CONVERTING A GOOD GAS DESIGN INTO AN EVEN BETTER 400-450 BRUSHLESS SPORT MODEL

Sport Scale PT-19 Cornell

HISTORY:

As World War II approached, the U.S. Army Air Corp (USAAC) felt a need for a low wing higher performance basic trainer. They were looking for a more demanding basic trainer that would better prepare the fledgling aviators for the high-performance nature of the combat aircraft being developed. This led to the USAAC purchasing the Fairchild PT-19 two-seat monoplane in 1939. And as Mr. Forrest Gump said "That's all I have to say about that".

MODEL DESIGN:

From the start I need to say thanks to Robert Somers and give him the lion's share of the credit for the development of this model. This is actually an article on the process of converting a really good gas design by Bob into an excellent electric. In no way can I take credit for how well it flies. The fact that it has evolved into a great flying electric is grounded in the fact that Bob's initial work produced a light, stable gas model that took minimal effort to rework. His original design was a trussed structure built around an inverted OS Max .10 two-cycle with a 40 inch span and weighing around 30 oz with an empty fuel tank. It had excellent flight characteristics with plenty of power for aerobatics. As I watched him fly it that day my only negative thought was that the .10, being inverted tended to be a little on the finicky side to start. Shortly after seeing it fly our discussions led to the decision to convert the design to a speed 400 sized electric. Bob was gracious enough to loan me his original drawings. As a testament to Bob's original design, the only aerodynamic change made was to lengthen the nose. This helps balance it with the lighter electric motors.

Having acquired an older version of AutoCAD, I decided early on to use it for the design. While having the CAD program on my laptop gives me the capability to work on models while traveling, it also allows a modeler to pick parts off the drawings and set them up for cutting by the various kit cutters. This capability led me to using John Valentine at Top Notch Products for cutting the parts. Besides being very reasonable on price he is willing to work with builders going through the learning process of design layout. Due to the amount of travel with my work, time in my shop is a premium and being able to E-mail a cut file from a hotel and have the parts waiting when I get home is a great advantage. For the diehard scratch builder I have made sure the plans show all the parts so that the short kit is not mandatory.

GAS TO ELECTRIC CONSERNS:

Weight: Having flown glow/gas models all of my existence I must admit that I am one of those dinosaur in the world who has always looked down on electrics as toys. Like most

of my generations I carried the preconceived notion that an electric was going to be heavier and underpowered compared to any glow version. So with this mentality I started work with the idea of cutting weight wherever possible only to find Bob has been an advocate of light construction. If anything, as I made changes to switch to the laser cut parts and ease construction, I ended up adding weight to the basic airframe weight. As the model neared completion I purchased a set of digital scales and had trouble believing I was coming in at around 22 oz. with a 1650ma LiPo ready to fly. Bob and I were both surprised by this and have concluded that the weight savings came about due to the availability of all the new "light" electric hardware available today. The electric motor, ESC, and Battery weigh significantly less than the .10 engine, fuel tank, tubing, the throttle servo and its linkage. Other weight savings came about due to using the lighter micro receivers, servos, foam wheels, and the new lighter hardware available. One other savings came in the use of Solarfilm where Bob had used Monocoat.

Modifications: The initial effort was a trace of Bob's design where I laid out the parts in CAD and replaced the .10 O.S. Max engine with an E-Flite 450 brushless outrunner. I carried the fuselage sides past the original firewall and drew the electric motor mounted to a laminated nose block ending in a plywood nose plate. The motor is accessed through a removable top hatch. The primary advantage to mounting the motor this way was that it did away with the need for a separate fiberglass cowl. The most significant change at this point was to design the central fuselage into a tabbed and slotted box design that made it easier to build the fuselage straight. Also not wanting to have to turn the model on its back or take it apart to change batteries I designed the cockpit area to be a removable hatch giving access to the flight battery and servos. Both the motor and battery hatch are held down with rare earth magnets. The only other change I made was to change the landing gear mounting from solid hardwood blocks to build up plywood assemblies. This was done for those modelers who don't have a small saw to do the slotting work required.

