

# CHEAP FUN

Low Cost Sport Trainer  
for .049-.10 Engines

By Stu Richmond



For modelers of all skill and experience levels, here's Stu's answer for R/C on a budget, with maximum enjoyment!

One of the great (but little-known) values for our hobby dollars is the Tower Hobbies "Box-A-Balsa" that usually costs a bit under \$30.00. Back during the Cold War days, I used to buy these and ship them into Eastern Europe to modeling pen pals, and they were always most welcomed. The "Box-A-Balsa" assortment #1 comes with 2-1/2 lbs. of assorted sheets and strips of balsa as well as three different thicknesses of plywood and even has servo rail wood. The assortment is always the same and it's not scrap stuff left over from kit manufacturing or such; I regard the wood as being first-class quality.

A couple of years ago, I again studied the contents of the "Box-A-Balsa" and every time I added two-plus-two, I kept

getting a "five" for an answer ... better than getting "4". By this time, I was sure I could build not one model, but **two R/C models from a single box**. It was an interesting challenge. I had bought a new-in-box O.S. .10 R/C engine at a swap meet for \$25.00 and it had no home. Like many of us, I had an assortment of Cox .049 engines that were also homeless. I'd also been saving chopsticks from our favorite Chinese restaurant for some time, and there were always 35mm film containers from my photo projects. I'd always picked up old tire weights when I saw them, and a kid's toy car yielded a

couple of 1-3/4" rubber wheels I'd saved in my landing gear box of junk. When

Tower hobbies came out with their \$99.99 System 3000 4-channel FM servoless radio system, the total concept of "Cheap Fun" started to clearly come together.

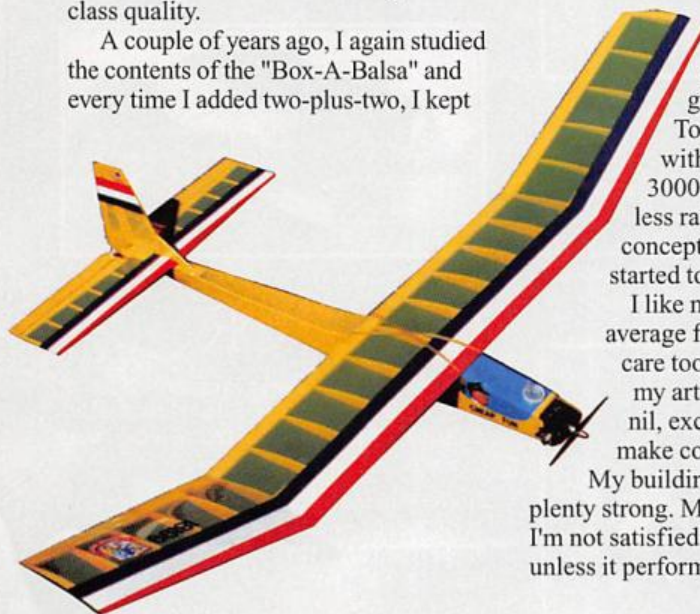
I like models that are above-average fliers. I don't seem to care too much for prettiness; my artistic talents are near nil, except for what I can make colorful on my models.

My building isn't super, but it's plenty strong. More than anything else, I'm not satisfied with an R/C model unless it performs well in the air.



## Design Philosophy

The Cheap Fun challenge was now clear. Build two R/C models from a single "Box-A-Balsa," use the O.S. .10 on one and a Cox .049 on the other, use 35mm film containers for fuel tanks (they hold just over an ounce), the use of chopsticks would work for dowels to hold on the wing, use chopped up lead from the tire weights for nose ballast, and toy wheels could be a belly-mounted landing wheel just like real sailplanes use. The models should be identical in size, but the lighter and thinner wood would build the .049 powered model, and the heavier/thicker wood would build the .10 powered model. One would get the \$99.99 Tower radio, and an extra receiver added to my Skysport would fly the other. The models should be sized for a standard airborne battery and standard servos. The emphasis would be on doing the project on a cheap budget to get the most flying fun. The models would therefore be named **Cheap Fun**. I even figured I could save money on wire by using a standard coat hanger for the wheel's axle, as well as for joining the two elevators together.



## Design Aerodynamics

Most model designers draw pretty planes and start building with no real aerodynamic concepts ... that's not so bad. My aim was to achieve better-than-average flight performance with adequate structural strength. I was out to design powered sailplanes that would give lots of air-time fun without spending much money. The bottom surface of the Clark "Y" airfoil is the starting datum line. The Clark "Y" airfoil was chosen for its simplicity in building/covering, its good lift over drag performance, and its depth allows good structural strength. The stab is mounted at a +1° angle to the datum line (the front of the stab is higher than the rear) so that the angle of attack on the wing is reduced from that of the normal model so that the wing's aerodynamic drag is lessened to **increase** flying speed without adding ballast. One eighth inch of washout (measured at the outside wing panels' rear outermost tip) reduces the wing's drag immensely in flight. The washout slightly reduces the angle of attack near the wingtips and the lift resultant. As the lift resultant reduces, so does the drag at the tip, where most of the wing's drag originates.

