



DOWNLOAD PLANS

Free Yin-Yang plans are available for download at modelaircraft.org/plans.



01

YIN-YANG

A different kind of twin

By Terry Dunn
Photos by the author
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The Yin-Yang offers an alternative approach to twin-engine aircraft design. It uses an asymmetric layout with one tractor motor and one pusher motor. Despite its unusual appearance, this airplane is quite simple and easy to build. The completed model is a quick and aerobatic park flyer.

I have always been fascinated by unorthodox aircraft designs. As far as I'm concerned, the more unusual, the better. The array of available building materials and inexpensive electric components help to fuel my curiosity. I've often found that I can sketch up a crazy idea and have a simple prototype ready for flight with just a few hours of work. The Yin-Yang is one such example.

Building the Yin-Yang

According to the plans, the Yin-Yang is built using two 30 x 20-inch foam board sheets. This is an inexpensive material. I use Adam's Readi-Board from Dollar Tree. It's hard to complain about a \$2 airframe! Other brands of foam board tend to be heavier and more expensive.

Foam board is easy to work with after you get the hang of a few basic techniques. Those who are familiar with Flite Test and its foam board RC models will feel right at home with the Yin-Yang. The primary difference is that I use traditional adhesives on my foam board models rather than hot glue. Anyone who has ever left a hot-glued model inside a car on a summer day will understand my aversion to that method.

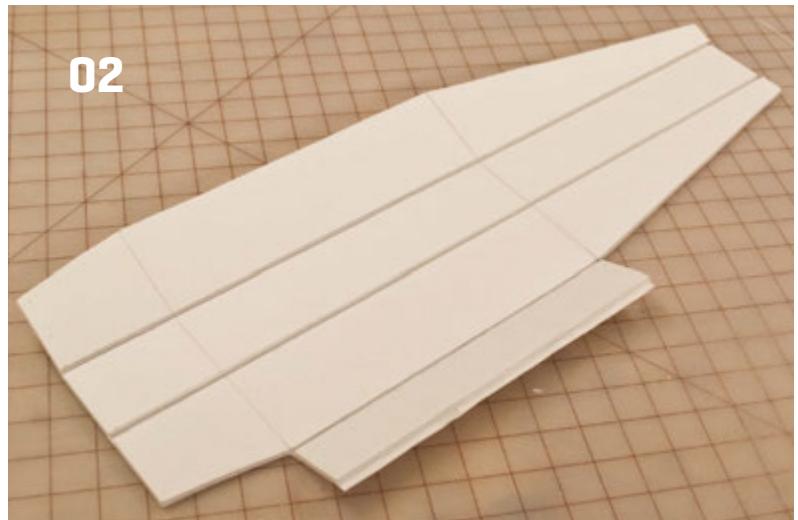
My primary adhesive for assembling foam board models is Elmer's white glue. Yes, that's the same stuff you used in elementary school. It is inexpensive, dries clear, and bonds foam board (and the plywood firewalls) quite well. The drying time of a few hours might be more than you're used to. It's rarely a problem for me because I can work on other parts of the airframe while the glue dries.

I use toothpicks to reinforce high-stress joints such as the firewalls and wing attachment points. All you have to do is dip the end of the toothpick in glue and push it into place. You can then trim away the protruding bits of toothpick when the glue has dried. It is a simple technique that adds a remarkable amount of strength.

If you have never built a model airplane with foam board, I suggest that you give it a try before dismissing it. It is a surprisingly versatile material. The real novelty of the Yin-Yang, however, is its asymmetric layout. This can be re-created with any other modeling



02



03



material that you prefer (at any size). Do not be afraid to use the plans as a starting point for your own foam or balsa adaptation of this design.

The plans include detailed instructions for building the Yin-Yang, so there's no need to get too detailed here. My best advice is to make sure that you keep your blades sharp. Foam board will dull a #11 hobby blade rather quickly. I use disposable razor blades for most of my straight cuts and save my hobby knife for the more intricate areas.

A variety of power systems can be used in the Yin-Yang. My prototype uses a pair of ElectriFly RimFire 250 motors with counter-rotating 5 x 4.5 BN-series propellers from Master Airscrew. Two 3S 450 mAh LiPo batteries from China Hobby Line and ElectriFly 8-amp ESCs round out the power system. This is a nice, lightweight setup with plenty of power for easy launches and big aerobatics.

Subsequent examples of the Yin-Yang have been powered with Emax 2204-2300 Kv motors, 12-amp ESCs, the

01. The Yin-Yang might look strange, but there are no oddities to its flight behavior. It is a quick and nimble sport model.

02. Working with foam board is easy when you've learned a few basic skills. Foam board models can be built inexpensively.

03. Most of the airframe is constructed using ordinary white glue. It bonds well and is easy to work with.

04. Toothpicks work well to reinforce the airplane's high-stress joints.

YIN-YANG

05. Using foam board to build the Yin-Yang allows for quick and simple assembly.

same Master Airscrew propellers, and 2S or 3S 850 mAh LiPo batteries. This setup weighs slightly more but provides tremendous power. This is the way to go if you like to push the limits.