Evolution: Once the prototype flew (I had two cut) life was good and I had my first electric. But unlike anything in the past, I could not leave it alone. I think the fact that CAD can be manipulated so easily has a lot to do with this. Most of these changes were inputs form friends and other builders (yes grasshopper, not all builders are your friend) who always seem to have a better way to do it. Every time I have put it aside someone comes up with a better idea for a new "widget" and we would end up testing it on the PT-19 drawings. Things like the hatch skin, all the wing components, tail components and even the stringers for the turtleback have been changed and added to the short kit. In this the last version the airframe is completely self-aligning sheet wood with everything included in the short kit but the hardwood blocks and hardware.

CONSTRUCTION

Wing: The wing construction evolved from a traditional method of slotted leading and trailing edges to a more modern version using all laser cut parts. Cover your plans with wax paper and pin the lower spar to the plans (If you can't get hard balsa I would use bass as the strength is worth the little weight gain). Fit R-1, R-2's, R-3's and R-3T over the lower spar and into false trailing edge notches (Note R-3T is slotted to accept the

wing tip former). Ensuring the ribs are aligned to the plans and perpendicular with spars, pin them to the building board. Glue them to the lower spar and notched false trailing edge using thin CA. Glue the top spar to the ribs and install the notched false leading edge. (Note that if using the short kit the bevel for dihedral is already cut and you need to orient it the right way) Install 1/8" leading edge and 1/4" trailing edge. Install 1/16" Plywood R-2A's and the 3/32" sheer webbing centered between the upper and lower spar. Grain should be vertical or perpendicular to the spar grain. Install the aileron servo mounting plates. Tubes to route aileron servo wires are made up of scrap paper and glued between R-1 and R-2 prior to joining wing halves and planking center section. Shape leading and trailing edge using razor plane and sanding blocks. All the material is included in the short kit as I even laser cut the center section planking.

Wingtip: Glue the wing tip formers to R-3T. Glue wing tip braces R-5 through R-8 to the top and bottom of the wing tip former (Note: This will require bevel sanding for proper fit where the braces meet R-3T). Glue a set of T-1, T-2 and T-3 to the top and bottom of each wingtip. Glue T-9 to top and bottom of each wingtip. Shape wing tip using razor plane and sanding blocks.

Joining the Wing Halves: The Wing panels are joined using epoxied 1/8" ply doublers. Install the 1/8" center rib centering to allow for 1/16" planking. Place scrap balsa on both sides of the center rib to provide material for the wing dowel mounting. Install 1/16" square stock across leading edge, spar and trailing edge for center planking to glue to. Plank the center section using 1/16" balsa. Install 3/16" dowel in wing center.

Installing Landing Gear blocks: Build up the left and right landing gear block assemblies by gluing two L-2 to an L-1 with spacing for 1/8" music wire. Glue up two sets of three L-3 into a stack and attach to R-1. Glue the landing gear blocks to the L-3 stack and ribs, using epoxy. The main landing gear is bent from one eighth inch music wire and held in place with tin straps and servo screws.

Fuselage: Pin one fuselage side assembly flat on the building board and install F-3, the battery compartment floor, wing hold down bracket, and F-4. Insuring the fuselage is not twisted Install second fuselage side. Pull the side formers together and install F-2. Build up the motor mount and nose block by gluing up two F-1s with F-1A through F-1C using epoxy. Install the nose block/motor mount assembly using epoxy. Glue in F-5 through F-8. Ensuring the fuselage is symmetrical and not twisted bring the two sides together gluing them at the rudder post. Glue in ¼" triangular stock along the lower fuselage sides between the wing mount and the rudder post and between F-2 and F-3 (This triangular stock provides material to sand the lower fuselage sides to a rounded corner). Using 3/32"balsa planks the fuselage top between F-2 and F-3. Plank the lower fuselage between F-2 and F-3 with 1/8" Balsa sheet. Plank the lower rear fuselage with 1/16" balsa. Glue in 1/16" X 1/8" balsa or basswood stringers on the turtleback. Shape the bottom edges of the fuselage. Using 1/4" balsa sheet build up top and bottom areas between F-1 and F- 2 with balsa blocks. (Do not glue permanent). Shape the nose blocks along with the bottom and top hatch blocks (To expedite the process a power disc and belt sander was used to rough sand the prototype to a rough shape). Hollow out the upper

and lower blocks to one quarter inch thickness. Using epoxy glue the bottom block between F-2 and Nose blocks (This block is critical as it carries motor stress back into the fuselage). Add guide blocks to the bottom of the upper block to align it with the fuselage sides. Install the pushrods for the rudder and elevator. Glue 1/16" X 1/8" balsa stringers to turtleback.

