STAR IMAGINEERING WWW.STARIMAGINEERING.COM

iStar Pattern Parkflyer

Construction Guide

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1 Introduction

Wing span: 33.3 in.
Wing Area: 272.0 sq. in.
Length: 35.1 in.
AUW: 13 - 14 oz.
Radio: 4 to 5 channels

Thanks for choosing iStar, the ultimate balsa parkflyer for precision aerobatics. I am sure you will be delighted with its elegant flight characteristics. But first, let us be clear that iStar is not meant for a beginner. Although, just like many sound aerobatic designs, iStar is designed to follow your exact commands, **it is not a beginner's first model.** The kit is not designed for a novice builder, neither. There are a few tricky sequences, as well as some options that would require some planning. This document was created to help you go through those building sequences successfully. Great efforts were put in this document to explain those steps. However, this document is not meant to discuss all the reasons behind everything. You are welcome to communicate with me for any questions you might have. I will be more than happy to answer them in great details. You can always reach me via email at martin_chou@yahoo.com.

Hope you enjoy iStar as I do.

Precaution: Please don't rush out and punch all the laser cut parts out. There are more than 200 balsa pieces in this kit. Although many parts are marked with a two-letter or three-letter designation on the wood, many more parts are grouped together on the balsa sheets without any mark. We will need their location **and orientation** for proper construction. There are many pictures and diagrams in this guide to help you identify them. Please read carefully and make sure the part you are looking at is the one that is called out for, before moving it to the building board.

A list of all materials in the kit is at the end of this document (Appendix: Kit Contents). Use CA for all wood joints, unless specified otherwise.

1.1 Tools Needed

A flat building board at least 12"x36".

Screw drivers, both flat and Philip types, Needle pliers, Wire cutter, Drills, Razor saw.

Hobby Knife, Super glue (CA), Polyurethane glue or Epoxy, T-pins, Wax paper, Phone books, Straight rulers, Yardstick, Triangular ruler.

Heat gun and iron. Scissors.

1.2 Additional items

Power System:

- Recommended power system: 3s Lipo 820 –1100 mah battery pack with ~100w brushless motor, such as Himaxx 2015-4100, and brushless controller. GWS C-gearbox and SF1080 propeller.

- Alternative brushed power system: 3s Lipo 820mah with GWS EPS 350 C-gearing and HD1060. ESC should be able to handle at least 10A max current. Throttle management is required with this

configuration. Otherwise, life expectation of the motor is greatly reduced.

Radio: at least four channel radio with small receiver and three or four Pico (9g or less) servos.

Servo extension wires: Depends on which option (see below), need one or two extension wires for aileron servos.

Covering: SoLite or similar.

Wheels: ~1.75" main wheels x2, ~0.6" tail wheel.

Optional parts: EZ connectors, Spinner and Wheel pants, (Instruction to build these from meant tray foam is included in this guide), Wheel collars.

2 Options

The first option with your iStar is whether or not to drive ailerons with dual servos. Both single aileron servo and dual aileron servo options were designed in. The major trade-offs are 1> weight, 2>adjustment flexibility, and 3>responsiveness. Decide it based on your personal preference and/or your equipment's capability. If you decided on **single aileron servo** installation, watch out for instructions after **Φ** sign.)

The second decision is the pull-pull control on rudder. Pull-pull wire (Kevlar thread) is included in the kit. But you have the option to go with traditional push-pull rod, if you so desire. Pull-pull is very easy to set up and has superior responsiveness for those precise maneuvers.

The third option is the elevator push-pull y rod. Push-pull Y rod is the default design. Parts are included. If you want to go with other mean of elevator control, such as pull-pull, you need to decide and plan it now.

You may opt for outrunner motor, such as AXI, for your iStar. In such case, some additional steps need to be taken for installing a modified F1x (included). Watch out for **Θ (Outrunner Motor)** signs in this guide. No validation of this installation is done, though.

For covering, some people prefer to cover the major components before putting them together, some prefer to do covering after the whole airplane is built. The choice is yours. There will be a checkpoint in this construction guild to remind you on this.

There are other things, such as the oversized battery and/or receiver that might affect the construction procedure. If you choose an equipment that is far different from the recommended ones, make sure you check the plan and understand its impact before proceed.

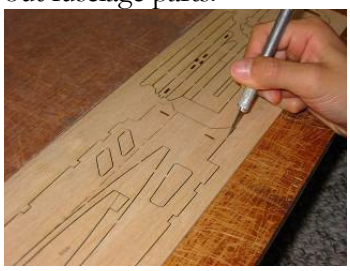
3 Construction

We will start building up major components, i.e. fuselage, wing, and, control surfaces, before assembling them together. Make sure you check off all steps in all components sections, before you go on to the pre-assembling session. Complete all the pre-assembling steps and proceed to the final assembly.

Before we proceed, please study the plan and this guide thoroughly. After all is clear, prepare your building table; make sure it is flat and level. Gather all tools and equipments (as listed above). Spread the plan on building board and cover it with wax paper. Use tape to fix the plan and wax paper on the building board. Then we are all set to go.

