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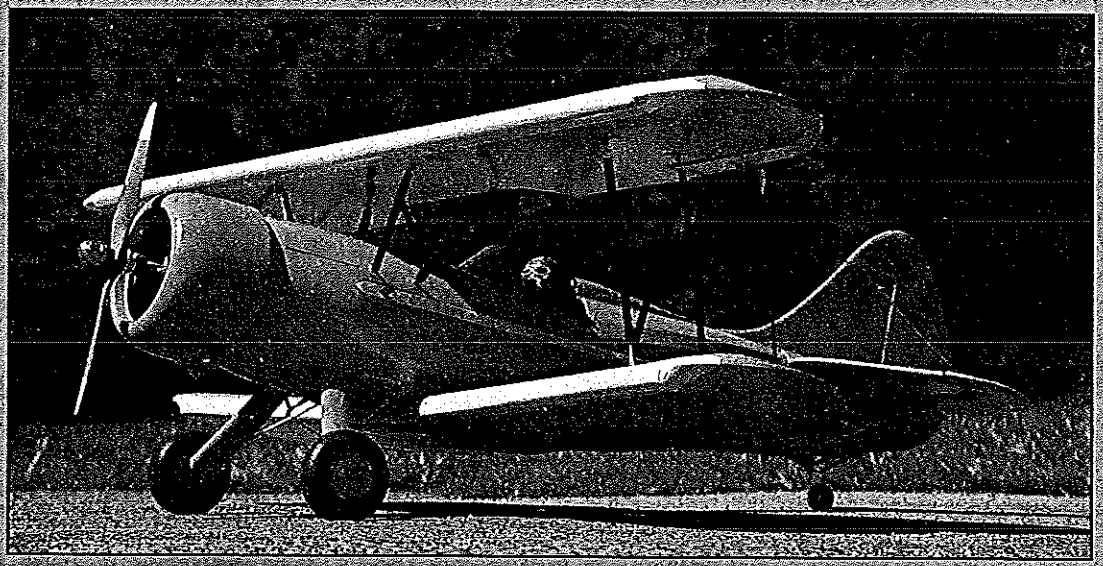
WACO UPF-7

A Biplane From the Golden Age



□ Roy Day

I have always admired WACO biplanes, both open-cockpit and cabin models. So it was a special pleasure a couple of years ago to attend the WACO Reunion in Mt. Vernon, Ohio.

For a biplane lover, this was close to

heaven. About 40 beautifully restored WACOs were there. Aircraft types ranged from the 1927 WACO 10 to the 1942 UPF-7. After taking a flight in one of the UPF-7s, I made up my mind to design and build a model of it.

I used Paul Matt's three-view drawings and designed a 1:6.4 scale model. I even used the Clark Y airfoil of the full-scale airplane, although I thickened it from 12% to 15%.

After many interruptions, I finally completed the airplane about a year after starting the design, and I took it out to our grass flying field for the test flight.

During the taxi tests it was hard to keep from overcontrolling the model, so I took it back to the shop, where I reduced the sensitivity of the tailwheel to 1/2 that of the rudder deflection. The WACO steered much better on the ground, and I judged that it was ready for the first flight.

Flying buddy Ron Bozzonetti made the first takeoff. The UPF-7 quickly came up on its mains, and with a little right rudder that big vertical tail held it arrow-straight down the runway. Liftoff occurred at about 3/4 throttle with the O.S. 70 Surpass four-stroke.

The WACO was very stable (yet maneuverable) in flight and looked every bit like the full-scale airplane.

The UPF-7 is stable yet maneuverable, with plenty of power for aerobatics. Covering is 21st Century fabric.

CONSTRUCTION

Fuselage: Assemble the fuselage sides of 3/16 square hard balsa directly over the plans. Make the second side over the first. Glue in the 1/32 plywood doubler on the *inside* of each fuselage side and also over the top view. Take care that the fuselage is straight.

There are a number of formers to cut from 3/16 sheet. I recommend that you use translucent template material made by See Temp. Lay the See Temp material over the plans, score it with an X-Acto knife, and flex it to break out the template. Mark the templates with a pen and save then for future use.

Glue the formers to the fuselage truss structure and also the 1/8 plywood landing gear mount. Note that the landing gear plate goes from former 4 all the way to the firewall.

Decide on your engine-mounting scheme and drill the 1/4 plywood firewall before you epoxy it to the front of the fuselage. I used J'Tec 6-32 soft mounts for the O.S. 70 FS. Add gussets and triangle stock as shown on the plans for reinforcement.

Add the 1/8 plywood cockpit floor (in the forward cockpit) for the cabane mounts. Epoxy 1/8 I.D. brass tubing in grooved landing gear blocks and glue these across the cockpit floor. The wire cabane struts will slide into these brass tubes.