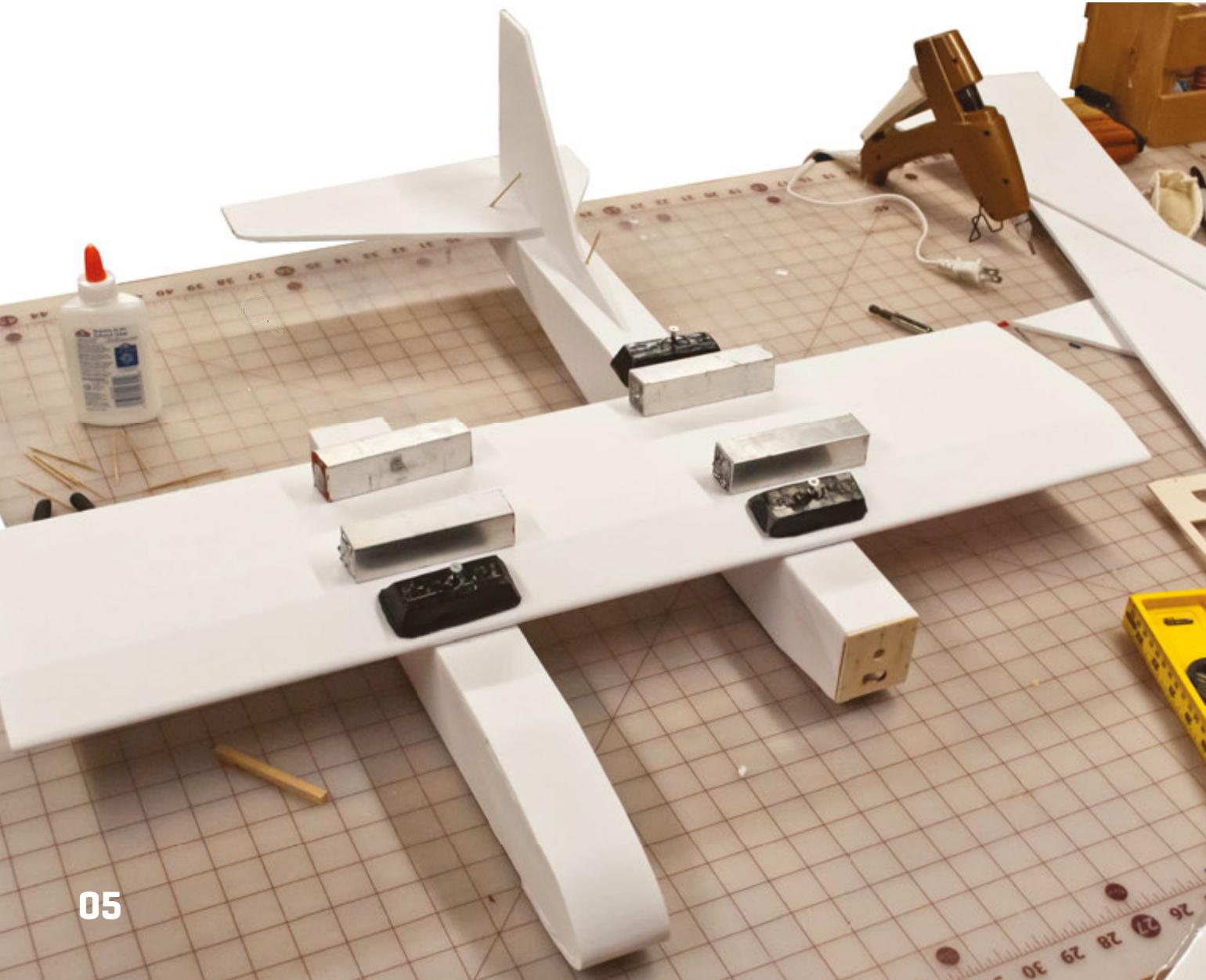
The Yin-Yang requires a minimum of three channels, so the radio setup is straightforward. The elevator and ailerons are controlled by Hitec HS-55 servos connected to each control surface. Servo extensions in the wing's center section connect the ESC and servos in the left fuselage to the receiver located in the right side of the fuselage. I disabled the BEC of one ESC (by removing the red wire from the receiver connector) to avoid any potential issues with parallel power sources to the receiver.

If you also want yaw control for your Yin-Yang, I suggest implementing differential thrust. It significantly expands the model's aerobatic abilities. Most

modern radio systems can accommodate differential thrust. The specific programming, however, can vary from radio to radio. An internet search noting your specific transmitter model is sure to yield examples of differential thrust mixes that you can use as a guide.

I use Du-Bro Micro Razor Control Horns on all of the control surfaces. They are easy to install on foam board models. My aileron pushrods are made of .047-inch music wire with Z-bends on both ends. If you prefer to have some adjustability, you can use a Du-Bro Micro E/Z Connector on one end. Du-Bro Micro Pushrods in .047-inch diameter work well for the elevator.

Standard foam board does not handle damp or humid conditions well. The paper laminate will wrinkle and warp the airframe out of shape. Painting





