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The Falcon 49 was designed as a test bed for various engines up to .49 cubic inches. Photo by Zajack Studios, Santa Ana, CA.

Falcon 49

Here is a working sport stunter that can put your idle engines on the active list and get you back into CL if you've been away.

■ **Fred Brigeman**

LET'S IMAGINE that you are a former control line flier who has been inactive for 15 to 20 years. Also imagine that you have been toying with the idea of returning to your old pastime, and you wanted to buy a kit, engine, and accessories and go flying—just like you had done before. Well, if you believe that you can pick up right where you left off, you *do* have a good imagination!

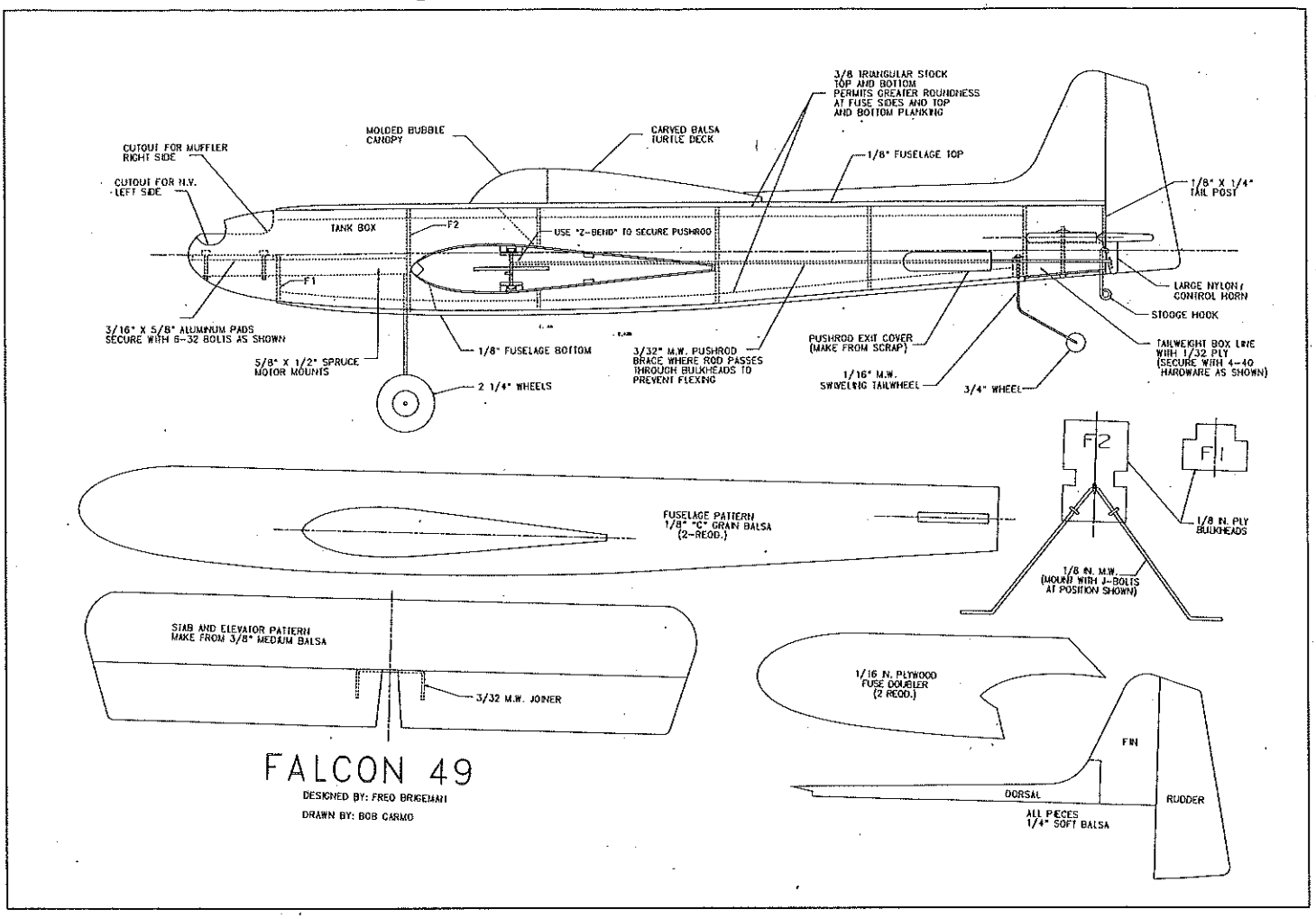
Mainstream commercial support for control line is for the most part nearly invisible. A lot of products are out there—with greater variety in most areas than ever before—but most items are not stocked by dealers, and are hard to find unless you know where to look.

Engines, the power behind our hobby, are relatively plentiful, but most are not timed for routine control line purposes, and they lack the required needle valve/venturi combinations. Such are the realities of life in a pastime dominated by radio control. Don't get the wrong idea—RC provides hours of enjoyment for many people, and that is good. However, if you want to fly CL as an alternative choice, you must be resourceful. It was in the spirit of necessity that the Falcon 49 was developed.

