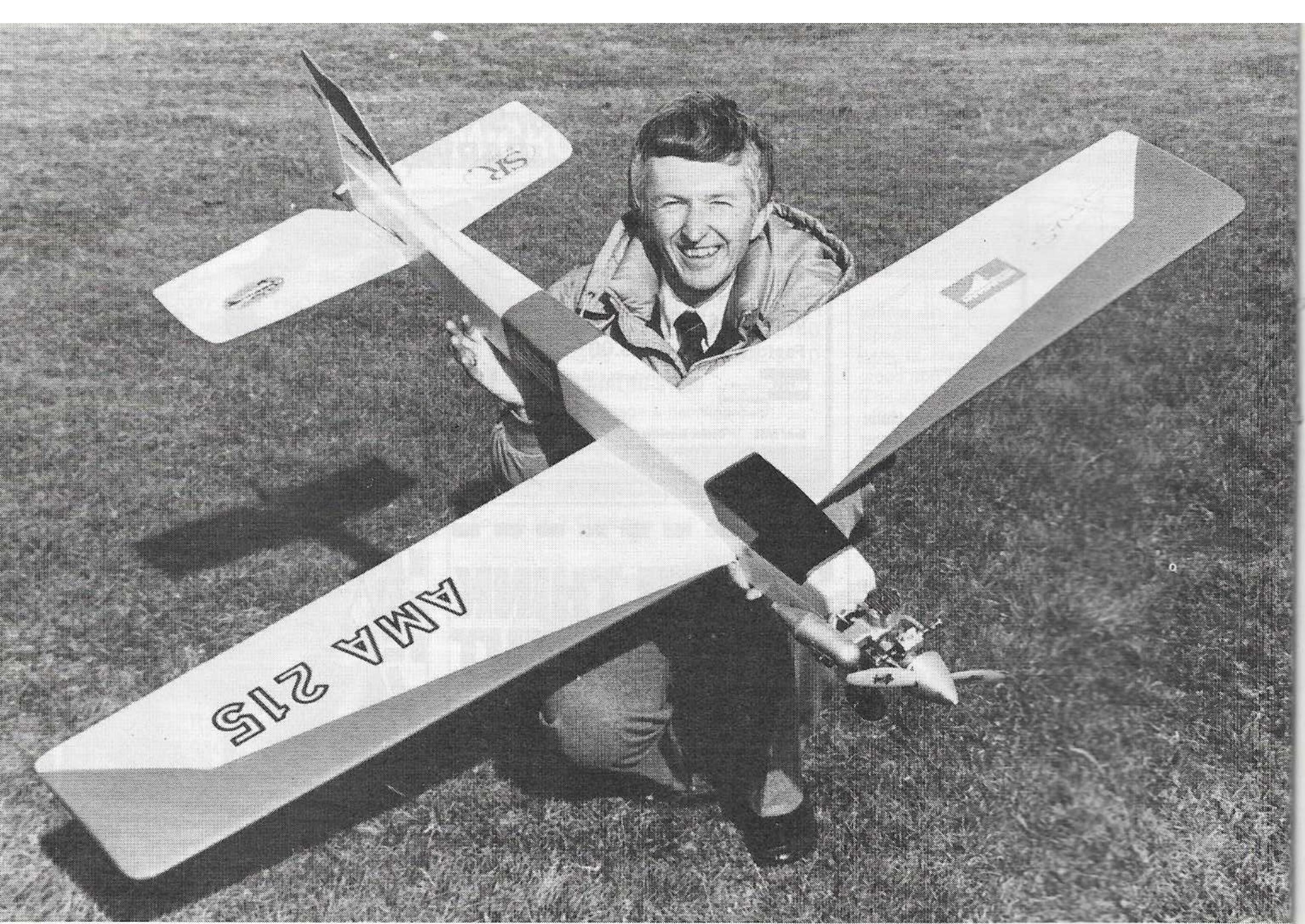


PHOTOGRAPHY BOB ABERLE

Image

By Bob Aberle

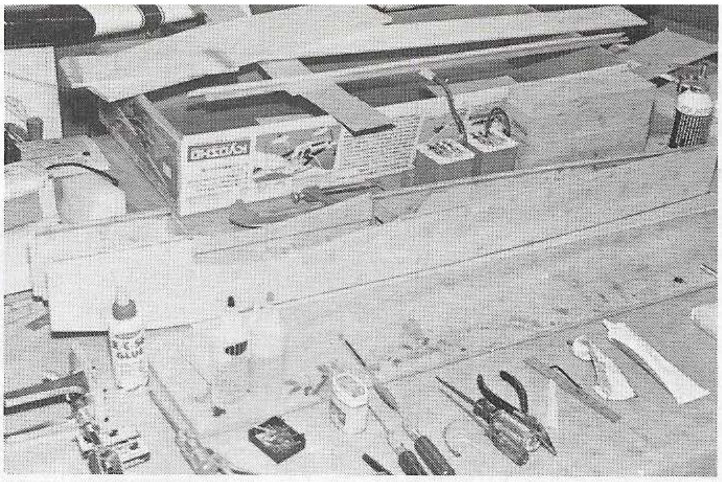
Early last year I decided to explore the new turnaround pattern competition. The proper name for this event is the FAI R/C Aerobatics (F3A). Much has been written on this subject and if you are interested in the specific rules you might want to look up the details which appeared in the March 1984 issue of *Model Aviation* (page 114). I doubt if my busy schedule will ever permit me time to become an expert at any particular facet of our R/C hobby. However, I have always felt that to be credible in my writing and design work it is important to constantly try new things. The basic theme in my articles is to get you to try new things, don't just lock into a single phase of this wonderful hobby. So, in this case, I will give you some pointers on my choice of a design intended as an entry point into turnaround pattern competition.

