

HD HOLVERSON
DESIGNS, INC.

Silver Hawk™

cat# HD12002

FLYING MODEL ROCKET KIT

**LASER-CUT
BALSA**



requires assembly
skill level 3
average experience

high efficiency
"flying wing"
glider needs no tail

straight boosts
and long, slow,
leisurely glides

oversized pop-pod
for easy prepping

special building jigs
for easy, worry free
construction

easy to follow plans
are designed to be
filed and collected

diameter: 19mm (.74")
length: 33.8cm (13.5")
span: 33cm (13")
net weight 21g (.75oz)
flight weight 29g (1oz)

recommended engines:
1/2A3-2T (first flight)
A3-4T

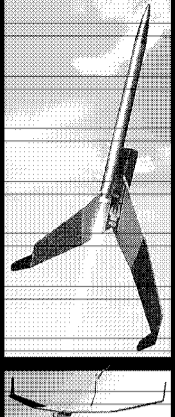
predicted altitudes:
1/2A3-2T: 37m (120')
A3-4T: 64m (210')

**made
in the
USA**

©1999 holverson designs, inc., all rights reserved

975
kit2002

Holverson Designs, Inc.
25075 CO HWY L20 • Soldier, IA 51572
<http://www.pionet.net/~holverson>



Silver Hawk™

HDI2002

Skill Level 3



HOLVERSON DESIGNS, INC.

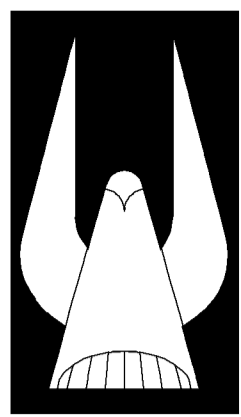
length: 34cm (13.3") • span: 33cm (13") • diameter: 19mm (.74") • net weight: 21g (.75oz)

recommended engines: 1/2A3-2T (first flight), A3-4T

predicted altitudes: 1/2A3-2T: 37m (120'), A3-4T: 64m (210')

Thank you! We would like to thank you for purchasing this Holverson Designs flying model rocket. We hope that you enjoy building and flying this model as much as we have. Please let us know if you like your kit, or if you have any questions or need technical advise. Contact us at: Holverson Designs, Inc. 25075 CO HWY L20, Soldier, Iowa 51572 or <http://www.pionet.net/~holvrson>.

This instruction sheet is laid out to allow you to start a rocket plans reference file. Save your entire set of instructions for future reference.



st2002

335

your new Silver Hawk™

is an efficient tailless sport boost-glider. Read the building instructions first. Become familiar with the names of the parts using the exploded view below. Check to make sure that all parts are included in this kit. Test fit all the parts before applying glue.

before flight

Read the trimming for flight procedure thoroughly. Follow the test glide and balancing steps exactly to ensure the best flight performance.

what is a boost glider?

The National Association of Rocketry (NAR) defines a boost glider as a model rocket with a portion that returns to the ground in a stable gliding flight supported by aerodynamic lifting surfaces which sustain that portion against gravity.

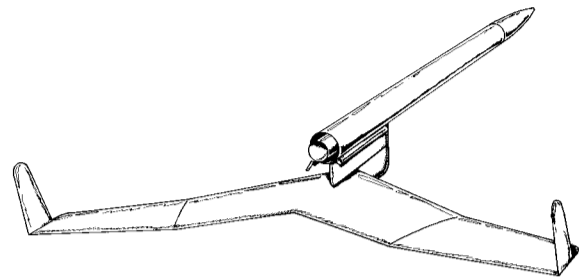
why is Silver Hawk™ unique?

You will discover that model rocketeers use many recovery devices to ensure that their model returns safely to earth for another flight. A boost glider is an exciting and challenging method since it combines the art and sciences of both rocketry and aerodynamics in one design.

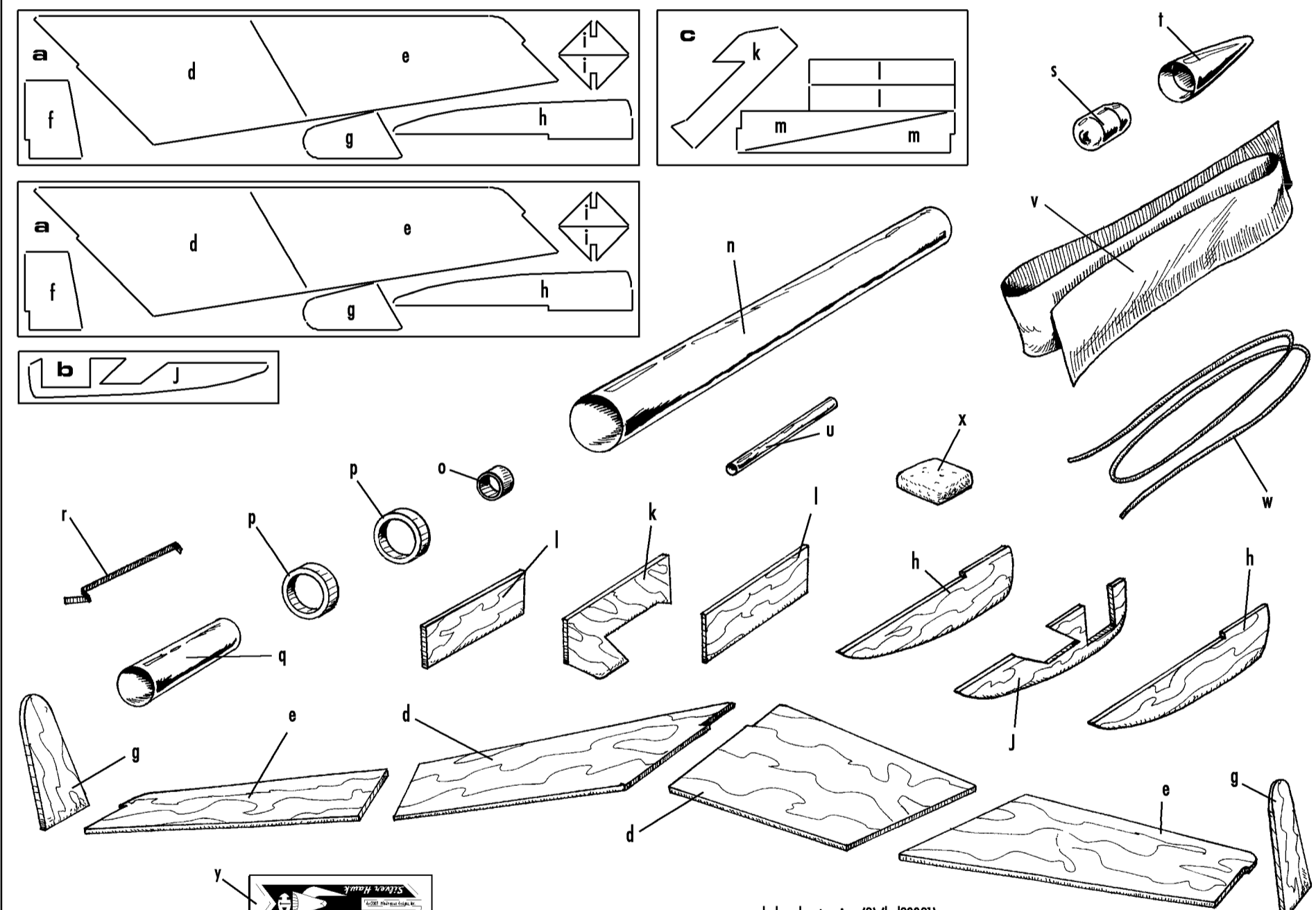
The Silver Hawk™ is even more unique because of its tailless "flying wing" design. Instead of having separate stabilizers, the outer wings are slightly inclined, combining both lift and stabilization. This is based on the concept of wing washout developed by aviation pioneers such as the Horten Brothers in Germany and Jack Northrop in the United States. The Silver Hawk™ eliminates the weight and drag penalties of a long boom and tail.