This ad was the basis for the Falcon 49. When Duke Fox owned Berkeley Models, he designed the Falcon "35" and other models to complement his popular engines.

The Falcon 35 was designed and kitted by the late Duke Fox back in the early '60s

Full Size Plans Available–See Page 176



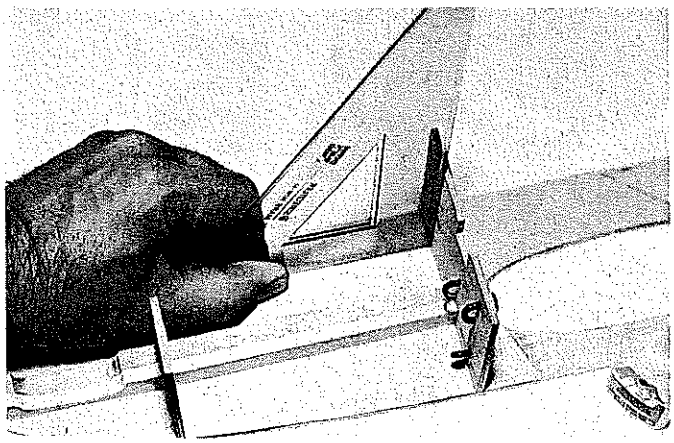
through his Berkeley Models subsidiary. Though it was not a particularly attractive airplane, Duke claimed he designed the model as a flying testbed for the Fox engines of the day. As my first sport-stunt project beyond the Ringmaster/Flite Streak-type models, the contest-plane-sized Falcon 35 was a ticket to a more advanced level of Stunt models, and in that role, it has always held a special place in my memories.

After my dormant period, I yearned to build another Falcon 35, but alas, it was not to be. Phone calls to Fox revealed that there were no kits or plans available, and that a fire at the factory destroyed the only existing copy of the airplane.

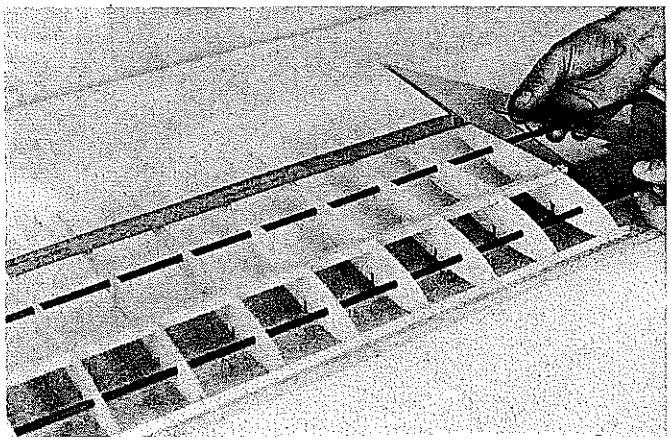
Viewing this as a temporary setback, I tried drawing plans for a reproduction, using old snapshots. The pictures I had available were clear side views, but repeated enlarging on a photocopier resulted in a disappointing and unacceptable loss of detail.

I then realized that maybe a *true* duplicate *wasn't* what was really needed or wanted. It was obvious that the logical approach was to design an airframe that would accept one of today's (or yesterday's) engines, then design the body to resemble the old pictures. I decided I should also plan, as Fox had, to try different engines on one airplane.

