Photo By John Preston

LEARJET 35A

Mark Frankel has been designing and building models of the Learjet for several years. This presentation that appears here, and follows in the April and May issues, is the result of his latest achievement. It is truly outstanding and was 1st in Non-Military Sport Scale at Toledo 1988.

By Mark A. Frankel

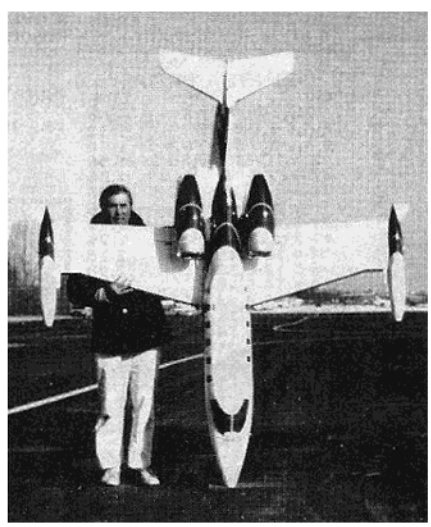
PART I

INTRODUCTION

The generic name for all high wing lightplanes is "Piper Cub" due to the enormous success of Bill Piper's product. To date, only one other aircraft has achieved the same degree of recognition — the Learjet. To most people "Learjet" is used to identify all corporate jet transports.

The original Learjet was designed by Bill Lear in the late 1950's. It was conceived to be a small, high performance aircraft based on the Swiss attack fighter, P-16. The initial design, known as the Model 23, was powered by two General Electric J-85 turbojets, the same engine that was used in the supersonic Northrop T-38A. The Model 23 possessed the highest cruise speed and cruising altitude of any business jet. In fact, its performance was so spirited that it displayed a higher initial rate of climb than the afterburner equipped North American F-100.

In spite of its superb performance, the Model 23 offered extremely limited cabin space and, on occasion, it exhibited some ferocious aerodynamic



qualities such as mach tuck and deep stall. Through a series of product enhancements, the Learjet became more spacious, longer ranged and easier to fly, while retaining most of its original performance.

In the early 1970's, Lear introduced a new turbofan fan design known as the Model 35A. This aircraft was powered by two Garrett AiResearch TFE731 turbofans which offered exceptionally good fuel efficiency with low noise. The design became a great success. With nearly 700 delivered to date, it represents the most popular business jet ever produced.

Unlike the Piper Cub, however, the Learjet is not an obvious choice for a radio control subject. It violates my first principle of twin jet design which is: Never — I mean never, build a twin that has its engines displaced from the aircraft's centerline. It also runs afoul of my second principle which states: Never — I mean never, build a twin with a high wing loading. Nevertheless, if you have ever seen a Learjet climb out from a local airport, or even seen one parked on the ramp, you can understand why I disregarded principles 1 and 2.

After abandoning my principles, I was left with the weighty issue of what scale to work in. Usually, ducted fan model size is dictated by the amount of thrust available. The obvious power plant at that time was the Turbax I

fan from Jet Hangar Hobbies with a K & B 7.5 engine. This seemed a perfect match for installation in the short nacelle. The K & B 7.5 would use a Mac's Products Wizard Pipe which could be completely concealed within the nacelle. Thus avoiding the age-old problem of a long tuned pipe hanging out of a short tailpipe — a sight guaranteed to offend any scale modeler.

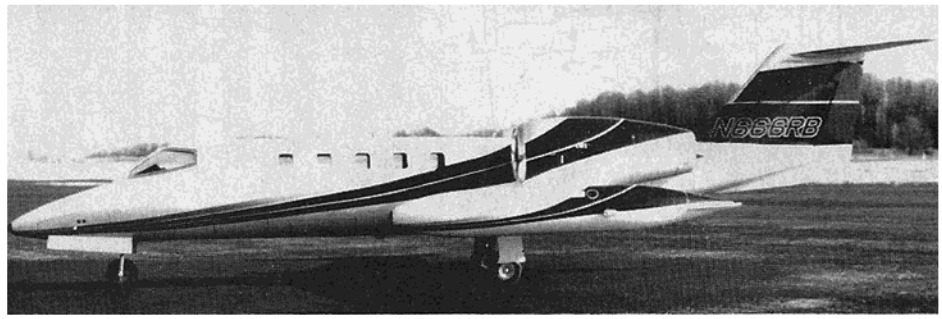
The Turbax/K & B propulsion package is light, compact, and it had worked well in an earlier twin design of the A3J Vigilante (see RCM, Dec 1983). Also, Tom Cook was having excellent success with these fans in his early F-4 Phantoms. However, the Turbax diameter is slightly over 5" and it dictated the use of a large scale to provide enough nacelle cross section to carry the fan.

At 2" = 1' (1/6 scale), I had a fuselage that was over 8' long, while the nacelle was still not quite large enough. Worrying about my ability to transport a monster fuselage, I decided to do the only honorable thing — cheat. I settled on the 2" = 1' scale as the largest practical size, but I had to expand the nacelle size (slightly) to house the ducted fans. While I was at it, I decided to add some wing area to relieve the anticipated wing loading problem. My original weight estimate was 20 pounds dry; however, I considered 22 pounds acceptable.

Throughout the entire process of drawing plans, building the fiberglass tools, and finally building the model, I could not help but wonder whether a model of this size would fly. Remember, in the early 1980's almost all successful ducted fan designs were small single engined examples weighing 9 to 10 pounds. Even large twins, such as Cook's F-4, weighed well under 20 pounds and were dimensionally smaller than the airplane that I hoped to build. Nevertheless, the words of Dave Platt kept ringing in my ears: "Little models flit — big models fly." (Platt is one of the deeper thinkers in our hobby.)

I started the model in earnest after obtaining a detailed set of lofting drawings from a contact at Gates Learjet who happened to be a modeler and who also happened to be a Learjet Vice-President. These drawings were rendered in 1/10 scale and showed nearly 40 fuselage sections, 5 nacelle sections, and frequent wing, stab, and fin sections. By photographically enlarging the factory material to 1/6 scale, I was able to obtain the precise dimensions and shapes for my model.

I chose to work in fiberglass and foam for several reasons. First, it occurred to me that the lightest and truest structure could be obtained with these materials (although no less an expert than Mr. Platt violently disagrees with me preferring balsa over composites in all cases); furthermore, fiberglass and foam models are easily reproduced when more than one example is desired. My experience with ducted fan design has taught me that two or three airframes are necessary before you produce a well behaved model. Therefore, it seemed prudent to use a construction technique that would allow ease of reproduction.



History of the Models

To date three examples of the Learjet 35 have been built from my plans and molds. Currently, example four is being built by an airline pilot, Charlie Lines, in Upstate New York, and number five is in the hands of Dr. Jack Tse's group in Toronto, Canada.

My original model was completed in the spring of 1985. It was painted to represent N23G, an aircraft operated by Goodyear Aerospace in Akron, Ohio. This model was the lightest of my three at 24 pounds (remember, I had targeted for 20-22 pounds). N23G, which carried two Turbax I fans with K & B 7.5 engines was well suited for that thrust level.

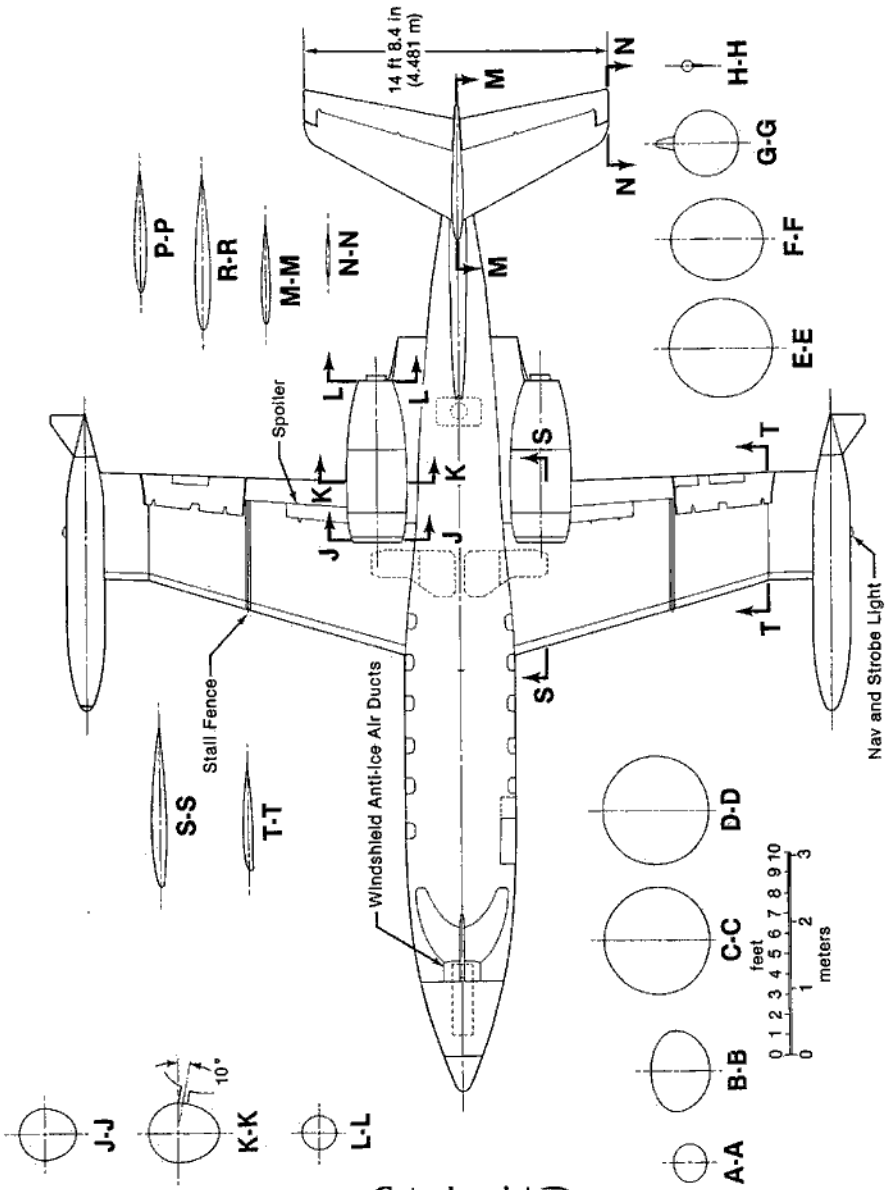
The initial flight was made from a hard runway with no wind on a cool, rainy day. The model was slightly tail heavy but controllable, and the only problem encountered was premature rotation and lift-off due to the tail heaviness. N23G was also flown twice from a grass field with little difficulty; however, the model was lost in a stall spin accident when an engine failed and the glide was stretched in an attempt to reach the runway.