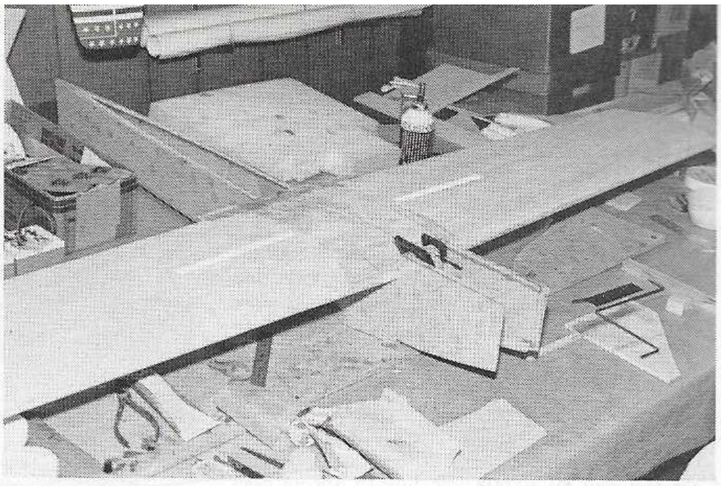
The single, evolving trend in this new event appears to be a *large* model. Conventional pattern models over the past ten years have averaged 600-700 square inches of wing area. New turnaround pattern models are now showing up with wing areas in the order of 800 square inches and more. For this new design, I settled on a wing area of 828 square inches. This somewhat odd figure resulted because of my insistence on using the entire 36 inch length of balsa. Hence, the 72 inch total wing span (36 inches × 2 wing panels). The aspect ratio was selected at 6.25:1 (wing span divided by the average wing chord) which is a compromise of current design trends. So with the balsa wood length and the aspect ratio as design constraints, my new *Image* wing ended up with an area of 828 square inches.

Being quite large, weight would definitely have to be another design consideration. I selected 7½ pounds as a target figure for this model. At that weight, the wing loading would work out to 20.8 ounces/square foot which is a very light loading. For reference purposes, my Hobby Barn *Curare* (October 1980, FLYING MODELS), weighed 9 pounds and had a wing area of 695 square inches, which yielded a wing loading of 29.8 ounces/square foot. That model flew (actually it is still flying) well with an O.S. MAX .60 engine and landed gently, despite the weight. But the trend in the new turnaround event is for lighter wing loading. To achieve lighter weight, I decided, as many modelers have, to drop the use of retracts (landing gear). A fixed gear was employed on this design which probably saves over a half pound of weight and certainly makes the model easier and faster to build. Another popular innovation in these large pattern models is to install separate aileron servos out in the middle of each wing panel. The idea being to operate the ailerons at the center of their span where extra control force can be imparted (can also help prevent aileron flutter). To make the aileron linkage installation and adjustment easy, the servo actually hangs out in the slip stream. Does that add drag? Yes, but the overall effect is negligible when considering a model of this size.

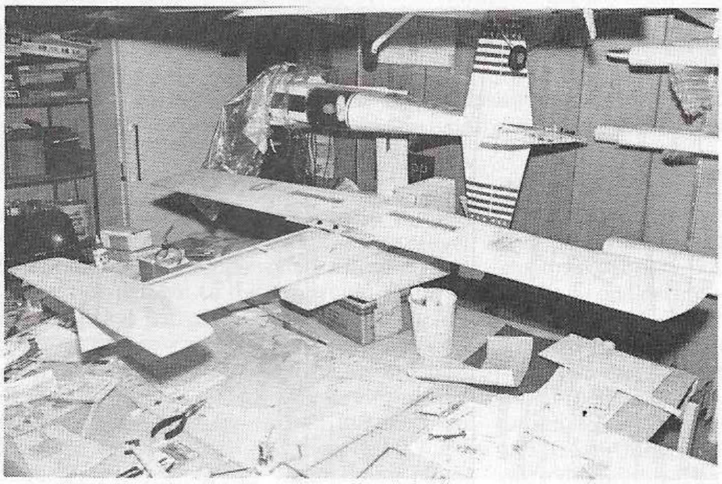
As a further innovation I chose to establish the engine thrust line, wing and stab centerlines, *all* on the fuselage reference line (FRL as it is called in the aircraft industry). This gives you a "zero, zero, zero" configuration of engine thrust line, wing, and stab. You obtain certain advantages out of this set-up but unfortunately, as will be explained later, there are some drawbacks as well which must be addressed.

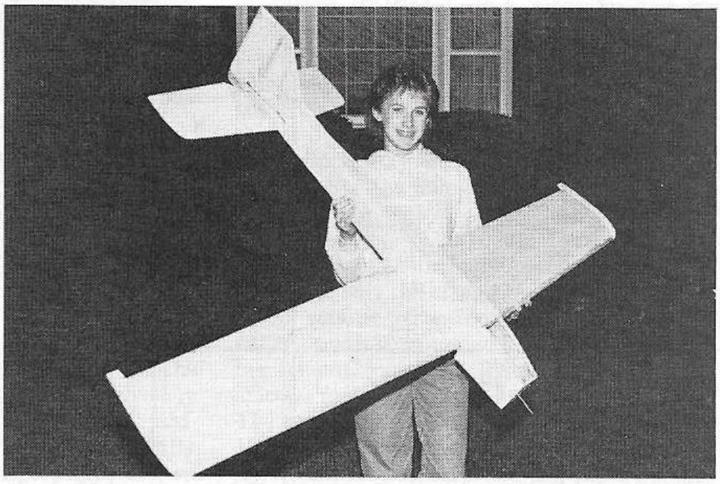
Simple construction was the final overall criteria for the *Image*. Everything I design *must* be simple because I only have a month





At this point in the construction of the *Image* (**above left**), the sides and tail post have been aligned and joined. Don't install the firewall (F-1) until after the holes for the wing dowels have been drilled. The wing is then set and aligned in the wing saddle (**above right**) prior to drilling the 1/4 inch diameter holes for the wing dowels. If you left the firewall out, access to this area with drill is much easier. When the stab is installed (**below left**), make sure it's aligned carefully with the wing. Jill Aberle holds the completed airframe (**below right**) ready for finish. Gives you an idea of the model's size.