The formula for lift is as follows:

$$L = C_L \frac{d}{2} S V^2$$

L — is measured in pounds

$C_L$  — is the coefficient of lift of the airfoil

d — is the density of the air

S — is the area of the wing

V — is the velocity or airspeed.

On the right side of the equation you see that "V" is squared ... that is, V is multiplied by itself **one** time. If everything to the right of the equation sign is held steady (except V), we see then that V is a major, big-time player in

**The Tower Hobbies "Box-A-Balsa" assortment #1 is a great value. Its contents yielded enough wood to build two of Stu's "Cheap Fun" R/C models.**

the generation of lift. If a model's V is 10 miles an hour, then V squared is 100. If V is 15 miles an hour, then V squared is 225. If V is 20 miles an hour, then V squared becomes 400 ... so you see that minor increases in V (velocity) generate **major** increases in lift.

This explains the advantage of the stab at +1° (model designers seldom use positive stab incidence) and the resultant lower drag and higher V. The wing's washout further reduces the major source of wing drag (vortices off the wingtips) and this lower drag adds further to V. An interesting point is that the Spitfire's elliptical wing had about 5° of wing washout but I've never seen a Spitfire R/C model with similar washout. Another interesting point is that the Piper Cub is rigged with something near 2-1/2° of washout which gives good high speed without much horsepower and nice slow landing speeds without flaps. But I don't know of a single R/C model of the Piper Cub that has the washout of the real thing. All Boeing airliners use washout. When a model spirals tightly in a thermal, it must be able to easily speed up and generate more lift with the increased V to sustain sufficient lift while banked sharply towards the center of the thermal.

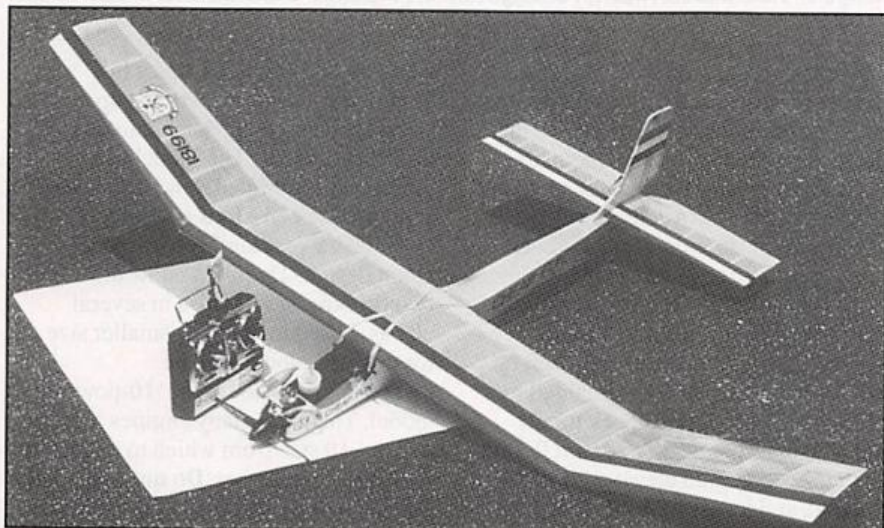
GRADE AAA

# BOX-A-BALSA

**TOWER HOBBIES**  
PO Box 176, Champaign, Illinois 61820

ASSORTMENT #1

<p><b>CONTENTS:</b></p> <ul style="list-style-type: none"> <li>2 - 1/2" x 3/4" Balsa</li> <li>2 - 3/8" x 3/4" Balsa</li> <li>2 - 1/4" x 3/4" Balsa</li> <li>2 - 3/8" x 1/2" Balsa</li> <li>2 - 1/4" x 1/2" Balsa</li> <li>2 - 3/8" x 1/4" Balsa</li> <li>2 - 1/4" x 1/4" Balsa</li> </ul>	<ul style="list-style-type: none"> <li>1 - 1/2" x 1/4" Balsa</li> <li>1 - 1/2" x 1/2" Balsa</li> <li>1 - 1/2" x 3/4" Balsa</li> <li>1 - 1/4" x 1/2" Balsa</li> <li>1 - 1/4" x 3/4" Balsa</li> <li>1 - 3/8" x 1/2" Balsa</li> <li>1 - 3/8" x 3/4" Balsa</li> <li>1 - 1/4" x 1/4" Balsa</li> </ul>	<ul style="list-style-type: none"> <li>1 - 1/2" x 1/4" Balsa</li> <li>1 - 3/8" x 1/4" Balsa</li> <li>1 - 1/4" x 1/4" Balsa</li> <li>1 - 1/4" x 1/2" Balsa</li> <li>1 - 1/4" x 3/4" Balsa</li> <li>1 - 3/8" x 1/2" Balsa</li> <li>1 - 3/8" x 3/4" Balsa</li> <li>1 - 1/4" x 1/4" Balsa</li> </ul>
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*The aero design is aimed at above-average flight performance and flying fun with a minimal hobby dollar expenditure.*