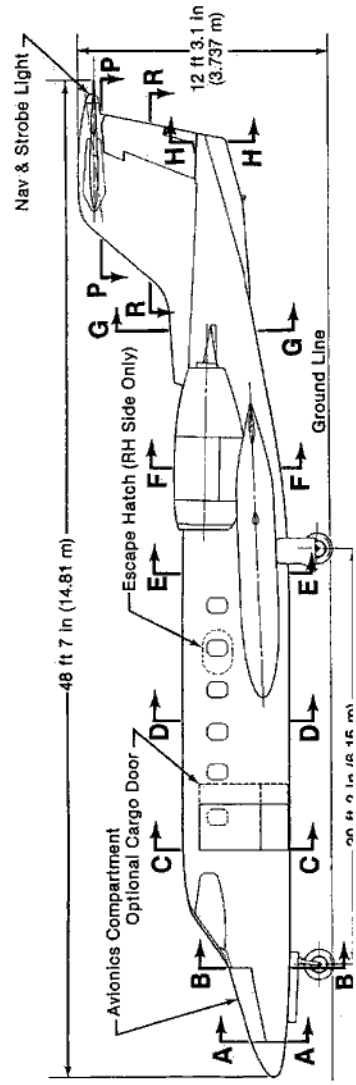
The second model was a replica of N80SM, a special mission demonstrator that Learjet hoped to sell to military services as a maritime surveillance aircraft. This model was modified to carry the Jet Model Products Dynamax fans with Rossi .65 engines. The additional weight of these engines required additional nose weight to achieve the proper Center of Gravity and the result was a substantially heavier aircraft at 26 pounds. However, on N80SM I made the fatal mistake of not adding enough nose weight and the effect was obvious from the instant the model became airborne. It was so erratic in roll and pitch as to be almost uncontrollable. It was apparent that the Dynamax fans provided ample power; in fact, N80SM was quite fast for a 26 pound model. After a few circuits around the field, I was able to sort things out by using an extremely light touch on the sticks. I got the gear up and made a nice pass down the runway. With increasing confidence, I pulled up into a crisp right turn and promptly snap rolled the model as it turned downwind. Now two models were splashed, but I was convinced that the design possessed excellent qualities and that the accidents were the result of my carelessness rather than an inherent flaw.

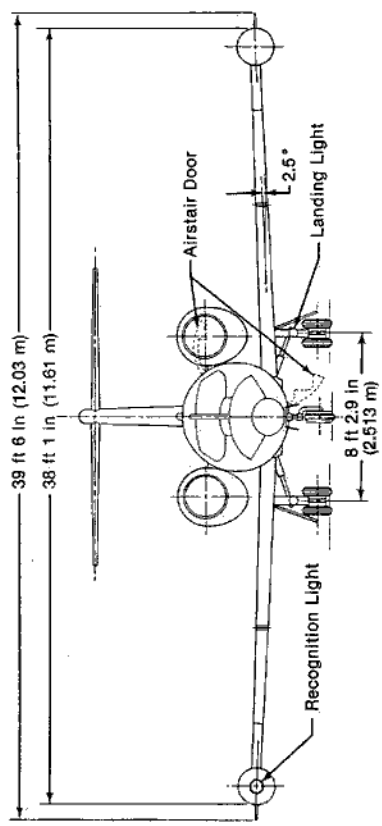
The third model, N666RB, was built to represent a particularly colorful aircraft that was based in the Dallas-Fort Worth area. I resolved to apply the lessons learned from N23G and N80SM to make N666RB a better model aircraft. I became obsessed with Center of Gravity considerations. Kerry Sterner determined the appropriate point with his computer program (see his excellent description in the "Fan Facts" column, *Flying Models*, Nov. 1987, p. 70), and I checked the model's balance at this point with fuel tanks full. I also became obsessed with proper control throws as a result of the wild ride that I experienced with N80SM. So far the lessons have been well applied. N666RB is as well mannered as I had hoped. My only regret is that this third model is flying at 28.5 pounds, a full 4.5 pounds heavier than my first model, and 8.5 pounds heavier than my original projection.

Preparation for Building the Model

For those who choose to build the Lear 35, various components will be available through Dave Hyatt's Hyatt-Tech at Marchwood Shopping Center, Exton, Pennsylvania 19341, (215) 524-7244. Fiberglass fuselages, tip tanks, and engine nacelles, as well as all foam flying surfaces and vacuum formed windshields will be available on a custom order basis.







GatesLearjet

MODEL 35A/36A

Two new additions to the Learjet product line, the Learjet 35 and Learjet 36, were unveiled in the fall of 1973. Both received FAA certification in July, 1974. Learjet 30 series aircraft are probably the most versatile business jets flying today. They are one of the quietest business jets in the world, and the one with the highest fuel efficiency per mile flown.

Passenger cabins are as much as 50 percent roomier than earlier models and can carry up to eight passengers in even greater comfort and versatility. A new record for speed around the world was set in February, 1983, by a standard-equipped Learjet 35A. In April, 1976, the Century III wing was certificated. This wing provided improved low speed performance and was certificated as the 35A/36A. In March of 1977, the shirt sleeve environmental system was introduced for flight above 41,000 feet and in August, 1979, the Softflite wing modification was added for improved low speed and high speed handling characteristics. The following specifications are for the Learjet 35A:

Powerplant: Garrett TFE 731-2-2B Turbofan engines (two each)
Thrust: 3,500 pounds each
Normal cruise: 460 knots (529 miles per hour)
Long range: (with 45 minute fuel reserve) 2,289 nautical miles (2,632 statute miles)
Empty weight: 9,571 pounds
Ramp weight: 17,250 pounds — Optional 18,550 pounds
Approved cruise altitude: up to 45,000 feet

In order to successfully build and fly this Learjet, the modeler should have some familiarity with fiberglass and foam structures as well as experience in flying fast retractable gear models. It is also desirable to have access to a large flying site with a paved runway (although my first model was flown from grass). The eight foot fuselage also imposes transportation considerations. The model fits easily into a full sized station wagon (Chevrolet Caprice, etc.) and may squeeze into an intermediate wagon (Chevrolet Celebrity), but anything smaller will require a roof carrier or trailer.

In next month's issue I will describe the building sequence. In the final installment, I will cover assembly, weight and balance checks, test flying, and future developments of the design. □

LEARJET 35A

Part II of Mark Frankel's 1/6th scale replica of the Learjet 35A takes you through the building stage right up to painting. Next month, Part III will get you into the air.

By Mark A. Frankel

PART II

Construction Overview

This model is somewhat unusual in that it is built in several separate modules independent of each other. They are gradually integrated as construction progresses. The fuselage aft section is the most difficult and critical since it carries the wings, engine nacelles, and tail surfaces. Therefore, it determines the alignment of the entire airplane. The nose portion of the fuselage is added late in the assembly. It carries little structure aside from the nosegear; it merely goes along for the ride. The tip tanks, like the forward fuselage, are not load carrying structures, they are little more than fiberglass shells.

The flying surfaces are typical polystyrene foam covered with a 1/16" balsa veneer. If you have limited experience with foam surfaces, I recommend that you read *Foam Wings* in the RCM Anthology series. The wing halves are joined with two 1/8" plywood spars that also serve to carry the main landing gear mounts.

The wing is removable from the fuselage giving ample access to all radio, fuel tank, and retractable landing gear components. The engine access is provided through hatches on the upper halves of the nacelles, and the elevator servo is reached by removing the fin cap. The tip tanks detach from the wing for ease of transportation.

All fiberglass components as well as foam cores and vacuum formed parts will be available on a custom order basis from Dave Hyatt, Hyatt-Tech, Marchwood Shopping Center, Exton, Pennsylvania 19341, or phone (215) 524-7244. Look for the ad in this magazine under Hyatt Hobbies or call for a price quote.

Fuselage and Nacelle

Begin by making templates of all fuselage bulkheads, nacelle bulkheads, and the fan bearing parts. Roughly cut the parts patterns from the plans and glue them to posterboard with rubber cement. Then carefully cut each template to its exact outline with a sharp X-Acto knife. Trace the part onto the appropriate material and jigsaw the part to the proper outline. Notice that the plan shows one half of the bulkhead shape so that a right and left tracing must be made on the bulkhead centerline. I feel that this technique helps insure symmetry of the part.

Cut the wing belly pan from the aft fuselage and remove the root airfoil section. The belly pan is set aside; it will be attached to the lower surface of the wing later. This operation is best accomplished with a Dremel saw wheel. Also cut the nacelle hatches and the nosegear well from the belly of the forward fuselage. The nosegear well is a 4" wide, 8¾" long rectangle which begins 1⅛" aft of the F1 location. Trial fit all bulkheads in place. The front face of each should align with the etched mark on the fiberglass.

After obtaining a good fit, remove all bulkheads and prepare the thrust bulkheads, F9 and F10, for the fan bearer rings. Tack glue the fan ring stems in position on the face of F9 and F10. Drill through the stem of the fan rings and the bulkheads to receive 6-32 socket head bolts and blind nuts. After mounting the blind nuts on the rear sides of F10 and F9, remove the fan rings and prepare to epoxy all bulkheads in place.

Rough the inner surface of the fuselage and nacelle with 80 grit sandpaper at all points where the bulkheads will contact the skin. Epoxy F12 in position first. Working forward, glue each bulkhead in place up to F6.

