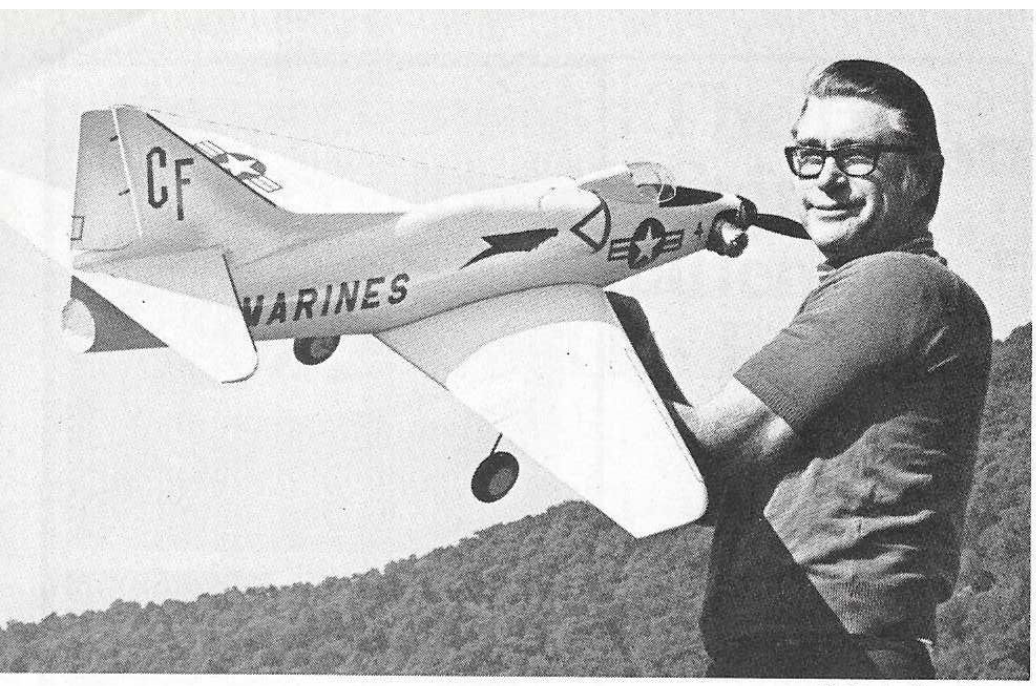


Photos by Bryce Petersen

Douglas A-4D-5 "Skyhawk"

by Stan Hines

Foam and frame team up to create a Semi-Scale Navy machine. Super Tigre .51 and a radio command send it across the blue.

This bantam jet with a wingspan smaller than a *Cub* may well go down in aviation history as the finest Naval attack aircraft ever built. Scrappy, durable, Herculean, gangly, this Tom Thumb of the Navy and Marines is affectionately known as the "Ford" not only because of the obvious *4D*, but more from its ease of maintenance and ability to bring its pilot home after a fight.

Conceived in 1948 by Edward H. Heineman, Chief Engineer of Douglas El Segundo Division and first flown in June of 1954, it saw combat duty for the first time in 1964 in attacking North Vietnamese coastal routes. It was soon to become the favorite of the pilots who respected its ability to take great punishment and still get them home. I have some pictures of "Fords" flying with the rudder and much of the fin shot away; another of two mechanics standing in a hole shot through the wing and more, but these planes got back. It stayed in service as a first line ship until replaced by the *F-4 Phantom*. In all more than 2,500 of Heineman's "Hot-Rods" have been delivered to the United States and a fair number to other countries such as Australia, Argentina and Israel to name a few.