## CHEAP FUN

Designed by:

Stu Richmond

**TYPE AIRCRAFT**

Sport/Powered Sailplane

**WINGSPAN**

61 Inches

**WING CHORD**

7-3/4 Inches (Avg.)

**TOTAL WING AREA**

476 Sq. In.

**WING LOCATION**

Top Of Fuselage

**AIRFOIL**

Clark "Y"

**WING PLANFORM**

Constant Chord Center

Tapered Tips

**DIHEDRAL, EACH TIP**

6-1/2 Inches

**OVERALL FUSELAGE LENGTH**

36 Inches

**RADIO COMPARTMENT SIZE**

(L) 11" (W) 2" (H) 3"

**STABILIZER SPAN**

22 Inches

**STABILIZER CHORD (inc. elev.)**

5-1/2 Inches (Avg.)

**STABILIZER AREA**

121 Sq. In.

**STAB AIRFOIL SECTION**

Flat

**STABILIZER LOCATION**

Top Of Fuselage

**VERTICAL FIN HEIGHT**

7 Inches

**VERTICAL FIN WIDTH (inc. rud.)**

5 Inches (Avg.)

**REC. ENGINE SIZE**

.049-.10

**FUEL TANK SIZE**

1 Oz.+

**LANDING GEAR**

Single On Fuse

**REC. NO. OF CHANNELS**

3

**CONTROL FUNCTIONS**

Rud., Elev., Throt.

C.G. (from L.E.)

3 Inches

**ELEVATOR THROWS**

3/8 Up — 3/8" Down

**AILERON THROW**

—

**RUDDER THROWS**

5/8" Left — 5/8" Right

**SIDETHRUST**

0°

**DOWNTHRUST/UPTHRUST**

(.049) 7° — (.10) 7°-9°

**BASIC MATERIALS USED IN CONSTRUCTION**

Fuselage ..... Balsa, Plywood

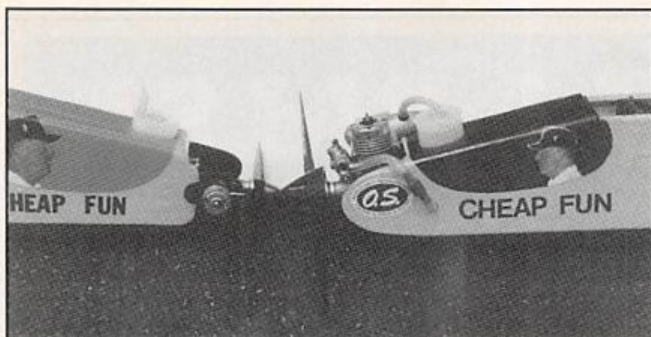
Wing ..... Balsa, Plywood

Empennage ..... Balsa

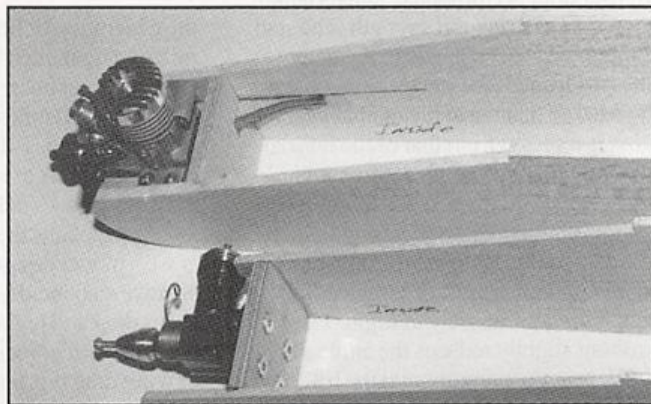
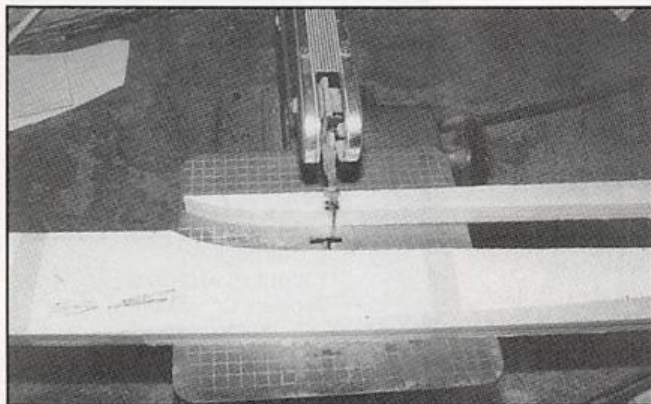
**Wt. Ready To Fly** ..... 28-35 Oz.

