By Ivan Pettigrew and Scott Copeland Photos by Ivan Pettigrew

The DH 90 Dragonfly

The last of the de Havilland multi-engine biplanes

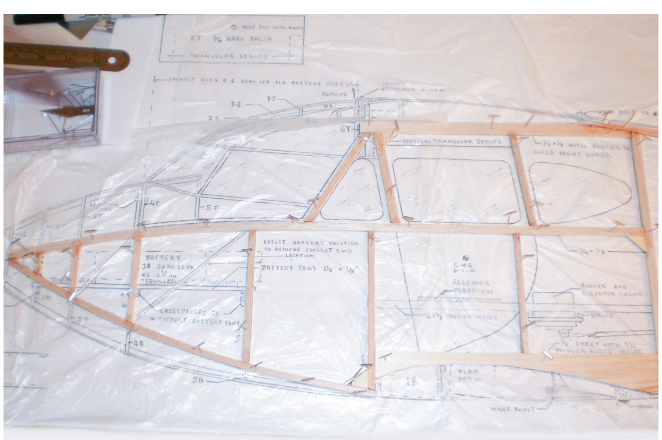
The De Havilland Aircraft Company built a series of multi-engine biplanes in the 1930s and the DH 90 Dragonfly was the last of this series. The first design was the DH 84 Dragon powered by 4-cylinder 130hp Gypsy Major inline inverted engines. The DH 86 Express was next, powered by four Gypsy Six engines. The DH 89 Rapide was the third, utilizing two 6-cylinder Gypsy Queen engines. Last but not least, was the Dragonfly. In some ways it was like a scaled-down Rapide. It used twin 4-cylinder Gypsy Major engines and carried four passengers in addition to the pilot.

FUSELAGE

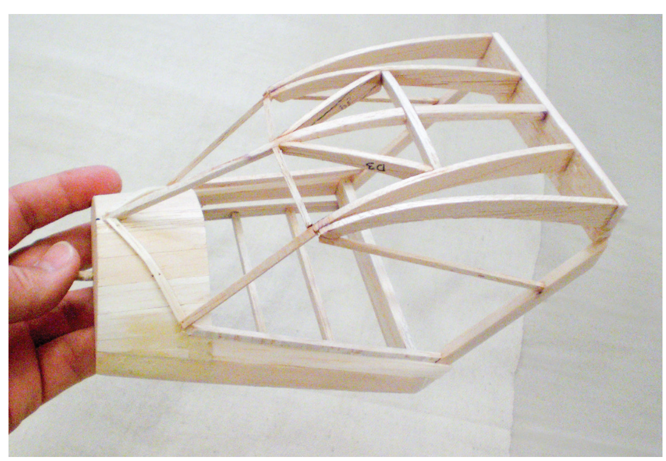
For most wood construction, I use regular carpenter's glue. It gives time to set the parts in the correct position, and when building a box fuselage structure, it is much stronger than CA glues for crosspieces where the end grains are being glued. The primary section of the Dragonfly fuselage is a traditional box construction. The two sides are built over the side view on the plans, and are then assembled together with crosspieces. I made the cockpit area detachable to give access to the motor batteries. I built the removable cockpit area while it was pinned to the fuselage to get a good fit.

The top and bottom bulkheads are added to the crosspieces of the fuselage, then sheeting is applied forward of fuselage station no. 5. Aft of the wings' trailing edges the square fuselage cross-section transitions to rounded top and bottom corners. I used solid balsa fill shaped to fit. Other additions are the doublers that add strength inside the wing saddles, and the stringers inside the fuselage sides that support the crosspieces that hold the servo mounts.

The platform for the motor battery is longer



The fuselage construction starts with building the side frames flat over the plans.



For easier battery access, the cabin section is built as a removable hatch section.