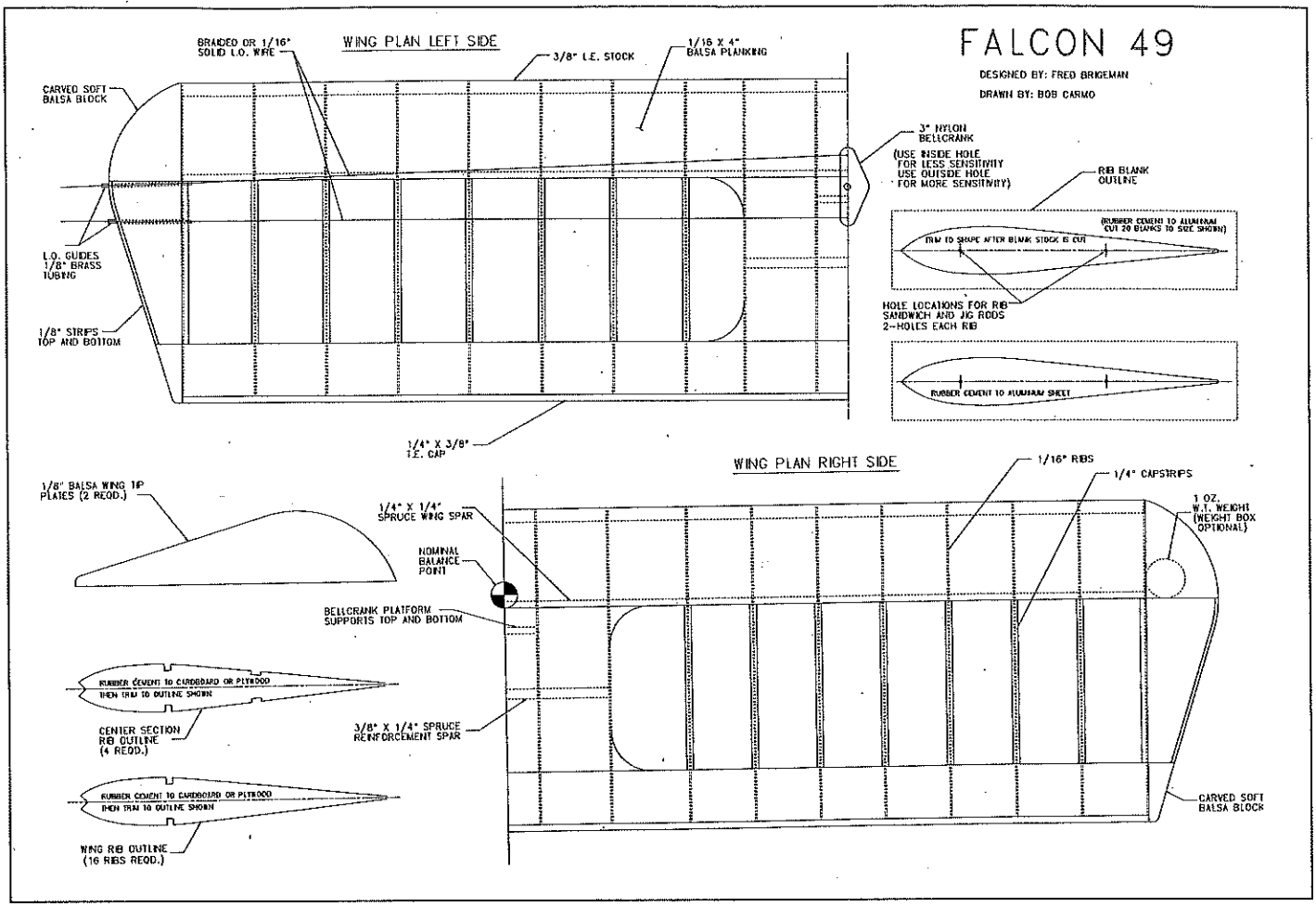
I altered my original goal and tried to think like Duke Fox, who set out to design a nonflapped airplane that was not especially attractive, but was capable of flying reasonably well. I wanted something that would be able to perform general maneuvers with a variety of engines up to .49 cubic inches. In doing so, I would satisfy my dream.



A straight fuselage begins with properly aligned bulkheads. Here F2 is checked with a drafting triangle to assure that it is perpendicular to the fuselage side.



Author recommends use of a rod-type jig to assure a warp-free wing. Wing ribs are slipped onto the rods and aligned as shown. Asymmetrical wing requires different rib spacing for each half.



I set about researching proven airfoil and moment combinations from the many articles published over the years. After shamelessly borrowing some of the ideas, I sat down with a draftsman and his CAD machine to transform the Falcon 49 concept onto paper. With a picture of the original Falcon 35 and rough sketches of the new model in front of us, we arrived at a compromise that turned out to be a modern, utilitarian design, with old-time style outside and up-to-date features inside.

Not knowing exactly what to expect, I used those early CAD drawings to cut parts and build the model. I was pleasantly surprised to find I had constructed a heavy-duty, flying test bed that can accept an engine as large as a .60 but is kept busy trying numerous .40-, .46- and .49-sized power plants.

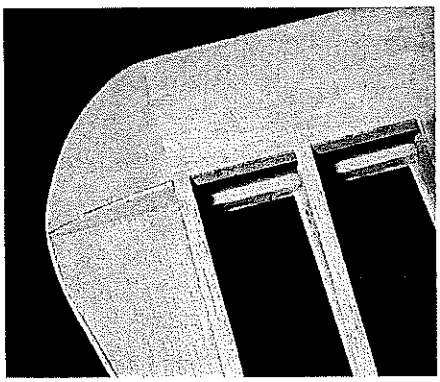
The Falcon 49 is stable, and is capable of carrying fuel loads to match the engine being used. It's an easy, straightforward project that utilizes both old and new technologies. If building an airplane that can test-run most of your favorite old engines or some of today's newer, RC-based power plants sounds good to you, then I suggest we get started!

MATERIALS SELECTION

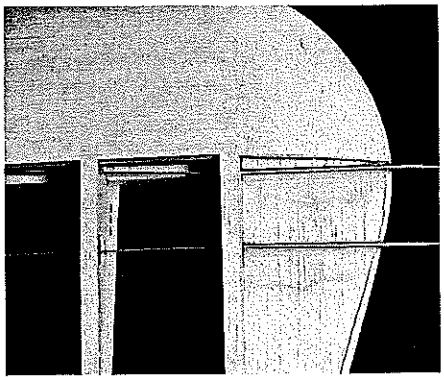
All materials used to build the original Falcon 49 were purchased from hobby shops near my home. If you are lucky enough to have a local hobby shop, I suggest you use and support it, as there is no substitute for having a place to pick out your own wood and other items.