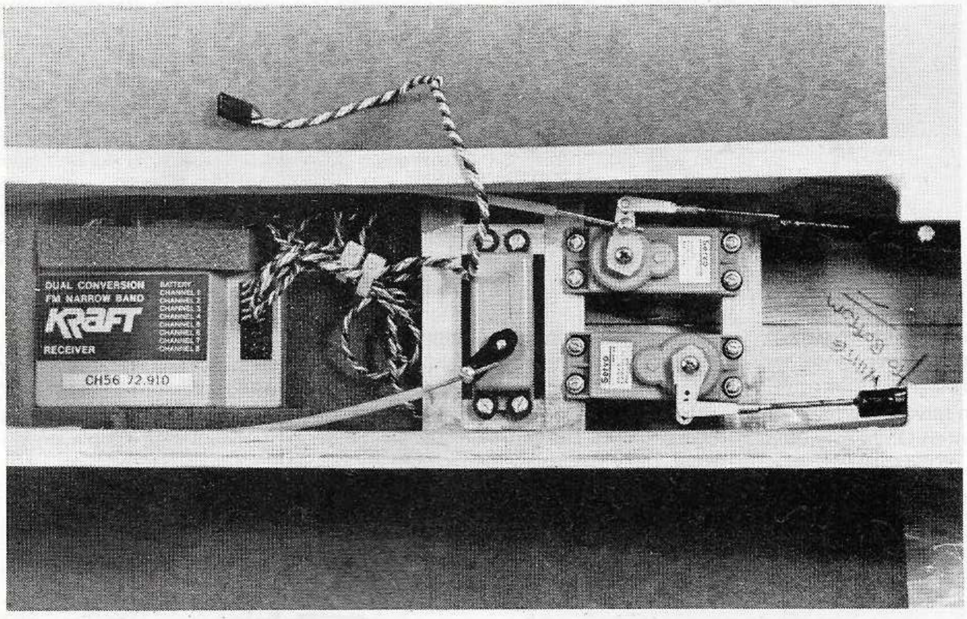
Give "turnaround" pattern a try with this large, easily constructed model. For two or four stroke powerplants.

or two to dwell on a subject before moving on to the next magazine project. An Aberle design has to be easy to build with a minimum expenditure of time. This model is in the *Image* of a true pattern design, except that it builds like a *Quickie 500* racer. Total construction time for me was just under six weeks including the drawing board time and final finishing. The engine was left "hanging out" for simplicity of building and maintenance. An optional fiberglass cowl could easily be added to clean up the model if you felt it necessary. Even the fuselage sides (top and bottom) are parallel to one another and the FRL. Alignment during the assembly phase of the construction is again made easy by this type of design.

One final design consideration was the selection of an airfoil. I do use a computer program to automate my plotting of airfoils. This program has an extensive library of airfoils which, I must admit, does make the final choice difficult at times. Initially I wanted a 17% thick full symmetrical section. The usual "0017" most commonly used just didn't seem right (just a feeling on my part). After some searching with fellow Grumman engineer, Nick Dannenhoffer, I chose an "NACA 64/1-017" airfoil. This is a 17% maximum thickness section, full symmetrical, but with a slight reflex towards the trailing edge. This reflex (you might call it undercamber although it appears on both sides) would have been difficult to duplicate during construction, so I leveled it out to a straight line, eliminating the reflex portion. The interesting thing to note is that the point of maximum camber is back at 40% from the leading edge. This tends to approach a laminar flow type section. My reasoning may be faulted on this selection since it is primarily based on "intuition", but the test flight results to date indicate some interesting properties. More on that later.

Construction highlights

If you have enough experience to fly this type of model you shouldn't need a step-by-step construction article. Some highlights, however, may prove helpful. Although the full size plans show an easily constructed built up wing, my particular model employed foam core construction. FM Editor, Bob Hunt, is an expert in this field and was good enough to not only cut out my cores, but to skin them with 1/16 inch balsa as well. With that kind of help, how could I resist the offer. Bob used Hobbypoxy Formula II epoxy to attach the balsa sheeting and the balsa leading/trailing edges to the foam cores. Before applying the sheeting, Bob cut a channel in the lower surface of the foam to permit passage of the aileron servo cables out to approximately the center of each wing panel. For information, the fully sheeted wing panels, without tips or landing gear blocks installed, weighed 8 1/2 ounces per panel (a total of 17 ounces for the full wing). A built-up wing structure would probably weigh less, but not that much less. Bob has made arrangements through a local company to have these foam cores cut to my exact specifications. A pair of cores (not sheeted) will cost $25.00 postpaid from Marc Salvador of Par-Troy Sound, Sussex County Mall, Route 206, Newton, New Jersey 07860. My particular foam wing was joined with a single 1/8 inch plywood dihedral brace (approximately the main spar position on the plans) which projected about four inches into each panel. The wing center section was covered with two ounce fiberglass cloth and Hobbypoxy Formula II epoxy. This cloth was run from the centerline out to the beginning of the landing



For R/C guidance, Bob used an all Kraft set-up. The receiver is the KPR-8FD dual conversion (fixed frequency) while the throttle used a KPS-14II servo, and the rudder and elevator used KPS-24's. Plenty of room.

gear blocks. I decided to use 5/32 inch diameter landing gear wire for the main struts. Even though they are longer than average there has been no tendency for these struts to bend or deform to date. I would say the choice of that wire diameter was correct. Although the plans call for 2½ inch diameter main wheels and a 2¼ inch diameter nose wheel I decided to go one size larger on my prototype (2¾ inch mains and 2½ inch on the nose wheel). This helps clear a 12 inch diameter prop, especially when flying off a grass field.