Ascending like a rocket and returning via lifting wings poses several challenging tasks for you as a rocket modeler. The balancing of lifting and gravity forces to allow a conventional boost to altitude, then a transition to gliding flight and finally a smooth aircraft-like landing, all without the long

momentum stabilizing action of a conventional tail, require that you build your model as well as you can.



parts views

 Check the parts in your kit with this illustration. This drawing shows how the parts go together. This drawing is not intended to be used to assemble your kit.

- a. balsa sheet- wings(2) (bal20021)
- b. balsa sheet- fuselage (bal20020)
- c. balsa sheet- hook (bal200212)
- d. inner wings (2)
- e. outer wings (2)
- f. rudder jig (2)
- g. rudders (2)
- h. fuselage doublers (2)
- i. jig stands (4)
- j. fuselage
- k. hook
- l. hook doubler (2)
- m. wing jigs (2)

- n. body tube (bt01923)
- o. thrust ring (tr01400)
- p. centering rings (2) (cr01914)
- q. engine tube (bt01404)
- r. engine hook (eh00045)
- s. nose cone tenon (1/2 of pnc19001)
- t. plastic nose cone (2/2 of pnc19001)
- u. launch lug (l04051)
- v. streamer (st03046)
- w. shock cord (sc03050)
- x. clay (mcs00001)
- y. decal (dec02002)

required building materials

- carpenter's (preferred) or white glue
- pencil
- sandpaper: 120, 200, and 400 grit
- hobby knife
- ruler or straight edge
- cotton swabs (fillet forming tool)
- plastic model glue (tube type or liquid)
- masking tape

optional building materials

- sanding block
- nail file
- wax paper
- "slow" cyanoacrylate (CA) glue
- clothes pins
- paint brush
- sanding sealer or aerogloss
- spray paint
- food coloring or marker pens
- Japanese tissue
- razor plane

getting started

- This is a complicated model. Get the big picture first by studying the exploded view diagram before beginning assembly. This view will show you where parts are to be used and what names they have.
- You will need a flat surface to work on. A piece of flat cardboard works great to protect your table top and allow you to pin parts or glue and sand. When the cardboard gets too rough, replace it with a new sheet.
- After reading the instructions and visualizing the assembly steps, work slowly and carefully and most of all, have fun!
- The more care you use in building your Silver Hawk™, the better it will perform and the more fun you will have flying it!
- Also read Holverson Designs Technical Report #2 if you are interested in building a performance competition Silver Hawk™. The supplement has information on tapering and streamlining the fins and building alternative pop-pods.

1. remove parts from balsa

NOTE: there are four balsa sheets. You will be removing the tool jigs first. Label each part on the four sheets and remove as needed. Follow step one and step two each time you prepare a part for use.

- Identify and label the various balsa pieces before cutting them out.
- Carefully cut pieces from balsa sheets.

2. preparing balsa parts

- Carefully sand edges of balsa pieces, remove any burrs. Remove as little balsa as possible.
- Sand lightly
- Do not round any edges

3. tool jig assembly

- Glue jig stands into notches of wing and rudder jigs as shown.
- Make sure jig stands vertically with sides perpendicular to work surface.
- Label wing jigs and rudder jigs.
- Allow to dry.

4. streamline the airfoils

NOTE: Decide how much effort that you want to put into the gliding performance of your Silver Hawk™. All airfoils on the Silver Hawk™ must be symmetrical, having the same curve mirrored on both surfaces top and bottom.

- Although a blunt-edged wing (a) will fly, more streamlined shapes will allow better air flow around the wing and better performance.
- Rounding both leading and trailing edges (b) is the easiest airfoil. Rounding the leading edge and symmetrically tapering the trailing edge (c) is even better.
- Full airfoil (d) is best, but difficult to make accurately. It is recommended only if you want to fly your Silver Hawk in contests. Airfoil shaping is detailed in the Holverson Designs Tech Report #2.
- Sand the wings and rudders into a symmetrical streamlined cross section.

5. inner wings assembly

- Lightly coat roots of inner wings with glue and let dry.
- Once dry, apply a generous glue bead to the root edges. Attach wing roots together and lay on a flat surface (don't forget to cover the building surface with wax paper). Smooth or clean up any excess glue. Allow to dry.

6. prep the outer wings

NOTE: make sure that you make one left and one right outer wing.

- Use sandpaper or a nail file to slightly bevel the notch where rudder attaches. The angle is relative to the top and bottom as shown in the illustration.

7. rudder attachment

- Lightly coat notches of outer wings and inner root of the rudders with glue and let dry (see illustration).
- Once dry, apply a generous glue bead to the notch. Attach rudders and prop up with rudder jigs.
- Make sure rudders dry at jig angles perfectly or stability and performance will be reduced.

NOTE: When the wing panel is flat, the rudder will be slightly tilted away from vertical.

- Allow to thoroughly dry.

8. marking tubes

- Find a convenient channel or groove, such as a door jamb, partially open drawer, or molding to use as a guide. Draw a single straight line along the entire length of the engine tube.
- Repeat for body tube.

9. engine tube prep

- Lay engine tube on this drawing and mark at positions "a" and "b". Place marks "a" and "b" across the line made in step 8.
- Cut a 5mm (3/16") slot across mark "a".

10. engine tube assembly

- Apply glue inside the slotted end of engine tube.
- Insert thrust ring until it's flush with the end of the engine tube. Let dry.
- Insert end of engine hook into slot "a".

11. centering ring attachment

NOTE: Hold engine hook into slot "a".

- Apply ring of glue along the outer side of each mark on engine tube.
- Slide the centering ring up to the marks, but not past them.
- Smooth glue into joint between rings and tube.
- Allow to dry.