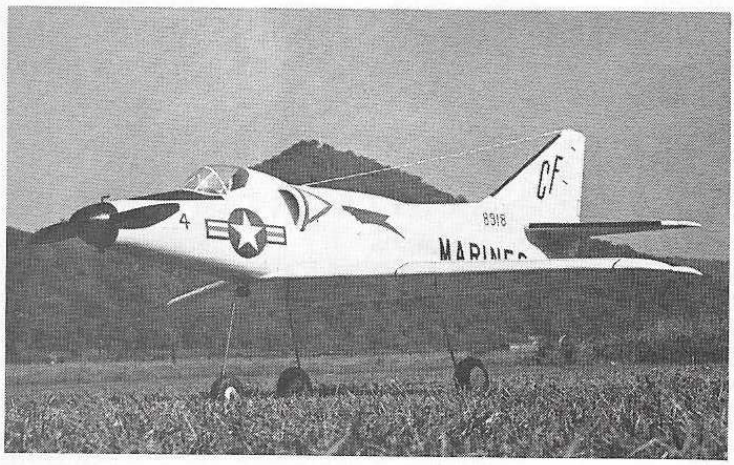
The Navy wanted an attack plane capable of delivering a tactical nuclear device and after the then usual design competition, awarded Douglas a contract for both prototype and production ships. This was a bold step considering that the *A-4D* represented a reversal of the trend toward larger and larger planes and abandonment of a near tradition in the Navy that carrier planes must have folding wings. The ultra-short delta wing was borrowed from the larger *F4D-1 Skyray*, but a conventional tail was added, probably from the *D-559 Skyrocket*. The result was a tiny plane having a dry weight of only 8,000 pounds, powered by a Wright J 65-W-2 engine capable of delivering nearly 8,000 pounds thrust which permitted the "Ford" to carry over twice its weight in combat load at speeds well over 700 mph and still land at less than 100.

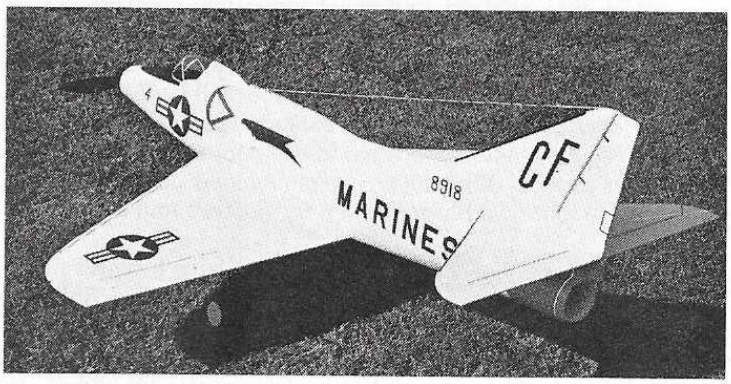
I had an opportunity to examine the plane and talk with a Marine pilot at Glynco Naval Air Station during an Open House weekend a few years ago and fell in love with it too. I'll admit to some weakness for Marine tales, however, having served three years in the Corps, including six months on a carrier. It was not until recently that I began experimenting with some stability calculations which convinced me that a near-scale R/C model was not only possible but also practical. So, it was off to the drawing board for my first delta wing, a military, semi-scale jet in Marine dress, of course.

The *A-4D* has gone through at least five major model changes in more than a dozen years including two place training types. One of the later versions (1961) is the *A-4D-5* (A-4E) which was powered by a Pratt and Whitney J-52-P-3 giving nearly 10,000 pounds thrust. The length had increased from 39 to 43 feet and it could carry nearly 50% more load on its tiny, 27½-foot wings. This is the model I chose to work with and that you see in the accompanying photographs.

The model, unlike its namesake, is not for everybody. It definitely is not for the beginner to build or to fly. Not that building it is that hard, but actually it is intended for an experienced radio modeler.