On the forward fuselage start with F1 and work aft to F6 (Note: There is an F6 at the end of the forward fuselage, and an identical F6 at the beginning of the aft fuselage — these

identical bulkheads assure that the forward fuselage will slip into the aft fuselage when they are joined later in the assembly.)

After the bulkheads have cured, cut 1/4" x 1" slots in the fiberglass skin for the fan bearer rings to slide into position on the forward face of F9 and F10. Bolt these rings in place with 6-32 socket head bolts using a long ball driver. Tack glue the 1/4" plywood fan bearers in place between the forward and rear fan bearer rings. If you intend to use the Jet Model Products Dynamax Fan, the fan bearers should be placed 1/4" below the ring centerline (since the fan mounting tabs are located 1/4" below the fan shroud centerline).

The fan should carry 1° of down thrust (i.e., the tailpipe is canted down by 1°). This can be checked by placing the aft fuselage assembly upright on a level, flat surface. Using a carpenter's angle finder or a Robart Incidence Meter, each fan bearer should be 1° from vertical.

Once the correct alignment is achieved, the bearers can be epoxied to the rings, and reinforced with 1/4" triangular stock.

Temporarily mount the fan shrouds to the fan bearers with 6-32 socket head bolts and blind nuts. The shrouds should be aligned so that their vertical centerline is parallel to the fuselage seam (i.e., 0° side thrust).

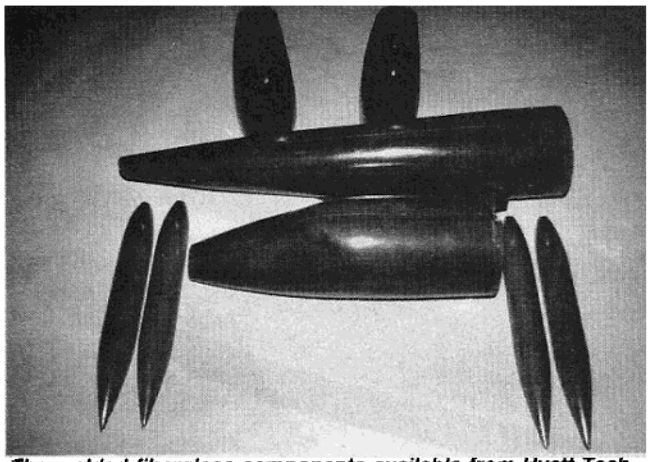
Glue nacelle bulkhead N1, N2, and N3 in position in each nacelle. Then cut 1/4" x 1½" slots on the inboard side of each nacelle at the N2 and N3 positions to allow the nacelle to slide in position on the engine bearer ring stems. Trial fit both nacelles using the centerlines and thrust lines of N2 and N3. Once satisfied with this alignment, you can epoxy the surfaces of N2 and N3 to the forward and rear engine bearer rings.

Cut the tailpipes from 1/64" plywood. The tailpipe template shown on the plans is drawn slightly oversized to allow the tailpipe to be trimmed to the exact size as it is fit in place. Tape the tailpipe around the shroud and allow the exhaust end to form a circle conforming to the shape of the nacelle exit. Carefully mark the tailpipe to reflect the end of the nacelle and the line where the tailpipe tube overlaps itself. Remove the tailpipe and cut away the portion that extends outside of the nacelle as well as the portion that overlapped. Glue the long edges of the tailpipe together with a 1/2" strip of 1/64" plywood which laps on top of the seam.

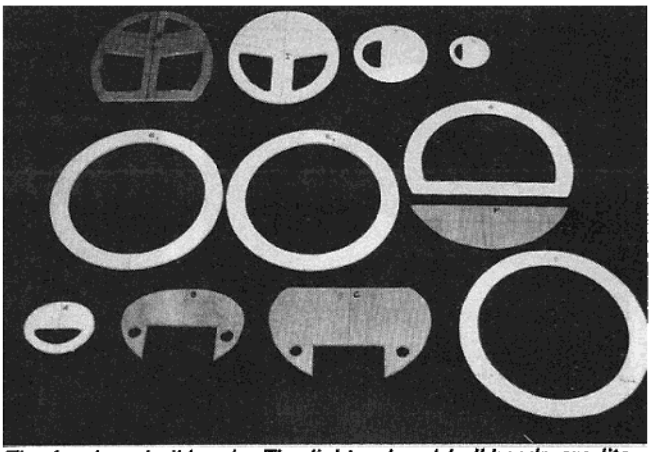
Remove the shroud and the tailpipe from the nacelle, and tape the tailpipe around the shroud again. Mark the position where the hatch flanges TP1, TP2, TP3, and TP4 are located, and carefully glue them in position with a CA glue such as Flex Zap. Be sure to leave a 1/64" gap between these flanges since a razor saw must slip between them to cut the hatch away from the tailpipe. A fiberglass cylinder head cap, which is available from Jet Model Products, 304 Silvertop, Raymore, Missouri 64083, or phone (816) 331-0356, is epoxied in position on the hatch to seal the gap where the tailpipe clears the cylinder head. The tailpipe hatch is secured to the tailpipe with 3/4" 2-56 socket head

LEARJET 35A

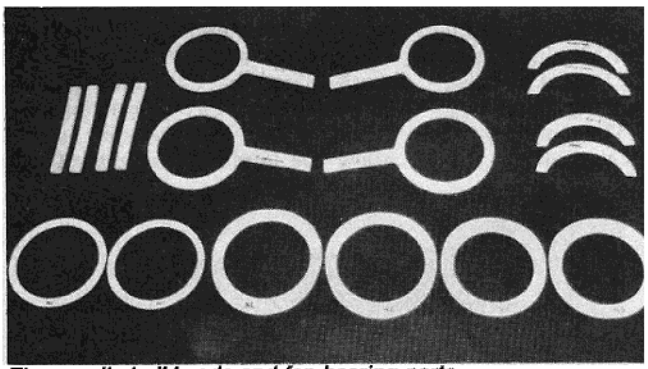
Designed By:
Mark Frankel
TYPE AIRCRAFT
1/6th Scale
WINGSPAN
76½ Inches
(83½" w/tip tanks)
WING CHORD
18½" Root; 11¾" Tip
TOTAL WING AREA
1157 Sq. In. (Approx.)
WING LOCATION
Low Wing
AIRFOIL
Symmetrical
WING PLANFORM
Swept-Tapered L/E
DIHEDRAL EACH TIP
1⅞ Inch
OVERALL FUSELAGE LENGTH
92½ Inches
RADIO COMPARTMENT SIZE
Ample
STABILIZER SPAN
29½ Inches
STABILIZER CHORD (inc. elev.)
7¼ Inches (Avg.)
STABILIZER AREA
216 Sq. In. (Approx.)
STAB AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Top of Fin
VERTICAL FIN HEIGHT
11½ Inches
VERTICAL FIN WIDTH (inc. rud.)
13½ Inches (Avg.)
REC. ENGINE SIZE
(2) .65 w/fan units
FUEL TANK SIZE
(2) 24 oz.
LANDING GEAR
Tricycle
REC. NO. OF CHANNELS
6 (min.)
CONTROL FUNCTIONS
Rud., Elev., Ail., Throt., Flaps, Ret.
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Fiberglass, Balsa & Ply
Wing ..... Foam & Balsa
Empennage ..... Foam & Balsa
Weight, Ready To Fly 456 Ozs.(28 Lbs. 8 Oz.)
Wing Loading ..... 55 Oz./Sq. Ft.



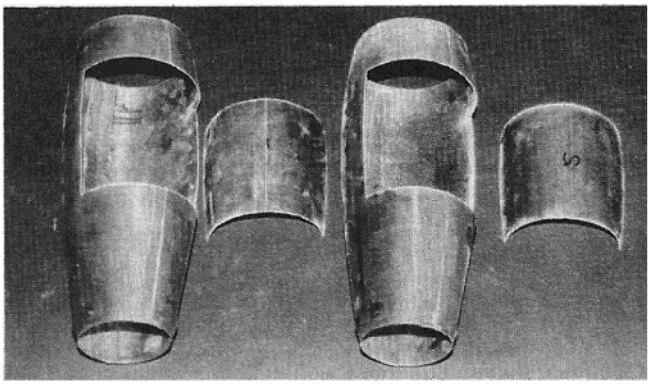
The molded fiberglass components available from Hyatt-Tech, Marchwood Shopping Center, Exton, Pennsylvania 19341, (215) 524-7244, consists of: 2 nacelles, 2 tip tanks, and the forward and aft fuselage sections.



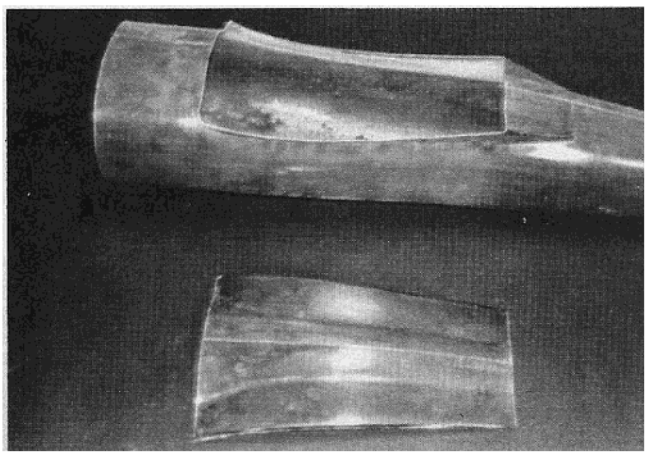
The fuselage bulkheads. The light colored bulkheads are lite plywood, while the dark bulkheads are hard aircraft plywood.



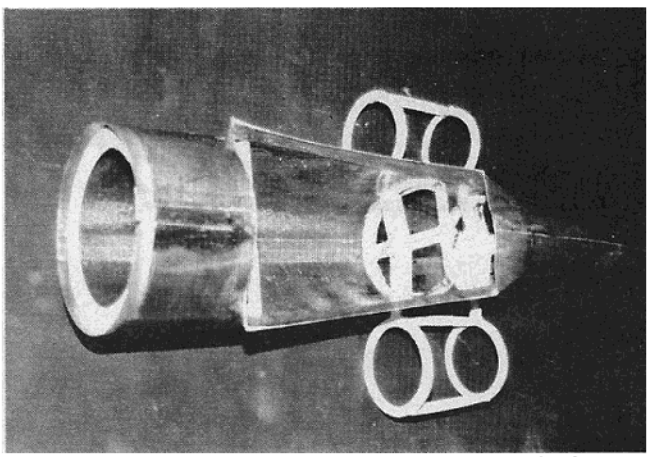
The nacelle bulkheads and fan bearing parts.