12. fitting inner and outer wings

NOTE: It's very critical that the wing panels are evenly joined!

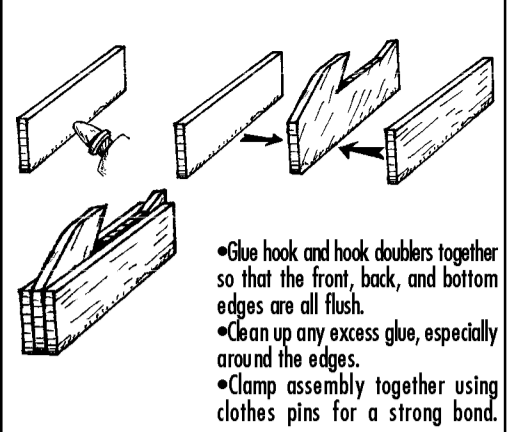
- Once the glue is dry on the inner and outer wings, slightly bevel the inner edges of the outer wings. When properly beveled, the outer wings will butt evenly together with the inner wings, while being propped up on wing guides as shown, (see illustration).
- The angle where the wings meet is called the dihedral.

13. wing assembly

NOTE: angles of wing jig positioned from corner to corner

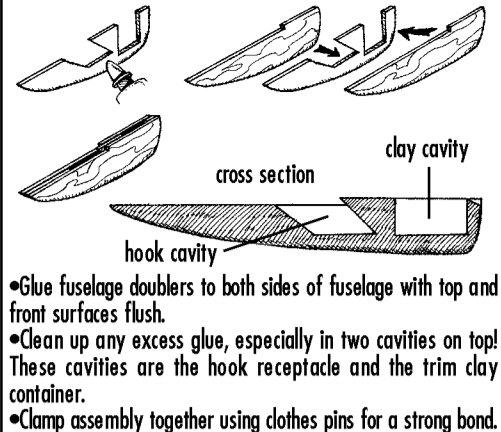
- Lightly coat inner and outer joints of wings with glue, smooth with a wetted finger, and let dry.
- Once dry, apply a second generous glue bead to the joints and attach together. Outer wings should rest on the wing guides as shown. (Tip: this is another good step to perform on flat sheet of wax paper.)
- Smooth or clean up any excess glue.
- Check the angles as the glue dries. This type of glider is sensitive to variations in washout.
- Allow to thoroughly dry. Any sagging of the wings degrades flight performance.
- Make sure that the inner wing is perfectly flat and the outer panel is resting on the wing jig as shown.

14. assembling the hook



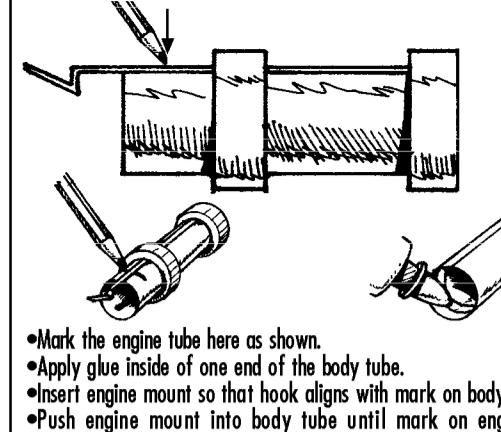
- Glue hook and hook doublers together so that the front, back, and bottom edges are all flush.
- Clean up any excess glue, especially around the edges.
- Clamp assembly together using clothes pins for a strong bond.

15. fuselage assembly



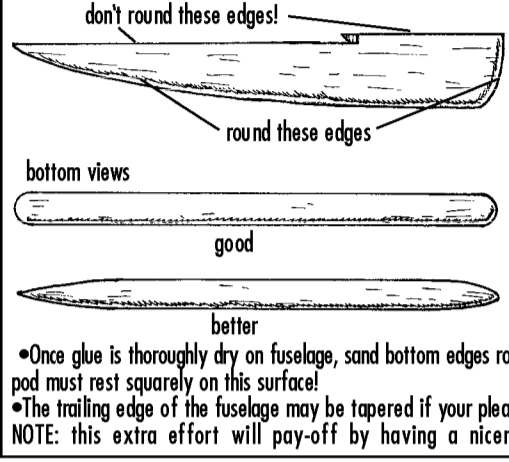
- Glue fuselage doublers to both sides of fuselage with top and front surfaces flush.
- Clean up any excess glue, especially in two cavities on top! These cavities are the hook receptacle and the trim clay container.
- Clamp assembly together using clothes pins for a strong bond.

16. motor mount insertion



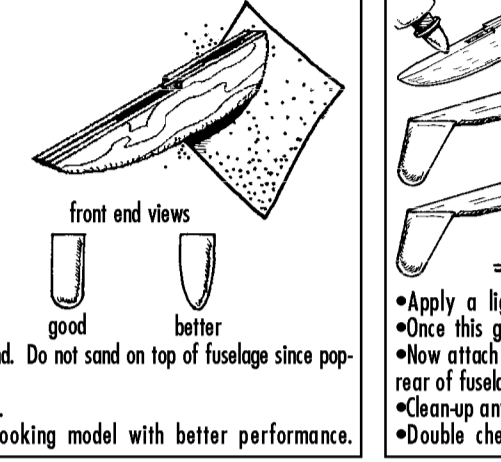
- Mark the engine tube here as shown.
- Apply glue inside of one end of the body tube.
- Insert engine mount so that hook aligns with mark on body tube.
- Push engine mount into body tube until mark on engine tube is even with end of body tube.

17. fuselage streamlining



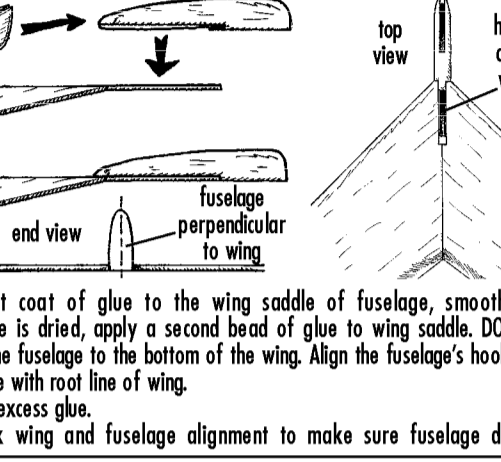
- Once glue is thoroughly dry on fuselage, sand bottom edges round. Do not sand on top of fuselage since poppod must rest squarely on this surface!
 - The trailing edge of the fuselage may be tapered if your please.
- NOTE: this extra effort will pay-off by having a nicer looking model with better performance.