The fuselage sides were cut from 1/8 inch thick × 5 inch wide × 48 inch long (medium/hard) balsa. Don't skimp on the 1/32 inch plywood doublers. They run from behind the wing trailing edge forward to the firewall. A second doubler is added at the point where the stab joins the fuselage. Equally important is the ¼ inch × 3/8 inch spruce spar reinforcement that is part of the vertical fin. This spar extends all the way down to the bottom of the fuselage and greatly strengthens the fin. Don't leave this support out! Sig Epoxolite, my favorite fillet material for the past 15 years or more, is used liberally around the stab to fuse joint and the fin to fuse joint. It was also applied inside the firewall area where it joins the fuselage and around the wing hold down blocks. Don't forget to cement a red Sullivan Gold N' Rod tube along the top (inside) of the fuselage from approximately the mid-wing position back to the tail end. Inside this tube you can insert your radio receiver antenna (full length) and keep it internal (out of the slip stream). Du-Bro standard hinges (not the quarter scale variety) were used throughout (ten on the ailerons, six on the elevator, and three on the rudder). As a matter of information I used plenty of cement on this model. Yes, my planes do come out heavy, but they last a long time. To give you a rough idea, I actually consumed during the construction of this model: one four ounce set of Hobbypoxy Formula II; one four ounce set of Northeast Hobby Products Epoxy 12 (sets in 12 minutes); a tube of Ambroid (I always manage to use some of that even after 30 years of modeling) and some Carl Goldberg Jet to help in the initial alignment of parts and some special applications. Just prior to painting the bare structure, weight—less all hardware—amounted to 3¼ pounds which is certainly not bad considering all the cement I used.

Engine system/mount

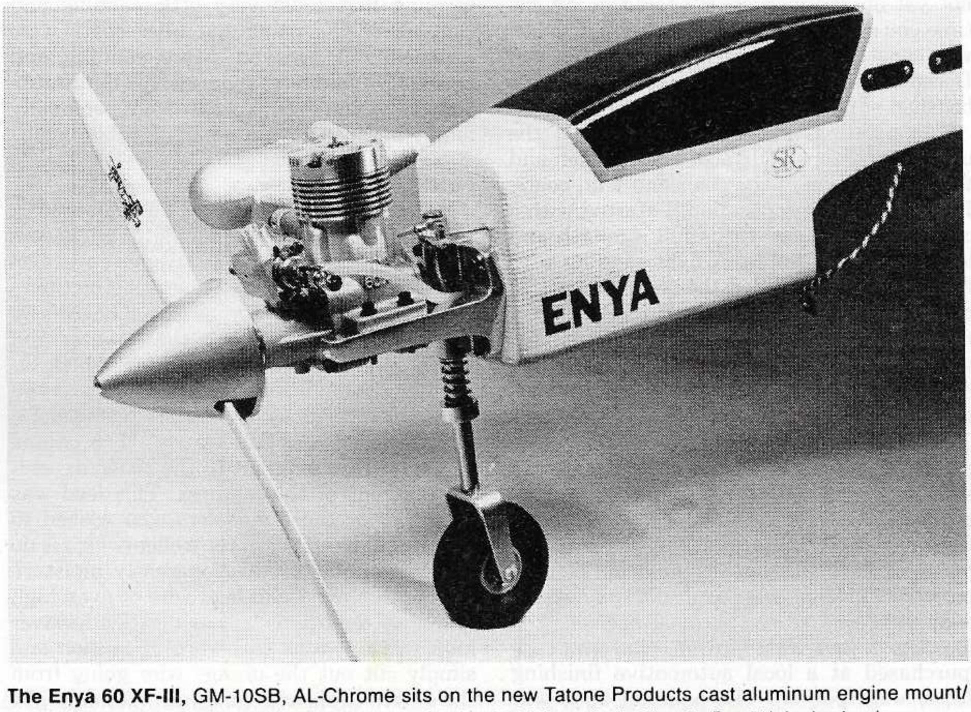
As you can see in the photos, I chose the top-of-the-line Enya .60 engine which they designate as their Model 60 XF-III, GM-10SB, Al-Chrome. This is a beautifully crafted engine with plenty of power and an excellent carburetor system. It is available from Altech Marketing Inc., P.O. Box 286, Fords, New Jersey 08863. Total weight of this Enya is 17.5 ounces. The conventional Enya 60X muffler added another 4.5 ounces. Enya also makes available a tuned pipe (Model TM60-II S70) specifically for this side exhaust engine. I haven't tried this pipe at this time, but will in the near future. The conventional muffler is fine for sport flying, but the pipe is essential for both added performance and reduced noise, which is now a requirement in pattern competitions. During my initial flight testing of the *Image,* I used a Zinger 12 × 6 prop and Red Max 10% nitro regular fuel. Right now, that appears to be the correct prop considering the size and weight of this design. You might want to try an 11½ × 7 prop and 15% nitro fuel. But I leave that decision up to you.

