so you have to use a square or triangle on the outside to check the alignment as you build. Since the parts are long and narrow, you also have to check that everything is straight.

Remove the two F-2 parts and the F-3 bulkhead from the die cut sheets. Be careful not to break the thin legs on the bulkhead. Use a knife to help separate the part from the sheet if required.

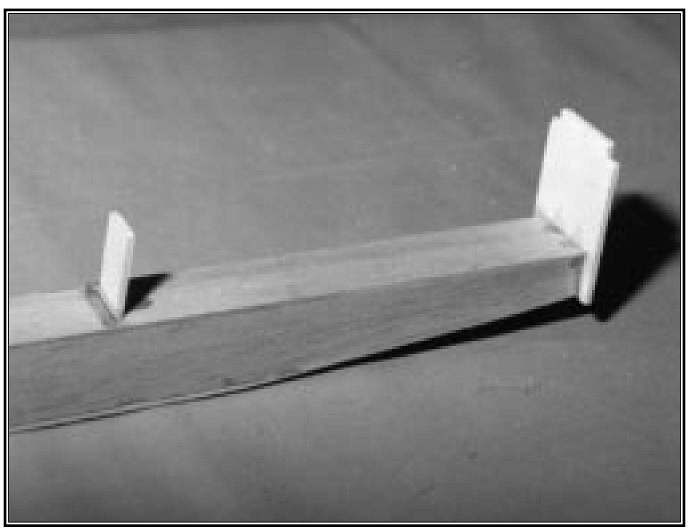
Pin one F-2 onto the board. Check it with a straightedge, and use pins to hold it straight during assembly. This part will be the bottom of the tailboom. Trim back of F-2 until it is the length shown on the plans. Glue the side assemblies in place on top of F-2. Make sure the sides are vertical. Slip the F-3 bulkhead over the front and adjust the sides for a snug fit as shown. Do **not** glue the bulkhead in place.



Assemble tailboom

- ❑ **Trim top to length**
- ❑ **Glue in place**
- ❑ **Check for straightness**
- ❑ **Check that boom is square**

THE other F-2 is the top of the tailboom. Trim the front and back to the length shown on the plans. Glue it in place. Check the entire boom one more time to make sure everything is straight and square before the glue dries.



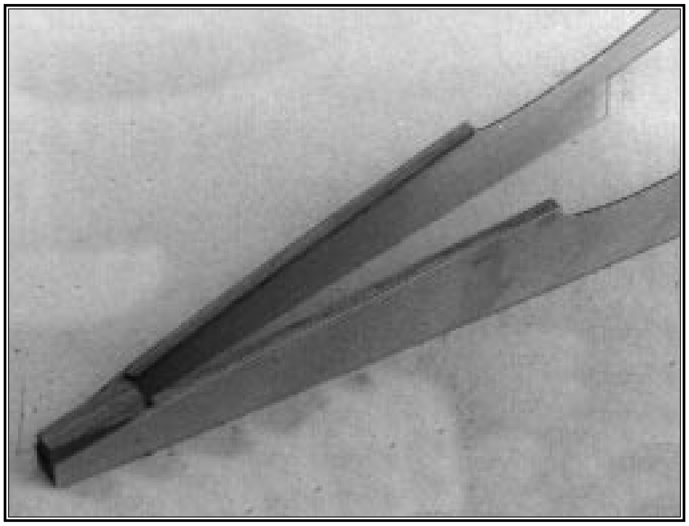
Attach bulkheads to boom

- ❑ **Drill holes in F-3**
- ❑ **Glue F-3 in place**
- ❑ **Locate position of F-4**
- ❑ **Glue F-4 in place**

MARK and drill the 3⁄16" hole for the wing dowel and the larger hole for the aileron servo leads in bulkhead F-3 as shown on the plans. (Yes, they do not show in the photo, but it is easier to drill the holes now!) A “bradpoint” type wood drill (available from a good hardware store) will cut a much cleaner hole than a normal twist drill.

Glue F-3 on the front of the tailboom as shown. It should be perpendicular to the workbench.

Use the pod sides to locate and mark the position of bulkhead F-4. Note the position of the parts on the plans. F-4 should be centered on the boom side to side. the back of F-4 should be flush with the back of the pod sides. It should canted forward at the bottom to match the back edge of the pod. Glue in place with CA. You can make small adjustments to the angle by flexing F-4 when you glue the pod sides in place.

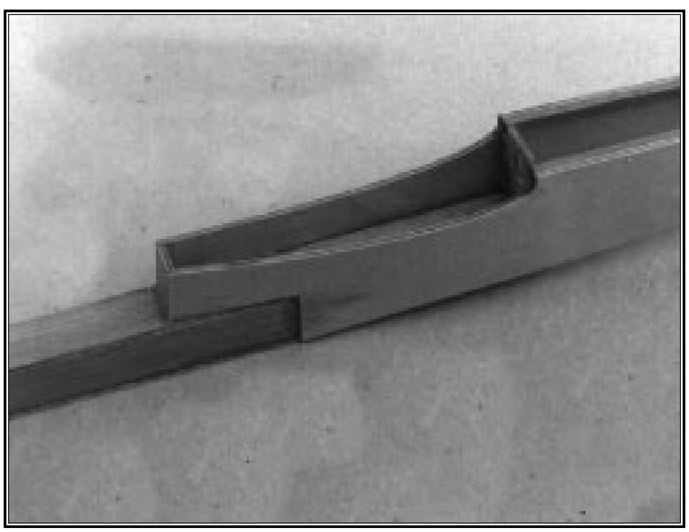


Attach pod sides to nose

GLUE the pod sides to the pre-cut hard balsa nose block. Note that the nose block is flush with the **top** and **front** of the pod sides. Assemble everything together upside down on a flat surface as shown. Thick CA or aliphatic glue both work well.

When the glue is dry, trim and sand the bottom of the nose block flush with the bottom of the pod sides.

- ❏ **Glue sides to nose block**
- ❏ **Align nose block with sides**
- ❏ **Trim block flush with sides**

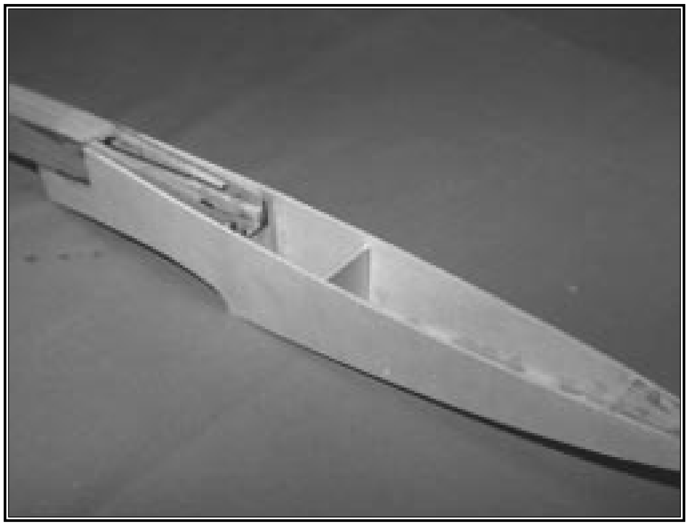


Glue pod to boom

BEVEL the top aft edge of the pod sides as shown on the plans. Check the fit on the boom as shown in the photo. When the sides fit properly over the boom, glue in place. We use either aliphatic glue or thick CA. Check carefully to make sure the pod is straight in relation to the boom. If you build over the plans, check the position of the pod sides over the drawing using a square.

This interlocking construction of the pod and boom provides a very strong fuselage.

- ❏ **Bevel aft upper edge of pod**
- ❏ **Check fit to boom**
- ❏ **Glue in place**
- ❏ **Check for straightness**



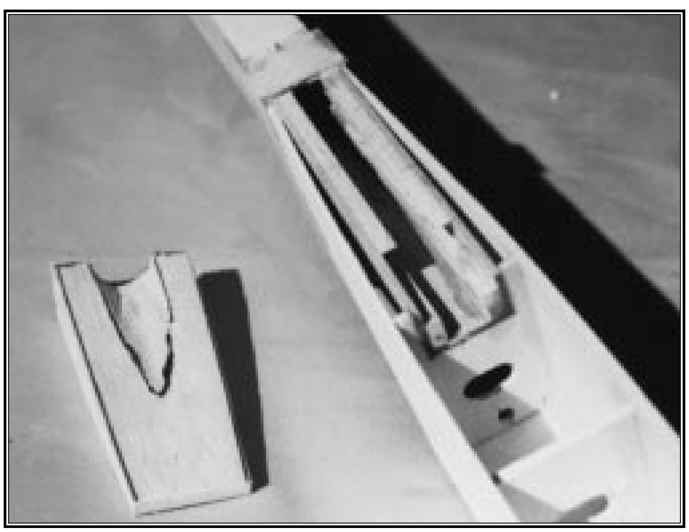
Finish pod assembly

- ❑ **Cut servo lead hole in F-6**
- ❑ **Glue F-6 in place**
- ❑ **Glue servo mounts**
- ❑ **Glue pod bottom in place**

WHEN the glue is dry, determine where to install the F-6 bulkhead. Its position is set by the size of the rudder and elevator servos you are using. Remember to allow for the servo mount rails. Cut the hole for the servo leads in F-6. Glue F-6 in place.

Install the 1/4" x 3/8" servo mounting rails. The rails should be positioned so the servo arms are at the height shown on the plans. Do not drill the servo mounting holes at this time.

Sand the bottom edges of the pod smooth. Glue F-7 and F-8 in place to the pod sides, nose block and bulkheads. These parts are cut slightly oversize to allow for trimming later.



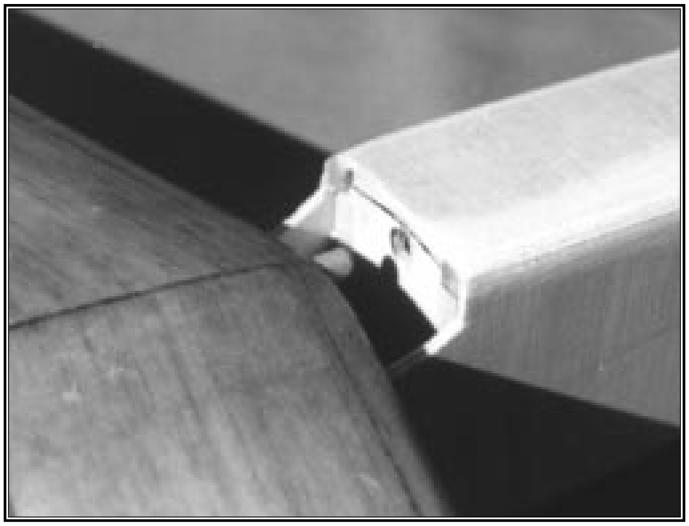
Attach aft canopy block

- ❑ **Test fit and trim canopy**
- ❑ **Hollow for pushrods**
- ❑ **Glue aft block in place**

USING a flat sanding block, sand the edges of the tailboom sides and stringers flush with the top of the pod sides. Do not sand F-2. Carve out the bottom of the aft canopy block to clear the pushrods.