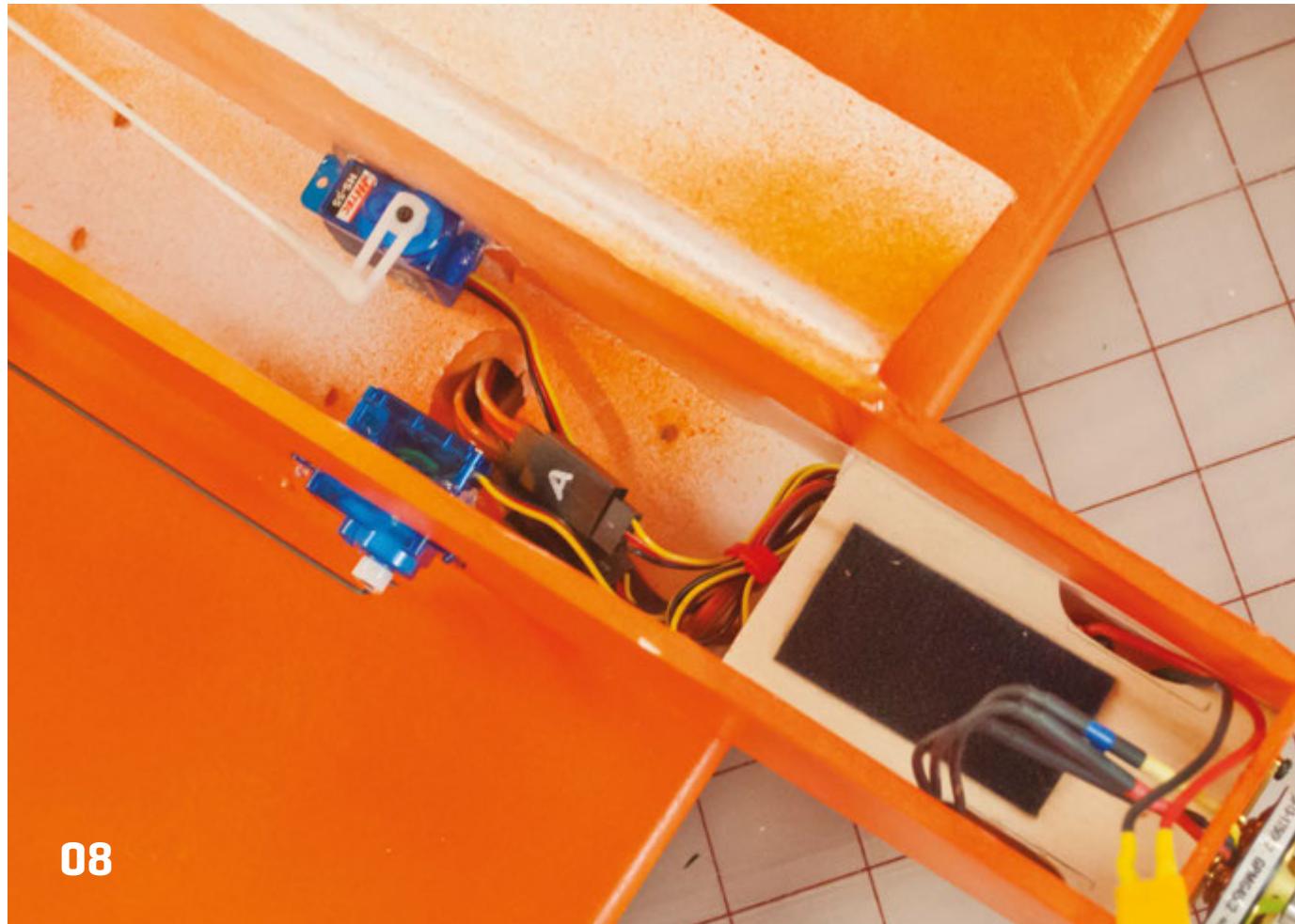
the foam board protects against this tendency. I use standard spray paint. It is important to apply the paint in numerous light coats to achieve a good finish. Another option is to use the waterproof foam board that is available from Flite Test. Be sure to decorate your Yin-Yang with contrasting colors and patterns that will accentuate the model's orientation in flight.

06. Servo extensions are routed through the wing to connect the ESC and servos in the left fuselage to the receiver in the right fuselage.



When balancing the Yin-Yang, consider lateral (left-right) balance, as well as fore-aft balance. The lateral balance point should be in the middle of the wing spanwise. You might need to add a nail or other ballast in one of the wing-tips to correct any lateral imbalance. The fore/aft balance can typically be achieved with battery placement.

07. The author uses Du-Bro Micro Razor Control Horns on all control surfaces because they are easy to install on foam board models.



08. The control setup is simple with this model. The servos can be glued into place with epoxy or hot glue.



At a Glance



Specifications

Wingspan: 30 inches

Length: 29.5 inches

Wing area: 233 sq. in.; 1.6 sq. ft.

Control throws: All surfaces: +/- .5 inches (high rate); +/- .25 inches (low rate)

Power system: Two 75- to 150-watt brushless power systems. Prototype uses two ElectriFly RimFire 250 brushless motors; two ElectriFly SS-8 8-amp ESCs; Master Airscrew 5 x 4.5 BN-series propellers; two 3S 450 mAh LiPo batteries; three Hitec HS-55 micro servos

Radio: Three-plus-channel transmitter and mini receiver

Flying weight: 15 to 20 ounces

Flying the Yin-Yang

With no landing gear, you'll need a hand launch to get the Yin-Yang airborne. I prefer to grasp the left fuselage just behind the wing, power up to 1/2 to 3/4 throttle, and give the airplane a gentle, underhand toss. I release the model in a slight upward trajectory and it departs with no drama.

Aileron authority is particularly good with the Yin-Yang. Rolls are fast and crisp. In fact, I reserve high-rate throws for hot-dogging. Low rates are perfectly fine for most of my flying with this airplane.

There is plenty of power and control for nearly any three-channel aerobatic move that you can dream up. With

differential thrust, you can add yaw-dependent maneuvers as well (spins, stall turns, wingovers, etc.). The airplane has a light wing loading, so recovering from any botched maneuver is easy to do without losing much altitude.

You might need some time to adjust to the unusual planform of the Yin-Yang in flight. Visual orientation can be challenging, simply because it doesn't look like a normal airplane. That's why I like to paint mine in bright colors with a white and black yin-yang symbol on the left wing.

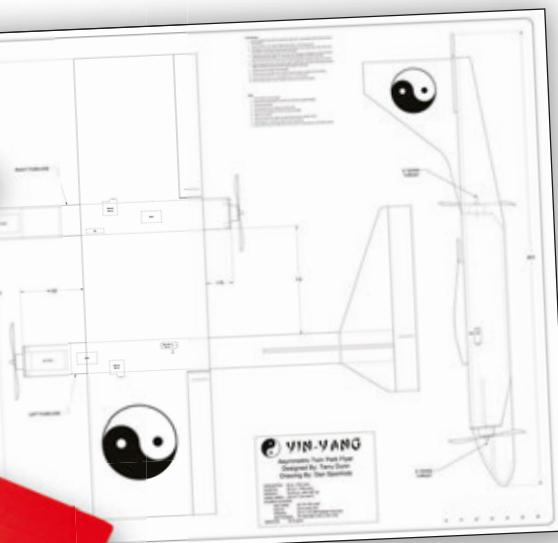
The right and left motors are fed by separate batteries, so it is possible for one side to run out of juice before the other. Be conservative with your flight times and come in for a landing while you still have power on both sides. If you ever do lose a motor in flight, your best bet is to kill the good motor and glide in for an immediate landing.

