OSPREY AIRCRAFT

Dear GP-4 Plan Holder:

The following building instructions cover drawings #2 through #57.

All of the flight testing has been completed, and through 155 flight hours the systems are working quite well. The design is frozen and no major modifications are anticipated.

The engine drawings are predicated on the Lycoming IO 360-A1A. Any of the IO 360 (200HP) series is fine providing that the servo injection unit mount on the forward side of the oil sump. Rear-mounted servos can be modified by changing the oil sump and the intake induction tubes on any of the IO 360 series engines. If you intend to use a different engine than that mentioned, you can expect problems in weight and balance as well as possible fitting problems if the engine is carbureted.

I suggest that you get started on your project even if the plans seem confusing on first study. Things seem to fall into place once you see some progress on your work table.

Should you need help, don't hesitate to call me. The best time is between 7 and 9 p.m. Pacific Time. Have your plans by the phone. A self addressed stamped envelope helps, should you write.

Thank you for your interest in the GP-4. I hope your project proves to be as enjoyable and rewarding as mine was for me.

Sincerely,

George Pereira

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DRAWING #2 : The Fuselage

It is important to take a little extra time and thought in constructing your work table. All of your wood construction is built on this table. It should be placed in your shop with access to all sides and still leave room for your power tools.

The 4ft.x24ft. frame should be 2x4 or 2x6 lumber with 2x4 cross members spaced about 32" apart. Five sets of legs are 2x4 lumber with a 1x4 cross member about 8" above the floor. This gives you convenient lumber storage under your table. Use white construction glue when nailing the frame, legs, etc. together.

The table top should be 4'x8'x3/4" thick plywood, finished good on one side. Do not use particle board. Three sheets are required. A cross member is neccessary under the two joints. The top must be screwed to the frame and cross members, using flush wood screws. Wedges can be used under legs to plumb the frame. Thin shims may also be used under the ply for a level top.

GENERAL:

Scarf joints in all aircraft ply and spruce structure should be 10 to 1 unless otherwise specified. For example, in order to join 1/16" thick ply, each side is beveled 10/16" or 5/8". A 1/2" thick piece of lumber must be beveled 5" on each side.

All scarfing should be done prior to assembly.

GLUE:

Two types of wood glue were used on the prototype and are recommended. All spar laminations used Hughes FPL-16A.

Hughes was also used in gluing wing and tail skins to structure.

Hughes is a 10 to 1 mix epoxy. It is important to shake the can prior to mixing and 70°F to 80°F at the glue joint is ideal. Below 70° may cause a weak joint. Drying time can be accelerated with a heat lamp. Working time at 75°F is about 45 minutes. Hughes is a white glue and dries white.

The other glue used is T-88 epoxy. It's a 50/50 mix and will dry as low as 65°F. It is ideal for small jobs as it comes in a squeeze bottle and small amounts are easily mixed. It drys clear and was used in the cabin area to glue the ply and structure together. Working time is around 30 minutes at 75°F. Both Hughes and T-88 were specially formulated for wood.

Cover the table with brown or white wrapping paper. Use masking tape to hold down edges.

To transfer the fuselage side from drawing #2 to the paper, start with a straight line about 180" long. It should be 25" from the working edge of the table.

Cut and taper longerons. When a longeron is fitted to the drawing, cut another one exactly the same length for the other side, mark the station number and set it aside. If you use a hollow ground blade for ripping your material, the edges will be smooth enough for varnish. Keep several sharp blades on hand.

After all the side pieces are cut and fitted using the hold blocks and wood cam blocks, you can now take the structure apart one section at a time. Glue it and re-clamp it back in position. Use wax paper under each glue area to save your drawing.

Cover the inside of each side from station 0 to station 78 with 3/32" ply. Always note the grain direction. Always

apply glue to both surfaces. When you staple the ply to the structure, use a 3/8" staple and staple through a thin layer of cardboard. The paper cardboard is common in thickness to gift boxes etc., about 1/32" thick. By using the cardboard under the staple, the staple can easily be removed by lifting one side with a sharpened flat point screw driver and then pulling the staple out with plyers or dikes. The staple will not leave an indentation in the ply when using the cardboard. About every 3" is usually close enough for spacing. Remember that a lot of clamping pressure is not neccessary when using epoxy glue, just good solid contact.

After both sides are completed, replace the table paper and transfer the top view profile from drawing #2 to the paper using a center line down the center of the table.

The construction frames should be glued at the corners with the white construction type glue. They should be made so that the inside width falls just ahead or aft of a station.

The top profile is achieved by a line down the center 178" long with all stations measured down the center line from 0 to 178. The distance from center to theoutside is shown to give you the outside profile of the fuselage. When you clamp the two sides to the inside of each construction frame, you will note that the uprights or stations will move forward from station 78 aft. This is due to the radius of thebend. This is also the reason for the extra length of the longerons from station 149 1/4 aft.

When you place the sides inside the construction frames, station 0 must be directly over the station 0 mark on the profile drawing. Use a level to level the forward top of the longerons. Station 25 should rest on the table top.

You can now start gluing in the cross members and formers. The nose gear tunnel can also be installed. Note that at

station 25 the tunnel is 1/2" forward from station 25 at each side. The wing spar lays against these station 25 points. The wing spar requires this extra 1/2" due to its taper to a wider chord in the center. Note that the 9-1/2" and 2" blocks in each side of the nose gear tunnel are installed after the floor is installed from station 0 to 25.

Although the formers are laid out full size, they must be contoured to accept the 1/16" ply skin. This should be done after all formers are installed and the "T" section stringer is installed.

Laying a long straight edge from former 88 to 178 will give you some idea of the bevel at each former that is neccessary to fair in the formers.

When you eventually install the 1/16" ply skin, it is covered from former 88 to 178 and butting together down the center "T" section stringer. You then cover from former 78 to the front end of the canopy base. Bevel the ply skin at former 78 and former 88. Scarf the skin in place between these two stations. There is a slight compound curve there that requires this section scarf. This curve is later faired with a little foam and glass for a smooth transition to the skin.

You can now saw off the tops of the construction frames and lift the fuselage out. Turn it over and set it back in the frames. At this point you can install the bottom formers.

The following should be finished prior to skinning the fuselage:

The fin and stabilizer should be completed and glued into place. The battery shelf installed. Two idler arms and push rods completed, aft of the baggabe compartment. Fuselage antennas installed. Rudder pedal assembly fitted. Nose gear pivot plates fitted. Nose gear truss brackets and steering bearing plates fitted at the firewall. Fuselage tank installed. All inside structure varnishid.

DRAWING #3

The former templates are shown full size but only in half sections. They can be transfered to the 1/2" ply with carbon paper or a series of holes punched through the drawing. Be sure to check the ply layout on drawing 53. It's a good idea to lay out each full sheet prior to cutting so you know you will have enough ply left to cut each part.

DRAWING #4

The inside cutouts of the formers are easily done with a power sabre saw. The inside edges can have a radius except where the gussets are located. This will save some weight. Sand all inside cuts suitable for varnish.

The firewall can be filled with foam or any noise insulating material prior to gluing on the 1/8" birch ply outside wall. You should make a paper template of the firewall structure prior to covering with the outside wall. When you are drilling holes for engine wiring, hoses, etc, you will know where the structure is and can avoid drilling a large hole through a diagonal.

DRAWING #4 and #5

The GP-4 has a shallow cabin area so the frontal area is kept at a minimum for drag reduction. The instrument panel will only accommodate two rows of 3-1/8" diameter instruments. Only the center panel is shock mounted. The center panel will take care of the basic "T" for I.F.R. The small left side panel will accommodate the master switch, 2" vacuume guage, ignition mag switch and alternate air knobs. By careful planning, two more knobs will fit for cabin air and cabin heat. The extreme right side panel will accept all of the engine instruments. The prototype used Westach quad instruments. There are three 3" instruments. One has 4 cyl. head readings. Another has 4 E.G.T. readings and the third has oil temp., oil pressure, fuel pressure and

ampmeter. Also in this panel is a vertical row of switches. On the far right is a 2" fuel guage for the center tank.

The circuit breaker panels are divided, with one on each side of the radio stack. By removing the two screws at each end, the panel will drop down for easy wire access. Early planning for radios may be wise due to the limited space available. The prototype used all of the space available from the throttle box up to the bottom of the instrument panel. The following was used: On the bottom a King transponder. Next was a Terra 720 comm. and a 200 channel Nav. side by side. On top is a n R Nav 20 Loran. Don't forget to fit the pivot plates shown on drawing #49 prior to skinning the outside of the fuselage. See note drawing #5.

DRAWING #6

Number 6 is shown early in construction because the center fuel tank must be installed prior to any top skin or formers ahead of the windshield area.

Polyester resin was used on the prototype but epoxy can be used if that is what you are accostomed to.

Be sure that the mold will fit into the fuselage with room for the glass that will be added to the width.

The tank should have 3 layers of 7 to 8oz. cloth and one layer of 4 to 6oz. cloth. The baffles should be made on a flat waxed board that has been pre-fitted to the inside of the tank. It's important to pressure test the tank prior to installation.

The parking brake shown on drawing #6 is an option. A Gerdes A-850 series parking brake valve, plumbed into the system, is probably more reliable and reccommended.

DRAWING #7

Rudder pedals should be installed while fuselage is open.

The fold down pedal extension is a nice feature for the right seat. It will move the pedals 3" further aft. This is shown on drawing #8. If you are under 6' tall, you will have to weld a brake pedal extension on the pilot side.

DRAWING #8

The copper tape dipole antennas were designed by Jim Wier of Radio Systems Technology. You will note they are all internal to reduce aerodynamic drag.

The #2 comm.,VOR, glideslope, and transponder antennas were flight tested in the prototype. They worked very well.

If you are planning for a Loran, now is the time to install the antenna. Remember, a wood aircraft has no ground plane!

Try to keep the wire lengths coming out of the coax as short as possible. Subtract these wire lengths from the given copper tape lengths. Coil up each coax and mark it for further routing.

DRAWING #9

Install the engine mount brackets and nose wheel truss brackets prior to installing the asbestos/aluminium outside covering.

Steps 1 through 15 should be carefully followed.

Once all of the brackets are fitted, the asbestos/ alum. firewall cover can be cut to fit the firewall with the brackets removed. Drill through the asbestos and alum. from the inside, through the bracket holes. Paint all of the brackets and install them permanently. Note that the asbestos/alum. fire-

wall is 1/8" so that the cowl will fit flush to the outside skin. (see firewall, wing fillet drawing for detail.)

DRAWING #10

Trace or cut out of plan sheet the full size ribs and transfer to the 3/32" ply. Note grain direction. Ribs are 1/8" longer than shown for final fitting. Use the band saw and cut on the outside of the line.

Staple all of the pine cap strips to the ribs. Remove staples when glue dries. Sand cap strips down to the rib edge. Build the stabilizer vertical as shown. Use care to see that rib #5 and #1 are vertical with a level on each chord line. Check chord lines often!

To insure the L.E. spar is straight, you can clamp a straight edge to the top surface prior to installing ribs 2, 3, and 4.

DRAWING #11

The L.E. corner blocks are easier to shape if made of pine. They can be left extra long, longer than the L.E. is high, and trimmed after the ribs are glued in place. You can then contour the ribs and L.E. spar at the same sanding session. Note the grain direction of the 3/32" ply web of the stabilizer.

DRAWING #12

Trace or cut out of plan sheet the full size elevator ribs. Set ribs aside and build the elevator torque tube assembly. Start with the 7/8"x.049 tube, 20 1/8" long. Make dummy spar as shown and slip the two .063 horns to the center. Weld the four torque moumt brackets, making sure they are in the same plane. Use a large table model belt sander to mill the brackets plain to each other. Cut a 3/8" thick metal spacer and bolt the two horn plates together through the spacer. Bolt or clamp the mount brackets

to the dummy spar and center the horn plates on the tube 90° to the mount brackets. Weld the horn plates to the tube and cut the tube in the center after removing the 3/8" spacer.

DRAWING #13

Build the elevator the same way as the stabilizer in the vertical plane. Let the #6 rib extend down over the end of the table. Prior to assembly, rout out the spar for the trim pulley.

Balance each side individually after finish paint and trim tab is in place. (See lead balance detail).

DRAWING #14

Trace or cut out of plan sheet #14 and transfer to 3/32" ply. Note grain direction.

Unlike the stabilizer and elevator, the fin is built in place on the fuselage.

Level the fuselage from station 0 to station 78, using the top longeron as a datum. It must also be leveled from side to side and clamped.

The fin has no off set. It is built down a center line, fore and aft.

Mount the fin spar on station 178, using a level to keep the chord line vertical. Mount the #1 and #4 ribs to the fin spar and L.E. spar. When the glue has dried, install the #2 and #3 ribs. Note that the stabilizer incidence is set at 0 degrees. Relieve the longerons as neccessary to install the stabilizer.

General:

To fair the ribs and spars so that the ply skins will lay flat, it is done with a long, straight board, covered with 80 grit sand paper. This paper is available from dry wall supply stores. It is generally black and is in 18"

widths. It comes in rolls so any length can be purchased.

The sanding board should be from 3" to 4" wide and long enough to be drug back and forth over an area of 4 wing ribs and 1/2 of the stabilizer while sanding. The ends should be slightly beveled so that it will ride up and over a rib if you drag it too far. The paper can be folded up over each end and stapled. Handles can be attached to the boards top side for ease in pushing and pulling the board.

In a tapered wing or tail surface it is important to fair the ribs in a percentage wise manor. Let's take the fin as an example. Divide the #3 rib chord in 4 equal parts and draw lines ac ross the rib. Now do the same to #1 rib. When you sand the fin side, the sanding board should be drug back and forth across these rib lines, moving from the L.E. to the T.E. (trailing edge). The cap strips should be sanded until a straight edge laid on these percentage lines, shows a flat surface to glue the skin to.

In preparing the skins, a rough cut of the skin is made. While laying in place, drill a 1/4" hole through the skin and into the spar about 3/8" deep at each end of the spar. Push in a 1/4" dowel about 1/2" long. This will now insure that the skin will always go on the surface in the same place. With the skin in place, the structure side should be pencilled on the inside of the skins. You now know where the varnish goes and where the glue goes. The outside of the skin should have a center line over each rib so you will know where to staple.

Once the skins are fitted and marked, glue one side to the structure. Varnish the inside of the structure and skin. Mask off the glue area of the other skin and varnish it. You can now staple the skin in place, closing the structure. Drain holes must be drilled prior to closing.

The F.A.A. may require photos of the structure prior to closing. Be sure to check on this!

Varnish used on the prototype was Varathane or Urethane clear gloss. The first coat was thinned 10 to 15%. The following two coats were straight out of the can. All three coats were brushed with a two hour wait between the 2nd and 3rd coat.

DRAWING#15 and #16

Trace or cut out of plan sheet #15 and transfer to 3/32" ply.

The rudder is built like the stabilizer and elevators in the vertical plane on the work table. Great care should be used to align the hinges on all the controls. Start by aligning all of the rudder clevis hinges. Mount the bottom hinge or horn 90°to the chord line as shown. Next mount the top clevis hinge. A fine thread stretched through the center of these two clevis hinges will tell you if you need to shim the center hinge clevis or sand the surface slightly to keep the thread centered through all three clevis hinges. Varnish under all of these hinges prior to final assembly. Recheck alignment.

You now have a perfect alignment to start mounting the fin hinges. The 3/16" angle aluminium material is heavy enough so that up to 1/32" can be sanded away of the hinge line if neccessary. The skins should go on while the hinges are aligned in place. Use this same technique on all of the hinged control surfaces.

General:

The gap between the balsa fairing and the skin overhang should be held to a minimum for drag reduction.

When the control surface is moved to its maximum deflection, the gap should just touch. Remember, there is light glass and paint to go over the balsa fairing so make

a small gap allowance for this.

Balancing surfaces:

The lead mass balance shown in the drawings is generous enough so that after finish paint is completed, some lead may be removed by drilling holes in the lead. To balance, push in the clevis pins on the inboard and outboard hinges. Lay the surface on a blade at each end on each clevis pin. The blade can be any sharpened piece of metal that fits inside the clevis hinge, under the clevis pin. They have to be the same height above the work table.

The control surface should just slightly over-balance. The trailing edge will be somewhat higher than the clevis pin height. It should stabilize at about 10 degrees in a draft free room.

DRAWING #17

Probably the most challenging and yet rewarding piece to build is the main wing spar. The clue to trouble free construction is the preparation of all the pieces prior to gluing.

Start by scarfing the top and bottom caps as shown. Cut all cap lumber to length and mark top, bottom, etc. Build the 24 support frames and the 18 lamination clamps. Put a fresh piece of paper on the work table and lay out either the top or bottom cap. Screw the support frames to the table, about 20" apart, along the layout line. Tape wax paper on frame surface so glue will release from the frames. Preclamp all the caps without glue as a test to see where longer or shorter bolts are needed. Try to keep all of the laminations pressed down against the 3/4" thick spacer blocks so that the laminations are as even on top as possible. Get some help in gluing and bolting. Use ratchet wrenches to save time. Do not over tighten clamps. Be sure

to glue each mating surface.

The spar caps can be beveled with a good band saw which has at least a 1/2" blade. Use a roller stand or a helper when running through the saw. Always cut to the outside of the line and stop if you start to get into the line. A good, sharp hand plane takes longer but is safer.

Once both caps are beveled, draw a center line down each cap and lay out the top profile, 3-1/4" at the tip, tapering to 5-3/4" at spar center. Use care in keeping both caps the same taper in cutting and planning.

Put new paper on the work table and lay out the spar as shown. Re-locate the support frames on the outside of the top and bottom caps to hold while installing the diaphragms. Pre-scarf the shear webs from the 45 degree, birch ply. Use 1/4" dowles to locate webs. Scribe the diaphragms and cap areas on the inside of both webs. Glue the aft side web on first, then drill a 3/8" hole on the outboard side of the diaphragms, on the bottom cap for a drain hole. Varnish inside structure and non glue areas on the front web. Scribe lines on the outside of each web to show the areas you can staple.

Notes:

The spar is about 1/8" deeper than the wing ribs. This leaves material to shape the top and bottom of the spar, to contour with the rib profile.

Scribe the chord line front and back on the webs. Start 22" from the spar center and measure from the bottom cap to the chord line, 3-1/32". At the tip, it is 1-15/16" up from the bottom cap. Stretch a thread chord between these two marks and make a mark the length of your longest straight edge. It's very important that this chord line be scribed straight and is a fine line for rib location. Use a lead pencil that has a hard point and is very sharp for all scribing. Sharpen

often!

On all birch ply, it's a good idea to lightly sand the area to be glued. Some aircraft birch has a waxie finish that may inhibit a good glue bond.

It's a good idea to make the webs slightly larger than the spar, 1/16" or so, unless you get a perfect fit. You can always plane off the excess after the glue dries. Remember, you have to shape the top and bottom of the spar to contour with the rib profile. In order to do this, mark the rib location on the fore and aft side of the spar for each rib. The ribs mount 90 degrees to the center line. Take each rib and match the spar chord line with the rib chord line. Make a mark on the face of the web where the rib meets the spar, top and bottom, on the fore and aft side of the spar face. This line will represent the line to plane and contour the spar. The line should be straight. If the line dips or is high, you may have a rib that is slightly too thick. Keep the line straight and the rib will fair when you fair all of the ribs after they are glued to the spar. Plane the spar so that there is a slight contour to the top and bottom. Remember, the spar is not a flat plane through the rib area. Use a sharp smoothing plane and plane down to the outside of the line. The final shaping and contouring will follow when you fair all of the ribs in place. Use the sanding board 3" to 4" wide and at least 5' long. It should sand 4 ribs at one time. You can see why it must be straight. A good 2"x4" works well.

DRAWINGS #18, 19, 20, 21, 22

Trace or cut out of the plan sheets all of the wing rib drawings. Note grain direction when transfering to the 1/8" ply and the 1/2" spruce (or pine) nose rib material.

Stack two ribs at a time for band sawing. After sanding off all of the ribs to the thin, scribed contour lines, glue on all of the cap strips and staple through the ply, into the cap strips. Use care to staple the caps close to the rib contour. Never let the cap fall below the outside edge.

The solid nose ribs that fit around the fuel tank are left solid with the chord lines drawn on each side of the rib. The butt rib and tip rib are installed and a line is stretch from the L.E. chord line mark, for the full span. This gives you a point to line up the nose ribs on the L.E. end the chord line on the spar web gives you the other end.

