By Col. Art Johnson

F-100D

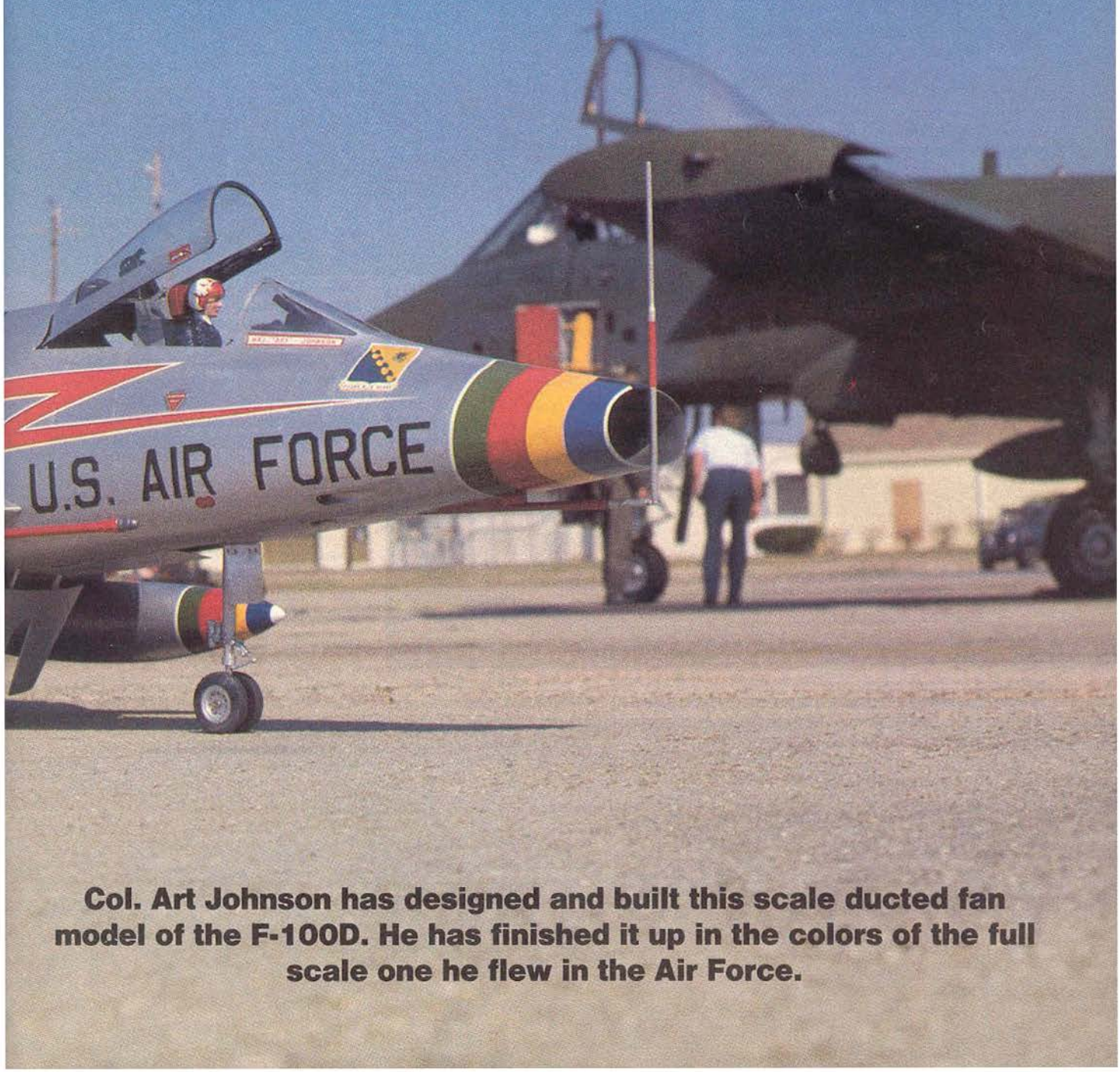
The F-100, the Super Sabre, as North American called it, or the "Hundred" or "Hun" as the pilots called it, has a very special place in the history of fighter aircraft development. The first of the Air Force's Century Series fighters, the F-100 was also the World's first operational fighter that could exceed the speed of sound in level flight. Designed as a pure interceptor, the "hundred" ended up doing everything except the all-weather job in the USAF's Tactical Air Forces through the late fifties on through the sixties and it is still in service today. Believe it or not, there are radio controlled F-100s flying routinely out of Tyndall AFB in Florida! These are the one-to-one scale variety and they send them out over the Gulf of Mexico for the missile guys to try their luck. Maybe it is a good thing that we have a weight limit for AMA competition. Just think of one of these R/C F-100s arriving at the Nats and the pilot announcing that he has a rather large entry for the R/C Giant Scale event.

I gave a lot of thought to the potential problems with the F-100 as a model before actually digging into this one which was my first attempt to design a ducted fan model of a jet fighter. On the plus side the F-100 has straight through ducting, the landing gear retracts inward in the manner that modelers can easily handle, the lines are clean and there was a very large hole in the back when the afterburner eyelids were open for take-off. I wanted to build the model to exact scale rather than enlarge the wing, the exhaust nozzle, and make the gear operate in a non-scale manner, features that are common to many of the jet models now flying. With the F-100, I thought I could stick very close to scale. On the other hand, the Hundred has a full flying stabilator, a very thin highly swept wing without a lot of wing area and a long fuselage that would be hard to keep light as compared to the wing. I also recalled the F-100 as not being one of the most forgiving fighters that I had flown. Remember the Sabre Dance? The "Hundred" was not kind

to pilots with poor flying technique. She was a reliable bird but in the "handle with care" class. I have found that models tend to retain many of the flying characteristics of their prototypes and I did not expect a model of the F-100 to be any exception.