Sheet the forward fuselage and cockpit areas with 3/32 soft balsa. Build the hatch in place and plank it with 3/32 balsa strips. Add the 1/8 square balsa stringers. Cut out the cockpits and line the insides with 1/64 plywood for strength. Shape the headrest from soft balsa and install it.

The fiberglass cowl is available from Fiberglass Masters. I mounted it with four L-shaped metal brackets fiberglassed to the inside of the cowl, and secured it to the firewall with 6-32 bolts.

This completes the basic fuselage structure. Later you can add the wing saddle cover, cockpit coaming, instrument panels and windscreens.

Wings: The top and lower wings have the same chord, wing tip bows, ailerons, and sheeting pattern. The top wing is flat (no dihedral); the lower wing has 2° dihedral. The top wing has 2° washout, which should be built in. The finished wing is very strong and cannot be twisted for washout after covering.

The top wing has the plywood cabane mounts, which are glued on the top side of the bottom sheeting, putting the mounts on the bottom side of the wing. The lower wing has the usual hardwood peg and nylon bolt attachment.

Note the N-strut mounting plates on both wings. Mount the plywood N-strut plates for the top wing on the inside of

Takeoff at 3/4 throttle is scalelike. Landings are easy, with excellent low-speed characteristics. E. Trybuch photo.

the bottom sheeting. Those of the lower wing must be on the upper surface, just under the top sheeting.

Top wing: Cut 1/16 sheeting for the leading and trailing edges per the plan. Before you pin the sheeting down over the plan, note those parts which will be hidden, e.g., the cabane and N-strut mounts.

Pin the bottom sheeting so it extends to 1/2 the width of the spruce spar caps, to allow for capstrips. Glue two 1/8 x 1/4 spruce spar caps together, double out to rib R8. Glue the lower spar caps on the sheeting and add the ribs, except for those in the center section. Add the 1/8 aileron spar, the 1/8 sub-leading edge and the top spar caps for the forward and aft spars. Shim the trailing edge up 3/16 at rib R10 for washout.

Glue in the plywood cabane mounts and the N-strut mounts. Be sure you have them put on the correct surface of the wing. Epoxy in the plywood center-section braces and add the partial ribs. Add the wing cutout trailing edge and the curved balsa block fairing at each side of the top wing cutout.

I use the covering material to make full-length hinges for control surfaces as shown on the plan. If you choose another type of hinge, add scrap balsa blocks at the appropriate locations before you close out the top of the wing with sheeting.

Complete the top sheeting of the wing and add the 3/8 x 3/8 soft balsa leading edge. Fit the wing tip bows and inset them in the leading edge. They tie to the leading edge, the tip rib R11, and the aileron spar. Gussets are added for strength.

Remove the top wing from the board and shape the leading edge. Add 1/16 x 1/4 capstrips top and bottom.

Lower Wing: Build both panels just as you did the top wing. Block up the tip of each panel 3/4 inch at rib R10 to give the correct dihedral. Epoxy the plywood dihedral braces and a balsa block for the wing peg. Add scrap blocks at the trailing edge for the hold- down bolts. Glue in the center section partial ribs and the plywood N-strut

"Close to heaven." Full-scale UPF-7 at annual WACO reunion, Mount Vernon, Ohio.

The WACO UPF-7 was introduced in 1937. It came along at a time when most open-cockpit biplanes used for civil pilot training had been replaced by monoplanes. Only the Army and Navy continued to use biplane trainers. However, with the outbreak of World War II, a greatly expanded Civil Pilot Training (CPT) Program was needed. Between 1940 and 1942 WACO produced 600 UPF-7s for the CPT. They had several modifications from the original 1937 aircraft, including a wider-tread landing gear and a bigger cutout in the top wing for easier access to the front cockpit.

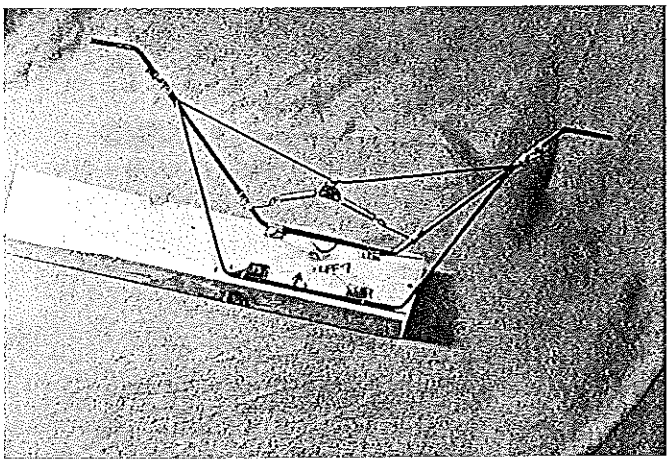
After the war, UPF-7s were primarily used for crop dusting and joy riding. Although the UPF-7 had been used for aerobatic training, it was no match for that other biplane trainer: the venerable Stearman. Hence the UPF-7 never made it big in air shows.