Once the solid ribs are butted up against the spar web and the chord lines all intersect, make a mark on the top and bottom web, rib intersection. This is neccessary because when the center of these ribs are cut out to fit over the fuel tank, the ribs may warp a little and you also lose the chord line mark at the web end.

With these marks on the spar web, you are now free to install the wing tanks. The ribs can then be installed around the tank and glued to the web. If the inside of the ribs ride on the tank in such a way as to inhibit its position to the spar, relieve the rib for a good fit to the spar face.

DRAWING #23

The fuel tank molds require a left and right side. The 3 interior baffles require only one mold for each baffle. The end baffles or plugs require a left and right because the flange goes inside on each end. Try to get help with the lay up when casting the main tank lay up. Use 3 layers of 7oz. to 8oz. cloth and one layer of 4oz. to 6oz. cloth for the outside or last layer. Pre-cut the cloth, allowing a generous 2" oversize on all sides. Resin all four layers, applying the first layer on your work table. Resin first layer, then stack each remaining layer and resin as you go. Pick up each end and drape over the male mold. Use care to position the cloth layers so they all cover the mold. Use a squeegee

to get any wrinkles orbubbles out of the layers.

After all of the pieces are molded, glass in all of the fittings. Glass in all of the baffles and end plugs. Glue 2 strong backs on the outside, full length to hold edges straight for the cap. After resin dries, use 2 layers of 4oz. about 1 1/2" wide to wrap around all corners on the end plugs and 3 layers of 4oz. down the cap joint. Fuel proof epoxy is recommended.

DRAWING #24

The installation of wiring,pitot lines, vent lines, etc. should wait until the landing gear has been installed. This will insure clearance around all of the moving parts.

Install the trailing edge ribs of rib 1 and rib A after flaps and ailerons are fitted.

Be sure when installing the ribs to the spars that the nose ribs, center ribs and T.E. ribs have the chord lines in the same plane. Use a straight edge with a notch cut out for the spars or use a level, or both. This is very important!

With the tanks pressure tested, rough up the back side of the tank with 80 grit paper. Paint the spar web face and tank back side with epoxy. Glue it into place on the spar web. Since the nose ribs have already been fitted, it is now time to glue them in place. Install the wing L.E. spar. Glass the nose ribs to the tank. With all of the ribs in place, use the 5' sanding board and fair in all of the ribs. Sand span-wise, covering 3 ribs at a time. Use a straight edge often to check rib heights. Mark the high ribs and sand them as you go.

You are now ready to foam the tank. The foam used over the tank is a polyurethane, 2 part liquid foam. Using equal

parts of part A and part B, it produces a 2lb. density structure. Your shop should be up to 80°F. Put the cans in a container of very warm water, not boiling but very warm, with the lids off the cans. Mix quite rapidly in a paper carton about 3/4 cup of each part. It's important to mix it thoroughly and pour it over the tank while still in a lquid form. You will have only about 7 to 10 seconds. It will swell up higher than the ribs, in great, uneven lumps. Don't worry because it sands very easily and the real high pieces can be cut with a knife or hand saw.

If you run into any real spongy places where the foam is not cured, dig them out and re-foam that area. Fill any holes or voids after fairing the foam. Foam both sides prior to fairing. Vacume clean often to see voids.

Warning:

If you leave any uncured foam in the wing, it could swell and distort the airfoil section on a hot day, once the ply is glued to the wing. This is why it's so important to preheat the foam. Use a hot shop and stir the foam well before pouring. Good insurance would be to heat the finished contoured foam with a heat gun or lamps to a surface temperature of about 110°F. Resurface if any uncured foam swells.

DRAWING # 25

The flaps and ailerons are built in the same way as the elevators and rudder. See instructions for drawings #10 and #13.

DRAWING #26

In mounting the flap hinge clevis, mount the #1, #2 and #3 as shown on the fitting notes A, to the spar. Use care to get all of the bearing holes in line.

DRAWING # 27

Mount the aileron clevis hinges on each end with the pivot point in the center of the spar. Use a thread through the center of the bearing at each end, to line up the center clevis hinge. Sand the spar slightly, under the hinges, for alignment if necessary. When the ailerons are covered and the balsa farings are in place, you can then mount the ailerons to the rear spar. See drawing # 25 for aileron hinge and balance, fitting positions. Hinges are mounted in the center of the rear spar. Assemble each hinge and clamp to the rear spar. Then check for freedom of movement. The clevis pins should be alligned for easy removal and aileron rotation.

DRAWING # 28

Start with the spar plate. The wheel well, attach fittings in the nose wheel tunnel, will be fitted to the AN 4-64A long bolts, later when the wing is in place in the fuselage.

Drill and bolt the bearing pillow blocks with the 7/8X .058 axle tube in the bearing holes to insure good aalignment. See drawing # 31 for axle tube retract handle.

Drill the hole through the spar web, front and back spar web from each each side, using careful measurements. Counter bore the front web and block for the flush forward bearing of the walking beam axle. See drawing # 29 for bearing retainer detail.

DRAWING # 29

Complete the walking beam, bearing assembly. Install the pulley brackets. Make up the cables to the walking beam. Leave the cables long and fit to spring end later.

DRAWING #30

Build the four seat rails. Install the 3/4" square, mount tube. See drawing #28 for position. Use the control stick axle, (1 x .049), to align the pillow block brackets and bearings.

The aileron bracket assembly can be built now or later. Be sure to ream the control stick and aileron assemblies, as called for.

Note the elevator push rod lengths on this drawing. When using adjustable rod end bearings on both ends of a push rod, be sure to use a check nut on both ends and rivet one end of the rod end, so that the push rod can not unwind, even if the check nut is loose.

Fold all brackets around a wood block, to give a good radius to the bend. See drawing #32 for seat rail brackets and mounting.

DRAWING #31

Make up the flap, motor clevis brackets to fit the Cessna 150 flap, motor assembly. Mount the pulleys at the rear spar. Weld the cable clevises to the worm gear tube. Weld the roller axle. Put the worm gear tube back and secure with an allen screw. Use heavy string as cable and align the 3/4" square channel rails parallel with the string. Use 12 volts to run the screw back and forth, to check freedom of movement. Set flap stop limit switches later, on final rigging.

DRAWING # 32

Install outboard flap, pulley brackets. Install each landing gear truss, idler arm assembly. Note the rear of the truss mount is high on the spar because the truss is symmetrical. Be sure that the chord lines of #4 ribs are parallel with each other before you set the aft end of the truss. See drawing #35 for details of the front mount brackets.

DRAWING # 33

The main gear leg assembly should have scalr removed from the inside of the 1-5/8 tube after welding. Use a rotory stone on a long shaft, until the 1-1/2 tube strut slides inside smoothly.

Heat treat leg assembly as follows:

Stress releive and heat treat to 38-45 R?C. Note instructions on aligning the wheel prior to welding on the scissors clevis.

Landing lights can be optional. Set one side for taxie and the other for landing. DO NOT modify and install landing lights in the wing L.E. !

DRAWING # 34

In mounting the 1-1/4" axle to the 1-1/2" strut, the hole method is easier, providing you have the drill and machinery to do it. Note change in brake lines from Aeroquip to Nyloseal tubing. With the Nyloseal the brakes can be filled from the wheel end and no air is trapped. Bleeding is not necessary. Be sure to use the brass inserts for trouble free fittings.

DRAWING # 35

Note that the retracting link assemblies require a left and right unit. Make up the 3/8"X.065 support tubes in a tack weld leaving the .080 mount feet longer than shown for drilling and fitting to the spar plate and pillow block bearings.

Be sure that the 7/8"X.058 spacer is on the link axle befor welding the vlevis arm to the axle at the 70 degree angle shown.

DRAWING #36

It is important that the main gear fits between the 2 spars at the correct angles. See drawing #32 showing the rear, spar gear socket location and the dummy axle used to position the gear leg assembly, 82 degrees to the spar face. The same alignment is neccessary for the retracting link assembly. It should be parallel in both planes to the dummy axle.

It is very important to set up the main gear assembly so that the tire will clear the retracting push rod. If you have to move the axle sockets left or right a little, you may have to shim the spar slightly, for a flat face against the spar socket plate. This can be done by laying up layers of wetted fiber glass cloth in graduated widths that form a wedge. Wax the back sides of the socket plates and assemble the unit wet. This will insure a perfect fit for the sockets against the spar web face.

Remember, if you alter the angle of the gear leg assembly, the retracting link assembly must be matched to the same angle.

DRAWING #37

The landing gear up-lock system is neccessary due to the very high down loads on the main gear doors. The doors are bolted directly to the gear legs and at speeds over 200mph, they will sag down as much as 3 inches. A sharp pull up at speed could bend the retract system if the up-locks are not engaged.

A warning light system was designed by Scott Kemper, that works very well. It consists of red, amber and green lights. If either gear up-lock is not engaged, it will show amber. See drawing #40.

The air actuated uplocks should be fitted and tested prior to covering the wing. The air pump can be temporarily mounted on the wing to test the air cylinders and latch system. Note on drawing # 37 the up position and down position of the latch hook. The hook will lift the landing gear about 5/8" in the full up position. In the static test it may not seem necessary as the gear will be full up with the assist springs helping and no down load except gravity. In the air, however, with the gear doors in place the down load is quite high even at speed as low as 80 MPH. When you place the gear handle in the up position the air pump is automatically started and the latch hook will reach out and grab the strut and lift it solidly into position . The gear will never sag down even at high speed and positive G loads.

It is recommended that the gear down speed be no higher than 150 MPH. Leave the gear handle unlatched until the aircraft slows to 110 MPH, then push it into the gear down detent.
DRAWING # 38

When skinning the wing, make up all of the scarf joints so you are working with a full wing skin. Note that the skins are 1/2" over size on all sides. Make up all 4 sets, using the dowels to keep each skin positioned. Cut out the wheel wels on the bottom skins. Scribe all of the spar and rib glue areas. Make staple lines on the outside surfaces. If you use nailing strips they should be 3/16" thick X 3/4" wide. Pre-nail with a #17X3/4" nail. These can be used over when removed. Nails should be spaced at least 3" apart. Run two strips down the main spar and one over each rib and rear spar. Do not miss the rib and nail through the fuel tank!

The next step is extremely important and must be very accurate.

The wing has 1.5 degrees of negative twist at each tip. The L.E. goes down and the T.E. goes up with the wing right side up.

Step 1:

Turn the wing upside down, (or bottom side up), and block the inboard butt rib up off the table until the tip ribs are about 3" off the table. Set the butt ribs at 0 degrees incidence (chord line level). Run braces to the shop ceiling to insure that the butt ribs cannot move and the support blocks are secure. Use a level with a block under one end that represents 1.5 degrees. Twist the tip rib until the chord line with the level on the line reads level. The end of the level is on the line as is the block at the other end. Remember, when the wing is right side up, you want it to to have a negative twist. Since the wing is now upside down, the L.E. will go up and the T.E. goes down. Use blocks under the leading edge, wing spar and a brace from the ceiling to push the T.E. down.

If you can ~~bit~~ BOLT your table to the floor, you can rig all of the hold down braces to the table alone. With both sides set at the proper incidence and <u>triple checked</u>, you can skin both bottom sides.

Step 2:

Turn the wing over and varnish the inside and top wing skins. Be sure no varnish is on the glue areas. You might mask off these areas prior to varnishing.

Step 3:

Set the butt ribs at 0 degrees incidence, (chord lines level), and brace from the ceiling if possible. Set the

tip ribs at the negative 1.5 degrees, L.E. down, T.E. up. Use the level and block method. Brace the wing securely to hold this 1.5 degree negative line. Double check each side several times prior to skinning. Once the top skin is on, it will never move so be accurate!

Step 4:

Skin both top sides.

DRAWING #39

Make all of the wing attach fittings. Set wing on saw horses and set the fuselage down, over the spar. Station 25 should set the wing incidence at a positive 1.5 degrees to the datum. The top longeron from station 0 to station 78 is level with the datum. The wing chord line should be 1.5 positive to this level line.

See drawing #5, showing a shim over the spar where it joins the fuselage for a flat mating surface. Note shim directions on drawing #39. Follow the seven steps. Leave wing and fuselage assembled.

DRAWING # 40

The battery box installation should go into the fuselage prior to covering. The battery location is based on the use of a Lycoming IO-360 A1A engine and a Hartzel, 74" diameter, C/S propeller. Leave wing and fuselage assembled.

See drawing #35 for fuel valve location and assembly. Any aircraft, 4 way valve can be used providing it accomodates 3/8" size lines and 1/4" pipe thread openings for #6 AN fittings. The prototype used a Weatherhead valve, P/N 6747

DRAWING #41

Make gear handle locks and fit for a very positive up

and down detent position.(See Drawing #37-A for air valve assy.)

In the gear down position the links should be solidly closed, with no tendency to break even with a sharp blow to the link hinge with the palm of your hand.

DRAWING #42

Mount the Dukes aux pump, (P/N 4140-D0153) with an alum. strap around the pump and bolted to the ply floor between the floor and the bottom skin. (Right Side) Fit the fuel line through the tunnel as close to the wing brackets as possible and still be able to get the brackets out. Make the pump access door large enough for easy removal with doubler glued in the bottom skin.

DRAWING # 43

Be sure wing bolts are in place prior to fitting the wing fillets, gear doors, etc.

Use epoxy glue to attach the slabs of foam. Do not glue the edges of the slabs together. Score the foam slabs to lay down on a curved area. Use weights to hold foam down while drying.

The foam will be fragil at the T.E. fillet and may have to be supported underneath until the glass cloth is in place. When the wing is removed from the fuselage, glass the other side of the fillet so a smooth surface is available to fit the top mating fillet that attaches to the fuselage. (See drawing #45) Epoxy resin is used on all doors to minimize shrinking. The doors will not warp during curing with epoxy. The edges of the foam, next to the wood, may break or become ragged. Smooth this out with a slurry mix of microballoons prior to covering with glass.

DRAWING # 44

Use the same type of construction and finish for the inboard wheel doors.

Align the pulleys to rib #1 in order to align with the retract rod and the door attach point. Cut a cable hole through the rib as necessary.

DRAWING # 45

The wing must now be right side up and the fuselage set in place with attach bolts through the wing fittings. The riv nuts or blind fasteners should also be in place and the fillet, front and rear, screwed to the fuselage, into the riv nuts. The front and rear bottom fillets require wax paper over the flat, mating surface and over the top of the wing surface prior to attaching the foam fillet, top side. Follow steps 1 through 3.

DRAWING # 46 and #47

The canopy and windshield bow are made on the same jig. The fuselage canopy base can now be fitted to the fuselage and the fuselage top skins glued to the formers. The mating canopy base can be traced onto the 1/8' birch ply by laying over the fuselage base. It is important to get the masonite bow template the same angle as the windshield when fitting and handling. Use the manufacturers directions to cut and drill the plexiglass. Get help to hold the plexiglass while cutting and take it slow! I used a 6" rotory disc, non ridged. You could see light through it as it looked like screen. A variable speed drill motor allows a light pass down the plexiglass and the next pass cuts through. Cut large overlaps and keep triming and fitting until you get the canopy to lay down over the canopy base. Use a plexiglass drill bit on all holes over 1/16" dia.

DRAWING # 48

The wing tip is sculptured from solid polyurethane foam, 2lb. density. Make the wood, lens mold and stretch mold the 1/8" thick plexiglass lenses. A right and left side are required. If it is not hot enough to complete the stretching process on the first try, re-heat the plexiglass in the frame and it will return to its original shape for another try. The optics are not important so don't be concerned about waves in the sharper, curved areas. When the lenses are trimmed, tape them for protection. Tape them into position on the tip rib. Cut a block of foam and glue to the tip, butting up against the aft side of the lens. Cut 4 female templates from cardboard or ply from the drawings and sculpture to shape. Sculpture the top side first, all the way to the trailing edge. Before you complete the bottom side , T.E., lay up one layer of glass on the top, rear area to firm up this very thin section. You can then complete the bottom side.

A thin slurry of microballoons is squeegeed on the foam and sanded prior to laying up 2 layers of 8oz. cloth over the entire tip. Lap onto the wing skin about 2" and feather out. Make a smooth transition from the lens to the foam tip. Adjust the templates some if neccessary but make each side as close as possible.

The tip design provides minimum drag and excellent stall characteristics. The transition of air around and over the lens should be as smooth as possible, therefore the same technique used around the canopy, fuselage junctures should be used.

DRAWING # 49

It may be neccessary to install micarta rub plates in the center console to keep the rudder cables clear of all assemblies. Be careful when you install the rudder turnbuckles, to see that they clear everything in their travel fore and aft.

Aluminum AN fittings are used throughout the fuel system. In flaring your 3/8" aluminum versatube, be sure to use a aircraft flaring tool with a 37 degree flare.

Build a canopy latch as shown and chrome plate the assembly after it is fitted and working.

DRAWING #50 and #51

Build all of the components shown on drawing #51, as they are neccessary to complete the nose gear truss assembly.

The nose gear truss brackets, (drawing #9), should be bolted to the firewall. Also bolt the firewall mount assemblies to the four corners of the firewall. Use inexpensive hardware bolts,(3/8" x 4 1/2"), because welding the long truss tubes to the assemblies would damage the finish bolts. After the truss is completed and the engine mount welding is completed, the final assembly can be bolted to the firewall with the ANG-41A bolts.

To position the nose gear truss and pivot points, first level the fuselage fore and aft as well as sideways. The top longeron from station 0 to 78 is a good datum. The firewall is 90 degrees to this line, so a vertical level could also be used at the firewall. Any cross member should be satisfactory for sideways leveling.

Bolt the two pivot point truss tubes to the truss brackets located on the bottom and each side of the nose gear tunnel. Space the foreward outside edges of the pivot point truss tubes 10-1/4" apart by clamping a metal bar across the ends for spacing. Adjust the angle of these tubes to 3-3/16" above the bottom side of the firewall as shown on drawing #50. Note that the center of each tube is the point of measure.

Use a metal heat shield around the mount assemblies to prevent burning of the aluminum firewall while welding. With the pivot truss tubes positioned and braced, you can now cut and fit the long 3/4" x .058 nose gear truss tubes.

You may want to first use 3/4" conduit as a mock up for fitting these tubes. It could save an expensive mistake. The conduit makes a good guide for fitting the final tube to a tube cluster. After all tubes are tack welded, remove from the firewall and finish welding the four mount assemblies. The tubes to the foreward end of the nose gear pivot truss should be finish welded before removal. Note that the pivot plates , (drawing #51), are welded after aligning the swing of the nose gear strut into the tunnel. The pivot plate can be shifted so that the nose gear fork just misses the push rod and still has room on the opposite side of the nose gear tunnel.

DRAWING #52

The nose wheel used on the prototype is a Gerdes A-1230 with a 10 x 350-4 tire. This 4" wheel has 2 Timpkin LM 119 49L tapered bearings. See fork and axle drawing #52. Note that the axle bolt, AN7-47, has the head partially ground off, to keep the overall width of the fork assembly as narrow as possible.

After the entire nose strut and nose gear assembly is completed, the bushings are pressed out and the upper and lower struts are stress relieved and heat treated to 38-45 R/C.

DRAWING # 53

It is important that the grain in all of the plywood goes in the direction shown on all plywood components. This drawing will help in eliminating waste and insure proper grain direction.

DRAWING #54

To mount the engine, you must level the fuselage again, fore and aft as well as sideways. Do this about 3 to 5

feet from the shop wall, so that the engine can be braced once it is hoisted in position.

The nose gear truss should be bolted in place with metal fireshields around the four mount points.

Bolt the pre-welded engine mount ring to the engine. Both magnetos must be removed to do this. When you tighten up the four dynafocal lord mounts, note the distance between the engine and the dynafocal ring. Remove one lord mount and make a steel spacer from scrap tubing and large steel washers that duplicates the lord mount in spacing and positioning. Make three more spacers and remount the dynafocal ring to the engine. The large washers should be tack welded to the tube spacer to prevent any shifting out of position. You are now free to weld around the mount without burning the lord mounts. Its very important that your spacers represent the exact position that the lord mounts give to the engine and mount ring.

The dynafocal pre-welded ring and the recommended lord mounts are called out in your material lists. It is important to use these heavy duty lord mounts if aerobatics are performed. This mount assembly is very strong in all areas. The loads are well distrubited back into the longerons. The tubing sizes are the same used in the Pitts S2. The limiting factors in loading this assembly would no doubt be the Hartzell propeller and spinner assembly with the built in extension that is required. All snap rolls and vertical reverses are prohibited due to this propeller, spinner, engine combination.