The aft block is cut slightly oversize, and must be trimmed to length. Place the forward and middle canopy blocks in place as shown on the plans. Test fit the aft block, and trim as required.

Glue the aft canopy block in place. Make sure to get a good bond to both the tailboom sides and the pod sides.



GLUE the the two F-9 aft wing mounts together, using epoxy or thick CA glue. When cured, glue them into the fuselage as shown on the plans. Note that they are about 1/16" above the top of the wing. Use epoxy, and apply a fillet along the entire joint.

Place the wing in position on the fuselage and mark the location of the wing dowel on the leading edge. Drill a 3/16" hole through the leading edge. This is somewhat tricky, since the drill will tend to wander off center because of the epoxy in the dihedral joint, but do the best you can. Trim the dowel to length, and radius the front end with sandpaper. Chucking the dowel in an electric drill and spinning it while sanding the radius works very well.

Insert the dowel in the wing and position the wing on the fuselage. If necessary, use a file to enlarge the dowel hole in the wing until the wing fits properly in its saddle.

Remove the dowel and fill the hole with an epoxy and microballoon mixture. Insert the dowel and wipe off any excess epoxy. Place the wing on the fuselage, align carefully and allow the epoxy to cure.

Install wing mounts

- ❑ **Install F-9's**
- ❑ **Drill wing for dowel**
- ❑ **Glue dowel in place**
- ❑ **Check alignment**

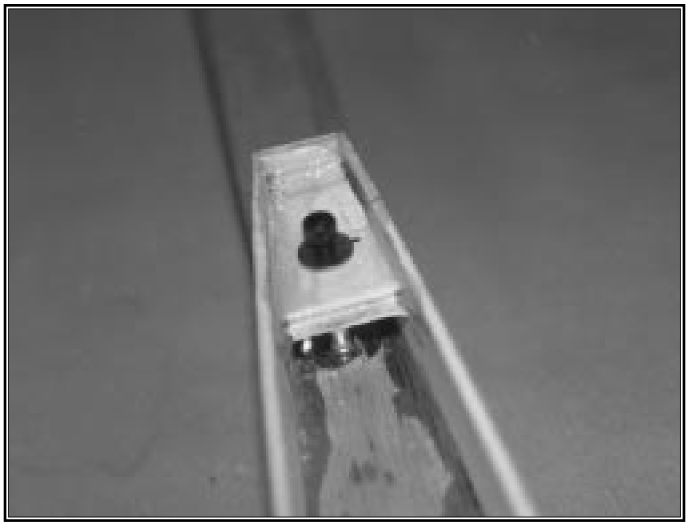
MARK the position of the wing bolt hole on the bottom of the wing. The hole needs to be approximately centered on the F-9 wing mounts. We prefer to make the hole along the side of the dihedral joint instead of on the exact center, to avoid drilling through the epoxy.

Align the wing on the fuselage carefully. Check the alignment by measuring from each wingtip to the centerline at the aft end of the tailboom. The dimensions on the right and left sides should be identical.

Drill the hole through the wing and the F-9's using a number 29 drill. The hole should be approximately perpendicular to the F-9 parts. If you do not have a #29 drill, use a 1/8" drill, and enlarge the hole slightly with a knife or file.

Drill for wing mount bolt

- ❑ **Mark hole position on wing**
- ❑ **Align wing on fuselage**
- ❑ **Drill hole through wing**



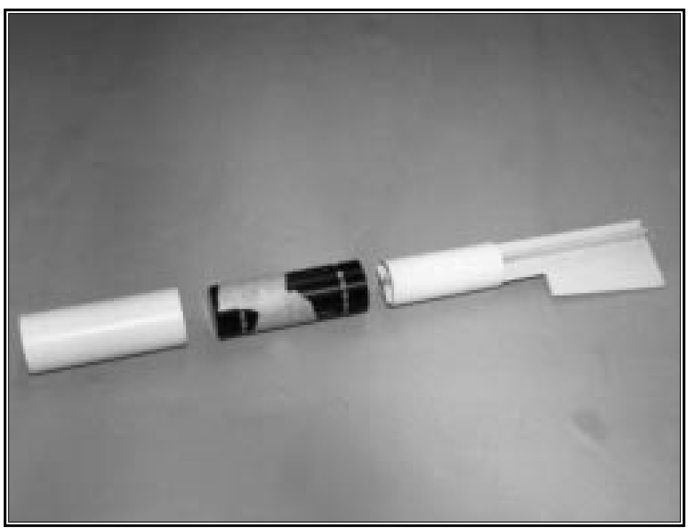
Install aft wing mount

- ❑ Enlarge hole in F-9's
- ❑ Install blind nut

REMOVE the wing. Enlarge the hole in the F-9's with a 11/64" drill.

Installing the 6-32 blind nut is a bit tricky since there is not a lot of room in the back of the pod. Set the fuselage on the bench upside down. Set the blind nut on top of the tail-boom and slide it aft until it is under the hole. Insert a 6-32 screw through the hole and thread it a few turns into the blind nut. Now pull the blind nut into place with the screw. Once the nut is started into the hole, you can tighten the screw to pull it fully into place.

Remove the screw and apply some thin CA around the nut so it doesn't fall out.



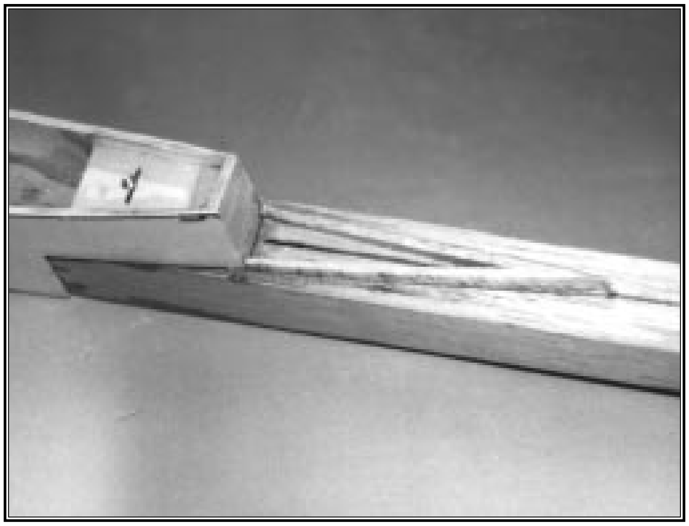
Assemble motor mount jig

- ❑ Assemble jig parts
- ❑ Fit casing to mount tube

THE motor alignment on Phoenix is very critical. To install the motor mount accurately, you need to build a jig.

Remove the J-1 and two J-2 parts from the die cut plywood sheet and clean up the edges. Slide the 1 1/8 " outside diameter liner tube over J-1. Slide the J-2's into place as shown. The front end of the liner tube should be flush with the front ends of the plywood parts. When all the parts are properly aligned, glue the liner tube, J-1 and the J-2's in place with CA.

The motor casing should be slid over the liner tube as far as it will go. Apply masking tape to the casing until it is a snug but not tight fit in the 1 3/16" motor mount tube. Slide the motor mount tube over the casing until it is flush with the front of the casing.



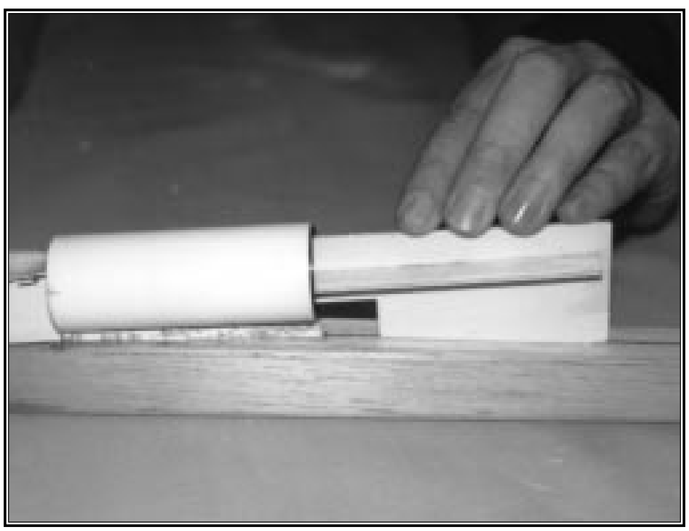
Attach motor pylon

- ❑ **Draw centerline on boom**
- ❑ **Bevel aft end of F-10's**
- ❑ **Glue in place**

CAREFULLY layout and draw a centerline on the bottom of the tailboom.

Remove the two F-10 motor spacers from the 3/32" die cut balsa sheets. Bevel the aft ends until they will fit together as shown, and glue in place.

A thin, trailing edge is important on the spacers where they meet. Excessive turbulence in the airflow in this area will tend to pull the hot motor exhaust up towards the tailboom.

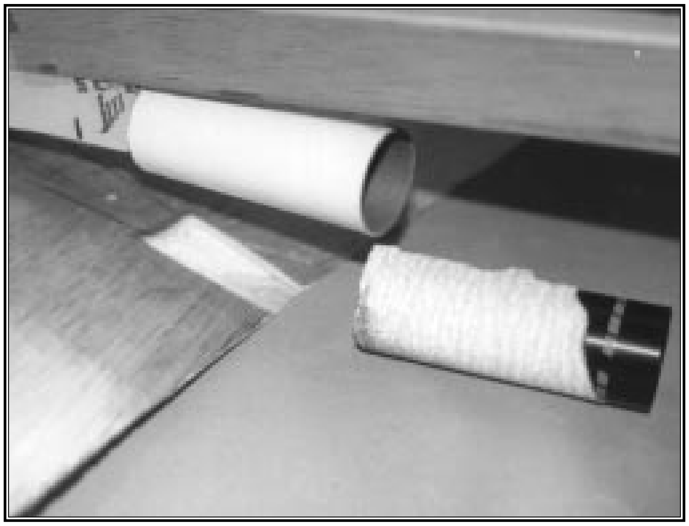


Install motor mount

- ❑ **Trim F-10's to fit tube**
- ❑ **Glue motor mount in place**
- ❑ **Check alignment !**

TRIM the edges of the F-10 spacers until the motor mount tube will fit in place as shown. The top of the motor mount tube should just touch the bottom of the tailboom. The spacers should be within 1/16" of the motor mount tube, but not touch it. This allows the motor alignment to be set entirely by the jig.

Apply epoxy to the spacers and set the motor mount tube and jig in place. Check that the jig is sitting flat on the tailboom and is aligned with the centerline. You can tack glue the jig to the boom with CA if you want. Wipe off any excess epoxy, and allow to cure. Remove the motor casing and jig.