But when the boom in antique airplanes began in the 1950s, many UPF-7s reappeared—revived and restored. Some of the restored aircraft have full cowls and wheel pants.

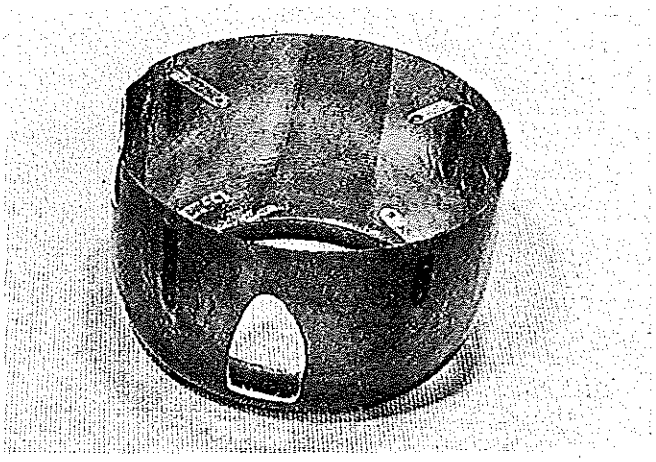
Over the years the number of UPF-7s has declined: in 1989, only 171 were registered.

One of the best places to see beautifully restored UPF-7s (and many other WACO models) is the Annual WACO Reunion held the last weekend of June at Mt. Vernon, Ohio. Here you can see the greatest collection of restored flying WACOs in the US.

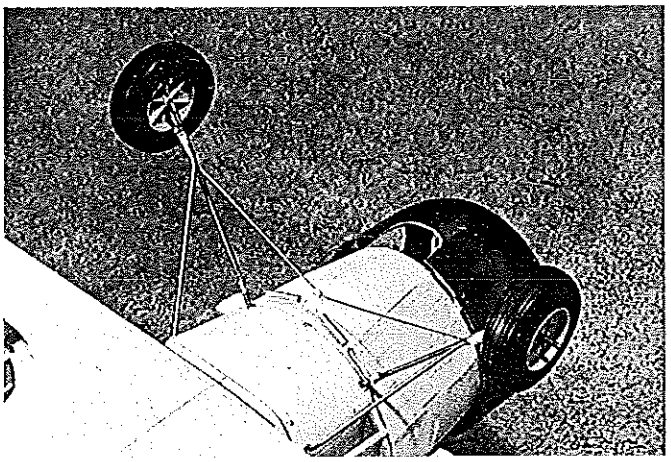
Roy Day



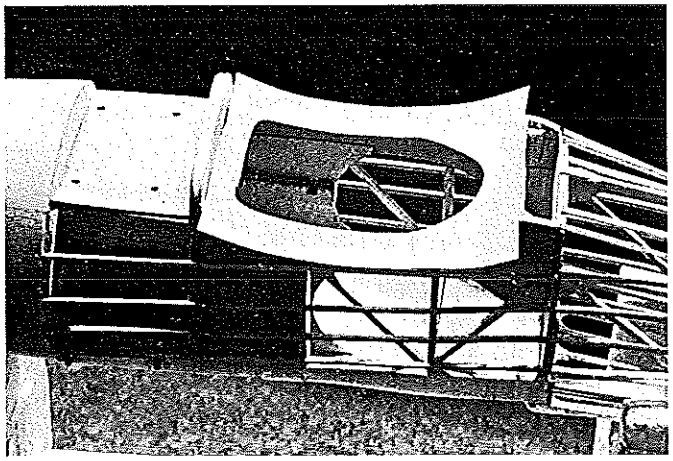
Solder landing gear on jig to match model mount. Crossbraces and springs simulate full-scale but are optional.



Metal brackets are fiberglassed to cowl and secured to firewall with 6-32 bolts. For soft mount, make engine cutout larger.



Removable Styrene belly pan allows access to nylon landing gear bolts in event of a hard landing.



The 1/32 plywood wing saddle cover provides base for wing fillet. Landing gear mounting holes also visible.

Before you sheet the top surface, put in the aileron pushrods. I used the flexible Nyrod type, but any type of your choice will work.

The top trailing edge sheeting should be dampened so it can be formed correctly around the wing cutout. After all the top sheeting is on, add the capstrips, top and bottom.

Fiberglass the center section of *both* wings with one-ounce cloth and laminating epoxy.

The four ailerons are built next. I prefer built-up ailerons because of their light weight, but solid lightweight balsa (with lightening holes) could be used. The built-up ailerons are easy to make with the simple jig shown, and the patterns for the top and bottom 1/16 skins as shown on the plan. Be sure to put in the 1/8 plywood mounts for the aileron horn and the connecting pushrod.