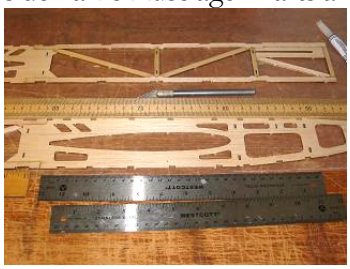
3.1 Fuselage

3.1.1 Find VV-5 balsa sheet. Carefully cut out fuselage parts.

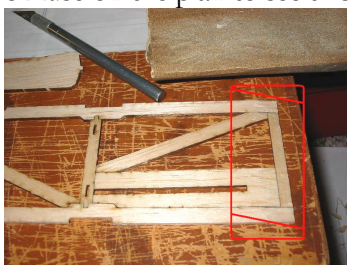


3.1.2 Use plan to identify parts. All fuse half parts are grouped together on this VV-5 balsa sheet. Dry fit all parts on plan before gluing them together. Use rulers to ensure straightness and alignment.

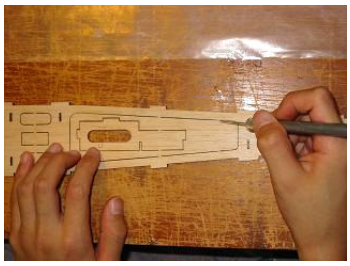
3.1.3 Repeat step 3.1.2 and 3.1.2 for right side half of fuselage. Parts are on VV-4.



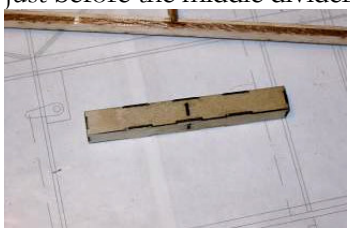
3.1.4 Use sandpaper to bevel end of each fuselage half (see picture below). You need only remove about 1/32 at the end. Check the top view of fuse on the plan to see this.



3.1.5 Find VV-6a (top) and VV-6b (bottom). Carefully cut out fuselage box top and bottom.



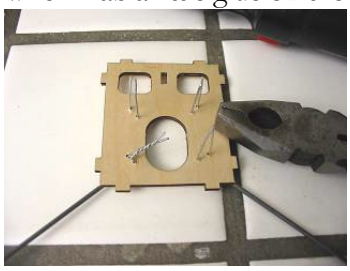
3.1.6 Find motor mount stick parts from 1/32 ply sheet. Assemble and glue. (**Θ: Complete this stick assembly.** Then, cut the motor mount just before the middle divider.)



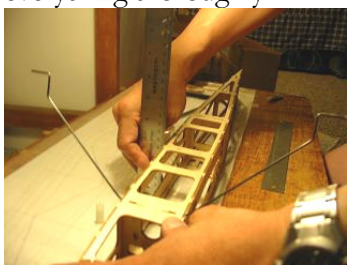
3.1.7 Glue motor mount to bulkhead F3y and L1. Glue the whole assembly to fuselage top.

NOTE! make sure fuselage top is upside down on the plan! Be careful with this step. The right thrust angle is built into fuselage box top part.

3.1.8 Glue F4a (ply) and F4b (1/16 balsa) together. Drill eight holes for landing gear tie wire. Place landing gear wire **on the side of F1a (ply)!** Twist the tie wire to hold down the landing gear wire. Cut and leave about ¼" to 3/8" of twisted wire. Dab a little glue on the twist wires afterwards.



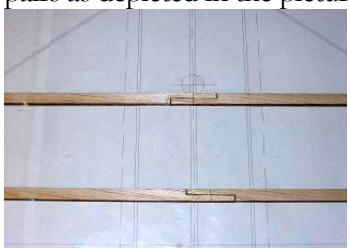
3.1.9 Identify and cut F2b, F6b, F7b, and F8b bulkheads out of balsa sheets. (No F1 yet.) Test fit every part, including landing gear assembly (check the orientation/order of the F4a and F4b on the plan, landing gear should be at the front!). Fit fuselage halves and box bottom, together on the fuselage box top (upside down on plan). After all checked out, apply CA glue. Check straightness and ensure square while you apply more glue to secure everything thoroughly.



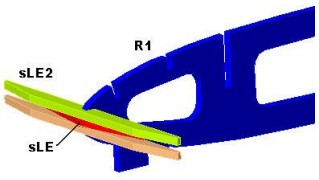
3.1.10 Once glue is dry, fuselage box structure is done.