Hoist the engine into position in front of the firewall. Use the slit in the top of the engine case as a center line. The tops of the cylinder fins can be used as a leveling point. Brace the engine from the shop wall, to hold the correct position shown on the 1/10 scale drawing. You are now ready to fit the engine mount tubes from the firewall to the engine mount ring. All of this tubing is 3/4" x .058. You may want to use 3/4" conduit mock ups as suggested, in the nose gear truss.

When welding the mount legs to the engine mount ring and the 4 points on the firewall, complete as much of the welding as possible prior to removing the mount for final welding.

To complete the welding at all the tube clusters, remove the mount from the firewall and engine. Bolt the mount to a large piece of plywood with the same dimension points as as on the firewall. You can now finish the welding.

To stress relieve the welded clusters, use a large heating tip and bring the cluster to a dull red. Slowly back the torch away until the tube cluster changes color. Cool it very slowly. This should be dome at the mount ring as well as the 4 firewall mounting points.

If the mount does not fit the engine or firewall due to warpage, heat the tubing as neccessary and realign to fit.

DRAWING # 55

The A-750 vernier propeller, mixture, and throttle cables should be ordered to length only after the engine control face plate is in place. Route a dummy cable from the face plate to the control arm on the engine side. All three cables are routed through the nose gear tunnel and attached to the top and side of the tunnel. The length you order may vary due to the make of propeller governor you use. Remember, the engine end will have a swivel end with a 10 32 threaded shaft to accept the rod end bearing. This must be taken into account in ordering the propper length. The Wicks catalog have instructions in ordering these vernier controls.

The avionics stack may differ from thoes on the drawing. The console can be changed to suit the builders selection.

The location of the engine controls seem to be very good and in a natural position for power changes.

DRAWING # 56

Due to the long arm and the up position geometry of the nose gear link assembly, no up lock is necessary.

The nose gear door and door stop assembly must be adjusted with the aircraft on jacks prior to first flight. This also holds true for checking the up locks and door fitting. With the augmenting assist springs hooked up the gear will almost come up by itself when the handle comes out of the detent. In the air however, some effort is required with speeds over 80 MPH.

DRAWING # 57

Fire shield protection hose should be used over all fuel lines forward of the firewall. A light aluminum box is recommended to cover the the vacume pump. A 3/4" blast tube should be directed into this box from the rear of the engine baffle. This is shown for the magnetos as well on drawing 56.

Use cardboard patterns for most of your baffling. Try to get close fits around the engine contours. Pop rivet baffle cloth to the baffle around the engine contours in the back baffle. Silacone putty is sometimes used for this air sealing however, I prefer the baffle cloth.

PAINTING:

As you know all of the wood surfaces are covered with fiber glass deck cloth. Ply surfaces should be sanded prior to laying the deck cloth over the dry wood. Use a razor blade to cut the light weight deck cloth. Always trim off the selvaged edge prior to lapping the cloth. The resin is always poured through the cloth and spread with a plastic squeegee. This seals the ply and makes an excellent base to build a paintable finish coat of enamel. I used a wet slurry of micro, (microballoons and resin) over all of the fiberglass prior to primer, Low spots may take another coat squeegeed like wall plaster to fill.

I prefer air driven sanding tools for surface preparation, using no finer grit than 120 sandpaper prior to primer. An excellent primer is Sterling High Fill. It surface builds, sticks well to fiberglass and is compatible with any of the polyeurthane enamels. Machine sanding the first coat of primer, I recommend no finer grit than 220. The final primer coats can

be machine or wet sanded with 320 grit sandpaper. Remember to clean your spray gun well after each session of spraying when using a two part paint such as Sterling High Fill. The prototype was painted with Dupont Imron for the finish enamel.

Painting of this kind is a difficult craft to learn since most of us have limited experience. Professional help is highly recommended if you don't have the experience or place to do it.

GP-4 WEIGHT AND BALANCE:

Weigh your aircraft with the thrust line at -O-. Use standard weight and balance procedures. Engine oil can be in the engine but no baggage, people, or fuel should be weighed. The cowl seam at the firewall was used as the datum. The wing L.E. is9" aft of the datum. Wing chord is 60".

FORWARD OF DATUM:

Oil.....14"

Nose wheel.....15.375"

AFT OF DATUM:

Main landing gear.....34.25"

Fuselage fuel.....12.5"

Wing fuel.....19.375"

Baggage.....66.625"

Pilot & passenger.....51.0"

MOST AFT CONDITION: Two pilots(170 lbs. each), 75 lbs. baggage, empty wing tanks and 5 gal. of fuselage fuel.

ALLOWABLE LIMIT:

30" aft of datum =(21" aft of wing L.E.) or 35% of M.A.C.

MOST FORWARD CONDITION: One pilot, no baggage and full fuel.

ALLOWABLE LIMIT:

22" aft of datum=(13" aft of wing L.E.) or 21.6% of M.A.C.

MATERIAL LIST FOR THE GP-4

Structural lumber is vertical grain clear spruce. Minimum of 12 growth rings per inch.

FUSELAGE:

3/4" x 6" x 8' S2S 1 ea. 3/4" x3/4" x 8' S4S 11 ea.

3/4" x 3" x 10' S2S 2 ea. Note: S2S= surface two sideds, ect.

3/4" x 3" x 8' S2S 8 ea.

3/4" x 3" x 6' S2S 3 ea. (Canopy bows)

STABILIZER:

3/4" x 3" x 8' S4S 1 ea. 1/2" x 11/4" x 8' S4S 1 ea.

ELEVATOR: 1/2" x 1 1/4" x 8' S4S 1 ea.

FIN: 1/2" x 1 1/4" x 6' S4S 1 ea.

RUDDER: 1/2" x 1 1/4" x 8' S4S 1 ea.

AILERONS: 1/2" x 2 1/2" x 6' S4S 4 ea.

FLAPS: 1/2" x 2 1/2" x 6' S4S 4 ea. 3/4" x 2" x 6' S4S 1 ea.

REAR WING SPARS: 1/2" x 2 1/2" x 8' S4S 4 ea.

L.E. WING SPARS: 1/2" x 3" x 10' S2S 2 ea.

MAIN WING SPAR: (Top Caps)

1/2" x 7" x 12' S2S 2 ea. 1/2" x 7" x 10' S2S 1 ea.

1/2" x 7" x 8' S2S 4 ea. 1/2" x 7" x 6' S2S 2 ea.

Bottom Caps:

1/2" x 7" x 10' S2S 2 ea. 1/2" x 7" x 8' S2S 5 ea.

1/2" x 7" x 4' S2S 1 ea.

WING SPAR DIAPHRAGMS:

1/2" x 7" x 6' S2S 3 ea.

WING NOSE RIBS:

1/2" x 7" x 6 S2S 2 ea.

PLYWOOD, AIRCRAFT GRADE WITH MILL SPEC.

Note: Mahogany plywood must be Phillippine ribbon cut.

4' x 8' x 1/16"	Mahogany	7	ea.	Fuselage and tail
4' x 8' x 3/32"	"	4	"	Fuselage
4' x 8' x 3/32"	"	5	"	Wing skin (All 45 degree grain)
4' x 8' x 1/8"	"	1	"	Wing ribs
4' x 8' x 1/8"	Birch	1	"	Fuselage
4' x 8' x 1/8"	"	1	"	Wing spar web (45 degree grain)
4' x 8' x 1/2"	Mahogany	1	"	Fuselage canopy base and formers

PHENOLIC CABLE PULLEYS:

AN 210-1A	6 ea.	MS 20219-2	4 ea.
AN 210-2A	3 "	MS 20219-4	2 "
AN 219-2	2 "	MS 24566-1B	1 "

TURNBUCKLES:

AN 130-8S	2 ea.	AN 140-16S	4 ea.

CABLE BUSHINGS: AN 111-4, 8 ea. AN 111-3, 2 ea.

CABLE SHACKLES: AN 15-16, 4 ea.

CABLE: 1/8" 7x7 GV, 48' 3/32" 7x7 GV 14' 1/16" 7x7 GV 22'

NICOPRESS SLEEVES: 18-1C, 8 ea. 18-2G, 6 ea. 18-3M, 10 ea.

PIANO HINGE: 20257P4, 18" 2 ea. 20001P4, 12" 1 ea.

TRIM TAB MOTOR: MFG. VON WEISE GEAR CO. MODEL# VW 36A, 1 ea.

MAIN GEAR WHEELS: CLEVELAND 500 x 5 WICKS Kit # 199-102

NOSE WHEEL: GERDES A-1230 4" 1 ea.

TIRES: Main, 500 x 5 6 Ply or equvalent. (Note: Low profile such as Condor will lower wing thickness on bottom profile.)

NOSE TIRE: 10 x 3.50 x 4 1 ea.

THREADED WELD ON AXLES: 1 1/4" x 12" # AX- 1 1/4 x 9 2 ea.

AXLE NUTS: AXN-1 1/4 x 12 2 ea.

MAIN WHEEL TUBES: TB 100-030, 2 ea. NOSE WHEEL: TRB 100-050, 1 ea.

NYLAFLOW LINES AND FITTINGS FOR BRAKES AND UPLOCKS:

Union # 262P-03, 2 ea. Elbow # 269P-03 x 02, 9 ea.

Connector # 268P-03 x 02, 5 ea. Female Elbow # 272P-03 x 02, 1 ea.

Brass Inserts # 2030 x 4, 22 ea. Nylaflow line # SK 8201-3/16, 45'

BRAKE MASTER CYLINDERS: Cleveland P/N 1035, 2 ea.

FUEL LINE FITTINGS AIRFRAME ONLY:

AN 818-4D 20 ea. AN 816-4D 5 ea. AN 815- 4D 5 ea. MS 20822-4D 1 ea.

MS 20819-4D 20 ea. AN 818-6D 6 EA. AN 816-6D 5 ea.

MS 20819-6D 6 ea. MS 20822-6D 1 ea.

ALUMINUM FUEL LINE: 3/8" Dia. 8' VENT LINE: 1/4" Dia. 85'

FUEL VALVE: WEATHERHEAD 4 way, P/N 6747 1 ea. DRAIN VALVES: F391-1B, 3 e

ROD END BEARINGS:

HF 5, 2 ea. XM5, 1 ea. F45-19, 2 ea. HF4, 12 ea.

CW3B-14, 25 ea. HF3, 2 ea.

THREADED ROD END STUDS:

AN 490 HT 6P, 14 ea. AN 490 HT 8P, 13 ea.

AN 490 HT 10P, 2 ea. AN 490 HT 11P, 2 ea.

FORKED ROD END: AN 486-3P, 2 ea.

EYE BOLTS: AN 43B-6, 1 ea. AN 43B-12, 2 ea.

ALUMINUM TUBING: 2024-T3

1/4" x .035 12' 3/8" x .058 3' 1" x .035 8'

RIGHT ANGLE: 6061-T6, 1 1/2" x 1 1/4" x 3/16" 8'

1 1/2" x 1 1/2" x 3/16" 6'

ALUMINUM CHANNEL: 6061-T6, 3/4" x 3/4" x .125 7'

ALUMINUM RIVETS: MS 20426 AD3-5, 1/2 lb. MS 20470 AD3-12, 1/4 lb.

1/8" Dia. MS 20470 AD4-17, 1/4 lb.

ALUMINUM SHEET:	2024-T3	.025	4' x 4'	1 ea.
" "	6061-T6	.032	2' x 2'	1 ea.
" "	"	.050	4' x 6'	1 ea.
" "	"	.063	2' x 2'	1 ea.
" "	"	.080	2' x 2'	1 ea.
" "	"	.125	2' x 1'	1 ea.
" "	"	.160	2' x 1'	1 ea.

STEEL TUBING 4130 Round:

1/4" x .035, 6'	7/16" x .065, 1'	1" x .058, 1'
5/16" x .058, 1'	3/4" x .035, 8'	1 1/8" x .058, 1'
3/8" x .035, 14'	3/4" x .049, 1'	1 1/4" x .065, 1'
3/8" x .058, 4'	3/4" x .058, 32'	1 1/2" x .080, 2'
3/8" x .065, 6'	3/4" x .065, 2'	1 1/2" x .120, 2' 6"
1/2" x .035, 32'	7/8" x .035, 13'	1 5/8" x .058, 6'
1/2" x .058, 3'	7/8" x .049, 5'	1 3/4" x .058, 1'
1/2" x .095, 1'	7/8" x .058, 3'	2" x .065 1'
5/8" x .035, 8'	7/8" x .065, 1'	1/2" x .065, 5'
5/8" x .058, 8'	1" x .049, 6'	

SQUARE TUBING 4130 STEEL:

1/2" x 1/2" x .065, 3' 5/8" x 5/8" x .058, 1' 3/4" x 3/4" x .035, 4'

STEEL PLATE, 4130:

9" x 18" x .050, 2 ea. 9" x 18" x .063, 2 ea. 9" x 18" x .071, 1 ea.

9" x 18" x .080, 1 ea. 9" x 18" x .125, 1 ea.

FIBER GLASS DECK CLOTH (1.4 Oz. per sq. yd.) 50" width, 40 yds.

Note: Other weights such as 4 oz. and 8 oz. boat type glass is not listed as well as microballoons and the resin of your choice.

AIRCRAFT BOLT HARDWARE:

AN3-4, 8 ea.	AN3-43A, 4 ea.	AN4-30A, 4 ea.	AN6-41A, 4 ea.
AN3-13, 5 "	AN4-7, 2 "	AN4-33A, 1 "	AN7-22, 2 "
AN3-16, 2 "	AN4-12, 2 "	AN4-40A, 2 "	AN7-47, 1 "
AN3-5A, 26 "	AN4-20, 2 "	AN4-51A, 4 "	CLEVIS PINS:
AN3-7A, 32 "	AN4-22, 2 "	AN4-52A, 4 "	AN392-7, 2 ea.
AN3-10A, 32 "	AN4-36, 1 "	AN4-54A, 8 "	AN392-29, 1 "
AN3-12A, 86 "	AN4H-20A, 2 "	AN4-61A, 9 "	AN393-9, 3 "
AN3-13A, 55 "	AN4H-23A, 2 "	AN4-64A, 4 "	AN393-13, 2 "
AN3-14A, 58 "	AN4H-30A, 2 "	AN5-21, 1 "	AN393-19, 4 "
AN3-15A, 67 "	AN4-5A, 5 "	AN5-23, 1 "	AN393-27, 9 "
AN3-16A, 12 "	AN4-7A, 4 "	AN5-26, 2 "	AN393-21, 2 "
AN3-17A, 8 "	AN4-10A, 6 "	AN5H-16A, 2 "	AN393-49, 2 "
AN3-20A, 2 "	AN4-11A, 2 "	AN5-5A, 1 "	AN394-17, 6 "
AN3-24A, 8 "	AN4-13A, 5 "	AN5-16A, 2 "	AN394-39, 2 "
AN3-25A, 2 "	AN4-22A, 4 "	AN5-63A, 2 "	AN394-61, 4 "
AN3-26A, 8 "	AN4-25A, 2 "	CLEVIS BOLT: AN231032-23, 2 ea.	

MACHINE SCREWS:

MS 23215-61, 4 ea.	MS 24693-S34, 10 ea.	MS 24694-S66, 20 ea.
MS 24693-S268, 10 "	MS 24694-S60, 22 "	MS 35190-222, 10 "
MS 24693-S52, 8 "	MS 24694-S58, 4 "	MS 35190-238, 8 "
MS 24693-S278, 8 "	MS 24694-S13, 4 "	AN-526-1032R26, 8 "
MS 24693-S50, 50 "		

AN WASHERS, CORROSION RESISTANT:

AN960C-3, 200 ea.	AN960C-4, 100 ea.	AN960C-3L, 100 ea.
AN960C-4L, 100 "	AN970-3, 30 "	AN970-4, 30 "
AN936-A10, 30 "	AN936-A416, 30 "	

ENGINE COWL FASTENERS, FLUSH PHILLIPS HEAD:

4002-6, 42 ea. 4002 series receptacle 214-16D, 42 ea.

STROBE AND POSITION LITE ASSEMBLY:

Mfg. Wheland P/N A650-PG/PR-14, 2 ea. (One green, one red)

Two outlet power supply and strobe wiring harness. Figure a 25 foot span with a center, fuselage mounted, power supply for length.

ENGINE MOUNT ASSEMBLY: (Available from Wicks Aircraft Supply)

IO-360 Lycoming Mount Ring. P/N 33521

One set of Heavy Duty Dynafocal Mountings. P/N 50401-300

Four Spacers. P/N 50588P1

UPLOCK COMPONENTS: ARO Micro Air Cylinders, series 01-0176-3019, 2 ea.

ARO Air Control Valve, Model # 213B, 1 ea.

MONROE AIR SHOCK PUMP. P/N 25185-1, 1 ea.

FLIGHT INSTRUMENTS: (Wicks Catalog #)

3 1/8" True Airspeed (0 to 300MPH, Knots also on inner face) P/N TA1

" Sensitive Alt. P/N ALT 1

" Vertical Speed Ind. P/N VSI 0 to 3,000 FPM

GYROS:

3 1/8" Turn Coordinator (Electric) TC-14

" D/G Vertical Card.

" A/H Blue Face.

ENGINE INSTRUMENTS, WESTACH:

3 1/8" Quad. EGT P/N 3AQ2, Four Senders. P/N 712-2WK

" " CHT P/N 3AQ1, " " P/N 712-5W

" " Oil press., Oil Temp., Fuel Press.,Ampmeter. Order with all senders

OTHER ENGINE INSTRUMENTS:

3 1/8" Tachometer, clockwise rotation and mechanical.

" Combination M/P and G.P.H., calibrated to the Lycoming IO-360 200 H.P. engine

MATERIAL LIST:

There are a few materials that have been deleted from this list that are readily available from your local hardware store. The light aluminum angle, wood screws, varnish, small items of this kind.

None of the hard bronze bushings are listed. Bushing stock, in all fo the sizes shown on the drawings, are available in different lengths. You may want to purchase bushings with the minimum amount of waist. Your local bearing house supply can guide you in what is available.

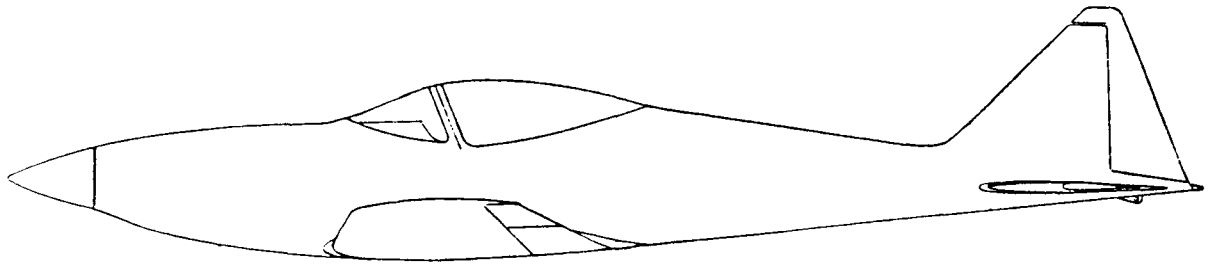
Fiber glass resin is deleted because of the many different types available and the builders preference. I prefer epoxy or vynalester to minimize shrinkage.

