

THE KR-1

KR-1 # 6215

LENGTH 12' 9"
WING SPAN 17'
WING AREA 62 sq. ft.
EMPTY WEIGHT 375 lbs.
GROSS WEIGHT 750 lbs.
ENGINE V. W. 1700

FUEL CAP. 8 to 50 gal.
TOP SPEED 200 mph.
CRUISE SPEED 180 mph.
STALL SPEED 45 mph.
SEATS 1
FUEL CONS. 3 gph.



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1.0 GENERAL DESCRIPTION

1.1

The KR-1 is a single-place low wing monoplane with a retractable main gear and a steerable tailwheel. Length is 12' 9" and the wing span is 17 ft. Effective wing area is 62 square feet. The airfoil used is the RAF-48. This airfoil has a gentle stall characteristic and provides a comfortable spread between cruise and landing speeds. The airplane is designed to use Volkswagen engines from 1,200 cc to 2,100 cc. Design empty weight, using the 1,200 cc engine, is 340 lbs. and design gross weight is 750 lbs. Fuel capacity is up to 50 gallons. Design top speed is 200 MPH and cruise speed is 180 MPH (1700 cc engine). Landing speed is a function of weight and is between 42 and 48 MPH. The prototype was tested with a 1200cc-36 HP and 1700cc-60 HP VW turning a Warnke 52-inch propeller set to 62 inches of pitch. With electrical system and Nav-Com the empty weight was 390 lbs. Climb rate was 1,100 ft. per min. at 600 lbs. and 800 ft. per min. at 750 lbs. Normal takeoff run was 300 ft. Cruise speed was 180 MPH at 3,400 RPM. N1436 has been let down at 215 MPH.

1.2

Design intent, so successfully carried out in the original high performance KR-1, is to provide the cleanest airplane and the best performance possible with the available and reliable Volkswagen engine. The cost and construction time for achieving this goal is minimized by using a combination of wood, polyurethane foam, Dynel fabric and epoxy resin. The result is a structurally strong, clean, hard-surfaced and exceptionally fast airplane for the power used.

1.3

To achieve simplicity of construction, the airplane is designed such that no machining or welding is required in building the airframe. All parts can be made and assembled with ordinary hand tools and small power tools.

1.4

Before beginning construction **STUDY THE PLANS**. If there are any wooden-type home-built airplanes in your area, visit with the owners and get a good look at the airplane and the quality of the workmanship. Construction of the KR-1 fuselage is not unlike that used in making flying model airplanes, just scaled up a bit. The gluing technique is very similar, even to the use of waxed paper to prevent parts from sticking to the jig board. Rigid foam is very easy to work with. It can be sawed, carved, cut and sanded easily and rapidly into straight, curved and complicated shapes; such as leading edges, wing tips, fillets and cowlings. If you get below contour, just glue on some more foam. When the glue is dry, sand it down again. The Dynel fabric weave is open enough to adjust to almost any contour and penetration by the resin is rapid. Air pockets are easily seen and worked out before the resin hardens.

1.5

Elaborate jigs and holding fixtures are not required. However, a sturdy and properly sized work table, adjusted to a working height that best accommodates the builder, is helpful. While applying epoxy resin, care should be taken to observe the cautionary instructions provided by the manufacturers of these materials. Tolerance to these materials varies with the individual. Adequate ventilation and hand protection are suggested.

1.6

The desire to create or be different is very human. There are many opportunities in this design for the individual builder to express his own ideas; especially in the cowling, forward and rear decks, the cockpit and the instrument arrangement. **MODIFICATION OF THE BASIC AIRPLANE STRUCTURE AND PROPORTIONAL CHANGES ARE NOT ENCOURAGED.** Another thing to remember about changes to a basic design; "Changes usually mean increased weight." *Keep it light.*

1.7

Epoxy is very important to this airplane. Epoxy is the bonding agent. To achieve a good bond between two surfaces—**THE SURFACES MUST BE CLEAN AND BE IN CONTACT.**

Clean: No old epoxy or paint on surface to be glued. Contact: Ninety percent or better interface fit between surfaces to be epoxied. In addition to contact, pressure must be applied. This pressure can be supplied by clamps, nails, staples, or screws. Failure to make a large area contact, and/or squeeze out the excess epoxy, leaves an epoxy-filled cavity that is undesirable and prone to fail under stress: wood around a good glue joint fails before the "joint" will. Don't dally, get the pressure applied as soon as possible. Some building agents won't wait while you break for lunch or get hooked into answering a long-winded phone call.

1.8

Many supply houses do not like to ship plywood in 4' x 8' sheets. This should be your option (whether to use 4' or 8' lengths of plywood). The 4 foot sheets will require much more splicing. The 8 foot sheets are a little harder to handle and the crating and shipping charge is higher, but your fuselage skins will be spliced only once.

1.9

The Rand technique: of combining density controlled polyurethane sheet foam, fabric and epoxy resin into structural material for wings, is unique. Anyone who has seen Rand walk on the KR-1 wing needs little additional convincing that this type of construction may soon be "STATE-OF-THE-ART" for home builders. In Sections 7, 8, 9, and 11 every effort is made to transmit to you, by word and picture, the "Know-How" acquired from the actual foam and Dynel work performed in constructing the KR-1 and KR-2 airplanes.

2.0 TOOLS

2.1

Most people who will want to build this airplane will have the required tools. If not, the following are suggested: hand saws, cross cut and rip; table saw, wood plane, sanding discs, belt sander, carpenter square, protractor/square set, hacksaw, files, ¼ inch drill motor, drills, screwdrivers, wrench set, staple gun, plumb bob, steel tape, Prussian blue (for dyeing the surface of metal to scribe mark cut lines); 2-inch circle saw on ¼-inch mandrel, glue brushes and squeegees, hammer, pair of pliers and a bench vise. For outer wing attach, a level is useful.

2.2

Make a level, well-braced table. For the top, use 2 sheets of 4' x 8' x ¾" particle board, lengthwise, butt-end together and cut off to length of table desired. This material has a finished surface and is not susceptible to splintering or distortion during use. It makes a fine jig board. If particle board can't be obtained, use ¾" plywood.

2.3

The instructions in the assembly chapters that follow will assume, for the most part, that the individual parts will have been already fabricated per the supplied drawings. Expensive holding fixtures or assembly jigs would be required if interchangeability of assemblies or parts were needed. However, inasmuch as each home built is a "one-of-a-kind", much of the fit and drill becomes a progressive matter with the airplane itself being used as the jig.

3.0 FUSELAGE

Make a layout of the side elevation of the fuselage per Drawing No. 1

The fuselage longerons and the vertical members can be cut to size (5/8 x 5/8) on your table saw or for a small additional charge, they can be cut where you buy your spruce.

3.1

Make a fuselage side frame by laying the upper and lower longerons along the jig board. Hold in place by driving nails into the jig board (not through the spruce—please). Cut and fit the vertical members and the associated gussett blocks. Here is where the vertical sander attachment for your saw table really pays off. When all but the vertical stern post have been fitted, place waxed paper under each glue area. (The particle board is "hell for strong", but a bit too heavy for a fuselage skin.) When the glue has set, remove the frame from the jig. Then assemble and glue the other side frame. Note that an auxiliary piece of longeron is installed at the tail end. The notch in the longeron is for allowing the nose of the elevator full travel. Do not cut notch at this time. Leave longerons approximately one inch too long, to be trimmed later as the stern post is fitted.

3.2

Remove the nails from the jig board. Lay a sheet of plywood on the work table. Place a fuselage side frame on the plywood. Adjust so that one edge of the plywood is even with and parallel to aft side of a vertical member and even with the top longeron. Pencil the outline of each member on the plywood. This will be your glue application guide. Remove the fuselage side, reverse the plywood sheet, lay the fuselage side on again and coordinate it with the marks made on the other side. Pencil outlines as before. These marks will be your staple or nail guide. Identify as "OUTSIDE".

3.3

Cut the marked area out of the plywood sheet. With "OUTSIDE" up, mark a line ½ inch back from and parallel with the "aft" edge of the sheet. Clamp plywood to the edge of the table using "C" clamps and a "hold-down" board back of the scarf line.

3.4

Chuck a small sanding disc in your hand-held drill motor. By observing the wood layers, as you sand, you can make a beautiful scarf. Oh yes, remember to keep direction of rotation of the sanding disc in mind or you may shatter the edge of the scarf just as you think you're "home free".

NOTE: check your SPORT AVIATION for December 1973, Page 27, for a precision hand scarfing device.

3.5

Lay the fuselage side frame on the work table and check the fit with the plywood sheet for "ready to glue". Place waxed paper under all fuselage members. Apply glue to all fuselage surfaces that will contact the plywood sheet. Apply glue to "inside" marks of plywood. Place plywood in place on fuselage side and staple. Staples should not be more than one inch apart. Remember, put plenty of pressure on the staple gun before you pull the trigger (to squeeze out all excess glue). And — *work fast*, the glue may not wait.

3.6

Make a ½" scarf line on the sheet of plywood that will be used to continue the fuselage side. Clamp and sand the mating scarf as described in step 3.4. (Be careful, the actual scarf must be on the correct side of the plywood sheet.)

3.7

When glue has set, remove staples (step 3.5) from the scarf. Lay and adjust sheet prepared in step 3.65. Clamp in several places. Raise fuselage side frame and pencil outline of all fuselage frame members. Release clamps and adjust sheet on opposite side of fuselage frame. Again, mark fuselage member outline on sheet. Release sheet. Lay fuselage frame on work table and repeat wax paper, gluing and stapling procedure described in step 3.5.

3.8

Repeat steps 3.2 through 3.7 for the other side of the fuselage. Remember this is the OTHER SIDE: otherwise, you may find you are making an identical side. This would be fine, if you were building two KR-1's!

3.9

Mark a line down the center of the table and lay out the contour of the top of the fuselage. Make provision for the installing of the aft vertical or stern post member, either by overhanging the end of the table or making an appropriate sized slot in the table.

3.10

Install guide blocks on the table to the inside contour dimension of the fuselage top longerons. Place a fuselage side on the table upside down and block into location by installing guide blocks on the table and against the plywood side of the fuselage. Erect the other side on the table in the same manner. Improvise restraint as required. NOTE: The auxiliary top longerons are not installed at this time. (See Paragraph 3.19)

3.11

Cut and fit belly cross members to dimensions given on Drawing and symmetrical about the center line referenced on work table. Mark center of cross member after fitting and with plumb bob locate mark to the center line marked on the work table. This helps "square" the fuselage.

3.12

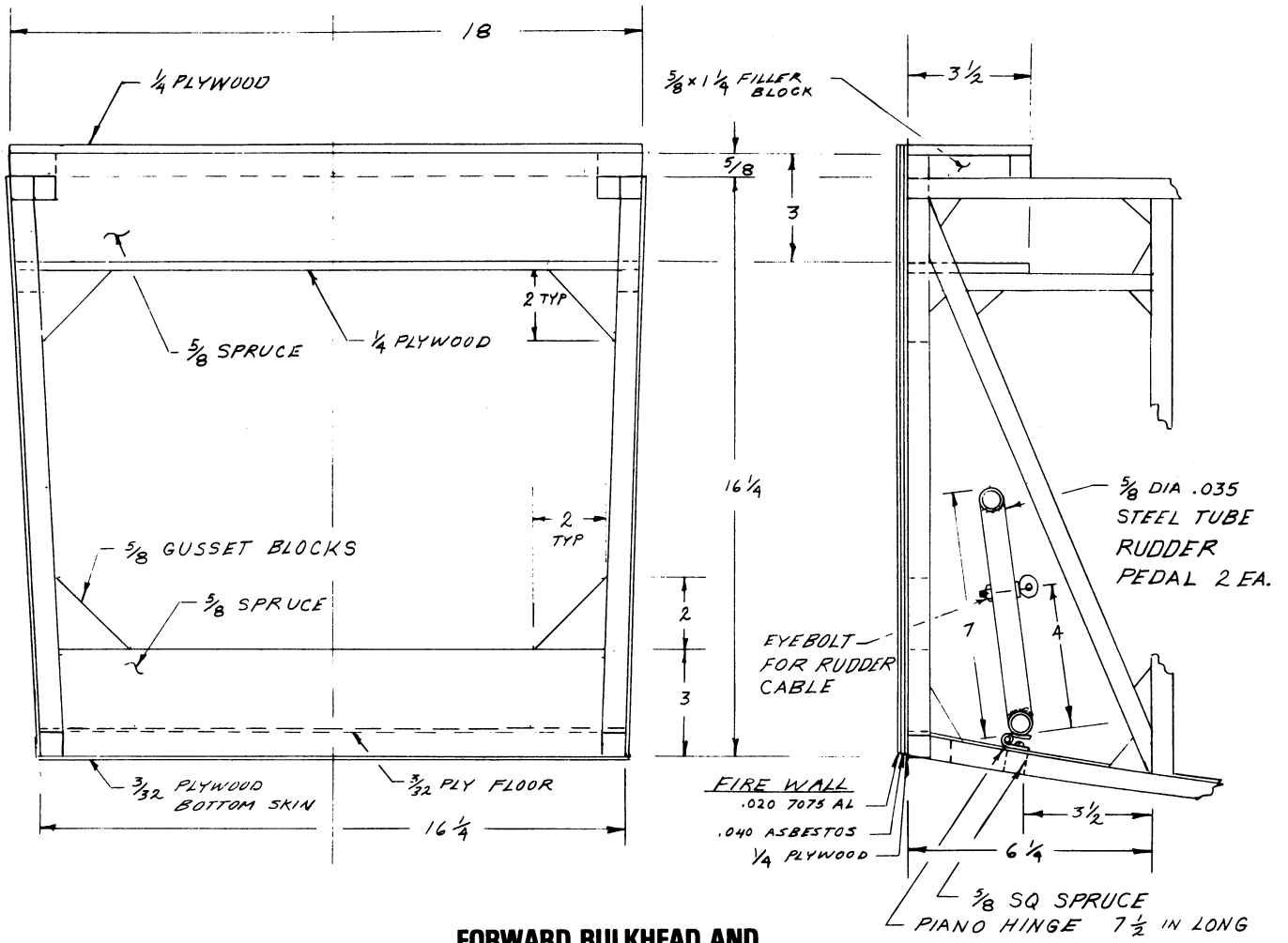
When fitting and centering is completed, remove the cross members one at a time for application of glue. Replace and clamp corner blocks.

3.13

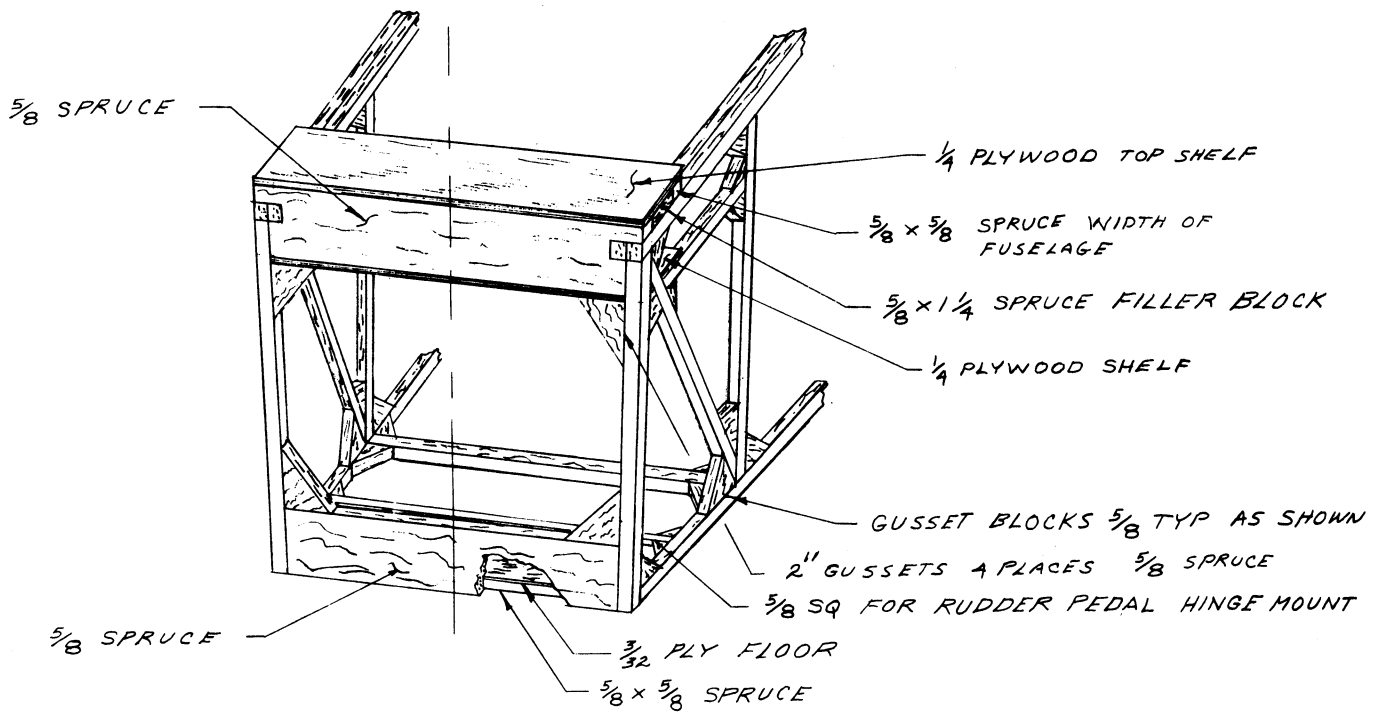
You will have noticed by now, that the belly longerons and the cross members are not "IN PLANE". It will be necessary to work the cross section of the longerons down to level with the cross members in order to obtain a good glue joint with the belly plywood. If you use a hand plane, "go with grain" to prevent pulling a splinter. However, don't do it until the glue has set between longerons and cross members.

3.14

The stern post is fitted at this time. See detail on Drawing No. 1, for establishing angle from the vertical and fitting the post (7° angle recommended).



FORWARD BULKHEAD AND BRACING INSTALLATION



KR-1 DRAWING NO. 3

3.15

Install the forward fuselage (firewall) cross members. The firewall plywood will be attached later (after the fuel tank has been made and attached to the top longerons). Cut a 5/8 x 5/8 notch in each side of the top cross member. This is to receive the top auxiliary longerons when they are installed. See Drawing No. 3, and step 3.19.

3.16

A cross member above the forward spar location is fitted temporarily at this time to retain fuselage contour.

3.17

When all epoxy has set, lay on the belly plywood. Fit, mark, scarf, glue, and staple as described in prior steps.

3.18

When epoxy has set, remove fuselage from work table. Remove all contour guide blocks from the top of the work table.

3.19

Place the fuselage right side up on the work table and fit, clamp and glue the auxiliary longerons. Fit and install the cross member that will be the bottom of the instrument panel. (Fitted in step 3.16.)

3.20

Make a template, from heavy carpenter's papers, of the cockpit floor forward of the front spar. Retain the template, it will be modified after the landing gear assembly is installed.

3.21

Two vertical members, on each side of the fuselage directly forward of the stern post, should be beveled or scarfed, as required to accept their plywood bulkheads. See Drawing No. 4, for details. Coordinate this step with Section 7, Step 7.2. See Photos 10 and 11.



Photo No. 10: Aft plywood web and elevator center hinge plate.

4.0 WING SPARS

4.1

Center Section Spars.

4.1.1

The spar caps are sawed and sanded to the dimensions given. Select, scarf and glue plywood into strips long enough to use as the webs. See Drawing Nos. 5 & 6 for direction of the wood grain of the plywood.

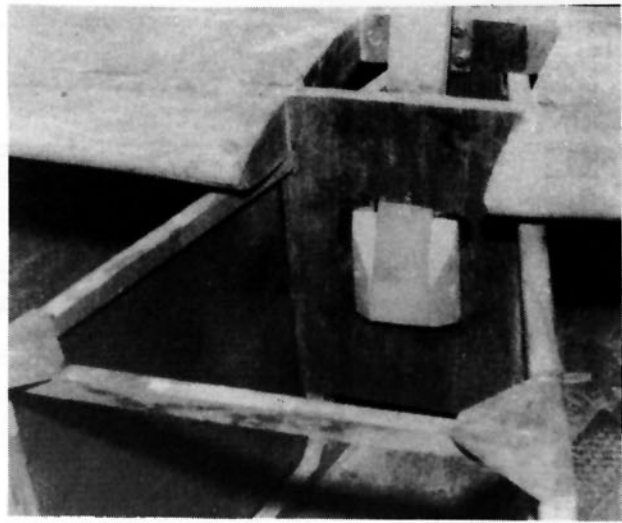


Photo No. 11: Plywood web attaching forward spar and anchoring vertical fin front spar.

4.1.2

Attach guide blocks to the work table dimensioned to the depth of the spars.

4.1.3

Lay waxed paper between guide blocks.

4.1.4

Fit vertical members. See Drawing Nos. 5 & 6.

4.1.5

Lay plywood in place and mark both sides for the spar cap and vertical members. Epoxy and staple locations.

4.1.6

Apply epoxy to spruce and plywood and staple in place. Use plenty of pressure on the staple gun.

4.1.7

When epoxy is set, remove from the assembly guide. Trim plywood as necessary and reinstall, plywood side down. Fit, mark and glue plywood web on other side. NOTE: Before closing spar obtain FAA inspection O.K.

4.1.8

When epoxy is set, trim the spar to length and paint both ends. This is to prevent checking.

4.2

Outer Wing Spars.

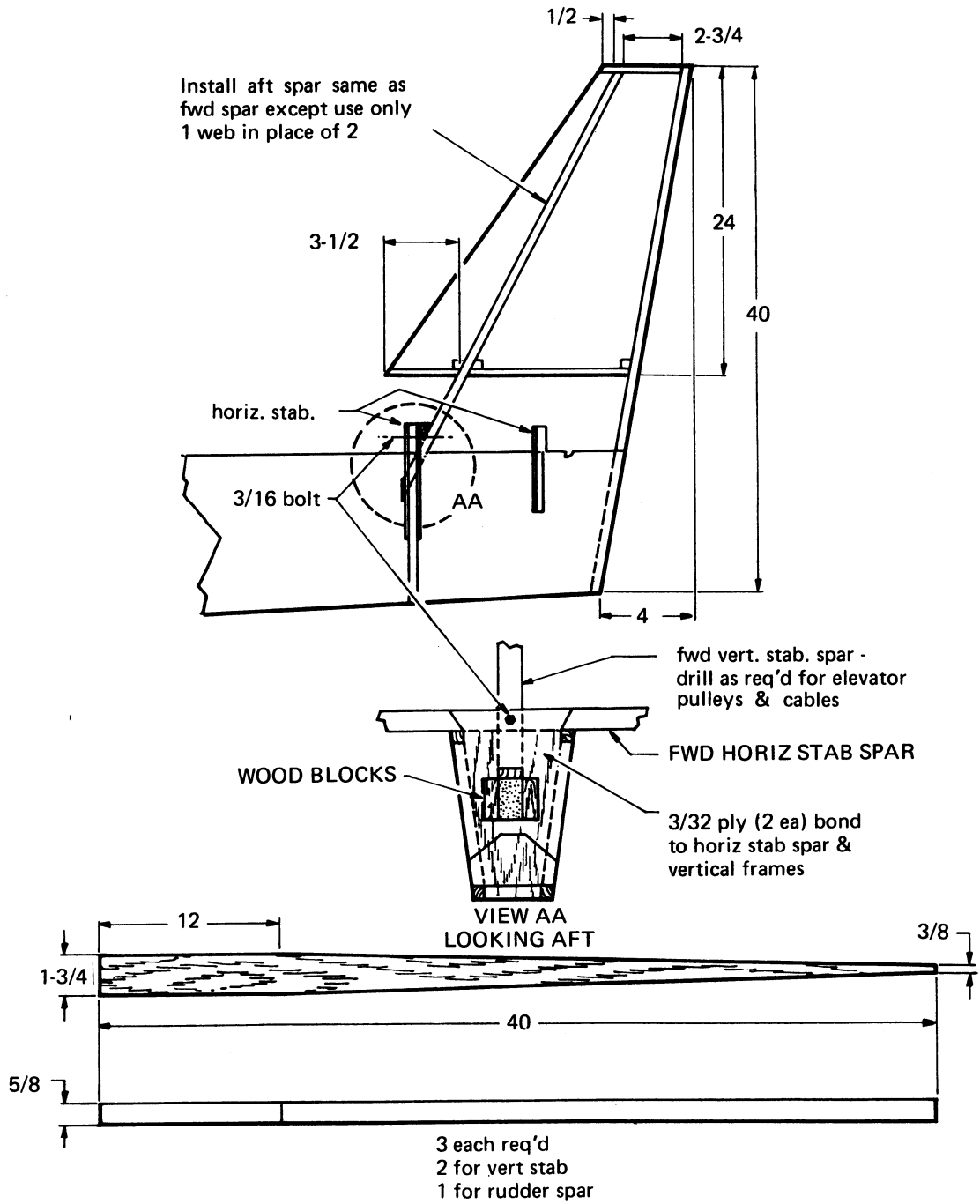
4.2.1

The outer wing spars are sawed and sanded to the dimensions given. Select, scarf and epoxy plywood into strips long enough to use as the webs. See Drawing Nos. 5 & 6 for plywood grain direction for the web.

