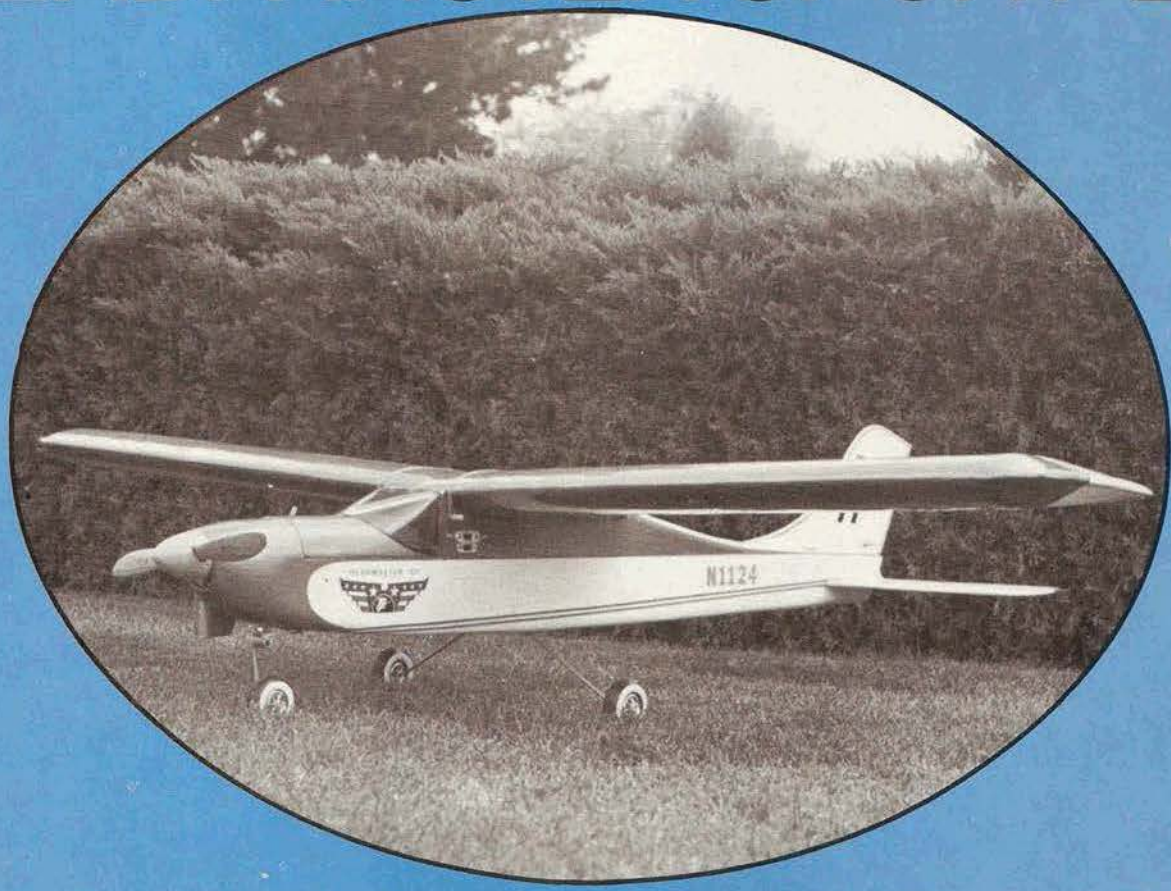
HEADMASTER SPORT 40



If you have flown any R/C airplane successfully and want to "step up" to high performance and sleek appearance, the Headmaster Sport 40 is the one you have been looking for.