18. fuselage attachment



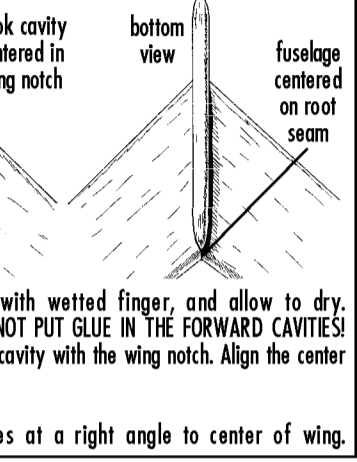
- Apply a light coat of glue to the wing saddle of fuselage, smooth with wetted finger, and allow to dry.
- Once this glue is dried, apply a second bead of glue to wing saddle. DO NOT PUT GLUE IN THE FORWARD CAVITIES!
- Now attach the fuselage to the bottom of the wing. Align the fuselage's hook cavity with the wing notch. Align the center rear of fuselage with root line of wing.
- Clean-up any excess glue.
- Double check wing and fuselage alignment to make sure fuselage dries at a right angle to center of wing.

19. hook preparation



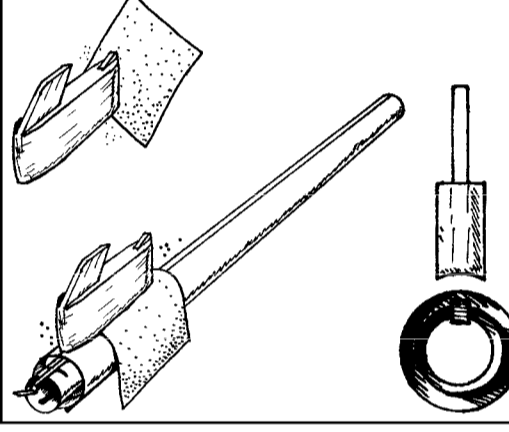
- Once glue is thoroughly dry on hook, sand the front and rear edges round. DO NOT ROUND THE TOP OR BOTTOM EDGES!
- If the trailing edge of fuselage was tapered you should also taper the trailing edge of hook to match.
- Sand the top edge of hook until its square. A nail file or other small file is good for this.
- Slightly sand the bottom edge of the hook concave until it has a tight, straight fit against the body tube. (Tip: a piece of sand paper wrapped around a spent 18mm (standard A, B, or C engine) model rocket engine casing is good for this.)

20. hook attachment



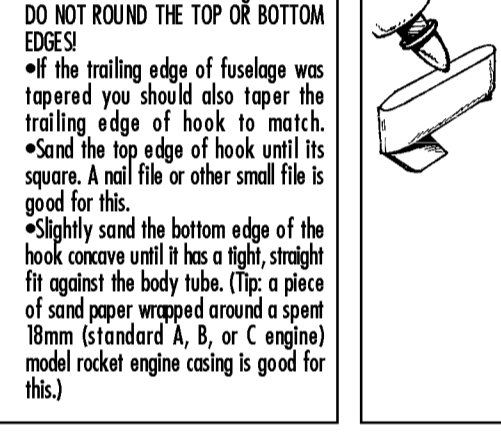
- Apply a light coat of glue to the bottom of the hook and press it against the line on the body tube, make sure back end of hook is flush with end of the body tube.
- Pull the two pieces apart. Smooth the glue with a wetted finger, and let the glue dry.
- Now apply a generous bead of glue to hook and permanently attach it to body tube, making sure it is straight and true.
- Clean up any excess glue.

21. nose cone assembly



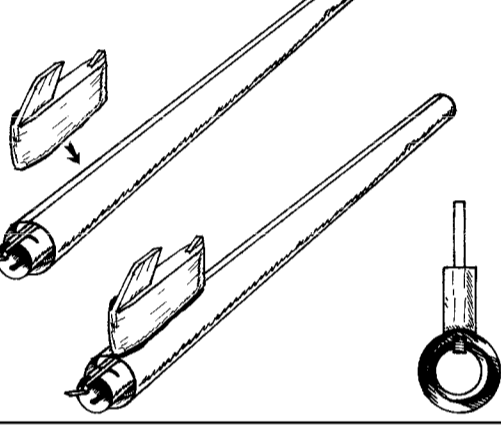
- Apply a ring of plastic model glue or CA inside of nose cone.
- Attach tenon to the inside of cone. Make sure tenon is installed straight.

22. shock cord installation



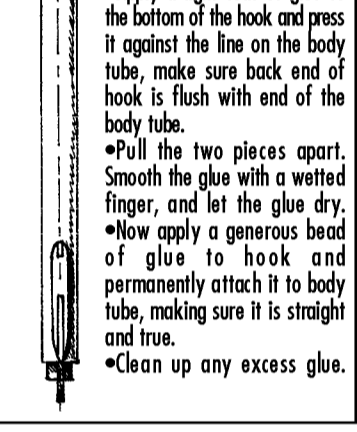
- Tie a knot in the end of shock cord. Seal knot with white or carpenter's glue (never use CA, it will make the elastic brittle!)
- Lay tube on drawing. Mark and cut the forward end of the body tube. Make the slits 7mm (1/4") wide.
- Press in the section of body tube between the slits.
- Pass shock cord through slits with the knotted end going through bottom slit and other end going through top slit. Continue cord out top of body tube.
- Press your finger outward against inside of tube, trapping shock cord against middle section.
- Gently pull shock cord until knot touches the bottom of slit.
- Fill slits and exposed cord smooth with glue.

23. streamlining the rudder joint



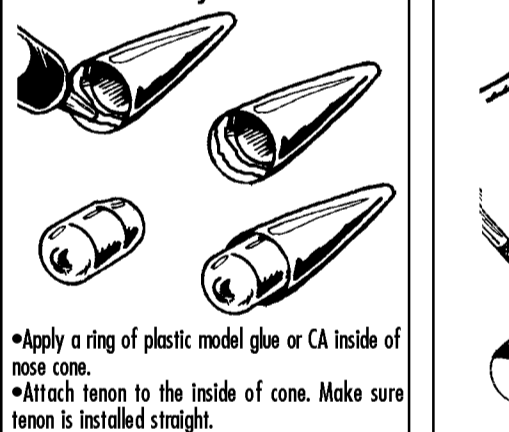
- Use sand paper to round wing tip and rudder joint here.

24. nose cone attachment



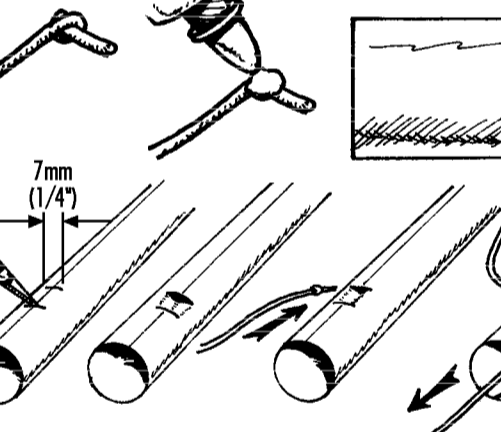
- Thread free end of shock cord through eye of nose cone.
- Tie shock cord and seal knot with a drop of white or carpenter's glue (never use CA!)