Tail: The structure of the horizontal and vertical tails (a 3/32 balsa sheet core with 1/8 square false ribs added on both sides) is simple, lightweight, and strong. It is particularly well suited for curved tail surfaces. Doublers of cross-laminated 3/32 balsa provide the necessary stiffness and edge protection.

The See Temp material is useful here, to cut out the entire sheet core of the vertical and horizontal tails at one time.

Sand the false ribs top and bottom to give an airfoil shape. As with the wings, covering-material hinges were used, but other types would work as well.

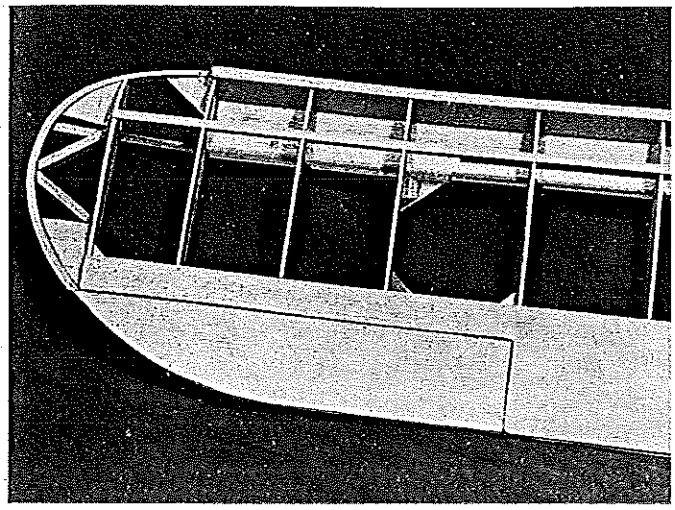
I prefer bolt-on tail surfaces, so a plywood tongue is inset in the bottom stab doubler and two 6-32 nylon bolts fasten the whole assembly to the fuselage. Shape blocks of light balsa to support the vertical tail on the stab and fair them into the fuselage at former 10A. The tail brace wires of .032 music wire add a lot of strength.

Assembly and finishing: It is a good practice to install the radio equipment before covering. Put the servos as far forward as practical. With the receiver battery alongside the fuel tank and an O.S. 70 Surpass FS, I did not have to add any weight to balance the model at the center of gravity (CG) indicated on the plan.

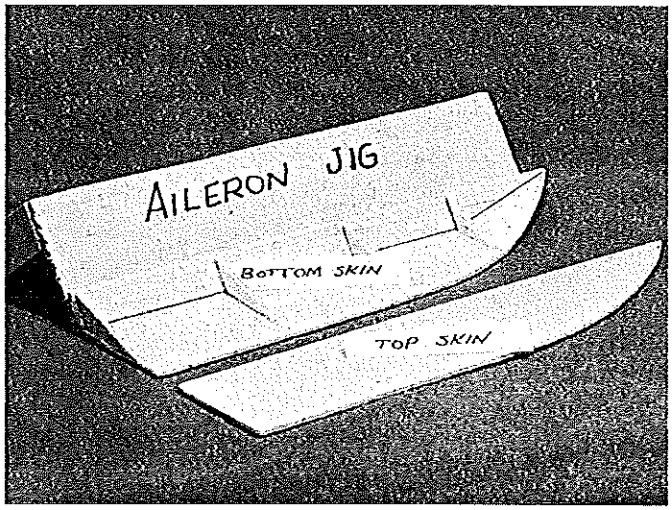
The main landing gear is made from 5/32 and 1/8 music wire bolted to the model with sheet brass straps and four 10-32 nylon bolts. I stretch-formed the belly pan from .060 high-impact Styrene to cover the landing gear mount. The belly pan can also be made of fiberglass or built up with balsa. Cross braces and some hardware-store springs were added for scale effect, but I consider them optional.

Before you glue the 1/32 plywood wing saddle cover in place, use a Robart Incidence Meter to check that the lower wing and the horizontal tail are at 0° incidence. The fuselage-to-wing fillet is made of 1/64 plywood supported by balsa gussets. It takes a little cutting and fitting to get the fillet right, but the result is well worth the effort.