1 Lb. 12 Oz. to 2 Lbs. 3 Oz.

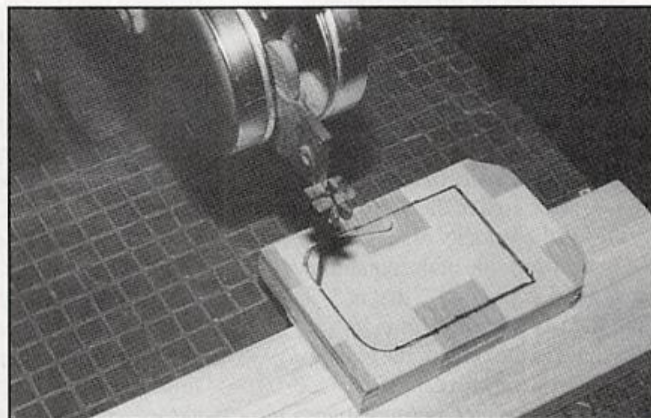
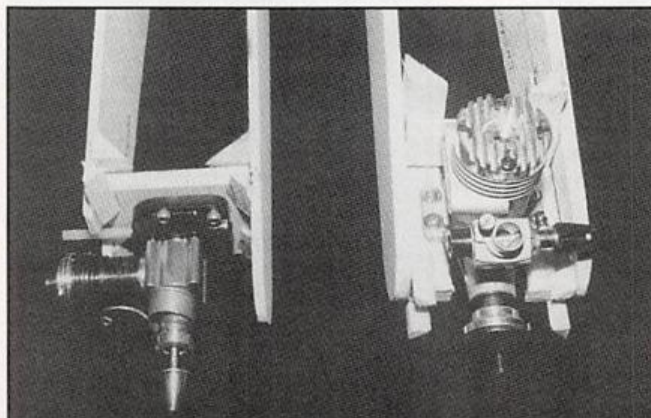
**Wing Loading** ..... 8.6-10.7 Oz./Sq. Ft.



LEFT: "Cheap Fun" on left uses a Cox .049 Killer Bee; on right uses an older O.S. .10 Stu bought NIB for \$25.00. RIGHT: There was a fuel draw problem with the .10. A pressure tap was added to the muffler with pressure led to the tank. Problem solved.



LEFT: Stu built both models at the same time from a single Tower Hobbies "Box-A-Balsa" (stock #TOWR2000 for \$25.99). Wood for four fuselage sides was taped together and Dremel-sawed to shape. RIGHT: Both firewalls are cut from the 1/4" plywood in the box. Greater thickness gives the most gluing area for maximum strength.



LEFT: Here you can see the firewalls have had triangular stock added. RIGHT: Fuselage formers F-8 and F-9 are identical in size. Photo shows four being cut out at the same time.

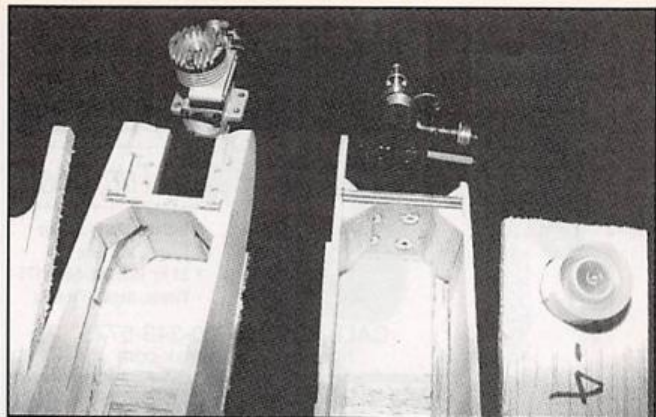
A "freebie" that comes with the washout is that tip stalling and the resulting loss of control is minimized. The minor washout also **decreases** the landing speed because the center section of the wing is at a higher angle of attack than the outer panels during low-speed landings ... and the center is creating drag to slow the model while it mostly flies into its landing on the outer washed-out sections. This comes from Georgia Tech Aero Engineering from the 1940's. The engine is mounted at a  $-7^\circ$  angle from the datum line to minimize the stall under power that comes from the thrust line being so far below the model's center of drag. The dihedral angle allows the model to spiral tightly in the weakest of

thermals; it enables the model to center itself in a thermal, and you simply add some "up" elevator trim (don't touch the rudder or you'll fly out of the thermal) and watch it ride the thermal for a lot of free air time. There's a delicate balance between the balance point at 37% back from the leading edge and all the angles.