Speaking of landing the Yin-Yang, there's nothing to it. Just pull back the



09



11**12**

power and glide it to the ground. A nice approach will let you float in ground effect for just a bit before belly-sliding to a stop.

Final Approach

As with my other asymmetric designs, I do not claim

any performance advantages because of the Yin-Yang's unique layout. Rather, it is a fun reminder that we have a lot of latitude when designing and building flying machines. Break from the norm every now and then and explore your weird side. It's always fun to show up at the flying field with something unique. 

SOURCES:

China Hobby Line

www.chinahobbyline.com

Dollar Tree

www.dollartree.com

Du-Bro Products

(847) 526-2136

www.dubro.com

ElectriFly

(800) 338-4639

www.greatplanes.com

Emax USA

www.emax-usa.com

Flite Test

(855) 669-2647

www.flitetest.com

Hitec RCD

(858) 748-6948

www.hitecrcd.com

Master Airscrew

(916) 631-8385

www.masterairscrew.com

R.L. Adams Plastics

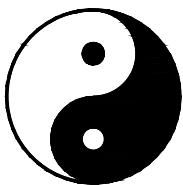
(616) 261-4400

www.goadams.com

09–10. The prototype Yin-Yang is powered by RimFire 250 motors. Subsequent models have used Emax 2204-2300 Kv motors. Both work well.

11. Paint is necessary to weatherproof the airframe. The author prefers to use spray paint in bright, contrasting colors.

12. Free Yin-Yang plans are available for download at modelaircraft.org/plans.



YIN-YANG

Designed By: Terry Dunn

Drawing By: Dan Sponholz

Version: 1.0

Date: 2020.09.21



General Specifications:

Length:	29.5 in (749 mm)
Center of Gravity:	2.0 in (51 mm)
Wingspan:	30.0 in (762 mm)
Wing Area:	233 in ² (15.0 dm ²)
Dry Weight:	12.5 oz. (355 g)
All Up Weight:	15-20 oz. (425-567 g)
Wing Loading:	9.3-12.4 oz/ft ² (28-38 g/dm ²)
Wing Cubic Loading:	7.3-9.7

Recommended Settings:

Channels:	4 (T A E + Differential)
Throws:	High = +/- .5" Low = +/- .25"
Expo:	30%

Recommended Electronics:

Motors:	2X 75-150 watt
Propellers:	2X 5 x 4.5 BN Master Airscrew
ESCs:	2X 8 amp min.
Servos:	3X 9 gram
Batteries:	2X 450-850 mAh 2-3S LiPo

Material:

This model is designed to be built with 3/16 inch thick x 20 x 30 inch ADAMS foam board with a weight per sheet of approximately 4 oz. The foam board can be purchased from Flite Test or local Dollar Tree stores. Use of heavier foam boards may affect flight performance.

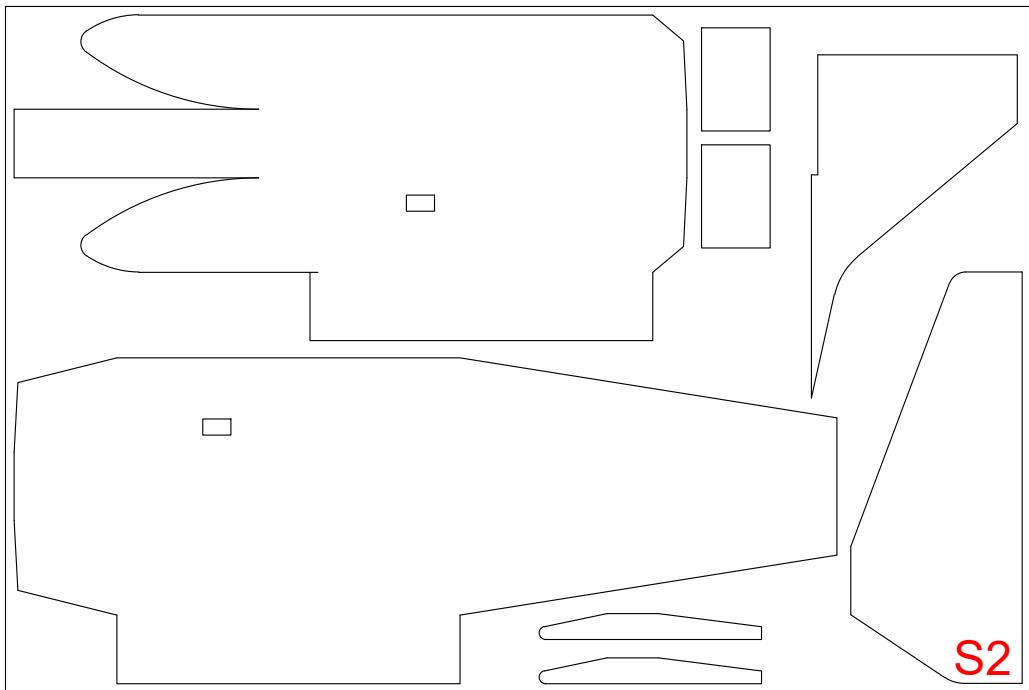
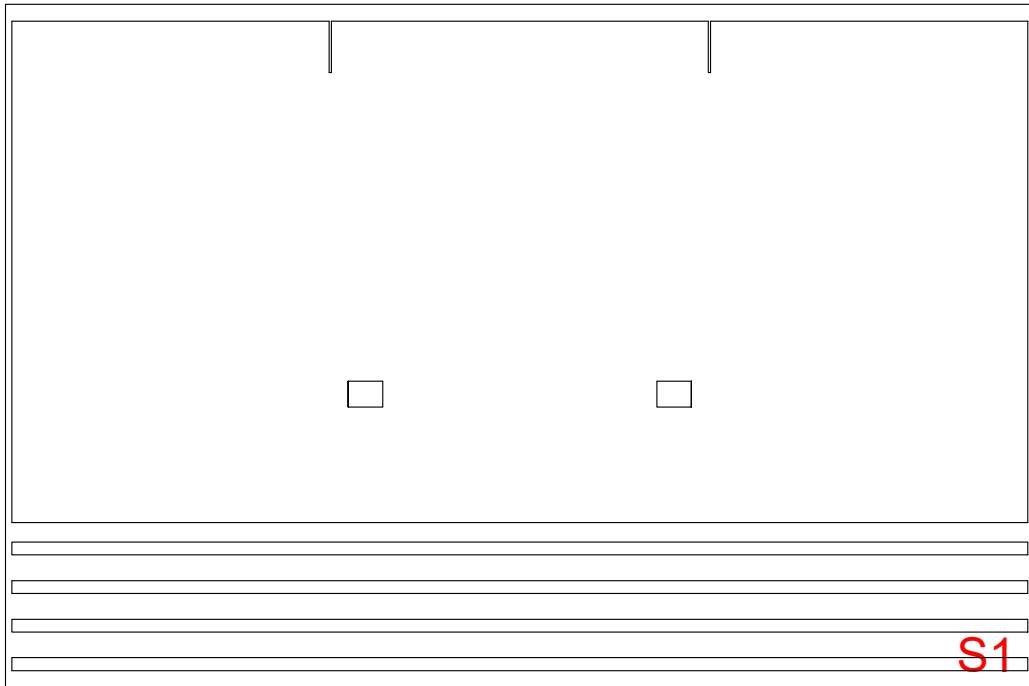
BUILD SKILL LEVEL:



PILOT SKILL LEVEL:



Yin-Yang: Full-Size Key

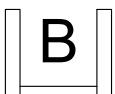


Drawing Key

FOLD TYPES



A - FOLD (ABOVE)

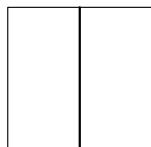


B - FOLD (BESIDE)

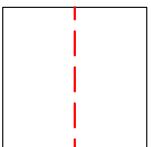


C - FOLD (COVER)

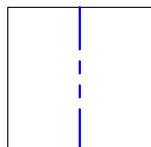
LINE TYPE/COLOR



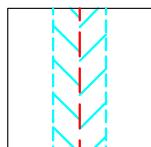
CUT



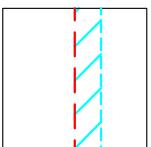
50% SCORE



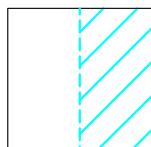
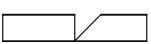
CREASE



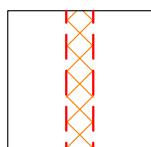
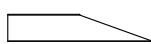
45° DOUBLE
BEVEL



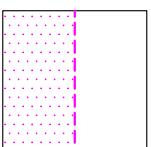
45° SINGLE
BEVEL



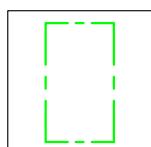
EDGE
BEVEL



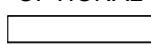
CAVITY



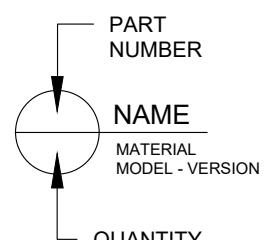
REMOVE
PAPER



REFERENCE/
OPTIONAL



SYMBOLS

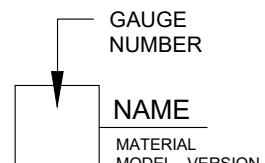


PART
NUMBER

NAME

MATERIAL
MODEL - VERSION

QUANTITY



GAUGE
NUMBER

NAME

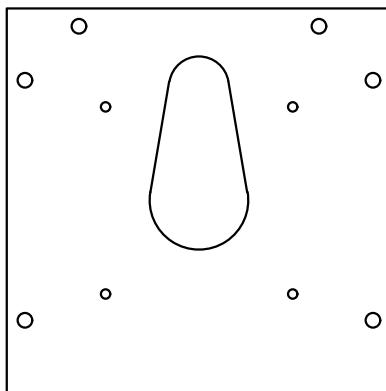
MATERIAL
MODEL - VERSION



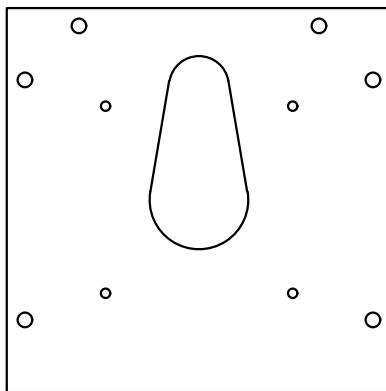
CENTER
OF
GRAVITY
(CG)