25. streamer attachment



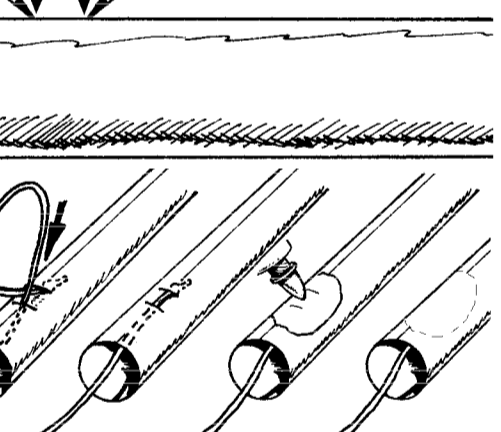
- Use a short piece of tape to attach plastic streamer to shock cord, near nose cone.

26. filleting



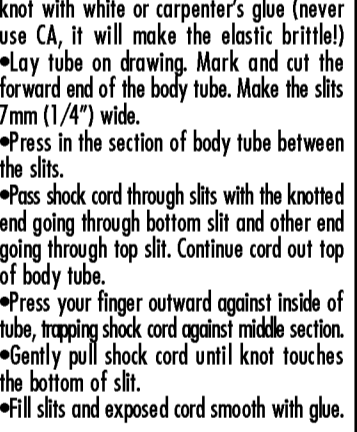
- Apply fillets to the various joints in places shown.
- Fillet by running a generous bead of glue at the joint; then evenly smooth and radius glue with your wetted finger-tip.
- Allow all joints and fillets to dry completely.

27. launch lug attachment



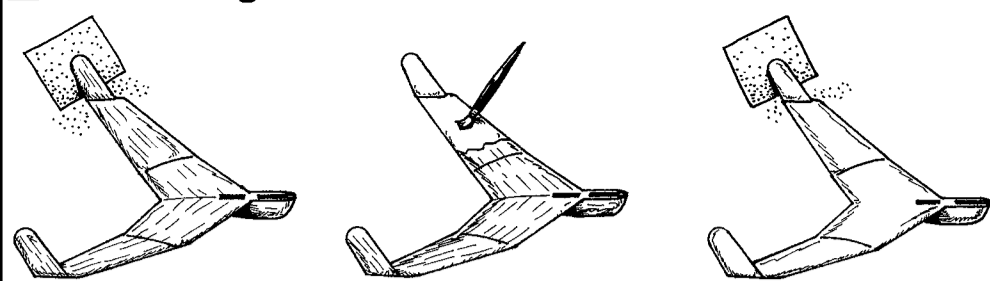
- After your fillets have dried completely, apply a bead of glue to the launch lug.
- Adhere the launch lug to one of the fillets at base of hook. Attachment of launch lug here provides additional gluing surface. More bond strength prevents lug from tearing away from the body tube.

28. fitting glider to the poppod



- Check to see if the glider easily slides on and off hook.
- Sand and smooth any binding surfaces on the hook, if necessary.

29. finishing



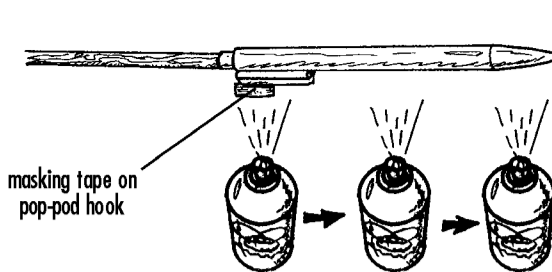
Boost gliders fly better when they are as light as possible and have a smooth finish for better airflow. However smooth finishes add weight, so a compromise between a smooth appearance and added weight must be found. There are several ways you can finish your Silver Hawk™. Some methods add more weight and strength than others.

Because you will have to track your model on both sky and ground, it's best to use very bright, high visibility colors. Most of the prototypes were finished by dyeing the gliders with food coloring and spray painting the pop-pods. A glider that was spray painted entirely was a little too heavy for soaring flights.

Food coloring does not add strength but it is very light weight and easy to apply. Simply brush it on the model.

Japanese tissue is a technique borrowed from model aviation. It's relatively light and adds strength. Tissueing requires that the surfaces are sanded lightly with 200-400 grit-sand paper to first prep them. The surface is then coated with a special aircraft dope and the tissue applied while the dope is still quite wet. The tissue is trimmed and sanded when the dope dries. A final coat of dope is applied and sanded smooth when dry.

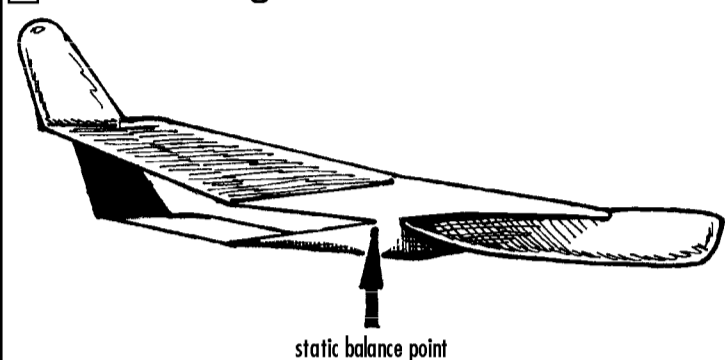
Aerogloss is a type of pigmented sanding sealer. It adds a little strength and is relatively heavy. Sand the surfaces lightly with 200-400 grit-sand paper to prep them. Apply a coat of Aerogloss. Sand the aerogloss smooth when dry. Apply a second and last coat. Sand this smooth when dry. Spray paint is the heaviest and should be used sparingly if used at all. First surfaces need to be sealed. Sand the surfaces lightly with 200-400 grit-sand



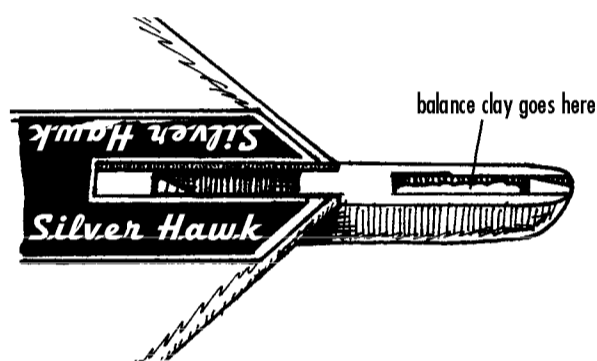
paper. Apply a coat of sanding sealer. To save weight, use one part thinner to two parts sealer. Sand the aerogloss smooth when dry. Apply a second and last coat. Sand this smooth when dry. Use a rag dampened in denatured alcohol to wipe away all sanding dust. Let the alcohol evaporate thoroughly and then apply the spray paint. Apply the paint in even strokes parallel to the surface being painted. Use the least amount of paint possible to cover. To aid in painting, make a painting wand. Hold your Silver Hawk™ horizontally with a wand made from a 1/2" wood dowel.