Secondly, many good dealers will gladly order control line items for you if they can locate a supply source. This special-interest service is frequently missing at the shop-by-mail, RC-oriented discount houses. If you do not have a dealer near you, however, order a catalog from Sig Manufacturing in Montezuma, Iowa. As a major supporter of control line activity, Sig is a reliable source for everything needed to build the Falcon 49, and it is as close as your mailbox or UPS truck.

Be reasonably sensitive to weight when selecting your balsa. Heavy, flintlike wood is something every modeler has kicking around



Outboard wingtip has a hollowed block that may be opened with a small drill to add lead shot for fine trim.



Inboard wingtip detail shows mounting for the permanently placed ⅛-inch O.D. brass tubing leadout guides.

Falcon 49

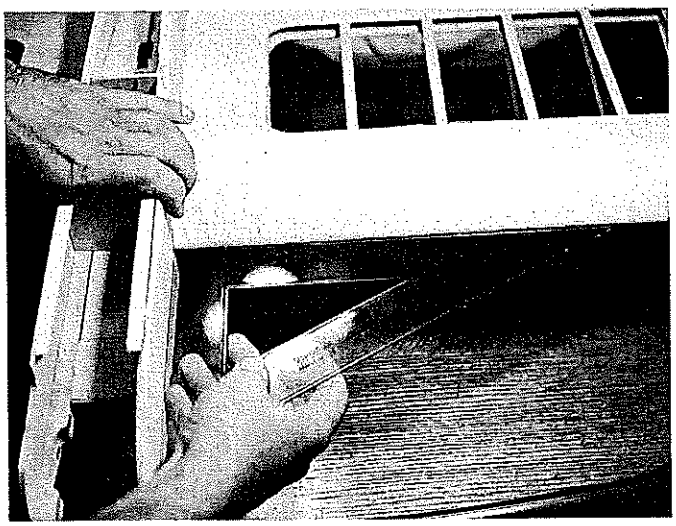
Type: CL sport stunt

Wingspan: 55¼ inches

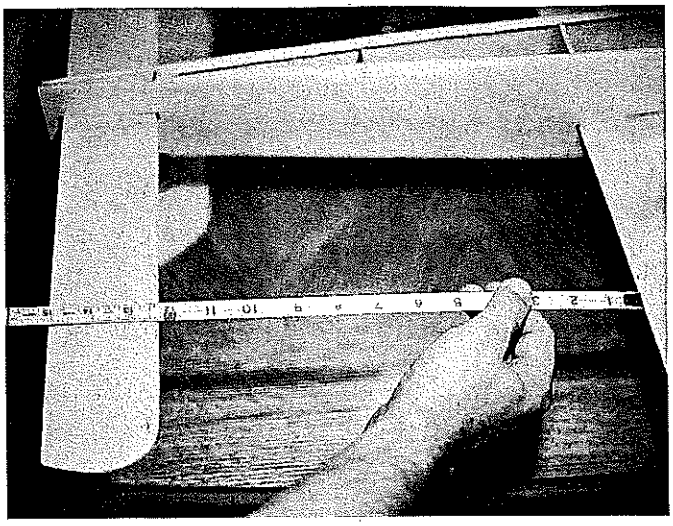
Engine: .40-.60

Construction: Built-up

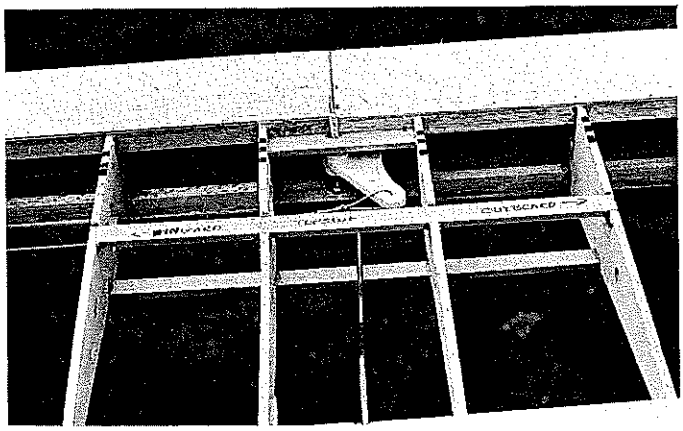
Covering/finish: Silkspan or iron-on coverings