THE HEADMASTER SPORT 40

Designed By: Ken Willard

TYPE AIRCRAFT
Sport/Trainer
WINGSPAN
59"
WING CHORD
12"
TOTAL WING AREA
696 Sq. In.
WING LOCATION
High Wing
AIRFOIL
Semi-Symmetrical
WING PLANFORM
Constant Chord
DIHEDRAL EACH TIP
1"
O.A. FUSELAGE LENGTH
49½"
RADIO COMPARTMENT AREA
(L) 12" x (W) 3½" x (H) 3½"
STABILIZER SPAN
23¼"
STABILIZER CHORD (incl. Elev.)
7⅜" (Avg.)
STABILIZER AREA
161 Sq. In.
STAB. AIRFOIL SECTION
Flat
STABILIZER LOCATION
Mid Fuselage
VERTICAL FIN HEIGHT
7⅛"
VERTICAL FIN WIDTH (incl. rudder)
6" (Avg.)
REC. ENGINE SIZE
.40-.60
FUEL TANK SIZE
8-12 oz.
LANDING GEAR
Tricycle
REC. NO. OF CHANNELS
4
CONTROL FUNCTIONS
Rud., Elev., Throt., Ail.
BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa & Ply
Wing	Balsa & Ply
Empennage	Balsa
Wt. Ready To Fly	88 Oz.
Wing Loading	18.3 Oz./Sq. Ft.

By Ken Willard

Fourteen years ago, after considerable needling from my friends to the effect that all my designs were for small engines like the .020, .049, and the .09 or .10, I decided to design a sport model for engines in the .15 to .29 range. So I did. Well, it wasn't really all that much of a design change, except for size. The Schoolboy, the Schoolmaster, and the Headmaster all looked similar; it was just that they were scaled up from basically the same drawing. And there's an excellent reason for that, commonly expressed as, "You can't fool Mother Nature." The aerodynamic force set-up is so dependable, reliable, and forgiving of minor deviations in building that the airplane will fly even when badly out of alignment, which occurs more often than you think as beginners keep coming into the sport of R/C. Yet, with the airplane built well and true in accordance with the plans, it is fully aerobatic in the hands of a resonably competent sport flier.

The Headmaster plans were published in RCM in September 1967 and were very popular.

In the past couple of years or so, the popularity of larger models has increased markedly. There are several reasons for that. They are easier to fly, and the larger engines, in the .40 to .60 range, have been refined to the point where they have excellent speed control from low idle to full power, even though the needle valve settings may not be precisely at the maximum performance point. And there are literally thousands of you sport fliers who have a good .40 or .60 that you'd like to put into a sport model and have fun. But you still don't want a pattern bomb; you'd like to have a model that looks like a Stand-Off Scale job, can perform like a trainer if you want to teach a friend to fly, yet will do the whole aerobatic list of maneuvers when you're in the mood.

And that is the basic idea behind the design of the Headmaster Sport 40. It's designed for you --- the sport flier. And for those of you who want to really "hot dog" around, it will take a .60 up front and give you some really wild maneuvers. That is, of course, if you can do them.

You'll be happy to note that the construction of the Headmaster Sport 40 is almost totally conventional. Yet, with just a couple of small changes, you can get that Stand-Off Scale appearance that you want. In fact, if you are a sport flier and builder, you probably won't even have to read the rest of this article; just get a set of the plans and build it. Everything called out on the plans is available at your local hobby shop; and if you don't have a local hobby shop, you can order the material from one of RCM's advertisers. So let's start with the fuselage.

Fuselage:

This is basically a simple slab-sider, made from 1/8" balsa sheet. But note that the longerons are 3/8" triangular stock. This allows you to put the box together, then carve the corners into a rounded shape to give the illusion of a modern molded fuselage. Look at the drawing of the cross section at Former F-1 to see how that is done. You can take it from there, and get that rounded appearance all the way back to the tail.

The 1/2" x 1/4" longitudinal reinforcing strips, as shown on the plans, give the added strength which may be needed when you goof a landing. And, of course, they provide a bearing surface for the mounting rails for the servos. Finally, up in the front area, the 1/8" sheet base for the tank compartment keeps fuel from getting down into the fuselage structure.

Take a good look at the photos of the tank and hatch structure. Note the easy access to the tank area. If you encounter any tank problems on the Headmaster Sport 40, all you do is lift off the hatch and replace, or repair the tank as required. You'll like it.

In fact, the hardest part of the whole fuselage, when it comes to building, is tailoring the cowl, forward of the firewall, to fit your particular engine mounting. In my prototype, I mounted my K & B .40 horizontally, with an Airfoil muffler, and then built a cowl around it, using pieces of scrap balsa which I Hot Stuffed together and then carved to shape. It took me as long to carve that cowl as it did to build the rest of the fuselage! All it took was patience.