The fiberglass engine nacelle with the hatch section removed.



The belly pan removed from the aft fuselage section.

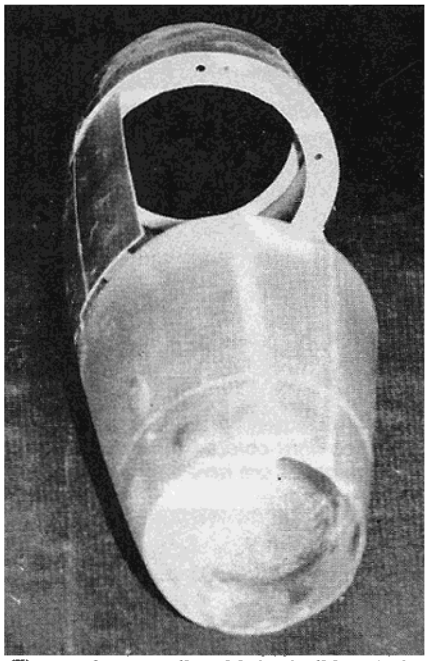


The bulkheads in place in the aft fuselage with the engine bearer rings bolted to F9 and F10.

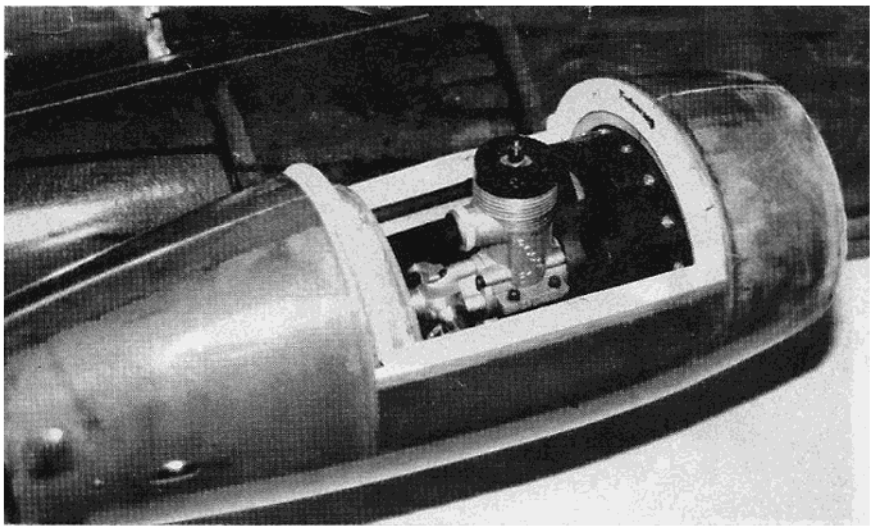
bolts and blind nuts which pass through the flanges.

Clear coat the tailpipe with K & B Super Poxy to protect it from fuel seepage. Then slide the tailpipe, with the hatch removed, through the nacelle inlet until it seats in position. Reinstall the fan shroud, add the tailpipe hatch, and glue the tailpipe to the nacelle assembly at the exhaust nozzle where the tailpipe should fit snug against the nacelle, and at the point where it passes through the rear fan bearing ring and N3.

Remove the tailpipe hatch and fan shroud and lightly tack glue the nacelle hatch former, H1, in position behind the forward fan bearing ring. Do the same to H2 in front of the rear fan bearing ring. The intention is to temporarily hold these formers in position while the hatch skin is fit. Ultimately, these formers will be permanently glued to the hatch skin and broken away from the fan bearing rings. Before attaching the hatch skin, drill through H1 and the forward fan ring to accept 2¼" x 3/4" hardwood dowels which align the hatch assembly. Add 1/8" x 1/4" plywood strips to form the base edge of the hatch. There should be an upper strip which is glued between the bases of H1 and H2 on the right and left side, and a lower strip which remains with the nacelle helping to maintain its shape. It is a good idea to place a layer of waxed paper between the upper and lower strips so that they do not adhere to each other when they are being glued in place. Now glue the hatch skin to H1, H2, and the upper base strips being careful that the hatch is not being glued to a permanent portion of the nacelle. When the hatch



The engine nacelle with its bulkheads in place, and slots cut to clear the bearer ring stems.

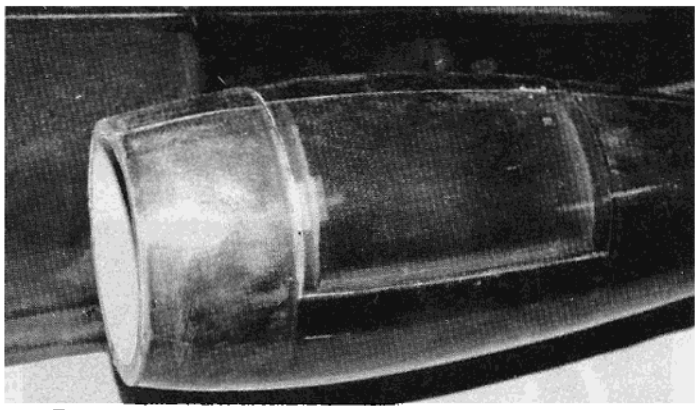


The nacelle in place with the engine and tailpipe in position. The hatch frames have been tack glued in place to receive the hatch skin.

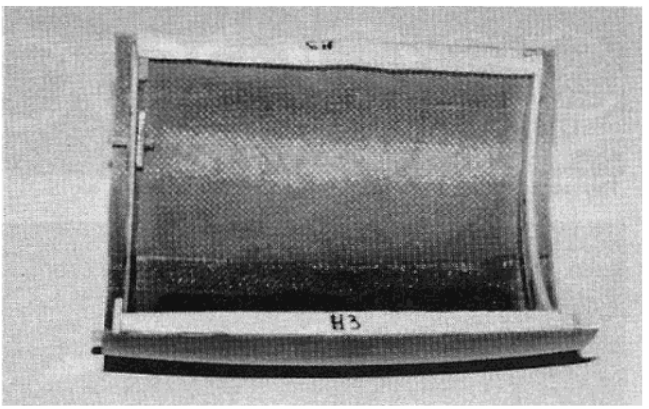
skin and the nacelle skin.

Install the 1/4" balsa pylon ribs on the stems of the fan bearing rings. Sheet the pylon with 1/16" x 4" balsa starting at the trailing edge and working forward. The balsa gain should run spanwise so that you will

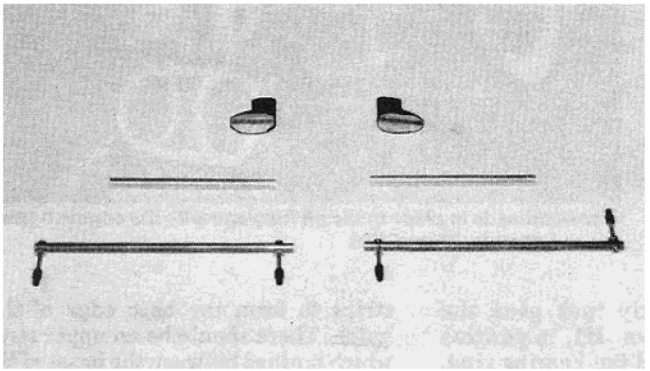
templates on the wing core with 1" common nails, and cut the spar slots and main gear well with a piece of 1/8" copper wire heated in a soldering gun. Remove foam from the lower surface of the core between the spar slots to allow the landing gear mount to be

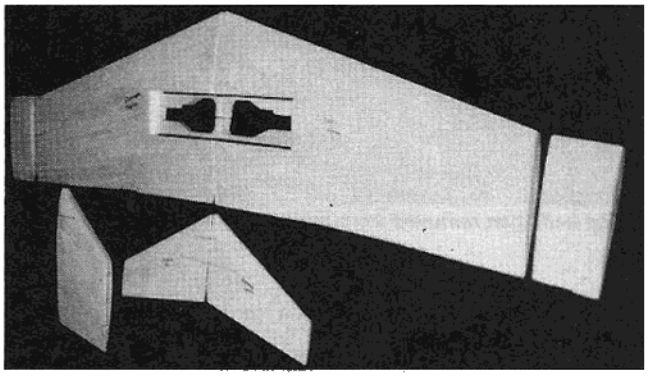


The hatch skin being applied to the hatch frame.



The inside of the nacelle hatch with the frame in place.





LEFT, TOP: Tuned pipe mount which will be epoxied to a slot in the tailpipe to support the aft end of the tuned pipe. MIDDLE: Outer case of the throttle torque rod which passes through the fuselage, nacelle, and tailpipe. BOTTOM: The throttle torque rod made up of 4-40 bolts and ball links. Assemble this after the rod is in position in the fuselage and nacelle. RIGHT: The foam cores with the spar cut-outs and landing gear well cut.

skin has cured to the hatch frame, it can be removed and set aside.

Throttle pushrod linkages should be fabricated at this point, and the fuel lines and pressure lines should be fed through 1/4" o.d. aluminum tubing which passes through the fuselage

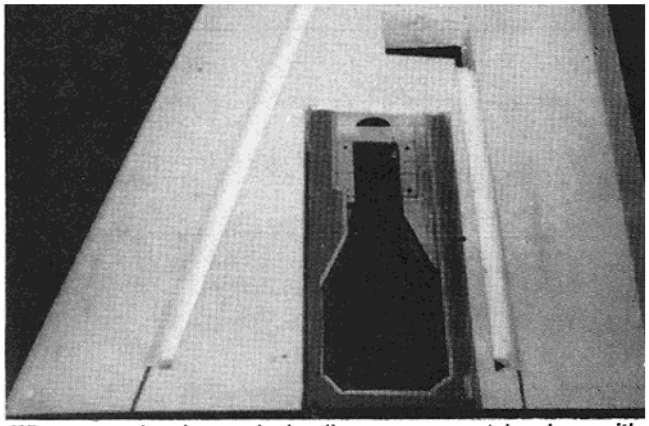
be fitting a series of 4" planks in position until the entire upper and lower pylon surface is covered.