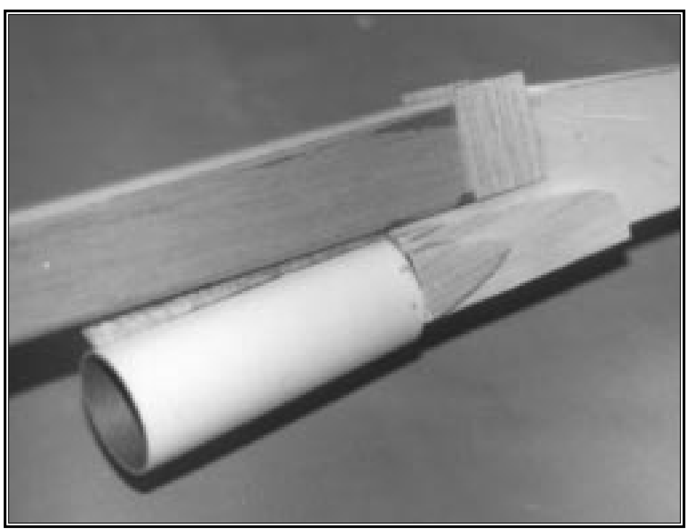


THE upper surface wing skins need to be trimmed away to clear the motor mount tube. Place the wing in position on the fuselage, and approximately mark the area to be removed. Begin trimming with a knife. The final shaping can be done with the motor casing wrapped in sandpaper as shown. Work carefully, and keep checking the fit of the wing to the motor tube and body. When you are finished, the wing should again fit properly in its saddle on the fuselage.

If you trim too much, the gap can be filled with microballoons and epoxy. Cover the motor tube with plastic wrap to protect it, apply the filler to the wing cutout and bolt the wing in place. After the epoxy has cured, remove the wing and trim the filler flush with the wing skin.

Trim wing to clear motor

- ❑ **Trim top of wing**
- ❑ **Check the fit often**



REMOVE the F-11, F-12 and F-13 filler blocks from the die cut balsa sheets. Glue in place as shown.

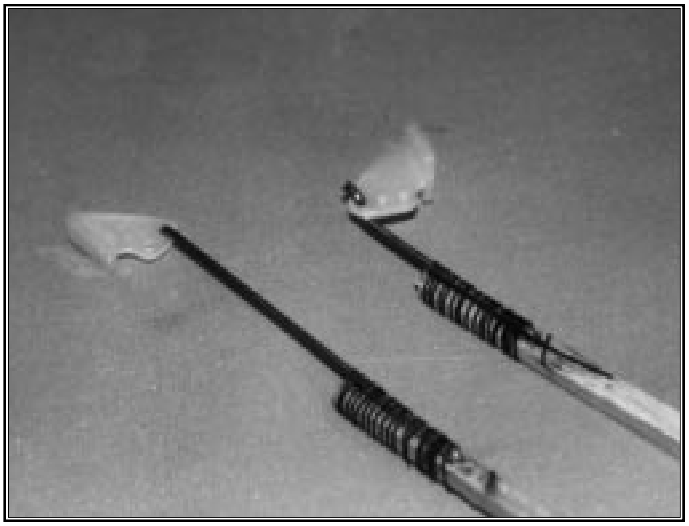
We prefer to glue these parts in place with a small amount of thick CA near the center of each part. Next, carve and sand the pieces to final shape. Be especially careful with the motor mount and lower tailboom area. A smooth, clean shape here helps to keep the motor exhaust away from the tailboom. Since there is no glue near the edges of the parts, it is easy to blend them into the body shape. Finally, flow thin CA around the edges of the parts to firmly attach them.

Tack glue the middle canopy block in place, then glue the forward canopy firmly in place.

Carve and sand the entire fuselage to shape as shown on the plans. Cut the middle canopy block loose.

Add blocks and shape

- ❑ **Glue filler blocks**
- ❑ **Glue canopy blocks**
- ❑ **Carve and shape fuselage**
- ❑ **Remove mid canopy block**



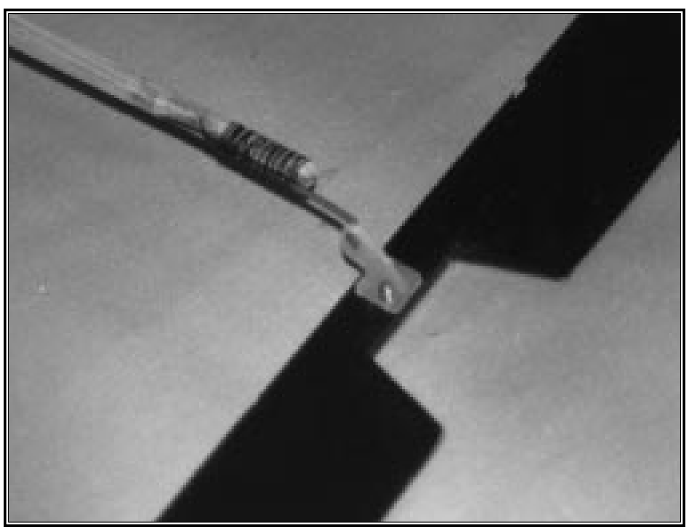
Assemble pushrods

- ❑ **Bend and cut the wire**
- ❑ **Glue and bind to pushrods**
- ❑ **Trim horns to length**

FIND the two 3⁄16" square balsa pushrods that you set aside earlier. Bend and cut the two pieces of 1⁄16" Z-bend wire as shown on the plans. There is not a lot of room in the back of the tailboom, so make the pushrods carefully. Drill the 1⁄16" hole through the pushrods. Glue the wire to the pushrods with CA. Wrap the ends of the pushrods with thread as shown. Saturate the thread with glue.

Trim the rudder and elevator horns to the length shown on the plans.

Phoenix uses wood pushrods for several reasons. First, and most important, balsa pushrods used in a model with a balsa fuselage will have essentially no change in trim with changes in humidity or temperature. Once you get the model trimmed out, it will stay trimmed. This is a big advantage on a model like Phoenix. Second, if you keep the pushrods straight, they will be very rigid, so you will have precise control at all speeds. The Phoenix tailboom and offset vertical tail were designed so the pushrods could be perfectly straight. Finally, the wood pushrods are very light.



Attach elevator horn

- ❑ **Cover the control surfaces**
- ❑ **Attach horn to elevator**
- ❑ **Hinge the control surfaces**

THIS is a good time to cover the elevator, rudder and the trailing edges of the horizontal and vertical tails. After all of the model is assembled, do the remainder of the covering.

Locate the position of the elevator horn as shown on the plans. The edge of the horn should be as close to the vertical stabilizer as possible. Drill the 1⁄16" holes for the mounting screws. Insert the two #4 x 3⁄8" sheet metal screws though the top of the elevator, and thread them directly into the nylon control horn. Install the elevator and rudder hinges using the same procedure as on the aileron hinges.

The small size of the Phoenix tail boom makes it difficult to use a normal clevis to connect to the horns. Instead we use a Z bend. All adjustments are made with the clevis on the servo end of the pushrod. To remove the pushrods, simply unscrew the control horns, and slide the entire pushrod out the back of the tailboom. The use of the #4 screws from the top of the elevator allows us to remove the elevator horn more easily.

Attach tail surfaces

- ❏ **Align horizontal tail**
- ❏ **Glue horizontal tail**
- ❏ **Align vertical tail**
- ❏ **Glue vertical tail**
- ❏ **Attach rudder linkage**

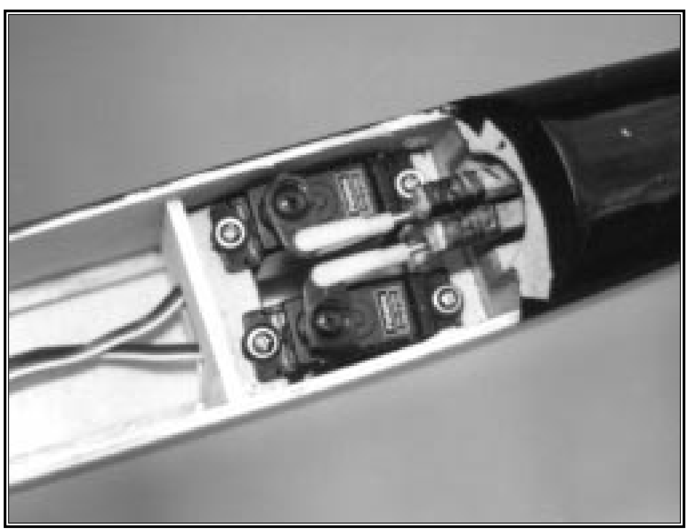
MOUNT the wing to the fuselage. Check the roll axis alignment of stabilizer and the wing. Sand the top of the boom until the tail is level. Glue the tail in place. Make sure the elevator hinge line is perpendicular to the boom centerline.

The vertical tail is mounted flush with the side of the tail boom, **not on the centerline.** This allows us to have a very strong attachment of the tail. The aft end of the F-1 tail-boom side will have to be trimmed as shown on the plans. Note the 1/16" clearance between the elevator joiner and the V-3 tailpost. You will have to trim away some of the lower 3/16" square stringer until the outer surface of the tailpost is flush with the side of the tailboom.

Carefully draw a centerline on the top of the horizontal tail. Glue the vertical tail in place. You should have a good bond to the side of the boom, the lower stringer, and the horizontal tail. Check that the tail is vertical and parallel to the center-line. Note that the tail is **not** parallel to the side of the boom!

Trim the bottom of the tailpost flush with the boom.

Install the rudder horn and pushrod as shown. Make sure the pushrods do not bind.



Install servos

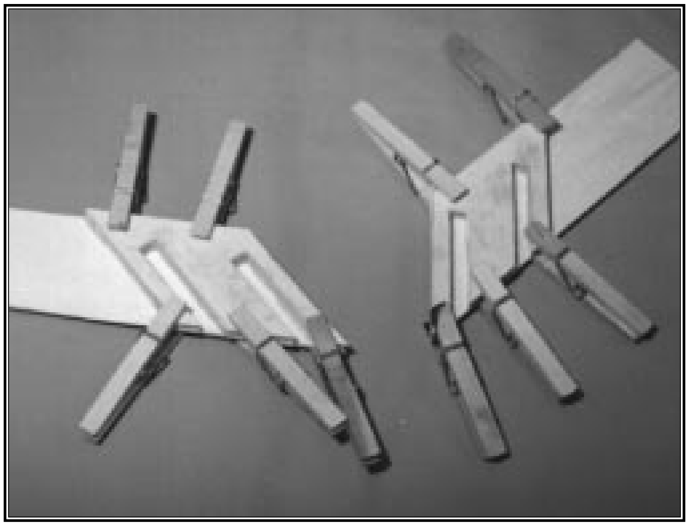
- ❏ **Trim pushrods to length**
- ❏ **Attach clevises**
- ❏ **Check control throws**
- ❏ **Mount servos**

SET the servos in place on the mounts. Trim a pair of servo arms so that only one arm remains. Attach a clevis to each servo arm. Hook up the servos to the radio, and center the trims. Install the servo arms and clevises.

Hold the elevator and rudder at neutral position with tape. Trim the front of the balsa pushrods off 1/4" in back of the clevises. Remove the elevator and rudder control horns and slide the pushrods out the back of the boom. Remove the clevises.