3.2 Wing

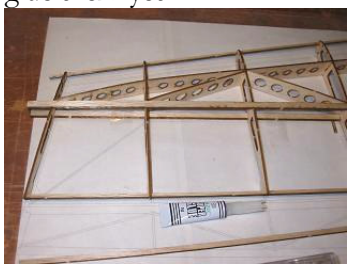
3.2.1 Find S4 from VV-1A. Join and glue pairs as depicted in the picture:



3.2.2 Find sLE and sLE2 (x2) from VV-3, along with center ribs, R1(x2), from VV-2; glue all together to form leading edge brace (see diagram below):

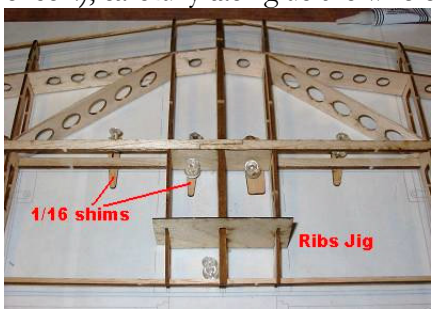


3.2.3 Find and cut all ribs (R2-R6) from VV-2 (x2). Fit them on the main spar on top of plan. Use Ribs Jig (ply) to ensure all ribs are vertically aligned. Cut out s3 spar (VV-2). Bent the last section a little bit, damp it with water if necessary. Dry fit the sLE and sTE (VV-3). Don't glue them yet.



3.2.4 Cut out sR2 to sR4 (not sR5 yet) from VV-2; sand the ends a little to a "V" shape to fit into the wing assembly (as above picture shows). The picture below shows sR5 in the sanding process. We need to treat sR2 to sR4 in the same way.

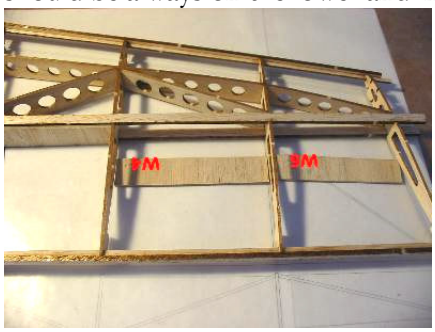
3.2.5 Under the main spar, place four pieces of 1/16 scraped balsa as shown. Fit center ribs and everything together. Fit W1 (ply). Use Ribs Jig to help alignment. Once everything lines up (double check!), carefully tack glue the whole wing together.



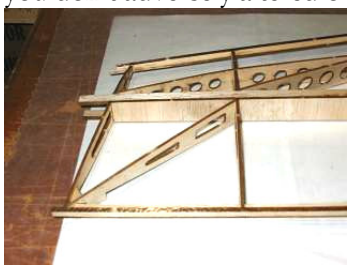
3.2.6 Cover the whole assembly with wax paper, then, carefully put down three thin phone books on top of the whole wing assembly. Don't go for heavy thick phone books. Find LEx2 (VV-6a and 6b) and TEx2 (VV-1A). Join and glue two TE pieces together. Then glue them onto the wing (while the weight is on.) Note, due to dihedral of

the wing, the TE (and LE) should form an upside down "V" as seen in the picture. (We are building the wing upside down.)

3.2.7 Remove phone books after a few hours. Fit and glue in all spar webs (VV-2). Note the orientation of those spar webs. The letter should be always on the lower and inner corner.

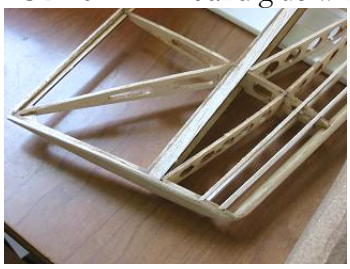


3.2.8 Prepare the v-end of sR5. Fit it with WT1 (VV-2) and then glue it in place. Make sure you don't adversely altered or twist the wing panel.

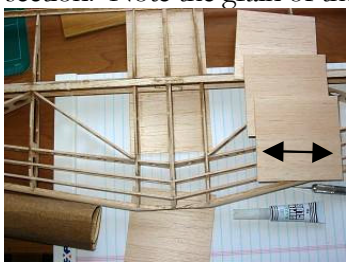


3.2.9 Trim all spars and LE joint.

3.2.10 Fit and glue wing tips in.



3.2.11 Fit and glue in 1/16x1/8 balsa stringers. Sand and round LE. Cut 3 squares out of 1/32x3x9 blanks. Glue them to the wing center section. Note the grain of the wood.



3.2.12 Trim and sand LE and stringers. The wing assembly is now complete!

3.3 Aileron

3.3.1 Identify left aileron parts according to a diagram in Appendix: Stab and Aileron Parts Identification. Use the designation letter as a guide for proper orientation. One by one, cut out a part and place it on plan. After all parts fit together, use rulers for straightness and apply glue. Repeat for right aileron.

Note, for dual aileron setup as shown, the second diagonal stick, b7, needs a trim to fit into the control horn base, AB (VV-1B). For single aileron setup, fit WT2 (VV-1B). There is no need to trim any diagonal sticks.

3.4 Horizontal Stab and Elevator

3.4.1 Identify all parts on VV-1A and VV-1B for horizontal stab and elevator. Check with the diagram, Stab and Aileron Parts Identification, in Appendix for proper identification. Cut loose one part/stick at a time and place it on plan. Refer to the letter designation in the diagram for proper orientation. Use rulers to help alignment and straightness. Fit and glue.