Wing and Tail

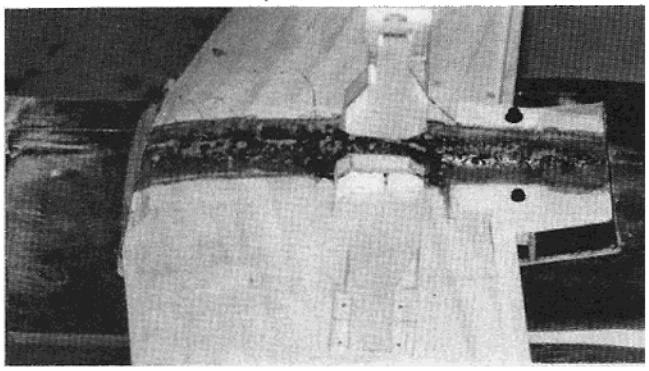
Make the templates used to cut the wing spar slots and main landing gear wells from 1/8" lite ply. Position the

recessed to a depth equal to the airfoil chord line. Cut the aileron and flap servo bays, and form a groove for the flap and aileron cables.

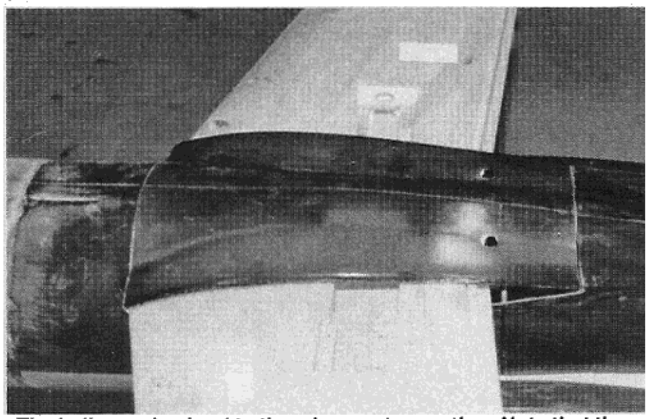
Glue the 1/8" balsa sub-leading edge and trailing edge stock to the wing cores. Epoxy the outer wing panel to



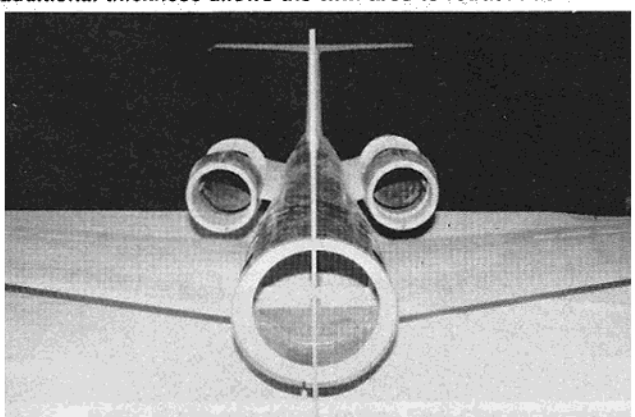
Wing core showing main landing gear mount in place with aileron and flap extension cable grooves. The dark material above the landing gear mount is urethane foam sanded to conform to the airfoil shape.



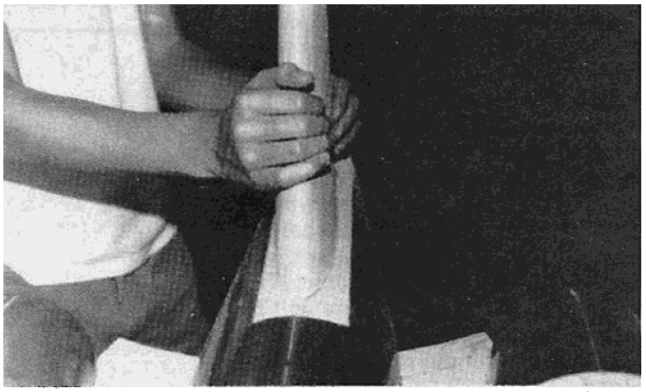
The wing is mounted on the fuselage in preparation for the belly pan.



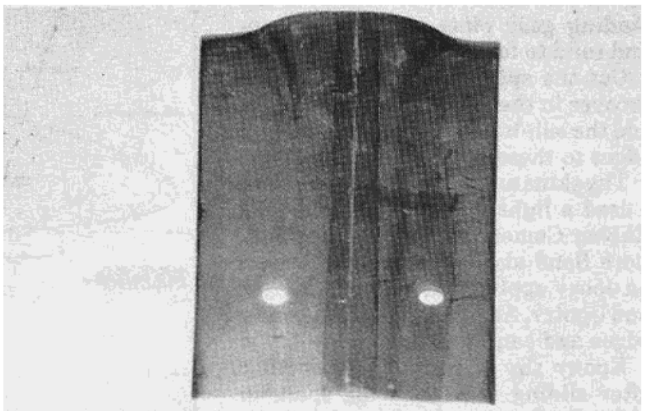
The belly pan is glued to the wing center section. Note that there is a "step" at the point the pan meets the wing surface. This additional thickness allows the twin tires to retract flush.



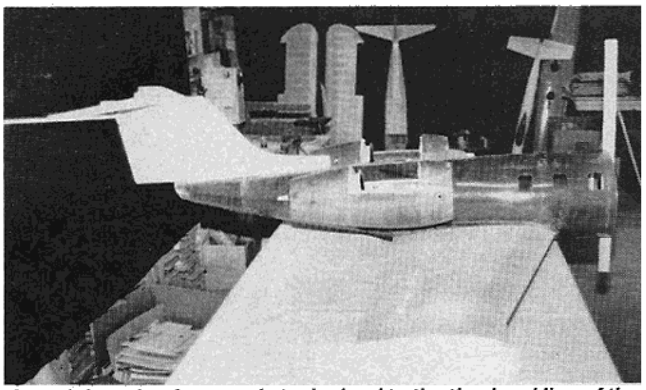
A head on view of the aft fuselage mated to the wing. Note that the fin is aligned with the vertical reference strip.



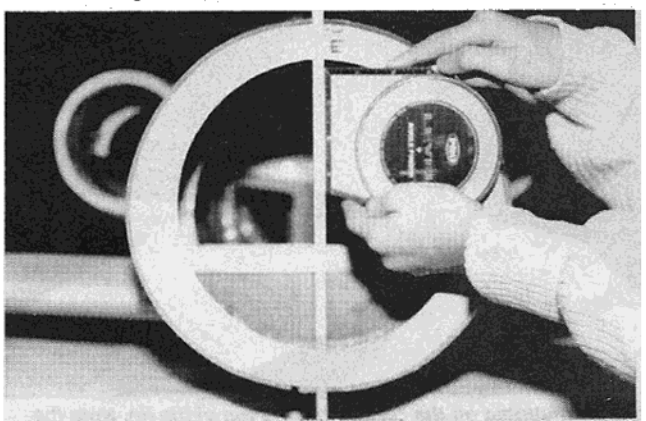
Before adding the fin spar, the fin base can be sanded to conform to the shape of the fuselage by gluing sandpaper to the fuselage top and passing the fin base over it.



The belly pan is trimmed to fit on the wing center section. The holes provide clearance for wing mounting bolts.



A straight strip of spruce is tack glued to the tip chord line of the stab to provide a horizontal reference as with the 1/8" balsa planks that are tack glued to the tip chord line of the wing. This allows for alignment of the wing when mating it to the fuselage.



The fuselage reference should be perfectly vertical when the fuselage is properly mated to the wings.

the inner panel, and sand the wing root so that the panels can be joined with 2½° of dihedral (1⅞" at the wing tip).

Drill the landing gear mount for 6-32 bolts and add blind nuts to the surface that will be epoxied to the wing. Epoxy the landing gear mount to the foam, and add 1/16" plywood sub-spars to each spar slot where it comes in contact with the front and rear of the landing gear mount. The full length 1/8" plywood spars will be epoxied to these 1/16" sub-spars at a later stage when the wing halves are joined.

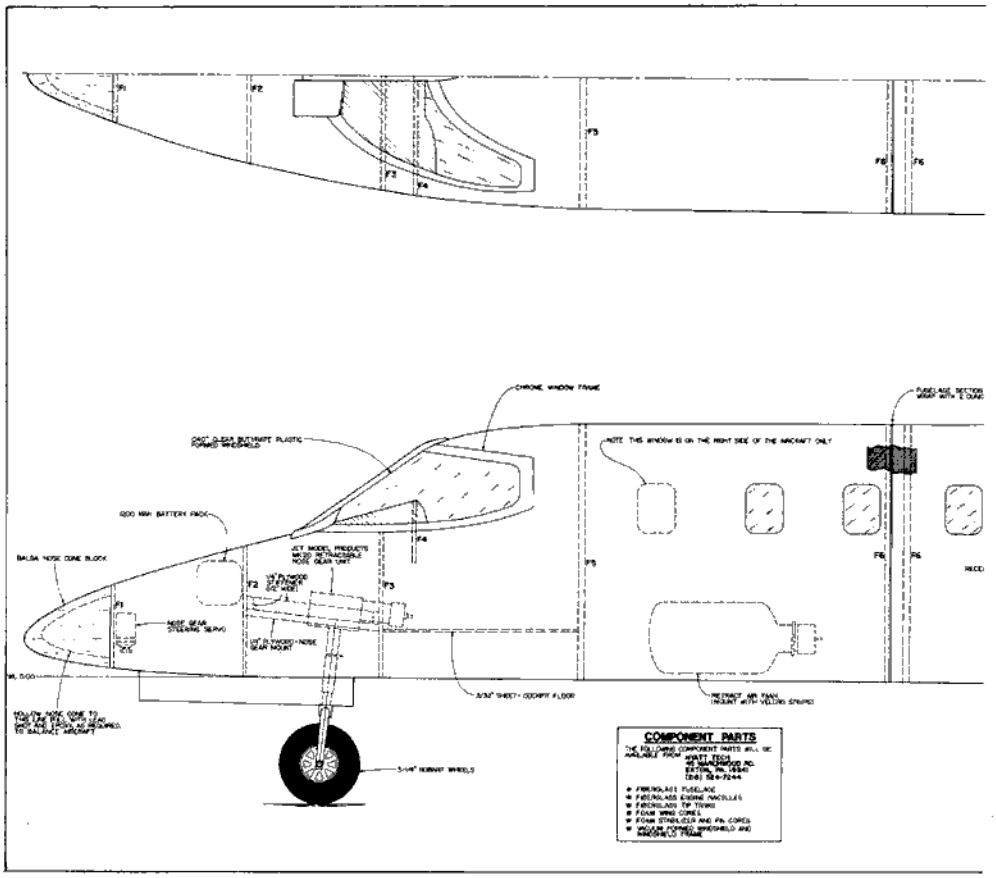
Prepare the wing and tail skins from lightweight (contest grade) 1/16" balsa. Fill in the lower surface of the landing gear plate with scrap foam and sand to follow the airfoil contour.