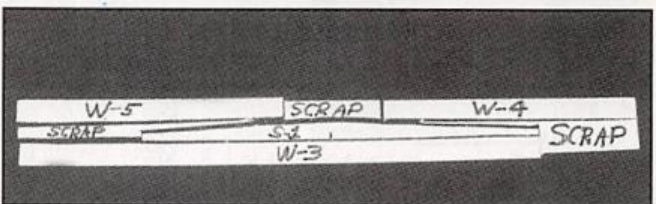
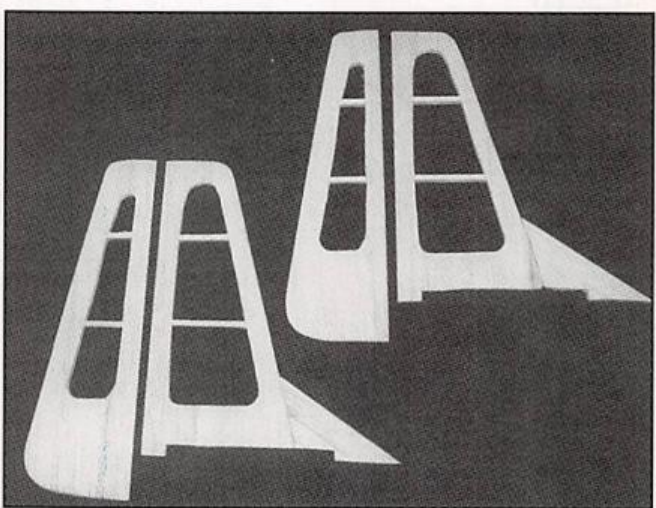
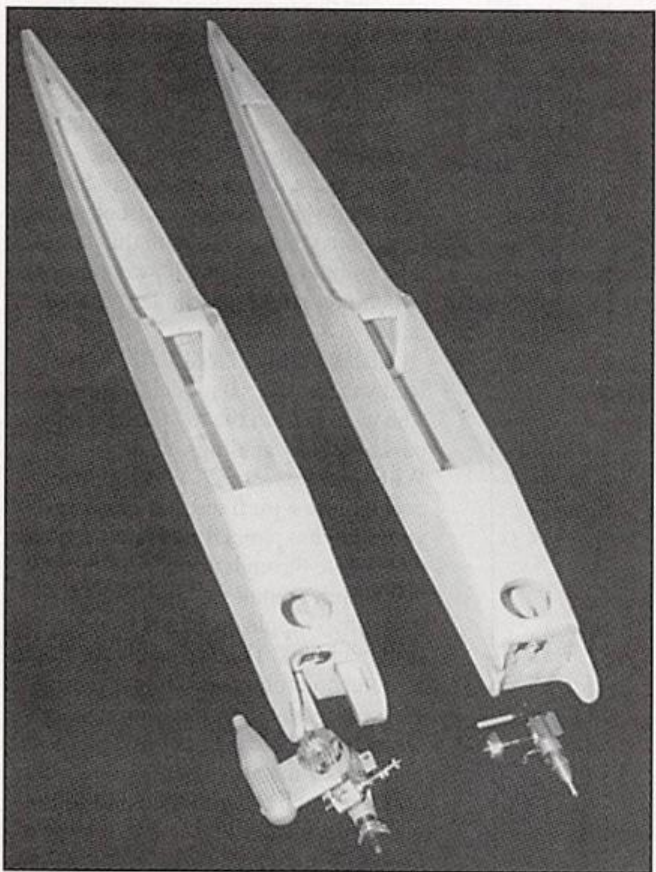
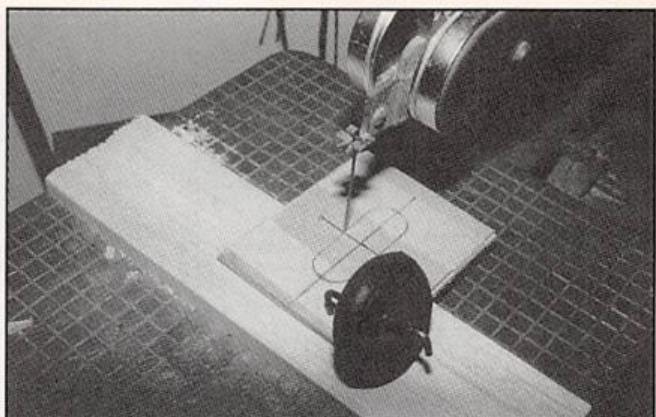
The first flight of the first-finished Cheap Fun was a 2 p.m. 20-minute thermal flight. It was practically out of sight overhead when it was decided to spiral down and land to check things over. Flights #2 and #3 were trim flights to get the rudder and elevator correctly centered, and to test for loops, rolls, try inverted flight, and then power dive for structural integrity to see if the wing

would break. Flight #4 was a full 40 minutes of riding thermals up and spiraling down to get back into good visibility altitude. The model was intentionally spiraled down and landed at 40 minutes. **We had a winner!**