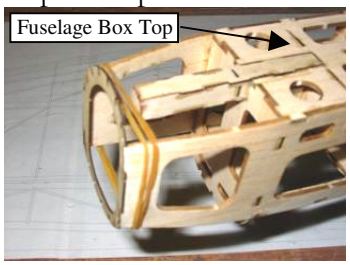
3.5 Vertical Fin and Rudder

3.5.1 Use the diagram, Stab and Aileron Parts Identification, in Appendix to identify sticks on VV-1B. Again, cut one part at the time. Place it on the plan. Fit and glue. Don't forget rulers.

3.6 Upper and Lower Decks

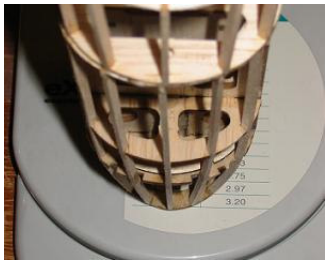
3.6.1 Back to the fuselage! Start with an upside down fuselage. Install all sub-bulkheads, F4c, F5c, F6c, F7c, and F8c, on the bottom. Install sub-vertical fin (VV-1B), too. (**Single Aileron Servo Option,** place a piece of oversized wax paper at the hatch location. Put in hatch base, HT, (VV-4) and glue two extra bulkheads (HT/F5H from VV-2) to the hatch base.)

3.6.2 Glue F1b (ply). Use a rubber band to help. Damp the end of fuselage halves if necessary.

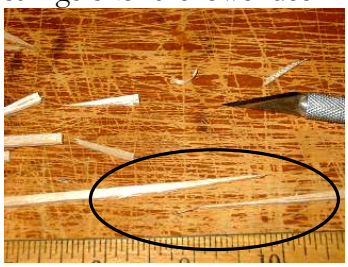


Θ: F1b needs to be aligned for thrust line. You may need to trim the fuselage halves to ensure right thrust line (1°) and down thrust line (1°) before gluing this F1b in. The way to do this is, vertically sit (see picture) the whole fuselage on the face of F1b, without gluing it yet, on a flat and level (0°) surface. Use a bubble level gauge to check

verticalness of the fuselage box top. It should be 0°. That is, fuselage box top was designed to carry 1°. Check the side view on plan to see this. For side thrust angle, use flat portion of fuselage sides for the 1° right thrust.



3.6.3 Cut and join two 1/16x1/8 x18 sticks into one stick/stringer as shown. We need five long stringers for the lower deck.



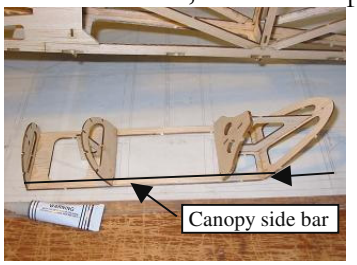
3.6.4 Install those five stringers on the bottom. The joints should be positioned roughly on F6. Trim the ends accordingly. . (**Φ:** After the glue dries, cut stringers to release the aileron service hatch.)

3.6.5 Install F6Aid (VV-4 and 5), bevel the F6a seat openings (as shown). Bevel the bottom of F6a to meet. Glue it afterwards.

3.6.6 Install F7a, F8a, and F9a. Glue in vertical fin. **Check alignment of the vertical fin from review view and side view.**

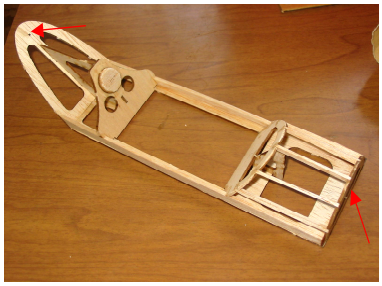
3.6.7 Glue and trim all seven 1/16x1/8 stringers. The notches on F6a would need some trimming/beveling (see picture.)

3.6.8 Canopy base. Prepare C1a and C1b by gluing C1x on the sides. Find all pieces of canopy base, C1b, C2, C3, C4, L2, and the base, C5. Bevel C4 at the bottom to meet C5. Trim the end of C5. Test fit the whole assembly against F6a on top of the fuselage. Glue everything once all fits have been checked out. Also, glue the two long side bar, found on VV-3, on this canopy assembly.

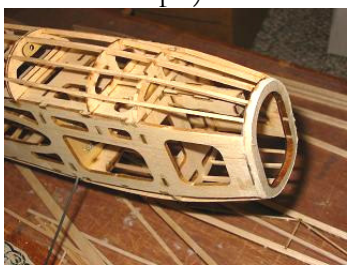


3.6.9 Now work on the front deck. Install all sub-bulkheads, F2a, F3x. Put a piece of wax paper, as shown, under the canopy base. Fit and glue in stringers all the way fromF1 to C2.

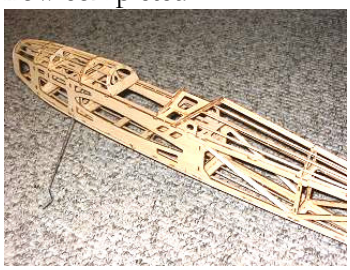
3.6.10 Cut the canopy free afterwards. Find a 1/8 wooden dowel. Cut a 1/2 in. length from it, and glue it to canopy's C1b/C1x. Glue (Polyurethane glue or Epoxy) the included thumbtack at the hole on the slanted C4.