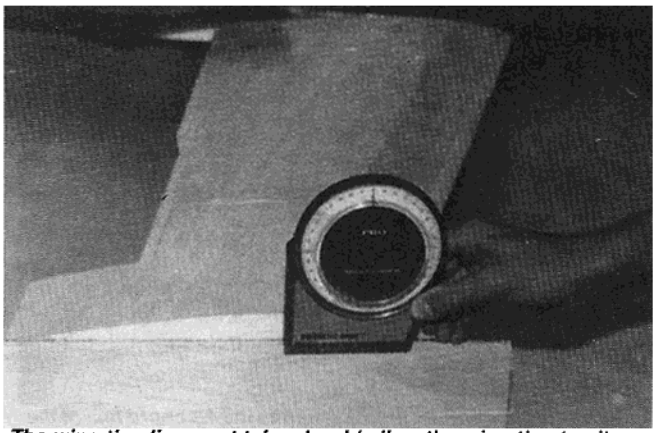
Cut the spar slots and servo cable grooves in the fin and stab cores. Also add the sub-leading edges and trailing edges to these components.

The skins are now glued to the cores. I used a light application of Carter's Rubber Cement as an adhesive; Sig's Core Bond also works well; however, an epoxy application may be stronger and lighter. Add the 1/2" balsa leading edges and sand to shape.

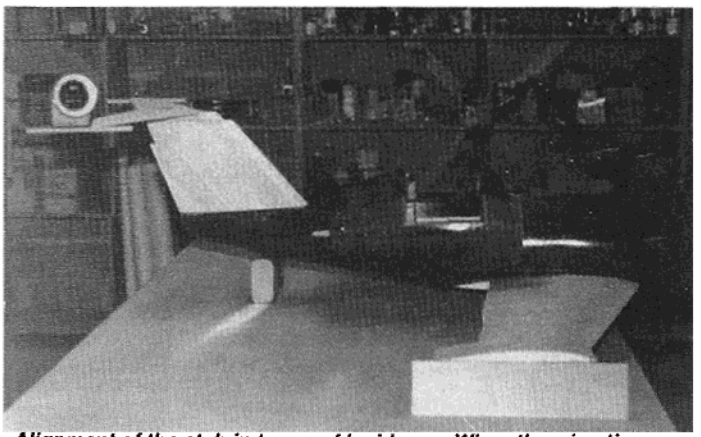
Epoxy the wing halves together after sliding the 1/8" wing spars in place. Do the same for the stab halves.

COMPLETE SET OF PLANS INCLUDES 4 FULL SIZE SHEETS

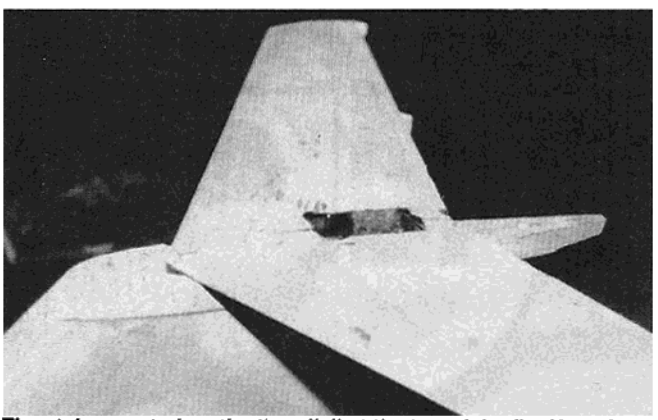




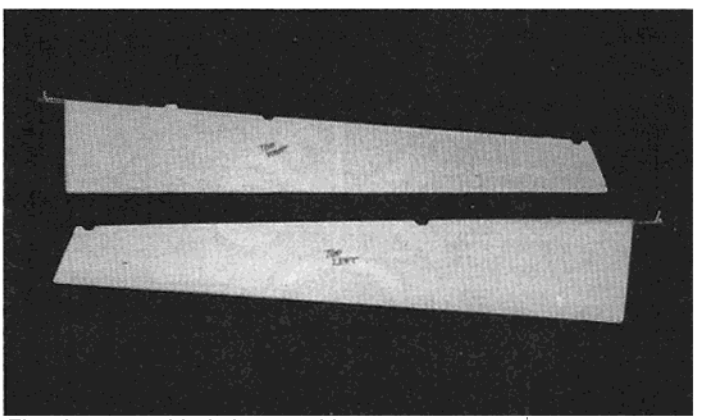
The wing tip alignment tabs should allow the wing tips to sit on the workbench at 0° incidence.



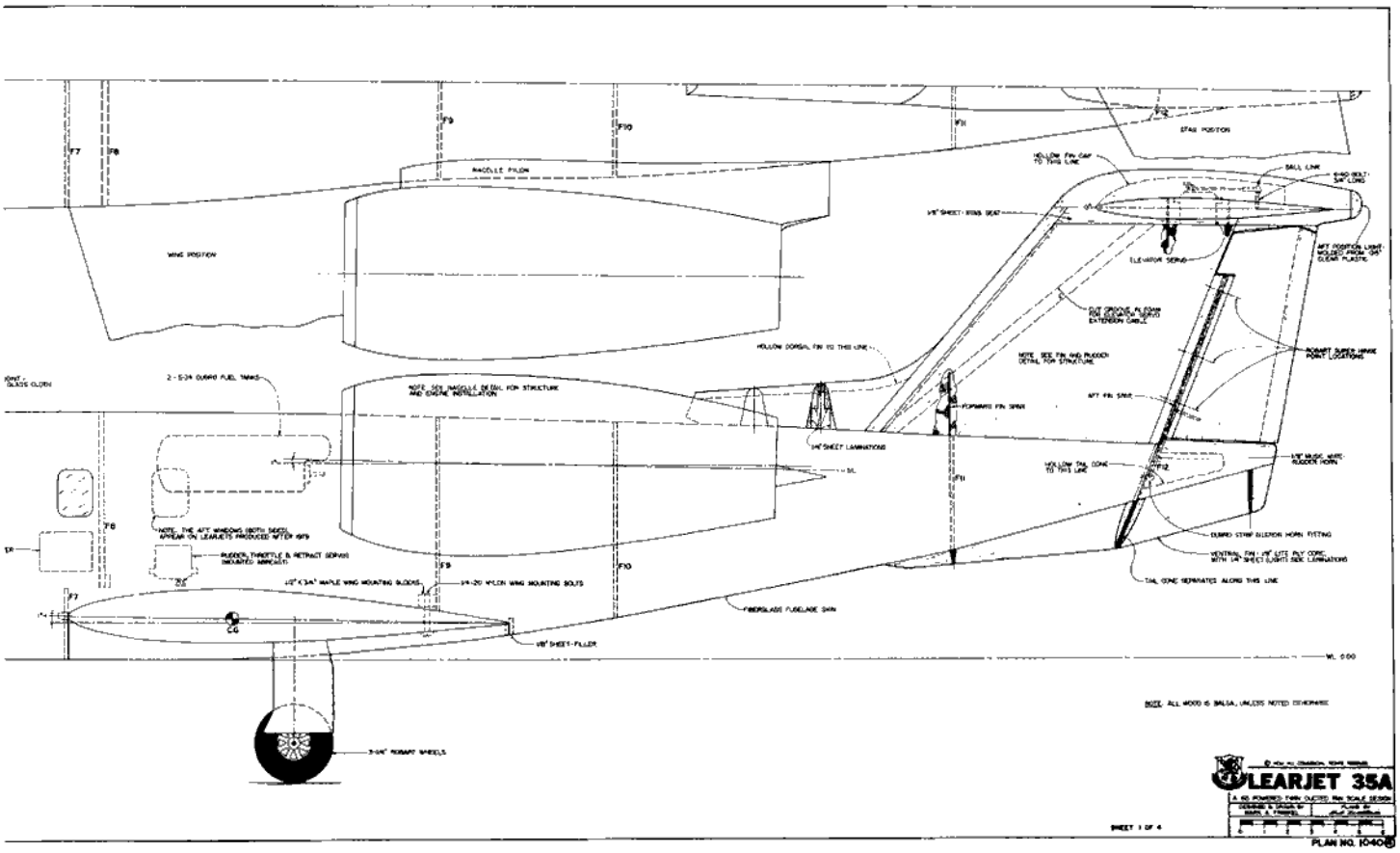
Alignment of the stab in terms of incidence. When the wing tips are jigged to 0°, the stab should be at −1°.

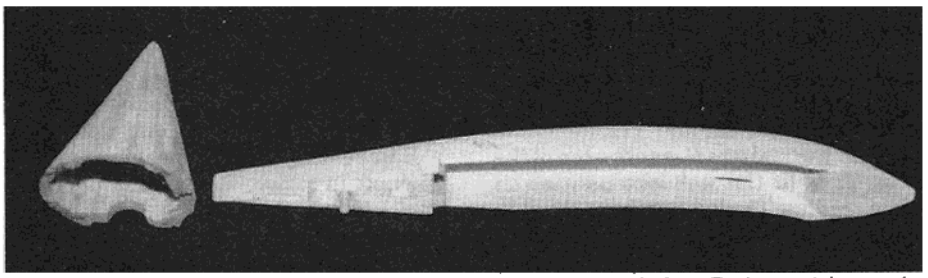


The stab mounted on the "cradle" at the top of the fin. Note the cut-out for the elevator servo.