After a few preliminary considerations of size, weight and power it was decided to draw the side view approximately to a 1" to the foot scale. The final scale was about 10% larger, giving an overall model length of about four feet. The same scale is used for the wing chord, but I am not about to try to fly a model powered by an ST .51 that has a wingspan of less than 30". Early calculations indicated 45" was probably a safe compromise, so construction of the fuselage was begun. Based on some earlier experience a strong skeleton would be needed with the proposed foam and balsa skin construction. For greater realism it was decided to try all hidden controls. As on the full size plane all control surfaces are aerodynamically balanced. This nearly resulted in disaster on the test flight. The effectiveness of the ailerons combined with the final choice of a 40" wingspan and the usual





Almost a delta with a tail attached. On the deck of a carrier, the full scale prototype is a tiny warrior by fighter-bomber aircraft standards. At left: Still and silent, but it dreams of flight. Quick and spirited.

practice of maximum travel set the stage for a wild takeoff. If you have ever experienced an almost vertical bank turn at less than 10' with motor screaming in your newest plane you will know how I felt.

But, back to the design considerations for just one more moment. Weight should not exceed 30 ounces per square foot, the airfoil should be stable throughout its span and all controls should be effective, but not critical. The ailerons mentioned earlier were slowed down simply by moving the adjustable arms to less sensitive positions, but with the rudder and elevator controls inside, these surfaces had to be right.

Construction

Sig lightweight plywood is used everywhere 1/8" ply is called for on the plan. The fuselage "box" is made 2½" wide for its full length. As shown on the side view it extends from the firewall (B) to slightly beyond station (G). There are only two permanent bulkheads inside this box, at the firewall and at (F). There is a ply floor from (B) to (C) on which the fuel tank will sit and a ply top from (B) to (F) on top. Behind (F) on top and bottom I used ¼" foam as the spacer, but 1/16" balsa could be used. Temporary bulkheads are needed during assembly of the box at (C) and mid-way between (D) and (E). The wing cutout and nose gear mounting block notches are cut before assembly. The nose gear bearing is bolted to the mounting block before cementing in place. Since there is no taper to the width of the box and straightness is important this whole assembly may be laid on its side on a flat surface and weighted until the epoxy or cement is thoroughly cured or set.

The firewall can now be laid out on ¼" ply using the (B_2) template. Also lay out the mounting holes for your motor mount and the holes for fuel line and throttle control rod. To get exact symmetry mark a centerline and use the half templates as shown on the plan. Epoxy the firewall to the fuselage box and drill all the holes previously laid out. With a felt tip pen clearly lay out the centerline on the top and bottom of the box. Mark all former stations (C to G) on all sides of the box in the same way.

You are now ready to put on the first set of foam blocks. One inch thick styrene foam is used for the fuselage and vertical fin. Where necessary, blocks may be laminated to get the correct thickness. I found that such foam can be obtained free in the shape of packing. Some roll type duplicating paper has two sheets of 1" material in each box that is thrown away. TV sets and even motorcycles come with various shaped foam packing which can easily be hot wire cut into 1" slabs. With a sharp knife cut five blocks 6" long, three 2½" wide and two wide enough to overlap top and bottom. Glue these in place between B and C. Trim the rear faces to the lines at former C and then using the correct templates transfer the outline on these faces with the felt tip pen.

Now comes the fun part! Sharpen a large knife to a razor edge (a butcher or carving knife is best) and very carefully, with a sawing action, take light cuts off the corners of the foam. Continue working around and around the body taking a little at a time until you have worked it down to the shape of the firewall at the front and the former lines on the rear faces of these blocks. Since the curvature between formers is very slight a straight edge can be used to check for high spots. Care taken at this stage will make sheeting much easier later on. When satisfied with this section, go on to the next section between C and D and so forth until the entire fuselage has been fleshed out over the ply skeleton. Do not hollow out the rear section until the body is completely sheeted.

Sheeting requires 4" wide 1/16" balsa. Due to the length of the fuselage, the two main side pieces will have to be end spliced. This is best done near 'C' since most of the joint will be covered later by the air intakes. If moistened well these sheets will wrap around the foam easily, with the overlap trimmed before final gluing. I used white glue and held the two sheets with lots of rubber bands. Let it stand overnight and then fill in the uncovered areas with smaller pieces of 1/16" sheet. Once this is dry some coarse sanding will level up the skin.