3.6.11 Fit and sand F1a (VV-1A). (For **Θ** Outrunner, fit F1x into F1a. Then, prepare 2x F2r (ply) to fit and install motor. Either glue or screw F2r to F1x. Glue the whole assembly to F1b and sand it to shape.)



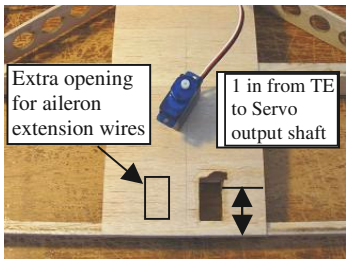
3.6.12 Enlarge the hole on F6a. Fit and glue the included magnet in place. Use Epoxy or Polyurethane glue for this. The whole fuselage is now completed



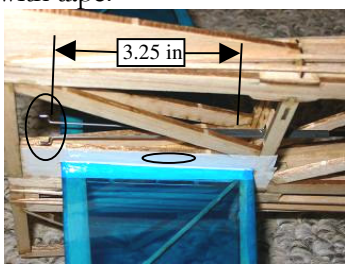
3.7 Pre-assembly

3.7.1 Servo Openings:

(If you decide to use servo tape to install the elevator servo horizontally, you may skip this step. You will need an EZ connector, though.) Cut an opening at the top of the wing for your elevator servo. Depending on your servo, you may need to cut through the bottom. Check the plan for its location. Fit but do not install the servo yet. Cut an extra opening as shown for dual aileron servo extension wires, (same opening is used for **Φ** single aileron servo wire outlet.) **Φ**: Cut an opening for the single aileron servo at the bottom of the wing according to the plan. (Note the orientation of the wing!) You will need to cut out a portion of R1. Do not install the servo yet.



3.7.2 Y push rod for elevator: Find the Carbon Fiber push rod. Cut two 4.75" long 0.032" wires. Bend one z end on each wire (with 0.25" protruding portion). Position 3.25" of the piano wires out from the end of push rod to the beginning of z-bend). Cut the included shrink tube in half (~1.5in.) Use one to secure these two z-wires. Note the z-bends orientation in the picture, and there is **NO** "V" bend yet. Drop some CA into the shrunken tube afterwards. Prepare the other end by cutting one 3.25" 0.032 wire. You may use EZ connector at this servo end. If not, bend a z-bend. Position the wire so that there is 1.5" from the end of push rod to the beginning of z-bend. After securing it with another half of the shrink tube, test fit the whole push rod through all bulkheads and **exit holes**. Make sure it moves freely when in position. Temporarily secure the push rod in place with tape.

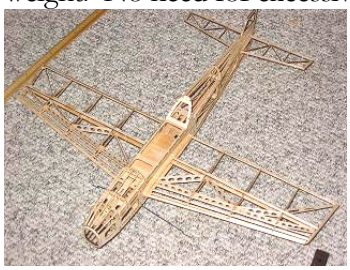


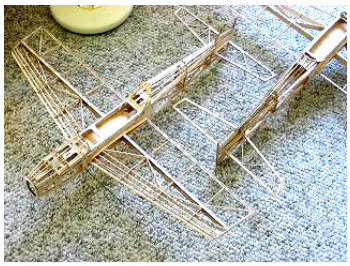
3.7.3 If you prefer to cover the major components before assembly, now is a good time. Remove portion of film at all joint/contact areas, though. (Do not cut into wood when you do so.) **Recheck all the steps above and then proceed to the next section.**

3.8 Assembly

3.8.1 Fit the horizontal stab through the opening. Trim the opening to ensure the horizontal stab is exactly perpendicular to the vertical fin. Check equal distances from both stab tips to a fixed point on the vertical fin (rear view.) Also, make sure the both tips of the stab are of the same distance to a middle point on F1 (top view.) Use a yardstick or non-stretching thread for this alignment. Recheck everything several times before applying glue.

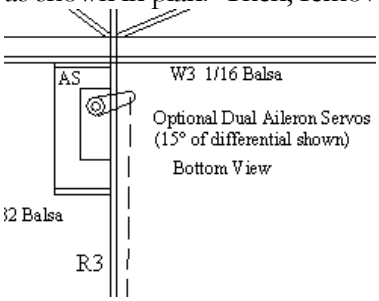
3.8.2 Test fit the whole wing assembly through the fuselage opening. Trim little by little until the wing comes to the right place. Align the wing from top view (equal distance to vertical fin) and rear view (parallel to horizontal stab.) Trim the opening more if necessary. If a gap becomes too big, you may use a stripe of balsa to shim the wing. **Recheck everything** before applying glue (Epoxy or Polyurethane.) (Note, more glue equals more weight. No need for excessive glue!)