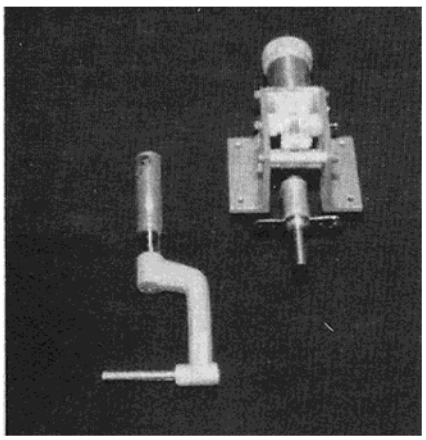


The elevators with their control horns epoxied in place.





The fin cap and tail cone carved from laminated light balsa. Both must be made removable from the airframe to permit adjustment of the elevators and rudder.



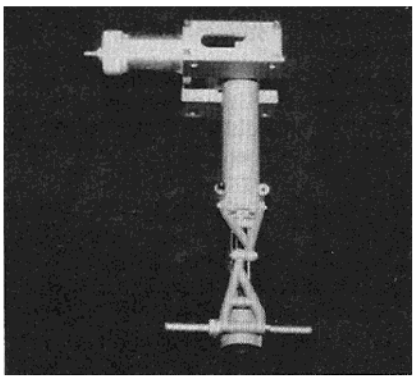
Jet Model Products nose gear unit with a custom made nose gear strut. The upper strut is 1/2" aluminum tubing. The lower strut is aluminum rod. The yoke portion is formed from P.I.C. epoxy putty over a 3/16" wire core. This strut is not shock absorbing.

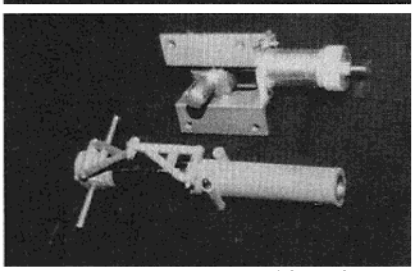
The ailerons and flaps are cut from the wing, the elevators are cut from the stab, and the rudder is cut from the fin. Each control surface is faced with the proper balsa strip. For instance, the flap leading edge facing is 1/2" balsa, the corresponding surface on the wing is 3/8" balsa. Be sure that the surfaces are cut to allow for these thicknesses of the facings.

Epoxy the forward plywood spar to the fin, and cut a slot above F11 to allow this spar to slip into position. The rear fin spar is epoxied in place after the fin has been glued to the top of the fuselage.

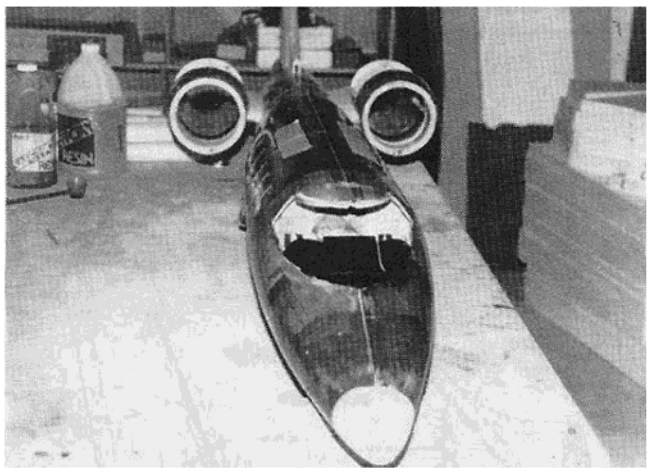
Mating of Wing and Tail to Aft Fuselage

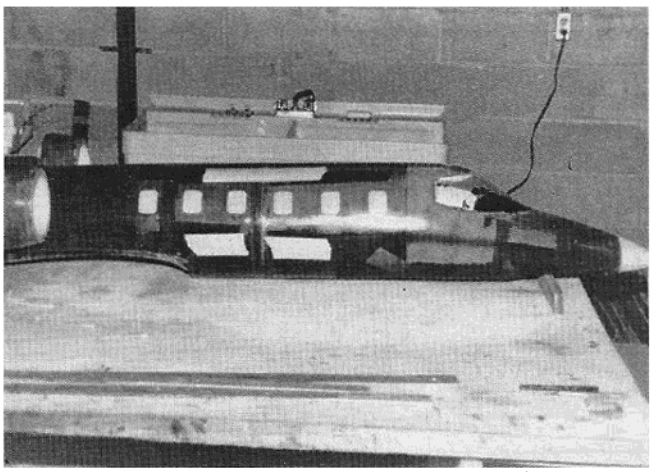
Place the aft fuselage on your workbench and temporarily tack glue a 1/4" strip of balsa to the face of F6 so that it is aligned with the upper and lower seams of the fuselage. This strip will act as a vertical reference line



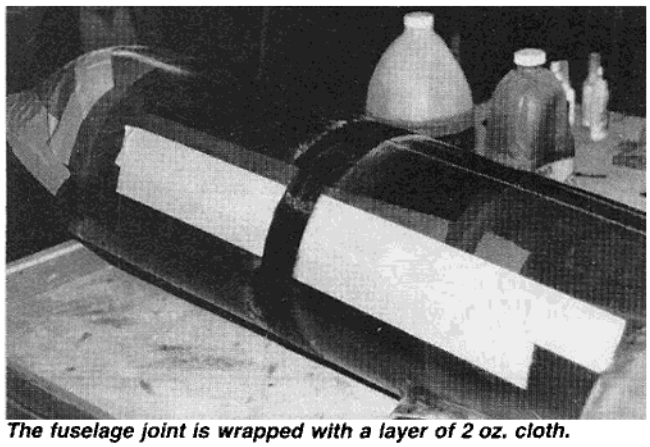


Jet Model Products retractable main gear unit with a Byron Originals strut. The strut is modified from the Byron nose gear strut by cutting it to the proper length, inserting a brass bushing in the upper strut to seat on the retract pivot block, and adding a 3/16" axle through the base of the lower strut.

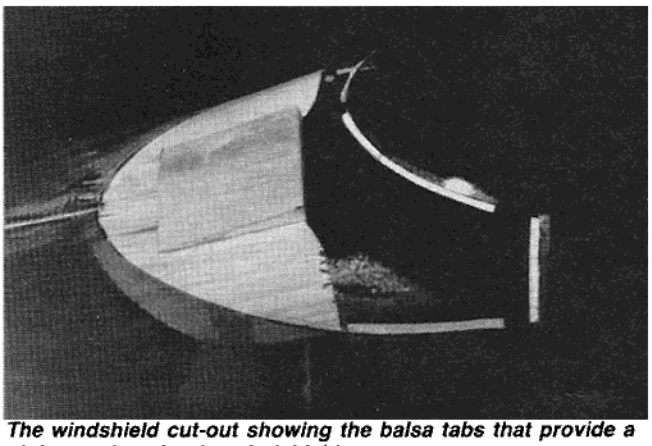




Forward fuselage is epoxied to aft fuselage. The two sections are aligned along the center seam, and the roof and belly lines from the side view.



The fuselage joint is wrapped with a layer of 2 oz. cloth.



The windshield cut-out showing the balsa tabs that provide a gluing surface for the windshield.

that is used to align the fin. The fuselage should be blocked so that the 1/4" strip is perfectly vertical. Use an angle finder to be sure that the fuselage is properly seated on your bench.

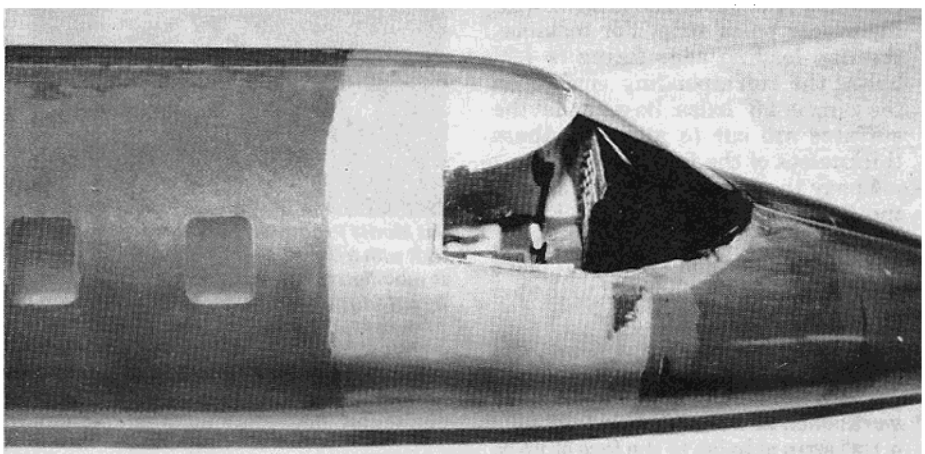
Epoxy the fin to the top of the fuselage being certain that the fin spar is glued to F11. Since the Learjet is a "T" tailed aircraft, this joint will carry all the loads of the horizontal and vertical surfaces. When cured, add the aft fin spar which is epoxied to the rear of the fin and F12.

Add the stab cradles to the top of the fin. Trial fit the stab into position on the cradles. The lower tabs of the stab spars slip into slots cut in the top of the fin core. The stab should rest perpendicular to the fin when it is properly aligned.

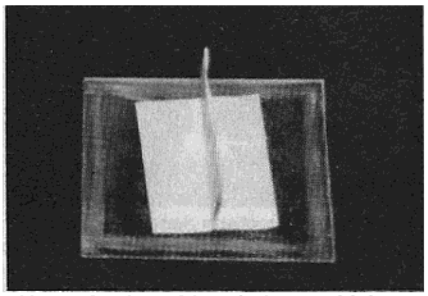
Tack glue 1/4" strip to the stab tips which are aligned with the stab chord line. These strips, like the fuselage vertical strip, are used as reference lines to measure the stab incidence.