Yin-Yang: Wood Parts

HOBBY GRADE PLYWOOD
3/32" (2.4 mm) THICK



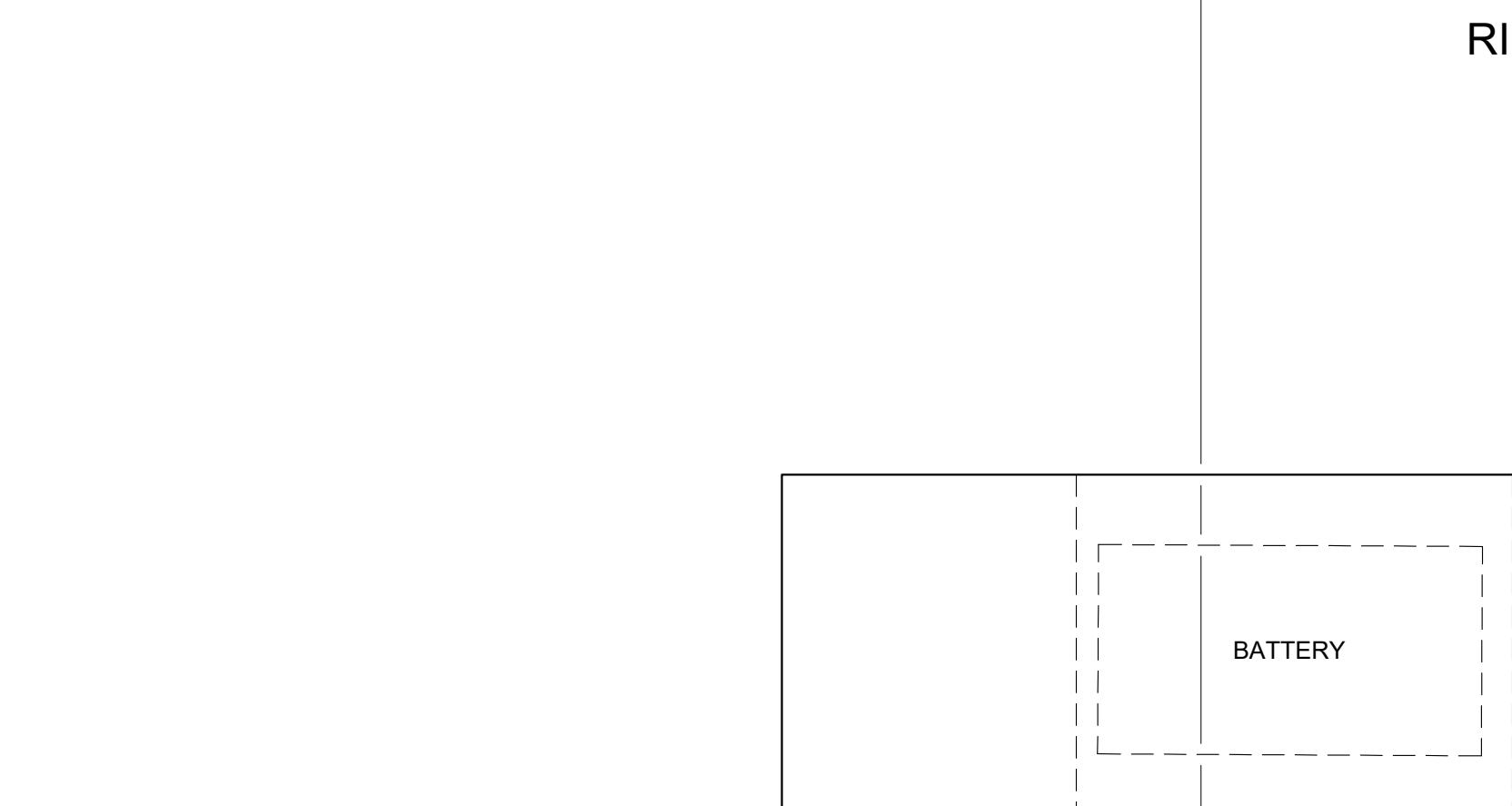
PLYWOOD FIREWALL
2 REQUIRED



Yin-Yang Build Directions:

Wing

- The wing is built from a single sheet of 30" x 20" foamboard.
- Cut four 30" x 3/8" wide strips from the foamboard.
- Create a wing spar by gluing one strip on top of another (paper to paper) using a thin film of Elmer's white glue. Use tape or tape to stabilize the parts and allow several hours for the glue to dry.
- Create a second wing spar by repeating step 3 using the remaining two strips.
- While the spars are drying, cut the wing outline from the foamboard. Also cut the servo wire exits as shown.
- Decide which side of the foamboard will be the inside surface and mark it with a pencil. All marks and cuts will be made on this inside surface.
- Referencing the plans, mark the inside surface of the wing with the locations of the wing leading edge, the top skin cuts, and the ailerons.
- Using a sharp hobby knife or razor blade, slice the foamboard along the leading edge line. Be very careful to cut through only the inside paper layer and foam. Do not cut through the outer paper layer.
- Fold the foamboard 180-degrees along the leading edge cut.
- Cut a 45-degree bevel along each side of the fold. Be careful to avoid cutting through the outer paper at the fold.
- Carefully fold the foamboard in the opposite direction. Apply gentle pressure along the fold until you create a nice rounded shape on the outside surface of the leading edge.
- Lay the wing panel flat on the table and slice the inside surface of the foamboard along the two top skin lines. Do not cut through the outer paper layer.
- Run the thin edge of a craft stick along the cuts to create a slight gap in the foam. This will allow the top skin to fold inward along the cuts.
- Once the spars are fully dried, glue them to the bottom skin of the wing panel (paper to paper) with Elmer's white glue.
- Apply a thin layer of Elmer's white glue to the following areas:
 - The top of both spars
 - The rear 1/8" of the inner surface of the bottom skin
 - The beveled faces of the leading edge
- With the bottom of the wing panel on a flat table, carefully fold over the top skin until it contacts the spars in the midsection and the rear edge of the bottom skin. The ailerons on the top skin should protrude past the rear of the bottom skin.
- Set weights on the top of the wing along the spars and trailing edge. Allow to dry for several hours.
- Use scrap foam to cover the open wing tips.