This is a very simple low-piece-count design. The plans show the use of **two thicknesses** of balsa in several places. I used the thinner/smaller size for the .049 model and the thicker/bigger size for the .10-powered model. There are many engines in the .049 to .10 size from which to choose for Cheap Fun power. **Do not use a .15-sized engine ... the design is not stressed for an engine bigger than a .10!**



LEFT: Triangular stock has been flush-trimmed and both F-4 pieces are cut slightly oversize. The film container fuel tank is a snug press fit through F-4. RIGHT: Two F-6 pieces are being cut. The wheels from a child's toy failed with runway landings. Axle is from a coat hanger.



LEFT: Finished fuselages show the open top area behind the wing. This makes installing the Du-Bro pull-pull cables real easy. ABOVE, TOP: .049 uses 3/16" balsa; .10 uses 1/4". ABOVE, BOTTOM: This shows how a 1/4" x 3" x 36" sheet from the Box-A-Balsa yields W-3, W-4, and W-5 plus S-1. Save all scrap wood for possible use later.

## Building

Because of the model's simplicity, we are not writing step-by-step assembly instructions. Instead, the photos and captions can serve as a simple building guide. But...

Step #1 is to order RCM Plan #1261 for \$7.50 as you read this.

Step #2 is to order a Tower Hobbies "Box-A-Balsa" (at typing time, it is Stock #TOWR2000 at \$25.99).

The following notes will aid you in building: You may have to reach into your scrap balsa box, but we didn't have to. We carved our own leading and trailing edges from the B-A-B: it may be challenging.

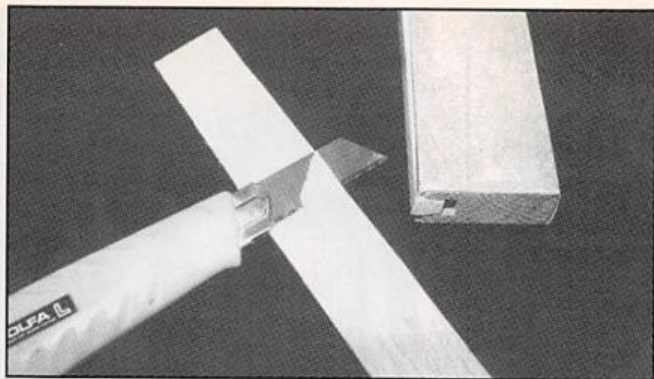
Plan to fly the model against white clouds and cover the bottom with **black**

**on its bottom surfaces for maximum visibility.** If you know you're going to fly against a blue sky (weak thermals only), **use white on the bottom surfaces.** MonoKote or Micafilm will best hold the intentionally twisted-in 1/8" of washout in the wing's outer panels; other plastic film coverings seem too rubbery. The 35mm film container holds enough fuel to run the .049 about 8 minutes, or the .10 for about 4 minutes. The container's top simply pops off; add the fuel and pop the top back in place. The fuel line tightly fits through the bottom and top hole drilled through the film container. A servo-mounting brass eyelet is shoved into the end of the fuel line to tighten the seal between the container and the fuel line.

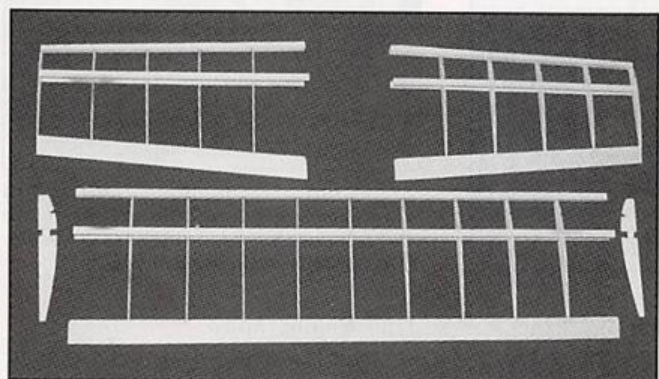
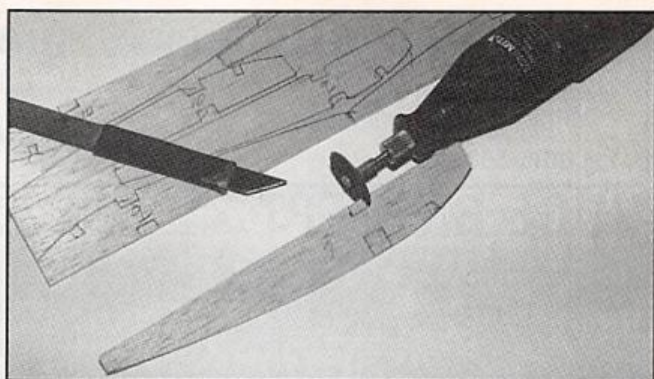
Ours don't leak, they work great and they're cheap fuel tanks! The models may climb up out of sight if the tanks are filled and you don't plan accordingly, be so warned. Our name, address, and phone number are on the models.