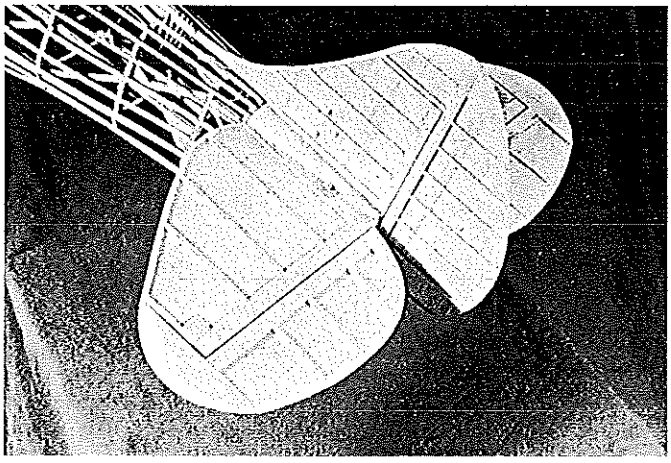
With the tail and lower wing installed, jig up the top wing to be at 0° incidence. Mount the fore and aft cabane wire struts (keeping the wing at the correct incidence), then wrap



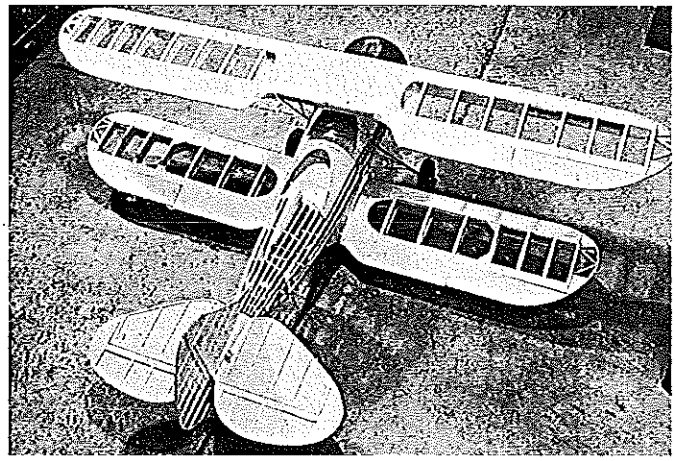
Nearly identical top and bottom wings use same ribs, tips, ailerons, and other parts—simplifies construction.



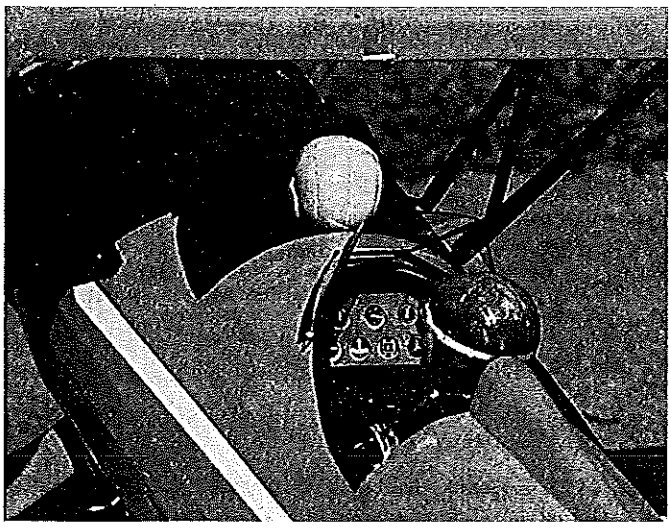
Solid balsa ailerons can be used, but built-up ailerons are light and easy to make with this simple jig.



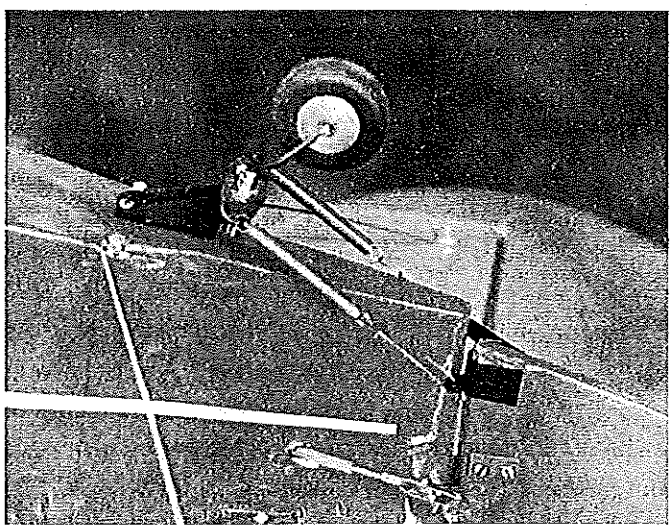
Bolt-on tail assembly is light and strong. Easily removed for incidence adjustment, repair, or transport.



Completed UPF-7 framework shows nice proportions and pleasing curved wingtips and tail feathers.



Dress up your model with an instrument panel and pilot(s). Cockpit combing is made from automotive rubber tubing.



Tail wheel tiller is made from sheet brass soldered to a wheel collar. Springs are from a local hardware store.

Paul Matt drawings were used as the basis for this 1:6.4 version. Clark Y airfoil was thickened to 15%.

the diagonal cabane brace in place with copper wire. Carefully remove the cabane strut assembly and place it in a jig to hold it steady while you solder it with silver solder.