Thread the clevises onto the short 2-56 threaded rods. There should be about 1/8" of threads visible inside the clevis. Attach the threaded rod to the bottom of the pushrods with CA. Leave 1/4" between the back of the clevis and the end of the balsa as shown. Wrap the joint with thread and saturate with glue. Reinstall the pushrods and horns.

Check the control throws, and move the clevis on the servo arm as required. Trim off any excess servo arm. Position the servos so the arms are as close to the center as possible, and install the servo mount screws that came with your servos.



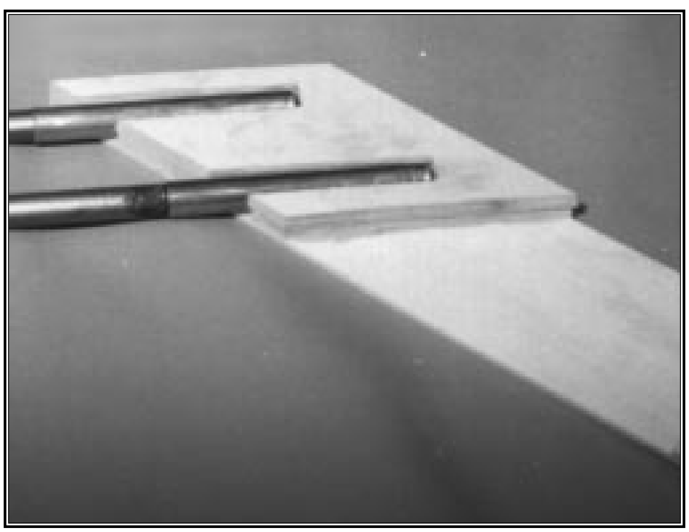
REMOVE all launcher parts from the die cut plywood sheets. Be careful when removing the eight L-2 parts, since the area around the slots is fragile. It is a good idea to use a knife to remove the parts from the sheets.

Lay the two L-1 parts on the bench. Be sure to orient them as shown so you make both a left side and a right side. Laminate four L-2's onto each L-1. This can be done with either epoxy or a thick CA glue. Make sure that the slots line up and are oriented as shown. While you are at it, laminate the four L-7 parts into 2 pairs of two layers each.

If you want, sand the edges of the laminations smooth. It doesn't make any difference in how well the launcher works, but it does look better.

Laminate launcher sides

- ❏ **Remove parts from sheets**
- ❏ **Laminate parts**
- ❏ **Make a left and a right**
- ❏ **Sand edges**



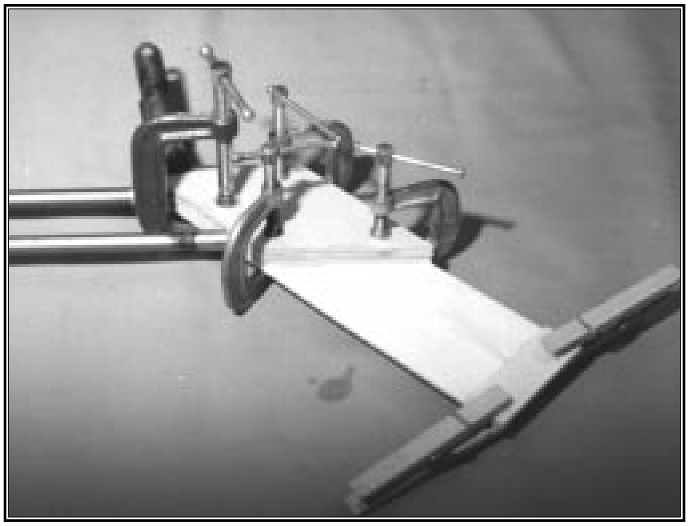
BEFORE you can continue, you will need to obtain 4 pieces of 3⁄8" diameter aluminum rod about 36" long. Aluminum rod is available from most good hardware stores in either 6 or 12 foot lengths. Take a piece of the 13⁄32" diameter by 3" long brass tube with you to the store to make certain that the aluminum rod is a smooth slip fit in the tubing.

Next, plug one end of each of the four 13⁄32" diameter brass tubes. Use a knife or file to sharpen one end of a tube by removing material from the inside edge to form a sharp bevel. Use this as a punch to cut four discs from 1⁄16" scrap balsa. Glue a disc into one end of each piece of brass tube with CA. The discs will keep the epoxy out of the tubes. Rough up the outside of the tubes with coarse sandpaper.

Lay the launcher sides on some waxed paper or plastic wrap. Slide the aluminum rods into the brass tubes. Glue the tubes into the slots in the L-2 parts with epoxy. Use enough epoxy to fill the voids between the tubing and L-1. Some epoxy will be squeezed out of the channel. It can be cleaned off later. Check that the rods are parallel before the glue sets. **Do not glue the aluminum rods in place.**

Install brass tubes

- ❏ **Obtain aluminum rod**
- ❏ **Plug ends of tubing**
- ❏ **Glue in place**
- ❏ **Make sure rods are parallel**



GLUE an L-3 on top of each L-2 stack. You might want to sand the edge of each L-3 nearest the rods before you glue them since it will be difficult to sand later.

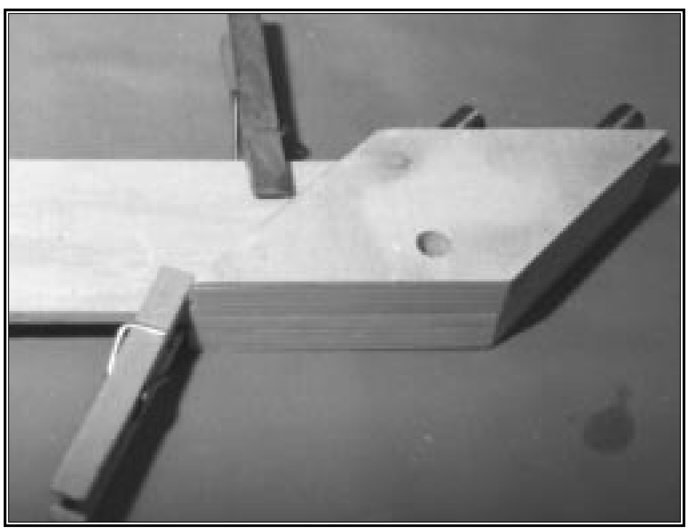
Fill the slots in the L-2's with epoxy. Microballoons can be used to thicken the epoxy to keep it from running. Coat the inside of each L-3 with epoxy and glue in place. Clamp the stack together until the glue cures. **Do not glue the aluminium rods in place!** Also note that the grain on the L-3 parts is parallel to L-1 grain.

This is also a good time to glue the L-4 parts in place.

Finish sides

Trim off the excess epoxy after everything is fully cured, and sand the edges of the stack.

- ❑ **Glue on L-3's**
- ❑ **Fill the slots with epoxy**
- ❑ **Glue on L-4's**



MARK the location of the ⅜" hole on one of the sides. The exact location is not too critical, but, you need to make sure to miss the brass tubes,and don't get to close to the edge of the part.

Tape or clamp the side assemblies together. Drill a ⅜" diameter hole through both sides for the pivot dowel. Try to keep the hole perpendicular to the sides. A"bradpoint" type wood drill makes a much cleaner hole than a conventional drill.

Drill for pivot dowel

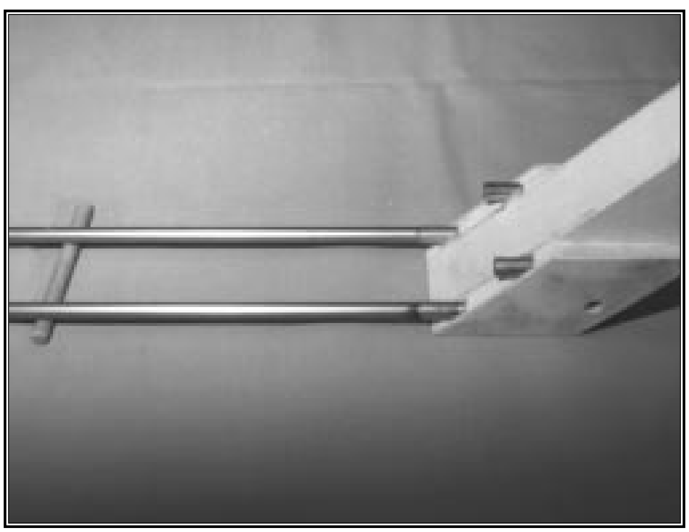
- ❑ **Layout location of hole**
- ❑ **Clamp sides together**
- ❑ **Drill hole**

Attach bulkheads

- ❑ Bevel ends of L-5 and L-6
- ❑ Glue in place

BEVEL the ends of part L-5 and the two L-6's as shown on the plans. Clean up the other edges with sandpaper.

Glue L-5 and the two L-6 's onto one of the sides as shown. Check to see that everything is square before the glue sets.



Attach second side

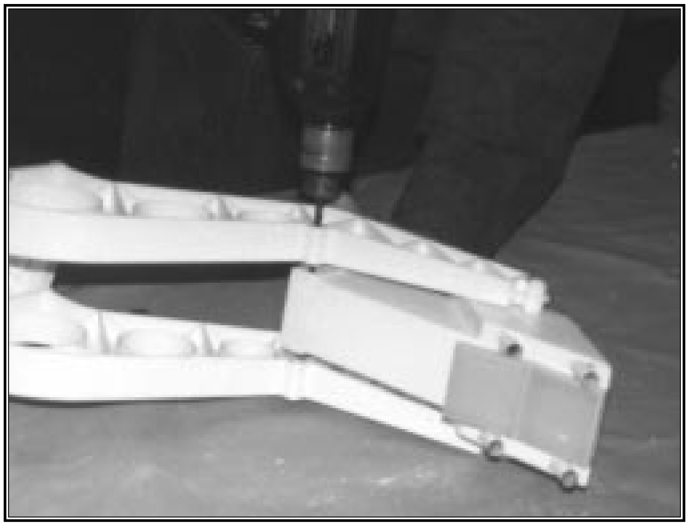
- ❑ Set up as shown
- ❑ Glue the side in place
- ❑ Keep rods parallel
- ❑ Glue the dowel in place

SLIDE an aluminum rod into the top tube of each side. Using the 3/8" dowel as a shim, set up the launcher as shown.

Glue the second side in place. Make sure the rods are parallel. Tape or pin the side in place while the glue dries.

If you want, this is the time to give the launcher a good final sanding. Also, sand the laminated L-7 parts smooth, and radius all the edges **except** the one that will be glued to L-6.

Radius the ends of the 3/8" dowel slightly. An easy way to do this is to chuck the dowel in an electric drill and sand the ends while it is spinning. Insert the dowel in the holes, make sure it is centered side to side, and glue it in place.