Wing:

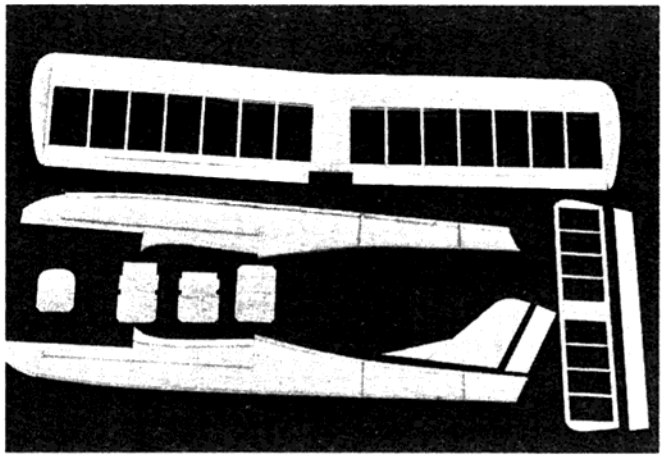
If the airfoil on the wing looks familiar to you, it should. It is the simplest semi-symmetrical airfoil structure you can build, yet one of the most efficient. That big leading edge, relatively thick trailing edge, and those big spars, with the shear web structure in the center rib bays, will assure you that no matter how violent a maneuver you want to do, the wing will stay together.

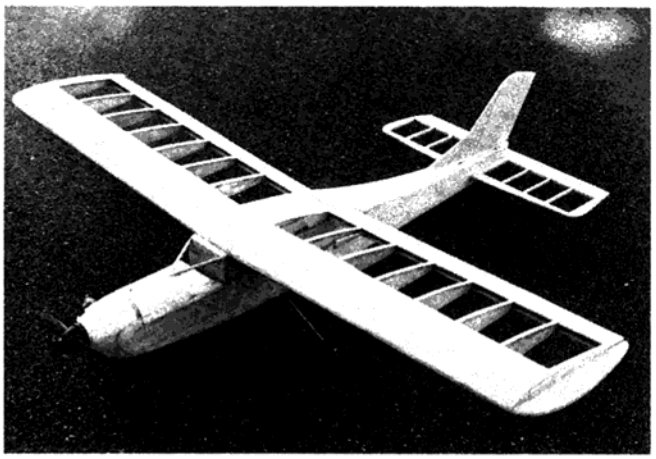
One thing that's worth noting is the aileron control horn arrangement. By attaching a 90° bellcrank to the servo wheel as shown, you get differential aileron travel --- more up than down, and that makes for very smooth aileron turn action, since the drag of the aileron in the down angle is higher than most of the up aileron, and with differential travel, that condition is minimized, and aileron turns are smoothed out automatically.

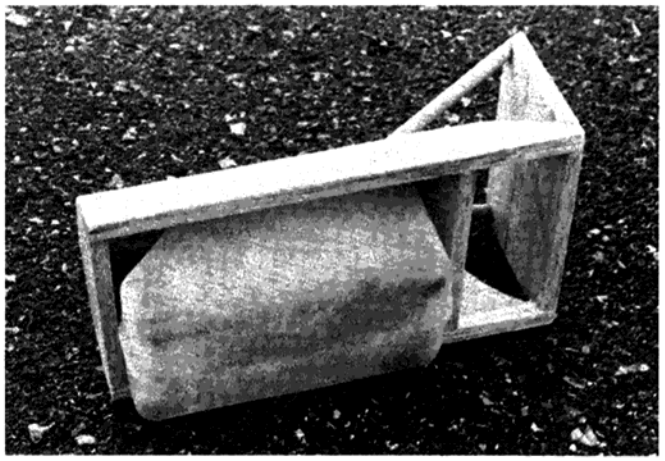
Note that the leading edge and the trailing edge is notched so that the ribs insert about 1/16". That notch gives you a glue joint that's three times as big as a straight butt joint. For my money, it's worth the little extra effort.