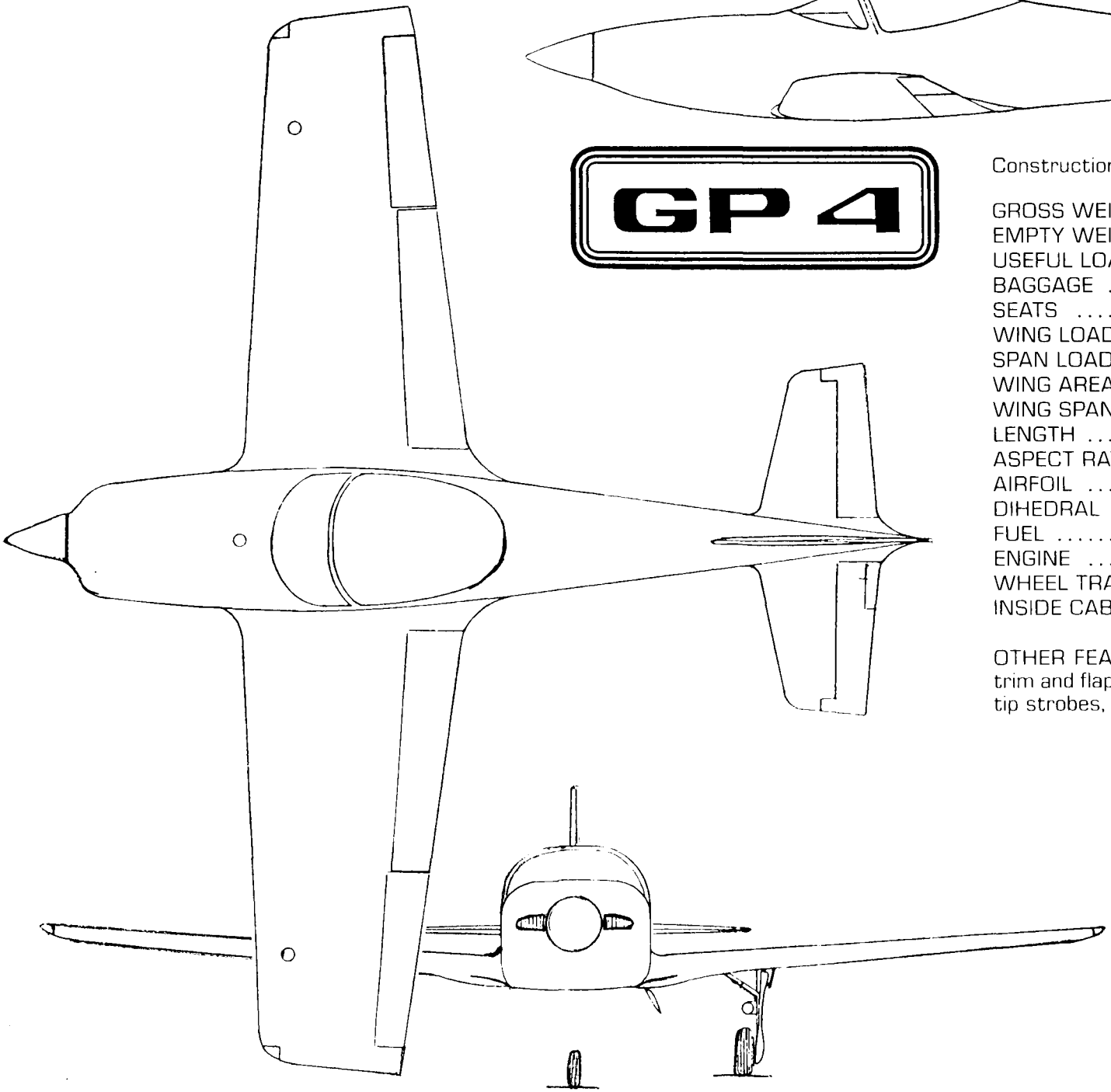
There are several wood adhesives available that I have used on the GP-4 that makes glueing pressures and close tolerance fits much easier. All were epoxys and are listed as follows. APCO # 9921, gel time 33 minutes. APCO # 9922, gel time 120 min. Comes in a squeeze bottle, part 1 & part 2. Drys clear. 50/50 mix. T-88, formulated for wood. drys clear, 50/50 mix. Squeeze bottle. Hughes FPL-16A, 10 to 1 mix, drys white in color. Should have 70 degrees or more to cure. Has excellent penetrating qualities. Good for spar laminating. It is more difficult to use however.

I would be very careful about making any major design changes in your GP-4. Your plans represent a very high performance aircraft that is a delight to fly.

I would appreciate a call or note on your progress when you get the time.

Good luck,
George





GP 4

GP-4 SPECIFICATIONS

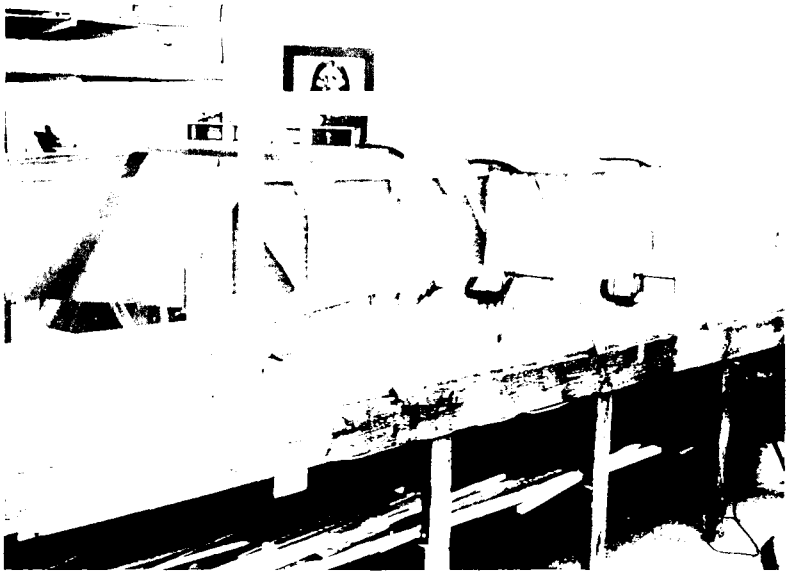
Construction: Primarily wood with some foam and fiberglass.

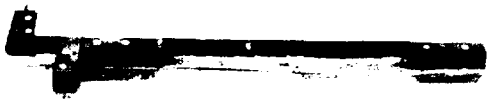
GROSS WEIGHT	1985 lbs.
EMPTY WEIGHT	1248 lbs.
USEFUL LOAD	739 lbs.
BAGGAGE	10.5 sq. ft. -75 lbs.
SEATS	2
WING LOAD (FULL GROSS)	19.09 lbs./sq. ft.
SPAN LOADING	80.45 lbs./sq. ft.
WING AREA	104 sq. ft.
WING SPAN	24 ft. 8 inches
LENGTH	21 ft. 6 inches
ASPECT RATIO	5.54 to 1
AIRFOIL	Laminar 63 series
DIHEDRAL	5 degrees
FUEL	54 gallons
ENGINE	IO 360-A1A Lycoming
WHEEL TRACK	8 ft.
INSIDE CABIN WIDTH	40 inches

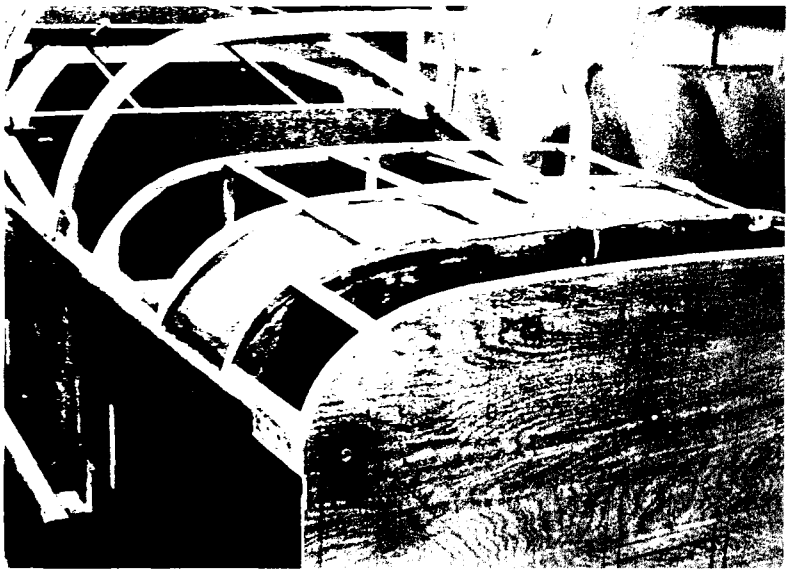
OTHER FEATURES: Manual retracting tricycle gear, electric trim and flaps, steerable nose wheel, full light system including tip strobes, IFR panel.

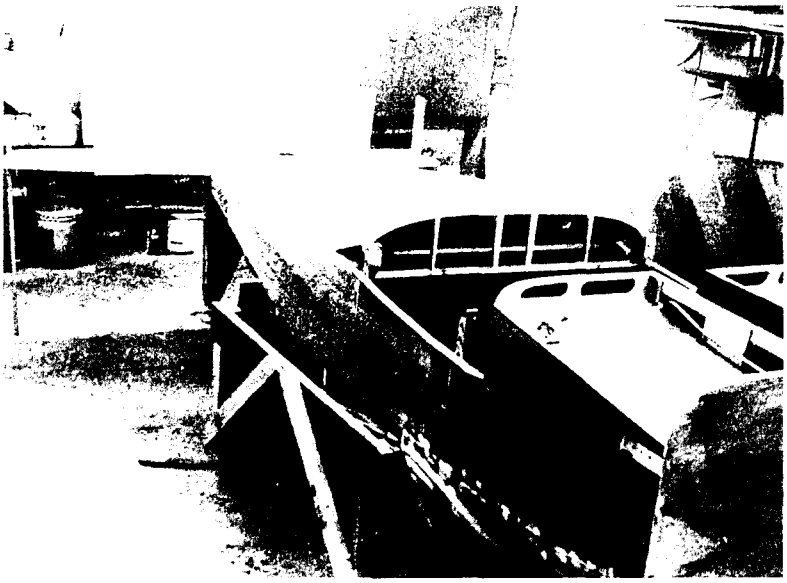
PERFORMANCE

Cruise speed 75% power	240 mph
Stall speed (clean)	65 mph
Rate of climb (full gross)	1500 F.P.M.
Rate of climb (2 people, ½ tanks)	2200 F.P.M.
Range at: 75% power	1100 mi, 240 mph
Range at: 60% power	1250 mi, 225 mph







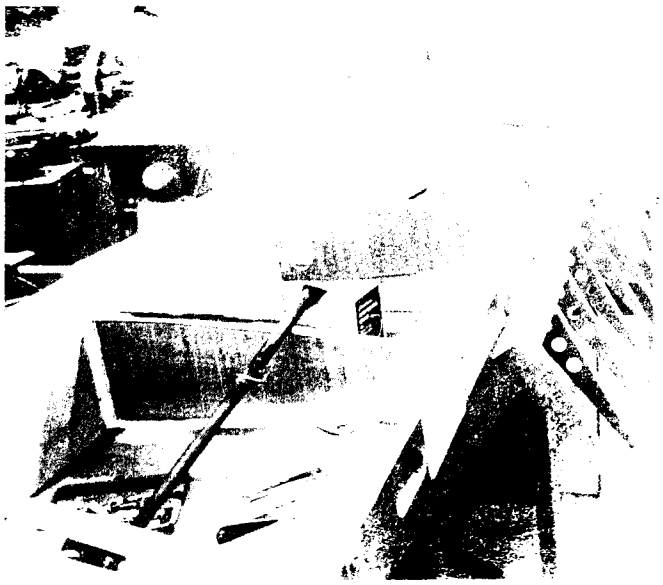


(Above) Wood fuselage side shown in gluing jig.

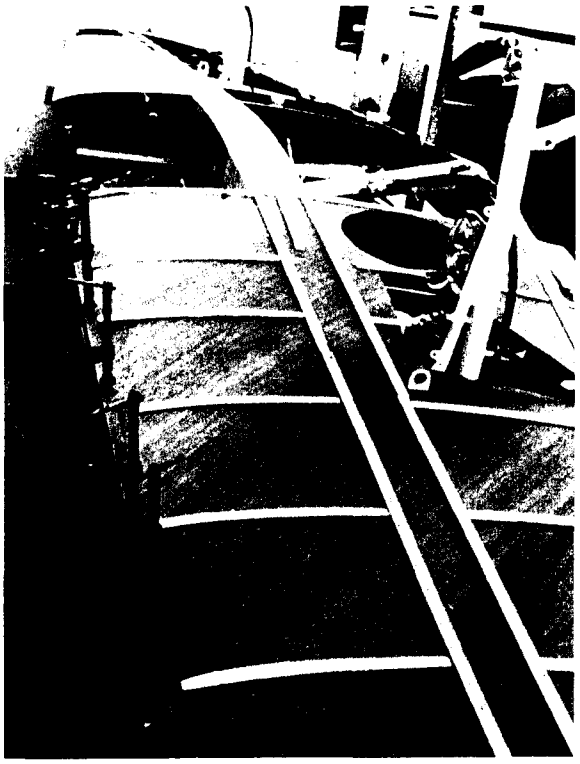
(Left Top) Completed fuselage sides shown inside construction frame jigs.

(Left Center) Fuselage front view showing 17 gallon tank over laminated windshield bow.

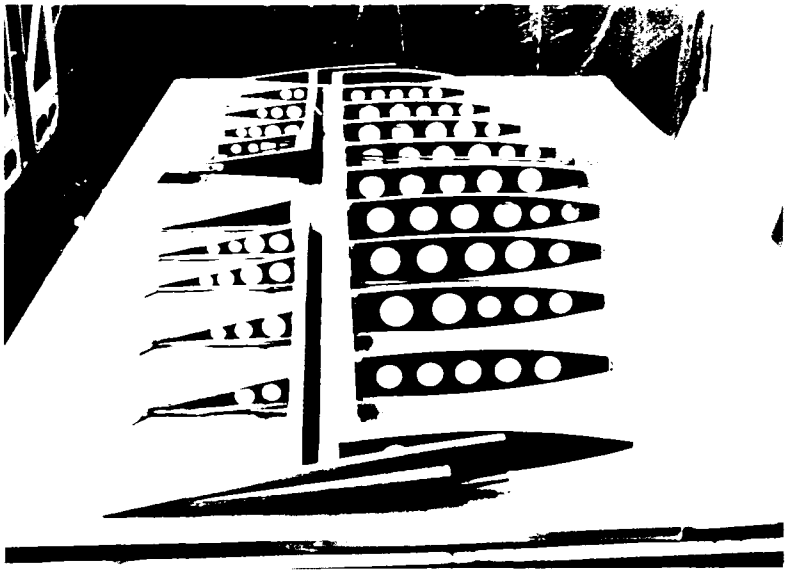
(Left Bottom) Fuselage shown upside down. Large open area accomodates wing assembly.



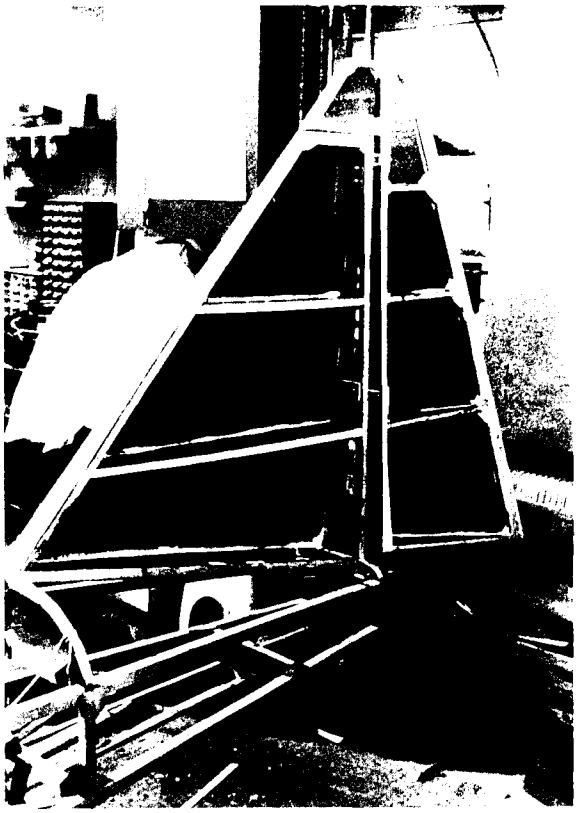
Aft wing section. Flap in temporary position to show placement.



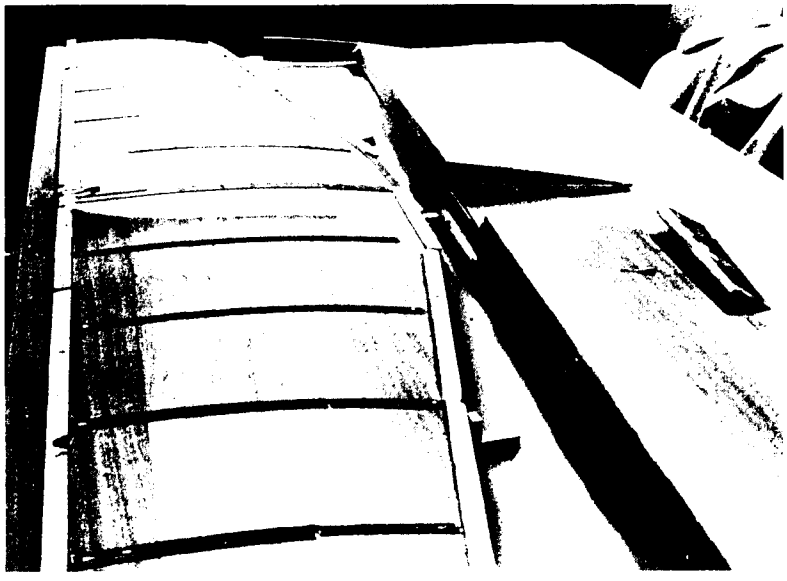
Bottom wing skin being installed with nailing strips and clamps. Note landing gear and landing light.



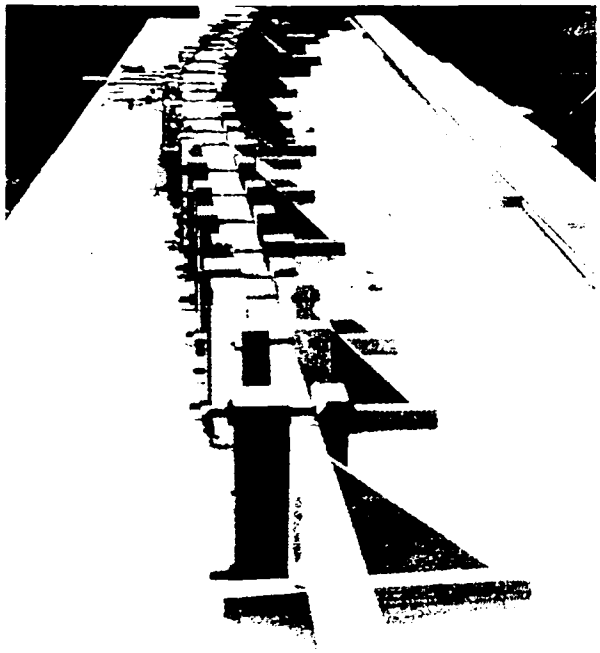
Unskinned elevator and stabilizer.

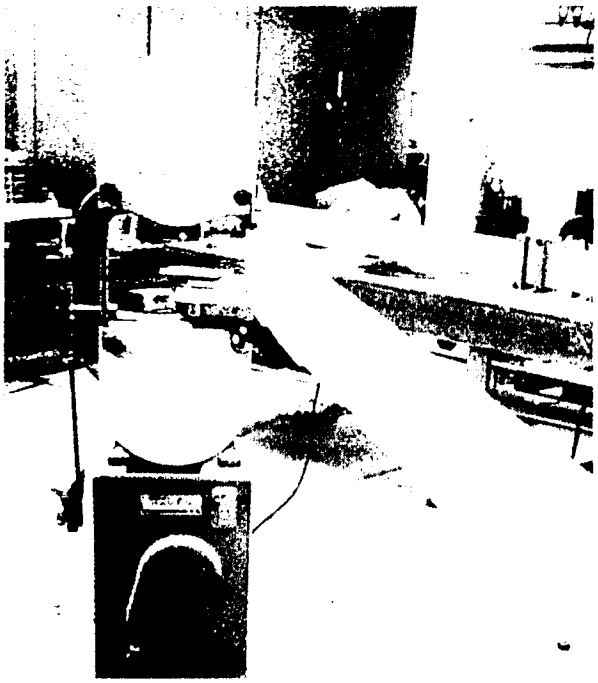


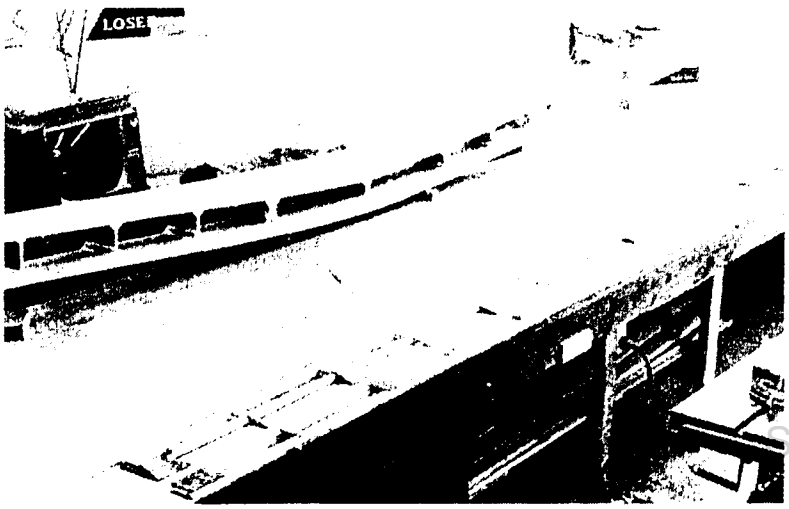
Fin and rudder assembly, one side skinned.