The photos clearly show the new Tatone Products (1209 Geneva Ave., San Francisco, CA 94112) single unit engine mount and nose gear assembly. John Tatone has identified this as his Model No. 60014. It will list for $24.95. That may not sound cheap, but I assure you when you see it and try it you will be as impressed as I was. It is made from a thick aluminum casting which is machined and polished to it's final form. The actual nose gear strut is 3/8 inch diameter and is shock mounted. It includes a cast aluminum steering arm as well. Total weight of this complete engine mount is 8½ ounces (less the wheel). I was so pleased with this product that I decided to do a separate product review which may either appear elsewhere in this issue or the following month.

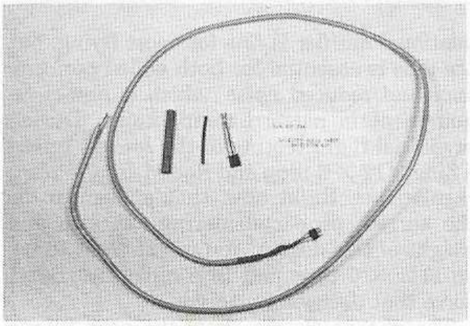
For a fuel tank I selected the Kraft 13 ounce variety (P/N 200-027). Many model designers select the nose moment arm (length) simply to suit the size of the fuel tank. This model was no exception in that regard. The entire tank is surrounded in ¼ inch foam rubber for cushioning. AeroTrend "Blue Line" silicone fuel tubing was used on this model. The specific size is their "standard" type (No. 1003). Only two lines were employed, one going to the engine carb and the other to the muffler pressure tap. Since I didn't use a cowl, access to the engine, fuel lines, steering arm, etc., is a snap, which add convenience and *fun* to the hobby, at only a small sacrifice in appearance.

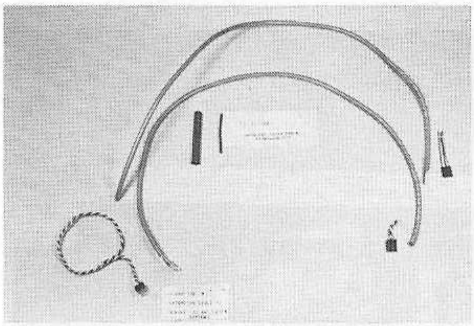
Finishing

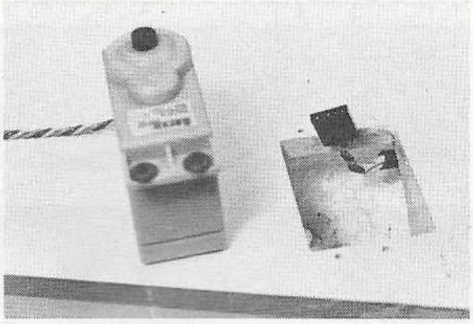
I really like to tell it all in these articles. This particular model was finished totally



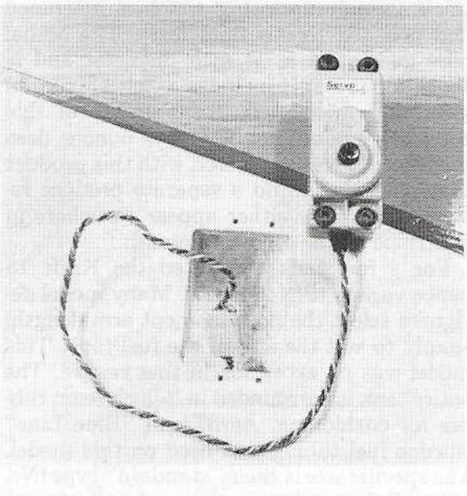
The Enya 60 XF-III, GM-10SB, AL-Chrome sits on the new Tatone Products cast aluminum engine mount/nose gear unit. The 3/8 inch diameter strut is spring loaded. The yoke holds a DuBro 2½ inch wheel.

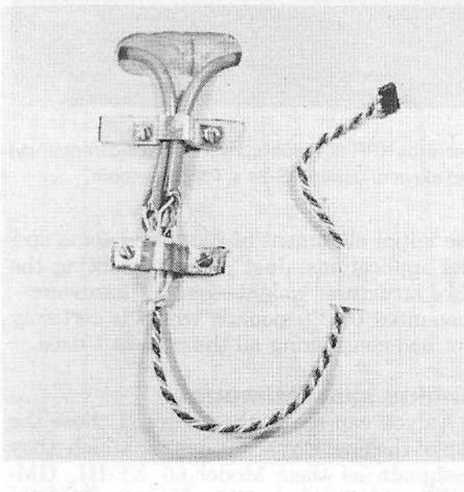






The long servo wire leads necessitated by the increasingly common pattern practice of using individual servos for each aileron increases the potential for signal problems. To eliminate that possibility, Bob selected a shielded Kraft cable, P/N 200-284 (**above left**) to connect the respective aileron servos. This required the use of a Kraft 12 inch aileron extension cable (**above center**). On the extension cable, cut off the female connector one inch from the end; on the shielded cable, cut in half and remove the attached male connector. Pass the two shielded cable lengths through the wing panels to the servo mounting areas (**above right**) and solder the female connectors to the shielded cable ends. When you plug in the servos, tape the connectors (**below left**) to avoid possible separation. At the wing center section, the aluminum bracket (**below center**) serves as a cable strain relief. The Dow sealant (**below right**) is a special non-corrosive type.





with Hobbypoxy products. I like Hobbypoxy because it is durable. My *Long Islander* R/C glider fuselage is now 11 years old and looks as good as the day I first painted it. My building time is valuable and I love to fly. That's really what it is all about. I hate re-ironing plastic film material that continually works itself loose. On this particular model, I had the opportunity to try out a new Hobbypoxy product called, "Fast-Fill" which is a single component (no hardener necessary) filler or actually a sanding sealer. Although not yet on the market, it should be by the time you read this article. Because this model was constructed during late November and December (1984), I had to resort entirely to brushed applications instead of spraying.