The .049 uses a 6 x 3 and the .10 uses an 8 x 4. Flying weight for the .049 powered one is 28 ounces with two of the new Hobbico Command CS-15 Sub-Micro servos. Flying weight for the .10 powered one is 35 ounces with three (one is for throttle control) of the new FMA Direct tiny S80 servos. The fuselage space will take standard-size servos, but I couldn't resist going first class with this new generation of tiny, light servos that are now available. I also went first

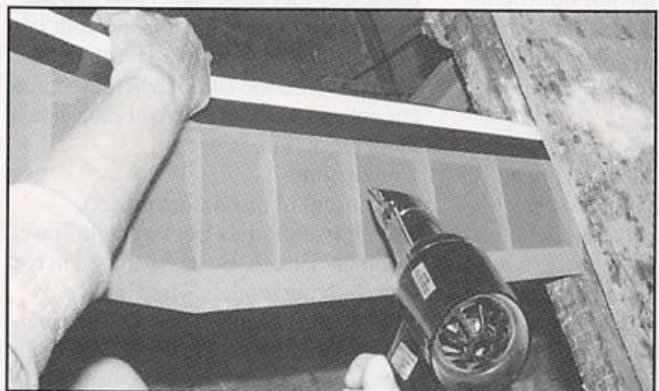




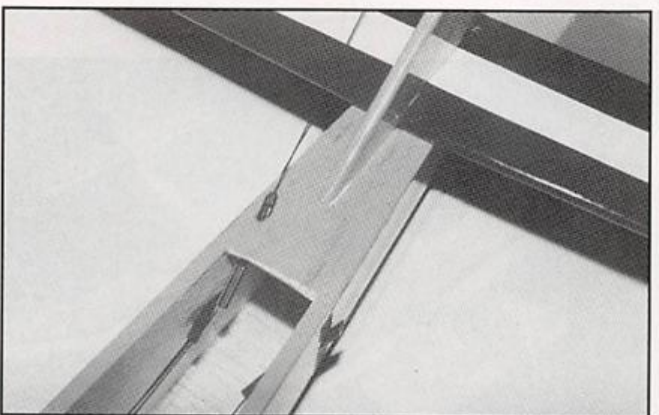
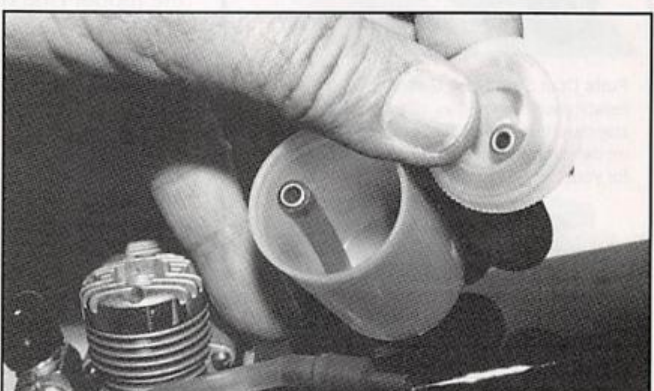
**LEFT:** It's easiest/best to carve the leading and trailing edges to shape before building. 80 grit sandpaper finishes the job. **RIGHT:** See how closely together the wing ribs are traced on the sheet balsa. Dremel MiniMite is the easy way to cut notches.



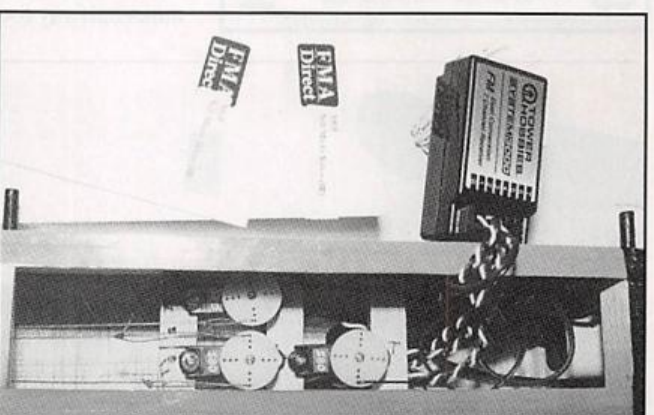
**LEFT:** Wing structure is basic, but proves to be extremely strong; however, the model is not stressed for an engine bigger than a .10 R/C. **RIGHT:** Both models were covered with transparent yellow MonoKote on the top. Red/white/blue was added over the yellow, and for maximum in-flight visibility, bottom surfaces were covered (last) with black.