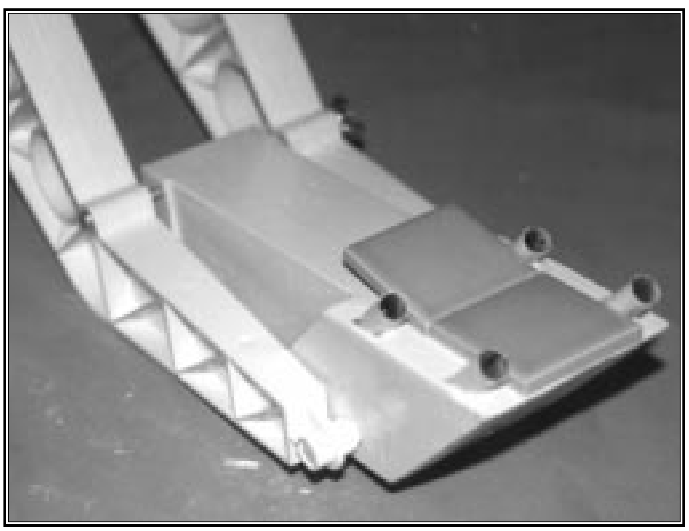
Drill elevation holes

- ❑ Insert launcher in Mantis™
- ❑ Drill holes as shown

IF you are going to use a Mantis™ base for the launcher, you need to drill holes for the elevation screw. First, note the location of the holes on the plans. Install the launcher adapter into the Mantis launcher by flexing the side supports apart and inserting the 3⁄8" dowel in the molded holes. Using the holes in the Mantis as a guide, drill the 2 sets of 3⁄16" holes. Unless you have an extra long drill bit, you will have to drill the hole in one side, flip the launcher over and then drill in from the other side. Insert a screw or dowel through the first holes to keep the parts aligned while you drill the hole on the other side.

The exact location of the holes is not critical, as long as the screw will fit and it is not too sloppy. The locations shown on the plans give launch elevations of about 45° and 60° respectively. The 60° setting is used for initial flights, while the 45° setting is better for “zoom” style launches once your Phoenix is trimmed out.

If you want to build your own launcher base, instead of using the Mantis base, a set of plans is provided in Appendix E.



Final assembly

- ❑ Glue on the L-7’s
- ❑ Coat with resin
- ❑ Install 3⁄16" shim
- ❑ Epoxy tiles in place

ASSEMBLE the entire launcher and your Phoenix. Set the Phoenix in the launcher, and center it carefully. Glue the L-7 parts in place on top of the launcher as shown on the plans. Allow about a 1⁄16" space between the L-7’s and the tailboom. Make sure the radius on the edges of the L-7’s is smooth so they do not scratch the finish on the model. These parts help guide Phoenix when launching in gusty weather.

Remove the launcher from the Mantis base. Give the entire launcher a good coat of finishing resin to seal the wood. If you want, you can apply extra resin, sand and paint. Just remember, you are building a rocket launcher, and it **will** get very dirty with use, so don’t go overboard! At least you don’t have to worry about adding too much weight!

Finally, glue the ceramic tiles in place with epoxy. Note the scrap 3⁄16" balsa shim under the lower tile. You might have to remove a paper or cloth backing from the tiles before you glue them in place.

THE main thing to remember when finishing your Phoenix is to keep it light! All of our prototypes have been covered with iron-on plastic film coverings. We prepare for covering by sanding the model with progressively finer paper, finishing up with 400 grit. Carefully vacuum the model to remove the dust. Just before covering an area, lightly wipe it with a painters "Tack Rag" to remove any remaining dust.

Use a cloth cover over the iron to prevent scratching the covering. Since all of Phoenix is sheeted with wood, we start adhering the covering near the center of the panel and work outwards in all directions, using care to avoid trapping bubbles of air. Once a piece of covering is fully attached, we go around the edges using an iron without the cloth cover. The extra heat available from the bare iron does a better job of sticking down the edges.

The area around the motor mount tube is tricky to cover. Use a number of small pieces of covering and work carefully, it can be done!

For the wings, we cover the upper surface, install the aileron servos and linkages, then cover the bottom surface. There is no wing servo access hatch except for the covering itself. If you need to remove a servo, just cut the covering away. Be especially careful near the wing leading edge. Any wrinkle could cause a substantial increase in drag.

We hold the canopy/hatch block in place with standard black electrical tape. It is simple, light and effective. If you want to do something fancier, go ahead, but make sure your latch is strong enough to hold the hatch on during launch! Use the enclosed plastic tube to run the antenna down the tailboom.

Finally, check the CG location. The position shown on the plans is for a complete Phoenix, with the motor casing, but without a propellant reload or nozzle installed. The range shown is where our prototypes balanced with no additional weight. If you need nose weight, use a larger battery pack. If your model is nose heavy, consider using a lighter radio system, and enjoy the extra performance of the lighter model!

Flying Phoenix

Introduction

NOW that your Phoenix is built, it is time for its first flight, and perhaps for your first Rocket Glider flight! Review the following sections closely, because they outline what you need to know to successfully fly Phoenix - from its first flight through its aerobatic and thermal flights. Even though you may be an experienced pilot - either with power planes or with gliders- there are a few unique steps to follow when flying rocket gliders and you need to be aware of them. **So read the following sections of the manual before your first flight.**

The information in this section comes not only from the 100 plus test flights of the various Phoenix prototypes, but from many years of teaching pilots of all skill levels how to fly rocket gliders. Learn from their experiences.

Launch Tower and Controller

IN addition to the model, you need a launch tower and an electrical launch controller to fly your rocket glider. Rocket gliders, especially Phoenix, must be launched from a tower to ensure a safe and controllable launch. The tower guides the model until it has reached a speed where the controls become effective. No other method will do. Next, the motors are designed to be ignited electrically, by an electrical launch controller - this provides for a safe, controllable launch.

In this kit we have included a semi-kit for the launch tower. A launch tower is the upper part of the launch system. It guides the model during the first critical seconds of launch. The launch tower must be supported by a base. You have two options. The first is to obtain the

AeroTech Mantis™ launcher. We like it because it is lightweight and disassembles for easy transport.

If you would rather build your own base for the launch tower, we've included the plans for a base that you can build from readily available parts. Refer to Appendix E for the plans for this base. Note that the launch tower that we've included works on both types of bases. So if you start with the base that you built yourself, you can easily upgrade it to the Mantis base at a later date.

An electrical launch controller and a battery are used to actually ignite the Phoenix motor. This combination provides a push-button, controllable method for the launch. The controller is essentially a "switch" to connect the battery to the igniter that you insert into the rocket motor (igniters are included with each AeroTech rocket motor).

For safe and easy operation, we suggest you use an AeroTech Interlock™ launch controller. First, it has a safety interlock switch - to help prevent your model from being launched accidentally. Next, it has an audible continuity indicator - so you know that all of the connections from the battery through the igniter are all set and ready to go. These two features - the safety interlock switch and the continuity indicator - should be in your electrical launch system for Phoenix, regardless of what you use.

AeroTech offers a starter set that includes both the Mantis launcher and the Interlock launch controller. This is an ideal way to get going. Information on both are included elsewhere in this kit.

In addition to the controller, you need a battery. The standard 12 Volt rechargeable batteries used to run model airplanes starters are ideal, but a car battery can also be used.

When you wire the final system, we suggest that the wires from the launch controller to the model be at least 30 feet long. This provides for more than enough space between whomever pushes the button and the model - for safety as well as for an ideal spot to watch the launch!

Test Glides

IF you have experience with test gliding other high performance RC gliders, you might want to consider giving your Phoenix a hand toss before you rocket launch it. Be careful, however, Phoenix is not an easy model to hand launch. It has a moderately high wing loading, and it is difficult to hold on to while throwing it. Just make sure that you launch it wings level, with the nose pointed slightly down and with adequate flying speed. Try to trim the model for a smooth fast glide. If the model is properly balanced (CG is in the correct place) and it is correctly built, a test glide is not essential. So, if you would rather not hand toss the model, go ahead and do the first flight with rocket power.

Launch Trim Setting

Phoenix requires a different trim setting for launch than it does for glide. Just like any other airplane, it requires a different elevator setting to fly fast than it needs to fly slow. You actually want to set the launch trim so that the wing will not produce any lift at all. This trim setting is the same as you would use for a vertical dive. It is also halfway between the settings for steady inverted flight and normal upright flight. While the actual trim settings will vary from one model to the next, approximate elevator positions are shown in the drawing. This should get you close enough for first flight.

Since there are two distinct trim settings required, it helps to set up your transmitter to make finding the setting easy. If you have a transmitter with programmable mixing, it is easy to set up a two position trim. Some transmitters designed for competition sailplanes have this as a standard adjustment. On a power plane transmitter, we typically will mix a small amount of the retract gear channel into elevator. We set the“gear down” position to produce no change in the normal elevator settings, while “gear up” puts in the appropriate amount of down trim for launch. Set the glide trim normally, while the boost trim is set either by the retract gear throw adjustment or the mixing adjustment. You could also use throttle or some other channel to mix with elevator.

If your transmitter does not have mixing, set up the launch trim to be full down elevator trim. Once the model is up and gliding, you can then pull in up trim to get the glide speed you want. Set the launch trim by adjusting the clevis on the pushrod. That way, you can easily and repeatably find the correct trim setting before launch.

Control Throws

The control throws shown on the plans are the ones that we have used. The high rate settings will give a very responsive model, especially at high speed during launch. We use exponential on all controls to allow both smooth flying and aerobatics without having to flip rate switches.

Motor Selection

For your first flights, obtain several AeroTech F13-RC reload kits. These motors were specifically designed for test flying Phoenix. They have enough initial thrust to get the model off of the launcher cleanly, but the sustain thrust is low enough to keep the maximum speed reasonable. They also produce very little smoke. This is an advantage for test flights, since you do not have to worry about flying the model to keep it from being hidden behind its own smoke trail. The F13 will give you a 400 to 500 foot launch altitude.

Preflight Inspection

It is a good idea to give your Phoenix a thorough inspection before your first flight. The CG should be in the range shown on the plans. Check the lateral balance and add weight to the light wing tip if required. Check all of the controls for direction, throw and accurate centering. Do a pull test on all of the control surfaces to make sure the hinges are properly installed. Make sure the model is structurally sound, and has not been damaged. It is much better to find any problems on the ground than it is at 100 mph in the air!

Pre-Flight Check List

Radio On

Controls Check

Trim check

Wind

Visibility

Traffic

Continuity

Announce launch

5 Second Countdown

First Flight

Once your Phoenix is finished and the launch equipment is ready, it is time for your first flight. Pick a day with winds under 10 mph. You will need an assistant to operate the launch controller so you will be able to dedicate your attention to flying the model. **For first flights it is a very good idea to stand at least 100 downwind from the launch pad.** You should be looking at the top of the model while it is on the launcher. Standing this far back will give you much better visibility. If your Phoenix is out of trim and pitches up after launch, it is very difficult to fly the model if it goes behind you! Also by being far away from the model, it makes it less likely that the motor's smoke trail will be in the way and prevent you from seeing the model.

Set up the launcher so it points upwind. If you are using the Mantis base, set the launch elevation at the 60° position. When we fly from a normal RC power field, we set up near the upwind end of the runway, on the edge closest to the pit area. Check with the field or safety officer in your club to select the best launch area. Next, set up your launch controller and battery. Finally, load the RMS motor and install it in the model. Perform one last check of the radio, and make sure the elevator trim is set to the launch position.