The Decal can be applied once the chosen finish has dried. Trim it, remove the backing, and place it over the top root of the glider. THIS WILL KEEP ENIGNE EXHAUST FROM SCORCHING THE GLIDER!

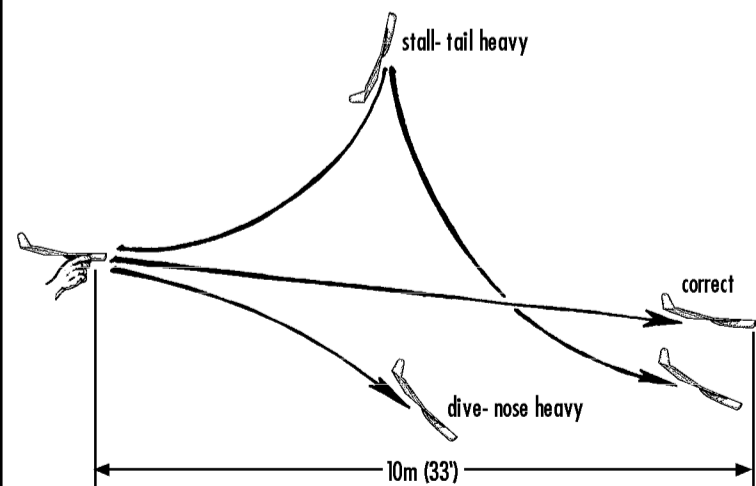
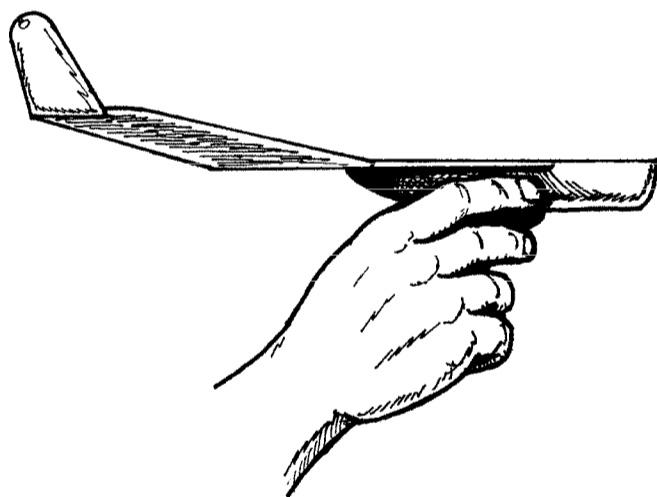
30. trimming



static balance point

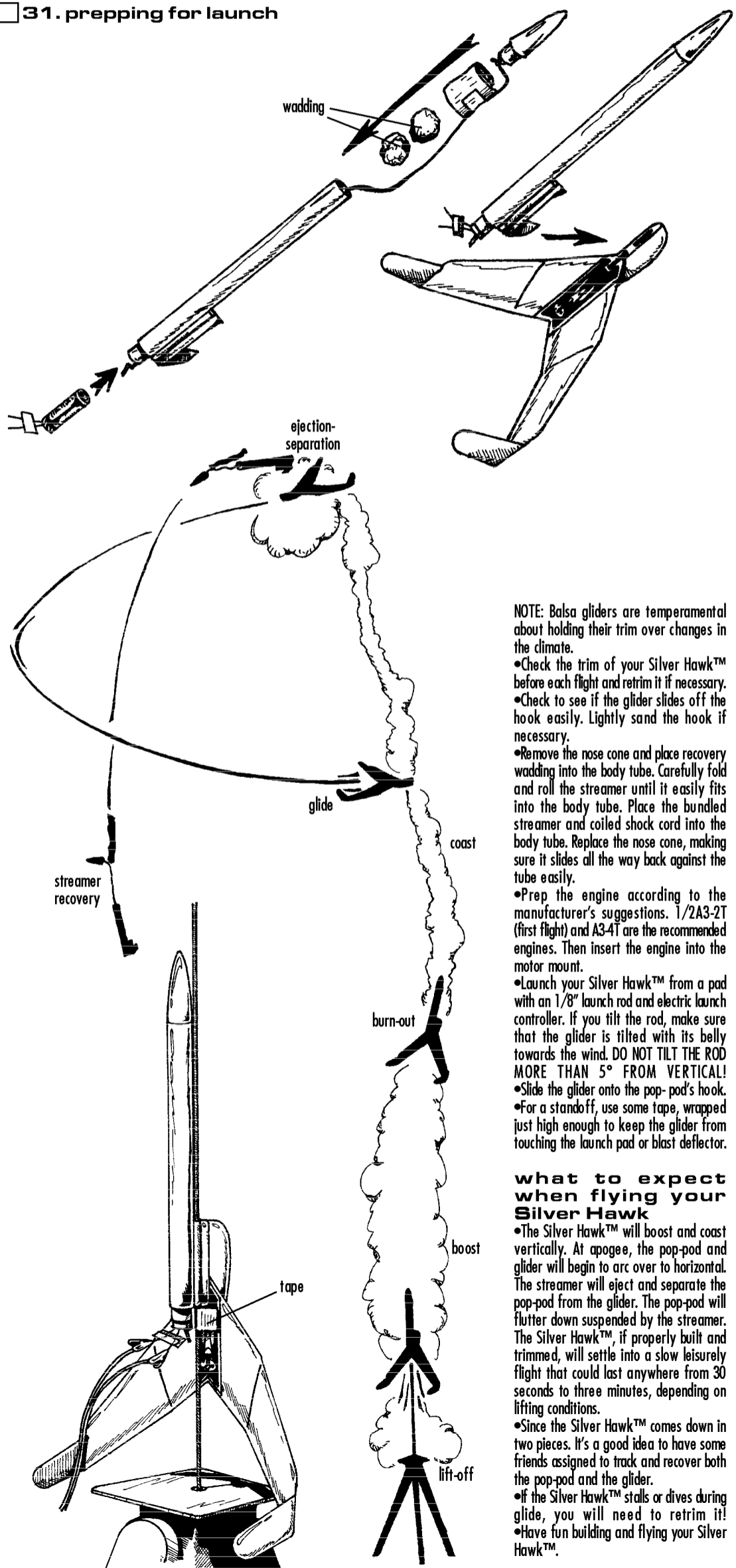


balance clay goes here



- Your Silver Hawk™ will have to be trimmed before each flight.
- Statically balance the Silver Hawk™ by adding small amounts of clay inside the forward compartment until it balances at the trailing edge of the wing root. If it is initially nose heavy, add small equal amounts of clay to the rear of each wing tip.
- Now glide test your Silver Hawk™. A park or field with soft grass is preferable. Grip fuselage under wing. Gently toss in a smooth motion. Always toss glider into the wind.
- A properly constructed and trimmed Silver hawk™ should have a flat glide of about 10 meters (33') or more.
- If it stalls, add nose weight or delete tail weight until a correct glide is achieved.
- If it dives, remove nose weight or add tail weight until a correct glide is achieved.
- If it turns too sharply in one direction, add clay to the wing tip on the outside of the turn or sand lightly on the heavy side.
- Trim your Silver Hawk™ using the least clay possible.
- If the Silver Hawk seems to be unusually hard to trim, check to see if the dihedral hasn't sagged (tip: this is a good reason to save the dihedral jigs).