I was encouraged in this project after seeing a video tape at Larry Wolfe's Jet Hangar Hobbies booth at Toledo a couple of years ago. The tape showed an F-100 out at the West Coast flying rather well with a Turbax fan unit. In fact, I almost built this version but after weighing the hardware that I wanted to put into an all-out scale F-100, I decided that I had better go for a larger model with more wing area. Besides, I find it a lot easier to fly a larger model simply because I can see it better and, believe me, your eyes do not get better with age. (That has to be one of the major attractions of Giant Scale.)

A larger model meant that I needed a larger fan unit and there was only one available, the Byron unit. I will be the first to admit that a tractor fan has to be more efficient, and that it is harder to cool the engine with a pusher, but, on the other hand, a large diameter fan with a lot of horsepower pushing it, is going to put out a healthy amount of thrust. I have flown all of the Byron ducted fan models (all belonging to other modelers) including models of the F-16 that weighed over 14 pounds. The Rossi .81 will get any of these models moving fast enough for anyone satisfied with



Col. Art Johnson has designed and built this scale ducted fan model of the F-100D. He has finished it up in the colors of the full scale one he flew in the Air Force.

Art Johnson's F-100D on the ramp at Eglin AFB, Florida. The model is painted as it was when Art flew it in the first world wide All Supersonic Fighter Weapons Championships at Nellis AFB, Las Vegas in 1958. (See color shot on previous pages.) The 12.5 pound model is a little less than 1/8 scale and is powered by a Rossi .81 turning a Byron fan.

had kept copies of the handbook and tech orders that were available when I was flying the bird for a living. I was actually flying R/C models at the time

anything less than a scale speed of mach three. I figured that if I could keep the weight of the F-100 model within reason, that the Rossi would provide enough push for this very clean design.

The engine-fan choice actually sized the model and I found that a scale of 1 to 8.4 produced a fuselage that would accommodate the Byron fan unit. There is plenty of information available for constructing and detailing a model of the F-100 although I found myself wishing that I

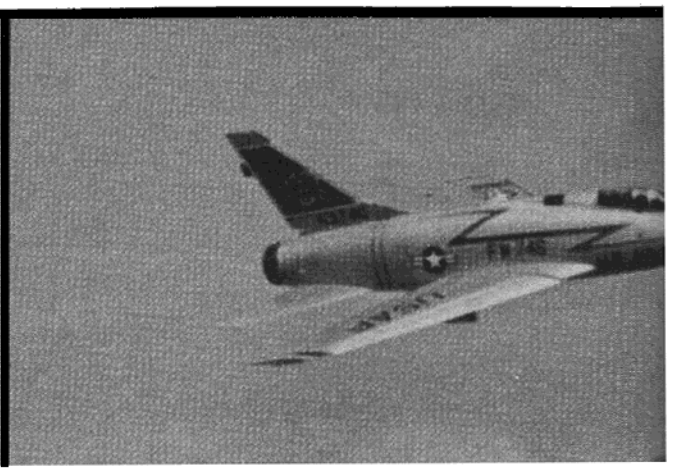
F-100D model with USAF A-10 in background. Note hinged pitot tube. It was always raised when aircraft were on the the ramp to avoid damage.

The F-100 was flying 30 years before this photo was taken of Art's model with the taxiing F-16 in the background. Afterburner eyelids on the F-100D model are in the take-off position.

but in those CW and escapement days, it never occurred to me that we could some day build and fly an actual model of a jet aircraft. Getting to the moon seemed easier in those days (and it was) and the photos I kept were mostly general shots, good for color and markings but not for close-up details.

If you are building any version of the F-100D, I highly recommend that you get Monogram's new plastic kit for the plane. I found it as accurate as any of the three views and it comes with

Below; Sequence photos of the F-100D on a fly-by pass. It looks like the real thing from any direction. Flight trim position of full flying stab is readily visible.



the different types of refueling probe, external racks and the two types of afterburner. Monogram's version of the 275 gallon drop tank is a little off so go with the tank as I have drawn it. I spent a lot of time with a steel tape crawling over an F-100 at Eglin AFB getting measurements to double check the three views. The drop tanks received their share of attention and I am sure that I know more about the dimensions of an F-100 now than I ever did when I was flying the bird. After all, what pilot ever cared about the diameter of a gear strut on a plane he was flying.

The F-100D model is built up from ply and balsa with foam wings and stabilators. In laying out the design, I figured that I might come out a little lighter with a built-up fuselage than if I tried molding it from glass-resin. The fuselage did come out very light but adding all the scale operations, the hardware required, including ten servos, brought the weight up to 12½ pounds ready to fly. Still not bad considering that the wing area projected through the fuselage is 843 square inches with 678 sq. in. actually outside the fuselage.

CONSTRUCTION

A blow by blow account of the construction of this model would fill this magazine so instead I will talk about those construction features that may be a bit different from the average scale model. This was my first scratch scale model of a jet and I tried every technique that I could think of to reduce weight and improve strength.

Fuselage:

The exhaust tube from 1/64" ply is the basic structural member used to start the fuselage. There is a lot of 1/64" ply in this model which is available from Bud Nosen Models and retail outlets. The tube is fuelproofed on the inside with K & B resin and epoxy. I used a sponge to apply the resin after forming the tube but it might be easier to paint it before assembly. The firewall and the fuselage former that supports the nose gear are sandwiches made by laying strips of Dave Brown's carbon fiber tape on each side of the lite ply former with Hobbypoxy 2 and then adding a layer of 1/64" ply. The result is a very strong but light former whose edges will hold glue well. The other formers behind the wing are made using 3/32" balsa between sheets of 1/64" ply and without the carbon fiber. Those forward of the wing are laminates of 3/32" balsa with the grain crossed.