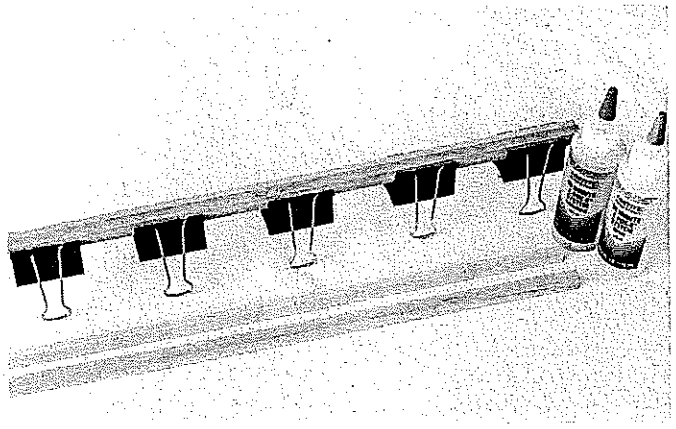
"Barn door" wings make wing and fuselage alignment easy. The triangle confirms alignment, then the wing is tack-glued in place with CyA. Thirty-minute epoxy is used after the CyA sets.



The relationship between flying surfaces is the difference between a good-flying airplane and a dog. The stabilizer tips must be equidistant from the wing trailing edge.



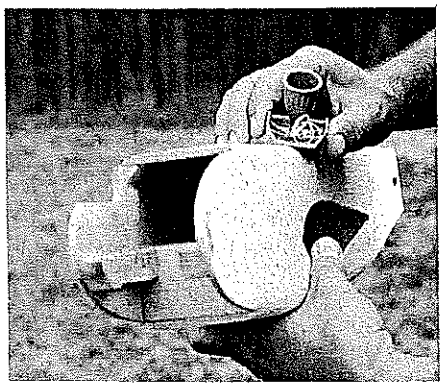
The wing center section before planking has been installed. The bellcrank is suspended between plywood platforms. A spruce stringer gives extra strength for abrupt maneuvers.



Strong, practical motor mounts are made from a maple-spruce "sandwich" to save weight over solid maple mounts. They are assembled with CyA or epoxy and securely clamped together.

in the shop, and I mistakenly used some of my heftier stuff in this project, just so it "wouldn't be wasted." Trust me—unless you want to *hope* your lines will hold a really heavy airplane through a six-to-eight-minute flight (you *have* heard about the rock on a string, haven't you?), use your dense wood to build a deck in back of your house.

I encourage you to pick the lightest and best balsa you can find for the job to be done. A lighter airplane performs better, and in this case, a lighter airframe will permit mounting a heavier engine and balancing weights while retaining acceptable flight characteristics.



Razor plane shapes fuselage prior to installing the empennage. Use of triangular stock allows large-radius corners.

The original model used four-inch-wide stock for the leading-edge planking in order to retain a true airfoil shape from the front radius to the high point (spar area) of the wing. The same result can be achieved by splicing more-economical pieces of three-inch-wide stock with one-inch strips to make wider planking. Be sure that the edges have been trued with a straightedge to assure a good fit.

The same procedure can be used with the ⅛ fuselage sides, which were also cut from four-inch-wide stock on the original version. If you decide to splice balsa planks, be certain that the cement used is a type that can be sanded easily.

Speaking of cements, longtime builders will remember the traditional, solvent-based model cements that were once used almost exclusively for general construction. These days, there are other choices, such as quick bonding cyanoacrylates (CyAs), water-based aliphatic resins, and epoxies. All of the adhesives mentioned are currently available and can be used to build the Falcon.

If you are a traditionalist and want to use Ambroid, Sig-Ment, Duco, or Testors for the fun of it, feel free (as I did) to do so. These cements are strong, reliable, and still have the familiar odor you will recognize from many years ago.

For safety, be aware that solvent model cements, some CyAs and even some epoxies can give off powerful fumes that may be harmful. Therefore, providing good ventilation and taking appropriate precautions when and where you build is essential.

CONSTRUCTION

Many designers will tell you to precut all of the parts needed to "kit" a model; however, some builders, such as me, find this process a rather dull and tedious undertaking. As a compromise, you may find it more productive to cut parts for major subassemblies on an as-needed basis. Whatever method is used, precutting usually starts with the wing.

Some modelers have never attempted to scratch-build a design because they think producing a wing, for example, might be too difficult. Actually, it's only a matter of coming up with a good set of parts, so let's spend a little time here on some of the details.

Several options can be used to make a stack of identical ribs for a constant-chord wing. A craftsman friend of mine fashions a

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Falcon 49/Brigeman

Continued from page 46

beautiful brass template that he uses to cut identical ribs, one at a time, while he's away on business trips. Another method that may work a bit faster is to sandwich a stack of balsa blanks between two thin aluminum templates, then use a large sanding block to shape the blanks to their final form.

The plans show template drawings that show both the wood size needed for rib blanks and the outline of the ribs themselves. Cut the rectangular, dotted outlines from the plans, and use rubber cement or spray adhesive to attach them to a piece of rigid material, such as .015 aluminum sheet, that can be easily fashioned with a sheet metal cutter. The aluminum can be found at or ordered by your hobby source, or you might use scrap aluminum siding.