Install your Phoenix in the launch tower, make sure the controller safety interlock is in the “safe” position, and hook up the igniter clip. Check continuity with the launch controller. Your assistant should verify that you are ready to launch. Check for low flying aircraft. If there are people in the area announce verbally that you are launching. We use a preflight check list to make sure we didn't forget anything.

CHECK the controls one more time. Your assistant should give a 5 second countdown, and press the launch button.

It will take a fraction of a second for the igniter to fire. Your Phoenix will accelerate out of the launcher at 5 g’s. During the first half second, while the thrust is high and the airspeed is low, the flight path is mostly determined by the launcher angle, the motor position on the model and the wind. If there is no wind, your Phoenix will probably pitch up slightly. If there is some wind, it will pitch down slightly into the wind. At the end of the first second, Phoenix will be at 50 feet altitude moving at 60 mph.

Phoenix launch with F13-RC

After the first second, any errors in the launch elevator trim will show up as a tendency to pitch up or down. Try to fly your model in a straight climb at approximately a 60° climb angle. The motor will burn for about 4 1/2 seconds, and at burnout Phoenix will be moving about 90 mph. While this is about the speed of a pattern plane, the fact that you are going nearly straight up and got there in a few seconds will make it seem a lot faster! Avoid rolling during early flights until you are comfortable with the visibility and the perspective. It is easy for new pilots to accidentally roll the plane and become disoriented.

AFTER the motor burns out, Phoenix will continue to coast vertically for a few more seconds as it slows down. When the model slows to glide speed, change your elevator trim to the glide position. You might want to have a friend remind you to change to glide trim at the top of boost. Even after hundreds of rocket glider flights, we occasionally wonder why the model is gliding so fast, only to realize that it is still set for launch trim!

Now, spend some time getting the feel of your airplane. Adjust the trims as required, try some turns, and a few stalls. Get set up for landing. Phoenix has a good glide ratio, especially at moderate speeds. Even very experienced sailplane pilots have overshot their first landings with Phoenix, so allow plenty of room!

After you land, think about how your model flew under power and adjust the elevator launch trim to compensate. If you are using mixing to provide the trim change, make the correction in the transmitter. (Remember to allow for any changes you made in the glide trim setting also, since the changes are cumulative!) If you are using the full down trim method, make the adjustment with the clevis at the elevator servo. It will probably take you a few flights to get your Phoenix fully trimmed.

Once trimmed, your Phoenix should fly nearly hands off under power. We have done some boosts without even touching the transmitter sticks! Of course, you will generally have to fly the model to compensate for gusts and turbulence.

Other Phoenix Motors

Once you have gotten familiar with your Phoenix and it is trimmed out, you should definitely try the other RMS-RC reloads available. The G12-RC will provide initial launch performance similar to the F13’s that you have been using. The difference is that it burns twice as long and you will go twice as high! Launch altitude will be about 1000 feet. The distance that you should stand back from the launcher depends upon the power of the engine. The bigger the motor, the higher it will go, so the farther back we stand.

With the long burn G12, you can actually get slightly higher launch altitudes by doing a "zoom" launch. Set your launcher to 45° elevation. Once you leave the launcher, climb out at an angle of 30° or so. This will allow the model to accelerate to a higher speed than it would in a vertical climb. After about 3 seconds, smoothly pull up to a vertical climb. After burnout, when Phoenix slows down do a 1/4 inside loop to inverted, followed by a 1/2 roll to a normal upright glide (similar to an Immelman turn). This gives the best launch altitude possible.

White Lightning launch

AeroTech will also be providing "special effects" reload kits in the near future. The White Lightning™ reload produces a white smoke trail and a large bright exhaust flame, as shown on the box cover. This motor has higher average thrust and higher launch speeds. Make sure you are comfortable with flying your Phoenix on the F13 and G12 before trying the White Lightning!

The BlackJack™ reload will have a dense black smoke trail. Its thrust characteristics are such that the model will sit on the pad for a couple of seconds after ignition, start accelerating moderately slowly, and then really move out! With both of these motors, you have to fly Phoenix so your line of sight is not obscured by the motor's smoke trail.

Aerobatics

Phoenix can do any aerobatic maneuver that can be flown by a glider. We have done loops, rolls, Cuban eights, stall turns, 4 point rolls and even a rolling circle! Phoenix has been carefully designed and, if correctly built, it will handle launch loads and all maneuvers while gliding. So try your favorite aerobatic maneuvers during glide and have fun! We have done a 900 foot vertical dive followed by a full up elevator loop. We also like to do rolls during the last few seconds of the launch. At high speed, Phoenix has a very fast roll rate!

Thermalling

On the slightly more sedate side, Phoenix can also be thermalled for long flights. Don't expect Phoenix to out float your 2 pound, 100" thermal glider, but if flown properly, it has very good performance. The main thing is to keep the speed up while thermalling. It is quite easy to fly too slow. Try to do a smooth flat turn of moderate diameter. While you can fly with ailerons only, we get the best results by holding rudder into the turn, with ailerons at neutral or slightly opposite to help hold up the inside wing. Phoenix has a very good high speed cruise when it is time to find the next thermal.

Whatever you do with your Phoenix, we hope you have as much fun with yours as we have had with the prototypes! (Those hundreds of test flights took a lot of time, but somebody had to do it!)

Please let us know what you think of your Phoenix. We welcome all of your comments and suggestions.

Thanks again for choosing Phoenix!

OFFICIAL AMA SAFETY CODE
JANUARY 1, 1992

Model flying MUST be in accordance with this Code in order for AMA Liability Protection to apply.

GENERAL

1) I will not fly my model aircraft in competition or in the presence of spectators until it has been proven to be airworthy by having been previously, successfully flight tested.

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

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

4) If my model weighs over 20 pounds, I will only fly it in accordance with paragraph 5 of this section of the AMA Safety Code.

5) At air shows or model flying demonstrations a single straight line must be established, one side of which is for flying, with the other side for spectators. Only those persons essential to the flight operations are to be permitted on the flying side of the line; all others must be on the spectator side. Flying over the spectator side of the line is prohibited, unless beyond the control of the pilot(s). The only exceptions which may be permitted to the single straight line requirement, under special circumstances involving consideration of site conditions and model size, weight, speed and power, must be jointly approved by the AMA President and the Executive Director. In any case, the maximum permissible takeoff weight of models is 55 pounds.

6) I will not fly my model unless it is identified with my name and address or AMA number, on or in the model. Note: this does not apply to models flown indoors.

7) I will not operate models with metal-bladed propellers or with gaseous boosts, in which gases other than air enter their internal combustion engine(s); nor will I operate models with extremely hazardous fuels such as those containing tetranitromethane or hydrazine.

8) I will not operate models with pyrotechnics (any device that explodes, burns, or propels a projectile of any kind) including, but not limited to, rockets, explosive bombs dropped from models, smoke bombs, all explosive gases (such as hydrogen-filled balloons), ground mounted devices launching a projectile. The only exceptions permitted are rockets flown in accordance with the Safety Code of the National Association of Rocketry or those permanently attached (as per JATO use); also those items authorized for Air Show Team use as defined by AST Advisory Committee (document available from AMA HQ). In any case, models using rocket motors as a primary means of propulsion are limited to a maximum weight of 3.3 pounds and a G series motor. Note: A model aircraft is defined as an aircraft with or without engine, not able to carry a human being.

9) I will not fly any model using turbojet power (axial or centrifugal flow) unless I have obtained a special waiver for such specific flights from the AMA President and Executive Director and I will abide by any restrictions imposed on such flights by them. (Note: this does not apply to ducted fan models using piston engines or electric motors.)

RADIO CONTROL

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

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

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

4) I will operate my model using only radio control frequencies currently allowed by the Federal Communications Commission. (Only properly licensed Amateurs are authorized to operate equipment on Amateur Band frequencies.) Further, any transmitters that I use at a sanctioned event must have a certified R/CMA-AMA gold sticker affixed indicating that it was manufactured or modified for operation at 20 kHz frequency separation (except 27 MHz and 53 MHz).

FREE FLIGHT

1) I will not launch my model aircraft unless at least 100 feet downwind of spectators and automobile parking.

2) I will not fly my model unless the launch area is clear of all persons except my mechanic and officials.

3) I will employ the use of an adequate device in flight to extinguish any fuses on the model after it has completed its function.

CONTROL LINE

1) I will subject my complete control system (including safety thong, where applicable) to an inspection and pull test prior to flying.

2) I will assure that my flying area is safely clear of all utility wires or poles.

3) I will assure that my flying area is safely clear of all non- essential participants and spectators before permitting my engine to be started.

Rocket Glider Safety Code

In addition to the normal AMA Safety Code, a Radio Control Rocket Glider (RG)must be flown in accordance with the following:

1) An RG shall be propelled only by commercially-made rocket motors used in the manner recommended by the manufacturer. A person shall not alter the rocket motor, its parts, or its ingredients in any way.

2) An RG shall not weigh more than 1,500 grams (53 ounces) at lift off and its rocket motor shall produce no more than 160 newton-seconds of total impulse. An RG shall weigh no more than the motor manufacturer's recommended lift off weight for the motor used, or motors recommended by the manufacturer for the RG shall be used.

3) An RG shall be launched outdoors in an area free of tall trees, power lines or buildings that might be a hazard to its flight. The launch area shall be clear of dry brush and grass.

4) An RG shall be launched from a stable launching device that provides rigid guidance until the RG has reached a speed adequate to ensure a safe and predictable flight path.

When not in use on the launch field, a launching rod assembly whose free end is below eye level shall be capped to prevent accidental eye injury or the user shall cap the rod with his hand when approaching it.

A launch rod assembly that is stored shall be disassembled or capped to prevent accidental eye injury. A launch rod assembly shall not be stored in a vertical position with its free end at or below eye level.

An RG launching device shall have a jet deflector to prevent the motor exhaust from hitting the ground directly.

The area within a radius of 5 feet around the launcher shall be cleared of brown grass, dry weeds, or other materials that are easily ignited.

5)The system used to ignite an RG rocket motor shall be remotely controlled and electrically operated. It shall contain a launching switch that will return to the "off" position when released. The system shall contain a removable safety interlock in series with the launch switch that will prevent electricity from reaching the igniter until the safety interlock is inserted in the system.

All persons shall remain at least 30 feet from an RG being launched.

Only the electrical igniter recommended by the rocket motor manufacturer shall be used to ignite an RG rocket motor.

The electrical launch system and the igniter shall be capable of igniting the RG rocket motor within one second of actuation of the launching switch.

6)All persons within 100 feet of the launcher shall be made aware of the pending launch of an RG before the person launching the RG begins an audible five-second count-down.

If a misfire occurs in an attempt to launch an RG, person shall not approach the launcher until the safety interlock key has been removed from the igniting system and one minute has passed since the ignition attempt.

7) A person shall not launch an RG when the wind is 20 miles an hour or more.