SPECIFICATIONS

Model: 1/7-scale DH 90 Dragonfly
Wingspan: Top: 74 in.; Bottom 66 in.
Wing area: 1,026 square inches
Length: 54 in.
Weight: 78 oz.
Wing loading: 13.7 oz./sq. ft.
Airfoil: Selig 3010 (modified towards the tips)

GEAR USED

Radio: Transmitter: Futaba Conquest FP-T6NFK (futaba-rc.com); Receiver: Hitec Supreme; Servos: Hitec HS-81 for elevator/rudder/flaps; HS-322 for ailerons (hitecrcd.com)
Hardware: Wheels: DuBro Lite (dubro.com)
Covering: Hangar 9 UltraCote (hangar-9.com)
Motor: (2) E-flite Park 450 outrunners (e-flite.com)
ESC: (2) Turnigy Plush 30A (hobbyking.com)
Battery: (1) Turnigy 3S 360mAh LiPo20-30C

Author Ivan Pettigrew assembles the Dragonfly for the first test flight. (Photo by Hal Norrish)

than required to provide fore and aft movement of the battery to achieve correct CG location. Thin plastic food wrap is used to prevent the cockpit section from being glued to the fuselage. The lower horizontal section of the removable cockpit section has a compound curve. To get a good fit, carve it from an oversized balsa stick. The tail cone is built up from scrap balsa and cannot be completed until after the tail surfaces are attached.

TAIL SECTION

With a model's long moment arm, weight of the tail surfaces is critical so don't overbuild them. Although the battery pack can be moved forward for proper balance, lighter always flies better! Notice that the spars for the stabilizer and fin are tapered, being quite wide at the root in order to give added strength. Having a relatively thick cross-section like this means that the construction can be very light while remaining strong. Build the surfaces over the plans. Although the stabilizer spar is built in one piece, it is necessary to build half of the stab at a time due to the spar taper. After building the first half, block the tip up so that the bottom surface of the spar on the other half is flat on the building board. Be aware that because the spars and ribs are tapered, the tail units cannot be built with the lower surfaces pinned right down to the building board, or they will end up warped.

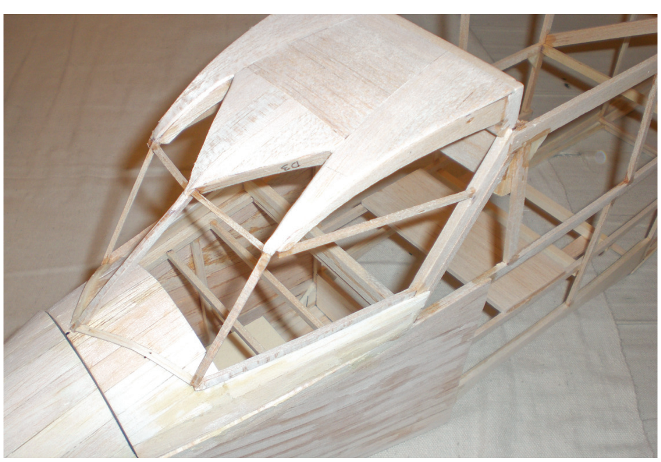
The horizontal stabilizer is held in place by inserting it into the tapered slot formed in the fuselage sides. It must be glued in place before the fin is attached. The fin spar continues down to the bottom of the stabilizer. To give it maximum strength, the base of the fin spar should be glued to the beams on the side of the fuselage.

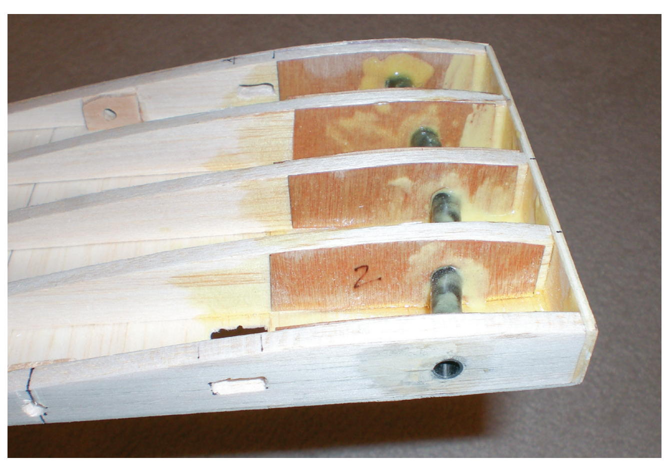
The rudder should not be attached to the fin until the tailwheel wire has been installed. After bending the tailwheel wire to shape, insert it from the bottom, threading it through the brass sheet rudder control horn. It can be soldered to the wire arm when everything is in place. Leave the top end of the wire straight until it is in place, and then make the 90-degree bend at the top. The final step is sliding the rudder onto the hinges and the wire steering arm.