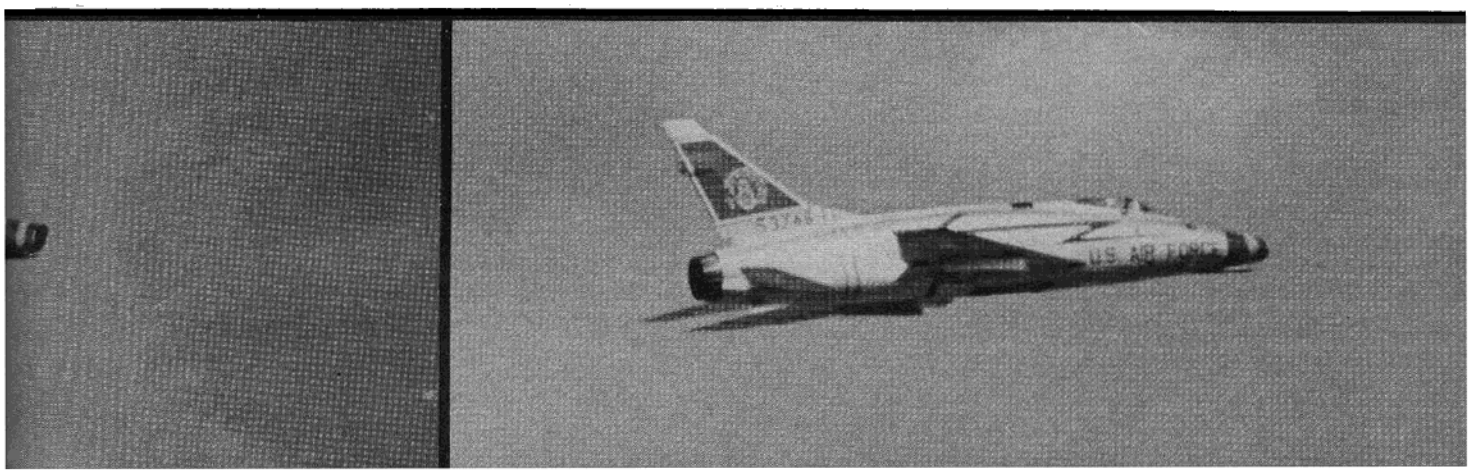
The fuselage structure is started by installing the Byron fan shroud in the firewall, gluing the exhaust tube in place, adding the formers to the exhaust tube and then gluing the top and bottom ply keels in place. When all the formers are in place, strip planking can be started with 1/2" wide, 3/32" balsa. Strip planking is an easy job with Zap-A-Gap and Slow Zap. In fact, these glues plus Hot Stuff CA were used for the entire structure except where Hobbypoxy 2 was needed for insurance. Care must be taken to keep everything lined up when starting the strip planking but the fuselage will become more rigid as you progress. The 1/4" x 1/8" basswood longeron is fitted to provide added strength from the nose gear former back through the engine section.

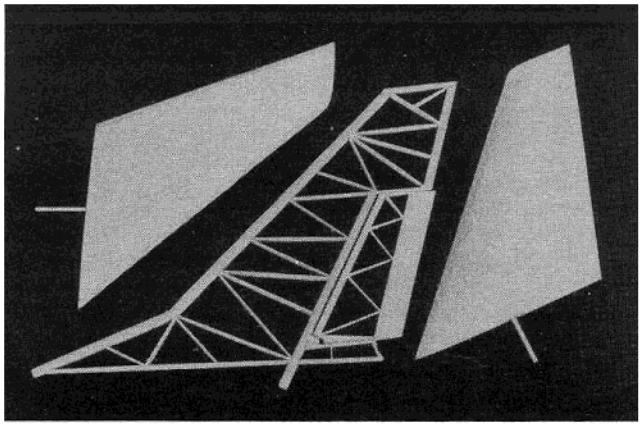
A built-up fuselage has some advantages over glass when it is time to install equipment. I left the entire bottom planking off until after I had covered the fuselage with silkspan paper, doped and primed it and installed all the retract lines, valves and servos. This was a lot easier than reaching into a glass fuselage to work and cutting your wrists in the process. As the radio receiver, battery pack, four servos and a gear door air cylinder are installed in the rear of the fuselage, a large hatch is built in to provide access after the planking is finished. The top and bottom ply keels are used primarily to form the fuselage outline as construction proceeds. Sections of these keels are cut out later to give access to the engine, cockpit, and nose gear.