Trim one of the rectangular templates precisely to the dotted outline with your cutter, and rough trim the other. Using the precision-trimmed rectangular template as a guide, cut twenty 1/16 sheet rib blanks to size.

Drill two 1/8-inch holes in each of the rectangular templates at the locations shown. Using the precision-cut template as a guide, carefully drill similar holes through all of the blanks, five at a time. Then cut out the actual rib templates by carefully following the rib outlines.

Sandwich 10 rib blanks between metal rib templates and bolt the stack together with firm (but not crushing) pressure. Place large washers between the bolt heads and templates to help spread the load. Rough-carve the excess balsa, then sand the blanks to shape, taking care not to grind excessively at the metal templates.

Clearly mark the top of the rib stack with a felt-tip pen, then disassemble it. Repeat this procedure with the second group of blanks, taking care to align both templates right-side-up exactly as they were placed on the first set. Again, mark the rib tops before you disassemble the stack.

Cut out and paste the finishing rib pattern to a rigid piece of cardboard or plastic, trim to the outline, and cut the shaded spar and LE locations. Use this pattern to mark each of the ribs. Carefully hand-cut and remove the spar/LE locations where required. When finished, you should have a stack of identical ribs—just as you would find in kit.

Assembling the wing requires a building surface that you have regularly verified as being free of twists and warps (you *do* check it, don't you?). The traditional "pin the trailing edge and then add the leading edge and spar" method of building is certainly acceptable; however, if you want to increase the chances of having a good, warp-free wing, I suggest that you try using a rod-type jig.

A steel-rod jig was originally developed by Al Rabe, and was discussed by Bob Baron in his Fierce Arrow 86 article (July 1987 *Model Aviation*). Great Planes' version of this jig can be ordered through your dealer or from Tower Hobbies. It takes a bit of adjustment to adapt to building "on the rods," but once you try it, you'll have a real problem going back to your old ways.

If you have decided to try the jig, the 1/8 holes that you drilled in the rib blanks will now be used as locations for the 1/4-inch jig rods. To make the proper size holes, I use a Dremel tool mounted on a Dremel drill press fixture and a 1/4-inch tapered reamer. However you choose to do it, keep in mind that the holes must be kept in the same plane and must fit snugly on the rods.

Make sure the index marks you added earlier are facing up, and carefully slip the ribs onto the rods. Space the ribs as shown on the plans, and construct the wing framework. Note: Because of the size of the jig fixture, you will be building the left and right panels independently. Since the wing is asymmetrical (one panel is slightly longer than the other), make sure the rib spacing for each panel is the same as shown on the plans. When each panel is completely dry, carefully remove the rods using a gentle, rotating motion to avoid damaging the structure.

When both panels are complete, trim and sand the center section to be certain all planked portions are parallel and true. Reinsert the rods (remember to rotate them) through the central areas of both the right and left sides—use the rods for a joining

guide. Pin the trailing edge of each panel to your building surface, and measure the leading edge height to make sure both sides are equal.

Join the panels at the center section with spruce stringers and balsa splices, and let dry. Remove the pins and rods, then add the bellcrank assembly, the trailing edge cap, wing tips, tip blocks, and center section planking. The wing is now solid, straight, and ready for sanding.

(Another, more expensive jig unit called the Adjust-O-Jig allows you to build the wing in one piece and avoid the joining process altogether.)

The Falcon's fuselage is wider and beefier than normal. It's designed to handle heavy vibration and the stress imposed by varied engine choices. It serves not only as a joining point for the wing and empennage, but also houses the mounting platform for the removable engine hardware and tank. For the structure to do its job effectively, one must pay particular attention to physical strength and proper alignment.

Begin by cutting the fuselage sides from ⅛ x 4 x 36 stock. As mentioned above, you may splice the wood needed from narrower sheets without any strength penalty. Similarly, cut doublers from 1/16 birch plywood. Check for fit, trim the doublers where necessary, and cement in place. I usually use 30-minute epoxy for this job; however, I have seen respected builders such as Windy Urtnowski use CyA to attach doublers on his .60-size models, so the choice is yours. CyA is fast and light, but once it "kicks," there are no second chances.

Before assembly, be certain that the parts match and that you will finish with right and left sides. Cut the ⅛ birch plywood bulkheads. It is here that you'll begin to see how the Falcon differs from other airplanes.

Notice that the motor mounts are larger than normal and are constructed from a hardwood/spruce combination. This increases the attachment area for the cement on the fuselage sides without suffering the weight penalty such large mounts would cause if they were made entirely from hardwood.

Make the mounts by cementing ¼ x ½ spruce strips to ⅜ x ½ maple motor mount stock. The objective is a mount that is ⅝-inch high and ½-inch wide. The spruce portion is located below the harder maple, which remains on top for strength.

After constructing the motor mount "sandwich," cut out the area shown for bolt clearance and prepare to cement the mounts to the fuselage sides. Trace a template of the upper fuselage side, and use it to draw layout lines on the doublers to make certain both mounts are identically located and are parallel to each other. Use 30-minute epoxy to glue the mounts precisely along the layout lines, then clamp them firmly in place while the adhesive sets up.