31. prepping for launch



NOTE: Balsa gliders are temperamental about holding their trim over changes in the climate.

•Check the trim of your Silver Hawk™ before each flight and retrim it if necessary.

•Check to see if the glider slides off the hook easily. Lightly sand the hook if necessary.

•Remove the nose cone and place recovery wadding into the body tube. Carefully fold and roll the streamer until it easily fits into the body tube. Place the bundled streamer and coiled shock cord into the body tube. Replace the nose cone, making sure it slides all the way back against the tube easily.

•Prep the engine according to the manufacturer's suggestions. 1/2A3-2T (first flight) and A3-4T are the recommended engines. Then insert the engine into the motor mount.

•Launch your Silver Hawk™ from a pad with an 1/8" launch rod and electric launch controller. If you tilt the rod, make sure that the glider is tilted with its belly towards the wind. DO NOT TILT THE ROD MORE THAN 5° FROM VERTICAL!

•Slide the glider onto the pop-pod's hook.

•For a standoff, use some tape, wrapped just high enough to keep the glider from touching the launch pad or blast deflector.

what to expect when flying your Silver Hawk

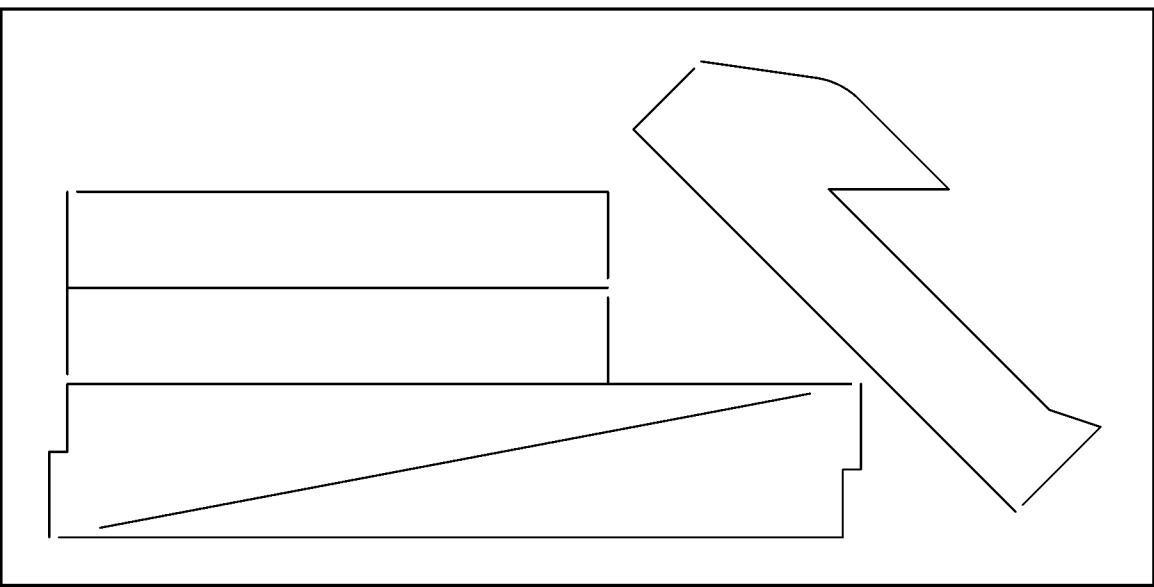
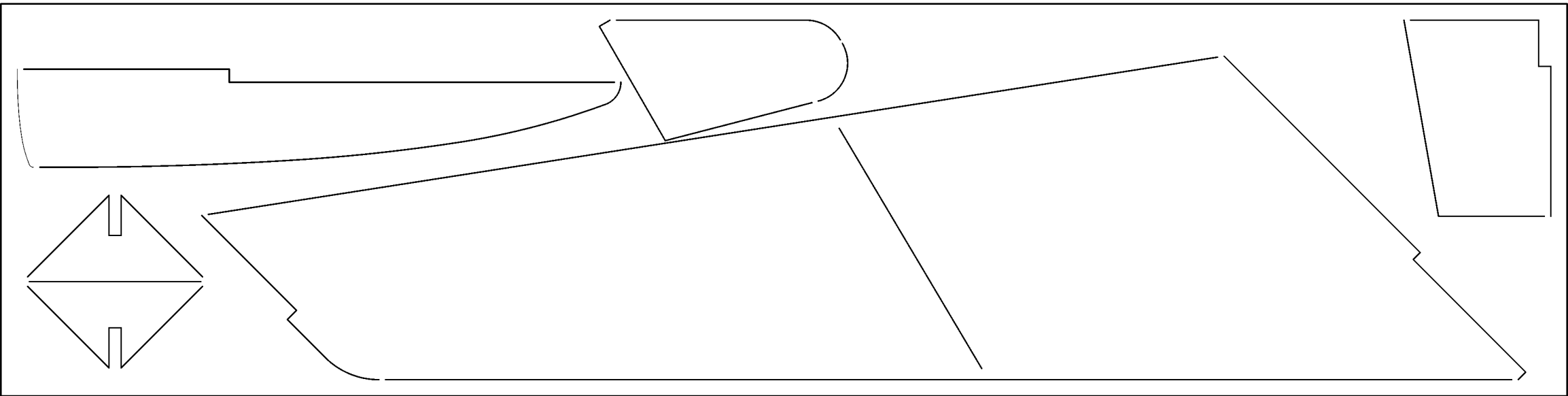
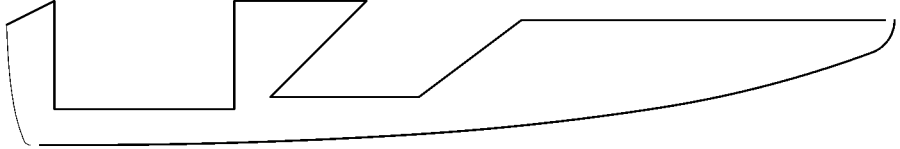
•The Silver Hawk™ will boost and coast vertically. At apogee, the pop-pod and glider will begin to arc over to horizontal. The streamer will eject and separate the pop-pod from the glider. The pop-pod will flutter down suspended by the streamer.