The canopy area is formed from a urethane foam block and finished with the fuselage to a point where it can be used as a plug for the canopy frame and canopy. The frame is laid up right on the fuselage with six ounce cloth and resin. When this is removed, the

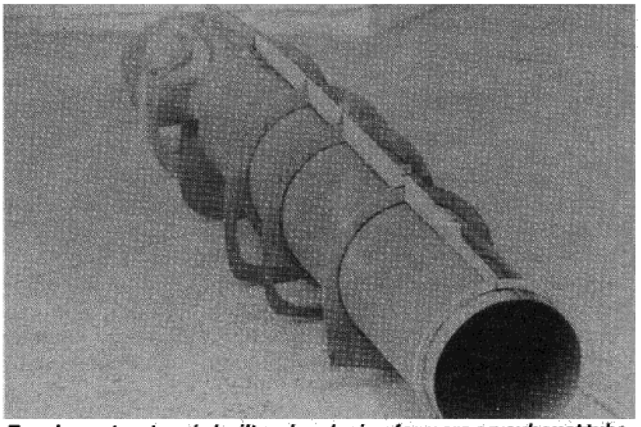
NORTH AMERICAN F-100D
DESIGNED BY:
Col. Art Johnson
TYPE OF AIRCRAFT
1 to 8.4 Scale Jet
WINGSPAN
56 Inches
WING CHORD
14" (Avg.)
TOTAL WING AREA
843 Sq. In.
WING LOCATION
Mid-Low Wing
AIRFOIL
Semi-Symmetrical
Laminar
WING PLANFORM
Swept Double Taper
DIHEDRAL EACH TIP
0
O.A. FUSELAGE LENGTH
67" (less pitot tube)
RADIO COMPARTMENT SIZE
Ample
STABILATOR SPAN
29 Inches
STABILATOR CHORD
7.5" (Avg.)
STABILATOR AREA
144 Sq. In.
STAB AIRFOIL SECTION
Symmetrical
STAB LOCATION
Low-Fuselage
VERTICAL FIN HEIGHT
13 Inches
VERTICAL FIN WIDTH
9" (Avg.)
REC. ENGINE SIZE
.81 Glow Fan
FUEL TANK SIZE
two 12 oz. (24 oz. total)
LANDING GEAR
Tricycle-Retracts
+ Retract Tailskid
REC. NO. OF CHANNELS
8 Minimum
CONTROL FUNCTIONS
Rud., Elev., Ail., Throt.
Retracts, Flaps, Drag Chute,
Drop Tanks
BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa & Ply
Wing	Foam & Balsa
Empennage	Balsa
Wt. Ready To Fly	**200 Oz.**
Wing Loading	**34 Oz./Sq. Ft.**

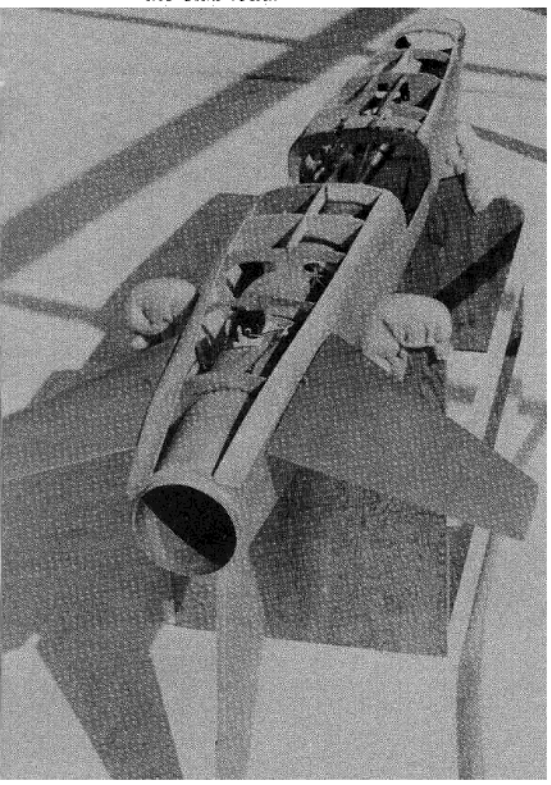




F-100D fin and rudder are Zapped together from balsa. Stabilators are balsa sheet over foam. 1/4" aluminum rod carries the stab load.



Fuselage structure is built up by placing formers on exhaust tube and aligning with ply keels.



Bottom strip planking is left off until most of the hardware is mounted in the fuselage.

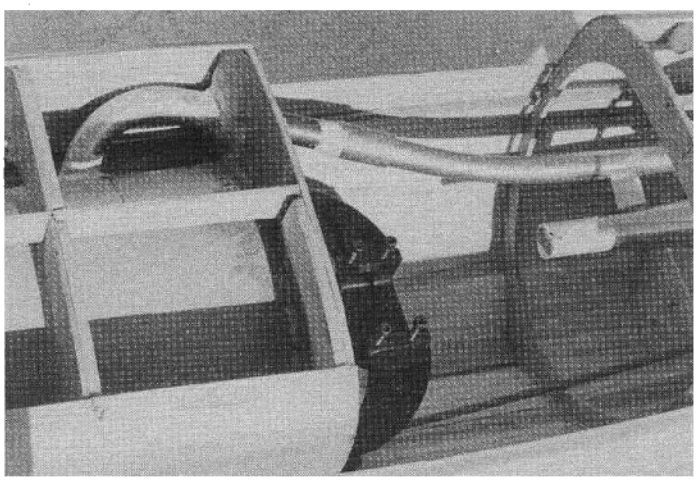
plug is cut out and set up to heat form the actual glass canopy. Sig butyrate sheet was used for this job with the kitchen oven as the heat source. The F-100 canopy opens clamshell style and a Du-Bro hinge at the back and spring loaded clips at the front hold it firmly in place for flying.