Once the epoxy has set, the fuselage sides may be joined. Assemble the fuselage with both sides and the two main front bulkheads upside down, using the flat top area of the fuselage sides as the parallel elements in contact with your building surface.

Some builders use a commercial jig to assure true alignment; however, a method that has proven reliable for me is to draw a centerline on the building board, and line this up with centerlines drawn on the two main front bulkheads. Using blocks of balsa pinned to the board and against the outside perimeter of the engine/tank-box area, the fuselage can be kept rigid and straight for the initial cementing. I also tack-glue the tail post at this time to make certain both sides are parallel front-to-back. When set, the tail post should be directly over the centerline.

To increase resistance to vibration, I recommend that you tightly fit a piece of ½-inch medium balsa (crosswise grain) between the motor mounts, closing in the area between F1 and F2. This piece acts as a stress web, tank floor, and provides the solid front end that allows this model to handle larger engines.

The remaining formers are cut from sheet to the proper width at each station, slip-fit in place, then are trimmed and sanded to correct height.

The tail surfaces are made from solid wood. Even though extreme light weight is not *necessarily* the goal for this aircraft,

you should make an effort to find the lightest, straightest stock possible for the empennage. It is interesting to note that most engine/muffler combinations I have tried cause the airplane to either balance right at the point shown on the plans or to be only slightly nose heavy. For your Falcon, don't gamble! Make the tail feathers light, which will allow you to add balance weight later.

The majority of the fuselage construction is conventional except for the rear of the aircraft. A weight box, located under the horizontal stabilizer, allows you to adjust the aircraft's balance point for different engines. The box area is lined with 1/32 plywood to help prevent vibration damage from whatever weights you select.

I use ½-ounce lead putty slugs, which are available from RJL Industries. This product can be molded to shape, doesn't rattle around or cause damage, and is infinitely variable as to the amount actually used.

A swiveling tail wheel is suggested on this design as well as the provision for a stooge-release ring. Did I say *swiveling tail wheel*? Yes, indeed! This old idea was once featured on some Sterling stunt kits that I always thought of as something different. Though it seems that a full-castering tail wheel might let the airplane turn in, in practical use I found that it doesn't affect takeoffs or landings at all. The freedom of the tail wheel to move in the direction of travel allows you to actually walk the plane back to the launch point from the center of the circle. If you fly from grass, however, this feature is not useful, and a conventional fixed wheel or skid is preferable.

FINAL ASSEMBLY

All subassemblies should now be planed, carved, and sanded to shape as necessary. All dings and other imperfections can be filled with Goldberg Model Magic filler, or a similar product that can be found at home-improvement stores. The objective is to make the surface below your finish smooth and free from major flaws.

Cut away the bottom of the fuselage in the wing mounting area as shown on the plans. Carefully insert the wing into its opening to check for fit. You may need to trim the fuselage openings slightly to be certain that the wing makes the best possible contact with the fuselage sides. Be careful not to cut away too much material. You must make this special effort to avoid changing the incidence of the wing or your ability to mount the wing parallel to the fuselage sides. Fit the stabilizer into its slotted opening and adjust the opening so the stab easily sits parallel to the fuselage.

Once you are satisfied with the fit of the wing and stab, check vertical and horizontal alignment with a triangle. I usually check the spar-to-fuselage area and the leading-edge-to-fuselage on both sides of the airplane, then tack the wing to the fuselage with CyA once I am absolutely certain that the alignment is correct on each side.

Hold the elevator joining wire in place at the rear of the slot for the stabilizer, and slip the stab into position. Secure the joining wire to the stab, then install the hinges and elevators.

Alignment of the wing and stabilizer is next. This is best accomplished by measuring the distance at the rear of both sides of the stab and the trailing edge of the wing. Sight down the fuselage from front to rear, eyeballing the relationship of the stab to the wing. Once you are certain that the stab is horizontally and vertically aligned (shim as necessary), tack-glue the stab in place and allow it to dry while you monitor the assembly for any sign of twist or droop.

Install the weight box in the tail section, and reinstall the underwing sections of the fuselage that you removed earlier. Reinforce to suit, then permanently cement the wing and stab in place, using a light coat of 30-minute epoxy. Install the fuselage top and bottom planking, carve and finish-sand to final shape. Add the canopy turtledeck, fin and dorsal assemblies, and the rudder, then allow to dry. You are now ready to finish the Falcon.

FINISHING

The wing structure of the Falcon 49 was designed for any of the popular iron-on covering materials. As one who appreciates the old-time, traditional approach, I used silkspan and dope on the

original. Either method has advantages and disadvantages, but if you want to update your knowledge and skills, you may wish to try plastics.

In addition to engine testing, I saw this project as an opportunity to experiment with Sig Epoxolite for fillets, instead of the plastic balsa I used years ago. I also tried adding a tinting medium to my clear dope in order to provide a vivid base color to the airplane without adding the weight associated with pigmented color coats.