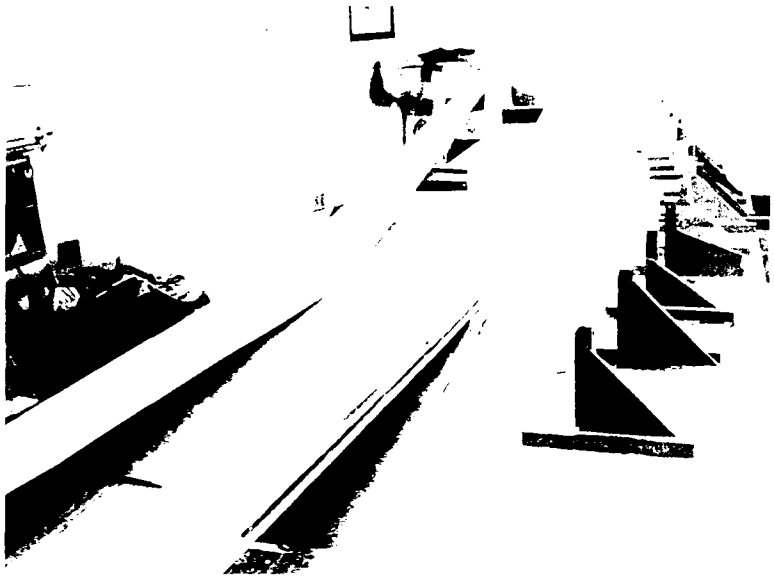


Elevator and stabilizer after installing skin. Note trim tab.

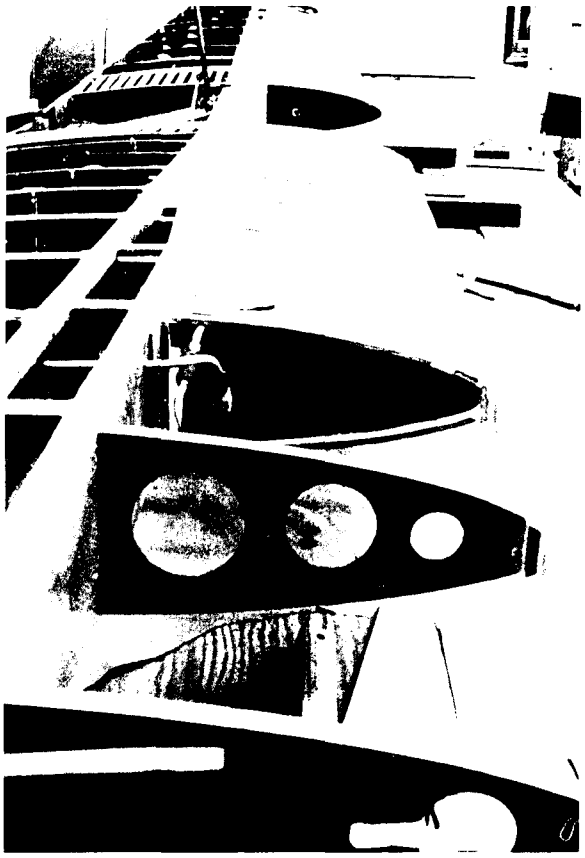




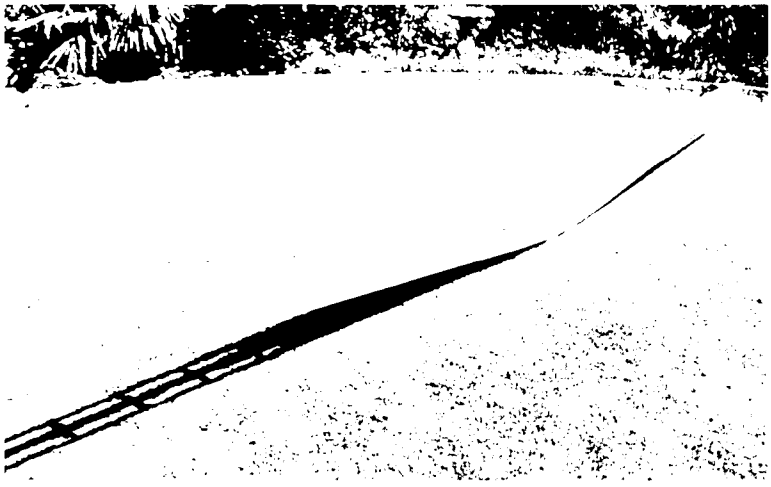




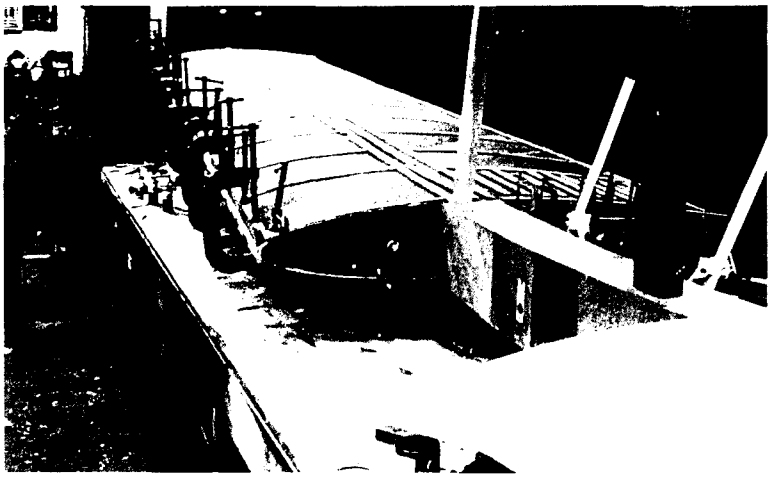
Wing Spar Caps. Top cap on left has been completed, bottom cap ready for shaping. Gluing jig on right.



Wing leading edge. Note fuel vent line and wing walks.

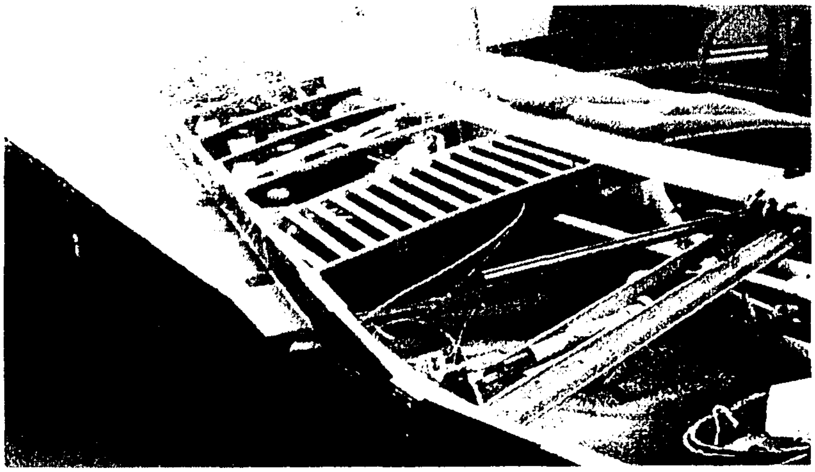


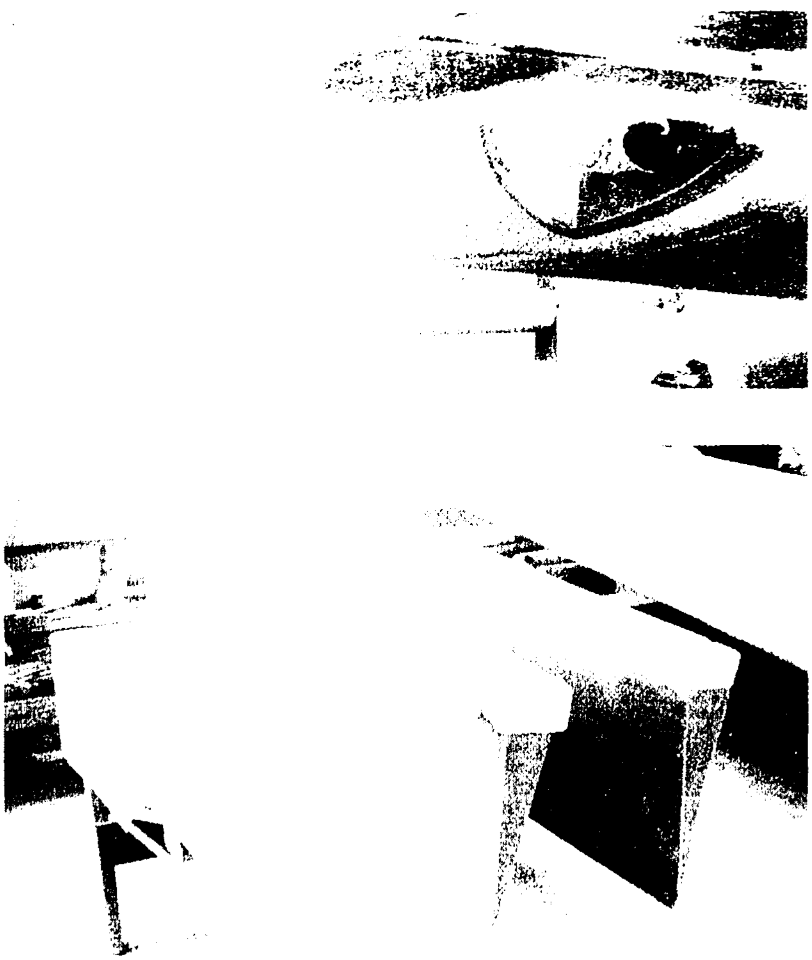
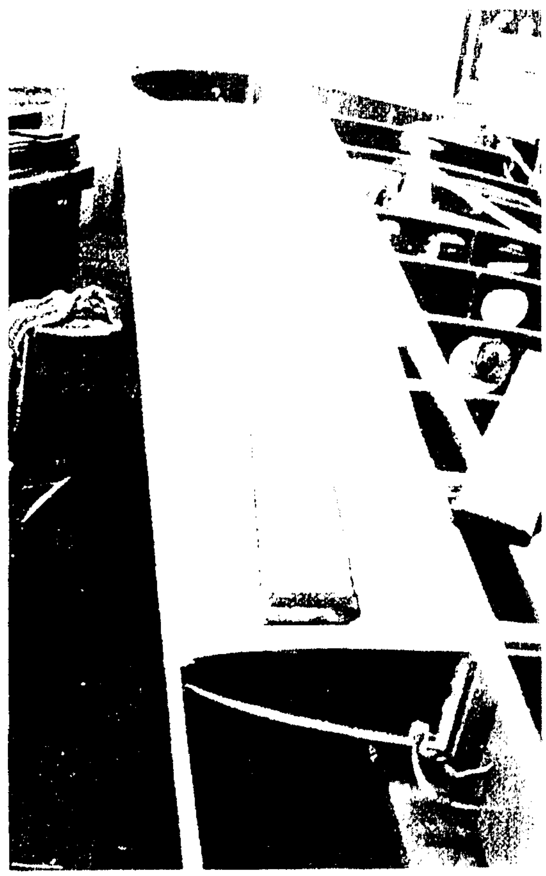
Complete 24' one piece spar less plywood webs.

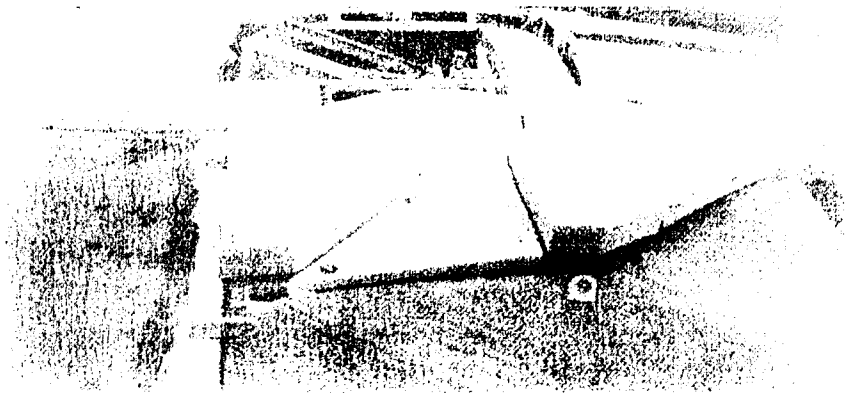


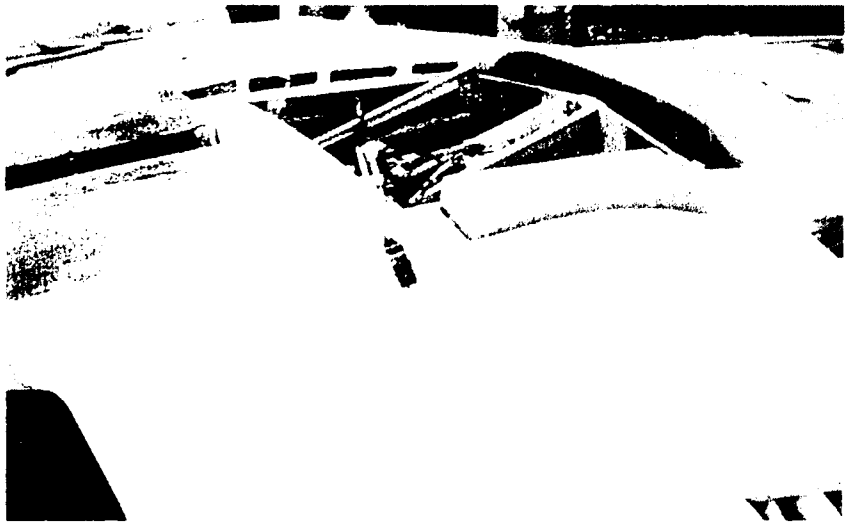
Applying plywood wing skin using nailing strips and "c" clamps.

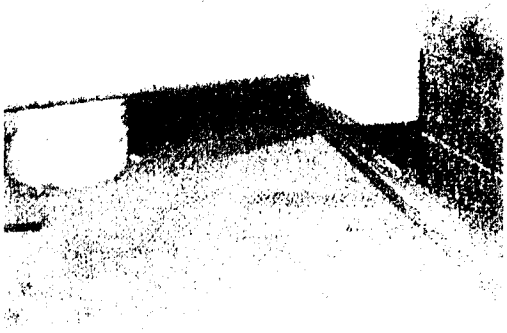
18.5 gallon fiberglass fuel tank (one side). Note outboard filler cap location.