Wing And Stabilators:

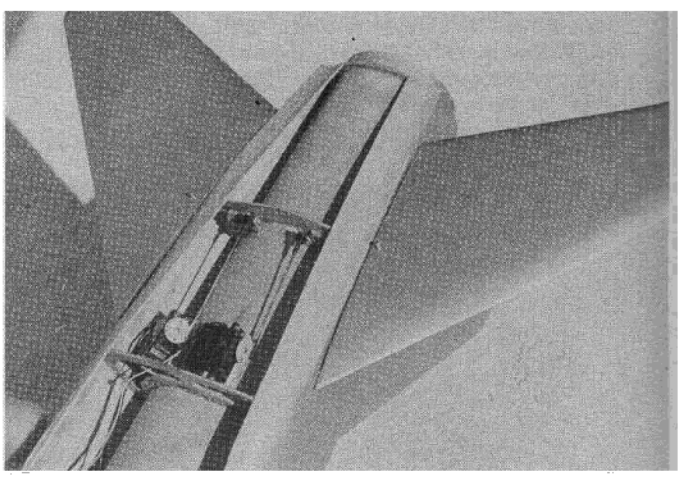
The flying surfaces were all cut from foam. The finished wing will come out at the right thickness if you use the templates as shown on the plans. The hot wire cuts a little below the template edge and when the blanks are sanded it will just about make up the 1/16" thickness of the sheet balsa covering. Before sheeting, squeegee strips of carbon fiber tape along the wing and stabilator surfaces top and bottom for added strength. About five strips on the wing are right, making sure that the slats, flaps and aileron areas are covered. Hobbypoxy 2 thinned a little with alcohol works well to hold the carbon fiber down. The flying surfaces on the F-100 are much thinner than on the average scale model and I doubt if they would be sufficiently rigid without the carbon fiber.

Trailing edges were laminated with a strip of Bob Violett's Magnalite (1373 Citrus Rd., Winter Springs, Florida 32708, 305 365-5869). The thin sheet is adequate and gives you an edge sharp enough to cut your finger. 1/64" ply between 3/16" balsa is okay for the leading edge as a sharp edge is not desired. The slats, flaps and ailerons are all cut from the wing after it is sheeted both sides. An X-Acto saw and knife blade will do the trick. Leading edges of the flaps and ailerons are surfaced with balsa and shaped while the inner surfaces of the slats are fitted with 1/64" ply to add strength. Ball bearings from used equipment give the F-100 the smoothest aileron action that I have ever experienced. The bearings are crimped into tubing at the outboard end and glued into the foam. The inboard end is set into a plywood brace. A needle bearing holds the inner end of the flap (I ran out of ball bearings) and one of the large Robart hinge points carries the other end of the flap.

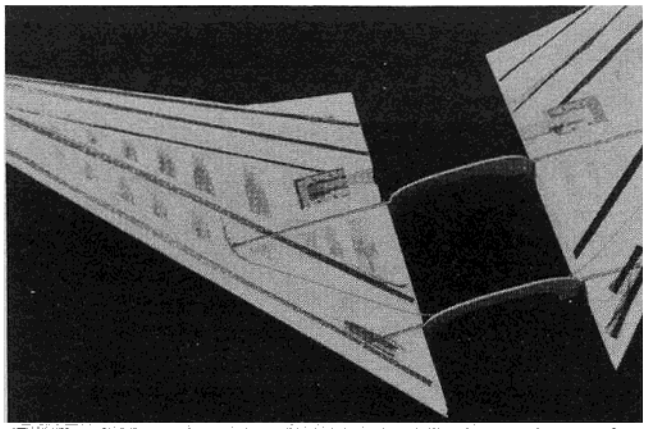
The F-100 stabilators do not rotate parallel to each other so a separate bearing is installed on each side of the fuselage. This bearing must be free



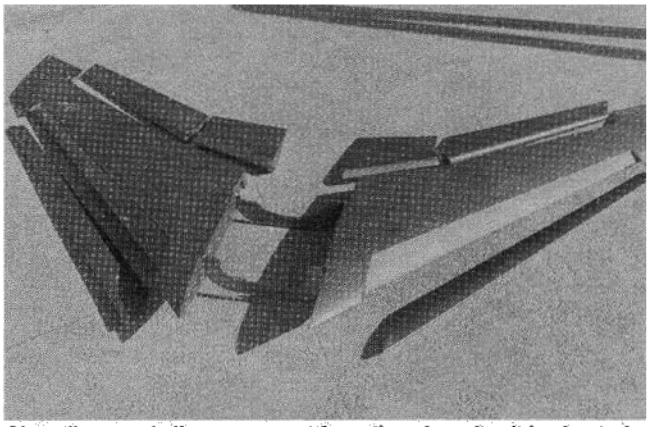
Exhaust extension puts hot gases behind the fan and keeps engine compartment clean. Silicon bathtub caulk holds the aluminum tubing in place.



Direct link to stabilators takes care of high air loads on full flying stab.



Details of this carbon fiber reinforcing of the foam wing on the F-100D were covered in the April 1984 issue of RCM.



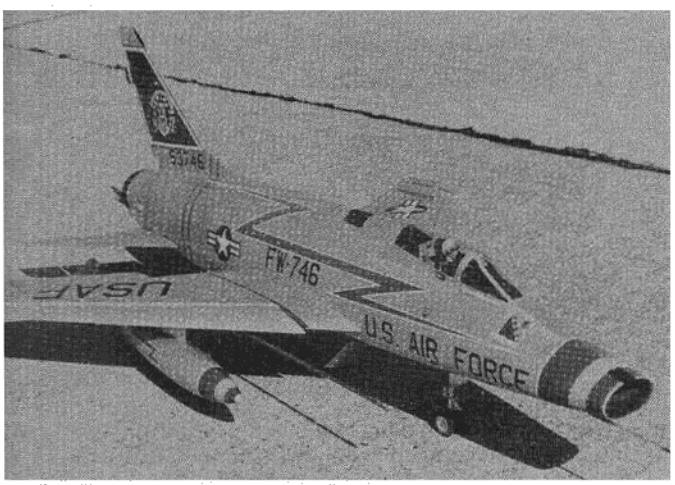
Slats, flaps and ailerons are cut from the wing after it is sheeted and glassed with first coat. Exposed edges are finished with balsa and 1/64 ply.

from slop as it carries the entire air load of the moving surface. A 1/4" aluminum rod set into aluminum tubing on the stab and running in brass tubing at the fuselage has worked well. A 4-40 bolt doubles as a retainer and control horn. A small aluminum plate was added to the stabilator with a bolt going through the bearing rod just to make certain that the rod did not rotate in the stab. The stabilators weighed only a couple of ounces each before adding about 1½ ounces of lead for static balance. I had not had any trouble with the unbalanced stabilators on the X-100 practice model that I had built but I was not taking any chances with the scale version.