When the wings have been installed and aligned, the N-struts can be measured and built in place. I made the N-struts from 2-56 pushrod wire with Z-bends on the upper ends and clevises on the lower ends. Balsa fairings (similar to those used on the cabane struts and landing gear) improve the appearance.

I covered the model with Coverite's 21st Century Fabric. Use a thermometer for your iron and follow the recommended settings for your heat iron; you will be pleased with the results. One suggestion: apply Coverite's Balsarite on the area that you fiberglassed, to ensure that the covering sticks. The corrugated effect on the ailerons is a formed plastic you can get from Sig.

Finish the cockpits with an instrument panel, cockpit coaming, windscreens, and a pilot figure(s). I split small-diameter rubber tubing from an auto supply and use it for cockpit coaming.

Flying: I have now made more than 25 flights with the UPF-7 and it continues to perform exceptionally well. The O.S. engine and a 13 x 6 prop are a good match.

There is plenty of power for aerobatics. Loops, aileron rolls, split Ses, snap rolls, and anything else you want to do is easy with the UPF-7. At a weight of 8 pounds, the wing loading is a comfortable 21.5 oz./ft^2.

Landings are easy—either on the mains or three points—with good low-speed handling characteristics. Stalls are gentle and straight ahead; there is no tendency to snap.

Several other pilots have flown the WACO and remarked on its versatile flight characteristics. Why not build one of the prettiest biplanes yourself, and enjoy some Golden Age flying? For any questions, contact me at 11709 Magruder Lane, Rockville MD 20852; Tel. (301) 468-0915.

Manufacturers mentioned are listed below:

See Temp, Box 105, Sussex WI 53089.

J'Tec, 164 School St., Daly City CA 94014.

Fiberglass Masters, Rt. 1, Box 530, Goodview VA 24095.

Coverite, 420 Babylon Rd., Horsham PA 19044.