Hatch Construction: On a flat surface covered with wax paper glue up hatch skin. Glue the three F-3A to the battery hatch base. Glue four 1/16" X 1/8" stringers into the notches in F-3A's. With the battery hatch base on the edge of a flat table, starting at the centerline, hold down one side of the hatch skin allowing the excess skin to over hang the table as you glue it. Trim the excess skin off allowing the hatch to rest flat on the table surface then glue down the other side. Add scrap balsa strips to each side of the base of the hatch to align it with the fuselage sides. Cut out cockpit openings.

Tail Surfaces: These are built over the plans. The only thing of note is to cover the horizontal and vertical fin prior to mounting them on the fuselage. The area where the vertical fin meets the horizontal stabilizer is filled in with balsa blocks and covered in blue after they are installed.

Covering: The various prototypes have been covered with everything from Solar-film to Econocoat. A slight weight savings comes with the film type covering but the weight difference does not have that any effect on flying and as my planes get a lot of hanger rash in the back of the car the stronger coverings hold up better.

Final Assembly: The motor used is the E Flite 450 Outrunner using a 10x5E or 10x7E APC propeller. It is rated for 14 amps and for scale models in the 30 oz weight range. Any motor in that range should work. Power is provided by an 18 amp Castle Creations ESC and Li Po 3S 1650 to 2000ma batteries by Common Sense RC. The motor current is set up using an Astro-Flight watt meter at 10 to 12 amps static using the ATV function on the transmitter. The transmitter used was a Futaba 8U transmitter with the flight pack made up of a Castle Creations 4 channel receiver with two HS-81 servos (Rudder, and Elevators) along with two HS-55 (Ailerons). The receiver along with rudder and elevator servos are mounted to the battery compartment floor, with the aileron servos mounted in the wings. Dubro aileron linkage and park flyer pushrods are used through out. Main wheels are E-Flite 2.5 inch diameter with a .75 inch diameter E-Flite tail wheel.

Flying: Just like Bob's original gas version the electric PT-19 is a pleasure to fly. It is the one model in my life that I can truly say flew right off the building board. If I had to compare it to anything out there on the commercial market I would say it is most like the Sig Four Star. The first flight was off a parking lot, but with 2 or 2 1/4 wheels I fly it off short grass. Airborne the PT-19 is not twitchy and tracks straight with good response. Elevator throws should be limited to the 3/8 inch range for the first few flights. It is a true sport model which is able to do aerobatics with ease. Large loops, inverted flight, stall turns, snap rolls, aileron rolls and spins are a breeze. With the 2000 ma flight packs and my flying style (half to three quarter throttle) flights are approximately 15 minutes leaving the battery only warm to the touch on landing. At a weight of twenty five ounces

it is best in light air but can easily handle mid afternoon breezes. Turnaround time between flights is less than a minute due to the easy access to the battery compartment.

Landings: do not require anything out of the ordinary. Keep the nose down and carry a little power on approach. Flare holding the nose up and let it settle.

Takeoffs: are a breeze with its wide gear and long tail. It tracks straight with no tendency to swing on take off. Of course if you use the 450 sized motor it only needs about twenty feet of runway to pull it off.

So why would you want to switch from gas and build an electric model? One of mine stays in the back of my Honda pretty much all season. As my club field is ten minutes away, I manage to slip away at lunch for a couple of ten minute flights even on days I have to wear a tie. I can also stop by a local church parking lot on the way home for a couple of hops. Everywhere I take it people ask me who makes it and I get to tell them it is scratch built. The self pride that comes from that will make it hard to go back to ARFs.

As in all my projects I did not do it alone and would like to give credit to Robert Somers for his design input, Callie's Graphics for the custom decals and John Valentine of Top Notch Products for the short kits.

Control Throws: In inches plus / minus /% expo

- Ailerons: 3/8 to 1/2 inch plus and minus
- Rudder: 1/2 inch plus and minus /10% expo
- Elevator: 3/8 to 1/2 inch plus and minus /10% expo

Specifications:

Model name: PT-19 Cornell
Type: Standoff Scale, monoplane, electric.
Wingspan: 40 in.
Weight 22 to 26 oz
Wing area: 300 sq. in.
Wing loading: 12.5 / Sq. ft.
Power system: E-Flite 450 Outrunner/18 Amp ESC/1650 or 2000ma 3S 10-15C LiPo.