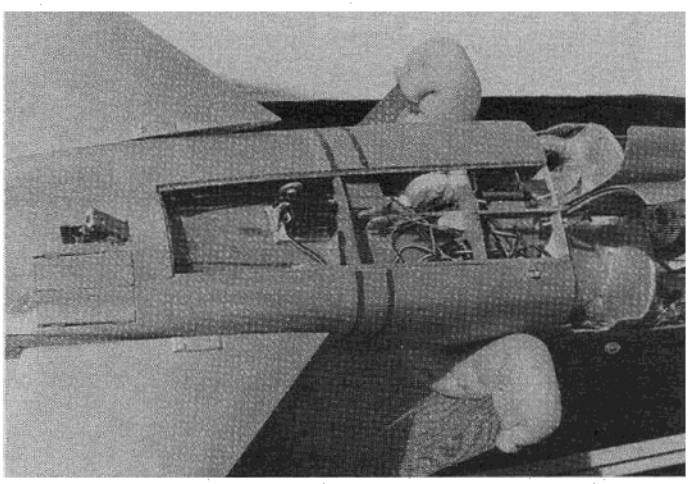
The wing spars are laid up with the same lite ply, carbon fiber tape, 1/64" ply sandwich as the firewall. The carbon fiber tape can be pulled apart into narrow strips if you are careful and shorter strips will have to be used to get around the curves. The spars are set into the wing after the top is sheeted. The long drying epoxies are best for this job. The F-100D has no dihedral and I did not put washout into my model. The flaps provide effective washout for landing and I do not plan to ever land the model without using flaps. If you build the F-100A or F-100C version, you will have a model of a fighter that did not have flaps --- but, a word of caution --- if your model lands like the original, you do not want to build one!

The fin and rudder are conventional balsa construction with the trailing edges laminated balsa and Magnalite. The fin and rudder were finished, covered and primed so that I could install them and connect the rudder horn before finishing the planking at the rear of the fuselage. Sullivan Gold'N-Rod actuates the rudder through a torque tube crank that transmits the motion from the servo on the bottom of the model to the control rod at the top of the model. In retrospect, I am not sure that connecting the rudder was worth the trouble. The rudder on the F-100 was used primarily as a yaw dampener controlled automatically by a yaw-roll gyro. You could fly any maneuver you wanted with both feet firmly on the cockpit floor. The area of the rudder is small compared to the fin area and of doubtful value on the model. Besides, slips or spins are a no-no on this type of plane --- big or little.

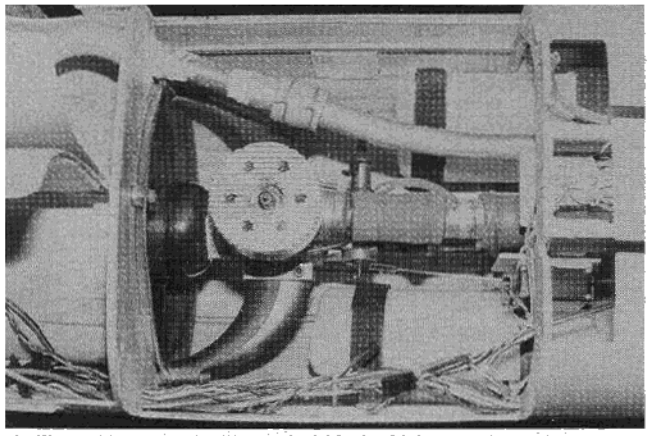
Full flying stabs need more throw than one might expect. This is full movement in high rate. Aluminum fairings hold drag chute cable as it snakes around from under rudder to drag chute compartment under the fuselage.



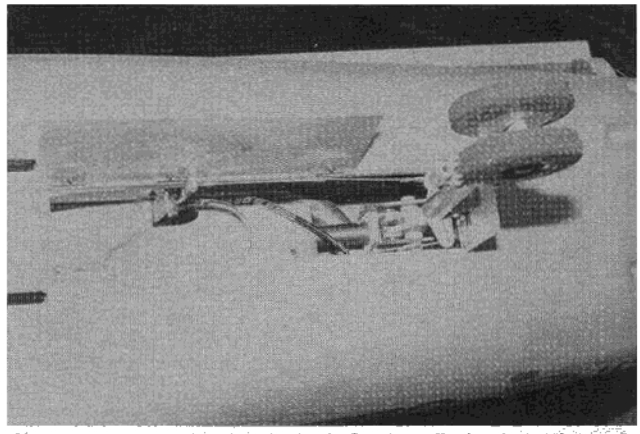
Leading edge slats on the original floated and were positioned by air pressure. On the model they are positionable, here shown fixed in take-off and landing position.