If you are a former CL buff coming back into the hobby, this airplane is just the type that can be used to experiment with different or unfamiliar materials. Never be afraid to try something new!

All engines you may want to use can be mounted on the 3/16 x 5/8 aluminum pads shown on the plan. The pads, which are cut from strips available at any metal supply house, are identically drilled to fit into the same holes on the motor mounts. By using the pads, it's not necessary to repeatedly redrill the mounts themselves when you want to change power plants.

The tank compartment is large enough for a Sullivan eight-ounce clunk. If you don't have much luck with clunk-type tanks, you may also use a metal tank of standard uniflow construction as a substitute.

Kenn Smith of Smith Fuel Tanks designed a special product just for this airplane called, appropriately enough, the Falcon 49 tank. This unit has greater height, width, and volume than the typical commercially available variety. It also comes properly vented for the upright engine configuration of the Falcon 49, and the pickup tube of the Smith tank is located to allow for the additional height of the engine mounting pads.

Once you have added the vinyl lettering (water transfer decals are rare these days), wheels, and hardware, balance the Falcon at the point shown on the plans. This is a good starting point and is where my airplane flew best; however, you may want to eventually move the balance point forward or aft to suit your own style. Remember that this airplane is not intended to be a giant-killer Precision Aerobatics model, so you may not want to expend a great deal of time on precise trimming. Sufficient attention paid to basic balance will allow you to gain the greatest utility and pleasure from your model.

FLYING

Always pick a calm day, or at worst, a day with a light breezes for test flying. Flying an unfamiliar airplane in high winds or gusty conditions is an invitation for disaster—you might as well include a Hefty bag in your field box.

Try simple maneuvers first; then, if things look okay, you may consider something more complex, like lazy eights or inverted flight. Be advised that losses of power while inverted are not particularly kind to the head of an upright-mounted engine. To be on the safe side, you may want to try your first inverted flights high enough to be able to safely recover the airplane in case of a flameout. Once you are confident of your model's fuel flow and general engine characteristics, routine maneuvers should be no problem.

In keeping with the spirit of promoting control line modeling to newcomers, this article was written with sufficient detail to take almost anyone through the rough spots. For you old hands who are coming back into the fold and are trying to catch up with the times, my experiences and building techniques may provide you with encouragement and some new ideas to try. Always read the articles offered in our magazines, both for inspiration and to find new approaches as to how routine things can be done.

If you have any questions about a design feature not mentioned here, feel free to call me at (714) 667-7178 after 7 p.m. Pacific time; I will be happy to try to answer any questions you may have. If you decide to build this airplane, I would be honored if you would send me a picture of your finished Falcon 49 for my album. You can write and/or send photos to Fred Brigeman, P.O. Box 1935, Tustin, CA 92681-1935.

MATERIALS SOURCES

If you have a local hobby dealer, try to buy as many items from him as possible. If no dealer is available or the one near you can't or won't supply your needs, try the following specialty houses that sell direct to the modeler:

Sig Manufacturing Co., 401-7 S. Front St., Montezuma, IA 50171; Tel.: (515) 623-5154. *Balsa, covering materials, and most CL accessories.*

Smith's Metal Fuel Tanks, 521 Jansen Ave., San Dimas, CA 91773; Tel.: (714) 592-2100. *Standard and custom-made fuel tanks.*

RJL Industries, 1831 Business Center Dr., Duarte, CA 91010; Tel.:(818) 359-0016. *Engines, lead putty, and after-run oils.*

Vinylwrite Custom Lettering, 16043 Tulsa St., Granada Hills, CA 91344; Tel.: (818) 363-7131. *Standard and custom vinyl lettering.*

Fox Manufacturing Co., 5305 Towson Ave., Fort Smith, AR 72901; Tel.: (501) 646-1656. *Engines, bellcranks, spinners, and miscellaneous components.*

Hobby Lobby; Tel.: (615) 373-1444, or Tower Hobbies; Tel.: (800) 637-6050. *Engines, covering materials, various usable accessories.* ✈

Aerodynamic/deBolt

Continued from page 30

neutral stability—the flight path will be in whatever direction the plane is pointed. Obviously that makes it most suitable for RC aircraft. This arrangement also adds to efficiency beyond the gain from lack of downthrust. With the additional tail lift required, the model's total lift is increased.

While these investigations were made with electric-powered Enduro-style RC models, most of the factors would also apply to other model types. This is especially true for the neutral-stability force arrangement, where we actually drew from previous Pattern design experience. In Pattern, effective speed control is a must; evaluators always say that a good Pattern design is one whose line of flight is where the pilot points it. In short, the findings are applicable to all model designs.

What we have reported represents two years of judicious investigations. I hope that the findings have proven interesting, and that they may be of some value to you. Further, I hope that this work may inspire your own investigations. Better flying can be had through aerodynamics! ✈