On the 'Wing... #154

Dave Jones' R-2, Part 4

Great flying weather and a willing accomplice were at the 60 Acres flying field at the same time we were, so we finally got to test fly the R-2!

The airframe was completed at the end of the third installment, so this column will be devoted to fiberglassing and painting the fuselage, covering the wing and fin-rudder assemblies, installing the radio gear, and test flying.

Fiberglassing and painting

The fuselage was entirely covered with fiberglass and polyester resin before painting. The bottom of the nose and the lower part of the ventral fin were first reinforced with a strip of six ounce cloth as these areas receive a lot of abuse. Lightweight 0.6 ounce per square yard 'glass was then used over the rear portion of the fuselage to seal the wood and form a base for the primer. Three ounce cloth was applied over the entire front end, including the canopy.

Following some sanding, an initial coat of Zynolyte Spay-Mate gray primer was sprayed on the fuselage. We like using primer as it sands easily, can be used to fill any pin holes, and makes imperfections in the surface easy to see. After wet sanding three or more applications down to bare 'glass, a final light coat is applied. When entirely dry, this last coat is smoothed out with 400 grit sand paper to allow the paint coat to firmly adhere.

We used gloss black Zynolyte for the fuselage. We would have preferred gloss white, but the yellow, green and blue chosen for the wing and vertical tail clashed severely. Black really absorbs sunlight and the canopy area can get pretty hot if the aircraft is left in one position for very long. Under these conditions it's best to take a light colored cloth and throw it over the canopy area. In flight, the aircraft is always turning and the problem pretty much disappears.

After painting, the center section of the wing and the fuselage were glued together using 30 minute epoxy. The fuselage structure is such that there is a large surface to which the wing is attached. Alignment must, of course be predetermined, and small adjustments are necessary after contact between the two pieces is made. Slow cure epoxy makes this an easy process.

Covering

We decided long ago that the color pattern for the R-2 would be similar to that of the modified Raven which we built a couple of years ago. While the Raven was covered in red, orange, and yellow, all transparent, the R-2 was to be covered in blue, green and yellow, again all transparent.

The idea behind the color pattern is to have the yellow portion extend across a portion of the span, the green/orange to extend across 2/3 of that distance, and the blue/red to extend across 2/3 of the green/orange distance. Mathematically, this turns out to be

$$b = X + \frac{2X}{3} + \frac{4X}{9}$$

where b is the wing span (100 inches in this case) and X is the portion of the span to be covered with yellow.

Solving for X, yellow should cover 47.6 inches of the 100 inch span. Following the preassigned proportions, green/orange will then cover 31.7 inches, and blue/red will cover 21.1 inches. (See, there are everyday uses for algebra!)

On the R-2, the ribs are three inches apart, so things work out fairly well once the black of the fuselage is used as the barrier between the green and yellow areas. As you can see from the photos of the covered airframe, the resulting color scheme is rather unique. The transparent covering allows the interior structure to be seen (including the identifying numbers on the wing ribs), and it looks great in the air, too!

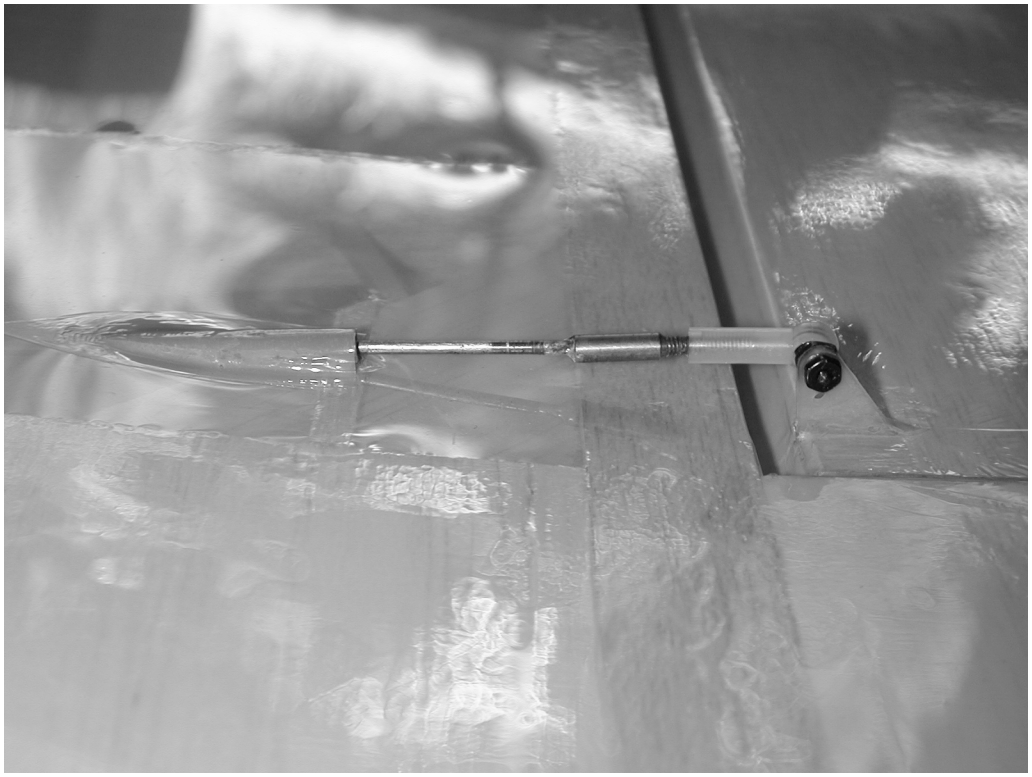
We had originally anticipated some problems in covering this wing as it is filled with compound curves. The rib shape includes areas of concavity, the 1/8th inch turbulator spars in front of the leading edge have flat tops but bend downward and back as they track to the wing tip. The wing tips themselves are constructed of plywood sheet and triangular “ribs” which support the covering. The fin and rudder assembly poses the nearly same problems.