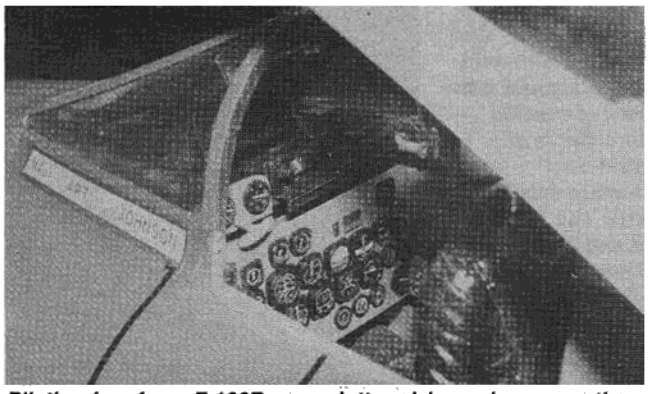
Large hatch gives access to radio compartment and gear door actuator. On left are the drag chute doors and the retracting tail skid.



Sullivan 12 ounce tanks are held in by Velcro strips. Wiring and plumbing is held in place with plastic tie-downs to prevent sucking into fan unit.



Nose gear compartment showing Sonic cylinder actuating gear door. Forward door closed by bungee cord.



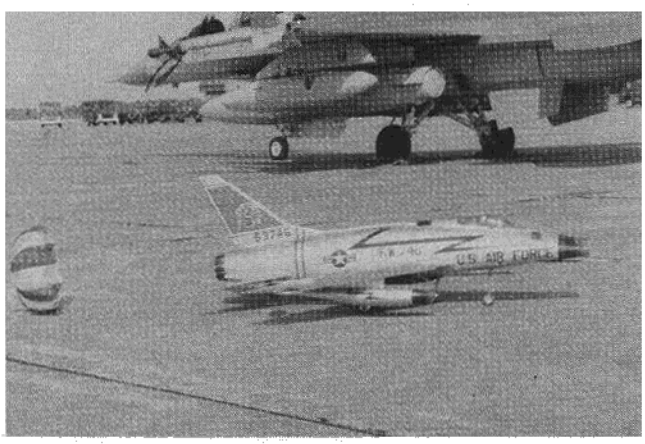
Pilot's view from F-100D was cluttered by radar computing gunsight, M-1 bomb sight, external tank gauges, drag chute handle, etc. Cockpit interior was in light grey rather than the zinc chromate of older USAF aircraft.

Nothing like checking against the original. Art's F-100D model on wing of camouflaged F-100. Bent refueling probe and ventral fin light were later mods.

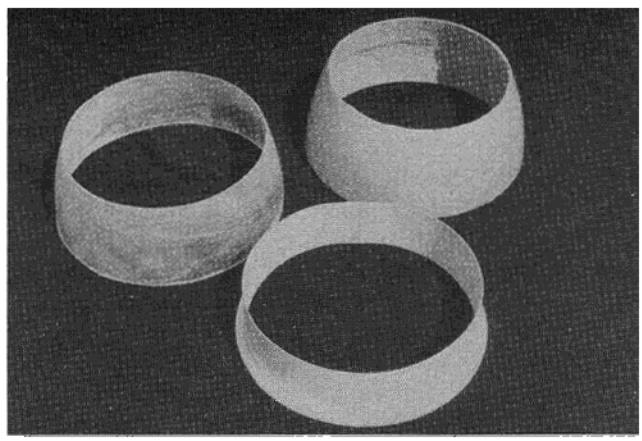
Retracting Landing Gear:

Naturally you would not want to build a model of this type without installing retracts. The mains and nose gear on the original rotated through about 90 degrees which makes it easy on the model. I chose the standard AMT retracts with a vertical nose gear mount. (AMT U.S.A., 5068 Greensboro Ct., Columbus, Ohio 43220, 614 457-0065.) These retracts are similar to, but perhaps a bit more rugged, than Rhom Air gears which would also be suitable. I did not use the tubing that came with the AMT gears as it is fairly large and stiff. The AMT tank is a good size with plenty of air for both the gears and door operation. I recommend Bob Violett Models' angle mounts of Magnalite for installation of the gears in the wing. They were not available for the original installation but I have tried them in other models and they would save some weight over the original ply mounts.

The F-100 is another one of those darned airplanes that has the gear doors closed except when the gears are actually moving. This problem was solved by using the Byron sequence valve operated by a slow moving Ace 180 degree servo. The main doors are opened by a Sonic cylinder with a separate cylinder on the nose gear door. The gear retract cycle on the F-100 was very fast compared to WW II fighters and with restrictors in the system, the sequence is quite realistic with the three gear doors opening, the gear going up or down and the doors closing again. A turn-on



Drag chute deployment demonstrated under wing of F-16 loaded for bear.



Afterburner nozzle is formed in 6 ounce cloth and resin over foam plug shown in upper right corner. Mount for nozzle shell is 1/64 ply in lite ply ring. Eyelids from second glass shell complete the assembly.

just to watch it work.

Radio Installation:

It would be nice to have a nine channel radio for the F-100, like the new JR. With my eight channel Futaba J Series, I had to forego operation of the dive brake or lose the chance to deploy the drag chute or drop the external tanks. Retracts, flaps and the other operations are all needed just to fly this model realistically. As it turned out, ten servos were installed with separate servos on each stabilator and aileron. With direct short linkage to each surface, the risk of high speed flutter is minimized and the weight penalty is not great when you consider that control rods and bellcranks are not needed. The smallest mini-servos are okay for operating the drag chute release and the tank release. Standard servos are used on all other controls except the retract valve. The antenna is routed forward through a nylon tube going almost to the nose of the model. A standard Futaba battery pack has been used so far without problems, however, I still plan to check the idle current drain before putting too many flights on the model in one day.