The painting procedure consisted of the usual two steps, surface preparation and then application of the color and trim coats. For the surface preparation, I started with a coat of Hobbypoxy Clear full strength and let it dry for 24 hours. A light sanding with No. 100 paper preceded the two coats of the new Hobbypoxy Fast Fill thinned approximately 25% with Hobbypoxy Thinner. This was left alone to dry for 24 hours between coats and then sanded first with No. 150 paper and next, No. 400.

Hobbypoxy Cream was my basic color choice and I applied two coats of it, full strength, allowing 24 hours drying time between coats. These color coats were sanded lightly with No. 400 paper. Next step was to mask off the plane for the trim color. Hobbypoxy Bright Red was applied in two coats and, when dry, all the decals I had selected plus the 1/4 inch wide medium blue trim tape (purchased at a local automotive finishing store) were put on. The painting task was completed with a coat of Hobbypoxy Clear thinned 25%, to hold everything in place. In all cases, I used the Hobbypoxy H-02 Gloss Hardener (except for the Fast Fill) in conjunction with the clear and color paints.

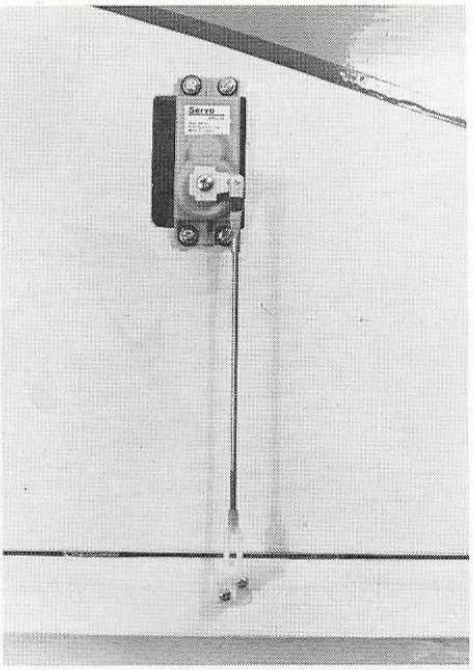
It took the better part of a week of evenings to complete the finishing job. Each coat of paint required about four ounces and about two hours of manual labor (brushing). Final weight of the painted structure (with decals and trim) was four pounds, one ounce which means that the entire finishing process added a total of 13 ounces to the model. Keep in mind that I did very little sanding and that all of the paint and filler coats were brushed, not sprayed. More sanding and spraying would have reduced this figure substantially (you bet!-Ed.) But I am personally happy because I have a very durable finish.

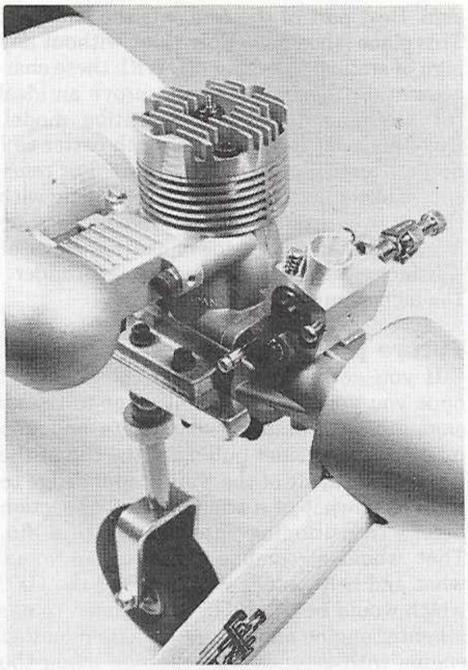
Radio System

A complete Kraft R/C system was used in this model. The airborne flight pack consisted of the Kraft KPR-8FD dual conversion (fixed frequency) receiver operating on Channel 56; a total of five servos (two KPS-24's on the ailerons, KPS-24's on the elevator and rudder, and a single KPS-14II on the throttle); an SR-900 flat battery pack (even though the plans show a square pack); and a standard Kraft switch harness. The orange signal lead running out to the charging jack was cut out of this harness. This lead was provided for those modelers who wished to use the old Kraft servo controller (which is no longer manufactured). Apparently moisture hitting this particular lead wire or even high humidity conditions will render this receiver inoperative. I took this word of caution and simply cut out the orange wire going from the switch to the charging jack. Total weight of my particular airborne flight pack was approximately 15 ounces which isn't particularly light. The transmitter in this case was a Kraft KP-7CS MK III (single stick).

Sullivan cable type Gold N' Rods (stock No. 508) were used to connect the servos to the nose gear steering arm and the engine throttle. Carl Goldberg push rod connectors (PC-1) permitted easy attachment of the brass control cables to the respective servo output arms. For the rudder and elevator control hookups, I employed a pair of Sig Graphite Pushrods (catalog No. SH-654). These rods are light in weight, strong, and dimensionally stable under large temperature variations. That means that your flight trim settings won't change as the air temperature changes. Goldberg control horns were used on the elevator and rudder (long variety) and on the ailerons (short type). The SR-900 battery pack was wrapped in as much foam rubber as possible and placed on top of the fuel tank. Don't use too much foam rubber or else the tank may be over stressed.