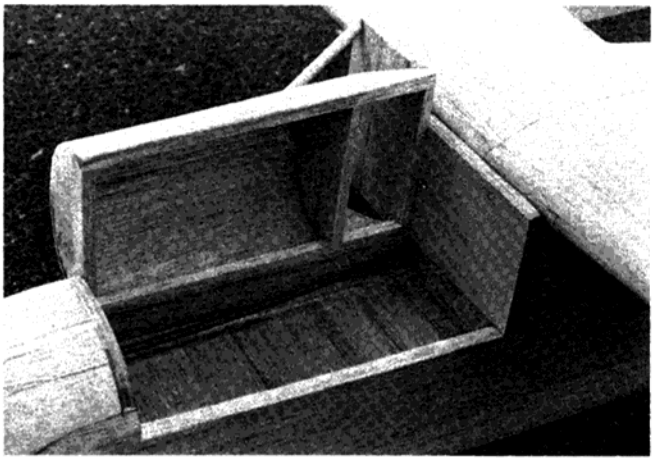
The wing tips are carved from 3/8" flat stock and butt joined to the tip rib. For those of you who may want a more rounded appearance, the tip could be carved from a solid block that is as thick as the wing. But it would be heavier, unless you hollowed it out.

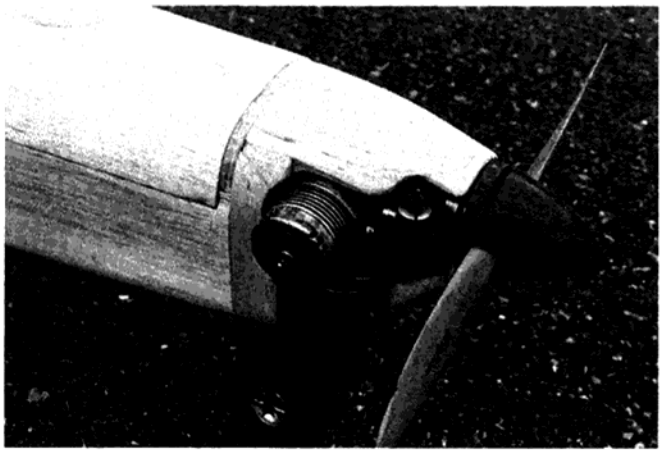
The dihedral angle of 2° is primarily for appearance, since the ailerons are fully effective even with no dihedral. But a straight wing does have a slight appearance of droop --- like the wing was a little tired --- so a bit of dihedral is used to avoid that look. There is one other slight advantage; with the











TOP LEFT: Major components. L.E. of stab tapered in final version. TOP RIGHT: Completed framed-up Headmaster Sport 40 ready for covering. CENTER LEFT: Tank and hatch detail. CENTER RIGHT: Hatch detail. LEFT: Side mounted engine is cowled in with balsa blocks.

dihedral you can also fly the airplane using only rudder control, although the control is marginal. But, if for any reason your aileron servo should become inoperative (like when you might have forgotten to hook it up), at least you can get the model around the field and back on the ground in one piece.

Note the detailed drawing on how to apply MonoKote for a hinge. I've used that type of hinge on many designs, and have yet to experience a failure. It's very effective, too, since it doesn't permit any flow of air through the hinge line.

Tail Surfaces:

The fin and stab are made from 1/4'' balsa stock, with the stab being a built-up structure to save a little weight. If you wanted to, you could do the same thing with the fin. The 3/8'' triangular stock along the base of the fin give it a good solid surface to glue to the top of the fuselage. And the stab slides easily into the slots in the sides of the fuselage for easy alignment. Incidentally, make sure the slots are evenly located from the top of the fuselage sides so the stab will line up properly with the wing as the wing sits in the wing saddle.

The fin and stab are glued in place, while the wing is held down with rubber bands. Old fashioned? Yes, but the method certainly saves a lot of minor repairs when you make a bad landing due to an unexpected gust of wind and the wing tips hit the ground first.