Sig Manufacturing, 401-7 South Front St., Montezuma IA 50171 ✈

WACO UPF-7

Type: RC Scale

Wingspan: 56 inches

Engine size/type: O.S. FS-70 Surpass

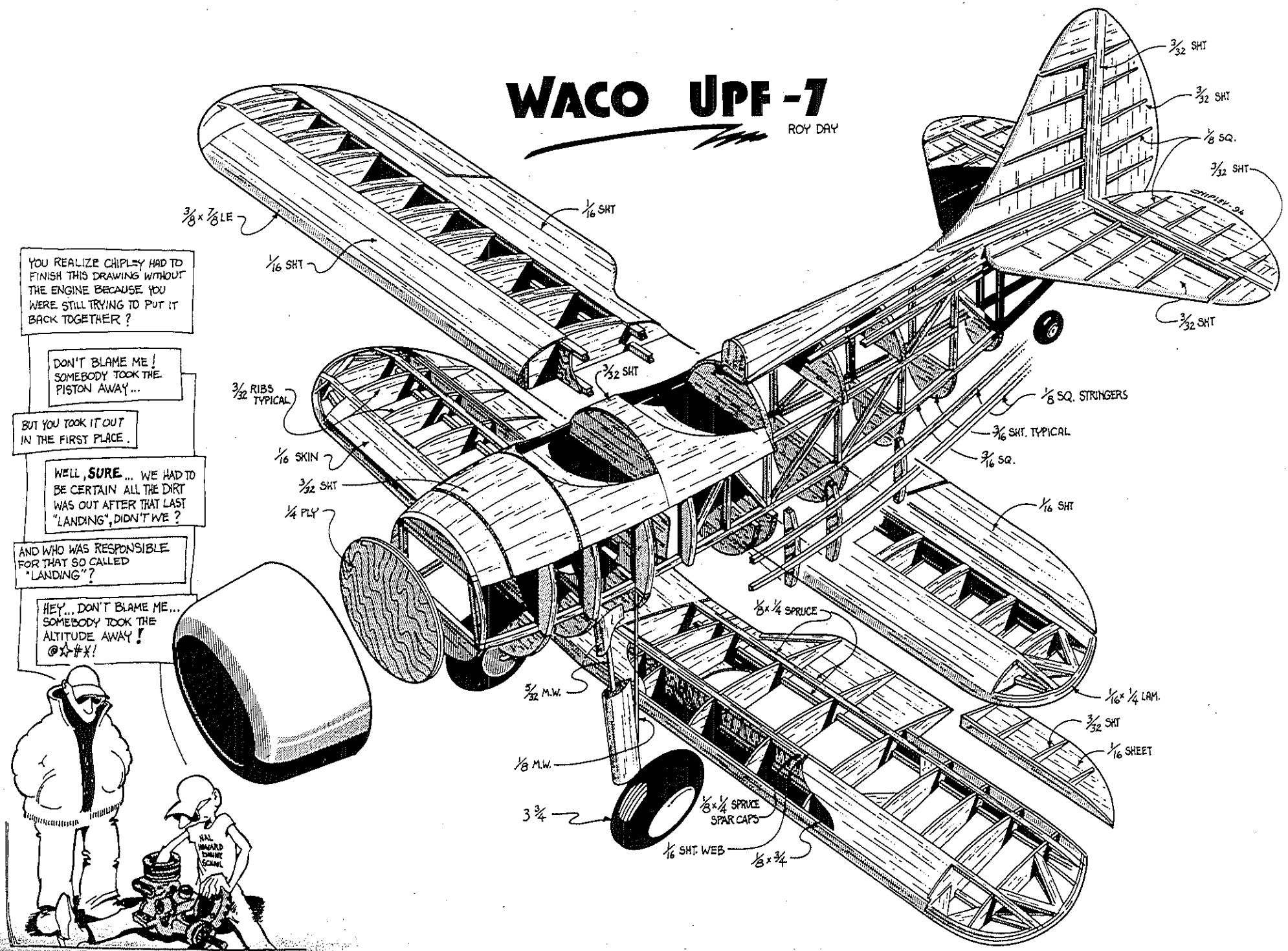
Flying weight: 8 pounds

Construction: Built-up

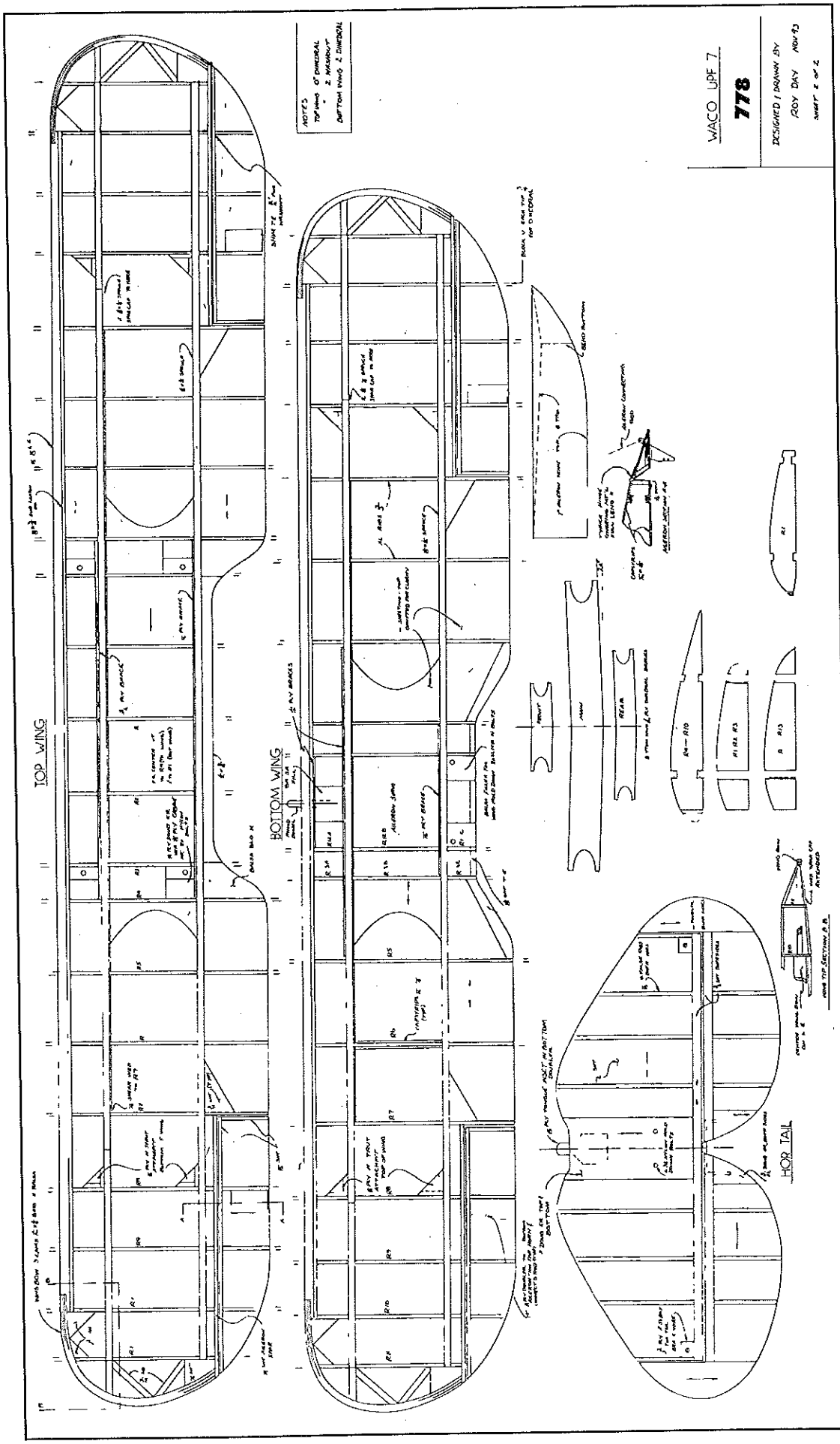