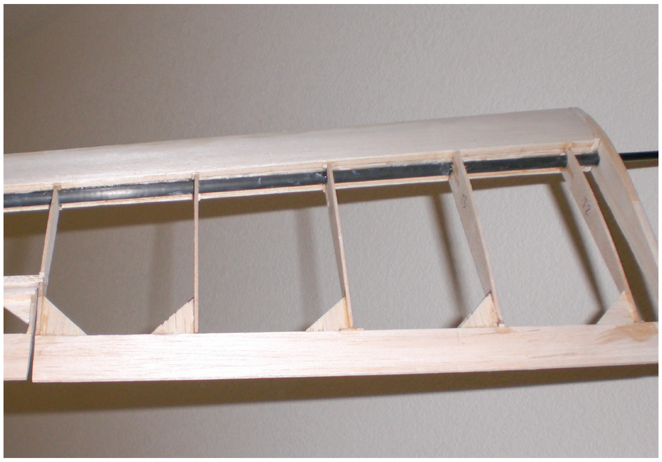
UPPER WING

The top wing is the easier one to build because the spar is straight all the way from the centre of the wing to the tip. Cut the main spar for the top wing and glue the spruce strips to the top and bottom edges as shown in the plan. If spruce is not available for these strips, bass or other softwoods that are stronger than balsa would be suitable. Join them together over the plan so that the sweep back and dihedral angle are correct. This joint is very important both for accuracy and strength. The spar must be held perpendicular to the building board while measuring the dihedral angle or it will not be correct. Tapered spruce or basswood doublers must overlap the joins in these strips at the center line.

All ribs are 1/16 inch-sheet unless otherwise indicated. Cut all the ribs into two pieces at the point where they will be glued to the spar. Trim 1/16-inch off the top and bottom edge of nose ribs to allow for the Forward wing sheeting. The ailerons will be cut out once the wing structure is built. Aft of the main spar, trim 1/16 inch from


The cabin/hatch assembly is built as part of the fuselage structure for a precise and neat fit.


Here's the top wing center section structure. Notice the wing tube sockets reinforced with plywood.



The wing panels use conventional built-up wood techniques with sheeted D-tube construction for added strength.

The landing gear assembly is sturdy and easy to build. The gear is designed to absorb rough field shocks and bumps.

the edge of the ribs where sheeting will be inset—at the wing center section, and for the plates for the strut mounts are securing the interplane wing struts.

Assemble upper left half wing flat on the workbench with the other half of the spar blocked up a little to give the correct dihedral angle. Pin the spar in place on the plans, using 1/16-inch shims to keep it a little clear of the building board and allow for the 1/16-inch sheeting that will be attached to the bottom of the spar. Attach the rear rib sections to the main spar and glue all of the trailing edge in place. Attach the nose ribs to the front of the spar, leaving a 1/16-inch space at the bottom of each rib to allow for the sheeting on the lower surface. The 1/8-inch inner strip of the leading edge and the wings tips can now be attached. When the wing panel is complete, block up the tip so that the spar of the other wing half is flat on the workbench, and assemble the other half of the wing.