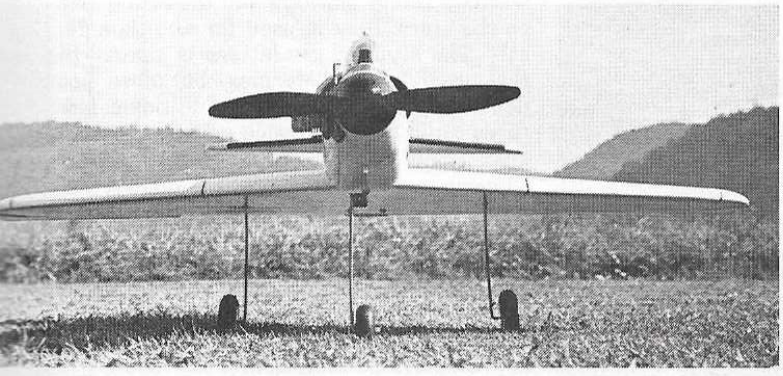
The air duct formers should be made of 1/8" balsa and glued in their proper places. Re-establishing the centerline on the top of the fuselage will help you get them on straight and also be very helpful to line up the vertical fin properly. Again 4" wide 1/16" sheeting is added over these formers. If the edges are feathered as needed from trial fittings, you will have less filling to do later. Cut four air intake cowl pieces from ¼" sheet to the shape shown by the dotted lines on template C-2. Pairs are glued together and then glued to the front of each air intake and carved to final shape.

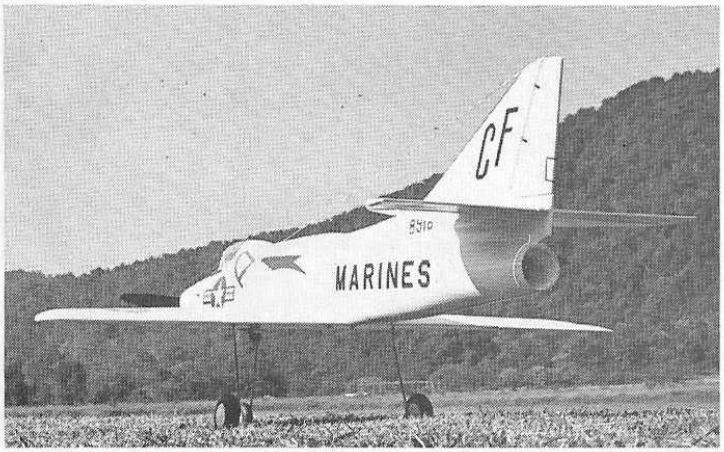
The nose section can be made next. Formers A-1, A-2 and B-1 are made from 1/8" ply. A-2 is a solid ring and the other two are cut as shown on the plan. Cut B-1 to fit around your motor mounts and control rod. Place plastic film such as Glad Wrap over the firewall and screw both halves of B-1 in place. Make the Motor template and lightly cement A-2 on the notches so that the centerline is even with the bottom of the template. Locate the template on the motor mounts and check to see that it is centered and square. Screw the split formers A-1 to A-2 with the split horizontal for the side mounted motor. Cut and glue the first layer of 1/16" sheet between formers A and B. Hold in place with rubber bands. After this has set add the other layer, cure and then slit between the stiffeners. Later these halves may be removed, the motor template discarded and the right side cut out to clear the motor cylinder. Save the solid ring A_2 for final assembly to give alignment and strength to the cowls. You may choose as I did to permanently fasten the top half to the fuselage before finishing to give a more realistic look. The engine can be installed and serviced by removing the bottom half only.