The elevator and rudder are made from 1/4'' stock, but if you want to shorten the time required to give them the tapered appearance, get some Sig 2'' aileron stock and use it. Just cut the leading edge of the elevator at the angle shown so you can use the MonoKote hinge method. Or if you prefer nylon hinges, you can use the stock just as is.

Landing Gear:

The plans show the Hallco B-106-5 formed gear. This gear is really bigger and stronger than required, but it will save a lot of landings when you're learning --- or teaching a beginner. Note it will have to be spread a bit so the model won't sit in a nose down attitude on the ground. The formed nose gear can be bought at most any hobby shop.

Radio Installation:

The long nose moment of the Headmaster Sport 40 makes it possible to have all of the radio gear immediately accessible in the

compartment area underneath the wing saddle opening, since the weight of the engine and fuel tank provides all the weight required forward of the leading edge of the wing. A standard type of radio installation is shown. One minor variation is having the elevator control rod come out straight through an opening at the rear of the fuselage. At first glance you might think this could make it inconvenient to adjust the elevator setting, but it isn't really. Two ways to handle it: one, turn on the receiver and transmitter, push full down elevator, and the horn is accessible. Shut off the receiver, make the adjustment, turn the system back on, and the adjustment is done. The other way is simply take off the wing, remove the control arm from the servo, turn it as required for whatever adjustment is needed, replace the arm on the servo, and the adjustment is complete. The advantage of the straight through rod to the elevator is that you won't get stress bends in the wire when performing heavy G load maneuvers.

What radio should you use? What radio do you like? There's room in the compartment for virtually any equipment on the market. My prototype has a Kraft unit installed --- one I've had for the last six years. Works great. I like it. So use one you like --- one that your fellow club members like, and it'll be fine. Nowadays the most important thing about radios seems to be availability of quick repair service, since they all work well when new. The choice is yours.

Covering and Finishing:

It seems that every modeler has his or her own favorite finishing method, so here again the choice is yours. I happen to like MonoKote for most areas, but up in front where the engine is, I use an epoxy material because of its great resistance to fuel soaking. Where the MonoKote meets the epoxy finish I seal it with MonoKote Sealer.

Other covering materials --- nylon, rayon, Coverite, silk, or various mylar materials, are available. In fact, one of the most unusual finishes I ever saw was one which used a flower print dress material which was fuel proofed with butyrate dope. When asked where he got the cloth, the modeler said, "I ripped up one of my wife's old blouses that she was going to throw away." Somehow, it looked like he was kidding.

"Saved some money that way, eh?"

"Yep."

"So how does the model fly with that covering?"

"Blousy!"

Oh, well. Guess you better use MonoKote. Smooth finish. Smooth flying.

Flying the Headmater Sport 40:

Three objectives were uppermost in consideration when the design of the Headmaster Sport 40 was conceived. They were:

(1) The aircraft should be relatively easy to construct, using proven construction techniques, which would also make it relatively easy to repair should it be required.

(2) The amount of actual construction required should provide the modeler with good reason to be proud of his building effort, and also give him enough opportunity in the final result to express his own personal preferences in detailing and decorating his creation.

(3) The aircraft, when finished, should be capable of serving as both a trainer and a sport flying model, while simultaneously presenting the appearance of a semi-scale model of a private full scale aircraft rather than the boxy appearance which is typical of most present day trainer/sport type models.

BILL OF MATERIALS
(All balsa unless otherwise noted)

Wing:
(2) 3/4" x 1⅜" x 30", Leading edge.
(2) 3/4" x 3/4" x 30", Trailing edge.
(2) 1/2" x 1¼" x 30", Ailerons.
(5) 1/16" x 4" x 30", L.E. sheeting, capstrips.
(1) 1/8" x 12" x 8", Ply dihedral braces.
(1) 1/2" x 1/4" x 12", Hardwood rails.
(1) 3/8" x 2" x 24", Wing tips.
(8) 3/32" x 2" x 36", Ribs.
(2) Strip aileron linkages.
(4) 1/2" x 3/8" x 30", Spars.

Stab, Fin, Elevator and Rudder:
(1) 1/4" x 3" x 36", (cut strips per plans). (Rudder and elevator can be made from Sig 2" aileron stock if preferred).