**LEFT:** With the wingtip pinched by the workbench, the wing is gently twisted as the covering is shrunk so that the rear of the last/tip rib is 1/8" higher than the front of the last/tip rib. This gives the outer wing panels 1/8" of wash-out. **RIGHT:** The 35mm film container holds about an ounce of fuel. Vent line is between the finger and thumb and its end is slightly expanded by a brass servo eyelet. The fuel supply line will be pulled down and seals into the hole drilled through the bottom surface. This makes a simple (and cheap) fuel tank.



**LEFT:** 2-56 pull-pull cables exit the fuselage through scrap plastic tubing. **RIGHT:** These models will hold standard servos, but Stu opted to go first class on the controls and used three of the tiny new S-80 servos from FMA Direct. Receiver fits between the battery (at right) and the servos.



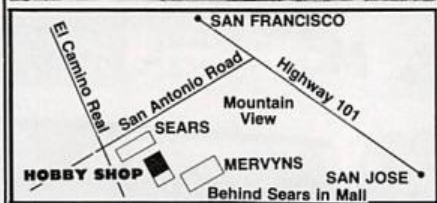
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Seven and a half ounces of cut up tire weights were glued behind/under the fuel tank of the .049 model for balance. The .10 model took five ounces.



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Model	(A) Length	(A) Wire Size	(B) Length	(B) Wire Size	Engine Size*	Price
RF 300	3"	1/8"	4"	3/16"	20-40	\$14.69
RF 350	3.5"	1/8"	4"	3/16"	40	\$14.69
RF 400	4"	1/8"	4"	3/16"	40 - 60	\$14.69
RF 450	4.5"	1/8"	4"	3/16"	40 - 60	\$14.99
RF 500	5"	5/32"	4"	3/16"	60 - 90	\$18.38
RF 510	5"	5/32"	4.3/8"	7/32"	60 - 120	\$18.75
RF 610	6"	5/32"	4.3/8"	7/32"	60 - 120	\$19.60
RF 710	7"	5/32"	4.3/8"	7/32"	60 - 120	\$19.60
RF 363	3" to 6"	5/32"	4.3/8"	7/32"	40 - 120	\$19.99
RF 573	5" to 7"	5/32"	4.3/8"	7/32"	40 - 120	\$20.39
RF 770	3" to 8.5"	3/16"	4.1/2"	1/4"	Gas	\$25.57
RF 800	3" to 8.5"	3/16"	4.1/2"	5/8"	Powered	\$36.08

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and set up the turn with "up" trim ... and watch. If you touch the rudder control, you'll generally fly out of the thermal. If you get into lift, it's hard to not touch the controls, but let the model ride the thermal bubble up and away. When you're either too high or too far downwind, take over control of the model and fly it back to you.

These models have 3-1/4 sq. ft. of wing area; the heavy one is flying at 10.7 oz./sq. ft. and the light one is flying at 8.6 oz./sq. ft. Due to the angular force set-up between the wing and stab, they penetrate extremely well with flying speed greater than you'd expect, so don't be afraid to fly on other than calm days. Be sure to hand-launch them directly into the oncoming wind and slightly upwards. Needle valves should be slightly rich and you might be smart to only fill the film container tanks halfway for first flights.

### Trick Photography

If you're wondering about the pilot in the cockpit, it's a simple cheap version of me to exact scale! My wife photo'd me in profile with my Canon Sure Shot camera at varying distances. When the prints were made, I got the one hour lab to print another set printed through the wrong side of the film. Then they were cut out and stuck in place on each side ... more cheap fun.

### Conclusion

The aim of this design project, getting **two models** from a single Tower Hobbies "Box-A-Balsa," resulted in two superb flying models. They build quickly and cheaply. They also thermal like crazy and give you the chance to get a lot of R/C air time on a very modest expenditure of hobby dollars.

If you build a Cheap Fun, I'd sure welcome a snapshot sent to me c/o RCM, P.O. Box 487, Sierra Madre, CA 91025. →



LEFT: The text details the exact scale pilot. Vinyl stick-on letters are from the stationery store. RIGHT: These models give a lot of air time for very few hobby dollars.