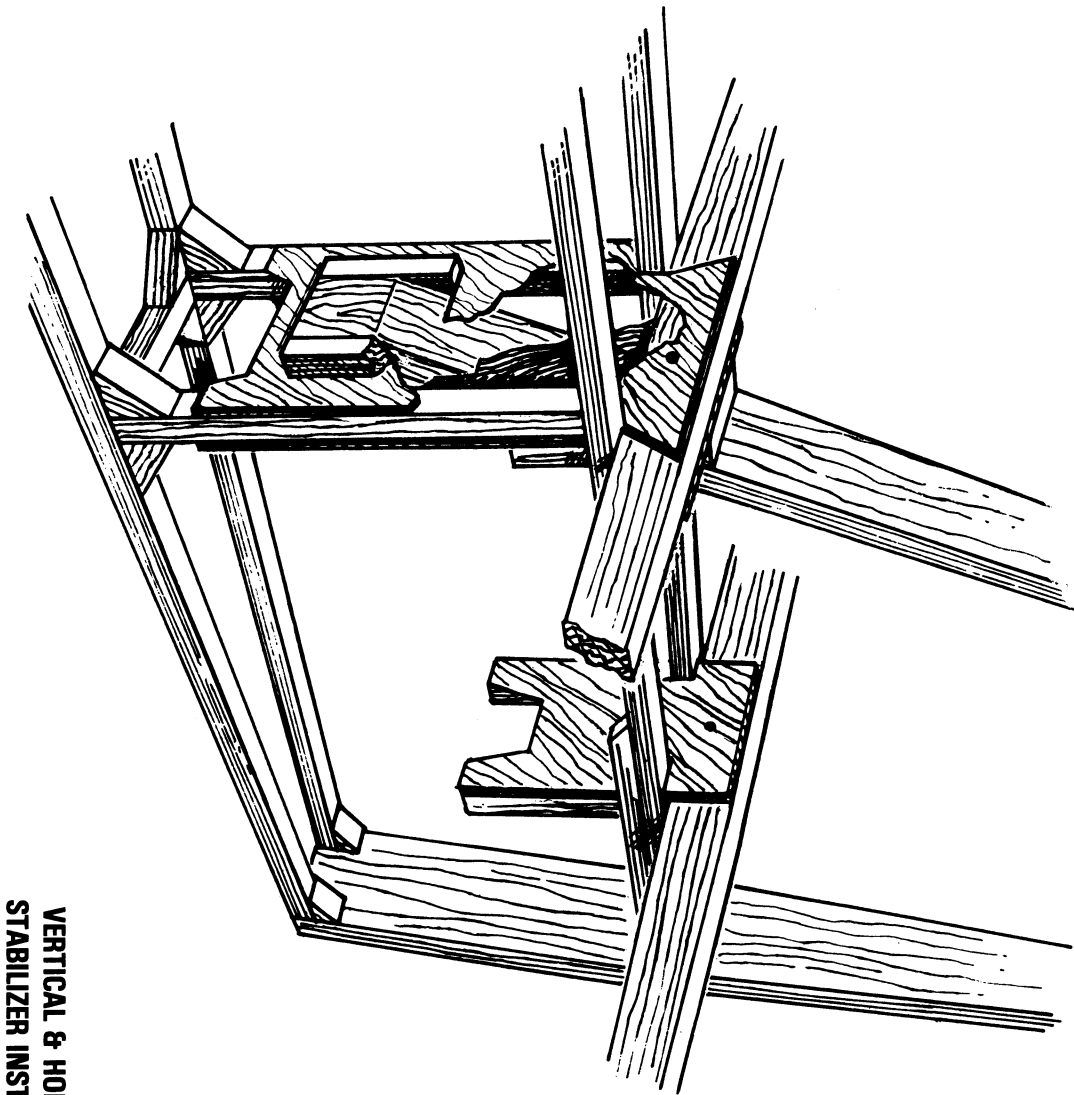
4.2.2

As these spar caps are tapered, the following sawing sketch may help to make them up using minimum time and material. By holding the spruce, to be sawed, to the spar CAP GUIDE, it can be pushed through either a circle or band saw and perfectly tapered caps result. Just clean them up with a sand block.

VERTICAL STABILIZER & HORIZONTAL SPAR ATTACH

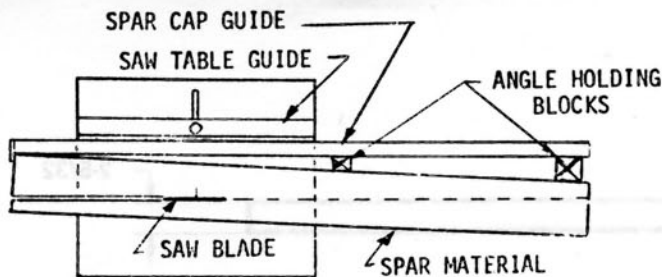


KR-1 DRAWING NO. 4-A



**VERTICAL & HORIZONTAL
STABILIZER INSTALLATION**

KR-1 DRAWING NO. 4-B



Spar Cap-Taper Sawing Fixture

4.2.3

Attach guide blocks to the work table dimensioned to the depth of the spars.

4.2.4

Install waxed paper. Install spar caps and fit vertical members.

4.2.5

Lay plywood web in place and mark both sides for epoxy and staple locations.

4.2.6

Remove the vertical members that are not full width of the spar cap. (to be installed after spar is removed from guide blocks.) See Drawings Nos. 5 & 6.

4.2.7

Apply epoxy to spruce and identical marked area of plywood and staple the web in place using lots of pressure on the staple gun.

4.2.8

Remove spar from guide blocks when epoxy has set. Trim plywood as required and reinstall with plywood side down.

4.2.9

Apply epoxy to plywood as marked and install vertical members removed in step 4.2.6. Use appropriate weights to apply pressure on the vertical members until epoxy has set.

4.2.10

Fit and epoxy the inboard piece of plywood to the forward face of the inboard end of the spar. Staple in place. NOTE: the FRONT spars have web full length *only* on the AFT face. The AFT spars have web full length *only* on the FORWARD face.

5.0 FUSELAGE/CENTER WING ASSEMBLY

Clear the top of the work table. Place fuselage on table convenient to perform the following.

5.1

Make a full sized template of center section wing rib.

5.2

Make the cutouts, in the fuselage side skins, for inserting the forward and aft spars. Check Drawing No. 1.

NOTE: The spars rest on the top of both the lower longerons.

5.3

Trace the rib outline on the sides of the fuselage for future reference. Insert spars into and locate about the center line of the fuselage. Check spars for being perfectly parallel and 90° (degrees) to the fuselage center line. Place a straight edge across the fuselage and check that the upper surface of spars are parallel to the top longerons. Shim at lower longerons to achieve parallel (if required). See Drawing No. 1.

5.4

Fit, epoxy and install 5/8 x 5/8 glue blocks (8 each) to wing spars and fuselage outer Side Skin. See Drawing No. 1.

5.5

Fit, epoxy and install the 5/8" tapered load transfer blocks to fuselage uprights above both spars. See Drawing No. 1.

5.6

Make cutout in each fuselage skin for spring bar of landing gear. See Drawing No. 1. See Photo 4.

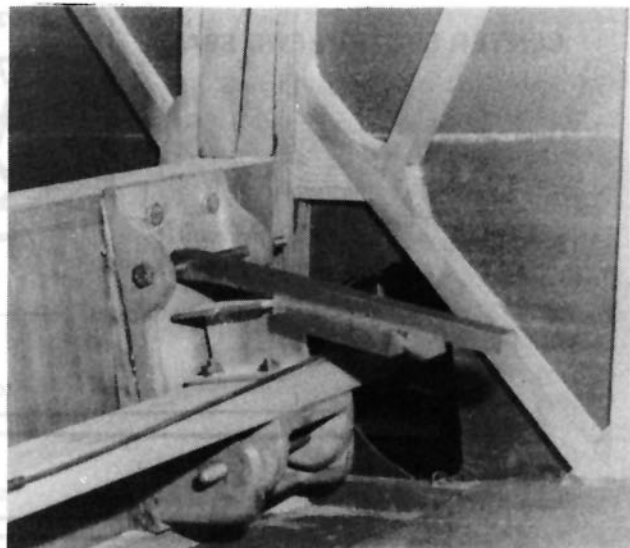


Photo No. 4: Left fuselage skin cutout for spring bar. Wedge installation.

5.7

Fit back of seat. Epoxy in place to fuselage sides and rear spar at this time. Install the sling seat holding fixture clamps, bolts, and slot belt attach fittings.

5.8

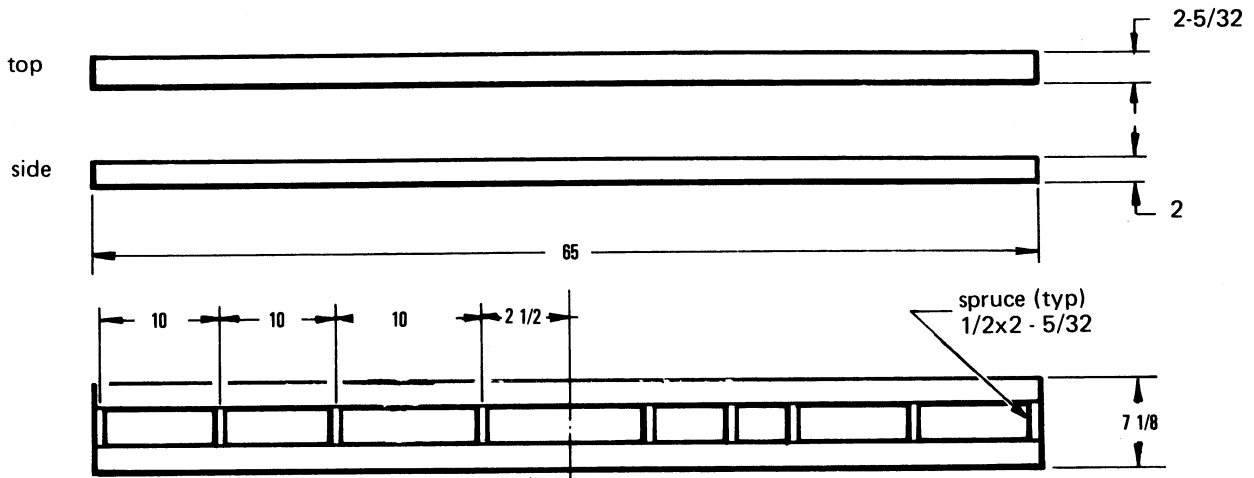
Position tail wheel spring and drill bolt holes. Install backup plate and drill holes. See Drawing No. 15.

5.9

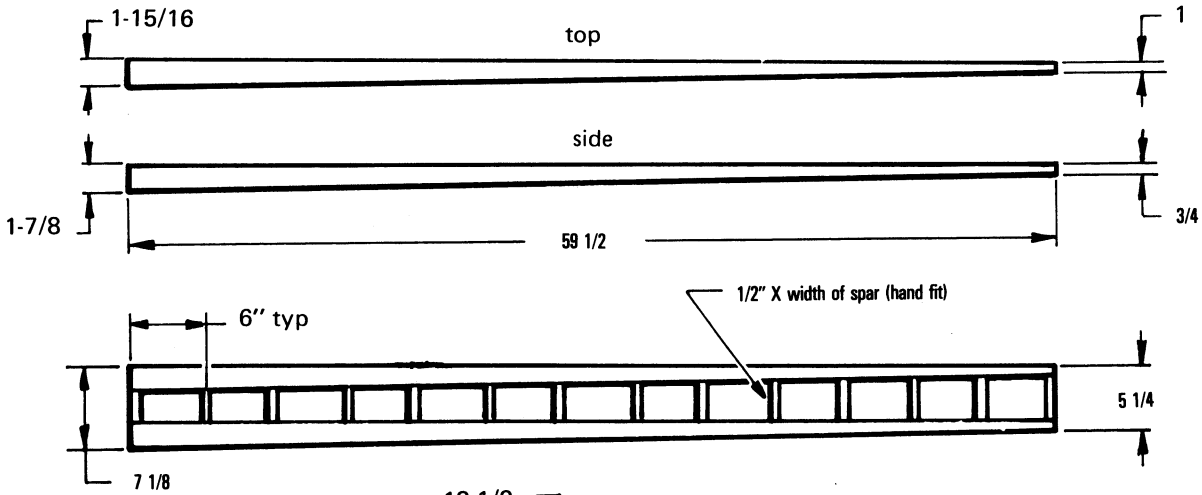
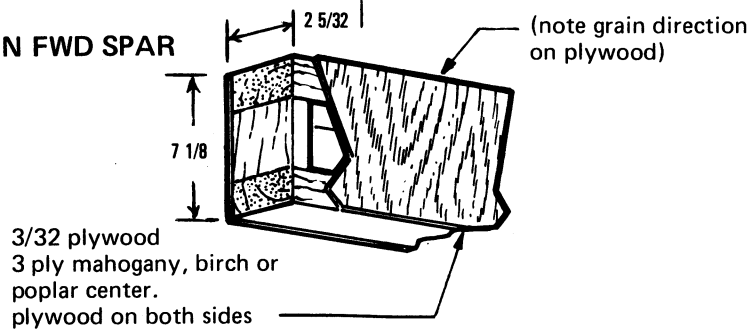
Paint tail wheel area wood with epoxy and when cured install tail spring, after giving it a good coat of rustoleum paint (or equivalent). NOTE: If shoulder harness is to be used, this is a good opportunity to shape the backup plate to accept a shackle for anchoring the shoulder harness cables.

5.10

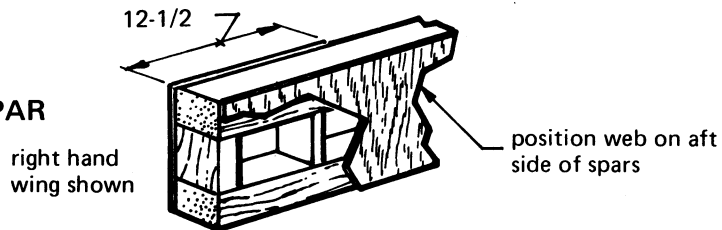
Locate and clamp a pair of wing attach fittings at end of center section forward spar. Align using a bolt through the outer wing attach fitting holes. Drill holes for attach fittings mounting bolts. See Drawing No. 16.



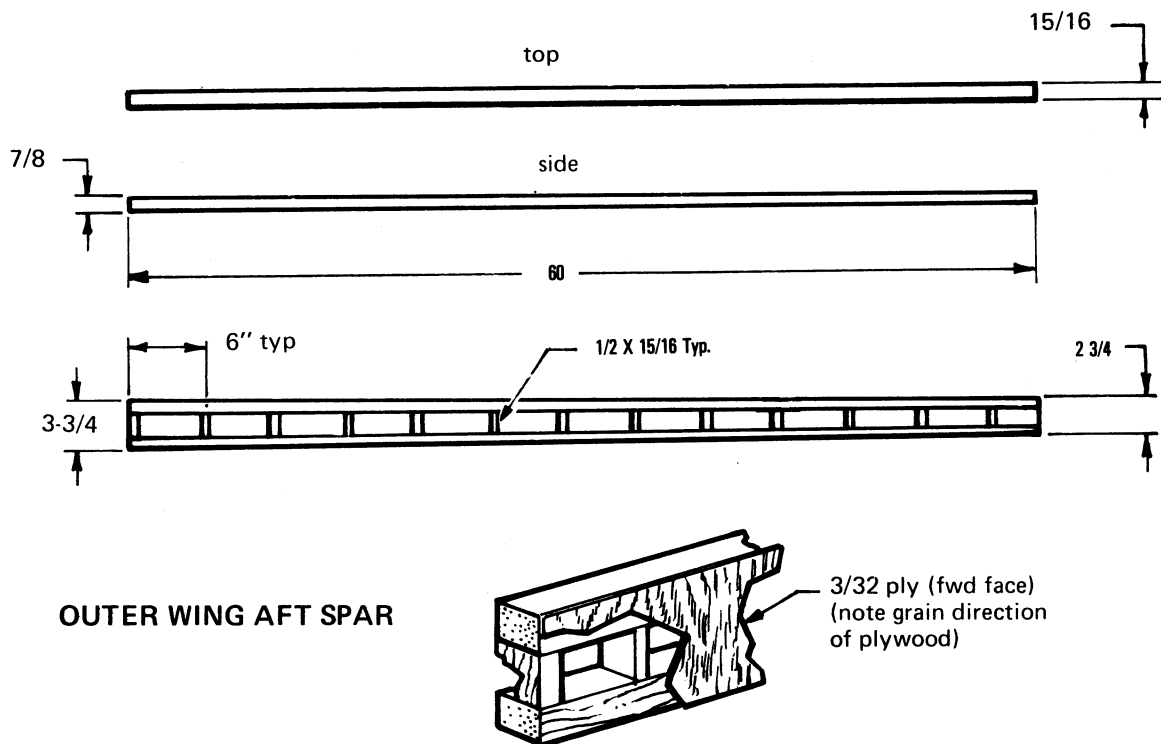
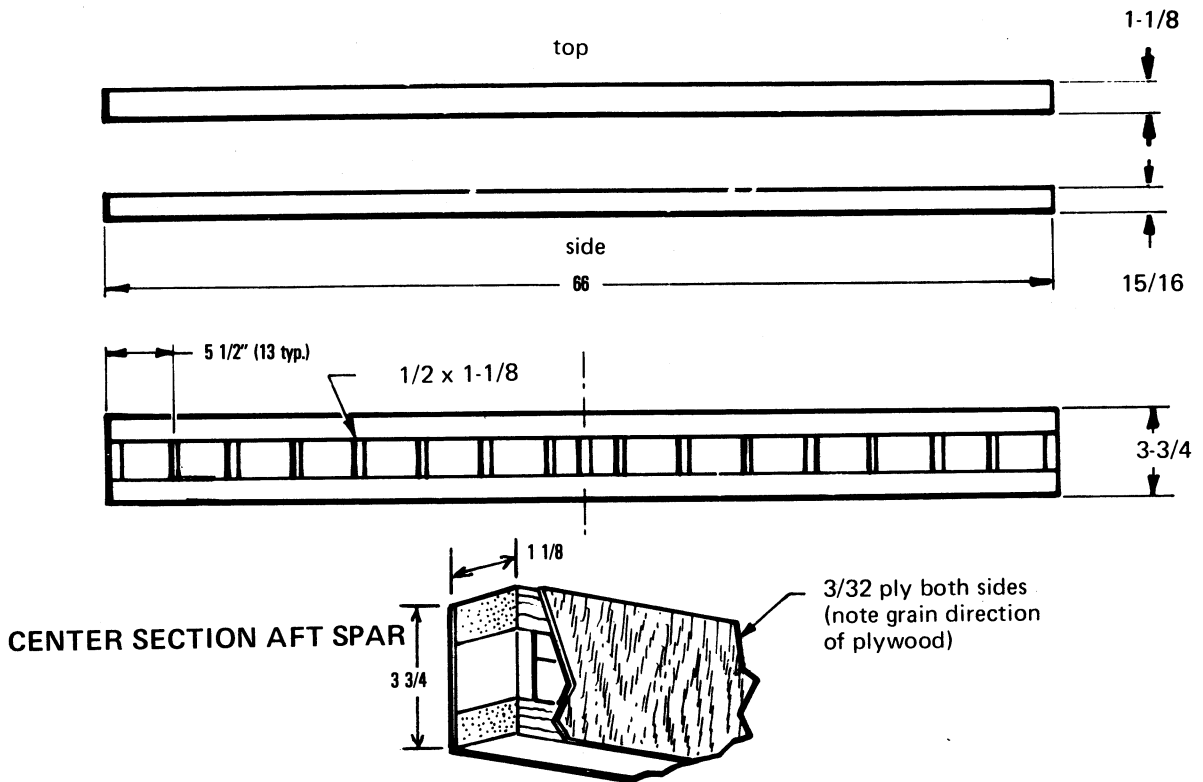
CENTER SECTION FWD SPAR



OUTER WING FWD SPAR



KR-1 DRAWING NO. 5



KR-1 DRAWING NO. 6

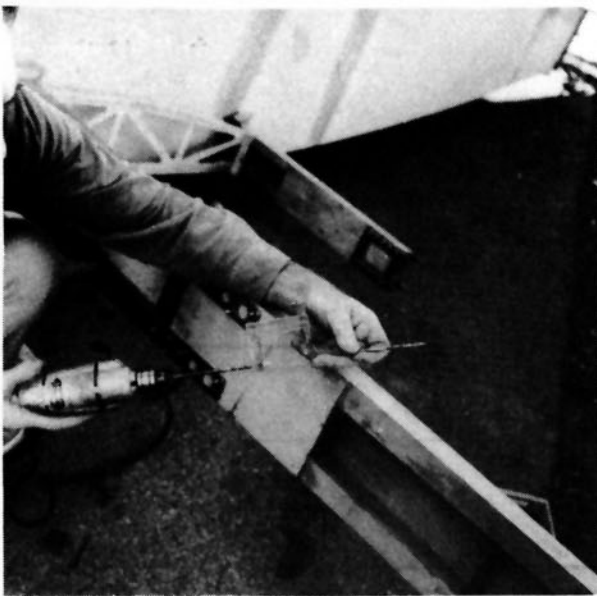
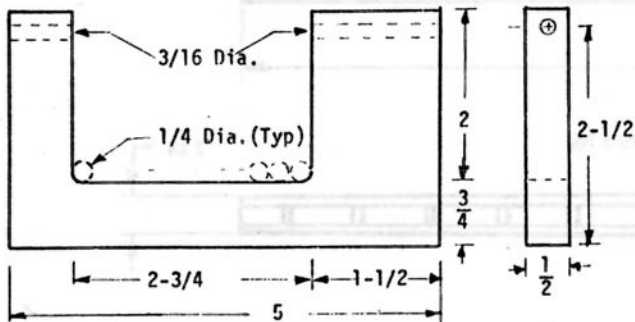


Photo No. 1: Wing spar attach fitting drill jig.



Photo No. 2: Bolt hole drilled straight through spar.



Wing Attach Fitting Drill Jig
(Make from mild steel)

NOTE: A drilling guide is a pretty sure way of going in the hole in one spar attach fitting and coming out through the center of the hole in the fitting on the other side of the spar. It cuts down on the need for prayer, before and after. The holes are drilled using a hand held drill motor. See sketch "How to make" and photos 1 and 2 on "How to use". A 3/16 drill shank is inserted in the small leg of the drill jig. The jig is then straddled over the spar and the wing attach fittings. The drill shank is inserted into the attach fitting hole to be drilled. The drill motor chuck-held 3/16 drill is then inserted into the large leg of the drill jig and into the mating hole of the opposite attach fitting. Then drill on.

5.11

Push 3/16 bolts into each hole as it is drilled to assist in holding alignment.

5.12

When all 8 sets of wing attach fittings have been located and drilled, remove them. Paint spar, wood side, and reinstall. Torque nuts up to snug. Do not crush the wood by over torquing.

NOTE: Center wing assembly, installation of plywood ribs, will be completed in Sections 6 and 9.

6.0 LANDING GEAR

6.1

Mark out the locations for the landing gear spring bar attach fittings on forward face of the front spar. See Drawing No. 17.

6.2

Mark out hinge bracket locations on the spring bar, then place spring bar in position in the fuselage. See Drawing No. 18.

6.3

Using appropriate sized "C" clamps, assemble hinge fittings on spring bar. Insert hinge bolts, joining spar castings and spring bar fittings. Rotate and adjust assembly until there is no binding. See Drawing No. 19.

6.4

Tape the spruce shims to the back side of the three spar mounted castings and using appropriate "C" clamps, secure in place in marked locations on the front spar. See Photo 4. NOTE: With spring bar in forward (retract) position, the bar should clear the top of the lower longerons (approx. 1/4 inch). See Drawing No. 17.

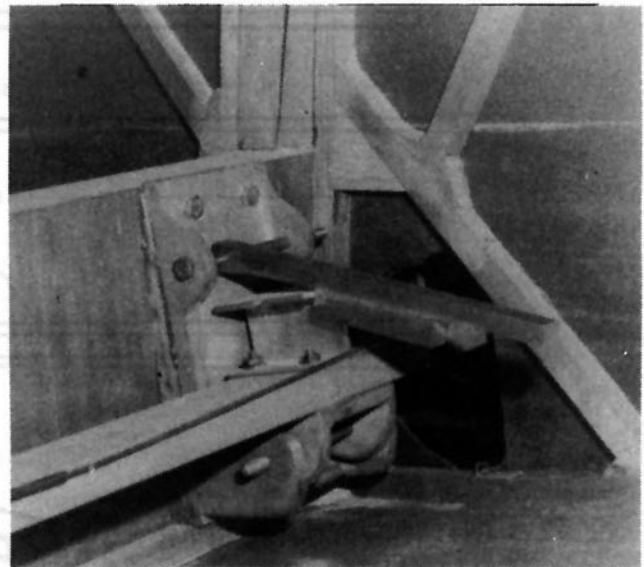


Photo No. 4: Left fuselage skin cutout for spring bar. Wedge installation.

6.5

Place the fuselage on a large packing box or a prepared fixture.

6.6

Install the plywood ribs between the spars. Use the outline marked on the fuselage in step 5.1 as a sighting guide. Epoxy and nail in place. NOTE: Outboard ribs are installed over the wing attach fittings. See Drawing No. 1.

6.7

Attach gear leg castings, with wheels installed onto the spring bar. Use "C" clamps to hold. Latch the spring bar in the down position.

6.8

Align the gear legs on the spring bar to be parallel with each other and center line of the fuselage. NOTE: A method of doing this is to clamp a long straight board to the side of each wheel. Use a tape measure to check equal fore and aft points on the boards to each other and the fuselage center line. Adjust the leg castings in rotation as necessary to obtain parallel track.

6.9

Place the gear in retracted position. The tire should be not closer than 1/8 inch to the top contour of the airfoil. Adjust for required clearance by moving position of the leg casting on the spring bar and/or by placing a shim on the lower surface of the spar cap.

6.10

When satisfied with location of wheels and leg castings, extend gear and recheck for parallel as performed in step 6.8.

6.11

Bolt small blocks of aluminum to forward face of hinge to set down stop of the wheels. See Drawing No. 18.

6.12

When satisfied with position, clearance and function of the landing gear, as assembled, drill holes and install bolts as indicated to complete installation.

6.13

Trim the "Down" notches in the latch levers to hold the spring bar assembly snugly against down stop blocks.

6.14

Trim "Up" notch in left latching lever to hold gear snugly against lower spar cap in the position obtained in step 6.9.

6.15

Make and install some "mouse trap" type coiled wire springs to apply pressure to the landing gear latch levers. Coil around the latch pivot bolt and adjust for pressure desired.

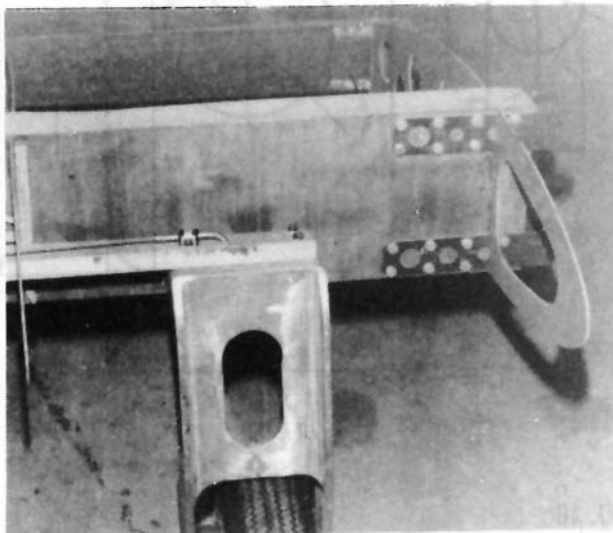


Photo No. 3: Landing gear and brake cable tube and clamp installed.