Fuselage:
1/4" x 4" x 5" Plywood, firewall.
Engine mount — your option.
Fuel tank — your choice.
Scrap balsa blocks — Cowl.
(2) 1/4" x 4" x 36", Formers, doublers, etc.
(8) 1/8" x 3" x 36", Sides, top and bottom sheeting.
(2) 1/4" x 4" x 36", To be cut and stripped to size.
(1) 1/4" x 36", Wing mounting dowel.
(6) 3/8" x 36" triangular stock, Longerons.
(1) 1/8" x 24" x 4" Ply, Forward fuselage bottom.
1/16" Plastic sheet cut to shape. Windsheild.

Landing Gear:
Hallco B106-5 (or 5/32" wire if bent to fit). Landing gear.
Sprung nose gear.
2½" Main wheels.
2¼" Nose wheel.

Once you have built the model, you will immediately recognize that the first two objectives have been achieved. Now it is time to fly it, and get the feeling that you are truly flying a small version of your own personal private full scale airplane. Let's talk about that.

First, it is important to remember that, just as with full scale aircraft, you should not attempt to fly this airplane if you are a raw beginner without first getting competent instructions from a qualified instructor in radio control flying. On the other hand, if you have flown any radio control airplane successfully, and want to "step up" to the Headmaster Sport 40 because of its high performance and sleek appearance, you will find that it is as easy to fly, if not easier, than any of its competitors in the sport/trainer category. The delicate balance between stability for a docile trainer, and controllability for sport aerobatics, has been achieved by incorporation of the basic aerodynamic principles which have been proven through the years to yield both high maneuverability at high speeds and reliable, gentle response at the lower speeds for cruising and landing.

So let's prepare for the first flight. Whether you are going to test fly your creation yourself, you've flown before, or if you're going to have your instructor test fly it, since you are a beginner, the same procedure should be followed, either by you or by your instructor.

First, check the alignment of all the flying surfaces. Carefully inspect the wing. Yes, you did build it on a flat surface, and it should be truly aligned, without any twist from the center section out to the tips. But check it again; sometimes, during the covering process, stresses are set up in the covering material that will cause small twists to occur in the wing. Should inspection show that to have occurred, the twist can be removed by careful application of heat to the covering, softening it slightly so you can twist the wing back to its orginal straight alignment and hold it there until the covering cools. A wing with true alignment is vital to good, reliable flying characteristics.

Second, check the tail surfaces, both for warps and for the alignment with the wing and fuselage. The horizontal stab should line up parallel with the wing, and the vertical fin should be directly in line with the centerline of the fuselage. Sight down the nose of the fuselage to check both of those alignments. Remove any warps in the same manner as with the wing --- and if by any chance you have misaligned the vertical fin, then correct it before flying. This is not likely, if you have followed the construction plans --- but check to be sure.

Third, check the location of the Center of Gravity --- the C.G. as it is popularly referred to. The plans show a range of locations within which you can get good flight; for your first flights, the forward position is preferable. The further back the C.G., the more responsive the model becomes to control inputs. Checking the location is easy; just lift the model by placing your index fingers on either side of the fuselage at the point where the C.G. should be. The model should hang from your fingers in horizontal flight attitude. If it doesn't, then add weight to the nose if it hangs nose high, or add weight to the tail if it hangs nose down.

Fourth, check your control surfaces for alignment and movement. Turn your transmitter and receiver on, with all trims on the transmitter set at neutral. With those settings the ailerons, elevators and rudder

should all be centered and in line with the wing, stab and fin respectively. For the first flights, control surface travel should be "mild." In terms of angles, that means 15° in either direction from the neutral setting. Later on, as you become familiar with your Headmaster Sport 40, you can increase the control surface travel to do the most violent maneuvers in the book --- snap rolls, spins, whatever you want to try. Caution --- when you get to that point, be sure you have plenty of rubber bands holding the wing in place.