My big concern with the radio equipment was the installation of the KPS-24 servos out in each wing panel for the aileron control. My buddy, Jack Albrecht, formally of Kraft Systems, suggested that I use the Kraft shielded cable servo extension (P/N 200-284) which lists for $13.95. I obtained one of these cable assemblies which basically consists of a four foot length of No. 22 AWG five conductor cable (only three of the five conductors are actually used). You could use extension cables with filter chokes, but you run the risk of voltage drop and loss of performance due to the resistance of the chokes. Using strictly shielded cable is fine provided you understand the basic principle or ground rule: the outer shield should be attached to the battery negative conductor (usually the black wire) at the receiver end of the cable, but should be left *disconnected* or "floating" on the servo end out in the wing panels. The sequence photos included with this article tell this full story. You will have to purchase a Kraft 12 inch aileron extension cable to complete this job. Cut the four foot length of shielded cable in half and run each piece from the wing center section out to the receptacle (cut-out) that will accommodate the individual aileron servos. Solder female connectors to the shielded cable ends at the servos. At the wing center section it gets a little tricky so be careful. You must solder together both sets of cable wires and the aileron extension cable. In each case connect all the red wires together (battery positive), all the black wire (battery negative) including the bare wires that come in contact with the shield and finally the servo signal leads must be all connected together. This works out to a lot of soldering and cabling. Use plenty of heat shrink tubing to prevent shorts or stress points on the joints. I fashioned several aluminum brackets to anchor the cables at the wing center section as a stress relief. Finally I coated these connections with Dow Corning No. 3145 RTV adhesive/sealant which is a non-corrosive compound. When connecting up the two aileron servos I applied tape to the connectors to prevent them from separating from vibration effects out in the wing later on. If you use servos with the same direction of rotation, you can attach the output arm, in each case, facing the wing tip. Unfortunately, the servo cables are a little long for this particular application. I was forced to wrap up the excess cable length, push it into the space next to the servo and use a piece of foam rubber to hold it in place. You certainly don't want to end up with an aileron servo cable hanging out in the slipstream during a flight. You could shorten the two servo cables, but that might limit their application in future models. The bottom line is that no interference was noted, despite the fact that each aileron servo was approximately three feet from the receiver. Should you expect interference? It's hard to say. You might want to initially try a simple "Y" harness, without chokes or shielding. If it works with your particular radio system, why look for a more complicated and costly installation.





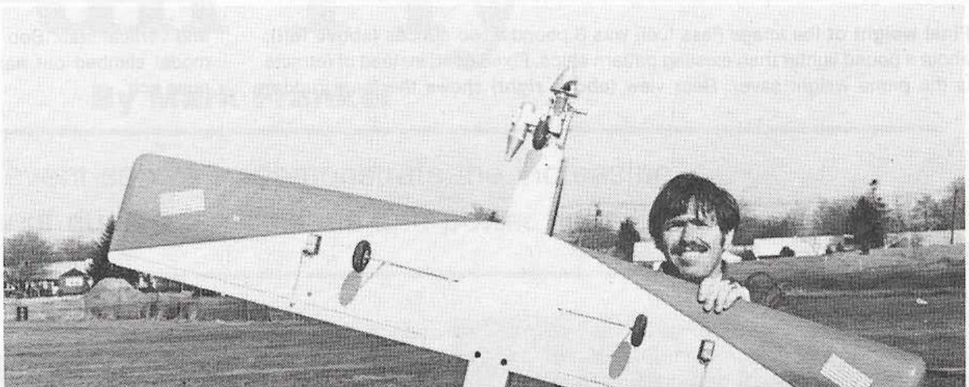
One aileron servo completely in place (**above left**). Scrap foam rubber holds excess cable in place. The Enya 60 XF-III (**above right**) with the Enya 60X muffler. A 12 × 6 Zinger prop worked very well with model's size.

Final weight and balance

The final wing weight, with wheels, servos, etc., was two pounds, thirteen ounces. The rest of the model weighed five pounds, five ounces, bringing the total weight (less fuel) to eight pounds, two ounces. That's about ten ounces over my original weight budget of 7½ pounds. At the eight pound, two ounce weight the wing loading worked out to 22.6 ounces/square foot, which is still a very light loading. Careful use of cement; lighter wood; a built-up wing, and the substitution of iron-on covering on the wing and stab could probably bring the weight down close to seven pounds even. Whether that would affect the already good performance is hard to say. The balance (CG) location at 25% of the mean aerodynamic chord (M.A.C.) mid-point of the range shown on the plans) was perfect, without the need for any additional ballast. Obviously the big engine, the heavy metal motor mount, and the metal spinner all helped to balance that very long tail moment arm.