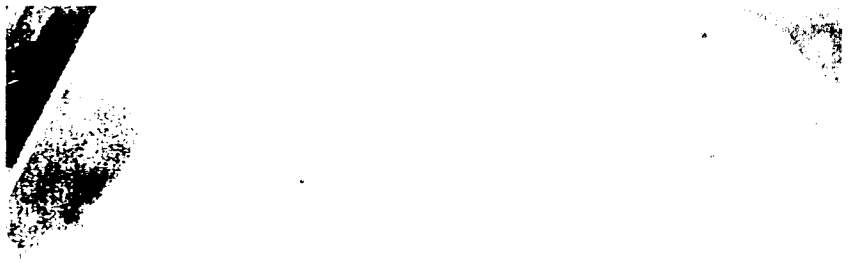


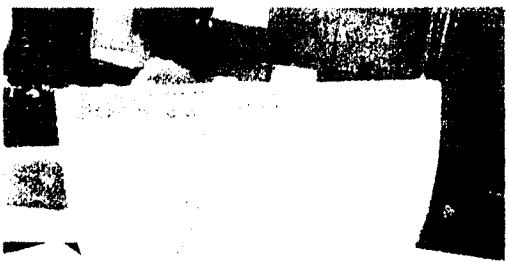




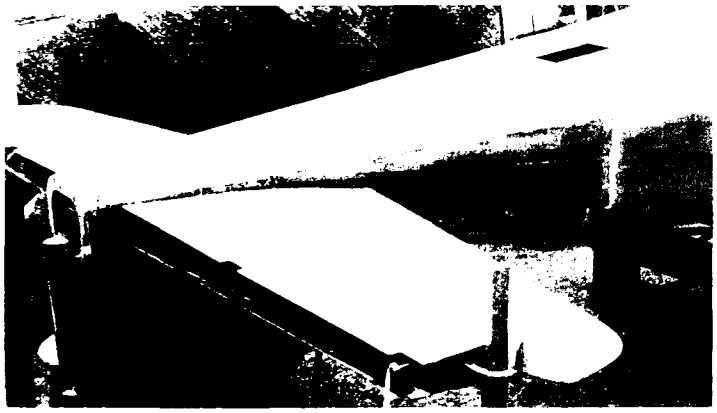


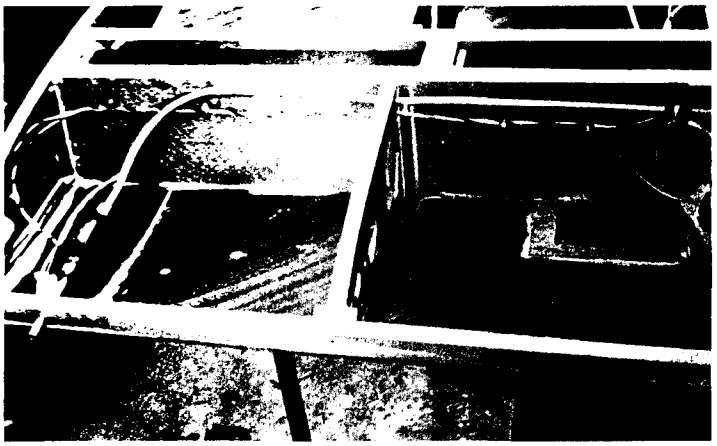


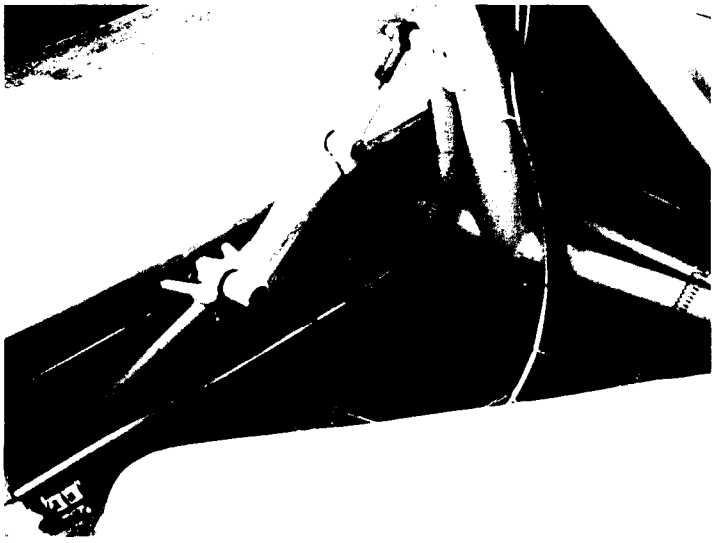


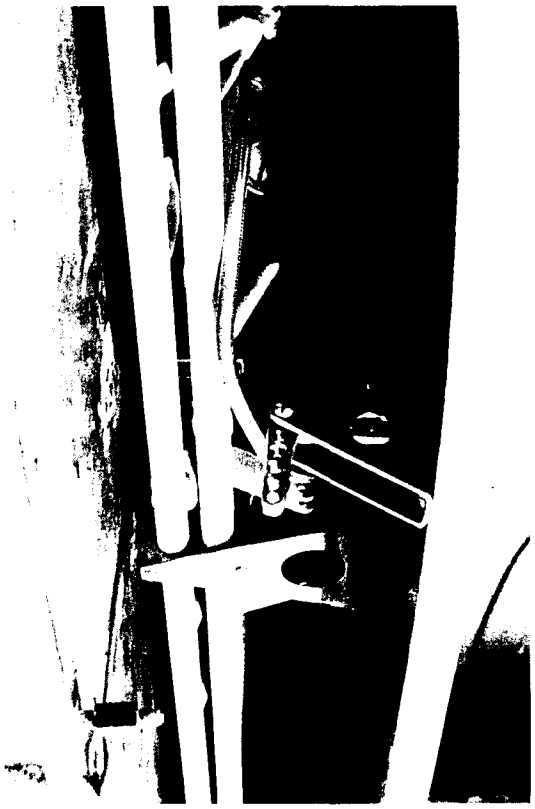


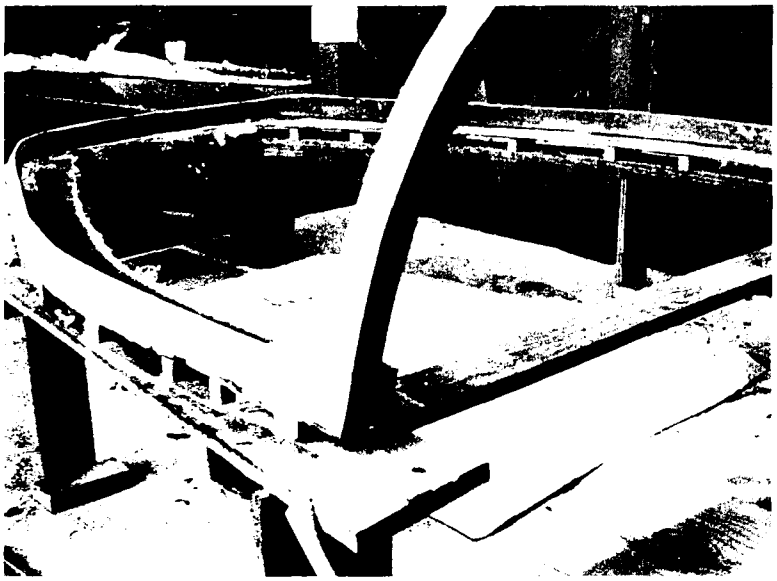








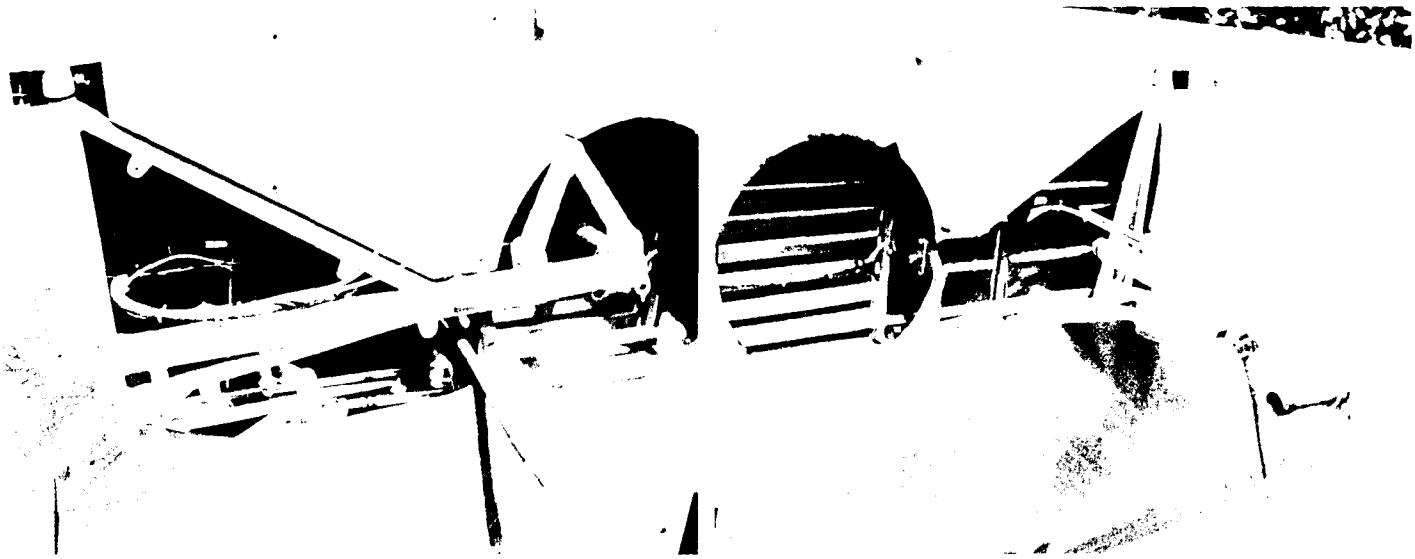


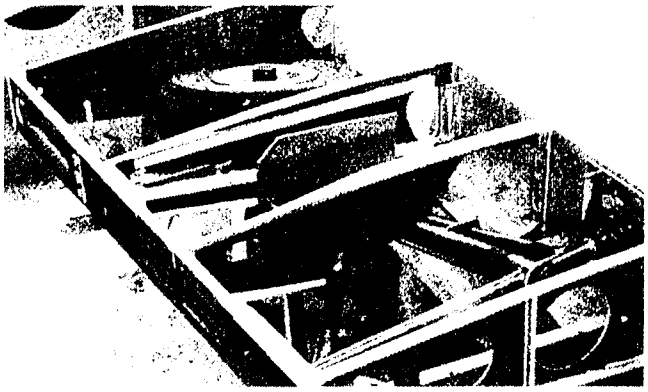


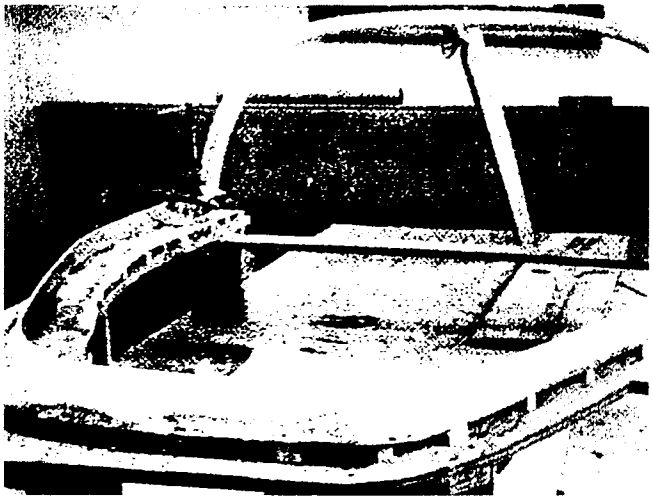
Laminated canopy bow with fiberglass skirt.

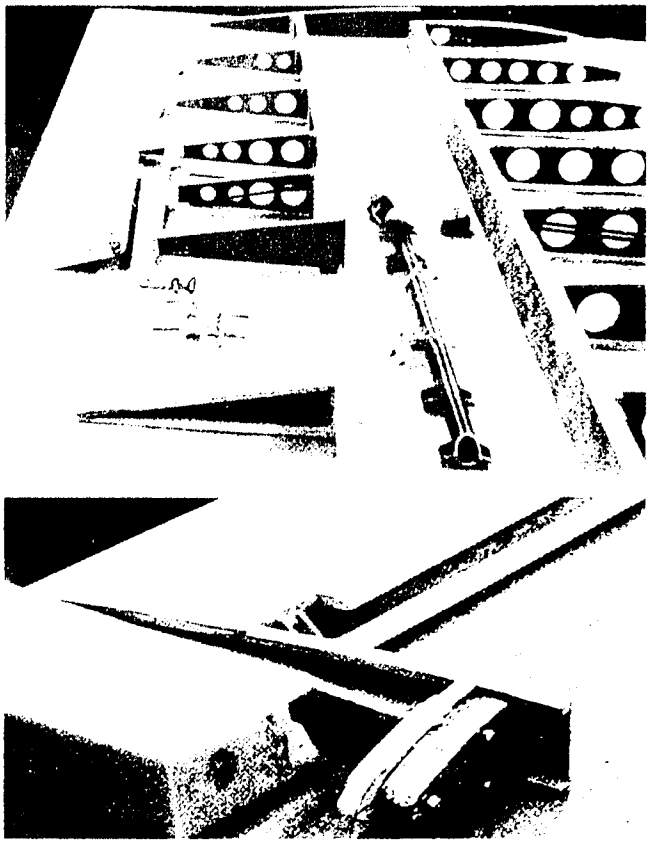
Aft fuselage showing plywood formers. Note canopy track loacation.

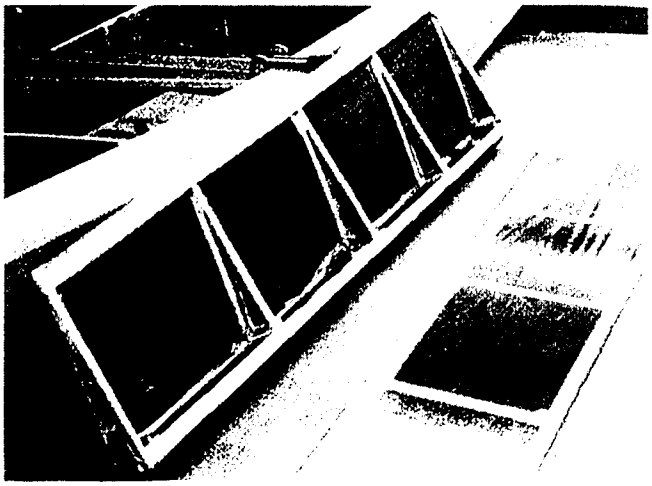
Landing gear shown up and down. Note wing walk reinforcement and 45 degree plywood installation.

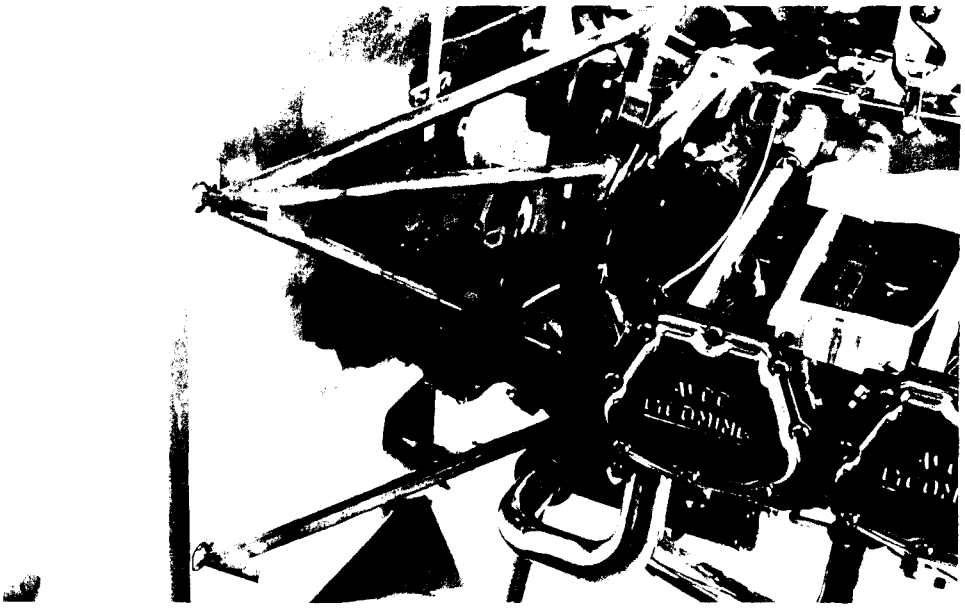




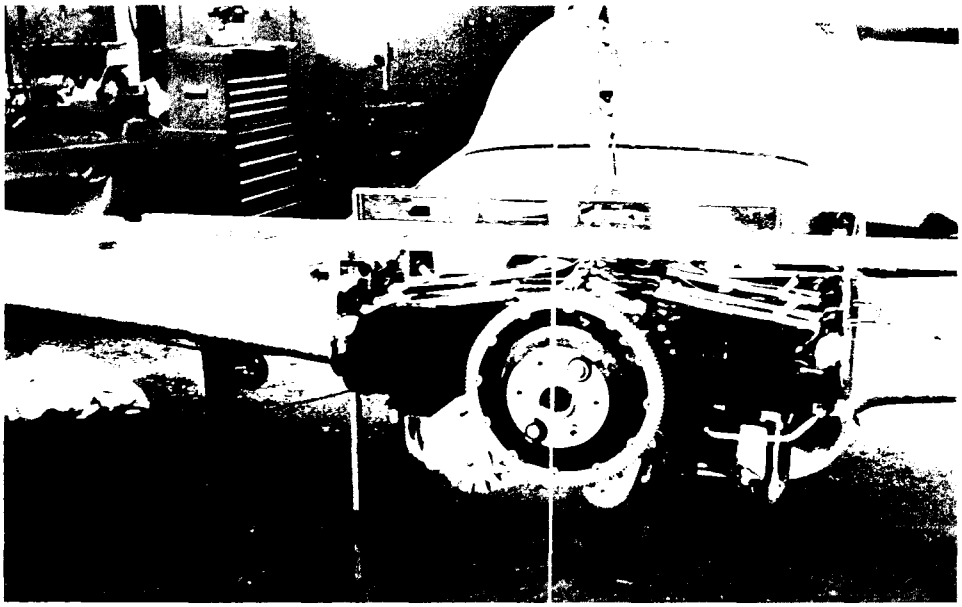






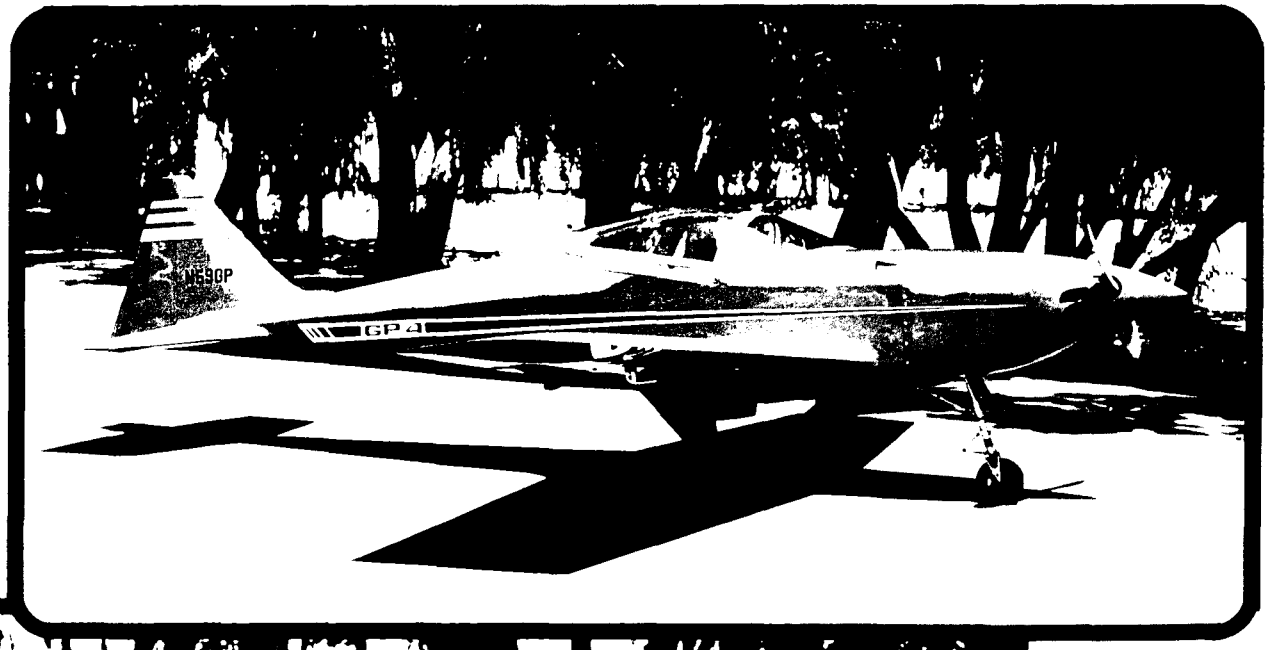


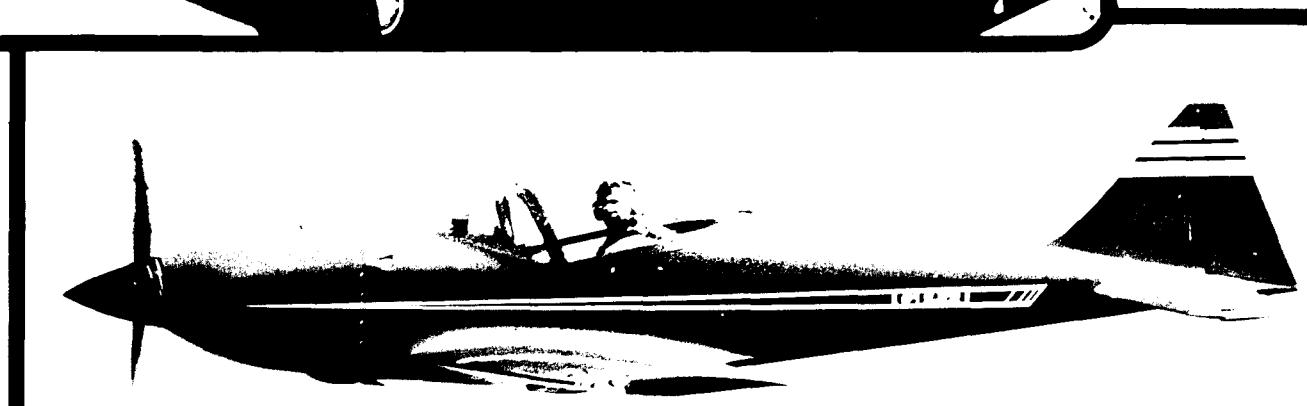
Firewall and engine mount detail showing fuselage attachment.

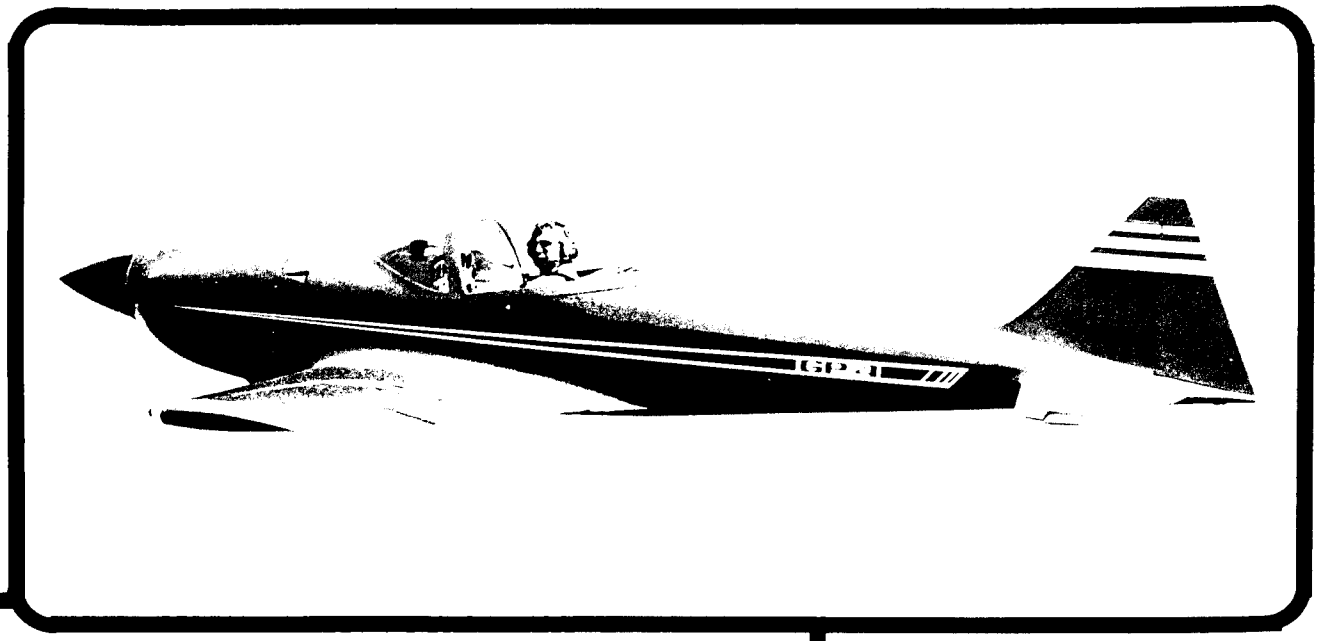


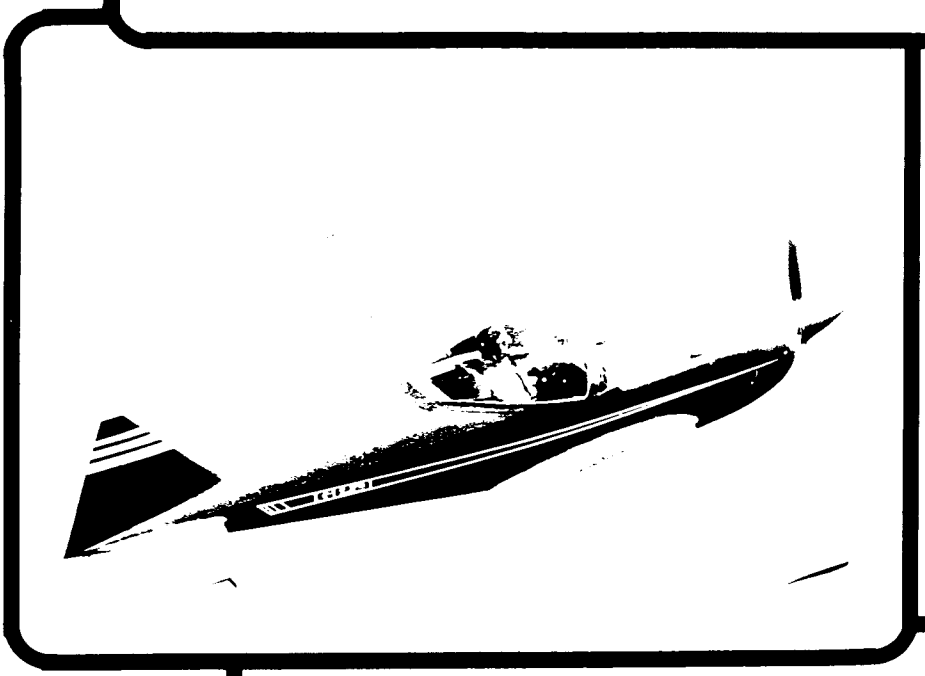
Engine alignment, using level and plumb bob to assure exact thrust line placement.