Fifth, check the movement of your nose wheel for steering. With the transmitter and receiver turned on, roll the model forward. It should roll straight ahead. Apply rudder control, which also actuates the nose wheel steering. The radius of turn with full rudder should be around twelve to fifteen feet. Anything less than that may cause the model to tip up on a wing when turning from downwind taxi into the wind. Adjust the linkages as may be necessary.

You now have checked out the model and set it up correctly for flight. It goes without saying that prior to flight you will also check out your radio for proper operation. That includes a distance check in accordance with the manufacturer's instructions and, in addition, an operational check with your engine running to be sure there is no vibration effect on the radio receiver or servo operation. This is not too likely with today's radio equipment, particularly if you have carefully shock mounted your servos with grommets, and wrapped your receiver and battery pack in protective foam.

In the same way that you check your receiver for reliable operation, you check the engine. If it's new, break it in on a test stand, as recommended by the manufacturer. Once installed in the Headmaster Sport 40, it should be operated through the entire speed range from idle to full throttle, and should go from idle to full speed and back again without stopping. Nothing is more frustrating on a test flight than to have the engine quit --- particularly on take-off.

You now have checked out the model, the radio and the engine, and all necessary corrections have been made --- if any were required --- and it's time for that first test flight. This is always exciting --- even though you know it's going to be fine.

Fuel up the model; then, if you are at a club field, be ready to fly when your turn comes up. When you have the frequency control assigned to you, proceed to the flight line, turn on the transmitter and receiver, start your engine, check control operation and engine speeds. Then, when ready, let everyone know that you are making the first test flight on your new model. This is a precautionary measure only.

With the Headmaster Sport 40 all checked out, taxi and take-off is almost too easy. Taxi slowly to the downwind end of the runway, turn and head into the wind and come to a stop. Slowly advance the throttle, and the model will pick up speed as it rolls along the runway into the wind. Minor corrections may be needed with the nosewheel to maintain heading, and then, when flying speed is reached, the model will lift off all by itself in a gentle climb. If by any chance you may have installed the nose gear slightly lower than shown on the plans, just a touch of up elevator control may be required to get the model airborne.

Once in the air, small trim adjustments may be required to the elevator and ailerons in order to acheive straight and level flight with the engine at cruising speed. If your instructor is test flying for you, he may call for help in making trim adjustments, since he will not want to take his eyes off the model. And, if you are doing the test flight, don't hesitate to ask for help in trimming while you keep your eyes on the model. Once it is trimmed it will fly straight and you can take your eyes off of it momentarily --- but wait until you have it trimmed. Things happen pretty fast if a model is out of trim --- no matter how good a pilot you are.

The first test flight should be just that. Don't go hot dogging around the sky --- unless you happen to be one of the fortunate modelers who got everything right the first time --- the model trimmed perfectly with the trim controls in neutral. In that case, go ahead, wring it out. But if, as is more likely, small trim adjustments are required, make them. Then throttle back at low cruise, and prepare for landing.

There's an old and true saying about landing --- "A bad approach usually winds up in a bad landing." How can you avoid it? By setting up a consistent landing pattern, and following it. The most common pattern is the same one as is used by full scale aircraft; bring the airplane into a "downwind" leg of the pattern, parallel to the runway and about two hundred feet off to one side with the engine at cruise setting. As the model comes in line with the downwind end of the runway, begin a gradual turn until the model is flying crosswind towards the runway. This is called the "base leg" of the pattern . The engine should now be reset at an idle speed fast enough to allow the model to sink slowly.

As the model comes toward the runway on the base leg, but downwind from the end of the runway, another gradual turn is made to line up the model with the runway. The model is now on "final" or approach leg, and should be lined up with the center of the runway. Minor corrections can be made, but if, in flying the landing pattern, you have found your model is too high or too low, don't fight it. Apply power, fly on out over the runway into the wind, climb to a safe altitude and start the whole landing pattern over.

If, on the other hand, you have lined up properly, and the model is gliding in with the engine idling, and will land on the runway, then just let it come on in, and when it is a couple of feet off the ground, a gentle touch of up elevator will "flare" the landing so the main wheels hit the ground either before or at the same time as the nose wheel. Test flight complete. □

By H.E
RCModeler
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