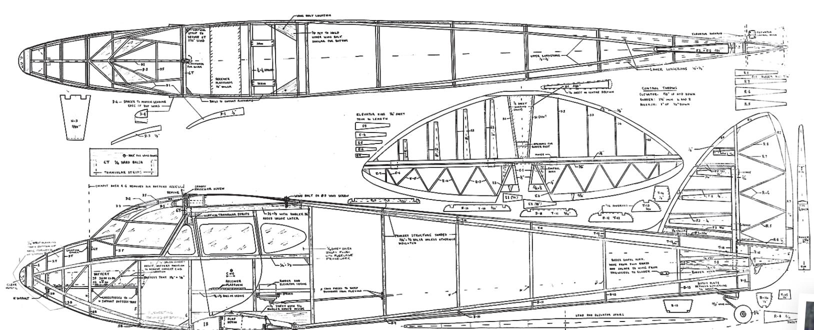
Apply the bottom wing sheeting from the leading edge to the main spar. There is no washout in the inner part of the wing but it starts where the ailerons begins. Before adding the top wing sheeting, weigh the wing down with a 3/16 inch block under the trailing edge at the tip to give the correct washout to the outer section. It's very important to weigh each wing panel down on a perfectly flat surface while applying the top sheeting. Once the top sheeting is glued in place, the wing will be quite rigid and warps will be difficult to correct.

After applying this sheeting to the top surface, the remaining leading edge strip is cut from 1/4-inch sheet balsa and glued to the 1/8-inch strip already in place. It is then planed and sanded to shape.

BOTTOM WING

Construction is similar to the top wing, but the center section is flat and not tapered. Build the central section directly over the plan on the building board. Then block up one end of the completed section so that the spar of the outer wing panel is flat on the building board while it is being built. Build the other outer wing panel in a similar way. It is best to build all three sections before sheeting is started. Proceed with the sheeting as for the top wing.

It is wise to install the wiring for the motors before applying the leading edge sheeting to the top surface of the central section. Note that the outer leading edge strip does not pass through the area of the engine nacelles, so it is best left until the nacelles have been built. Extra sheeting aft of the spar is applied to the wing to support the nacelles and the adjoining wing covering material, so it should extend beyond the edges of the nacelles. The bottom wing washout is the same as the top wing. The wing is straight out to rib B5, then gradually twists throughout the outer panel to give 3/16-inch of washout at the tip.



DH 90 Dragonfly | **K1114A**

This classic 1935 twin-engine biplane is designed and built by Ivan Pettigrew. 1/7-scale, the model uses traditional built-up balsa and ply construction and is an advanced scale design requiring intermediate to expert building experience.

Wingpan: 74 in.; Length: 54 in.; Power: Twin brushless 450 motors; LD: 3; 2 sheets; $23.95

To order the full-size plan, visit AirAgeStore.com

STILL FLYING!

Sixty-eight Dragonflys were built, starting in 1935. Unlike earlier de Havilland biplanes, the Dragonfly had a longer top wing than the lower one. Ailerons were only fitted on the top wing. The center section of the bottom wing had a thicker airfoil than the outer panels. The thicker wing section added strength to this critical area carrying the undercarriage. It also provided more space for the fuel tanks.

Two Dragonflys are still flying today. G-AEDU in England has a red fuselage and engine nacelles and the wings and tail are silver and ZK-AYR in New Zealand, which is blue and silver. G-AEDU has the possible distinction of being the oldest plane to fly the Atlantic. In 1995, it flew from the UK to Oshkosh, WI, and the following year marked its 60th anniversary by making the return flight to England.

ENGINE NACELLES AND UNDERCARRIAGE

The engine nacelles are built up using spruce beams secured to the lower surface of the wing and main spar. Then the pedestal that supports the undercarriage is built. The 1/8 inch plywood plates that the undercarriage legs are attached to are then glued to the bottom. Next, the motor mounts are glued in place on the front of the assembly. The undercarriage uses two nylon mounting clamps to secure the gear's torsion bar. The design allows the wheels to arc backwards and upwards when hitting a bump. This results in very good shock absorption while operating from a rough surface.

The nacelle bulkheads are next glued in place. Notice that the N-1 bulkheads at the front of the nacelles are cut from 1/4-inch balsa, but the nacelle planking comes just to the midpoint of that bulkhead. This leaves a 1/8-inch shoulder which serves for holding the cowling in place. When the planking is completed, the motors should be installed. The plans show the motor mount designed for the commonly used outrunner brushless motors.