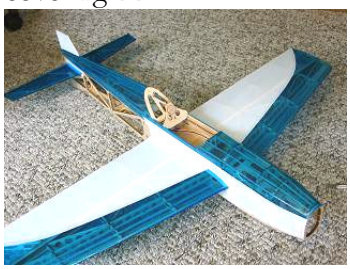


3.9 Finishing up

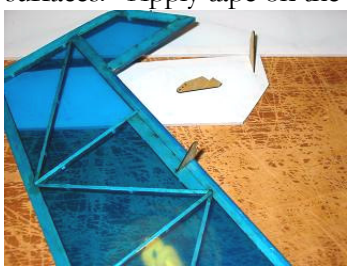
3.9.1 Dual aileron servo installation: Route servo extension wires from the extra opening at central wing section to R3. Prepare AS and its supports from VV-6b. Test fit the opening of AS with your servos. Glue the AS part along side of R3 as shown in plan. Then, remove the servo for now.



3.9.2 Refer to the instructions of your favorite covering. Cover your new iStar with light and strong covering film. You may find more detailed instructions online. For a covering pattern like the one in the picture, cut out both pieces, place them on a piece of glass, and peel off the backing at the overlapping portion. Use iron to tack them together (hot enough to activate glue, but not shrinking the film.) Then proceed as one piece of covering film.

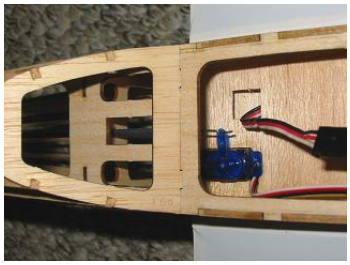


3.9.3 Install and glue control horns. Cover control surfaces. Use included transparent tape as hinge tape to hook up aileron and elevator control surfaces. Apply tape on the upper surface only.

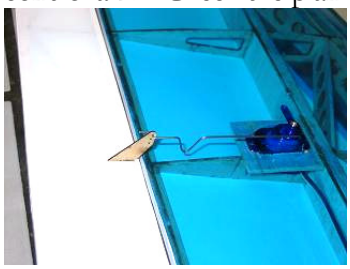


3.9.4 Refer to the plan, and install the tail wheel wire support (TB ply), then install small tube. Bend the remaining wire (~0.6 in) 90° as steering wire. Use Polyurethane or epoxy to attach the whole assembly to V10. Cut small piece of tape to hole the assembly on. Drill hole on rudder for steering wire. Install the rudder with tape on both sides as hinge.

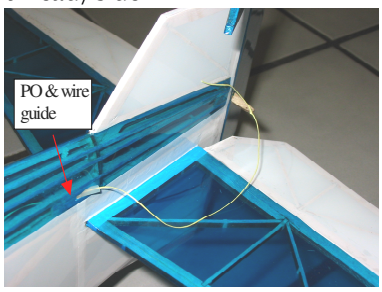
3.9.5 Fit and install the elevator servo. Hook up the y-push rod to the servo. Then, bend the "V" on each of the two elevator push rods. Each leg of the "V" is 0.5" in. See the plan for details.



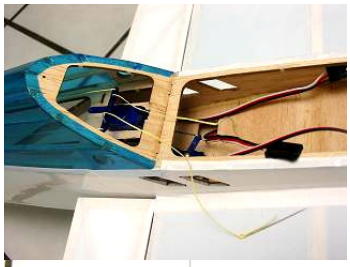
3.9.6 Install the aileron servos. Cut two 4" 0.032 wires. Bend a z-bend on both ends (with 0.25" protruding portion). Bend "V" with 0.3" on each leg (see plan, side view), Install these push rods. For **Φ,** drill holes on the fuselage sides for push rod exits. Install the single servo, bend and install the push rods. Use included plywood disk for the servo control arm. Check the plan for this.

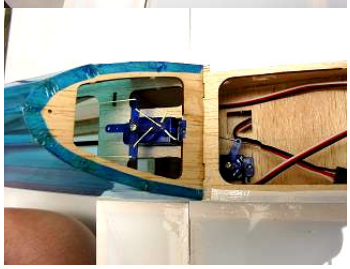


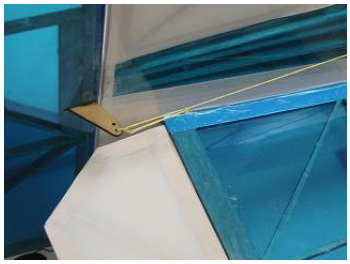
3.9.7 Rudder servo installation: Fit and install rudder servo in place. Glue PO part x2 from VV-4 and VV-5 in place. Drill holes and install the small plastic wire guide. Cut the included Kevlar thread in half. Tie one end of the thread on rudder control horn. Tie a small piece of 0.032 wire at the end of one thread; fish it through the wire guide all the way to rudder horn. Do the same for the other thread/side.



3.9.8 Run the pull-pull thread through holes on the servo arms. Loosen the servo arm and place it about ¼" closer to rudder. Pull both threads tight and tie them together. Then pull back the servo arm onto servo output shaft. Drop a little CA glue on the thread knot.