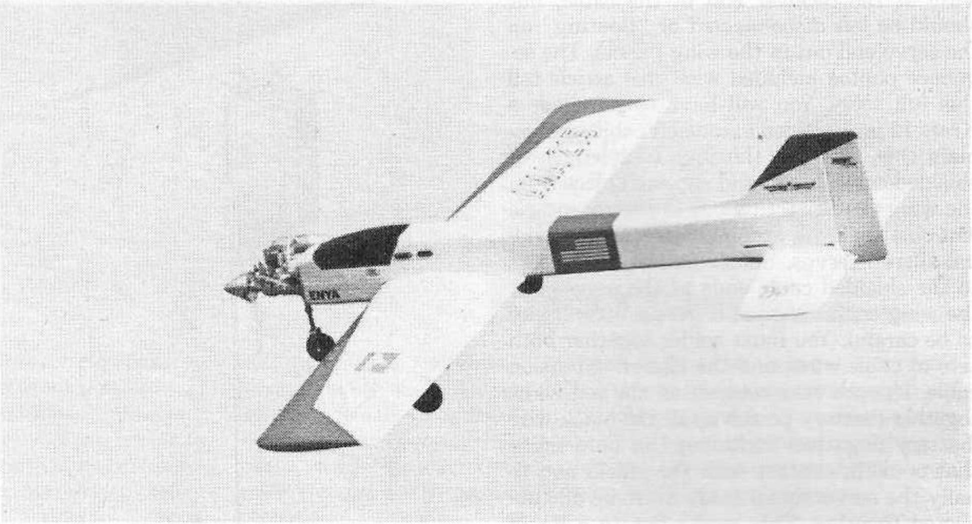
Flight performance

Let me tell you the way it is — at least for now. The *Image* took off and flew without the need for any trim (at all) on its first flight. With the new Enya running quite rich (per the instructions), the model was off the ground in approximately a 50 foot roll out. The climb out was at a 45° angle with plenty of power to spare. Just imagine the performance when the engine is broken in, it has the correct prop size, and, possibly, has a tuned pipe added! The new airfoil worked out well. I seemed to sense a feeling of constant speed performance regardless of the attitude of the plane. Pull a loop (inside or outside) and the speed remains about the same up and around without touching the throttle. Although this airfoil worked out well, there was a bad tendency noted in knife edge flight. Experts like Dean Pappas and Bob Hunt tell me that I have too much rudder on top of the stab and too little below the horizontal stab. This tends to cause the model to "fall off" in knife edge regardless of the corrective controls sent to the model. A solution to this would be to relocate the horizontal stab to the top of the fuselage instead of its present location. I point these comments out because I want to be perfectly honest with my readers. I'm going to work on this minor problem myself. I will be adding some area to the bottom of the existing rudder surface for some experimentation. Too much, of course, could prove a problem when landing. I would appreciate hearing from other modelers who try this de-



Grumman Aero Test engineer, Tom Hunt, holds the *Image* up to give you a view of the underside. Note the position of the aileron servos. This method allows such easy access and adjustments. Becoming quite common.

sign. Best part of the *Image* is the landings. This plane lands incredibly slow, without any sign of stalling or falling off. With these characteristics, the *Image* should prove an ideal turnaround pattern familiarization model. But I honestly feel it will do much better as I become further acquainted with it. For reference information, my prototype is flying with the following control surface movements: ailerons - $1/4$ inch either side of neutral; elevator - $1/2$ inch either side of neutral and rudder - $1\,1/2$ inches on each side of neutral.

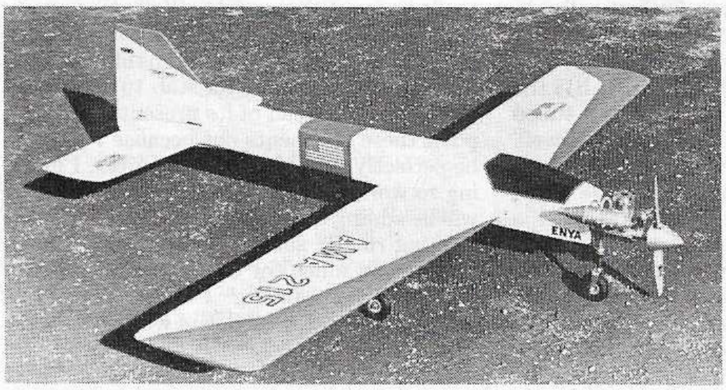


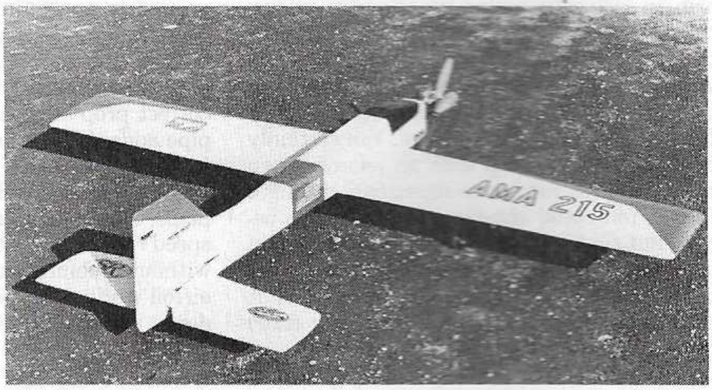
This one really did fly right off the board. Not a speck of trim was required on the maiden flight. The *Image* balanced perfectly at 25% of the Mean Aerodynamic Chord (MAC) as shown on the plans.

Future prospects

If you get a second *Image* model, and I hope you you do, you might want to try an engine cowl, possibly wing fillets and you might even consider pulling in the top of the fuselage sides aft of the wing trailing edge to form somewhat of a triangular cross-section before transitioning into the vertical fin. That would streamline the fuselage somewhat and help reduce weight aft of the C.G. which would be helpful if you planned to use a lighter engine and mount. A side mounted engine with a tuned pipe running along the bottom of the fuselage is another possibility. You could also try to install the stab on top of the fuselage as already discussed and follow a suggestion of Dean Pappas' whereby the stab's incidence angle can be adjusted by the modeler. That's pretty tricky to do in actual practice, but can offer some interesting benefits to the serious pattern flyer.

Should plans materialize, I should be receiving a new Enya .80 four cycle engine for evaluation shortly. This engine is claimed to have roughly the same mounting dimensions as the Enya .60 two cycle used here and approximately the same weight. The .80 should provide comparable power, but best of all will be the quiet running which is a characteristic of the four cycle engine. If all goes well I will be reporting on the performance of this new engine in conjunction with the *Image* model. Should you decide to build the *Image,* I wish you good luck and good flying. Let's hear from you!





Final weight of the *Image* (less fuel) was 8 pounds, two ounces (**above left**), about a pound lighter than existing pattern ships. Fixed gear, instead of retracts is the prime weight saver. Rear view (**above right**) shows the large rudder and vertical stab. Bob lifts the *Image* off on the inaugural flight (**below**). The model climbed out easily at this angle even though the Enya was running quite rich.