- Right and Left Fuselage**
- With careful planning the remaining airframe components can be cut from a single piece of 30" x 20" foamboard.
 - Cut out the Left Fuselage; Right Fuselage, Horizontal stabilizer, Vertical Stabilizer, and two battery trays.
 - Cut out the servo wire exits from the Left Fuselage and Right Fuselage.
 - Decide which side of the foamboard will be the inside surface of the Left Fuselage and mark it with a pencil. All marks and cuts will be made on this inside surface.
 - Cut and remove the foam and inner layer of paper where indicated on the plans. Be very careful to cut through only the inside paper layer and foam. Do not cut through the outer paper layer. The foam should be removed from the inside paper layer of paper with light pressure.
 - Make relief cuts on the Right Fuselage where indicated on the plans. Be very careful to cut through only the inside paper layer and foam. Do not cut through the outer paper layer. Remove the paper between these cuts.
 - Lay the Right Fuselage flat on the building surface with the inside surface facing up.
 - Apply a light layer of white glue to the edge of each side panel where they meet the top panel.
 - Rotate the side panels so they are vertical and the edge of each panel sits on the top panel.
 - Use tape and/or weights to hold the side panels in position and allow the glue to dry for several hours.
 - Repeat steps 7-10 on the Left Fuselage.
 - Remove the paper layer from one side of each battery tray.
 - Optional: Glue a strip of thin plywood (1/64" to 3/32"-thick) to the bare side of each Battery Tray.
 - Glue a strip of Hook-and-Loop tape to each Battery Tray using 5-Minute epoxy. If present, glue to the optional plywood strip.
 - Apply a layer of white glue to the side edges of each Battery Tray and install them in the Right and Left Fuselage.
 - Apply a thin layer of white glue to the edges of the forward Fuselage sides where the top panel wraps around.
 - Set the top panel of the Right Fuselage in place. Use low-tack masking tape to keep the top panel in position until the glue has dried.

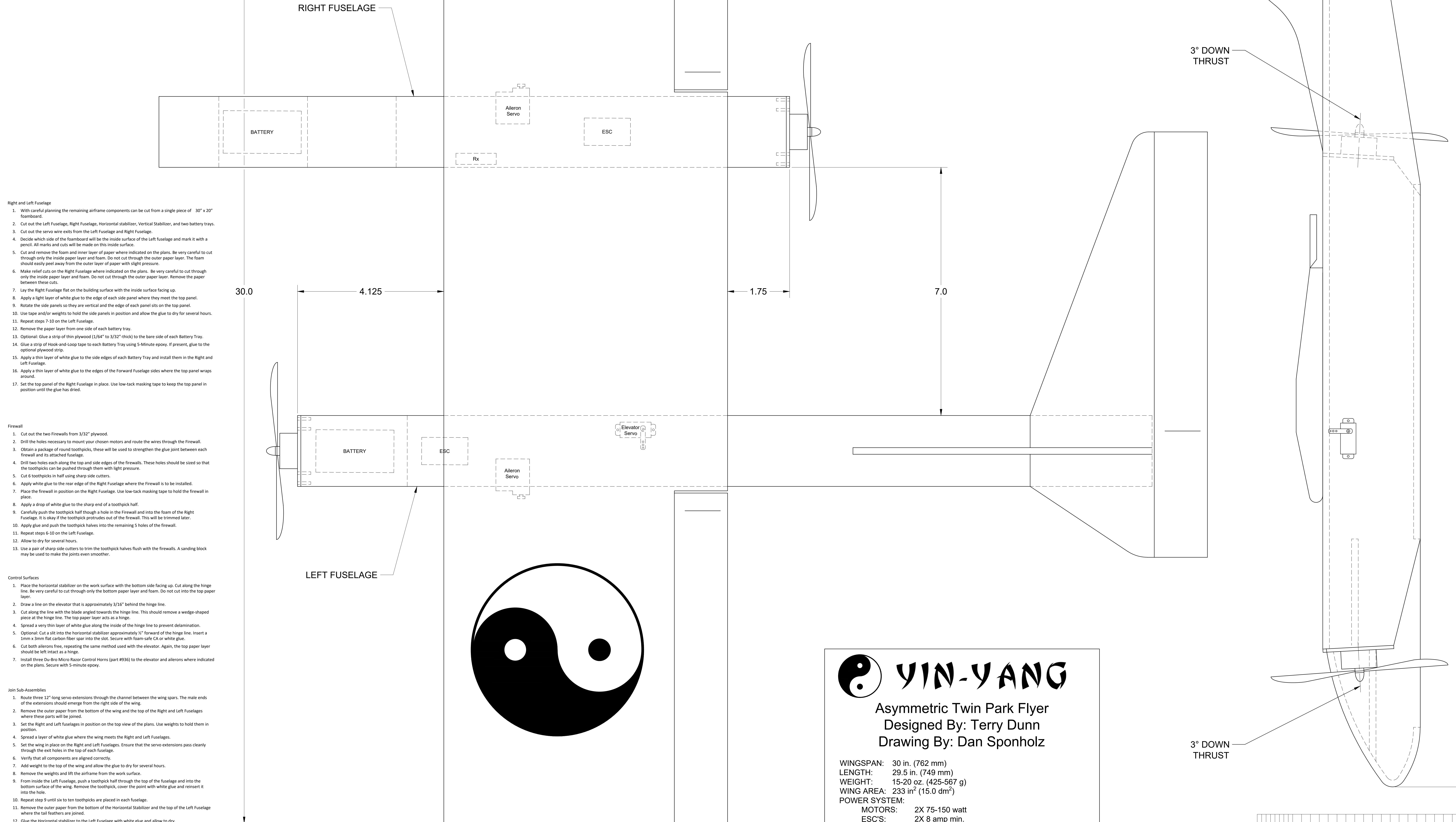
- Firewall**
- Cut out the two Firewall from 3/32" Plywood.
 - Bore holes necessary to mount the chosen motors and route the wires through the Firewall.
 - Obtain a package of round toothpicks, these will be used to strengthen the glue point between each firewall and its attached fuselage.
 - Drill two holes each along the top and side edges of the firewalls. These holes should be so tight that the toothpicks can be pushed through them with light pressure.
 - Cut 6 toothpicks in half using sharp side cutters.
 - Apply white glue to the rear edge of the Right Fuselage where the Firewall is to be installed.
 - Place the firewall in position on the Right Fuselage. Use low-tack masking tape to hold the firewall in place.
 - Apply a drop of white glue to the sharp end of a toothpick half.
 - Carry the point of toothpick half through a hole in the firewall and into the foam of the Right Fuselage. It is okay if the toothpick protrudes out of the firewall. This will be trimmed later.
 - Apply glue and push the toothpick halves into the remaining 5 holes of the firewall.
 - Repeat steps 6-10 on the Left Fuselage.
 - Allow to dry for several hours.
 - Use a pair of sharp side cutters to trim the toothpick halves flush with the firewalls. A sanding block may be used to make the joints even smoother.