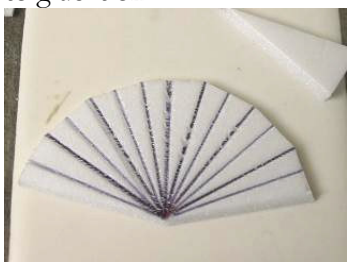




3.9.9 Trim the clear canopy to fit the base structure. Before gluing (Polyurethane) it on, install the instrument panel and paint the base structure. Tape a piece of white paper as the bottom of the cockpit. If you intend to use a big battery pack (although not advised), cut a portion of the base (C3 and C4) to fit it in. Install and glue the canopy hold-down magnet at the fuselage bulkhead, F6a, to work with the magnet on the C6.

3.9.10 Find the template for wheel pants in the Appendix: Wheel Pants Template. Scale up or down the template according to the size of your wheels. Cut those pieces out of foam meat tray, or some other flat foam such as depapered SturdyBoard. Find the tie down plate (ply), drill two holes for the tie down wires to go through. Glue all pieces together. Fit and tie down the wheel pants with the wheels in.

3.9.11 Find the template for a spinner in the Appendix: Spinner Template. The size of this template is for a typical GWS rubber spinner. Cut a piece of foam and use a ball pen to crease (hard but not to cut through) accordingly. Fold to form the spinner. Use tape to secure the whole thing together. Sand the base flat. Cut opening for propeller blades. Test fit it to the rubber spinner. You may have to scrap some foam material out for a better contact between this foam spinner and the rubber spinner. Once satisfied, use contact cement to glue it on.



3.9.12 Install the motor, esc, and receiver. Cut the Velcro in half, and glue them to battery bay and your battery pack. (Use Polyurethane or epoxy, do not just stick the Velcro belts on.) Make sure it has enough holding power for your battery pack.

3.9.13 Adjust battery position or add weight to bring the cg to 3.75in (at most 4.in) location for your maiden flight. **This step is mandatory!!**

4 Adjustments and flight trimming

4.1.1 Preflight tests: test radio and all control surface. Be sure that all control surfaces move in the right direction, and center truly. Make sure aileron surfaces are level (0 degree decalage), relative to wing and fuselage, when neutral. Do range check with motor running. Check and recheck everything. Follow all security procedures in your flying field. Good luck!

4.1.2 A few words on cg trimming. First, re-ensure aileron surfaces is 0 degree when neutral, (i.e. no camber, no reflex.) Assuming all basic trimming (level and straight flight, throws, differentials, etc.) is done, you may gradually move cg backwards. Inverted flight and straight down (power off) are two maneuvers that I used for this. If little or none down elevator is needed for inverted flight, your cg is in ballpark. During power off straight down, if model pulls up, cg is still a bit forward. If it pushes down, cg is too far backward. A slight pulling up is expected. You may experiment with decalage angle to get perfect straight down when you gain more experience with it.

That's it. Hope you like your new iStar.

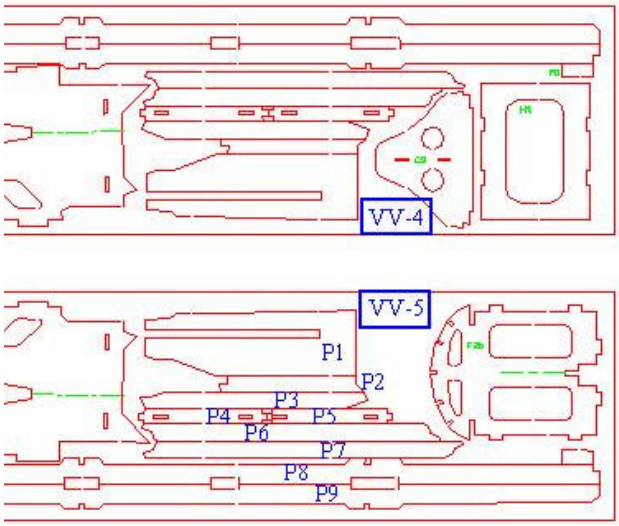
Martin Chou
www.StarImagineering.com 04/08/2005