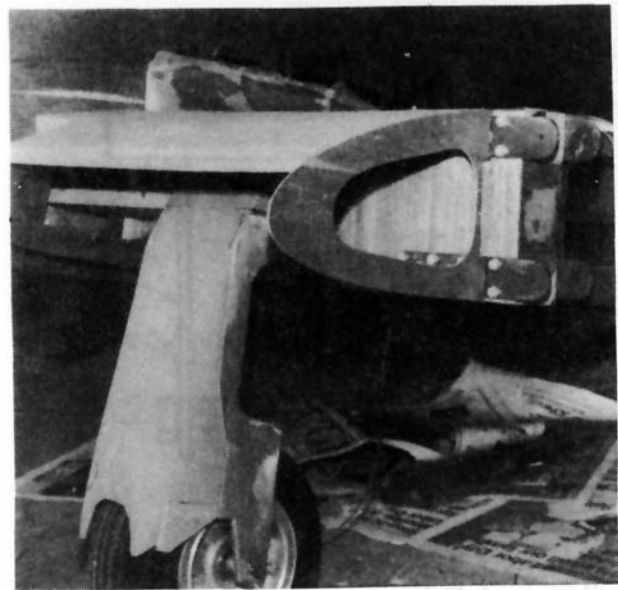


Photo No. 5: Landing gear with foam foundation for fairing sanded to shape.

6.16

Make up, route and install the wheels and brake cables at this time. The system used is simply a "grab and pull" as required. The steerable tail wheel makes differential braking unnecessary. Refer to Drawing No. 7, and Photo No. 3 for prototype installation.

6.17

From the cockpit floor template made in step 3.20, mark and trim to clear the landing gear locking "I" fittings and the actuating lever "knuckle" space. Make floor in 2 pieces; forward of 1/4" and aft of 3/32 plywood.

6.18

Make, fit, epoxy and install the cockpit floor. Use wood screws to hold the forward floor in place until the epoxy has set. When epoxy has set, remove screws. (Remember—keep it light.)

6.19

Epoxy foam blocks to landing gear leg castings. When epoxy is set, carve and sand to form fairing. See Photo No. 5.

6.20

Cut and fit Dynel to leg fairing. Apply resin to the foam. Add Dynel and more resin. Squeegee to soak fabric thoroughly.

6.21

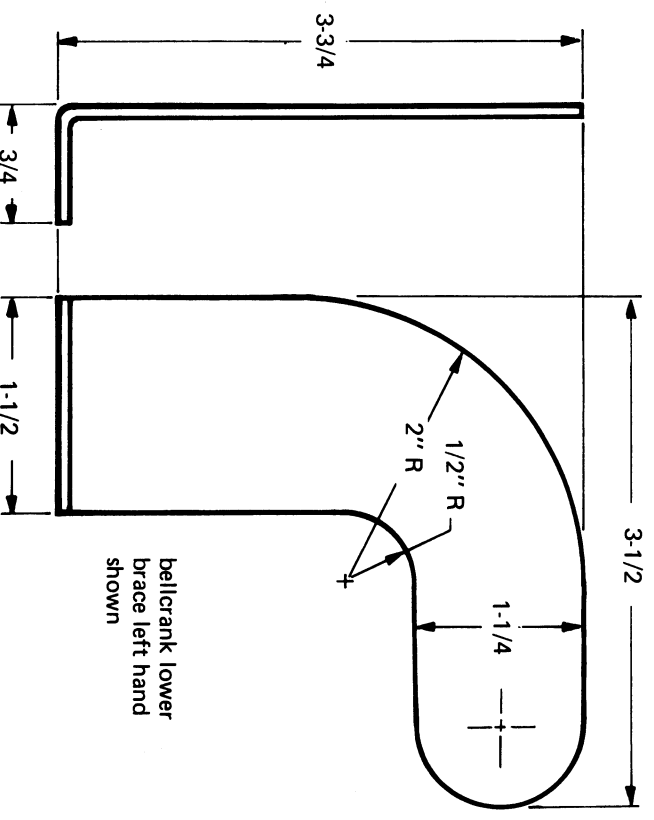
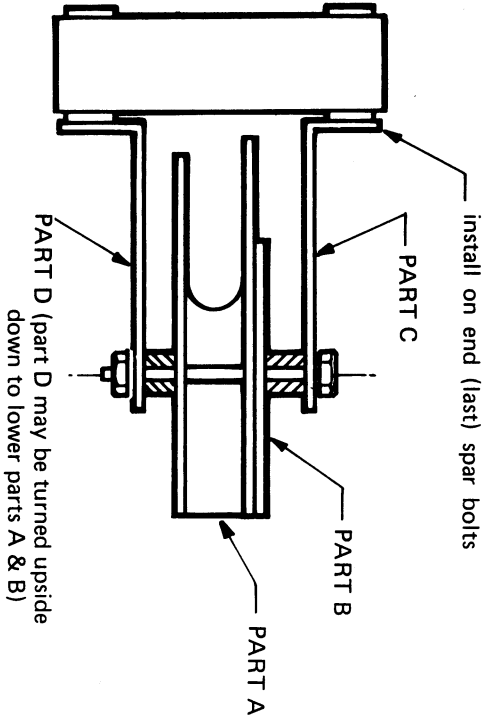
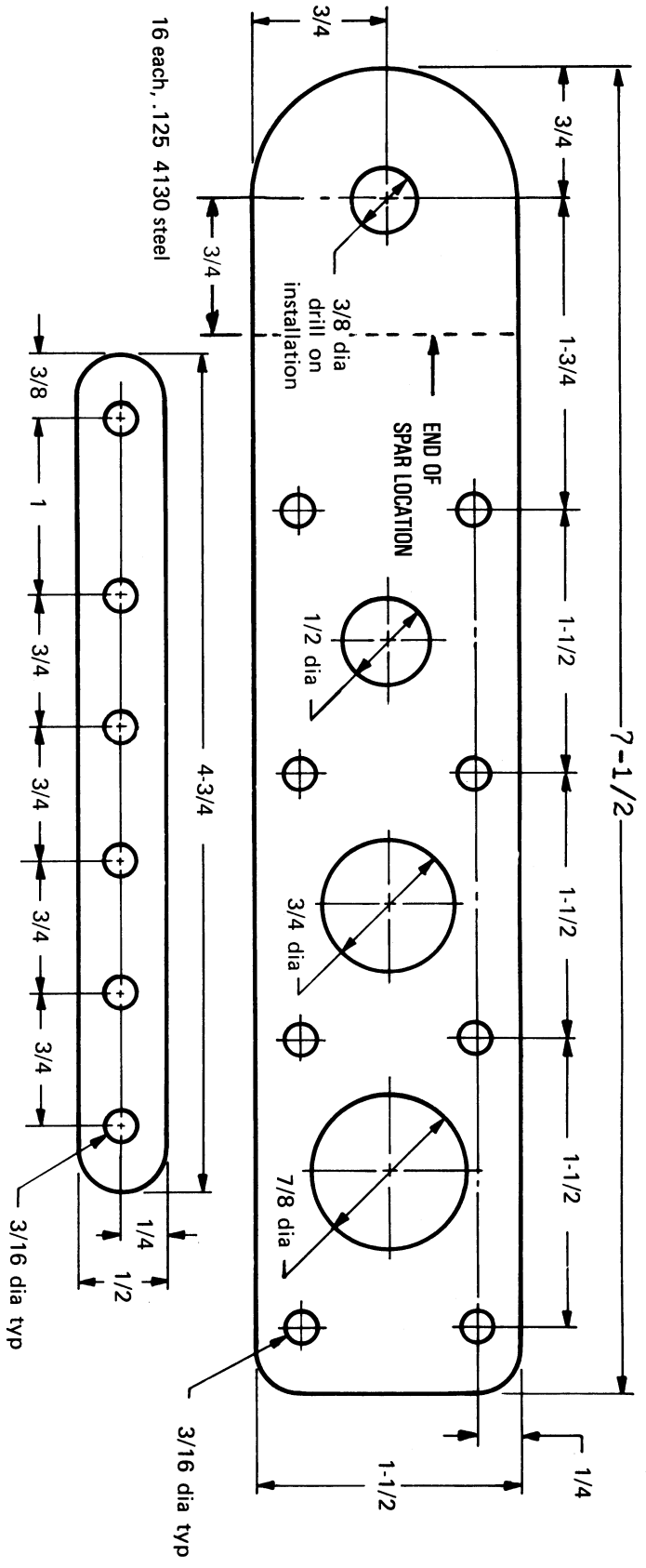
Cover with pieces of waxed paper and squeegee with small piece of plywood to chase air bubbles out.

6.22

When resin is set, peel waxed paper off. Sand as required to a smooth finish.

6.23

Make retraction test to check for clearances.



view looking inboard
 alleron bellcrank left
 hand side

install on end (last) spar bolts

PART C

PART B

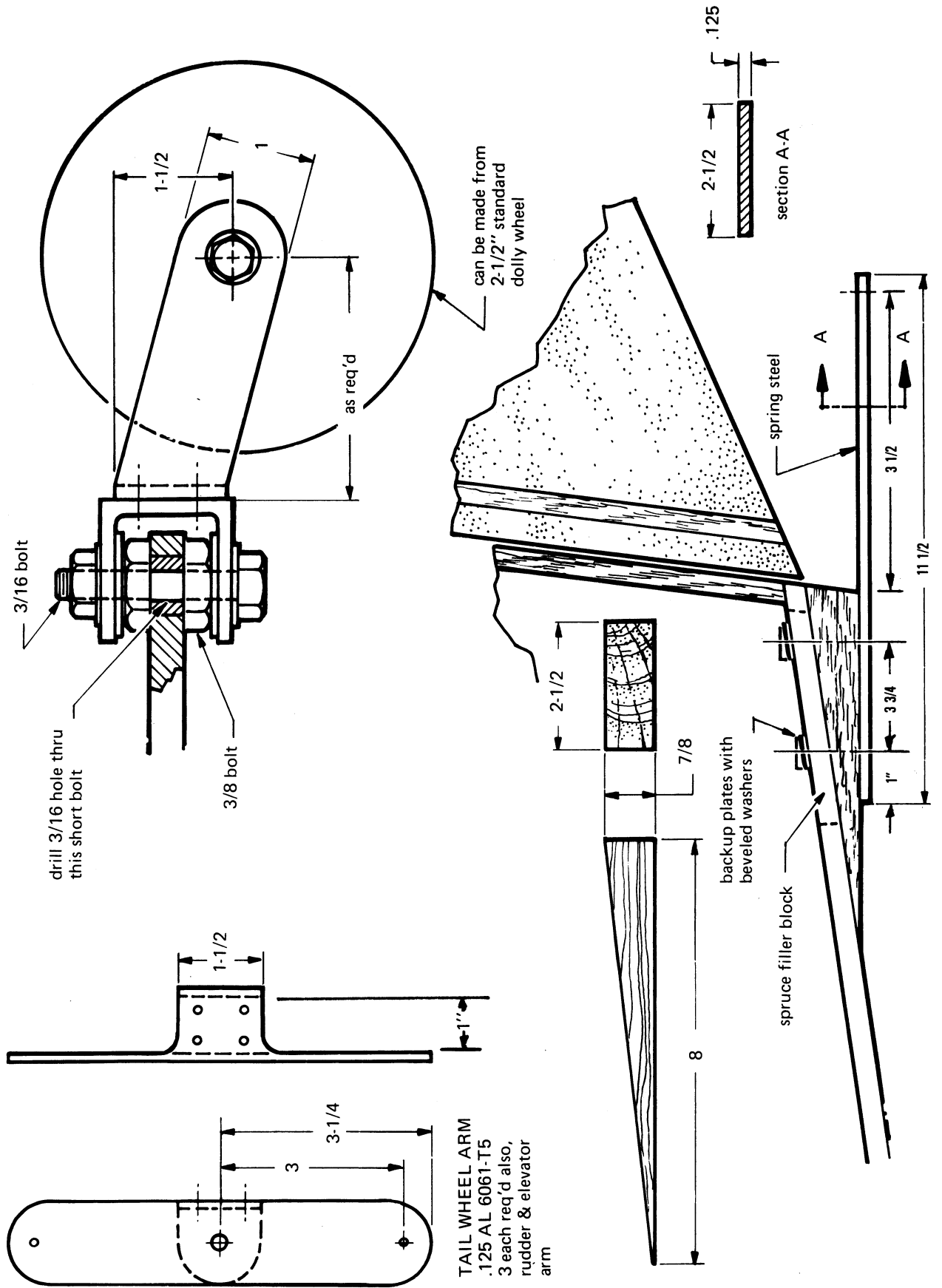
PART A

PART D (part D may be turned upside
 down to lower parts A & B)

WING SPAR ATTACH FITTINGS

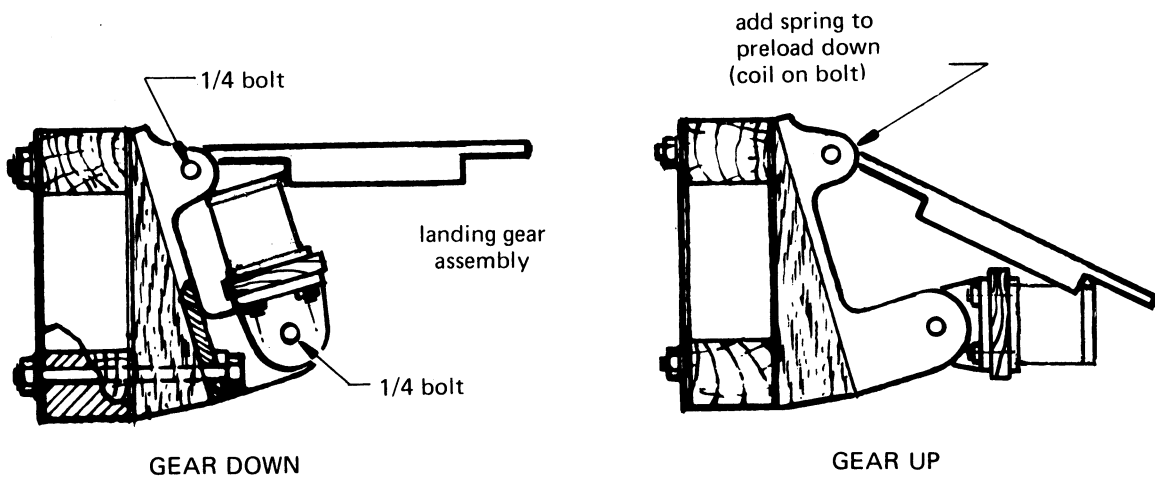
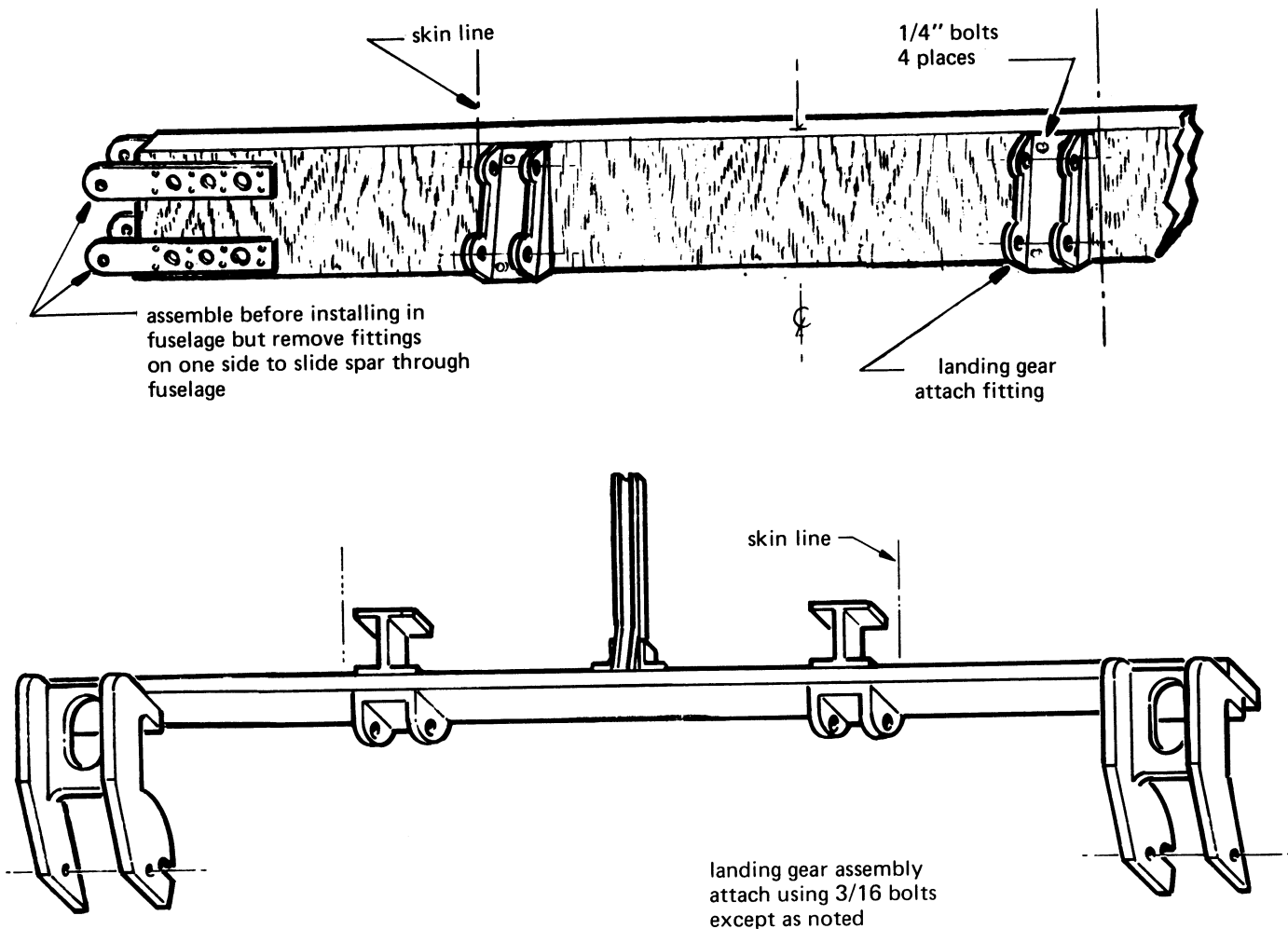
KR-1 DRAWING NO. 16

TAIL WHEEL

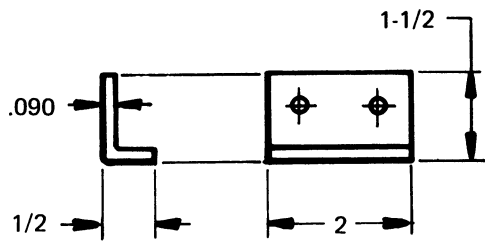
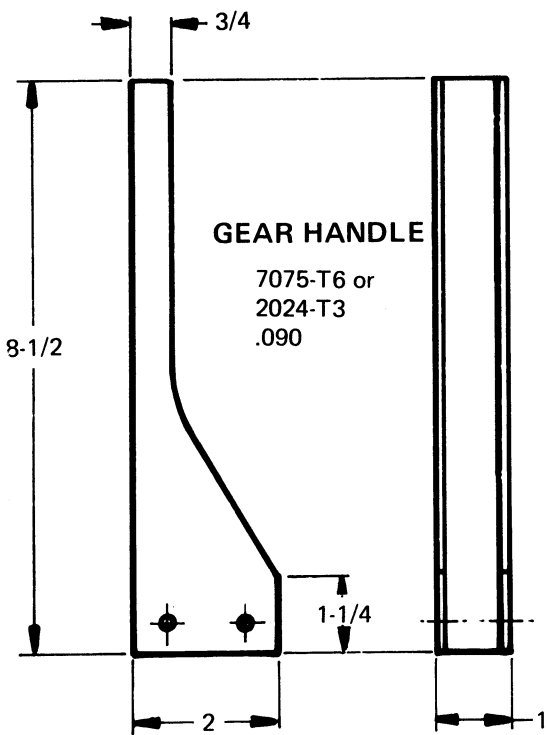
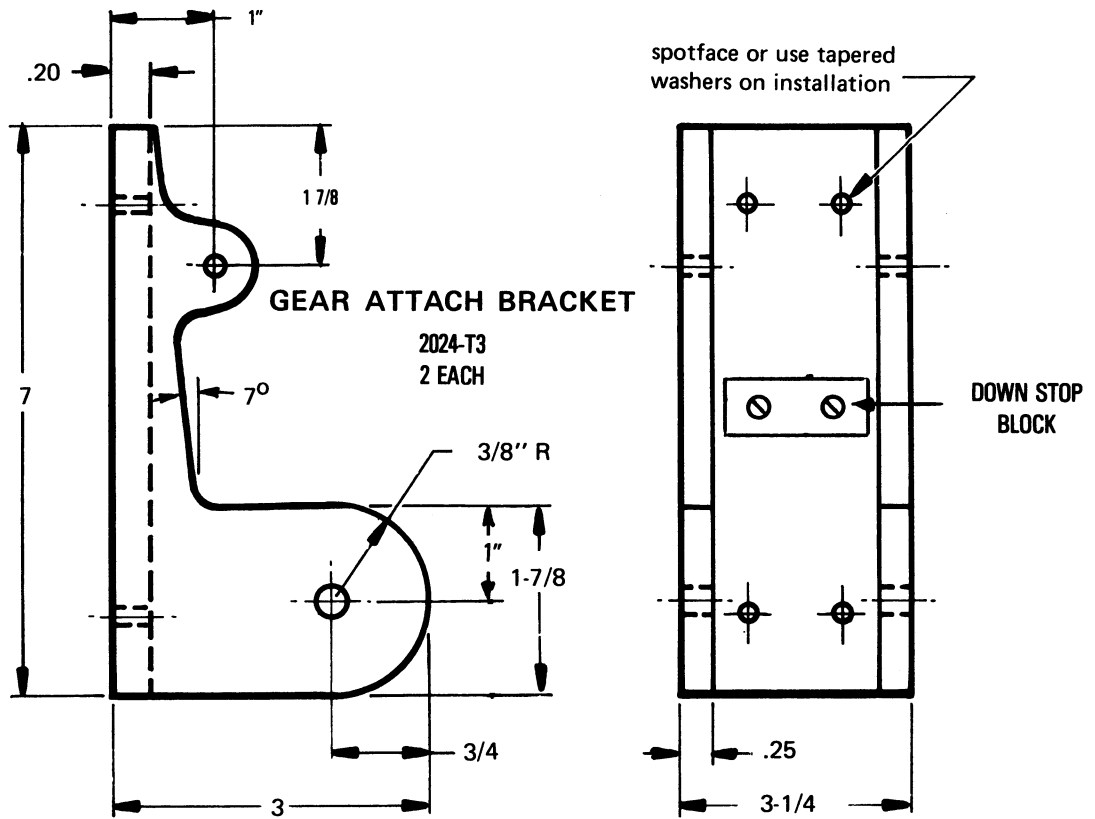


KR-1 DRAWING NO. 15

LANDING GEAR



KR-1 DRAWING NO. 17

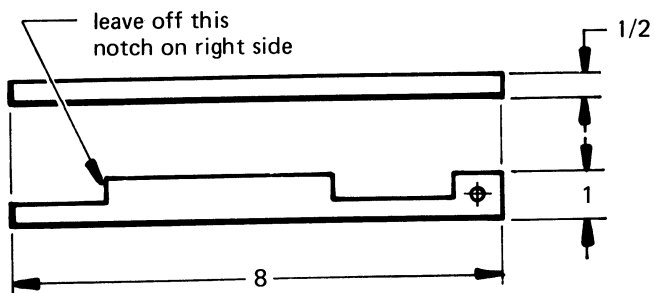
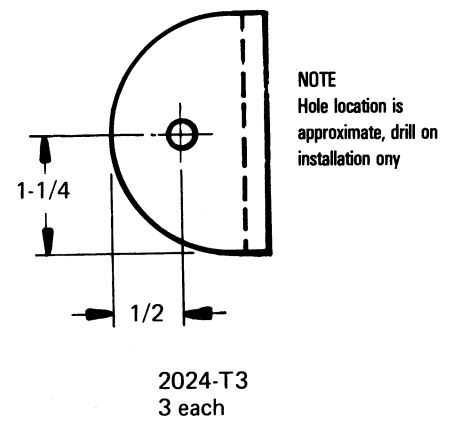
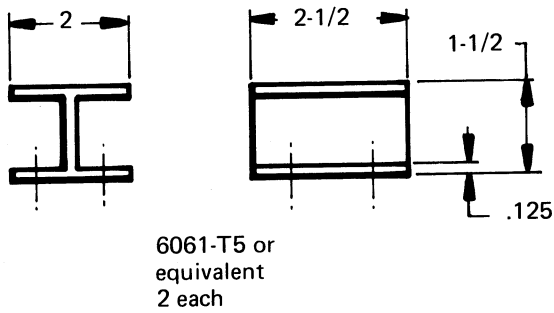
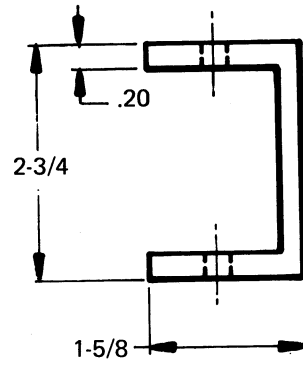
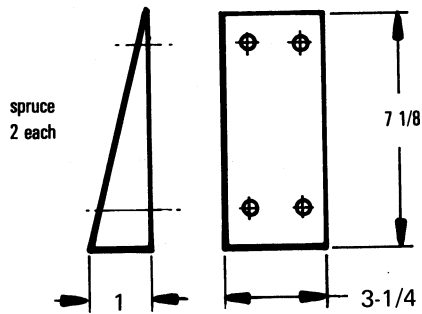
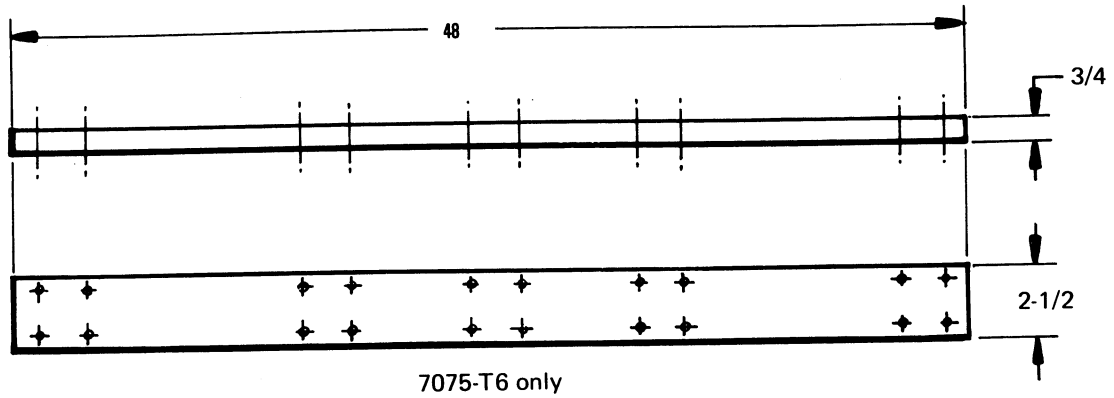