Before the stab is permanently epoxied in place, it is necessary to attach the wing to the fuselage. This is accomplished by fitting two 1/4" hardwood dowels in the wing leading edge. These dowels pass through F-7. The wing is bolted in place with two 1/4-20 nylon bolts which thread into a hardwood block that is epoxied to the base of F-9.

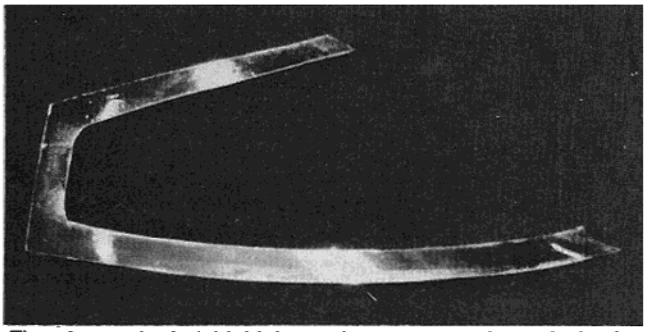
To assure alignment of the wing, be certain that the wing center joint tracks the line made by the fuselage seam. Lateral alignment can be checked by tack gluing a 3" x 18" sheet of 1/8" balsa to each wing tip.



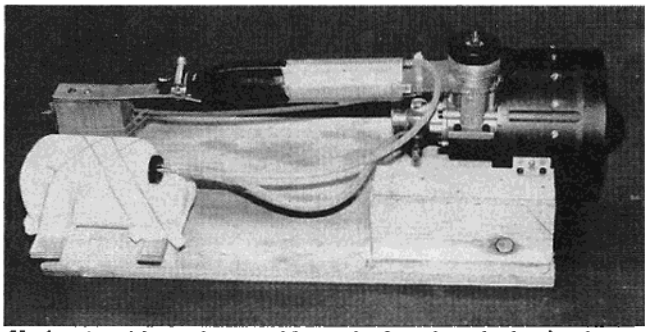
The windshield is glued in place on a balsa lip after the cockpit detail has been added.



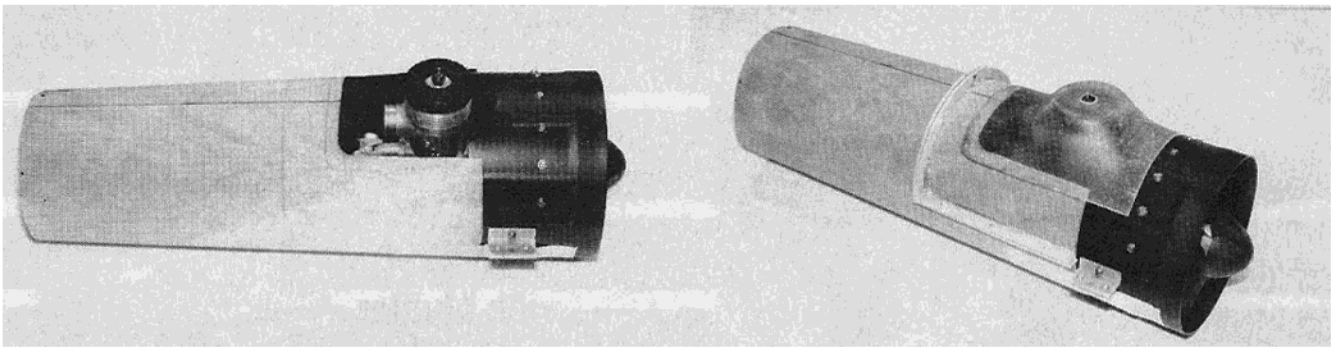
Clear plastic cabin windows which are sanded at the edges and are glued to the inside of the fuselage. The masking tape tab allows the window to be held in place.



The chromed windshield frame from vacuum formed plastic. This is added after the painting operations are complete.

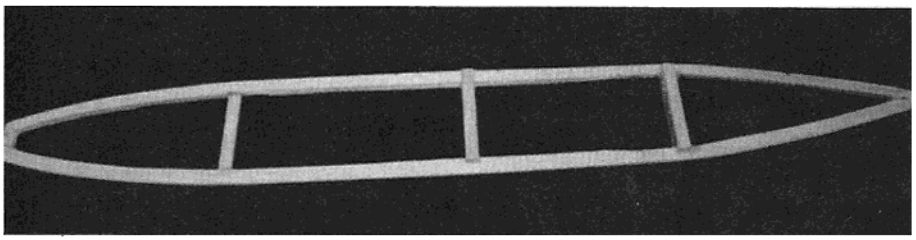


Mark set up his engines and fan units for a bench checkout run. Can save many hours later.



1/64" plywood tailpipe with the center joint complete.

The fiberglass cylinder head cap glued in place along with the 1/8" plywood flanges.



1/4" balsa wing tip tank crutch.

The balsa sheet is aligned with the wing tip chord line. These act as "feet" to support the wing on the workbench. Since each wing tip is now exactly 2" above the work surface, it can be assumed that the wing is horizontally aligned. The fuselage, therefore, should also be aligned. This can be checked by measuring the strip on the face of F-6 which, again, should be vertical. The 2" balsa "feet" also provide a reference for the wing incidence. Since the wing is cut with 2° of washout, the wing root is now at +2° with the tips parallel to the workbench, or 0°. The stab should be set at −1° (leading edge down). This is measured with the angle finder placed on the 1/4" strips glued to the stab tips. The stab spar tabs can be moved in their fin slots to obtain this −1° setting when the proper alignment is achieved, the stab is epoxied in place.

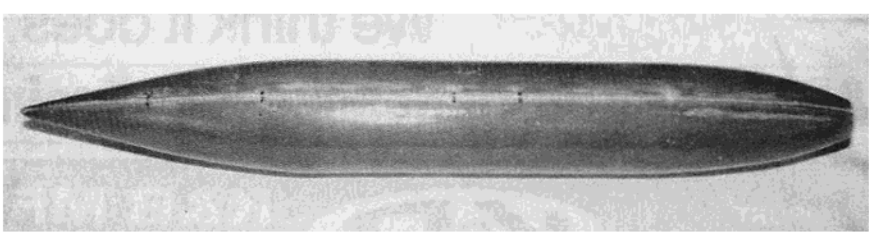
The elevators and rudder are temporarily hinged after their control horns are epoxied in position. The fin cap and the fuselage tail cone are shaped from laminations of 1/2" and 1/4" balsa. Each is hollowed to the dotted lines on the planes. The fin cap must be removable to adjust the elevator linkage and service the elevator servo. The fuselage tail cone also can be made removable to adjust the rudder linkage.

The Forward Fuselage

Cut out the window and windshield openings. The fuselage shows four left and five right side window positions; however, later Lear 35's have one additional window on each side. Determine the window configuration of the aircraft you are modeling, and remove the windows with a Dremel saw wheel. It is easiest to cut the window 1/16" undersized, than sand to the exact window line with 80 grit paper. The windshield opening is cut in a similar fashion.

Cockpit detail should be added at this point. The cockpit interior is painted white before adding the floor and dash panel. The area forward of F-4 is sheeted with 1/16" balsa and painted flat black. A lip to retain the windshield is made from 1/4" x 1/16" balsa strips that are glued to the inside of the fuselage skin leaving approximately 1/8" exposed in the windshield opening. This 1/8" area is the surface to which the clear windshield is glued with Wilhold® R/C 56 adhesive. The remaining cabin windows, which are cut from .040 clear plastic sheet, are glued in place after the airframe is painted.

The forward fuselage is epoxied to the aft fuselage. The joint is wrapped with a strip of 2 oz. fiberglass cloth. I wrapped the outer surface; however, the joint may be easier to hide if you wrap the interior. Be sure that the forward fuselage aligns with the aft by sighting for a straight line along the center seam. Also be sure that the roof line and belly line are straight in the side view.



The tip tank skins joined on the 1/4" balsa crutch.

The nose cone is formed like the tail cone from laminations of 1/2" and 1/4" balsa. It is hollowed to receive lead weight for the proper Center of Gravity.

Assembly Prior to Painting

Bolt the wing in place, and fit the belly pan to the lower surface of the wing. The outer edges of the belly pan do not lie flush on the wing skin, rather there is a step of approximately 1/4". This step is needed to contain the main gear tires when retracted. Cut the inner gear door from the belly pan, and line the gear wells with 1/32" balsa.

My current model uses Jet Model Products retracts, with Byron main gear struts. This system has been completely trouble-free, and looks very authentic. My first two Learjets used Dave Platt Competition Series landing gear with struts made from 1/2" aluminum tubing and aluminum rod. This system also was very dependable. Both types of landing gear are extremely durable and surprisingly light.

The 1/4" plywood nosegear mount is epoxied between F2 and F3. The glue joints are reinforced with 6 oz. fiberglass cloth. The nosegear doors are formed from the fuselage skin that was cut away to open the nosegear well. Sonic-Tronics Hidden Hinges (part number 130) were used for the nosegear doors. The doors are actuated by a light rubber band mounted between the doors, which is struck by the nosegear leg as it travels upward.

The nacelle inlet lips are formed from 1/2" balsa laminated to a 1/8" plywood N1 (note that one N1 remains at the front of each nacelle, while another N1 forms the backing of the inlet lip). The lip is tack glued in position, and carved to shape. Then it is removed from the nacelle and finished with 2 oz. glass cloth saturated with epoxy. The lip is then carefully sanded and primed.

The wing tip tanks are formed around a 1/4" balsa crutch shown on the plans. One skin is glued to the crutch leaving 1/2 of the wood area exposed (1/8"). When dry, the second skin is glued so that both skins meet at the center of the crutch. Hardwood 1/4" dowels are used to position the tip tanks in place. These plug into aluminum tubes that are imbedded in the wing core. The wing tip tank centerline should follow the tip chord line so that the tanks are canted 2° down when compared to the wing root.

The next installment (Part III) will cover: painting; radio and engine installation; weight and balance checks; flight test; and future considerations. □

From RCModeler Apr. 1989