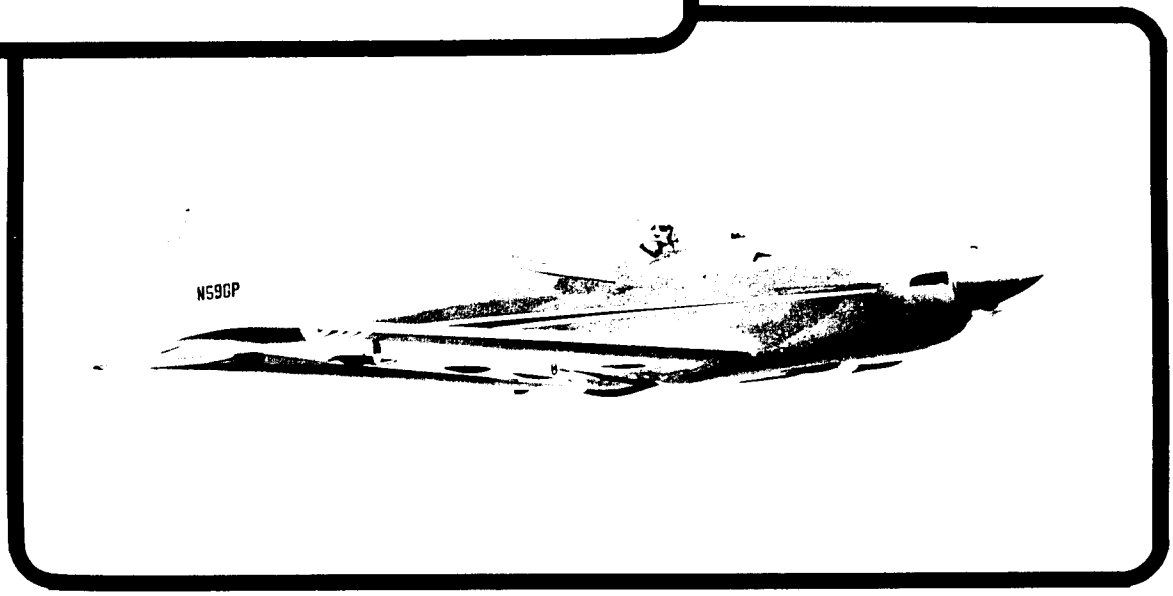
Spinner in place to establish cowling conture lines.

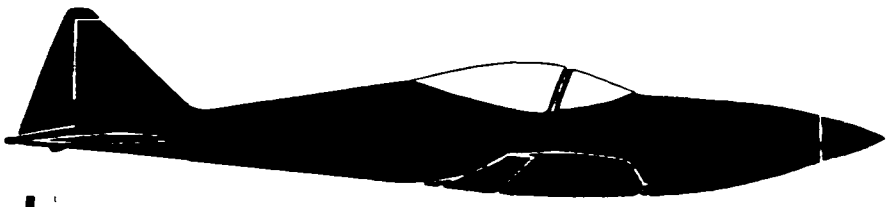












HYDRAULIC LANDING GEAR CONSTRUCTION MANUAL

Serial Number _____

3741 El Ricon Way, Sacramento, CA 95864

GP 4

GP-4 HYDRAULIC LANDING GEAR

The Gp-4 hydraulic landing gear retraction system was designed for builders wanting a more sophisticated retraction method other than the mechanical design used on the prototype. The advantages are obvious, flip a switch, sit back and fly the airplane. If there is a disadvantage, it is the possibility of electrical or hydraulic failure; or perhaps a little more component expense. I feel that if you have a sound redundant option of getting the gear down, the hydraulic system is a nice way to go. The hydraulic system has fewer parts than the manual system. It also will save considerable construction time.

You have to decide to use the hydraulic gear prior to covering both sides of the nose gear tunnel with the 3/32" ply. You must also have the wing exposed as the main gear and link assembly is in a different location. The main gear and nose gear struts are basically the same as the original drawings. The change is the retraction links for the main and nose gear assemblies. A retrofit into a finished wing would be difficult!

DESIGN PHILOSOPHY:

Some retraction designs use hydraulic pressure to hold the gear and gear doors in place. They use a pressure switch that turns the pump on if pressure starts to drop. Unfortunately, if you develop a leak, the gear keeps cycling in and out of the wells or it will pull out under high G loads as the pressure drops. I chose to use mechanical uplocks on all three gear struts. This allows the hydraulics to be shut down after retraction. Since the main gear doors are bolted to the struts and the inner doors close by mechanical linkage to the struts, the uplocks will keep the wheels tight in the wells and the doors flush with the bottom of the wing. At 240mph, the aerodynamic down load on the curved main gear doors is very high. Couple this with a four or five 'G' turn and you can see the value of the uplock.

Another feature I feel is very important is the use of a squat switch shown on dwg. M-8. With weight on the main gear strut, the gear will not retract when the master switch is on and the gear switch is accidentally moved to the up position. This can save a lot of embarrassment and maybe a new Hartzell!

EMERGENCY OPERATION:

There are three simple functions to do to get the gear down in the event of electrical or hydraulic failure.

1. Slow the aircraft to below 110mph. Turn the emergency valve 90 degrees. This opens a passage so that the hydraulic fluid can flow back into the pump reservoir. It also bleeds any possible air lock in the cylinders as both the up and down manifold is open to the reservoir.
2. Pull uplock release cables on all three uplocks. The main gear will free fall into a locked position. It's held there by the spring attached to the strut and link assembly. Dwg. M-7 & M-8. The nose gear will only free fall about 20 degrees as the relative wind against the strut and door holds further travel.

3. Pull the T-handle until the nose gear link locks into the full down position. The gear down augmenting spring assists the pull down and locks the link as well. If you still have electrical power, you should get a three, green down light indication.

GEAR LIGHT INDICATORS:

You have three green lights and one red light. They indicate as follows.
Gear down: All three green lights go on when all three gear links are locked tight. The red light is on only during transit. If it stays on, you have one or more links that are not tight in the down position.
Gear up: Red light goes on while gear is in transit. Green lights go off. Red light goes off when all three uplocks are locked. If the red light stays on, one or more uplocks are not locked. You should slow your aircraft to below 110mph and recycle the gear. Its probably a failed micro switch out of adjustment.

WARNING HORN:

The horn will blow anytime the throttle is retarded if one or more landing gear links is not tight in the down mode. The red light will also stay on. Some feel that the indicator light system is adequate by itself. The horn is just another safety warning factor you should consider. If you use a horn, get one loud enough to be heard while wearing a head set. If it's electronically dirty, causing static in your head set, so much the better.

LIMIT SWITCHES:

All of the micro switches have three poles. They are embossed as follows.---
NO=normally open, NC=normally closed, COM=common (see dwg. M-9).

For gear up operation , the hydraulic pump flows fluid into the up manifold which activates the main gear cylinders to extend while the nose gear cylinder retracts. When the three, up micro switches are made, the hydraulic pump shuts off. All lights are now out.

In the up mode, the main gear struts have to retract far enough to engage all three up locks which then activates the three up switches. To be sure that all three up locks engage, you need about 1/8" of play between the up locks engaging and the strut stop. The strut stop is the notch in the bottom side of rib #2. This play allows the strut to retract far enough past the up lock to insure uplock engagement, thus closing the micro switch mounted on the uplock. (See dwg. M-7). Remember, if one uplock switch is open, the hydraulic pump will continue to run, indicated by a red light.

Note that all of the micro switches are adjustable. Use lock washers on all of the #4 attachment screws to lock the final adjustment.

When you have your GP-4 up on jacks for final adjustment, you may want to add 5 to 10 lb. to each main gear strut while testing retraction. The weights will simulate part of the aerodynamic down load imposed by the curved shape of the gear doors.

CYLINDER CAMS:

There is only one adjustment for the three cams. (Dwg. M-7 & N-4) They screw in or out with a locking jam nut.

In retraction, the main gear cylinder cam moves inboard, up against the slot end. The link now breaks and the uplock ball bearing, (dwg. M-7) rides up over the cam lobe and the uplock is now in a position to lock into the uplock stud. (Dwg. M-5).

In the gear down mode, the main gear cylinders start retracting which moves the cam outboard against the slot end. The ball bearing then rides back over the cam lobe which trips the uplock . The main gear is now free to come down. The cylinder does not quite bottom out, so the cylinder piston is under pressure which holds the link tight in the down mode. (See dwg. M-8).

The nose gear cylinder works in reverse to the main gear cylinders. As the nose gear cylinder extends to put the gear down, the cam first trips the door uplock and then the gear strut uplock which extends the gear to the down and locked position. As the nose gear is going down, the roller arm ball bearing has past over the cam lobe and rolls up the cylinder shaft. (See dwg. N-2 & N-3)

PLUMBING:

The hard plumbing is all 1/4" X .035, 5052-0 aluminum or 1/4" X .035,6061-T6 tubing. All flairs are 37 degrees. I recommend steel coupling nuts, (AN 818-4) and steel sleeves , (MS 20819-4). The elbows can be aluminum, (MS 20822-4D).

The plans show Aeroquip 303 flexible hose. The 303 hose uses a female fitting, (Wicks P/N 491-4). Aeroquip or Stratoflex hoses and fittings are good for 3,000 P.S. I.. If you make up your own hydraulic hoses, be sure to use a #4 mandrel. (Wicks P/N MT 2701-4). The mandrel keeps from cutting a flapper out of the hose which can plug the line. Should you use other types of hoses and fittings, you need a minimum of 1,500 P.S.I. capacity.

The Oildyne hydraulic pump is a horizontal mount, 108 series. The address shown on dwg. M-5 is the manufacturer. They will probably refer you to a dealer. You will have to braze or silver solder a female, (1/8" pipe thread.) fitting either to the side or bottom of the pump reservoir. In this fitting, you will be using a MS 20822-4D elbow or a straight nipple AN 816-4D, depending on how you arrange your #4 hoses.

You should have the manufacturer or dealer set the hydraulic pump at 1,000 P.S.I. for both up and down outlets.

The hydraulic fluid can be CITGO DEXTRON II multi purpose hydraulic oil. Actually, this is automatic transmission oil. You can also ask the dealer what he recommends.

The hydraulic oil tends to dissolve varnish so you might consider a fiber glass or plastic tray under the filler portion of the hydraulic pump. A tray is not shown in the plans.

The gear switch, (dwg. M-9), is not called out by number. I recommend a type that requires a locking arrangement. Most certified aircraft have a switch that must be pulled

out before you can move it up or down. Some switches have a small wheel attached to the switch handle which identifies it as a gear switch. These switches are ideal but expensive. Its your choice. Remember, the components shown on these drawings are drawn as right side components only. Be sure to make both right and left components as required.

Good luck with your installation.

George

GP-4 DELETIONS AND CHANGES

The following is a list of components that are deleted or changed from the GP-4 plan set.

Dwg. 2 & 5: See new mount blocks for nose gear tunnel.

Dwg. 15: Eliminate cut out in right seat back. Make right and left seat frames the same.

Dwg. 18: Wing ribs 1, 2 & 3 have new mount blocks. See new drawings.

Dwg. 24: See rib spacing on new drawings, ribs 1, 2 & 3.

Dwg. 28: Eliminate .125 thick spar plate and entire manual retraction assembly. Center seat rails attach directly to spar shown on new drawing M-5. Maintain the 3/4" X 3/4" square tube for control mounting.

Dwg. 29: Eliminate pulley and cable assembly.

Dwg. 31: Eliminate landing gear retract handle and nose gear push rod.

Dwg. 33: Eliminate cable and augmenting spring from gear leg arm to aileron bracket. See new gear leg dwg.

Dwg. 35: See new dwg. M-6 for change in gear leg and possible elimination of scissors.

Dwg. 35: Eliminate retracting link. See new dwg.

Dwg. 36: See new dwg. for link bearing mount M-7.

Dwg. 37 & 37A: Eliminate uplock assembly.

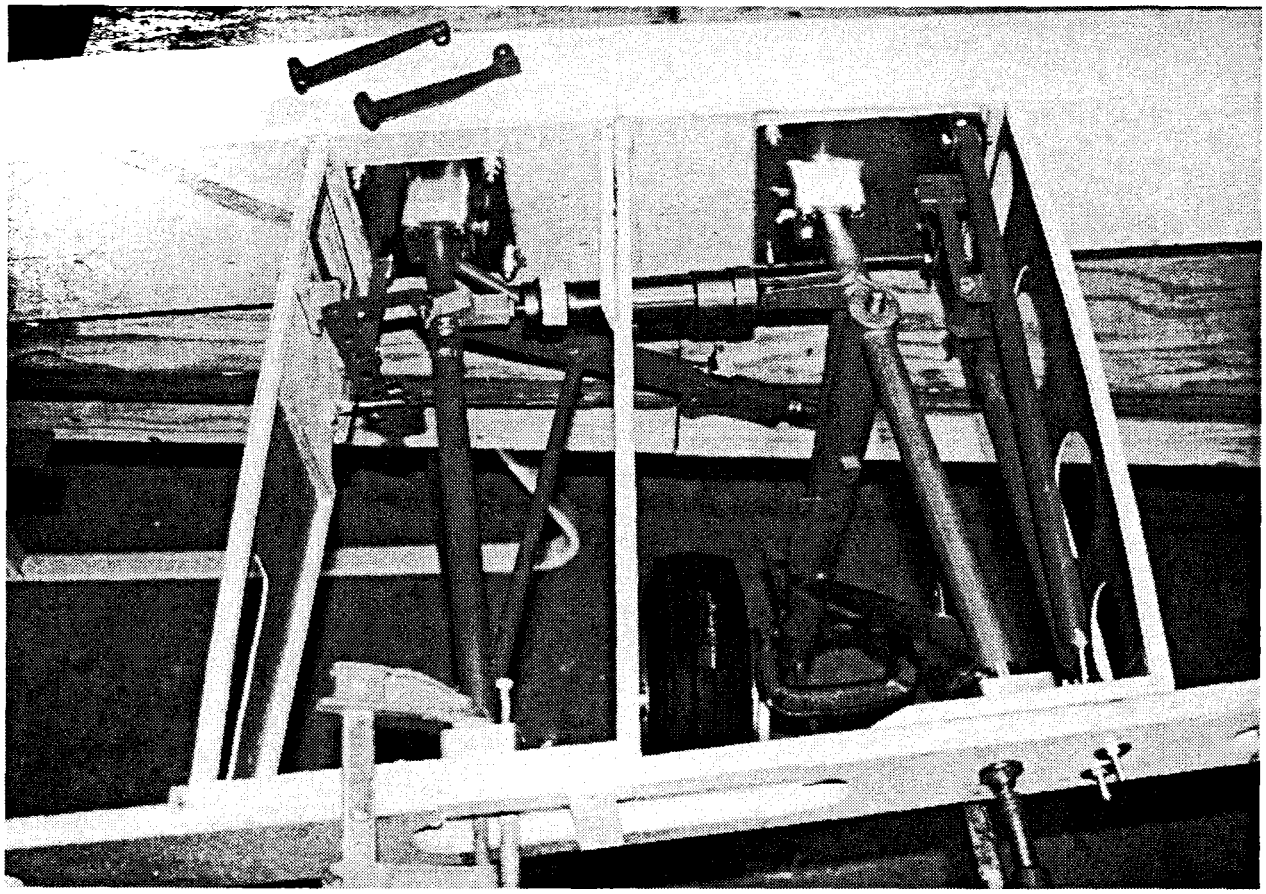
Dwg. 40: See new wiring diagram for hydraulic gear.

Dwg. 44: Eliminate all assemblies to close inner wheel doors. See new dwg. M-8.

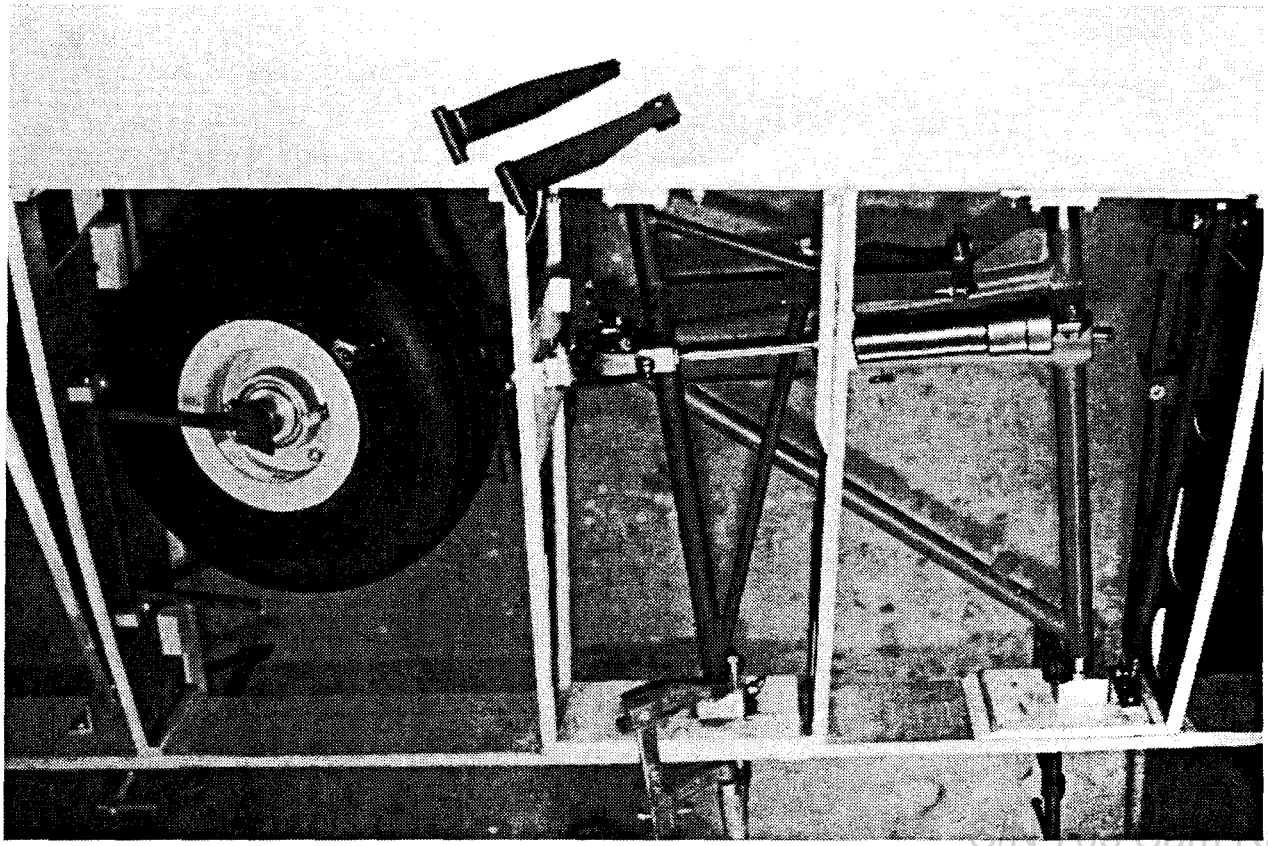
Dwg. 48: Eliminate nose gear spring assembly.