GEAR HANDLE ATTACH ANGLES

position with gear up &
gear down before drilling

2024-T3 or
6061-T5 2 each

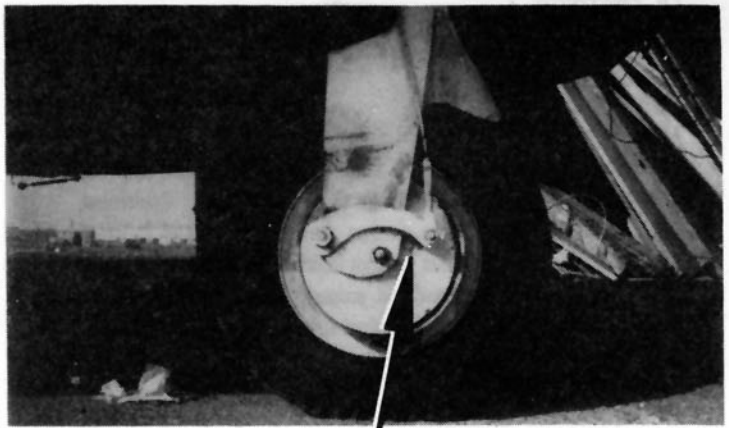
KR-1 DRAWING NO. 18



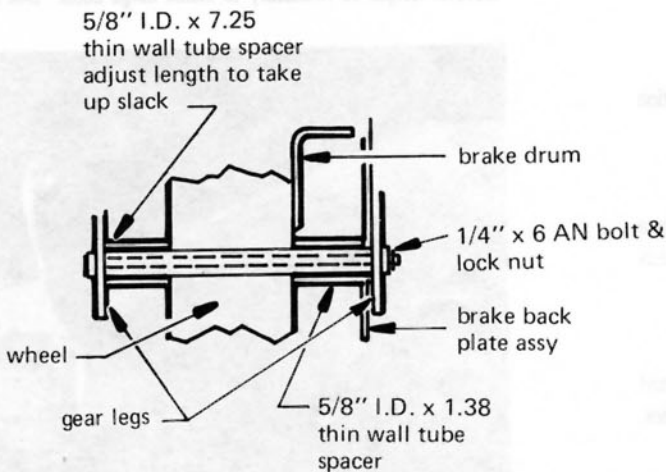
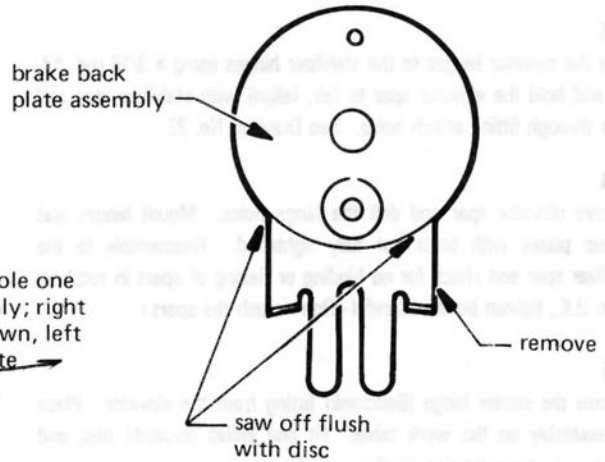
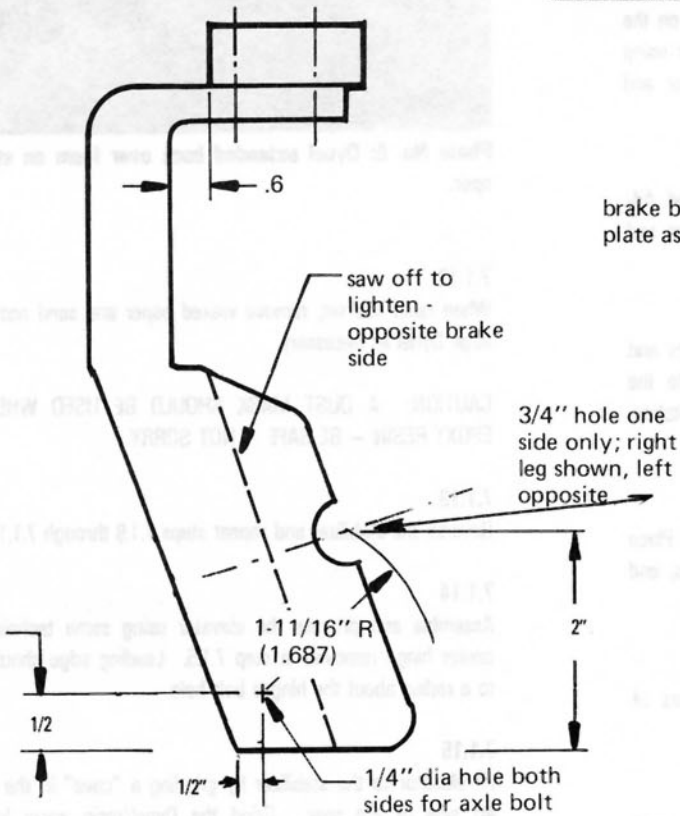
bar AL 6061-T6
cutouts req'd to
latch gear 2 each

LANDING GEAR
locate & drill all holes on
assy; clamp all parts together
in gear up position before drilling

KR-1 DRAWING NO. 19



install brake arm
in this position



WHEEL INSTALLATION USING KIT GEAR LEGS & 10-1/2" O.D. TIRES

NOTE: a washer may have to be added to each wheel bolt between the brake drum & wheel to make the drum run true

axle is 5/8" O.D. Alum rod
5" long with 1/4" hole
thru center

KR-1 DRAWING NO. 20

7.0 EMPENAGE

7.1

Horizontal Stabilizer and Elevator

7.1.1

Select the two pieces that will be the aft horizontal stabilizer spar and the elevator spar and mark the hinge (3 each) locations. Remember, the center hinge must locate so that the elevator control bellcrank and the cable connecting bolts will not interfere when the assembly is located on the top longersons and properly positioned in relation to the fuselage center line and the vertical spar.

7.1.2

A handy assist to lining up the hinges is a straight piece of 3/16" round tool steel approximately 52 inches long. Locate hinges on the aft stabilizer spar, mark hinge mounting holes and/or drill spar using hinge mounting holes as drill guides. Secure hinges to spar and recheck for alignment.

7.1.3

Mate the elevator hinges to the stabilizer hinges using a 3/16 rod. Adjust and hold the elevator spar to fair, (align) with stabilizer spar and mark through fitting attach holes. See Drawing No. 22.

7.1.4

Remove elevator spar and drill the hinge holes. Mount hinges and backup plates with bolts not fully tightened. Reassemble to the stabilizer spar and check for no binding or flexing of spars in rotation. When O.K., tighten bolts. (Careful—Don't crush the spars.)

7.1.5

Remove the center hinge (Bellcrank) fitting from the elevator. Place the assembly on the work table. Fit and install plywood ribs, end pieces and corner bracing blocks.

7.1.6

Cut and fit foam planks for leading edge and between spars of stabilizer. See Drawing No. 8 Horizontal Stabilizer details.

7.1.7

Epoxy a foam block along the aft side of the aft spar. This foam will be hollowed out later to accept the nose of the elevator.

7.1.8

When epoxy is set, sand foam to contour. NOTE: Get FAA inspection "O.K. to Close".

7.1.9

Cut and fit 4 pieces of Dynel fabric for the upper and lower surface of the stabilizer. Allow for overlapping the nose and extending back over the foam on the aft spar. See Photo No. 6.

7.1.10

Apply resin and spread over surface of foam. Apply Dynel fabric and additional resin. Squeegee to spread resin and remove air bubbles.

7.1.11

Cover Dynel with strips of waxed paper and squeegee lightly to remove air bubbles. NOTE: The waxed paper is applied to produce a smooth surface on the resin. A good squeegee for "working" the air out is made from a small piece of plywood (approx. 1 x 2 inch). Try and keep this squeegee dry. Resin on top of the waxed paper causes it to tear during removal.

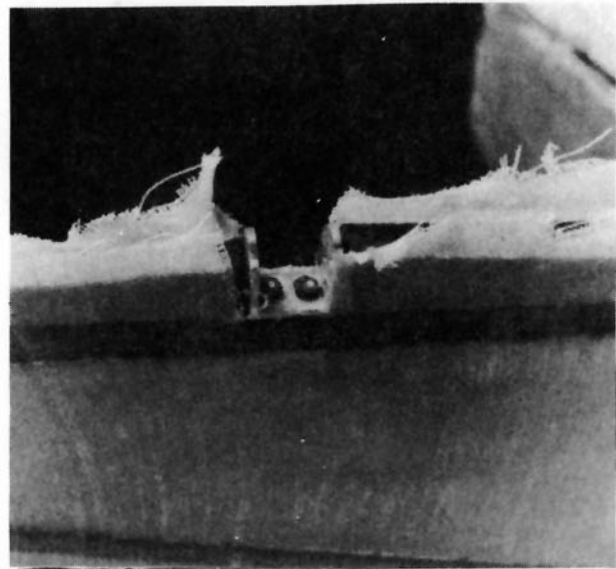


Photo No. 6: Dynel extended back over foam on stabilizer rear spar.

7.1.12

When resin has set, remove waxed paper and sand nose and trailing edge Dynel as necessary.

CAUTION: A DUST MASK SHOULD BE USED WHEN SANDING EPOXY RESIN — BE SAFE — NOT SORRY.

7.1.13

Reverse the stabilizer and repeat steps 7.1.9 through 7.1.12.

7.1.14

Assemble and process the elevator using same techniques. Install center hinge removed in step 7.1.5. Leading edge should be sanded to a radius about the hinges bolt hole.

7.1.15

Fit elevator to the stabilizer by grinding a "cave" in the foam on the aft side of the spar. Grind the Dynel/resin away locally at the elevator hinges as necessary to install hinge bolts. See Photo No. 7.

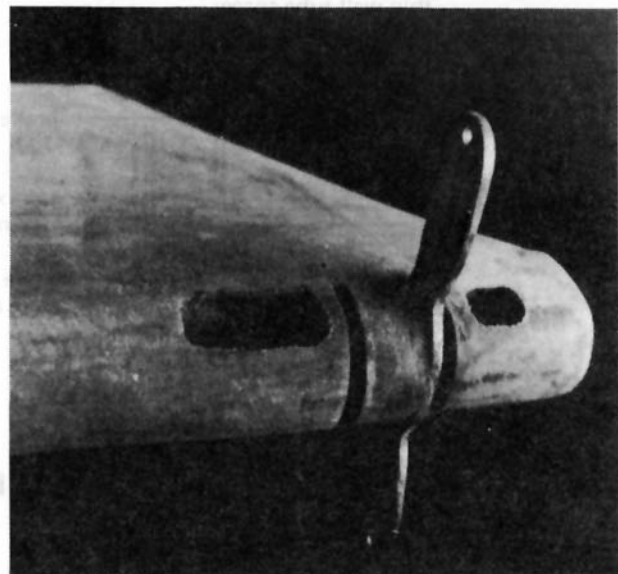


Photo No. 7: Rudder lower hinge. Dynel and foam ground away for access to hinge bolt.

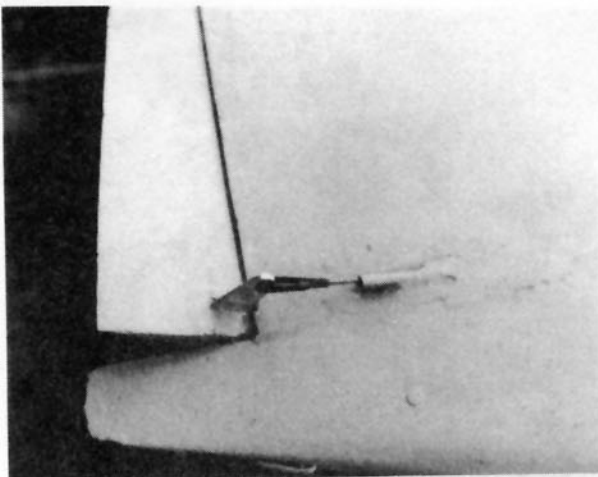


Photo No. 16: Elevator tab push-pull horn at clevis.

7.1.16

Cut out elevator tab 2½ x 6". See Photo No. 16.

7.1.17

Glass open ends and epoxy in 1/8" tubing at the hinge point. Epoxy in a model airplane control horn.

7.1.18

Drill a ¼ inch hole thru elevator and install a model airplane NYROD.

7.1.19

Install model airplane Quik Links per radio control model procedures. Install a U-control bellcrank in the fuselage and connect the inside end of the NYROID to it. Use .017 stainless steel U-control cable between the bellcrank and a handle in an armrest.

7.1.20

Insert a 1/16" steel rod thru the elevator and tab tube. Epoxy end closest to the rudder.

7.1.21

Place the horizontal stabilizer/elevator assembly onto the top longerons of the fuselage. See Drawing No. 1 and Drawing No. 4. Cut notch for the elevator spar edge in the top longerons. See Photo No. 8. Check from the tips of forward stabilizer spar to selected center line point on top of the fuselage. When identical measurement is obtained, epoxy and clamp assembly in place. See Photo No. 12.

7.2

Vertical Stabilizer and Rudder.

7.2.1

Mark center line on plywood bulkhead webs below forward spar of horizontal stabilizer. See Drawing No. 4. Cut webs as required and install forward vertical stabilizer spar. See Photo Nos. 9, 10, and 11.

7.2.2

Check center line alignment with rear vertical spar and a selected point on the fuselage. When satisfied, fit support blocks and glue in place.

7.2.3

Fit, but do not install, the horizontal rib above and between the forward and aft vertical stabilizer spars. See Drawing No. 4. To be installed when the elevator and tab control rigging is completed.

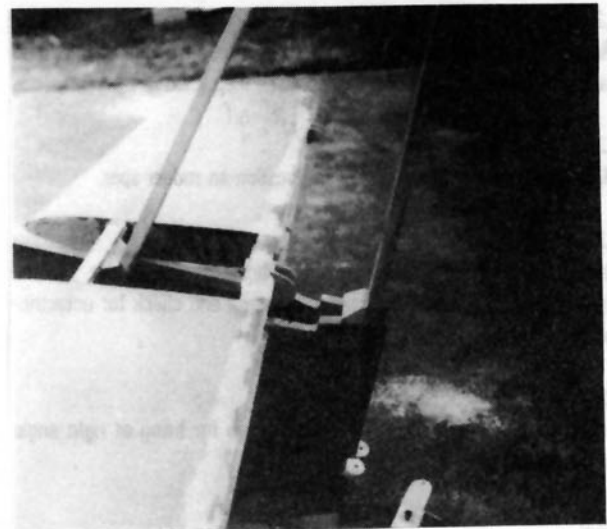


Photo No. 8: Longerons notched for elevator spar.

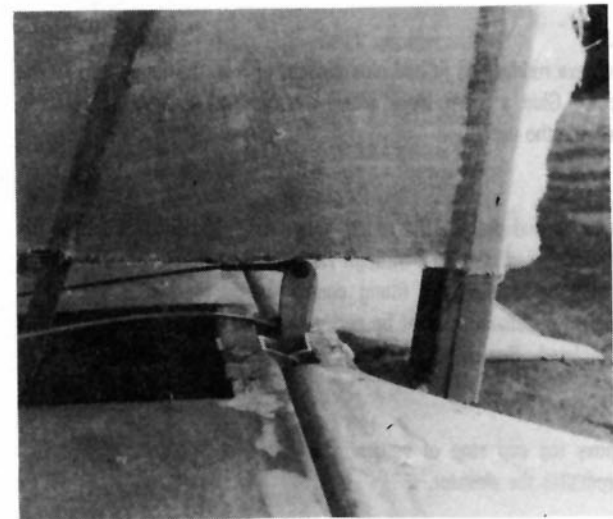


Photo No. 12: Stabilizer located and glued in place, elevator tab push-pull assembly installed.

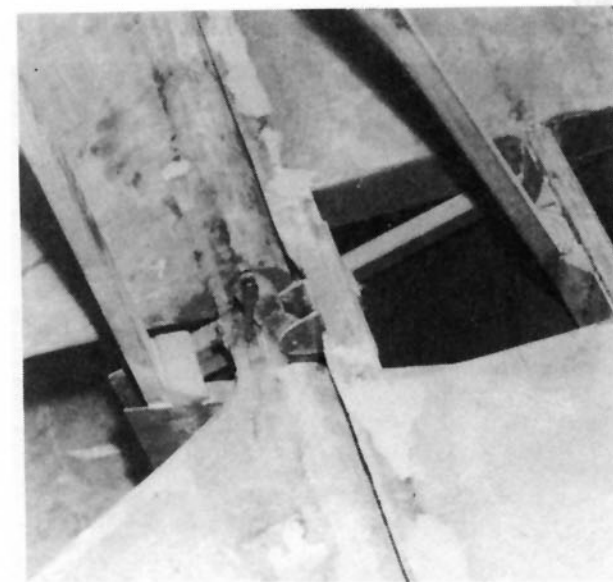


Photo No. 9: Horizontal tail group installation. Note plywood aft of vertical installation.

7.2.4

Mark hinge locations on aft vertical spar. Mount and bolt hinges and back plates. Use 3/16 tool steel rod. See step 7.1.2.

7.2.5

Mate rudder hinge fittings and mark location on rudder spar.

7.2.6

Remove hinges and use the mounting holes as drill guides. Install hinges and back plates. Reinstall rudder spar and check for unrestricted rotation.

7.2.7

Install lower rib of rudder. Check top of rib for being at right angle to the rudder spar.

7.2.8

Clamp rudder spar parallel to vertical stabilizer spar and cut, fit and glue the top cap strip of the rudder. Cut and fit, but do not glue the cap for the vertical stabilizer (Fin).

7.2.9

Remove rudder and fit and glue a sheet of foam to the aft side of the spar. Glue a foam block along the forward side of the spar to become the nose.

7.2.10

Build up and process the rudder foam, resin and Dynel same as the elevator. See step 7.1.8 through 7.1.12 and 7.1.15. NOTE: The rudder should be installed for fitting control cables for length, etc. Permanent installation cannot be performed until vertical stabilizer (Fin) is completed. See step 7.2.12.

7.2.11

Epoxy top cap strip of vertical stabilizer (Fin) in place. NOTE: This captivates the elevator.

7.2.12

Cut, fit and glue foam to the vertical stabilizer. Process same as horizontal stabilizer. See steps 7.1.6 and 7.1.12.

7.2.13

Fit rudder to vertical stabilizer—same as step 7.1.15.

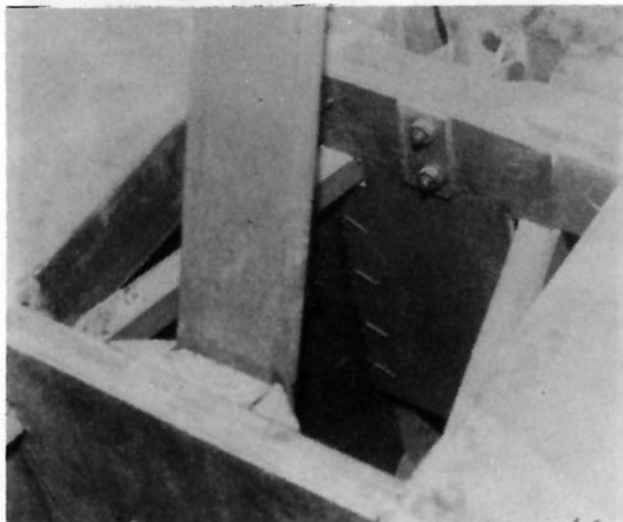


Photo No. 10: Aft plywood web and elevator center hinge plate.

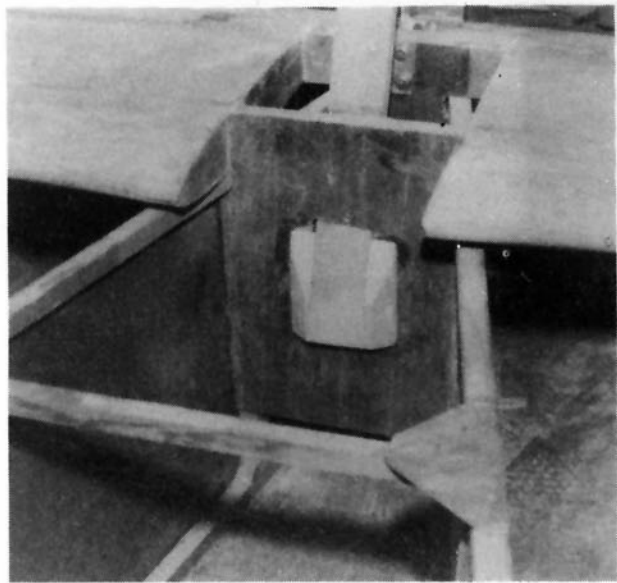


Photo No. 11: Plywood web attaching forward spar and anchoring vertical fin front spar.

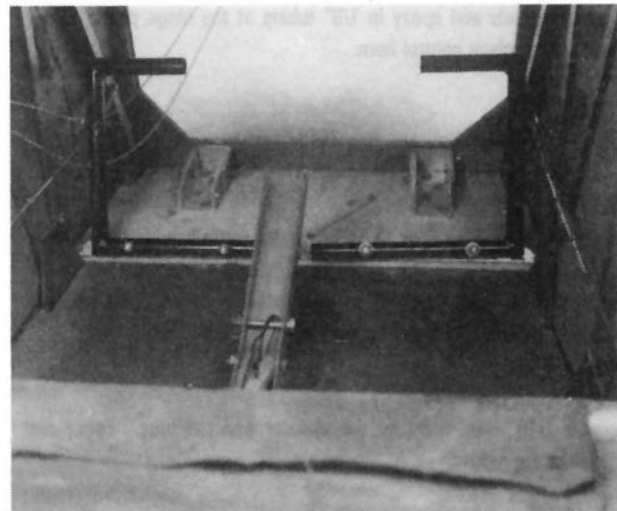


Photo No. 15: Rudder pedal installation.

8.0 CONTROLS

8.1

Rudder

8.1.1

Install rudder pedals. See Drawing No. 9 and Photo Nos. 14 and 15.

8.1.2

Attach cable ends to pedals and route cables through guides to and through holes to be located and cut in fuselage skins in line with the rudder bellcrank.

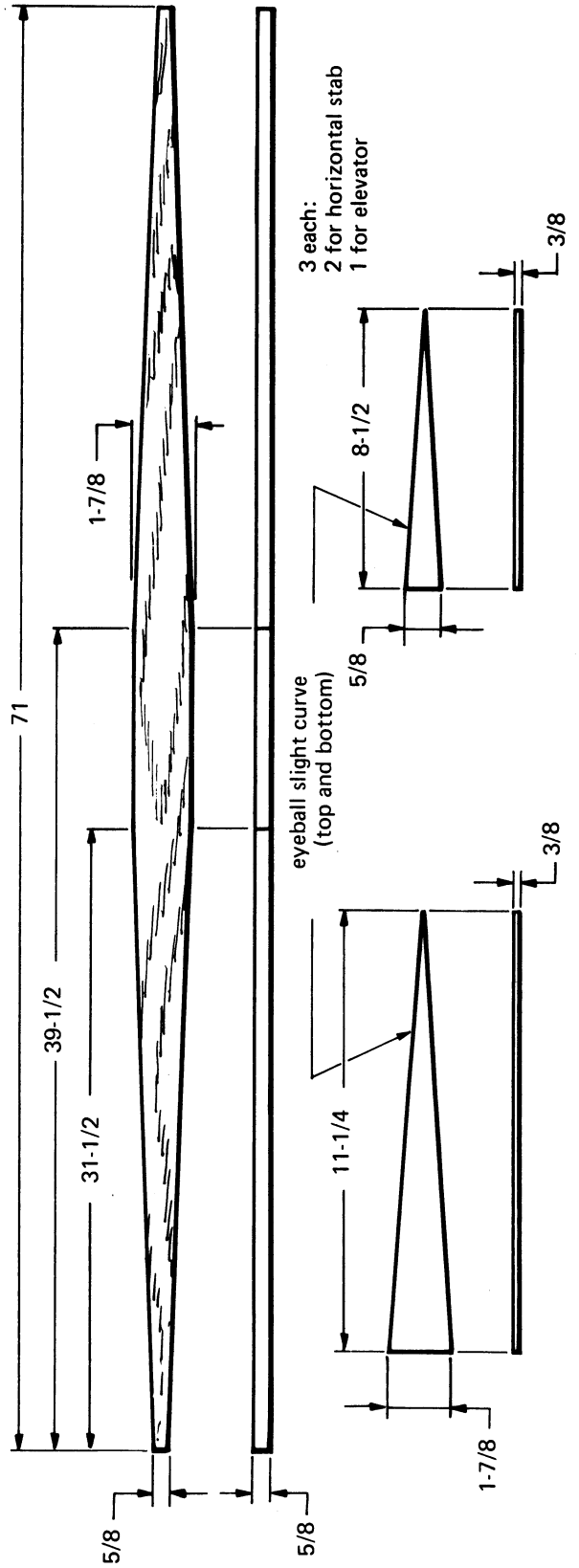
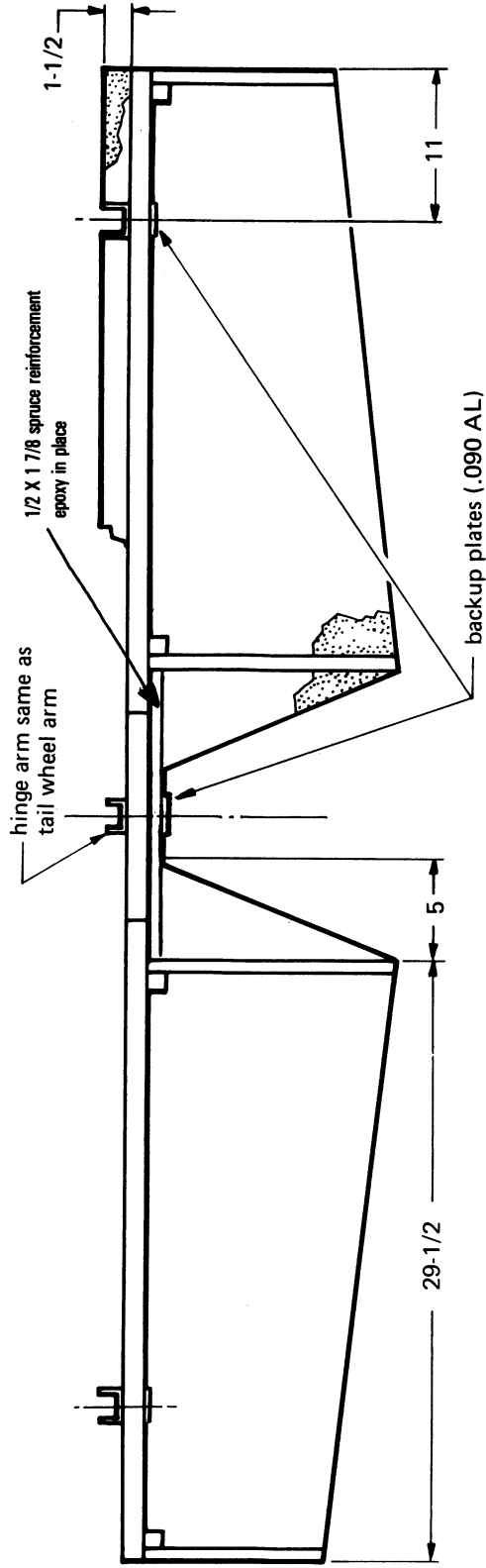
8.1.3

Attach, adjust and secure rudder pedal return springs (or run-around cable).