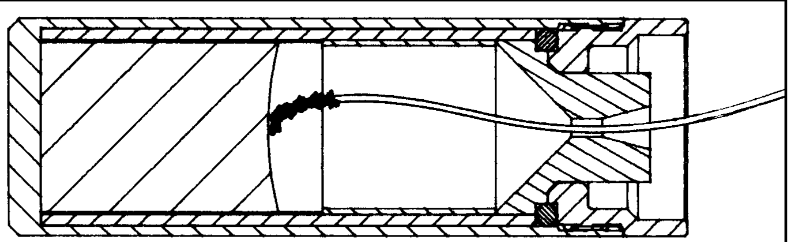
A person shall not launch an RG so it flies into clouds, near aircraft in flight, or in a manner that is hazardous to people or property.

8) When conducting flight tests with unproven RG designs or methods, the person shall conduct the testing in complete isolation from persons not participating in the launching.

9)An RG launch device shall not be capable of launching an RG at an angle less than 45 degrees from the horizontal. A person shall not launch an RG at an angle less than 45 degrees from the horizontal.

ROCKET motors are a very different animal than a typical gas or electric model airplane engine. Here is a bit of information on the Phoenix motors, what they are and how they work. You do not have to know any of this to fly Phoenix, but we thought that some of you would be interested.

First of all, while normal model airplane engines are rated in terms of power, either horsepower or watts, rocket motors are rated in what is called “total impulse”. Total impulse is measured in “pound-seconds”. A motor with 1 pound of thrust and a burn time of 1 second has 1 pound-second of total impulse. A motor with .1 pound of thrust and a 10 second burn and a motor with a 4 pound thrust and a 1/4 second burn also have one pound second of impulse. Most small rocket motors are actually rated in the metric system. The metric equivalent of the pound-second is the “Newton-second”. There are 4.45 newtons in a pound.



RMS-RC 32/60-100 Motor with F13-RC reload

If we are flying a spacecraft somewhere out in deep space, with no significant air or gravity effects, then firing any of the three motors will have the same effect. For example, if our spacecraft weighs one pound, then firing the motor will increase its speed by about 32 feet per second, about 22 miles an hour. Note that it does not matter if we have a lot of thrust for a short time or a low thrust for a long time. If the total impulse is the same, it has the same effect on speed of our spacecraft.

Things are different when we are launching from the ground here on planet Earth where we have both gravity and air drag to contend with. If Phoenix weighs about 1.5 pounds, and we use a motor with a thrust of less than 1.5 pounds, the model will never even leave the launcher. On the other hand, if we use a really high thrust motor, then we are likely to leave the wings behind on the launch pad! What we need to do is design an appropriate motor that has enough thrust to fly the model, while still keeping everything attached.

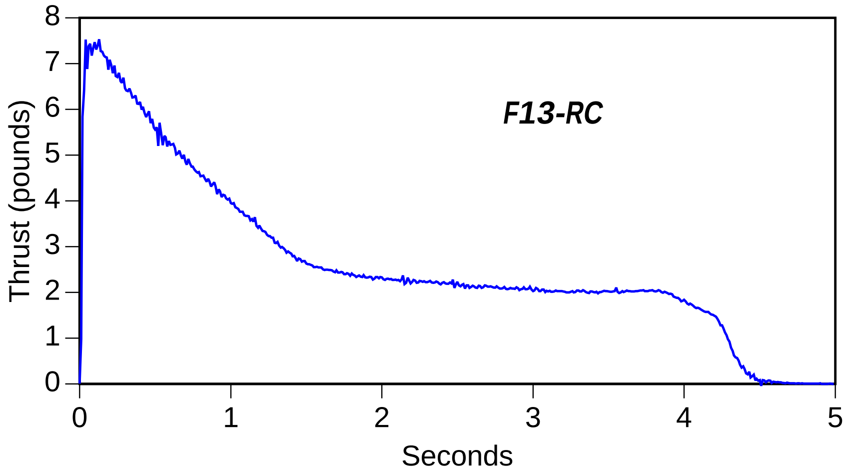
Fortunately, we have a bit more control of the motor performance than just setting a thrust level and a burn time. By specially shaping the propellant, we can get a motor that has extra thrust to help get the model moving and quickly get it up to a speed where the controls are effective. We then let the thrust decrease down to a level where we can get a nice climb at a reasonable speed.

THE performance of a motor is generally shown in what is called a thrust-time curve, which is just a plot of thrust versus time. If we calculate the area under the curve, in units of thrust and time, then we have the total impulse. This is easy if the curve is a simple rectangle, with constant thrust. If the thrust varies, we either work harder to figure the area, or program a computer to do it for us. From the curve, we can also find some other interesting information, such as the peak thrust (so we know how strong to make the wings!) and the burn time.

Just like model airplane engines are grouped into size categories by displacement, small rocket motors are grouped by total impulse. Each size category doubles the impulse of the previous size. The Phoenix motors are designed to fall into the “F” class (40 to 80 newton seconds) and the “G” class (80 to 160 newton-seconds). The letter designation is followed by a number indicating the average thrust in Newtons. Thus an F5 would have about one pound of thrust (5 Newtons) on the average, and would burn for 8 to 16 seconds. An F80 would average about 16 pounds of thrust and burn for one half to one second.

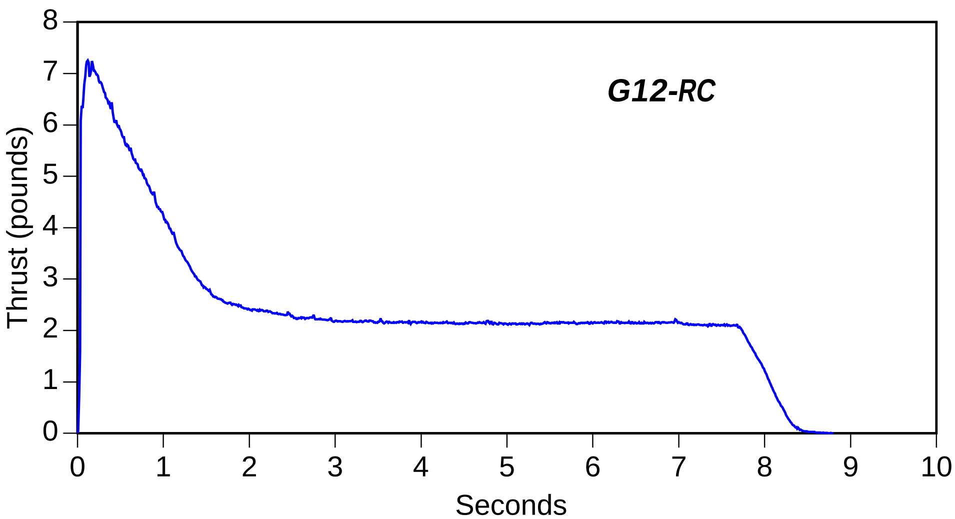
TYPICAL small rocket motors used in model rockets are designed to allow the model to coast for a few seconds, and then deploy a parachute or other recovery device. The motors contain devices called a delay charge and ejection charge to actuate the parachute at the preset time. The length of the time delay is indicated by another number in the motor designation. Thus, an F80-5 would have a 5 second delay time.

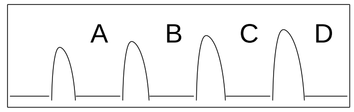
Phoenix is radio controlled, and we just fly it into a glide whenever it slows down. No built in delay time is required. The motors are designated something like “F13-RC”, where the RC stands for “radio control”. The lack of the delay and ejection charges is the reason you cannot use a Phoenix motor in a conventional model rocket. If you use a conventional model rocket motor in Phoenix, the ejection charge will damage the model.



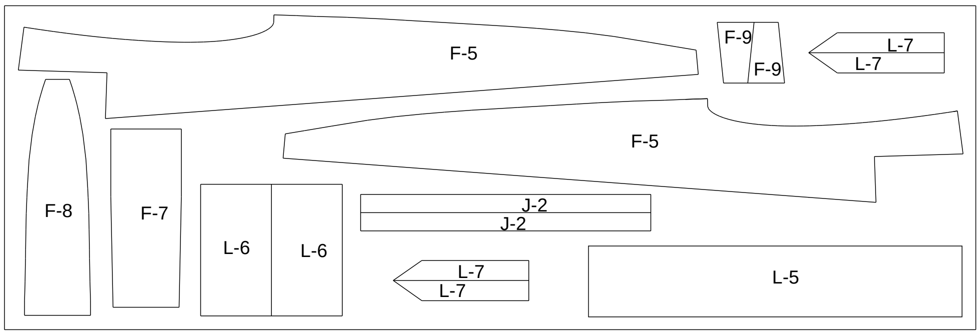
WE have included typical thrust-time curves for some of the Phoenix motors. The F13-RC is specifically designed for a low cost per flight. It is also the reload kit to use for initial flights. Its total impulse of 60 newton seconds will launch a typical Phoenix to about 500 feet in altitude, about the same as you would get from a typical hi-start launch. (Your mileage may vary.) It has an initial thrust of 7 to 8 pounds. This gives an initial acceleration of about 5 g’s to get the model up to flying speed. The thrust then decreases to about 2 pounds (sustain thrust) to give a nice steady climb.

THE G12-RC is designed for high performance flying once your Phoenix is trimmed out, and you have some experience flying it. It is basically the same motor as the F13, but it has a longer propellant charge to give a longer burn time and more altitude. A typical Phoenix will reach about a 1000 foot altitude on a G12. The impulse on the G was selected to launch Phoenix to about the highest altitude where you can see it well enough to still fly it. Why does the G12 have a lower thrust than the F13 even if it has more total impulse? Well, the both the peak thrust and the sustain thrust are the same on the two motors, but the G spends much more time at the sustain level, so the average thrust is lower.