The stab and elevator are a simple matter and may be built using foam core and sheeting or built up by substituting 1/8" ribs and a heavier spar. The split elevators are operated by a controline type control horn. To avoid "noise" substitute plastic tubing for the metal spring type hinges.

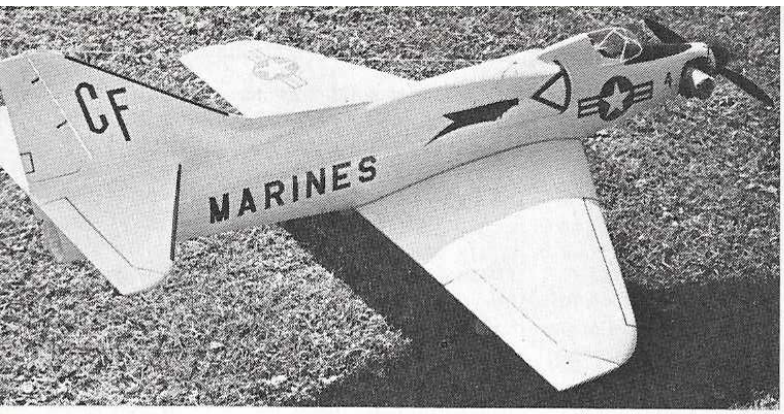
The vertical fin and rudder are made by cutting a foam core from 1" sheet to the shape shown inside the balsa leading edge and spar. Cut the slit for the horizontal stab and glue to the top of the fuselage. Take great care at this point to be sure it is square with the wing cut-out and exactly on the centerline. Leading edge stock 3/8"x ½" is notched and bent to fit the lower curve of the fin and beveled to fit the fuselage before being glued in place. The excess form will be pared away to a symmetrical section and then the entire fin can be sheeted. Suggestions for grain orientation will be found at various places on the plans. The rudder is made similarly and hinged at two points, top and bottom only with wire turning in plastic tubing. The lower wire extends into the fuselage where a right angle is bent to provide a control arm. An aileron linkage is attached to this to create the rudder pushrod connection.

Using a 1/8" wood dowel, drill a hole from the bottom of the elevator horn cutout in the fin at an angle such that it will intercept former F at about mid-point, but off center (e). The rudder pushrod (r) will

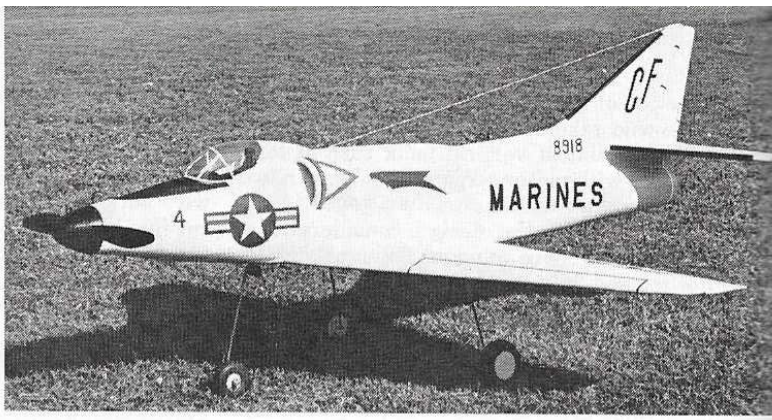




The prop disappears into just a blur the moment you rev the engine. Pure jet after that in neat looks department. Builds up fast with foam cores. At right: It's intended for the skilled R/C flyer. Fantastic roll rate.



A minimum of trim detail creates the illusion. Clean lines of the design are striking, ever remembered. The Navy pilots have a great love for it.



A pussycat it isn't. How much of a "tiger" depends a bit on what engine displacement you dare stuff into the nose. It flies with the very best.

come through the other side of this former. Push a flexible pushrod assembly through to at least the middle of the wing cutout and fit it with a simple offset wire connector. We don't want this connection to come loose later since it will be completely buried. Connect now and position the stab using white glue or epoxy, making certain the elevator control operates freely. Finish sheeting the fin under the stab and you will be ready to add fillets, sand and seal.