8.1.4

With rudder held in trail, with the vertical stabilizer, terminate cables with nicopress or equivalent sleeves to fit rudder bellcrank.

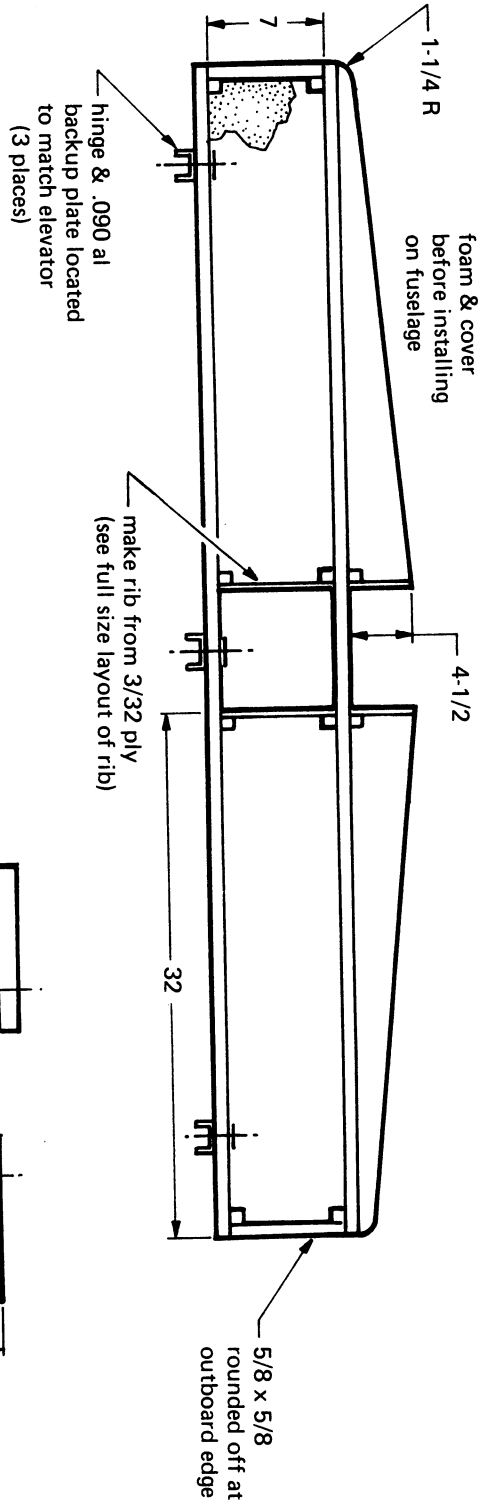
ELEVATOR



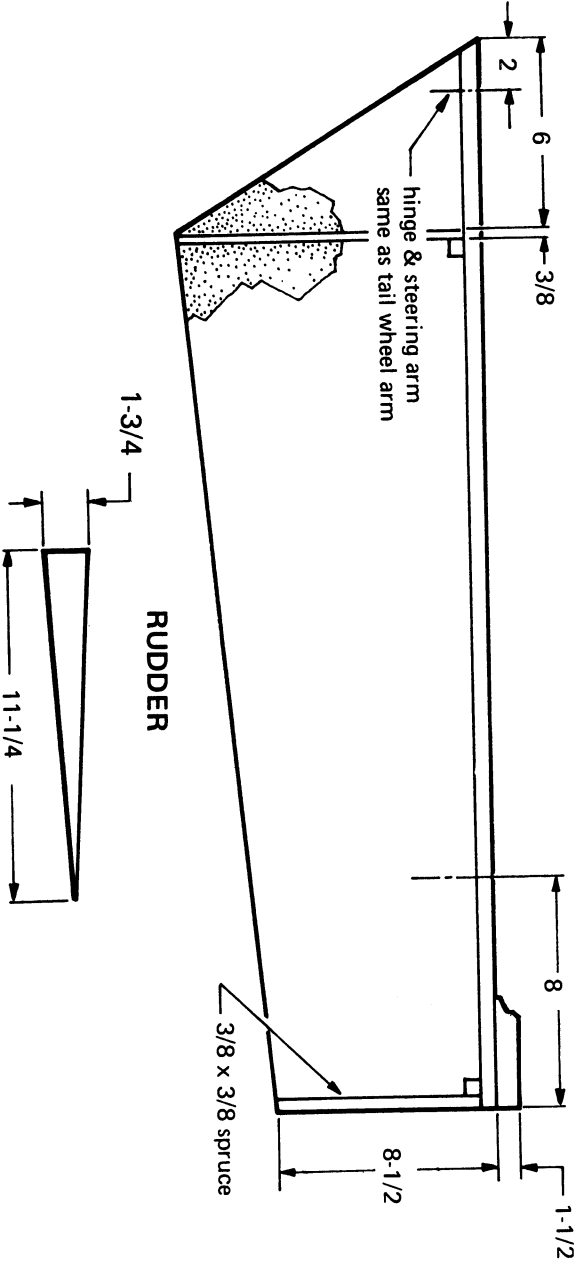
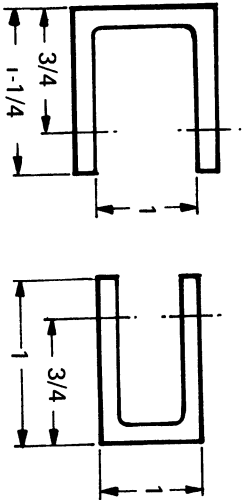
KR-1 DRAWING NO. 22

KR-1 DRAWING NO. 8

HORIZONTAL STABILIZER



rudder & elevator hinges .125 6061-T5 or equivalent



8.1.5

With tail wheel bellcrank parallel with rudder bellcrank, nicopress the cables for the tailwheel onto the rudder cables. See Drawing No. 9. Cut off the excess cable. (NOTE: Use two nicopress fittings per splice).

8.2

Elevator

8.2.1

Install control stick bracket on aft side of forward spar. Pick up the bolts holding the center landing gear spring bar hinge bracket. See Drawing Nos. 1 and 7 and Photo Nos. 14 and 15.

8.2.2

Install stick assembly and attach cable ends on stick fittings.

8.2.3

Locate elevator cable pulley bracket on aft face of aft spar. Cut slot in spar webs for cables to pass through.

8.2.4

Mount pulley bracket on upper spar of horizontal stabilizer. Clamp, do not drill mounting holes at this time. To be performed in step 8.2.7. See Photo No. 13.

8.2.5

Route cables through rear spar pulley bracket. Bottom cable from control stick to be routed over pulley in bracket clamped to stabilizer spar. Attach to elevator bellcrank. Install cable guards at all pulley brackets.

8.2.6

Connect other elevator cable to bellcrank.

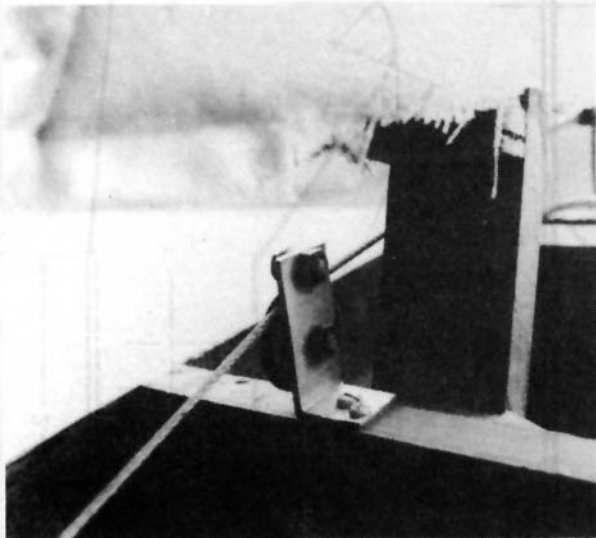


Photo No. 13: "Up" elevator control cable pulley bracket.

8.2.7

With stick and elevator clamped in desired positions, adjust elevator cable bracket for minimum side load from cable. Drill bolt holes and secure in place. See Photo No. 13.

8.2.8

Terminate elevator cables with nicopress sleeves or equivalent, and cut off excess. Adjust tension.

8.3

Aileron

8.3.1

Attach aileron control brackets to the wing spar lower attach fittings by picking up designated bolts. See Drawing Nos. 7 and 21, and Photo Nos. 17, 18, 19, 20, and 21.

8.3.2

Cut hole in both sides of fuselage behind front spar for aileron cables. (Check cable run with gear in up position. Cable *must* clear landing gear casting.) See Photo No. 26.

8.3.3

Install cable ends on control stick fittings. See Drawing No. 7.

8.3.4

Cut hole in web of aft spar, at both lower left and right wing attach fittings, in line with forward and aft aileron cable pulley brackets mounted on aft side of forward spar. See Photo Nos. 19 and 21.

8.3.5

Attach turnbuckles and cables to control stick and route cables through front spar bracket pulleys to aileron push-pull rod connecting assemblies mounted on the back side of rear spar wing attach fittings. See Drawing No. 7.

8.3.6

Cut holes in both sides of fuselage skins at aft side of rear spar and in line with aileron push-pull assemblies on rear spar wing attach fittings.

8.3.7

With turnbuckle in fuselage route cables through the fuselage side skin holes to the push-pull assemblies mounted on the rear spar wing attach fittings. See Drawing No 7 and Photos 18, 19 and 20.

8.3.8

With control stick vertical and aileron push-pull assemblies clamped in position, adjust cables to tension.

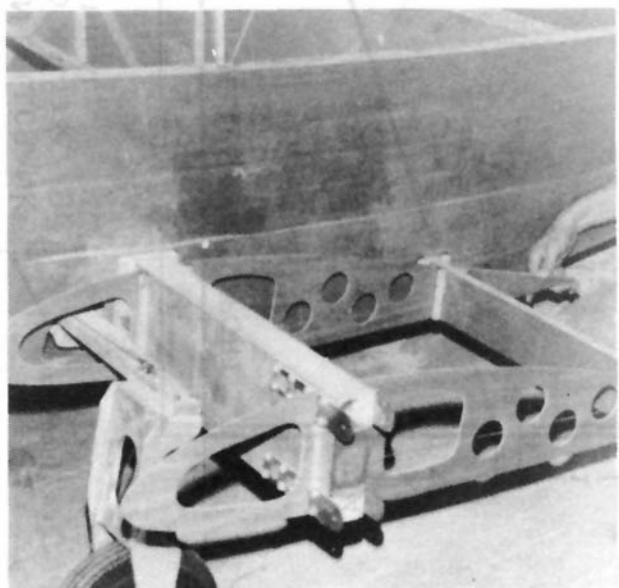
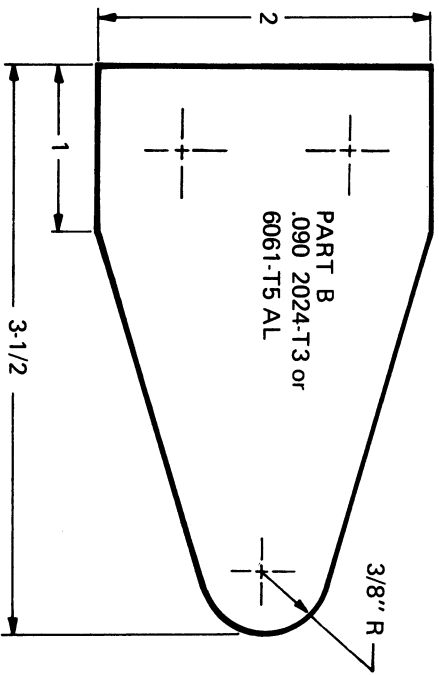
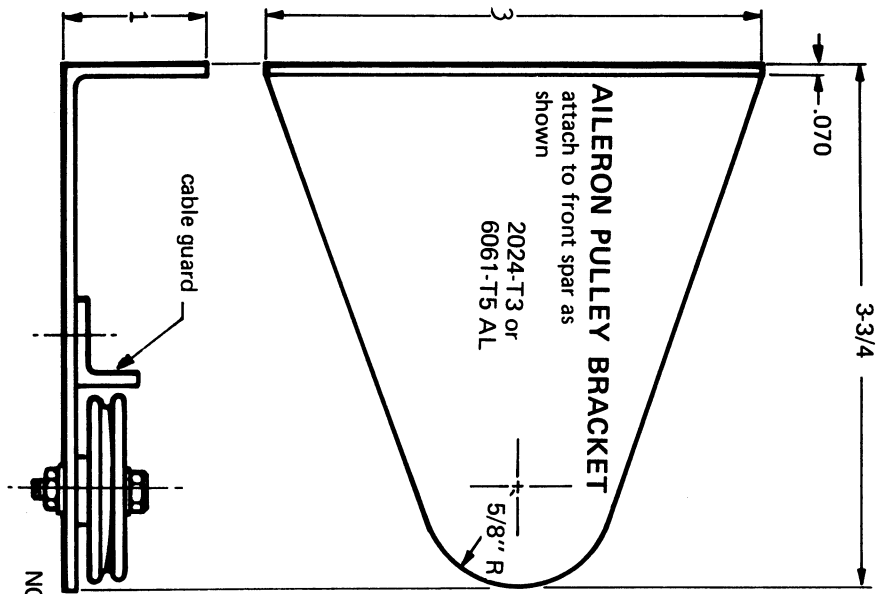
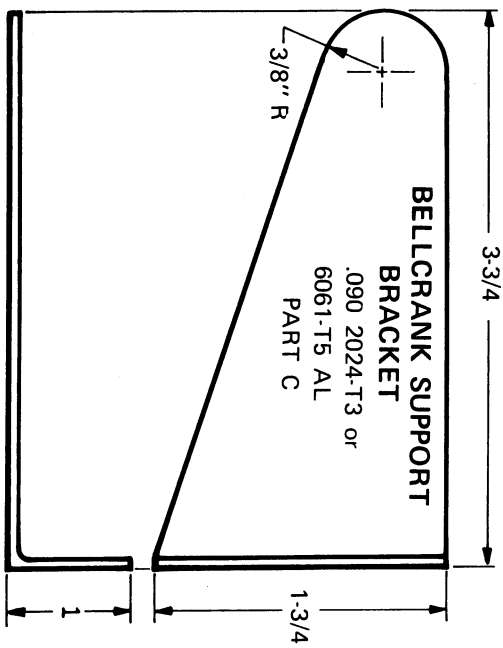
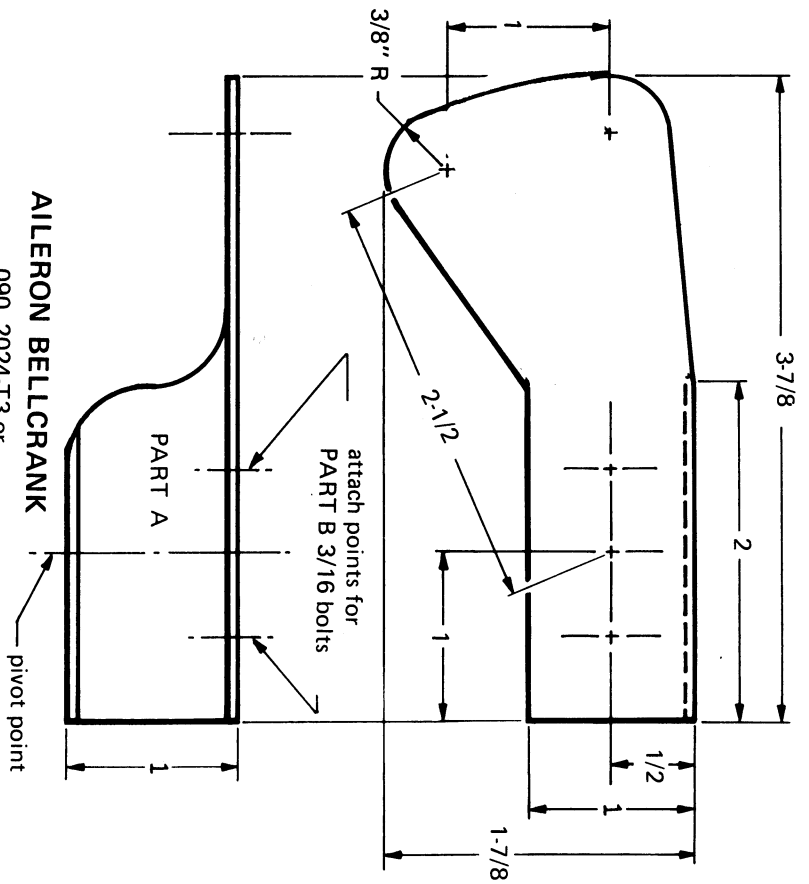


Photo No. 17: Aileron cable installation and forward wing attach fitting.

KR-1 DRAWING NO. 21



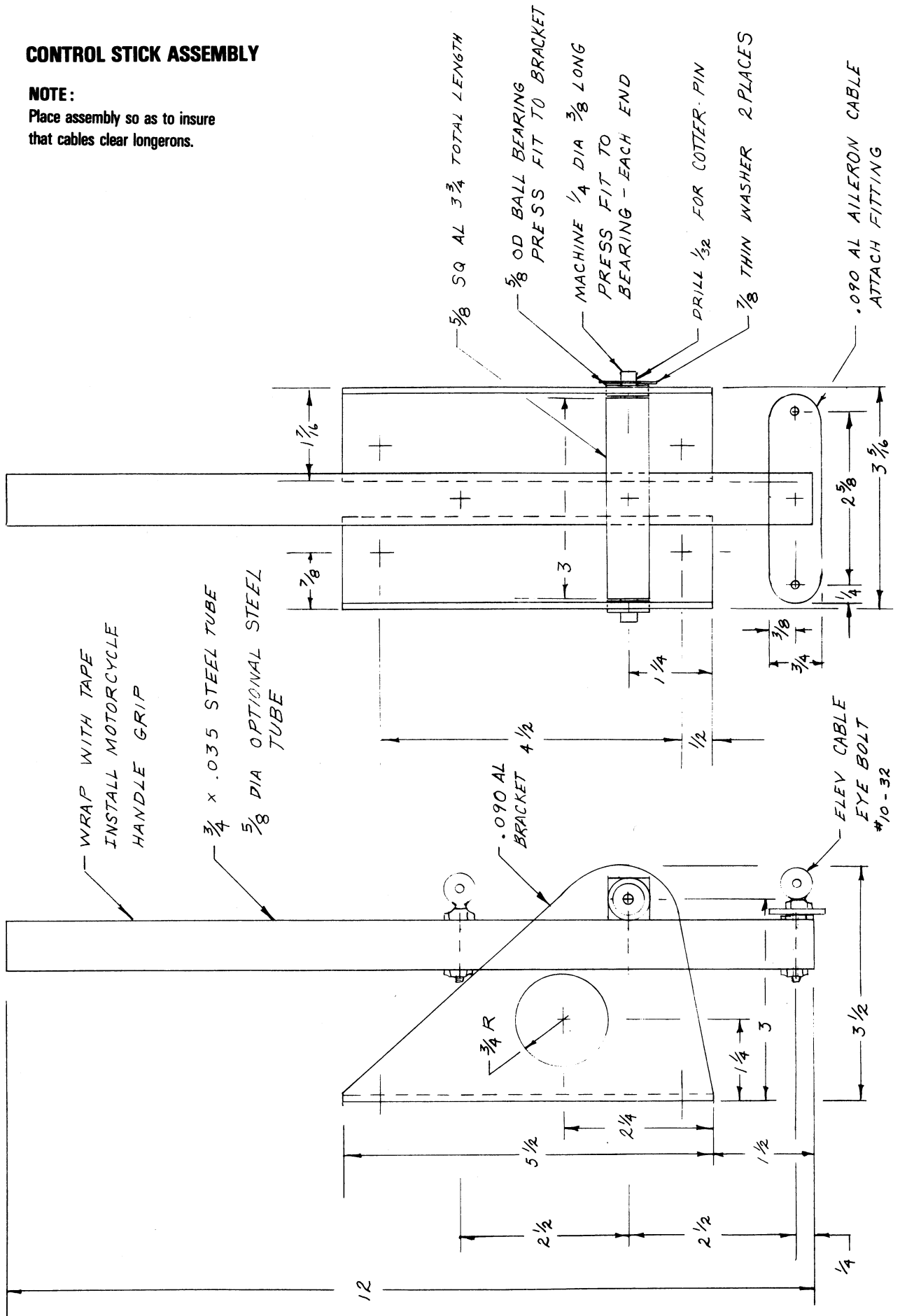
NOTE: all parts shown on this sheet are for left hand. Right hand parts are to be made opposite.



CONTROL STICK ASSEMBLY

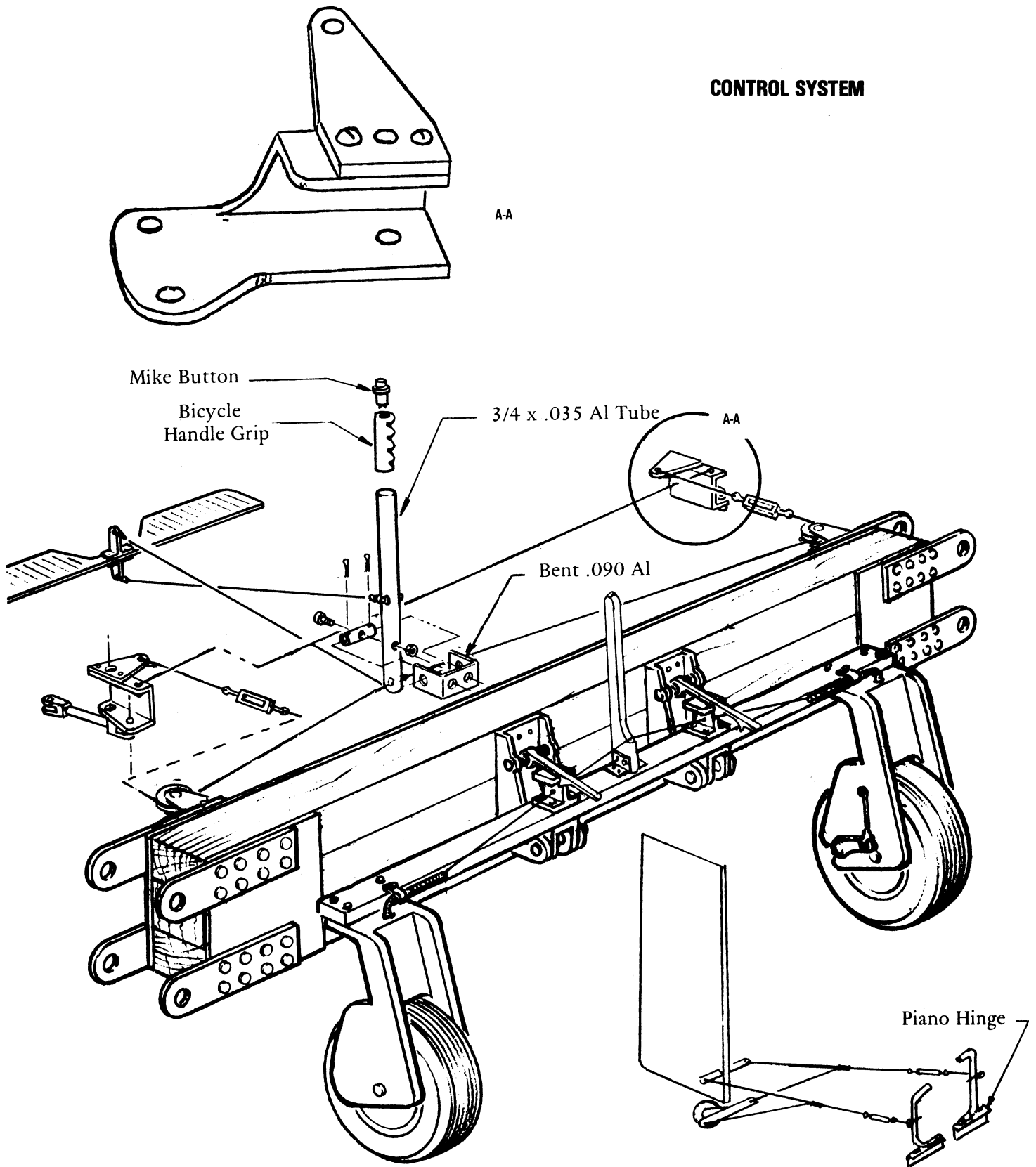
NOTE:

Place assembly so as to insure that cables clear longerons.