The engine cowlings are built in place with the motors installed. Each cowling will be held in place by two screws at the aft end of the cowling. The nose blocks are made, with the propeller shaft hole being a snug fit over motor. This holds the blocks in place while the cowling is built. After the cowlings are completed, the motor clearance hole can be enlarged. Curved sheets easily form the top of the cowling shape if the outer surface of the sheeting is moistened.

The wheel fairings are each held in place with two screws. They can be built in place so as to ensure a good fit and provide clearance for the undercarriage legs and wheels. The nosepiece of the wheel fairings is made with a single thickness of 1/16-inch balsa attached with the grain running vertically. The joints between the nose section of the fairings and the side panels should be reinforced with doublers on the inside.

The wing struts are constructed as shown on the plans. The struts are not functional, so they can be built from balsa.

COVERING AND FINISH

Covering is conventional with Solarfilm, MonoKote or UltraCote. The struts are covered with film covering as on the airframe. Clear (transparent) MonoKote is great for covering all the windows. It is best to do these first, before applying the rest of the covering to define the shape of the windows on the fuselage.

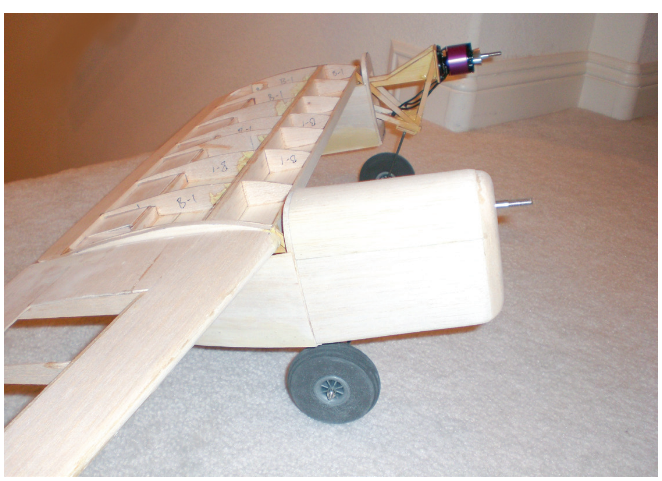
IN THE AIR

The Dragonfly is a robust model that can be thrown about and enjoyed. If the wings are built true and have the correct amount of washout, there is little danger of tip stalls.

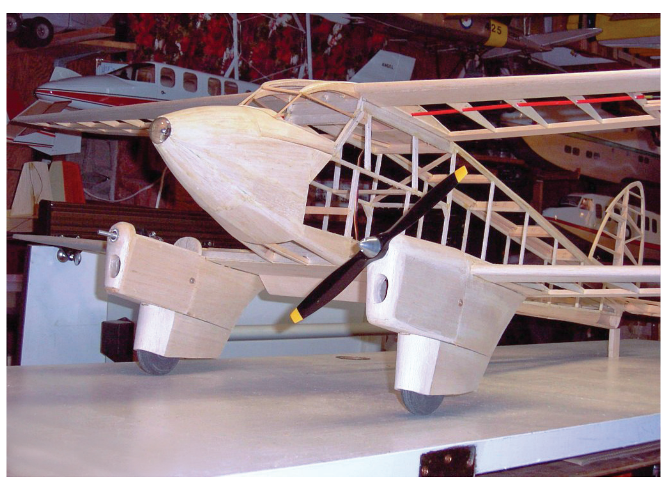
Flight characteristics are excellent. Unlike the full-scale aircraft, the model is easy to keep straight on takeoff, and slow 3-point landings are easy to do without the use of the optional flaps.

Aerobatics are not the norm for the Dragonfly, but the model is quite capable of doing very large graceful loops, stall turns and Cuban-8s. Rolls are on the slow side. Spins depend on the CG location and tail-surface throws. It is better to do a wheel landing if using flap. Good luck with your Dragonfly!

For additional construction photos, go to ModelAirplaneNews.com/DHDragonfly.



One of the engine nacelles has been sheeted and sanded to shape.



Even uncovered, the Dragonfly is an impressive-looking model airplane.