The covering must be pulled under heat and stuck to the framework in very small increments. The transparent coverings really lend themselves to this method. Planning ahead is a necessity, and extensive prior experience with iron-on coverings allows things to go much more smoothly.

In the end, the covering process went extremely well and the finish is very nearly perfect.

Radio installation

Readers of previous installments will remember that, as with most projects, a few unforeseen difficulties appeared during the construction process. Due to clearance constraints in the forward portion of the fuselage, the rudder and elevator servos had to be oriented diagonally. Additionally,



the elevator servo drives only one pushrod, and the elevator pushrod just happens to go directly over the receiver compartment. We're quite delighted over how things worked out, however, so we've included a couple of photos of the interior of the front end.

The aileron servos have direct pushrod connections with their respective control surfaces. We wanted the external mechanisms to be on the upper surface of the wing so as to be separated from weeds and grass. The bottom hinging of the ailerons allows the control horns to be almost entirely recessed within the control surface. Despite the ball links necessitated by the swept hinge line, exterior protrusions are kept to a minimum and the installation is relatively clean, as can be seen in the included photo.

We used our JR PCM 10 radio for the R-2 due mainly to the ability to use separate servos for the ailerons and have individual control over the neutral positions and control throws, something not available on the JR Century VII system which we use on our elevon controlled 'wings.

All three major control actions (rudder, elevator, aileron) were set up for 100% rate, adjustable to 75% and 50% during flight by use of the appropriate three-position rate switch.

Test flying

The R-2 plans show a CG range, so we marked the under side of the wing with the forward and rearward limits. The CG was then adjusted until it fell directly between the two marks. We anticipated this would place the CG a bit forward of its eventual location, as we tend to fly with a more rearward CG location.

Several runs across the 60 Acres field with the airplane being held more and more loosely seemed to indicate the CG was in the appropriate location, so actual test flying commenced with

The completed fuselage with radio gear installed. The servos are nearly as deep as the fuselage, and the traingle stock reinforcement between the sides and the bottom had some meterial removed so the servos could clear. The Hitec receiver in the picture has now been replaced with a smaller FMA Fortress eight channel.

several hand launches. Elevator authority was good, and nice flat turns could be made with rudder alone, but aileron authority was much greater than anticipated, so the rate switch was moved to 50%.

Our next visit to the field was a few days later, and lots of other Seattle Area Soaring Society members were there. Bill Henley volunteered to assist with the all important first winch launch. Bill's flown some swept wing tailless slopers as well as a number of aileron equipped conventional 'craft, so we felt comfortable assigning him test pilot duties while we managed the launch.

We started with some hand launches so Bill would have some idea as to control sensitivity. The only adjustment needing to be made was a fraction of an ounce of additional nose weight. The towhook was adjusted relative to the new CG, and it was off to the winch.

Despite a forward towhook location, rotation was quick and the climb steep. No zoom, but a clean release and immediate flat glide straight out to the north, the direction of launch. The west side of 60 Acres is reserved for electrics, so Bill turned to the east and then south over the heavily grassed area. The R-2 suddenly went into a right turn and Bill said something like, "Hey, I didn't do anything. What's going on?" Despite the course diversion the R-2 did not appear to be in distress, so Bill decided to let it go and see what would happen. Another circle to the right, then another. After about four circles, Bill reset the course to straight south again. But the R-2 was now noticeably higher than it was before the initial turn. Bill asked, "Did it just do some thermalling on its own?"

Bill asked for the aileron rate to be increased, so that switch was set to 75%. This added control authority was right on target. After some more turns, Bill set up for a landing. He was shocked by the extended glide in ground effect, but the deep ventral fin kept the aircraft firmly on the ground once contact was made.

Back on the ground, we decided to add another fraction of an ounce to the nose to eliminate the last vestiges of down trim, and couple aileron to rudder at the 100% rate to reduce the left stick workload.

The second launch was better than the first, and the R-2 was up in the air again. It hit some sink where the thermal was a short while before, but the extra nose weight has improved control feel, and the aileron-rudder coupling makes turns almost automatic. "Aileron turns are in the groove, and it flies almost like it's on rails," Bill remarks. While the vertical area and dihedral seem to be well matched and coordinated turns can be made with aileron-rudder coupling, rudder input alone leads to stable flat turns.

Positive comments come from all quarters — "It's beautiful in the air," "It's a real floater," "It looks like it thermals so easily," "Smooth landing..."

The R-2 is a floater (63 ounces and 1500 square inches for a six ounces per square foot wing loading) and reacts positively to very light lift. It launches well and flies smoothly. It exactly matches the tasks we had envisioned for it — cruising around at low speed in still evening air while watching the sunlight refract through multicolored transparent covering. In all, the R-2 has been and continues to be a tremendously rewarding experience. Our sincere thanks to Bill Henley for doing the initial test flying!