Covering: 21st Century fabric

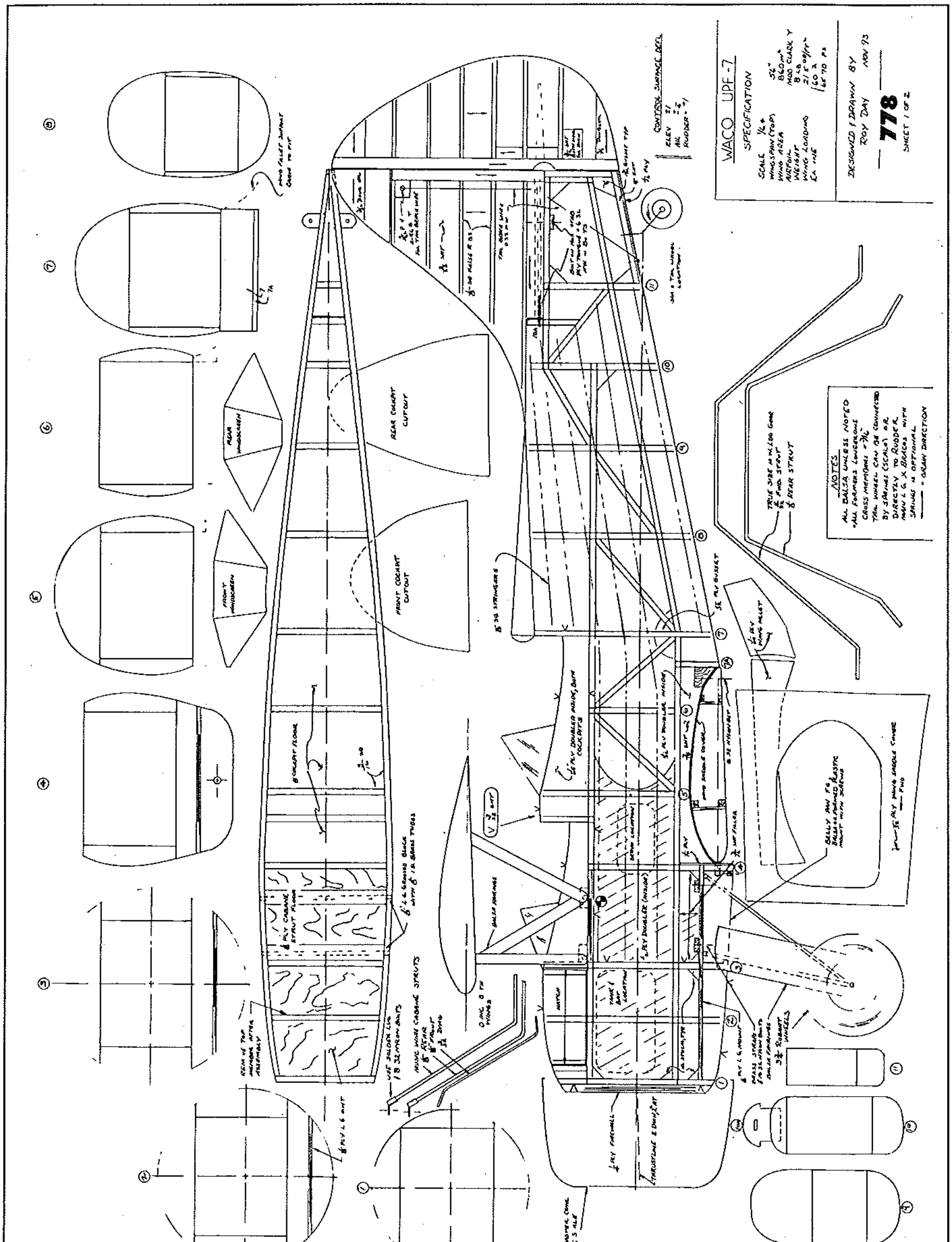
WACO UPF-7

ROY DAY



Full-Size Plans Available–see page 176




WACO UPF-7
SPECIFICATION
SCALE
WINGSPAN (TOP)
WING AREA
AIRFOIL
WEIGHT
WING LOADING
DESIGNED & DRAWN BY
ROY DAY NOV 93
778
SHEET 1 OF 2
NOTES