KR-1 DRAWING NO. 25

CONTROL SYSTEM



KR-1 DRAWING NO. 7

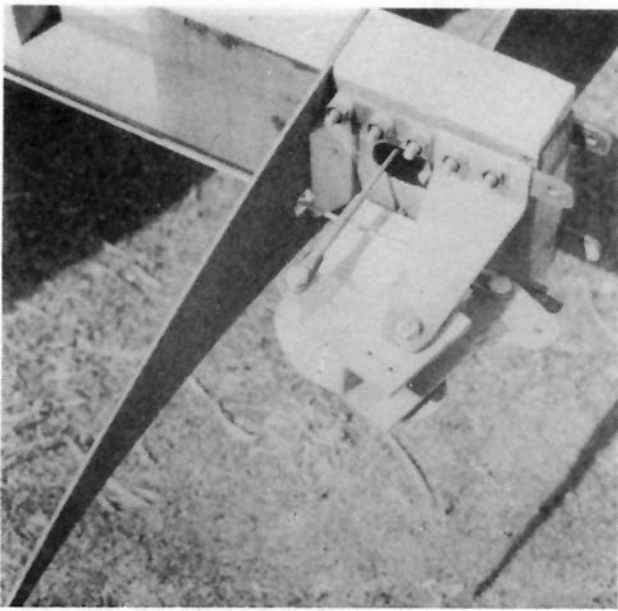


Photo No. 18: Aileron bellcrank assembly installed and rigged.

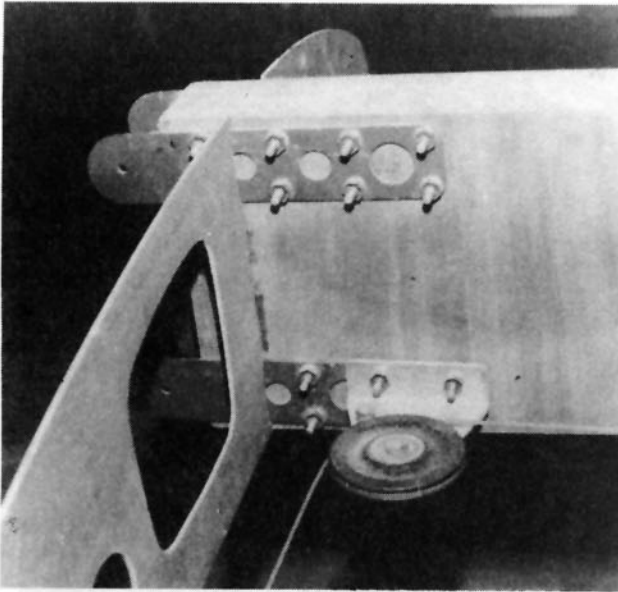


Photo No. 21: Aileron pulley and bracket at front spar.

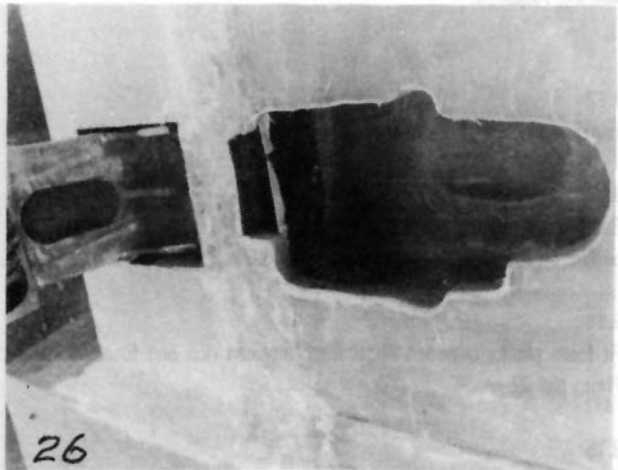


Photo No. 26: Wheel well cavity. Note aileron cable work protection and brake cable.

9.0 CENTER WING—FOAM AND DYNEL

9.1

Fit and install nose plywood ribs using airfoil outline on fuselage as a sighting guide. Contour upper spar caps at this time. A belt sander is an easy way to do this job.

9.2

Split aft end of inboard rib to install over spring bar. Cut clearance slot for gear spring bar until only $\frac{1}{4}$ inch of rib remains. This rib material must be retained until Dynel/resin is set. It is then worked off later to provide spring bar clearance as required.

NOTE: The landing gear must not be retracted again until the leading edge has been Dynel covered and the epoxy resin has set. Then the lower part of the plywood can be cut out of the inboard rib and a channel cleared in the foam. This is to clear the spring bar in the retract position.

9.3

Fit and install the aft sections of the ribs. Drill clearance holes as required to clear aileron control cable. Note that outboard trailing rib is set at inner end of wing attach fitting.

9.4

From one inch foam sheet stock, cut plates to fit between ribs, fuselage and wing spars. Fit plates high enough to be above airfoil contour. When fit is o.k., glue in place (top surface of wing only).

9.5

Fit one inch foam planking between fuselage and leading edge and trailing edge ribs. Glue in place.

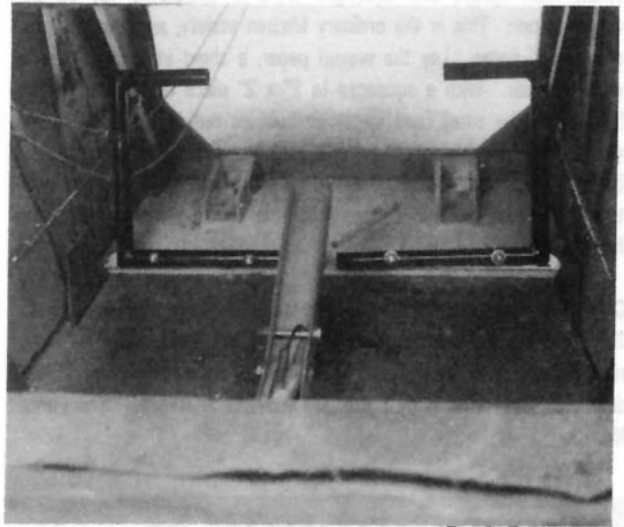


Photo No. 15: Rudder pedal installation.

9.6

When glue has set, sand the foam to airfoil contour using ribs as contour guides.

9.7

From foam, make and fit wing-to-fuselage fillet blocks. Glue in place.

9.8

Sand to contour desired. NOTE: A nice sanding block is made from a mayonnaise, salad dressing, or peanut butter jar (your option).



Photo No. 32: Laying out the Dynel to fit top of wing.

9.9

Lay the Dynel cloth on from the forward spar cap to the trailing edge of the wing and up over the fillet. See Photo No. 32.

NOTE: The wing leading edge is done later.

9.10

Pour a quantity of resin/hardener mix onto the foam and squeegee a thin coating over the surface. Lay on the Dynel fabric, add more resin and squeegee to spread, work through and wet the Dynel.

CAUTION: Do not use excessive pressure. You may crack the foam. Also, you may pucker the Dynel up into ridges which could result in the fabric being cut during the sanding operation.

Air under the Dynel fabric is seen as a "light" spot. Use the corner of the squeegee to "tap" lightly and work air to the surface.

9.11

When resin spread and squeegee work is completed, lay on the waxed paper. This is the ordinary kitchen variety, again select your own brand name. Lay the waxed paper, a sheet at a time, parallel with the spar. With a squeegee (a 2" x 2" piece of plywood works fine) work the small (and large) air bubbles out to the edge of the sheet. Lay another sheet, overlapping the first, and squeegee as before. See Photo No. 35. Try and keep this squeegee dry. Resin on top of the waxed paper causes it to tear during removal after resin has set.

CAUTION: Do not try to do the fillet with one piece of waxed paper. This is a compound curve and you will get many wrinkles with resulting ridges in the resin. This makes for much unnecessary sanding and filling with body putty and *increase in weight*. See Photo No. 23.

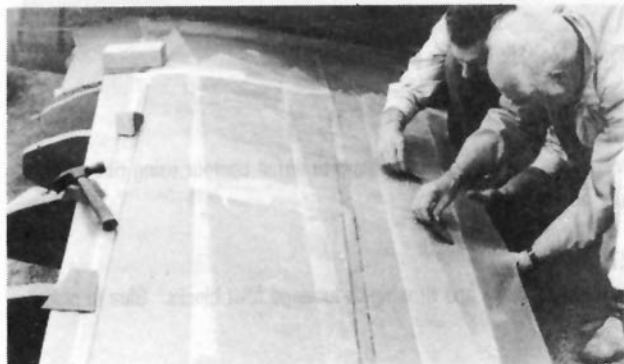


Photo No. 35: Squeegeeing the wax paper with plywood chips. Remove air.

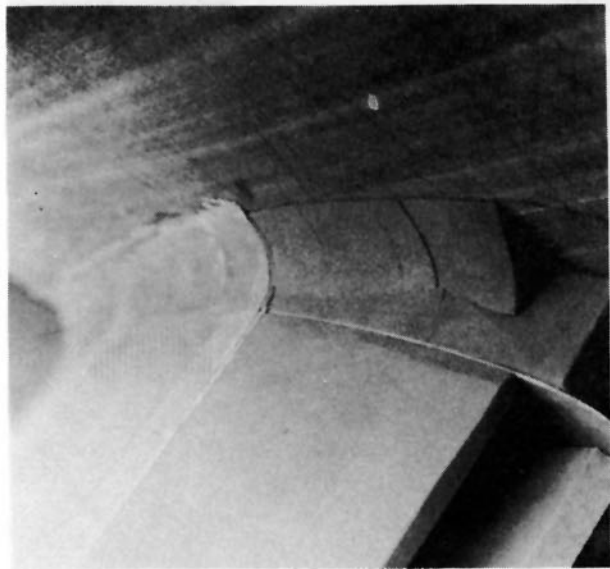


Photo No. 22: Fillet foam installation and shape nose foam installation incomplete.

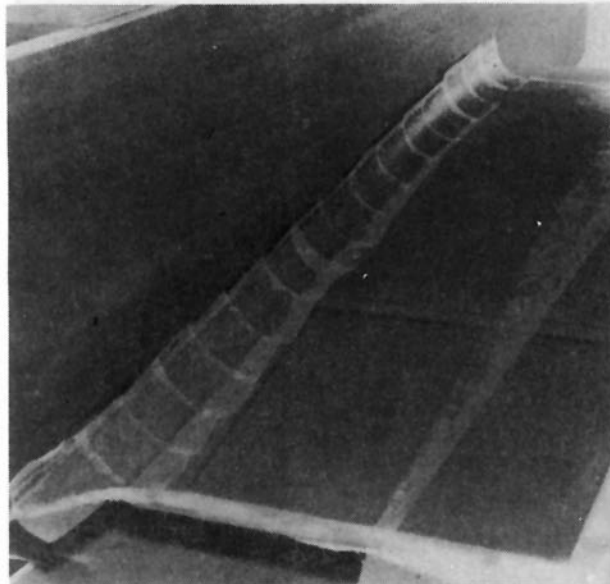


Photo No. 23: Method of applying wax paper to fillet. Minimum sanding required.

9.12

Turn the airplane, bottom side up.

9.13

Sand wing trailing edge foam to contour of airfoil surface. Use outline on fuselage and plywood ribs as guide.

9.14

Fit foam planks between ribs. Also between ribs and fuselage. See Photo No. 22.

9.15

Fit foam planks between spars.

9.16

Fit foam planks, front of spar between fuselage and nose ribs.

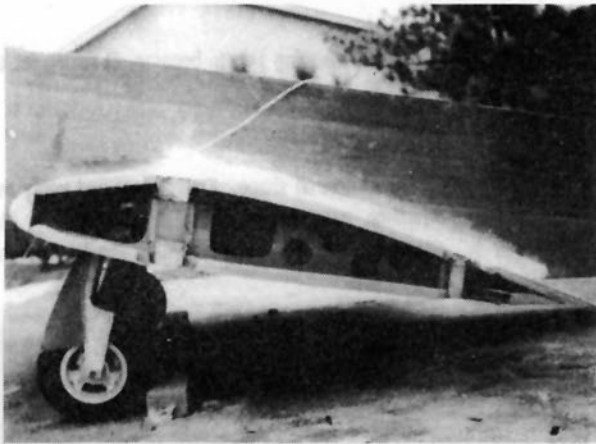


Photo No. 24: Profile of center wing foam. Note trailing scarf joint.

9.17

Vacuum up the dust and glue all fitted planking in place. Be careful to get a full surface coverage between the scarf of the lower trailing edge plank and the lower surface of the upper skin plank. Use epoxy to bond this joint. See Photo No. 24.

9.18

Fit Dynel from center of forward spar cap to trailing edge of wing.

9.19

Apply epoxy resin and process same as upper surface. See step 9.10 and 9.11.

9.20

Fit one inch foam planking between fuselage and leading edge ribs. Add the 2-inch foam blocks that will become the leading edge. Glue in place.

9.21

When glue has set, sand to contour using fuselage outline and nose ribs as guide. See Photo No. 37.

NOTE: The leading edge of the wing is covered with two layers of Dynel and three coats of resin.

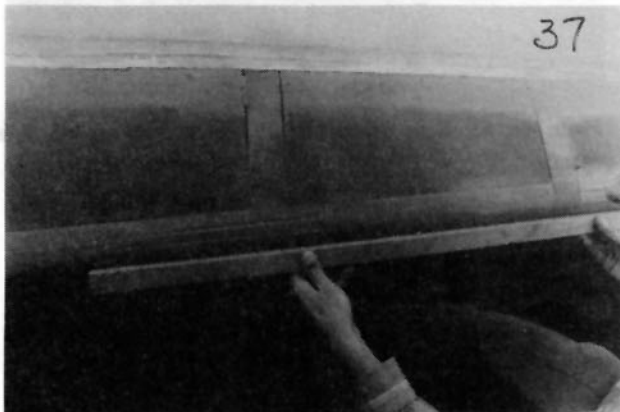


Photo No. 37: Using canted straight edge to conform contour of wing nose.

9.22

Fit Dynel from center of spar forward and approximately 1 inch past chord line of airfoil and up over wing fuselage fillet.

9.23

Apply epoxy and process same as in step 9.10 and 9.11.

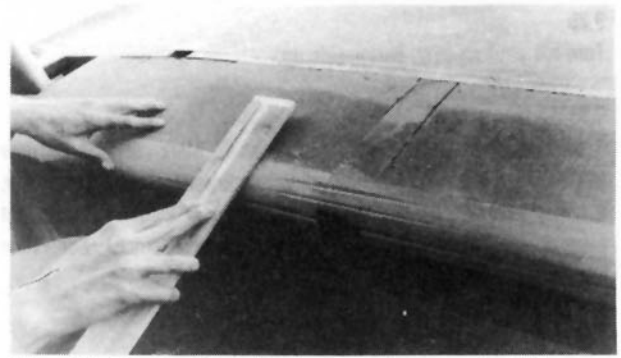


Photo No. 38: Rough sanding foam to contour marks. Wing nose.

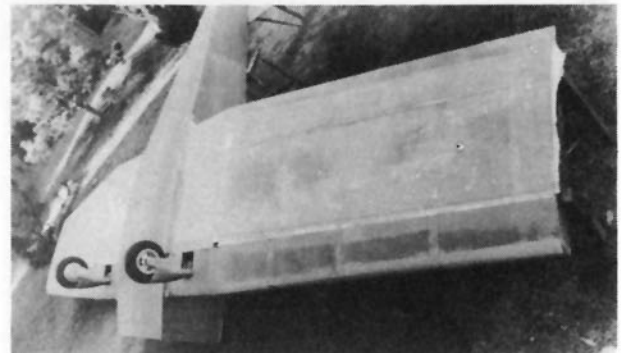


Photo No. 39: Dynel-resin hardening while the wing is held by wing tip ribs.

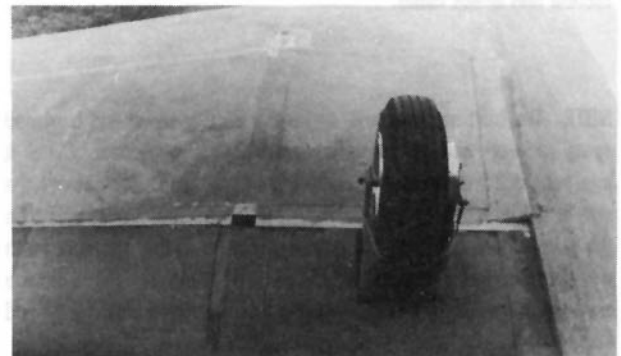


Photo No. 40: Note semi-transparency of resined Dynel. All joints in foam are seen.

9.24

Turn airplane over, right side up. Sand off overhanging Dynel and resin after resin has set.

9.25

Sand leading edge foam and fillet foam to fuselage line and rib contour.

9.26

Fit Dynel from center of spar forward and overlap the lower wing surface Dynel.

9.27

Apply epoxy and process same as in step 9.10 and 9.11.

9.28

Working through the end rib cutout and the fuselage skin cutout, trim the lower foam and inboard rib. Visualize how to clear the spring bar in the fully retracted position. Partially retract gear to confirm that adequate material was removed.

9.29

Turn the airplane over, bottomside up.

9.30

Retract gear until wheel touches wing skin. Mark cut lines for gear cavity slot. This is eyeball and judgment procedure. Just remember, it's easy to make a hole too big, so take it in stages. (You're not going to use the removed material again, so cut it small.) See Photo No. 26.

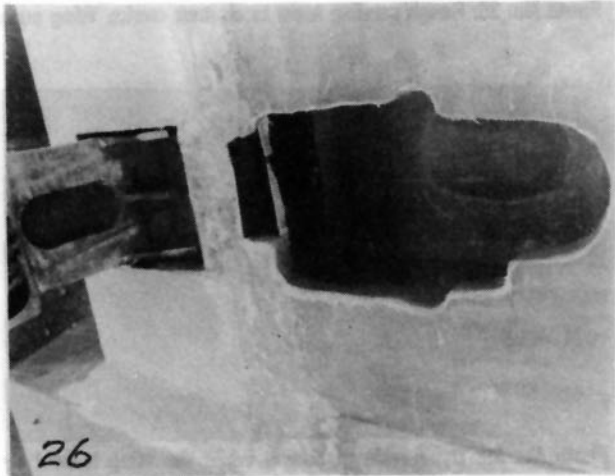


Photo No. 26: Wheel well cavity. Note aileron cable work protection and brake cable.

NOTE: The best means found, so far, for cutting Dynel and hardened epoxy resin without shattering, is a small 2-inch rotary saw. Chuck it into your drill motor so the teeth rotate "into" and not "out of" the skin in the direction you are cutting. Also, don't saw any deeper than the skin; especially if you are following curved lines. The saw teeth will then be raking the edge of the cut and doing the shattering we are trying to avoid, by using a rotary saw. See Photo Nos. 41, 42 and 43.

9.31

Remove material until the wheels touch the foam on underside of the top skin. Rotate wheels to mark the foam. Remove foam until the landing leg rests on front spar or the wheel touches the top skin. See Photo No. 26. If wheel touches top skin, it will be necessary to place an up-travel limiting pad on the spar to assure approximately $\frac{1}{4}$ inch clearance with the lower surface of the top wing skin.

9.32

When step 9.31 is satisfactory, extend gear and latch.

9.33

Fit one-inch foam sheet all around the inside of the wing wheel cavity and epoxy in place. Recheck with the wheels for adequate clearance.

9.34

Line cavity with pieces of Dynel. Brush and squeegee the epoxy into place. When resin is set, recheck for clearance and sand as necessary.

9.35

Place wheels in retract position.

9.36

Glue additional foam on to the wing skin to become aft fairing for the wheel. See Photo No. 25.

9.37

When glue is dry, sand to desired shape. Extend gear and verify that there is no interference with leading edge of the wing. (Approximately $\frac{1}{4}$ " clearance in leading edge slot with the landing gear leg casting.)

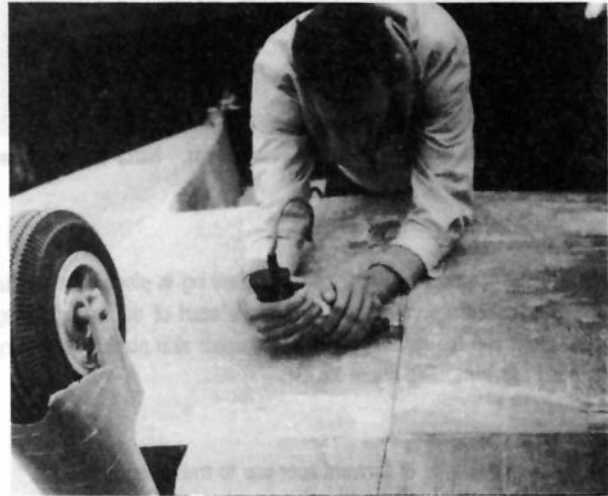


Photo No. 41: Rotary saw following edge of end rib.

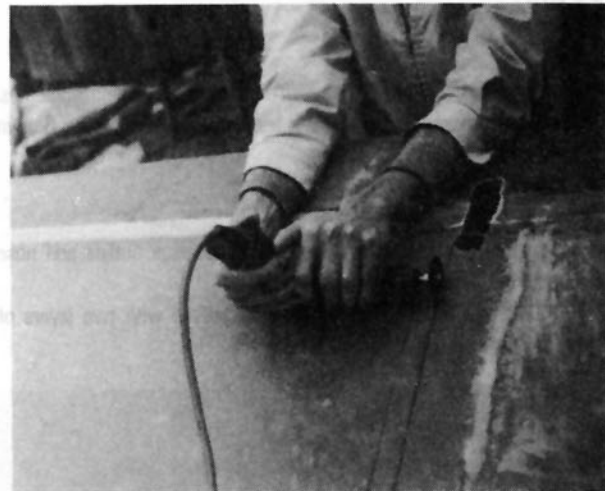


Photo No. 42: Note difference. Where resin is sanded, it is opaque.

9.38

Cover fairings with pieces of Dynel and carefully squeegee on the epoxy resin. Cover with waxed paper and squeegee as described in prior steps.

9.39

When resin has set; extend gear, remove waxed paper and sand as required.

9.40

Turn airplane over, bottomside down, and place in position for installing the outer wing spars and attaching and drilling the outer wing attach fittings. (See step 10.1).



Photo No. 43: Use both hands to control saw. Don't sand before cut.



Photo No. 25: Landing gear speed fairing, attention to detail here will pay off later.

9.41

Install airspeed pitot tube socket on outboard side of right outboard nose rib and route pitot tubing back through the nose cavity into the fuselage. Secure the tubing clear of the landing gear. Pitot tube should be parallel with top longeron and parallel with airplane center line. When location is finalized, remove for permanent installation later. (It's hard on shins and bends the tube if you leave it in place now.)

10.0 OUTER WING SPARS—ATTACHMENT

10.1

Attach outer front spar attach fittings to inner front spar attach fittings. Use a long, 3/16 bolt or 3/16-inch drill rod.

10.2

Improvise a means of holding the spars to the locations required for the attach fitting drilling and bolting operation.

10.3

Insert spar into upper attach fittings and clamp it to the fittings, with spar held at approximately the proper dihedral.

10.4

Position inboard end of outer wing spar cap to coordinate with center section spar cap. Use the spar fitting drill jig and 3/16 drill rod to get forward and aft attach fittings positioned on outer wing spar cap.

10.5

Check the dihedral marked on the tip of the outer wing front spar for being level with top cap of the center section front spar. When dihedral is in place and fore and aft alignment with center section spar checkout is o.k., sand bag or otherwise secure to prevent movement as attach fittings are drilled and bolted to the front spar. See Drawing No. 10 for dihedral dimension.

10.6

Using drill jig, drill spar and push bolts into fittings. Refer to step 5 & 10 and Photo Nos. 1 & 2 for procedure.

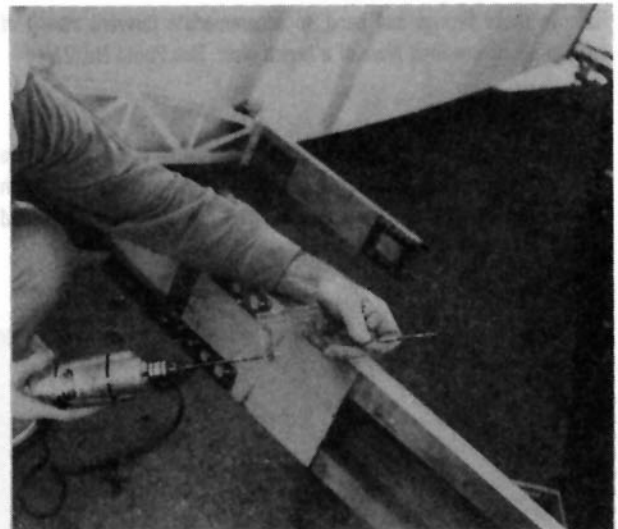


Photo No. 1: Wing spar attach fitting drill jig.



Photo No. 2: Bolt hole drilled straight through spar.

10.7

Locate and nail outer plywood wing rib to front spar, one nail only.

10.8

Install aft spar attach fittings to center section aft spar fittings. Do not tighten the 3/16-inch bolt used for alignment.

10.9

Locate tip of outer wing rear spar to marked position on plywood rib and nail in place with one nail only.

10.10

Insert the inboard end of the spar between the attach fittings and lightly clamp in place.

10.11

Raise (or lower) the trailing edge of the plywood rib and the outer end of the rear spar until the correct washout (3°) is obtained. See reference marks for fuselage. (Per Wing Rib Drawing.) Then nail the rib to the spar and clamp it to an upright to retain in position as the wing attach fittings are drilled.

10.12

Loosen the clamp holding the upper set of outer wing attach fittings to the spar cap. Observe the angle of forward sweep. Place a support under spar.

10.13

Remove these fittings and bend, to accommodate forward sweep of spar, in aluminum-lined jaws of a bench vise. See Photo No. 27.

10.14

Reinstall fittings and clamp to the spar cap. Attempt to remove the $3/16$ bolt joining the four fittings. When you can remove it with thumb and fingers the fit is o.k. Drill and bolt as in step 5.10 and referenced photos.

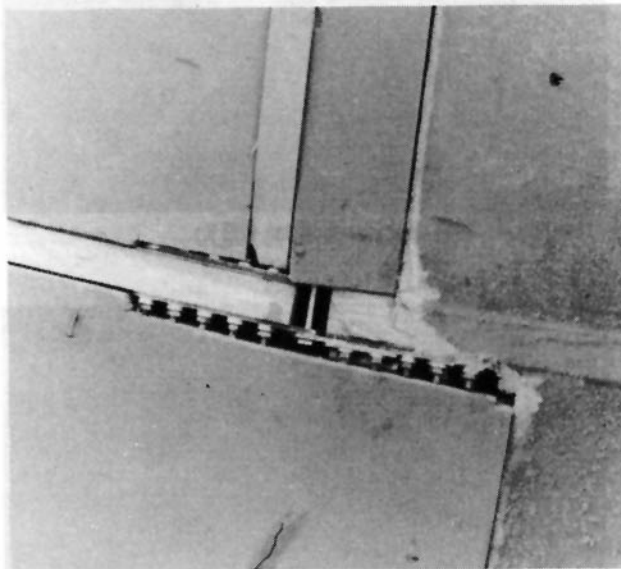


Photo No. 27: Outer wing attach. Note end rib and plate. Bolt area to be stuffed with foam chips.