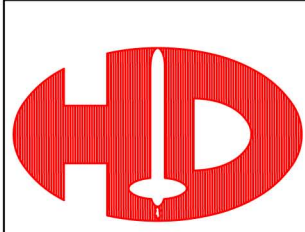
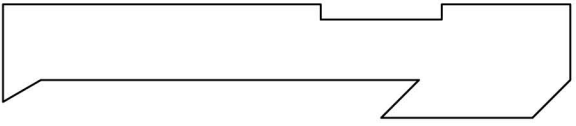
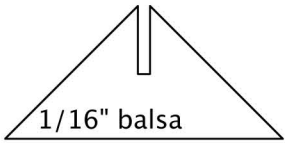
The Silver Hawk™, if properly built and trimmed, will settle into a slow leisurely flight that could last anywhere from 30 seconds to three minutes, depending on lifting conditions.

•Since the Silver Hawk™ comes down in two pieces. It's a good idea to have some friends assigned to track and recover both the pop-pod and the glider.

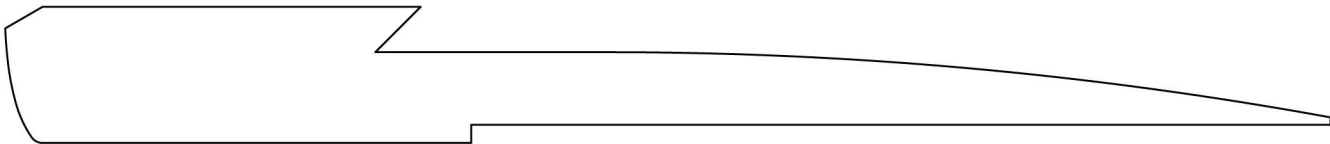
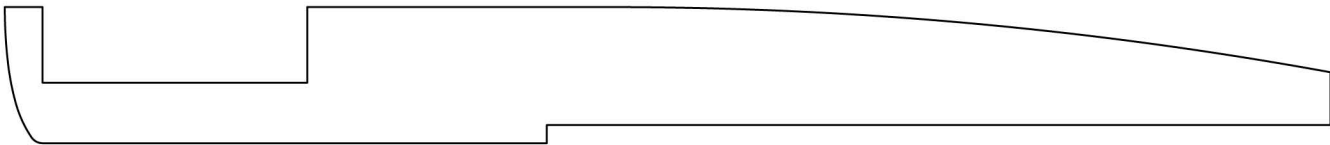
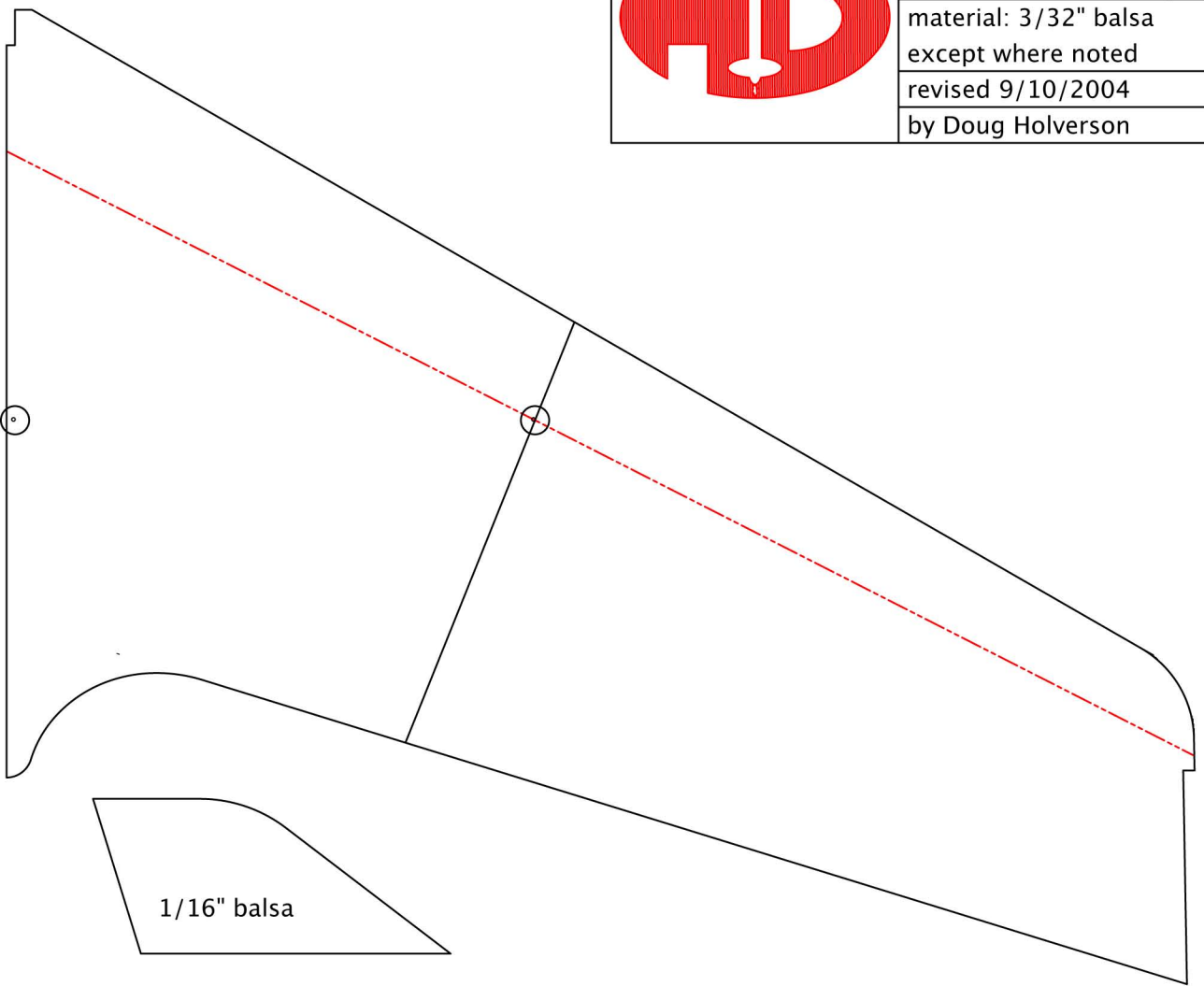
•If the Silver Hawk™ stalls or dives during glide, you will need to retrim it!

•Have fun building and flying your Silver Hawk™.





HOLVERSON DESIGNS, Inc.	
Silver Hawk v.2	
patterns	1 of 1
material: 3/32" balsa except where noted	
revised 9/10/2004	
by Doug Holverson	



Silven Hawk[®]



© 2002 Holverson Designs, Inc.

Silven Hawk[™]