If you have gotten this far, the wing will be a snap. Wire cut a straight center-section and two tapered wing panels using ply templates. These are glued together directly on the flat sheet that you have with great foresight already prefabricated. Lay out the ailerons and landing gear and cut away the foam. Make up a right and left hand main gear and ply assemblies and epoxy in place as soon as the wing can be handled. Check for squareness and rake. Let me digress here to point out that the nose gear leads slightly and the main gear trails. Although this was done to simulate the actual plane configuration it has proved to be very good for the model operating from our grass field. Takeoff and landings are straight and the gear is capable of taking a lot of punishment without any permanent distortion.

By now we can go back to the wing and add the balsa tips and aileron cut-out framing as shown on the plan. Next bury the aileron controls in the top of the foam after slipping plastic tubing on them. Sheeting of the top of the wing can now be completed with the first pieces parallel to the leading edges to make for easier shaping to the airfoil. The balance of the sheets should run spanwise. No spars are used in this wing and none are necessary due to its very short span combined with the very great strength of foam and balsa skin construction. In fact this is one more nice feature of the whole plane. I don't have to worry if someone wants to touch it or if the ever present "helper" at the field grabs hold while I am flipping the prop. There just isn't anything flimsy about this airframe. In spite of this and an older radio weighing about 17 ounces, the whole thing has a dry weight of 5¼ pounds. Powered with a Super Tigre .51 and an 11x6 prop I get very good performance, but I believe that any engine from .45 to .60 could be used. Speaking of props, I find the long, scale gear is a real prop saver. You do have to watch making sharp turns while taxiing fast or you can nose the aircraft over.

So far we haven't mentioned finish and decals because each of you has, no doubt, his own preference. However, for what it is worth the technique used on this plane is one I have used several times. A vinyl paste spackle compound was used for wood filler and fillets. Sanding with damp (not wet) wet/dry 220 grit paper gives a good base for painting. Several light coats of gloss white acrylic auto spray paint will produce a beautiful finish.

For trim, use self sticking vinyl trim sheets cut in 1/16" strips for outlining controls and cut to other shapes for decals. I used black for outlines, letters, de-icers and numerals. Red is used for air duct warning safety marking and the center bar on the stars. Blue is used for all other decals. The style of the letters is similar to that used by the Marines, but does not depict any particular unit. Additional features could be added such as main landing gear wheel covers, ordnance pods and, I suppose, even retracts. Watch out for too much weight! A high wing loading or the C.G. too far back and you will snap roll every time the stick is pulled back fast. Get it right and she will fly hands off or do spins, rolls and inside loops. Whether in the air or on the ground, what she does best is draw envious attention.

I won't go through the whole flight routine, but be ready for a pleasant surprise when you test hop her. Good luck.

SKYHAWK ROSTER

XA-4D-1 (A-4)	Prototype first flew at Edwards AFB, June 22, 1954.
A-4D-1 (A-4A)	Entered service 1957.
A-4D-2 (A-4B)	Entered service 1957. 25 also to Argentine AF.
A-4D-2N (A-4C)	Entered service 1960.
A-4D-3, 4	No production orders
A-4D-5 (A-4E)	Entered service 1963.
TA-4E	First 2 seat trainer delivered in Feb. 1966.
A-4F	Entered service 1967.
TA-4F	Two seat version of A-4F.
A-4G	Ten to Australian AF in 1967.
A-4H	Also TA-4F for Israeli AF, 1968.
A-4K	Also TA-4J for New Zealand, 1969, 70.
A-4L	Re-manufactured A-4C's for USN Reserve training in 1970.
A-4M	Delivered in 1970 with P&W J52-P400, 11,200 pound thrust engine.