10.15

When top fittings have been drilled and bolted, repeat steps 10.12 through 10.14 for the lower attach fittings.

10.16

Ream the forward spars attach fittings out to size at this time. Bolts are $3/8$ -inch.

11.0 OUTER WING PANEL ASSEMBLY

11.1

Mark location for foam ribs on spars and clamp laths to the spar caps adjoining the ribs. See Photo No. 28.

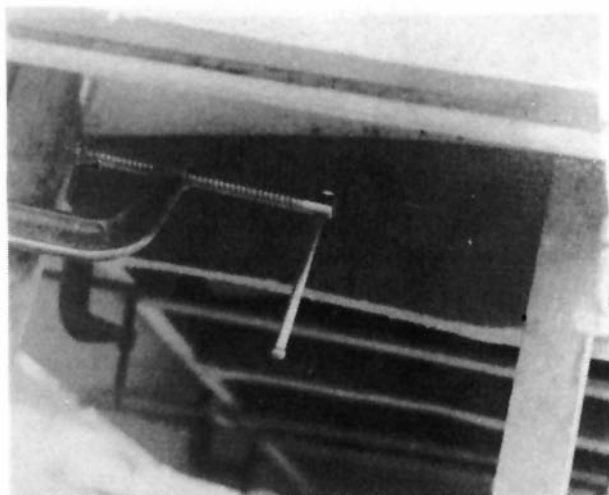


Photo No. 28: Spar supports and spread control laths clamped to caps.

11.2

Use the rib template and cut the four ribs from 2-inch foam. (Do not include rib section aft of the rear spar. No ribs in that location.) Use a hand-held hacksaw blade to cut foam. Cut the ribs at least $1/2$ " oversize. Then cut the ribs into two pieces each (nose and center section).

11.3

Fit the center pieces of the ribs between the spars and when all are fitted, leave in place.

11.4

Fit a one-inch foam plank onto the aft side of the rear spar between the outer-wing plywood rib and the center section rib. Support on the laths installed in step 11.1 and additional support as required. The top surface of this plank should be in the upper contour of the airfoil.

11.5

Make a closing rib from one-inch foam to fit between spars at the attach fittings. Notch and fit over the inboard bolt. (This one-inch foam rib can be bowed enough during installation to enable a good interference fit without cracking the foam. See Photo No. 27.)

11.6

When satisfied with the fit; remove ribs one at a time, cement and replace. Use some 2-inch nails toed through the ribs and lightly driven into spar caps to hold things in place *until* cement is set.

Epoxy the outboard plywood rib to the outboard ends of wing spars

Epoxy the outboard plywood rib to the outboard ends of wing spars with chord line lined up with reference marks of fuselage.

NOTE: Nose ribs are not fitted and glued at this time. You would only knock them off while doing other work. (We did!) However, this is only a suggestion.

11.7

Move spar supports so that they now attach to outer surface of tip rib. Recheck washout. (3°) **NOTE:** Washout is the difference between the angle of incidence at the root (5°) and the angle of incidence at the tip (2°) equals 3° .

11.8

From sheets of one-inch foam, make the upper surface plates and fit them between the ribs. Fit so upper surface is approximately $\frac{1}{4}$ " higher than the spar caps. Bow the plates up slightly and hold by pushing nails through the ribs below the plates. (Also support underneath if required.) At the end rib, drill several holes in the plywood, insert nails to hold foam in place.

11.9

Install a plate between closing foam rib and the center section plywood rib. See Photo No. 27.

11.10

When fit is satisfactory; remove, dust and cement in place. Again, nail plates lightly to spar caps to hold until cement has set.

11.11

When cement has set, saw off the ribs down to the plank surface. Again, that hand-held hacksaw blade can save a bunch of time.

11.12

Obtain a straight 1 x 4 board a foot longer than the span from the outer plywood rib to the inner plywood rib. "Cant" the board and "saw" the edge along the surface in several parallel positions. Work the foam surface down to these "grooves". Repeat the "sawing" and sanding until the upper surface is down to airfoil contour. See Photo Nos. 30, 31 and 37.

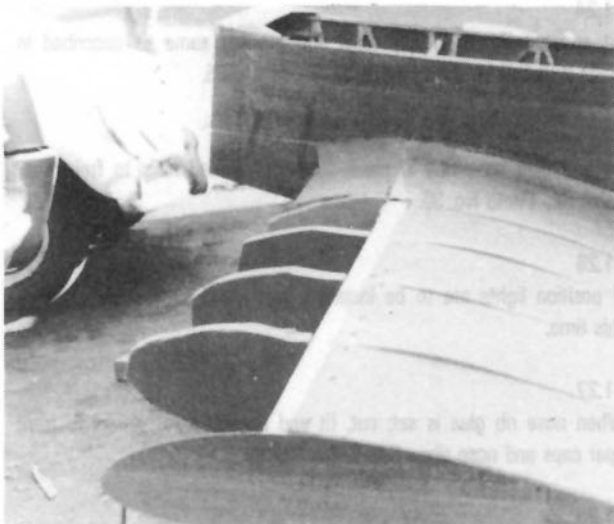


Photo No. 30: Upper surface foam plates installed between ribs.



Photo No. 31: Rough sanding ribs down to top plates.

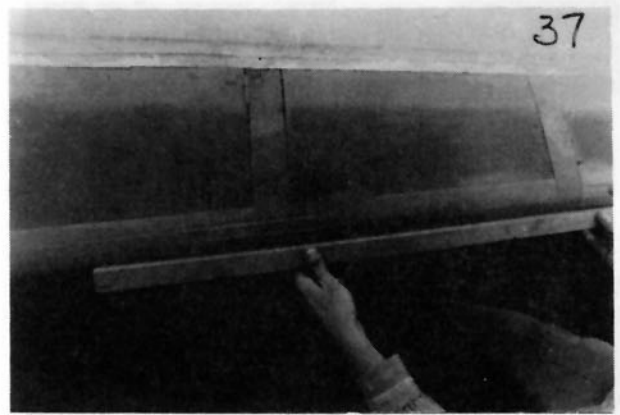


Photo No. 37: Using canted straight edge to conform contour of wing nose.

11.13

Cut and stuff foam into all slots at the rear and front spar wing attach fittings and sand down to contour. See Photo 27 of wing attach area.

11.14

Vacuum or blow area clear of dust. Fit and trim Dynel fabric from center of front spar to trailing edge; and tip rib to overlapping the center section rib. Apply resin and process, same as described in steps 9.10 & 9.11. See Photos 32, 33, 34 and 35.

CAUTION: Don't press too hard with squeegee.

11.15

When resin has set up, remove the waxed paper and sand off any ridges. Turn airplane over, bottomside up.

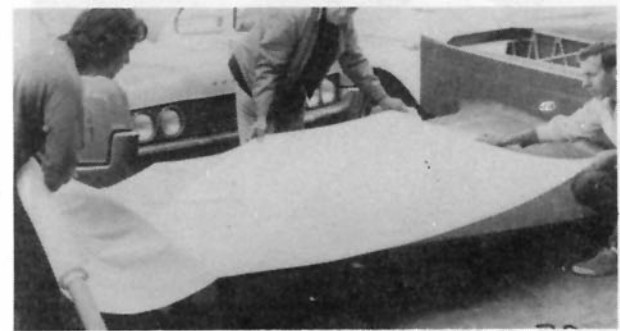


Photo No. 32: Laying out the Dynel to fit top of wing.

11.16

Check dihedral and washout. Nail supports to outboard rib. See Photo 29.

11.17

Support trailing edge of wing with a straight 2 x 4. Sand trailing plank lower (now upper) surface (scarf) to contour.

11.18

Contour lower spar caps as required. This is an "eyeball" exercise and remove only as little cap material as necessary to achieve contour. See Photo No. 20.

11.19

Fit a one-inch foam plank onto the aft side of the spar cap and scarf to fit the upper (now lower) surface plank.

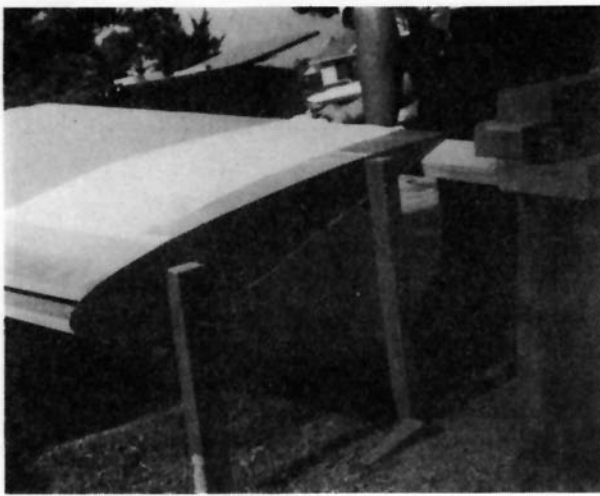


Photo No. 29: Dihedral and washout retention.



Photo No. 33: Rand and Robinson squeegee the resin to level and work out bubbles.

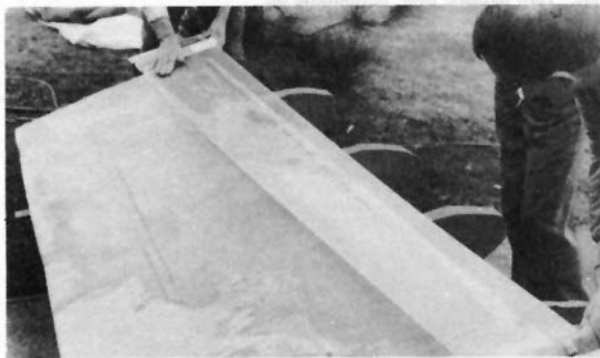


Photo No. 34: Laying on a strip of wax paper on wet resin.

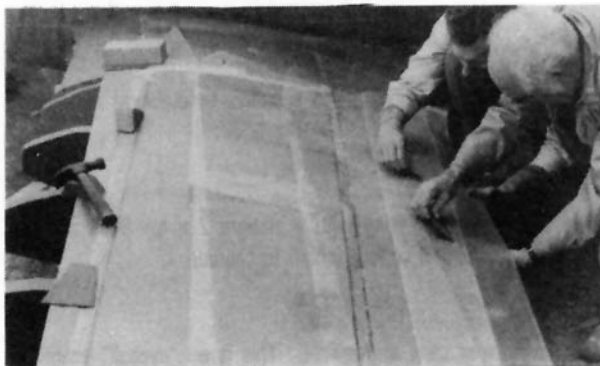


Photo No. 35: Squeegeeing the wax paper with plywood chips. Remove air.

11.20

From sheets of one-inch foam make and fit lower wing surface plates.

11.21

Remove nails pushed into foam ribs in step 11.8.

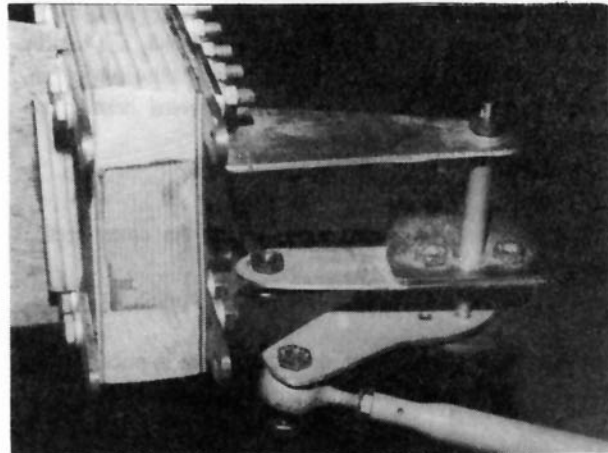


Photo No. 20: Aileron bellcrank. Note the bevel to contour of top cap.

11.22

Vacuum area and glue planks in place. Use toed nails to hold in place until glue has set.

11.23

When glue is set, remove nails and sand to contour using method described in steps 11.11 through 11.13. See Photos 30 and 31.

11.24

Fit and cut Dynel. Apply resin and process same as described in steps 9.10 & 9.11. See Photos 32, 33, 34 and 35.

11.25

Fit and glue nose ribs in place. Attach by toed nails to front spar caps. See Photo No. 30.

11.26

If position lights are to be installed, string and secure the wires at this time.

11.27

When nose rib glue is set; cut, fit and cement nose planks to front spar caps and nose ribs. See Photo No. 36.

11.28

Turn airplane over - top side up.

11.29

Fit and glue planks between nose ribs.

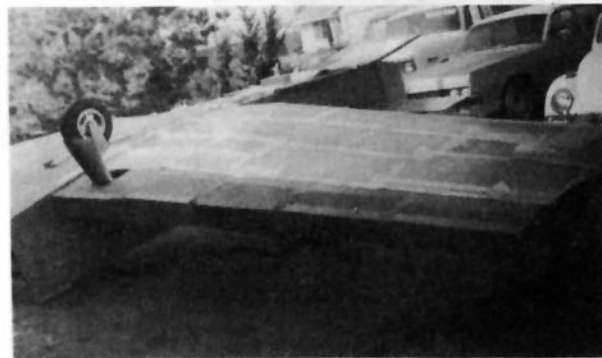


Photo No. 36: Lower surface papered; nose foam blocks glued.

11.30

Fit and glue the two-inch foam blocks onto nose ribs and nose planks.

11.31

When glue has set, carve and sand the nose section to contour. Use the long "edge" described in step 11.12. Same procedure. See Photos 37 & 38.

11.32

Fit Dynel from aft edge of the upper spar cap to the aft edge of lower spar cap. (Two layers of Dynel and 3 coats of resin.)

11.33

Apply epoxy resin, squeegee and waxed paper as in steps 9.10 and 9.11.

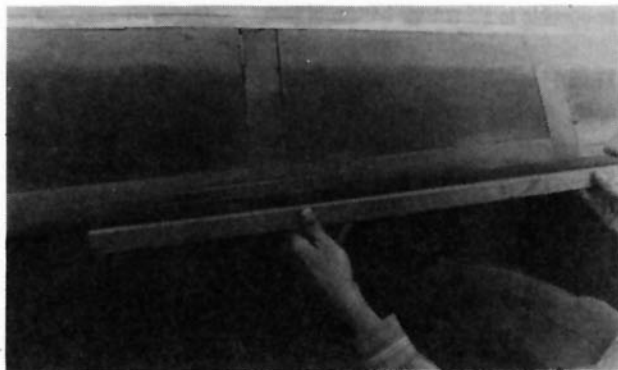


Photo No. 37: Using canted straight edge to conform contour of wing nose.

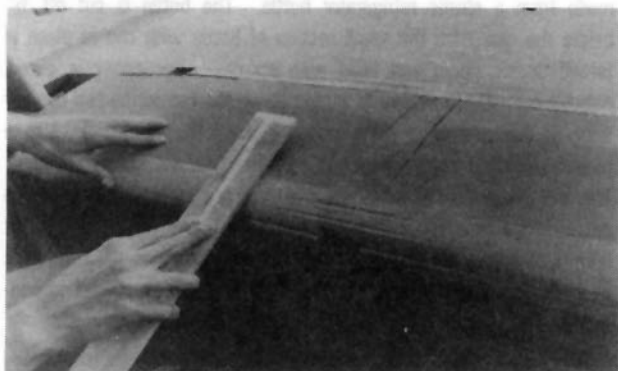


Photo No. 38: Rough sanding foam to contour marks. Wing nose.

REMOVING THE WING

11.34

Mark cut line with a crayon or marking pen along a chordwise line just inboard of the outer wing attach fitting inboard bolt. This should be parallel to the edge of the closing rib (visible through the resin).

11.35

Use a two-inch rotary saw chucked in the drill motor. Check that rotation of saw is in the direction of movement along the cut line. Do not cut any deeper than into foam and *do not* back up. See Photos 41, 42 and 43.

11.36

When bottom surface has been cut, turn airplane over—topside up.

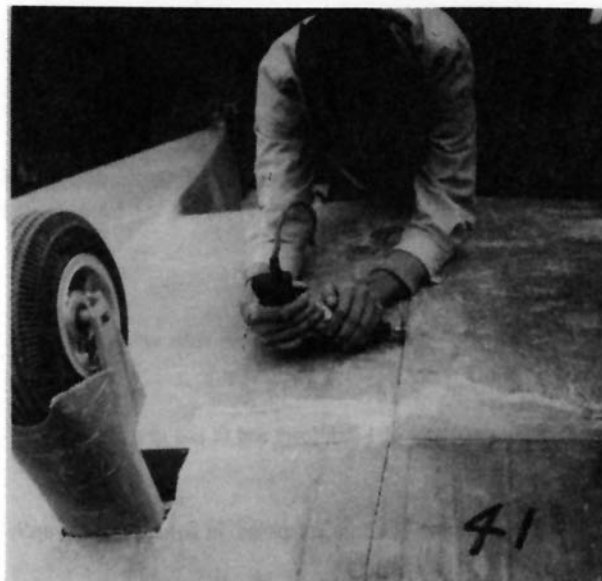


Photo No. 41: Rotary saw following edge of end rib.



Photo No. 42: Note difference. Where resin is sanded, it is opaque.

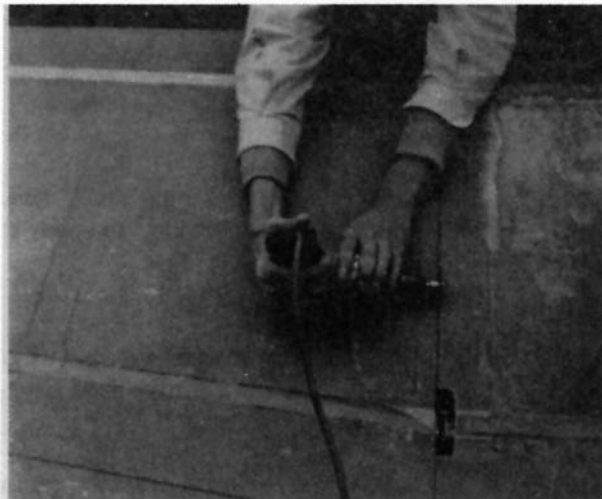


Photo No. 43: Use both hands to control saw. Don't sand before cut.

11.37

Repeat step 11.34. This line must coincide with the bottom side cut line.

11.38

Repeat step 11.35.

11.39

Using a hand-held hacksaw blade, cut foam following both the lower and upper rotary saw cuts.

11.40

Before removing bolts, make access cavities for installing and removing the wing attach bolts. See Photo No. 43 for suggested shape and size.

11.41

Remove bolts from attach fittings and remove outer wing panels.

11.42

Make closing end plates of 1-inch foam and fit and glue in place.

11.43

When steps 11.40 and 11.42 are completed, fit Dynel cloth and apply resin.

11.44

When resin is set, reinstall wings and verify attachability. Sand as necessary to obtain adequate clearance.

11.45

Remove outer wing panels and prepare for making and installing the ailerons and wing tips.

AUXILIARY WING TANKS

11.46

WING TANKS . . . if you have already completed your wings there's no problem . . . if you haven't finished them you can save a step by leaving the space between two inboard foam ribs open on the bottom of the outer wing panel. Larger tanks will need baffles.

11.46.1

Remove square section of foam/Dynel skin on underside of outer wing panel between forward and aft spar and first two foam ribs.

11.46.2

Coat all four sides of opening with epoxy and line with $\frac{1}{2}$ " foam. Foam liner should form ledge for tank bottom later. Use plenty of epoxy, especially in corners.

11.46.3

Cut hole for filler cap at highest possible location and epoxy cap in place. A flush cap can easily be made from a quart size plastic bottle.

11.46.4

Epoxy 2" wide strips of Dynel in all corners and around filler cap on inside of tank and allow to cure.

11.46.5

Cut a piece of 1" foam for tank bottom. Cover **one side** with two layers of Dynel/epoxy.

11.46.6

Line inside of tank with two layers of Dynel/epoxy. Make sure there are no air bubbles or pockets. Allow to cure.

11.46.7

Use $\frac{1}{4}$ " aluminum tubing for fuel line and install inside tank so pickup will be at lowest point in tank and exit line will be readily accessible for hook-up when wings are attached.

11.46.8

Trim tank bottom to fit and epoxy in place—make sure there are no gaps where leaks can occur. Use plenty of epoxy and weight around edges to assure proper sealing. Allow to cure.

11.46.9

Sand and shape bottom of tank to airfoil contour.

11.46.10

Drill $\frac{1}{4}$ " hole and epoxy vent in place. Vent should extend thru bottom of tank to $\frac{1}{4}$ " from highest point inside of tank — as near center as possible to $\frac{3}{4}$ " outside bottom of tank.

11.46.11

Apply one layer Dynel/epoxy to outside tank bottom—overlay four inches. Allow to cure and then fair in with rest of wing. File or bend a slight angle on forward side of vent tube to provide positive pressure to tank when flying.

11.46.12

Your wing tank is now ready to check for leaks. There shouldn't be any leaks but if you find a minor one a neoprene slushing compound would take care of it.

11.46.13

You're going to need a flush cap—a simple inexpensive one can be made from a plastic refrigerator bottle. The bottle is cut off $\frac{1}{2}$ " below the cap, then the small section of bottle with cap in place is turned upside down and filled with epoxy. After epoxy is cured, remove cap. Cut a circle the same size as the cap in the top of your wing at the uppermost point (about 2" from the outer rib). Use a rasp or very coarse sandpaper to rough up the outside of the cap. This will allow a better bond when the cap is epoxied in place, upside down, in the hole you cut in the wing. Bottom of cap should be at least $\frac{1}{8}$ " below top of wing. The cap now becomes the filler neck by cutting a hole thru to tank—the small bottle neck is filed to contour and is now the cap. Cut a slot in this cap for easy removal.

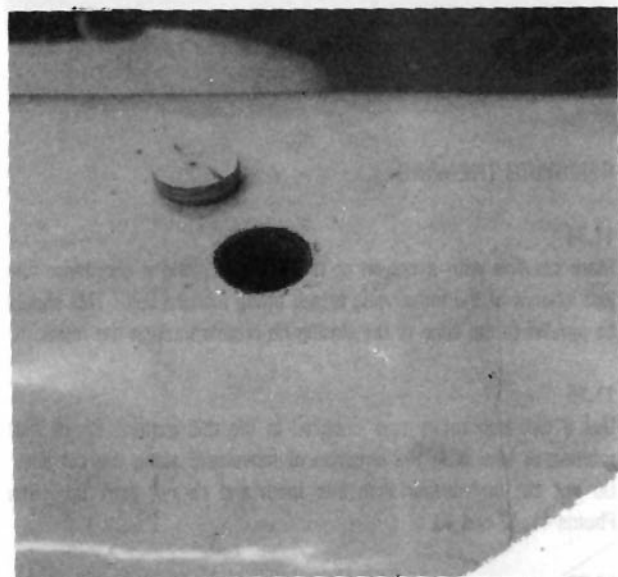


Photo No. 101: Flush gas cap assembly in place. Cap is actually a plug.

MAKING WING TIP

Wing tips are necessary. The following steps and pictures describe how ours was sculptured and how it looks. Whatever *you do*, do it to both tips *the same*.

11.47

Sand edge of the outboard end of wing. This is to provide for a scarf overlap of the Dynel later.

11.48

Fit a piece of 1-inch foam onto the end of the rib and extending out 8 inches, full depth of rib and sloping up to the 8-inch point.

11.49

Glue on pieces of 2-inch foam, forward of the triangle piece, flush with the top surface, but extending below contour of the lower surface. Hollow it out. (Even foam weighs something.) See Photo No. 59.



Photo No. 59: Foam in wing tip. Note the piece in line with front spar.



Photo No. 60: Build up of foam prior to sanding. Note nails holding foam, temporarily.

11.50

Fill in the nose. Sand a 2-inch radius (softball size) on the forward edge of the tip. See Photo No. 60.

11.51

Glue on a 1" x 8" plank of foam to the aft top edge of the end rib. Sand the top surface of the foam to bring it down about .020 below the top surface of the wing. Sand the rear corner to approximately a 6 inch radius.

11.52

Cut and fit Dynel to the top surface, apply epoxy, resin and waxed paper as in prior wing work. See Photo No. 61.

11.53

After resin is cured, close up the bottom with an inclined plank of 1-inch foam. Sand tip outline to a sharp edge. See Photo No. 63.

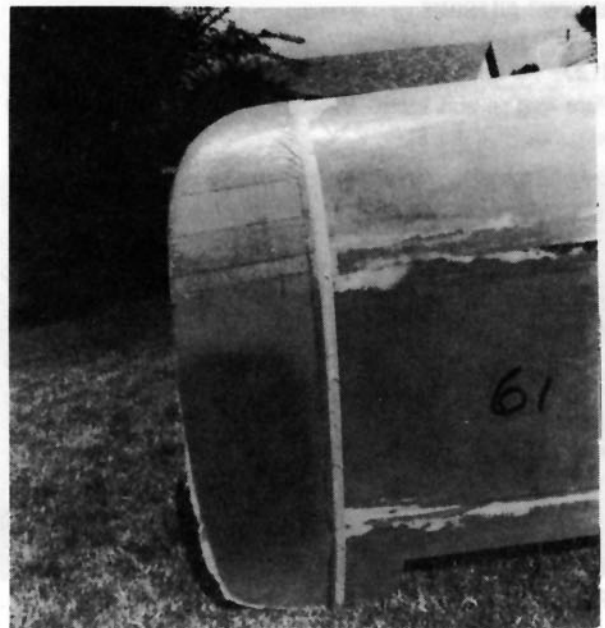


Photo No. 61: Upper surface of tip. Wax paper removed.

11.54

Finish carving the "dished out" portion of the forward section. See Photo No. 59.

11.55

Fit and glue in the wing tip position light(s) at this time. NOTE: Make cardboard template(s) of the first tip and use as a guide for making the other wing tip.

11.56

Cut and fit Dynel to the lower surface, apply epoxy resin and waxed paper. When resin has cured, sand to a sharp edge. See Photo No. 63.



Photo No. 63: Tip of wing with Dynel sanded to sharp edge.

MAKING AILERONS

11.57

Place wing on work bench. Mark aileron outline on upper surface of wing. See Photo No. 81.

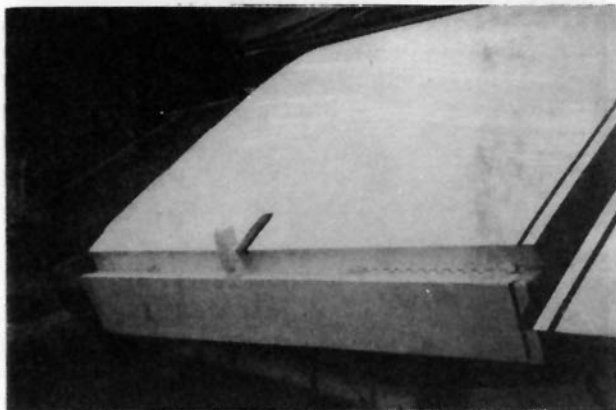


Photo No. 81: Aileron and balance weight installed.