Dwg. 50: See new link dwg. N-3 for arm and bracket additions . Link dimensions are the same as on dwg. 50.

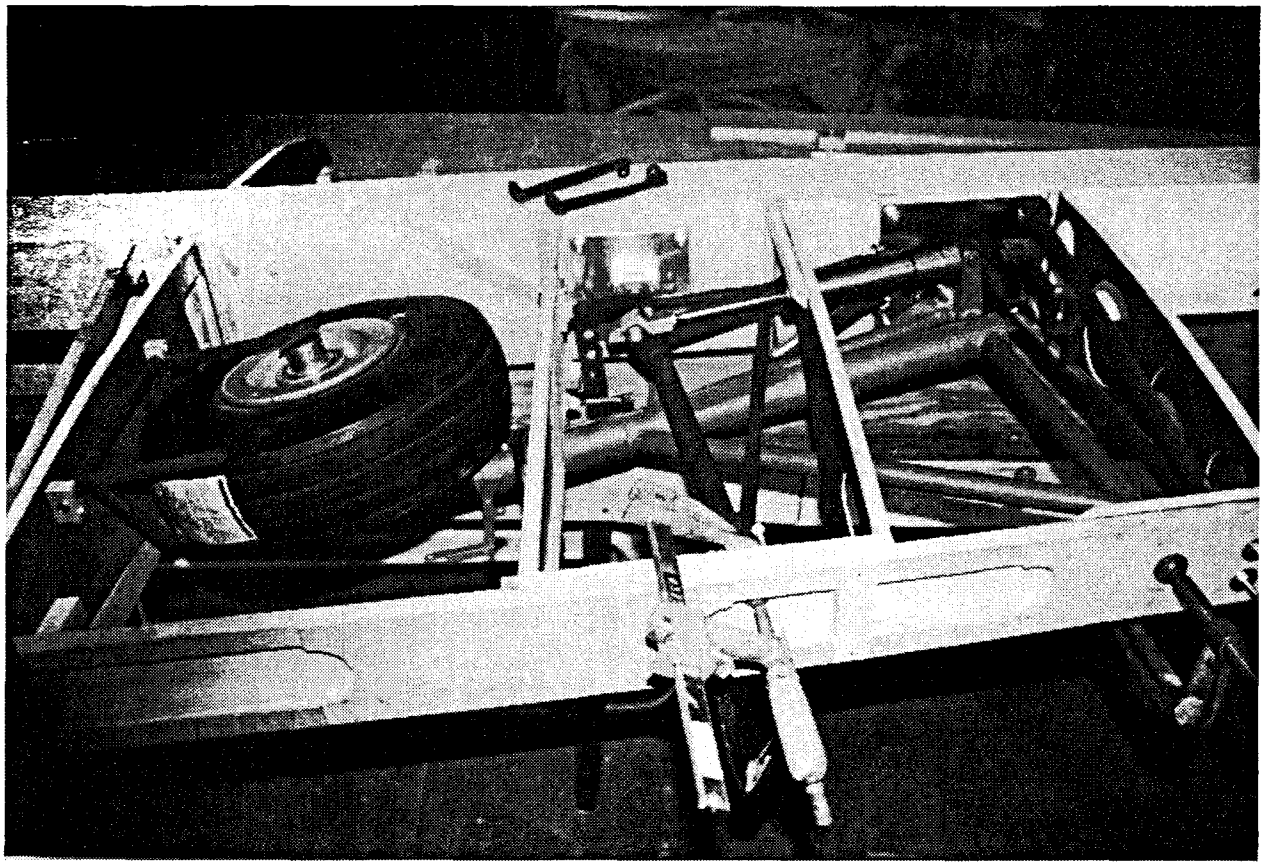
Dwg. 56: Eliminate nose gear door closure assembly. See new assembly dwg. N-4.



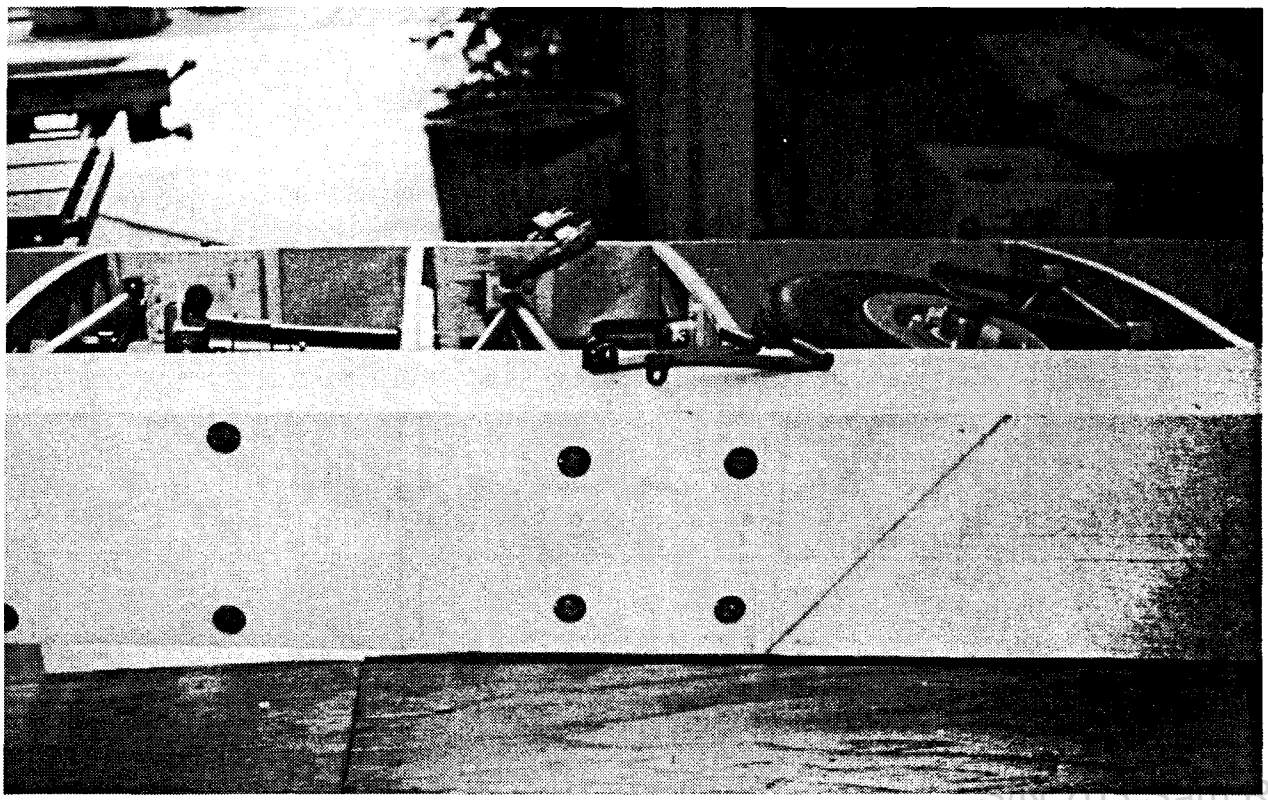
Gear down condition: Hydraulic cylinder shown is a Glasair cylinder for photo mock up only. The Don Austin cylinder is the same size but slightly different.



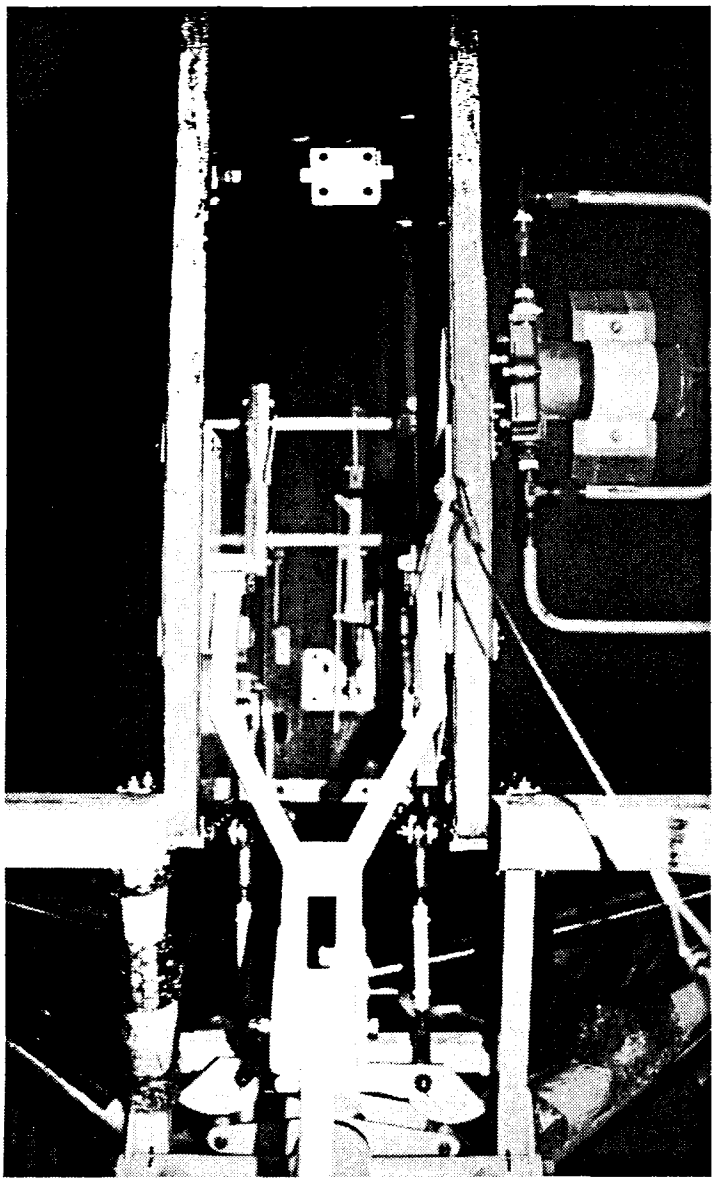
Note: uplock arm is on the low side of the cam. This allows the uplock to engage.



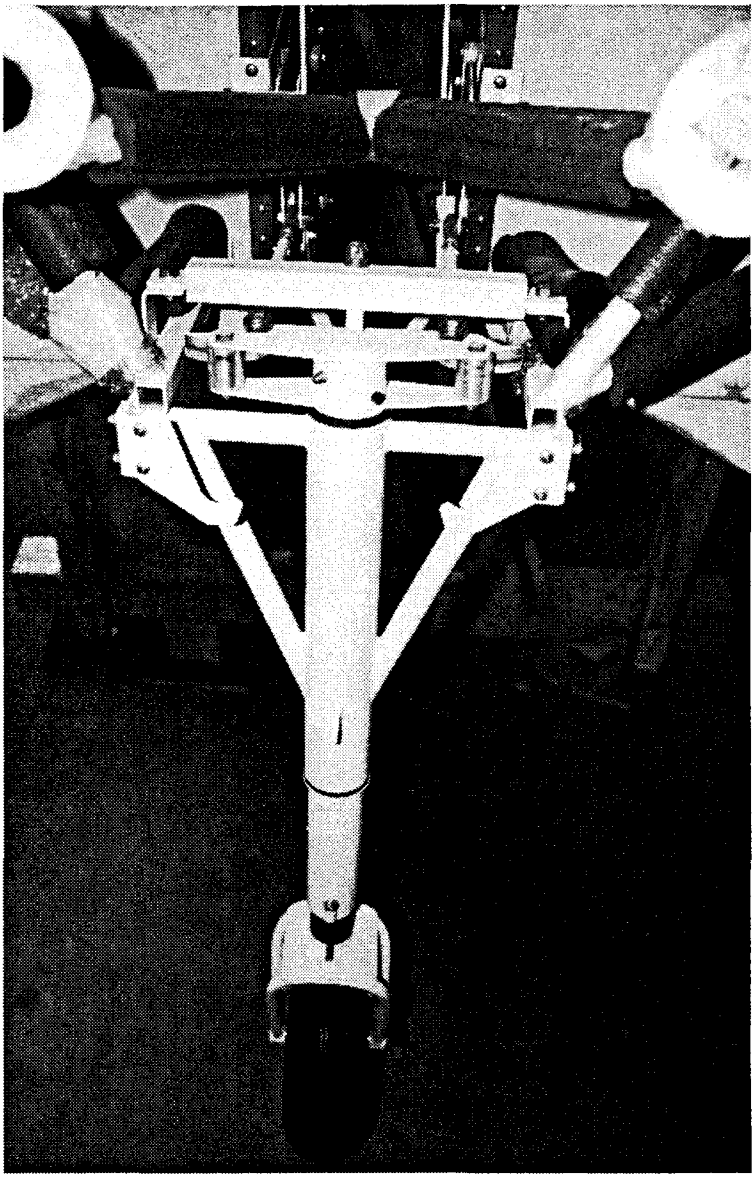
Note: wheel door striker plate striking axle nut.



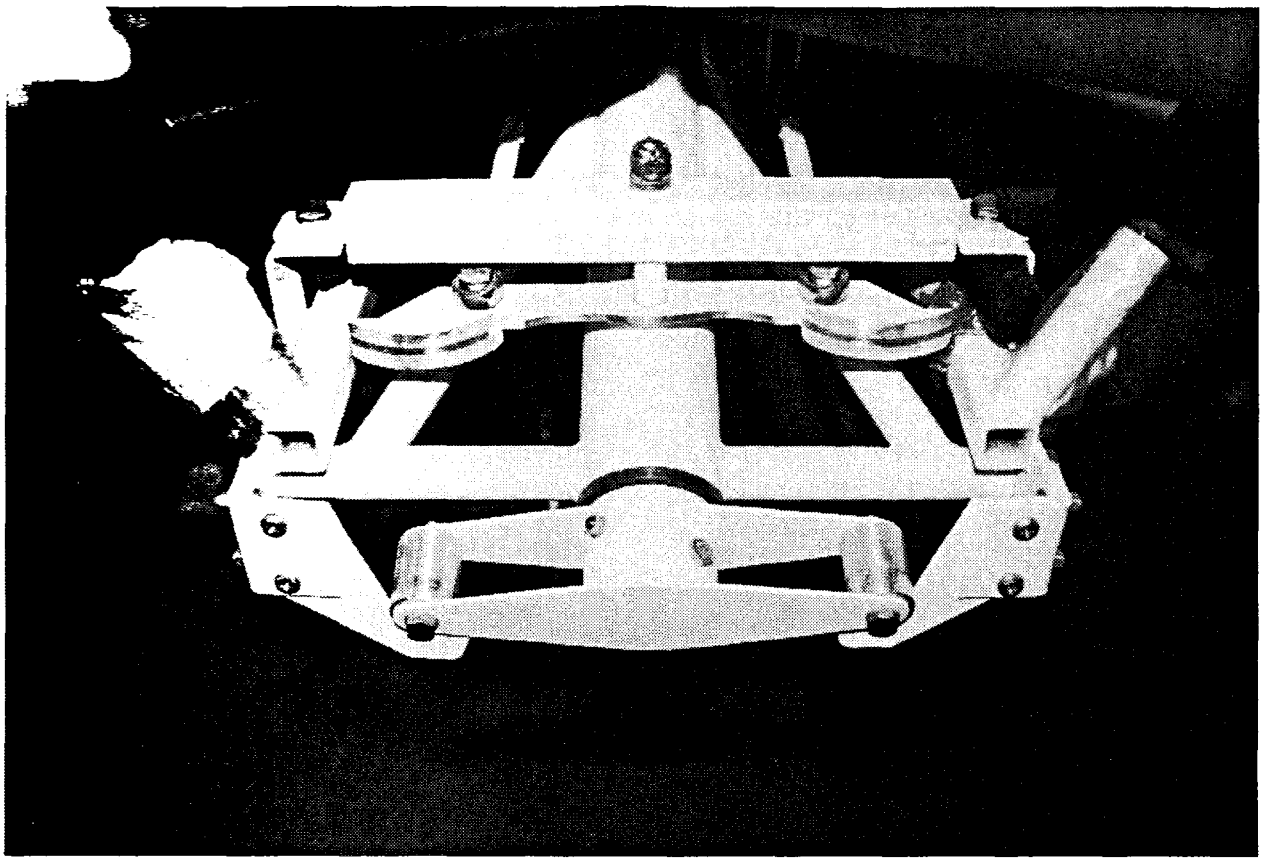
Front side of spar web showing recessed bolt hardware. Spar is now ready for fuel tank installation.



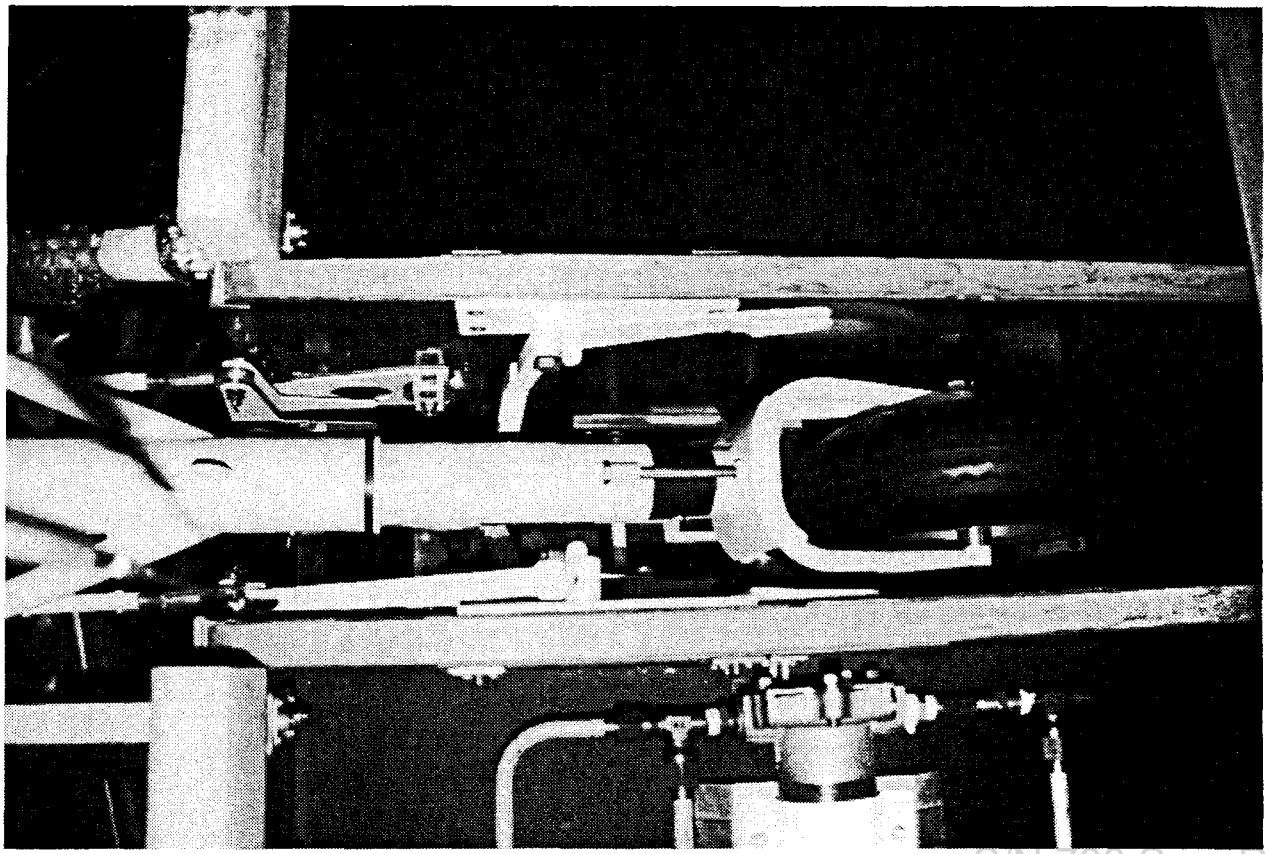
View is looking up into nose gear tunnel well. Emergency pull down cable is not installed in this photo.



Nose gear in down position. Note steering arm cam and rollers.



Nose gear retracted. Note centering horns on roller assembly that centers the wheel as it retracts into the wheel well.



Nose gear retracted. Nose gear door is not installed in these photos.