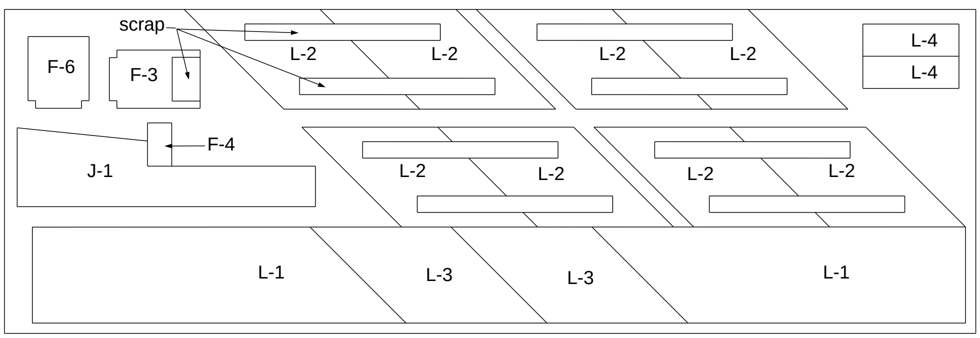




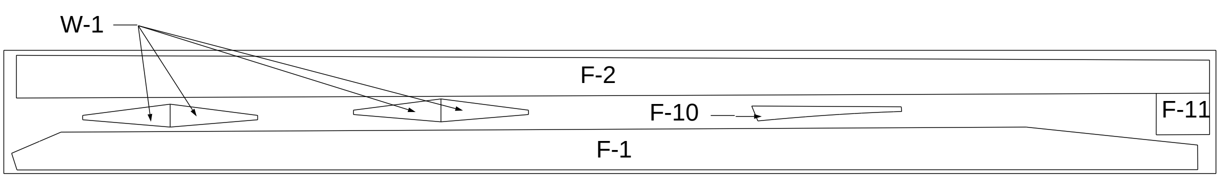
Die cut plastic leading edge templates 1 per kit



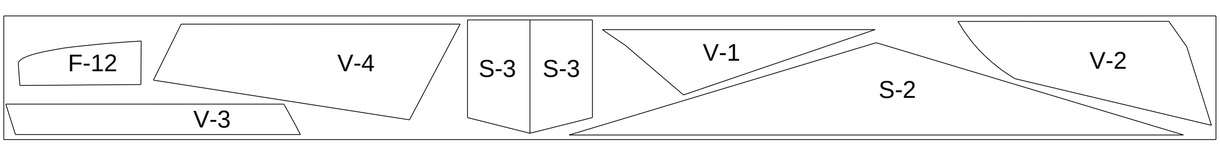
Die cut plywood 1/8" x 8" x 24" 1 per kit



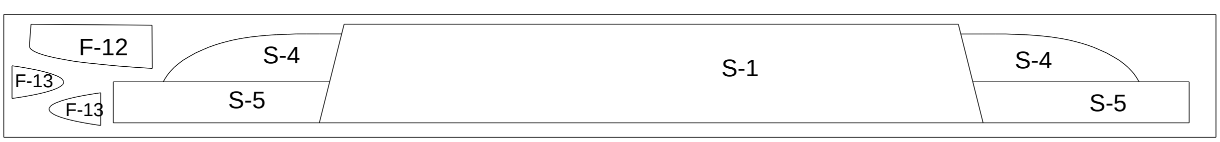
Die cut plywood 1/8" x 8" x 24" 1 per kit



Die cut balsa 3/32" x 3" x 30" 2 per kit



Tail surface and fuselage parts.
Cut 1 set from 3/16" x 3 " x 30" using die cut template supplied



Tail surface and fuselage parts.
Cut 1 set from 3/16" x 3 " x 30" using die cut template supplied

Sheet and strip balsa

10	wing skins	1/16 x 3 x 24 in.
2	Tail sheets	3/16 x 3 x 30 in.
2	Tail boom die cut sheets	3/32 x 3 x 30 in.
2	leading edge	3/16 x .4 x 24 in.
4	aileron le/wing te framing	3/16 x .4 x 9 in.
1	elevator joiner	3/16 x 1/2 x 12 in.
8	stringers/pushrods	3/16 x 3/16 x 30 in.

Cut balsa blocks

1	nose block
2	wing tip blocks
1	fwd canopy block
1	mid canopy block
1	aft canopy block

Other wood parts

2	plywood die cut sheets	1/8 x 8 x 24 in.
1	wing mount dowel	3/16 dia. x 3 in.
1	basswood servo rail	1/4 x 3/8 x 6 in.
1	launcher dowel	3/8 dia. x 4 in.

Other

1	left wing core
1	right wing core
1	1/2” x 13 ft. fiberglass tape
1	6” x 20” fiberglass
2	die cut cardboard templates
1	die cut plastic LE template
2	ceramic tile for jet deflector

Hardware

4	small control horns
6	small snap clevis
2	1/16" dia. Z bend wire
2	2 1/2” 2-56 threaded rod
2	1” 2-56 threaded rod
4	13/32" x 3" brass tube
1	# 6 blind nut
6	2-56 screws for control horns
8	#2 Allen sheet metal screws for wing servo mounts
1	ball end Allen wrench for #2 screw
1	Plastic antenna tube
1	6-32 x 1” nylon wing bolt
2	#4 sheet metal screws for elevator horn
13	hinges

Rocket motor package

1	RMS-RC 32/60-100 Rocket motor
1	motor mount tube
1	motor liner tube
1	Rocket motor instructions

Documents

1	instruction manual
1	plans
1	registration card

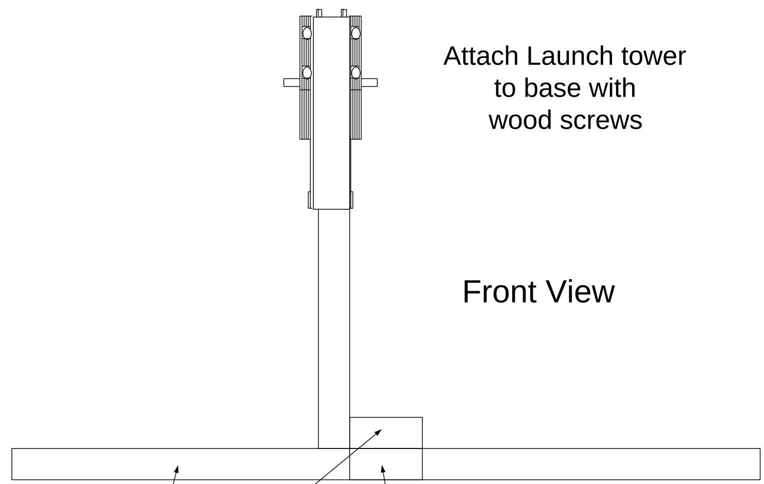
2 x 4 Launcher Base

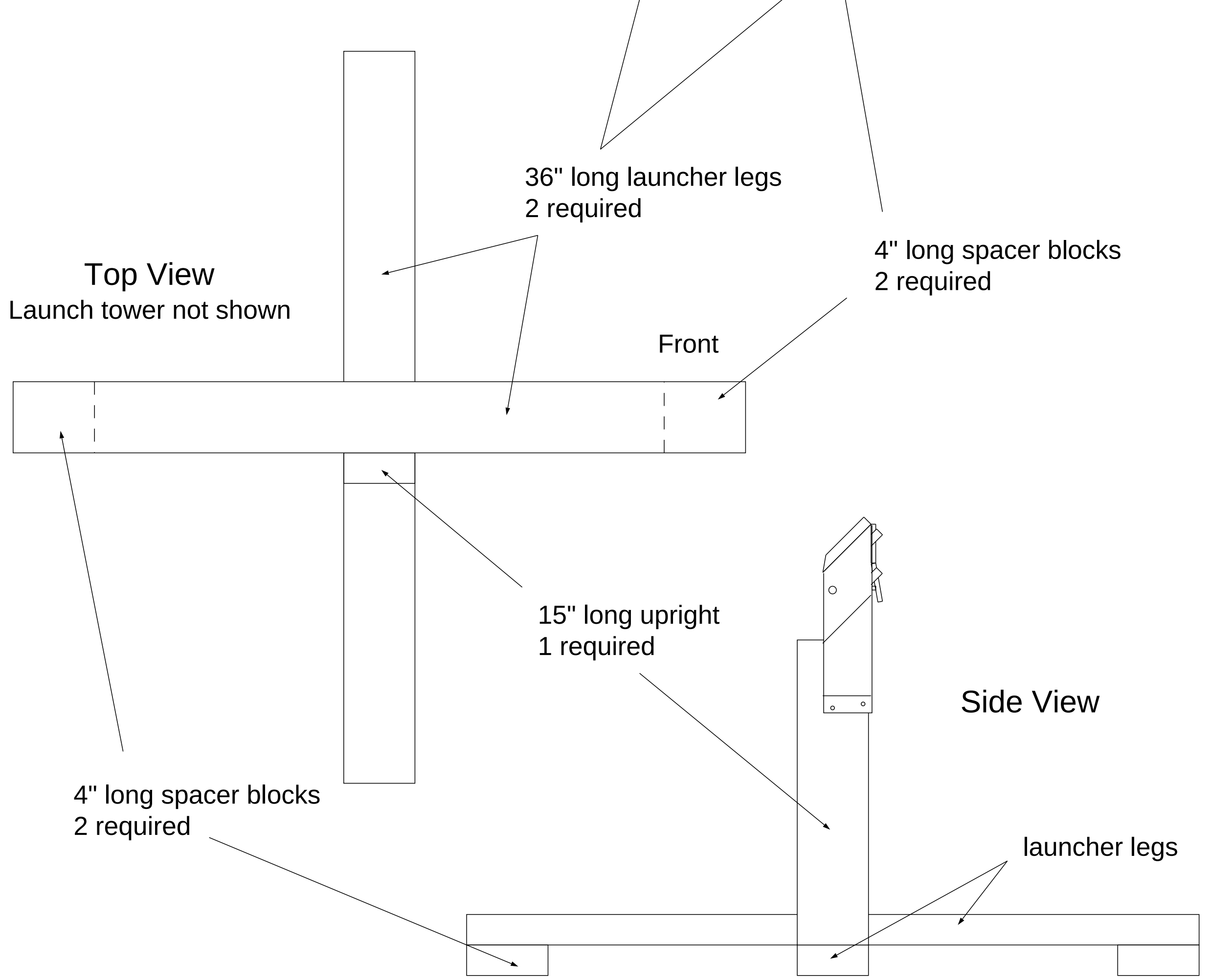
Not to scale

Assemble all parts with
wood screws and glue

Materials:
8 feet of 2 x 4 lumber
wood screws
wood glue (TiteBond or equiv.)

Cut 2 x 4 as follows:
2 pieces 3' long
1 piece 15" long
2 pieces 4" long





Epoxy and Vacuum Bagging Supplies:

Both of these companies can supply vacuum pumps and low viscosity epoxys for applying the Phoenix wing skins. They each have a low cost vacuum bagging starter set with pump, plumbing, and vacuum bag material.

Composite Structures Technology
P.O. Box 4615
Lancaster, CA 9353
(805) 723-3783

Aerospace Composite Products
P.O. Box 16621
Irvine, CA 92714
(714) 250-1107

3/8" Aluminum Rod for Launch Tower:

We have generally been able to find the aluminum rod in either a 6' or 12' length at a good hardware store. We have used anodized rod from the following companies:

Macklanburg-Duncan
4041 N. Santa Fe
Oklahoma City, OK

Futura Home Products
Freeport Center
Clearfield, UT 84016
(800) 824-2049
(part number HM 1203EA)

You could also try calling aluminum suppliers in your area.

Other matierials may be substitued for the aluminum rods mentioned. We have used some .325" diameter high quality aluminum tubes that are made for tent posts. Fibreglass rod or tubing of an appropriate diameter will also work. Music wire ($^{7}/_{32}$" or ¼" diameter) is acceptable, but you will have to be very careful to clean and oil it after every flying session to prevent corrosion. We do not suggest using wood dowels. The wood is not as strong or as stiff as the other options mentioned. It is also very difficult to find dowels that are not bent.

If you use some other type of rod, modify the launcher to keep the spacing between the rods approximately the same as is shown on the plans.

1955 South Palm St.
Suite 15
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(800) 752-8018
(702) 641-2301

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