5 APPENDIX

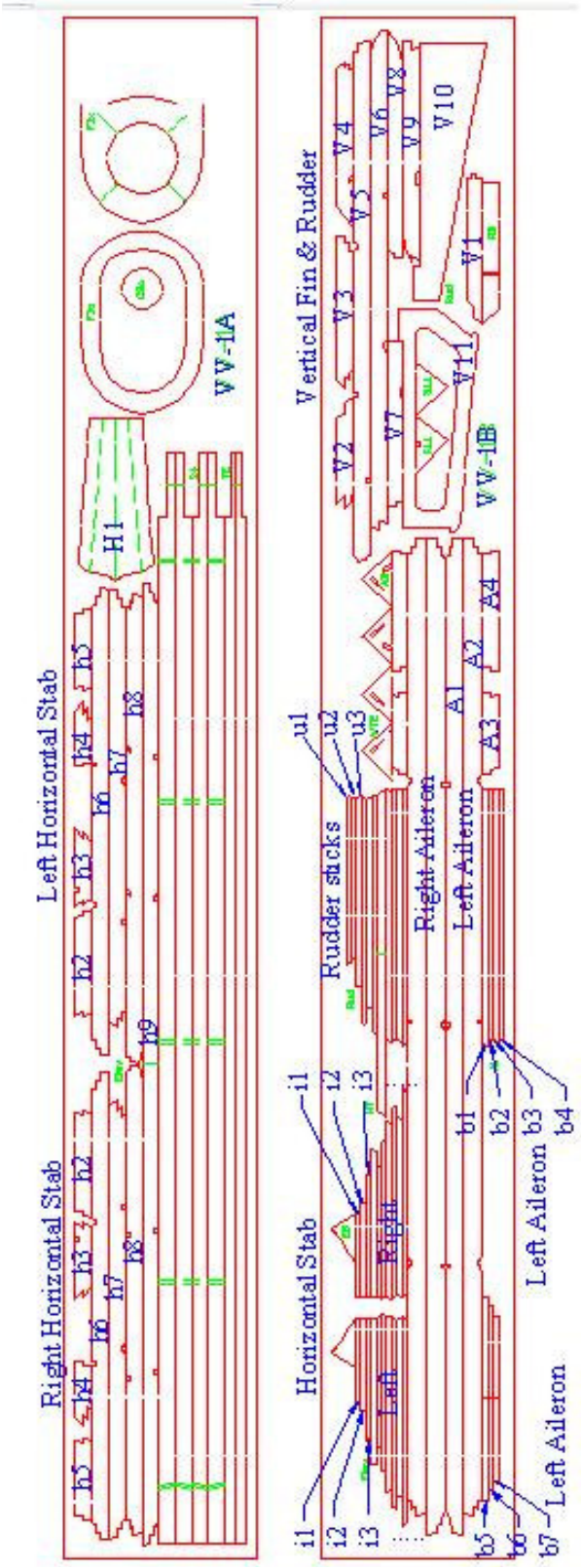
5.1 Kit Contents

Construction guide	This booklet	x1
Design plan	24"x36" Full size plan	x1
Balsa sheets	VV-1A 1/8 balsa	x1
	VV-1B 1/8 balsa	x1
	VV-2 1/16 balsa	x2
	VV-3 1/16 balsa	x1
	VV-4 3/32 balsa	x1
	VV-5 3/32 balsa	x1
	VV-6A 3/32 balsa	x1
	VV-6B 3/32 balsa	x1
	1/32x3x16 Wing central cover	x1
Balsa sticks	1/16x1/8x18 Fuse and wing stringers	x30
Plywood	1/32 ply	x1
Piano Wires	0.078" Pre-bent landing gear	x1
	0.032 pre-bent tail gear	x1
	0.032"x18" Push rods	X2
Misc.	Clear Canopy	x1
	Transparent tape	x1
	Carbon Fiber push rod, 12" long	x1
"Goody bag"	Canopy hold down magnet (x2), 1/8" wooden dowel, heat shrink tube 3", Kevlar thread, landing gear tie wires, wire exit guides, rubber band, double sided tape, etc.	x1

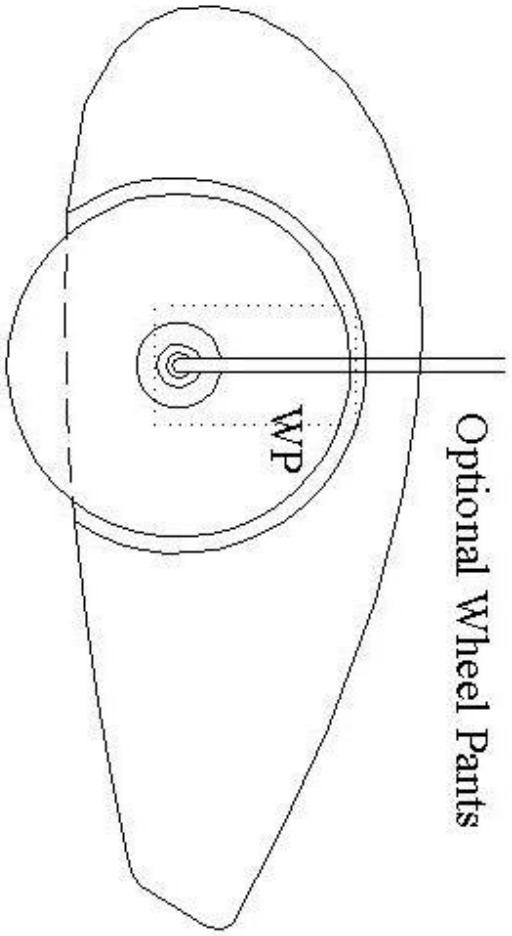
5.2 Fuselage Parts Identification



5.3 Stab and Aileron Parts Identification



5.4 Wheel Pants Template



5.5 Spinner Template