Finish And Painting:

Old fashioned silkspan paper and nitrate dope seems to be about the lightest system for finishing a balsa surface and this was used on the fuselage, fin and rudder. 3/4 ounce glass cloth and resin was used on the wings and stabs as there was a possibility that the dope finish might warp these thin surfaces. Dupont 100-S primer was followed by a coat of Hobbypoxy silver, and then the fun(?) began.

The F-100 has been around for thirty years now and there is an incredible choice of color schemes for this aircraft. It was flown worldwide by all the USAF Tactical Air Forces. The Thunderbirds flew it, many foreign Air Forces flew it (some still do), it received various camouflage paint jobs in Southeast Asia and one of the wildest paint schemes was on my own F-100D as it was flown in the Worldwide Fighter Weapons Championships back in 1958. Okay, you know from the photos which paint job I picked and I had plenty of reason to cuss my old line chief for dreaming up that paint scheme before I was finished. It actually took me longer to paint the model than it did to build it. Ever try free hand painting a Golden Eagle and have it come out looking like a dove every time? And that was only for starters. Anyway, the job finally was done but if I ever build another F-100, I will settle for a simple camouflage color scheme.

Flying:

Now we come to the real fun part. I usually cannot wait until a new scale model is finished before putting on the first flights. This time I do not know if I was just chicken or if I felt that I would never finish that paint job if I started flying the model. When I finally screwed up the courage to try it I had finished everything including the inflight refueling boom. I was able to make some high speed taxi runs and test the drag chute deployment at our local flying sites but the longest runway for models in South Florida is 400 feet and the over-runs can make junk out of a plane that does not get off in that distance. Just to make sure, I drove 600 miles to the Eglin AFB area in the panhandle of Florida for the first few flights.

The weather turned out perfect on Mother's Day in May and, thanks to some members of the Eglin Aero Modelers, we had the entire Choctaw Navy field all to ourselves. All of my other scale projects had flown well on their first flights but this model was so much different that I did not know what to expect. I had flown the original of the model for more hours than I had in any other individual plane but we all know that is not much help with an R/C model. Besides, I had not built any of those F-100s. Anyway, the engine started on the first try and I could not think of any more excuses. Taxi a couple of hundred feet down the runway, turn around and full bore for take-off, or so I thought. The F-100 looked like it was going 60 when it went by me but the nose wheel did not even lift with full up stab. Fifteen hundred feet down the runway I decided that I had better chop it.

I was not about to give up, so the game plan was changed for the next try. I had moved the battery pack forward to a position just in front of the wing on the usual surmise that if you are not sure of the C.G., it is better to be nose heavy. It was too much trouble to change the battery location at the field so next try was with 20 degrees of flaps and high rate stabilator on the transmitter. It worked! The F-100 jumped into the air as it went by me. Gear and flaps up and suddenly all the effort was worth it. Even in high rate, which gave about 45 degrees of stab angle, the plane was stable and moving fast. The rest of the flight was spent playing with the trims, rate switches and making passes for my son Bob working the video camera. Time to land, gear and flaps full down and darned if I did not overshoot the turn to final just as I had on my first landing in the F-100A over twenty-five years ago. Swept wing aircraft do not turn around like Ugly Sticks and you have to give them a little more room for maneuver. Landing is also like the big bird. You want to fly it on the runway. Set up a rate of descent to hit a spot and then use power to reduce the descent as you approach the runway. If you do it right, she will touch down nose high on the main gear slick as grease.

The next flights were back at the Air Force runway of the Eglin Aero Modelers. The battery pack was back in the original position and take-off was normal in low rate stab. The run was measured at 350 feet which put me in business at some of our model runways. The roll rate of the model was just right in low rate on the Futaba transmitter. The Rossi .81 provides plenty of push for a good climb rate and for climbing rolls. So far the model has been flown using 5% nitro fuel, no pressure on the tanks and with the tuned pipe exhausting through an extension which gets the fuel residue around behind the fan. This extension did not cost any rpm on the test stand but only time will tell if it is really a good idea. The engine compartment in the F-100D stays white glove clean and the hot exhaust gases go out behind the fan.

The F-100 operated from 10,000 foot, or longer, runways which means that a runway of 1200 feet would be right for the scale of this model. We should be so lucky. To shorten the take-off roll as much as possible, I installed ball bearings in the wheels before the next flights. This let the model get off from our runways of less than 400 feet with a full load including drop tanks. The F-100D turned out to be stable with the long finned tanks and on release, the tanks do not strike the stabilator. Apparently the shape of the 275 gallon tank works as designed pulling the tank down when released even without positive ejection. Finned tanks do not tumble when released but fly like unguided missiles. If one tank is released inadvertantly, plan on an interesting few moments with the trim tabs. Swept wing aircraft react more to asymmetrical configurations than do their straight wing relatives. As with most ducted fan models, I learned how the F-100 dead sticks fairly early in the test program. Keep the speed up, don't stretch the glide and she will do okay. Dead stick landings have been completed from scale altitudes where I would have punched out of the original without even thinking about trying to land, so I think the model is more flyable without power than the full scale bird.

Thinking back over the year it took to get the F-100D model from the drawing board to a first flight, I realized that scratch building this type of plane is a bit more work than building one from the usual ducted fan kit. However, if you are the type of modeler who takes pride in the craftsmanship that it takes to do it yourself, you might want to try this one. The F-100D is a classic supersonic fighter and the model of it flies well enough to be flown by anyone who can handle the other ducted fan models now on the market. □

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