- Control Surfaces**
- Place the horizontal stabilizer on the work surface with the bottom side facing up. Cut along the hinge line. Be very careful to cut through only the bottom paper layer and foam. Do not cut into the top paper layer.
 - Draw a line on the elevator that is approximately 3/16" behind the hinge line.
 - Cut along the line with the blade angled towards the hinge line. This should remove a wedge-shaped piece at the hinge line. The top paper layer acts as a hinge.
 - Spread a very thin layer of white glue along the inside of the hinge line to prevent delamination.
 - Optional: Cut a slit into the horizontal stabilizer approximately 1/8" forward of the hinge line. Insert a 1mm x 3mm flat carbon fiber spar into the slot. Secure with foam-safe CA or white glue.
 - Cut both ailerons free, repeating the same method used with the elevator. Again, the top paper layer should be left intact as a hinge.
 - Install three Du-Bro Micro Razer Control Horns (part #936) to the elevator and ailerons where indicated on the plans. Secure with 5-minute epoxy.

- Join Sub-Assemblies**
- Route three 1/2"-long servo extensions through the channel between the wing spars. The male ends of the extensions should emerge from the right side of the wing.
 - Remove the outer paper from the bottom of the wing and the top of the Right and Left Fuselages where these parts will be joined.
 - Set the Right and Left Fuselages in position on the top view of the plans. Use weights to hold them in position.
 - Spread a layer of white glue where the wing meets the Right and Left Fuselages.
 - Set the wing in place on the Right and Left Fuselages. Ensure that the servo extensions pass cleanly through the exit holes in the top of each fuselage.
 - Verify that all components are seated correctly.
 - Add weight to the top of the wing and allow the glue to dry for several hours.
 - Remove the weights and lift the airframe from the work surface.
 - From inside the Left Fuselage, push a toothpick half through the top of the fuselage and into the bottom surface of the wing. Remove the toothpick, cover the point with white glue and reinsert it into the hole.
 - Repeat step 9 until six to ten toothpicks are placed in each fuselage.
 - Remove the outer paper from the bottom of the Horizontal Stabilizer and the top of the Left Fuselage where the tail feathers are joined.
 - Glue the horizontal stabilizer to the Left Fuselage with white glue and allow to dry.
 - Glue the vertical stabilizer to the Left Fuselage with white glue. Ensure that it is properly aligned and allow to dry.
 - Optional: Add a small brace between the Horizontal and Vertical Stabilizers using a toothpick or small dowel secured with white glue.

- Final Assembly**
- Paint the airframe using common spray paint. Apply paint in several light coats to prevent the foam from warping.
 - Install the receiver in the right fuselage using hot glue or hook-and-loop tape.
 - Cut pockets in the foam as shown and insert Hitec HS-55 servos for each aileron. Secure the servos with white glue.
 - Create silicon pushrods using .047" mach wire. You may use any combination of Z-bends, Mini E/Z Connectors (Du-Bro part #945), or Z-links (Du-Bro part #920) to connect the pushrods.
 - Attach a Hitec HS-55 servo to the inside of the left fuselage where indicated using 5-minute epoxy.
 - Connect the elevator servo to the control surface using a Du-Bro .047" Micro Push Rod System (part #922). Glue the pushrod sleeve to the fuselage using 5-minute epoxy.
 - Install the motors and ESCs to each fuselage.
 - Connect all servos and ESCs to the receiver and ensure proper movement with no binding.
 - Set the control throws to +/ for the ailerons and +/- for the elevator.
 - Fold the bottom panels of each fuselage in place and secure with white glue.

- Flying**
- Insert a battery in each fuselage.
 - Verify that the model balances at 1-3/4" to 2" behind the wing leading edge.
 - Connect both batteries.
 - Verify that both motors respond to throttle inputs.
 - Grasp the Left Fuselage just behind the wing trailing edge.
 - Apply X to Y throttle.
 - Launch the model with a slight nose-high attitude using an underarm motion.
 - Enjoy flying your Yin-Yang! This model is fast and responsive.
 - Be conservative with your flight times to ensure that one motor does not cut off before the other.



YIN-YANG

Designed By: Terry Dunn
Drawing By: Dan Sponholz
Version: 1.0
Date: 2020.09.21



IN [REDACTED] CM [REDACTED]

SHEET 1 OF 2

Template Version 6.0

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1 WING
1 FOAM BOARD
YIN-YANG - v.1.0

45° DOUBLE BEVEL



2

WING SPAR

4 FOAM BOARD
YIN-YANG - v.1.0

2

WING SPAR

4 FOAM BOARD
YIN-YANG - v.1.0

2

WING SPAR

4 FOAM BOARD
YIN-YANG - v.1.0



YIN-YANG

Designed By: Terry Dunn
Drawing By: Dan Sponholz
Version: 1.0
Date: 2020.09.21



IN [REDACTED]
CM [REDACTED]

SHEET 2 OF 2

Template Version 5.0

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