11.58

Clamp a straight edge to the wing; to act as a guide to sawing a straight line, plus holding the saw at right angle to the upper surface of the wing. (Saw both surfaces at one time.) Start sawing at in-board end.

The saw cut will not be wide enough for the piano hinge. Prior to cutting, mark the total area (1/8 inch) to be removed.

11.59

After aileron is removed from the wing, mark back 1/2 inch on the lower surface of the aileron (including the width removed by the saw cut) and remove this foam and skin. See Photo No. 55.

11.60

Trim aileron and wing foam back as required to nest the 1/4-inch spars. Bevel the spars as necessary. See Photo No. 55.

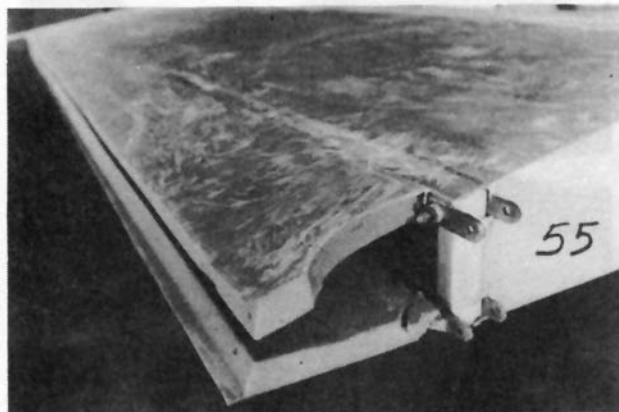


Photo No. 55: Lower surface of wing with aileron cut out. Foam cut back.

11.61

Attach aileron hinge to both spars so that upper surface of hinge is level with wing skin. Insert temporary hinge pin wire. See Photo No. 56.



Photo No. 56: Aileron with spar nested and offered to wing for fit check.

11.62

Nest spar into aileron skin and offer to wing. The aileron should be "in fair" with both surfaces. Use some laths strapped around the wing to hold aileron. Check and mark for shimming, etc. Aileron gap at bottom should be 1/2 inch. See Photo No. 56.

11.63

When aileron "fit and fair" is satisfactory, remove from wing and pull temporary hinge pins. See Photos 57 & 58.

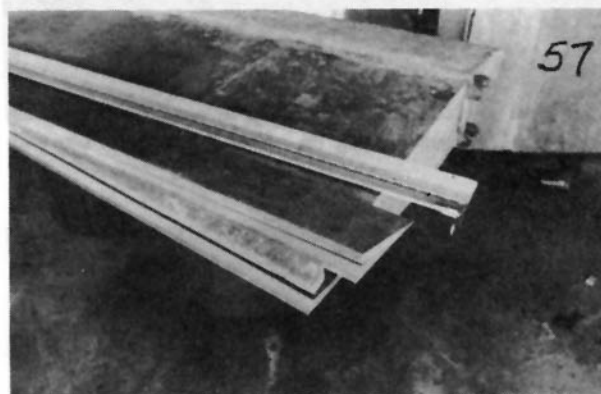


Photo No. 57: Aileron, spars and hinge are ready for fit check.

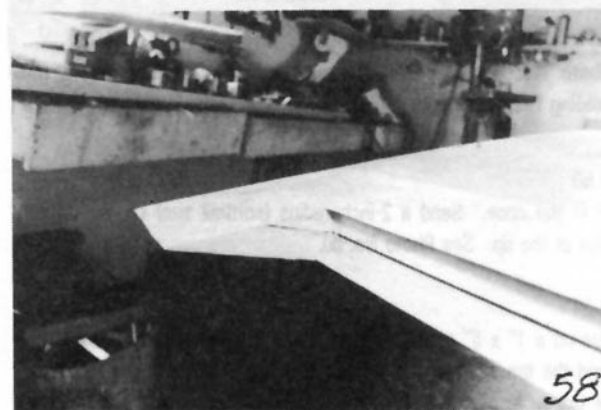


Photo No. 58: Aileron cavity end at outboard end of wing lower surface.

11.64

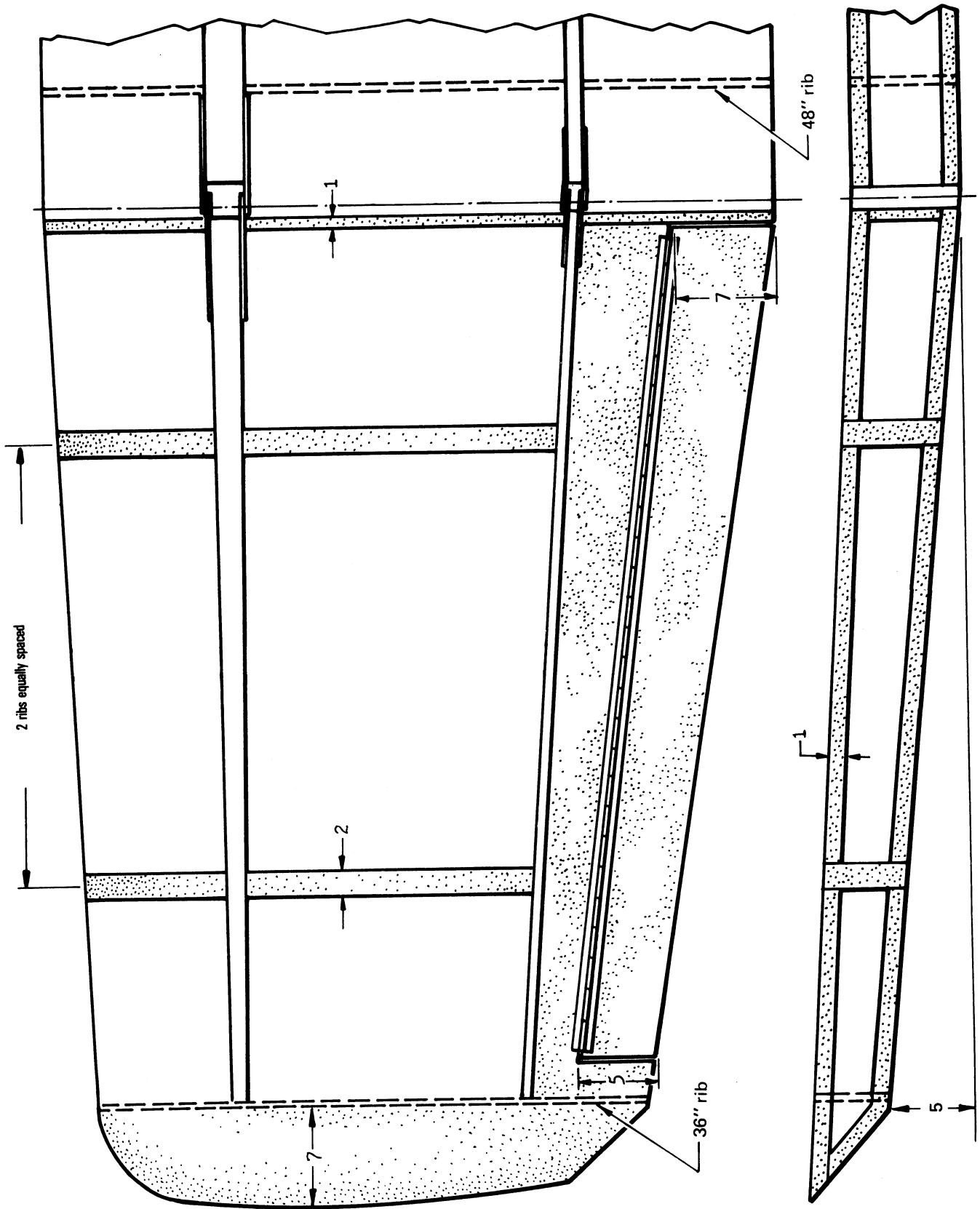
Attach aileron horn to inboard end of aileron spar. See Drawing No. 11.

11.65

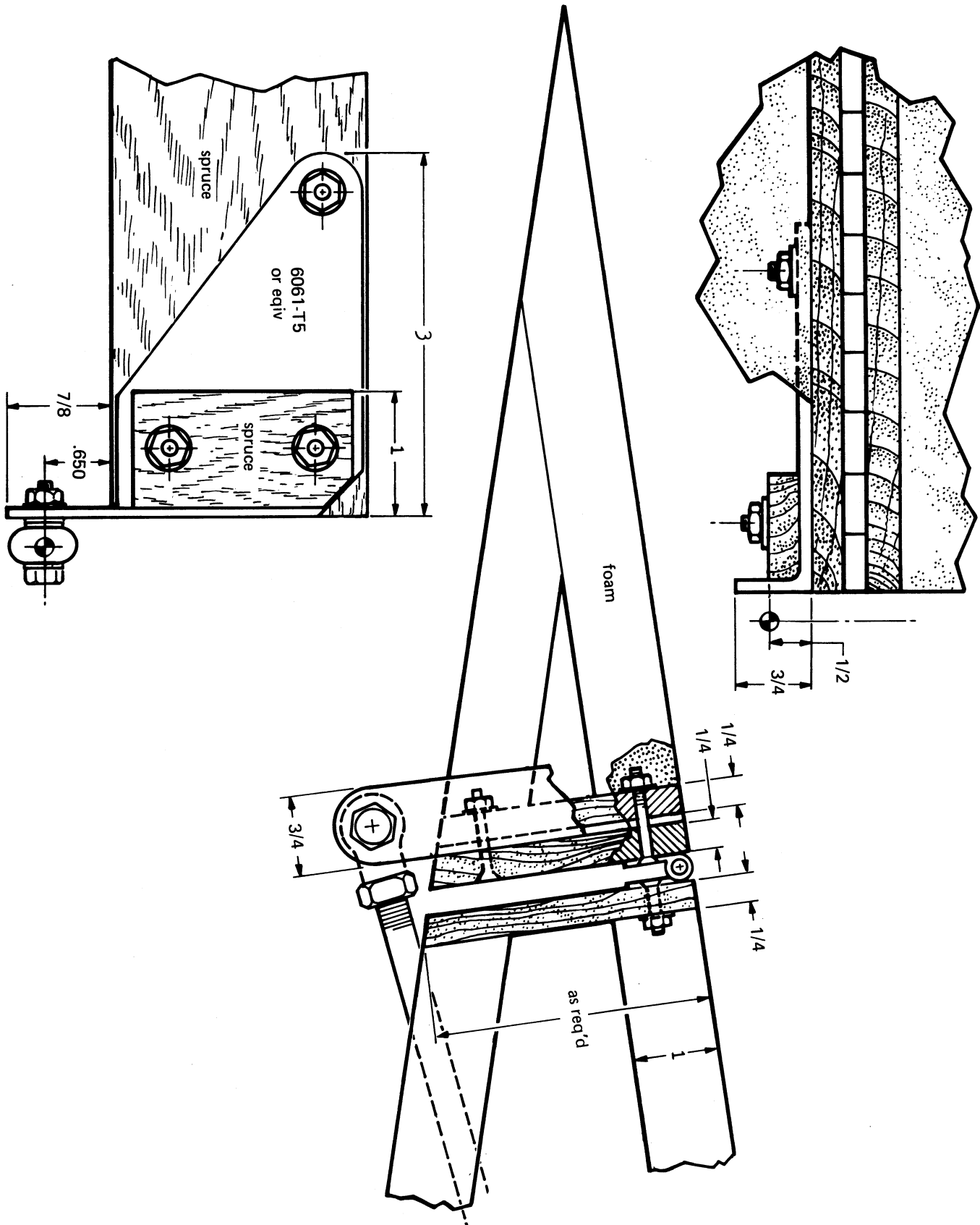
Attach static balance arm to aileron spar. (See Photo No. 74 and 82).

KR-1 DRAWING NO. 10

OUTER WING PANEL



AILERON INSTALLATION



KR-1 DRAWING NO. 11

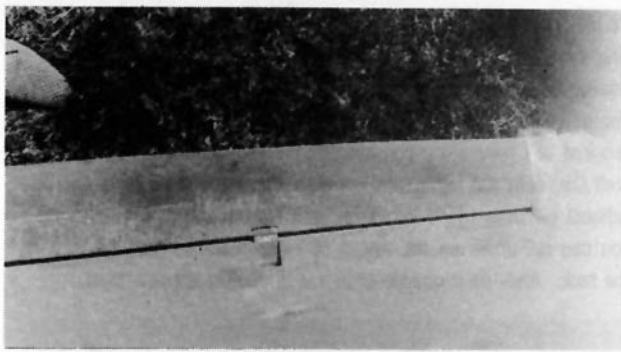


Photo No. 74: Aileron counter-balance installation.

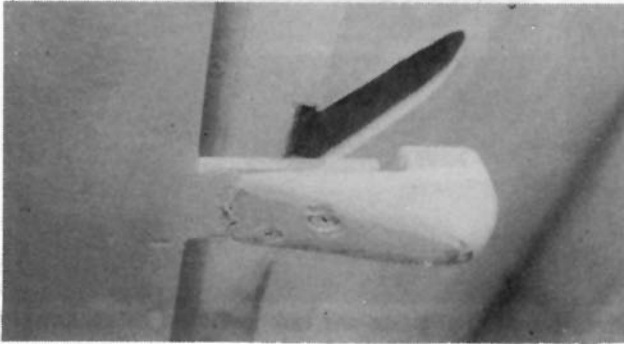


Photo No. 82: Aileron mass balance.

11.56

Epoxy aileron spar into place. Do no other work on it until epoxy cures.

11.67

Set up a holding fixture, with short pins to insert into aileron hinge ends, in a draft-free room. Adjust balance weight to hold the aileron slightly, trailing edge high. This is to allow for the weight of the paint to be added later.

11.68

Re-attach aileron to wing spar hinge and offer back to wing. Mark out the area for the balance weight excess. See Photo No. 74.

11.69

Remove aileron. Cut out lower surface skin and remove foam as necessary for balance weight travel.

11.70

Offer aileron back to wing and check clearance for balance weight. When satisfactory, remove aileron.

11.71

Install forward spar and epoxy in place. Line balance weight cavity with Dynel and epoxy in place.

11.72

When epoxy has set, reinstall aileron and check for final fit.

11.73

If fit is satisfactory, install full length piano hinge pin.
NOTE: A very effective way to install the hinge pin is to chuck one end into your drill motor. Lubricate the hinge, insert the end in the hinge, turn on the drill motor and advance. Have someone help hold the long pin so it doesn't "whip" as it is rotated. It can be removed the same way.

12.0 FUSELAGE, TOP FORWARD DECK, GAS TANK AND INSTRUMENT PANEL

NOTE: Photos in this section are KR-2, but construction method is the same.

12.1

Make two contour guides (1/4" plywood will do) and attach, temporarily, to the top longerons at the firewall and at a point aft that suits you. (The foam/plywood instrument panel will install into and become a part of this top.)

12.2

From one-inch foam sheet, make and fit planks between the contour guides. Hold planks in place by pushing nails through holes drilled in the contour guides. See Photo No. 44.



Photo No. 44: Forward deck contour guides. Planking starts.

12.3

When satisfied with fit, identify each plank to location and remove.

12.4

Apply waxed paper to upper surface of longerons and to contour guides facing the foam planking to prevent glue and epoxy bonding the foam to the guides, etc.

12.5

Reassemble and glue foam planks between contour guides.

12.6

When glue has set, sand to contour. Fit Dynel. Apply resin and waxed paper. Take care that you don't attach to fuselage skin.

12.7

When resin has cured, remove top deck. Cut and fit Dynel to lower surface. Apply epoxy resin. Squeegee, apply waxed paper. Be sure no air is trapped. Return shell to airplane and cure in place. See Photo No. 48.

12.8

Remove when resin is cured. Make and fit tank side walls (from 1-inch foam). "Tack glue" in place, and when glue is set, put back on airplane and make clearance check. See Photo Nos. 45, 46 & 47.

12.9

Glue foam, fitted in step 12.8, into place. When glue is set, trim walls as required and fit a 1-inch foam plate to bottom. Overlap the walls. See Photo No. 50.

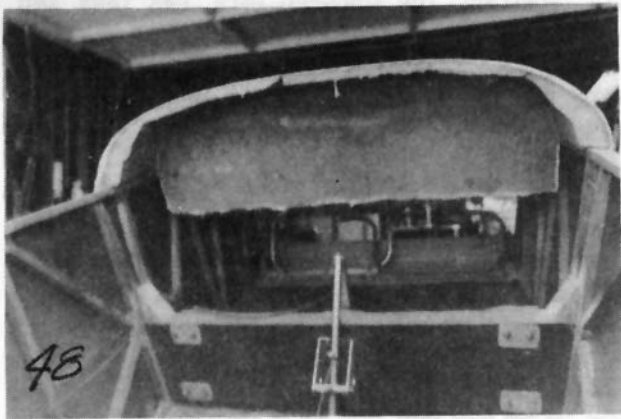


Photo No. 48: Top deck on fuselage for cure. Tank bottom not installed yet.

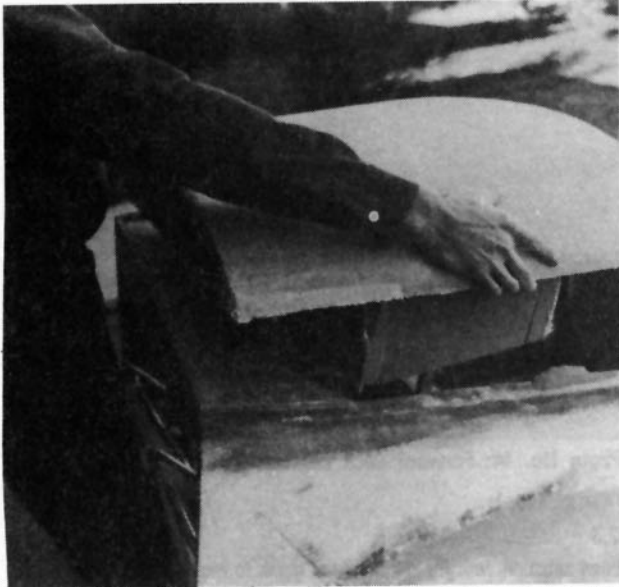


Photo No. 45: Fit check of top deck with tank wall installed.

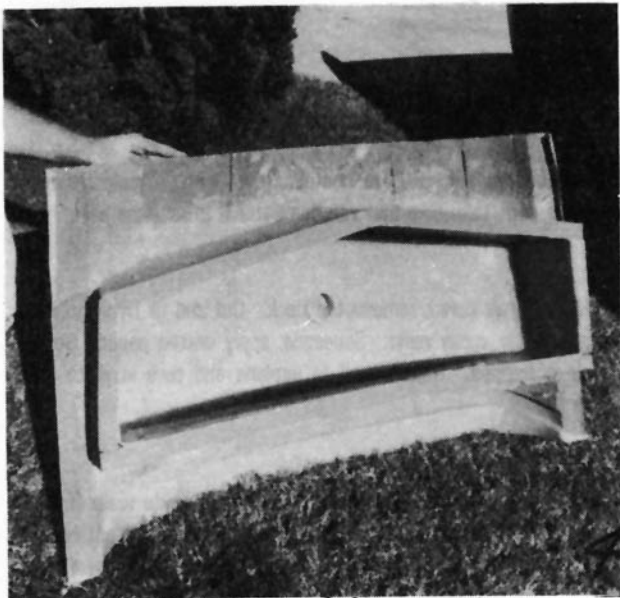


Photo No. 46: Foam walls of tank fitted into top planking.

12.10

Line tank interior with 3 layers of Dynel, and epoxy into place. Squeegee to remove air. Apply waxed paper and squeegee. See Photo No. 49. NOTE: The 3 layers of Dynel and the epoxy/resin required will generate a considerable amount of heat. In fact, it can melt the foam and bubble the epoxy. Supply a lot of cooling air. The exhaust air from friend wife's vacuum cleaner will do. In this way, you can cut down on the length of time otherwise required to build the tank. And—do it outside or in a well ventilated large room.

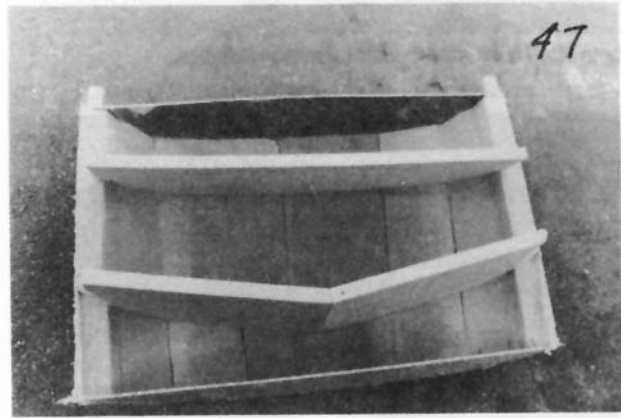


Photo No. 47: Top planks and tank wall foam before epoxy.

12.11

Fit and apply only one layer of Dynel and resin to exterior walls of tank. Squeegee, etc. See Photo No. 49.

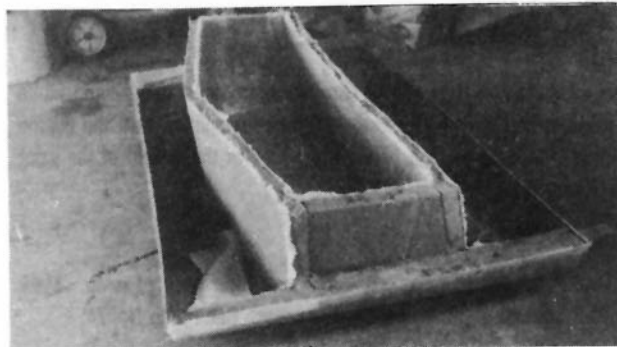


Photo No. 49: Tank walls with Dynel inside, outside but not on ends.

12.12

Cut hole in top of tank and fit the filler neck. If a recessed filler is desired, see wing tank installation instructions.

12.13

Sand a "sump" in top of the tank bottom plate. See Photo No. 50.



Photo No. 50: Tank bottom. Sump worked into bottom foam.

12.14

Fit Dynel (3 layers) to this surface of tank bottom and apply resin and squeegee into cavity. Apply waxed paper and squeegee.

12.15

When resin has set, trim (sand) Dynel to edge of foam and check fit to tank for full area contact with bottom of the tank walls. See Photo No. 52.

12.16

Fit and trim Dynel (one layer) to outer walls of tank and lower surface of tank bottom.

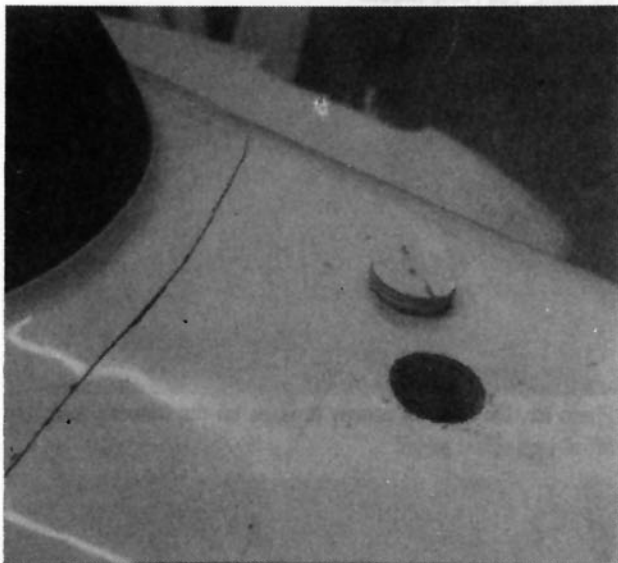


Photo No. 101: Top deck with recessed gas tank filler and cap.

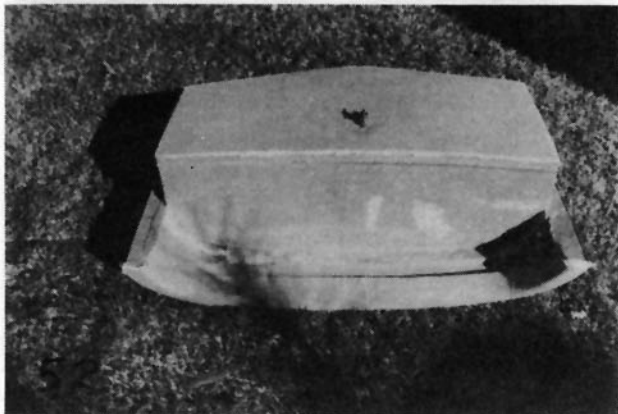


Photo No. 52: Tank bottom with tee installed. Note groove routed in foam for instrument panel.

12.17

Drill hole in upper aft wall of tank and install the fitting for the sight gage. The fitting is for the sight-gage clear plastic tube. This runs around the instrument panel and attaches to the bottom Tee of the tank. Drill and epoxy in place a 1/4" diameter aluminum vent tube thru top of tank close to forward wall.

12.18

Install Tee fitting in sump of tank bottom. Leg of Tee into sump and cross of Tee fore and aft. Epoxy in place. Take care that no epoxy gets into inside of Tee. See Photo No. 52.

12.19

Coat faying surfaces of the tank walls and bottom with resin. Add one wet layer of Dynel approximately 1-1/2 inches wide (gasket), epoxy resin and join. Use small bags of sand or other conformal means to hold bottom in full area contact until resin cures. (We used about 20 bricks.)

12.20

Apply resin and Dynel to outer surface of the tank bottom. Cut corners of overlap material and apply resin and Dynel to side walls. Squeegee, etc.

12.21

When resin has cured, cap Tee fittings and make leak check. REMEMBER, from now on treat this tank as though it was *partly full of gasoline*.

12.22

When the leak check is satisfactory, drain fuel and cap fittings.

12.23

Place tank upside-down on work table. Mark off lines for a channel in the aft end of the planking to receive the Instrument Panel. Angle of panel should be selected to best suit the individual. Route Dynel and foam approximately 1/2 inch deep. See Photo Nos. 46 and 52.

12.24

Make template to fit the slot routed in the top planking.

12.25

From a 1-inch foam plank, using the template made in step 12.24, cut and fit a panel to the slot in the top deck.

12.26

Epoxy 1/16 plywood to both sides of the foam panel. See Photo Nos. 53 and 54.

12.27

When glue has set, mark off for the instruments and with a hole saw, make cutouts. See Photo No. 53.

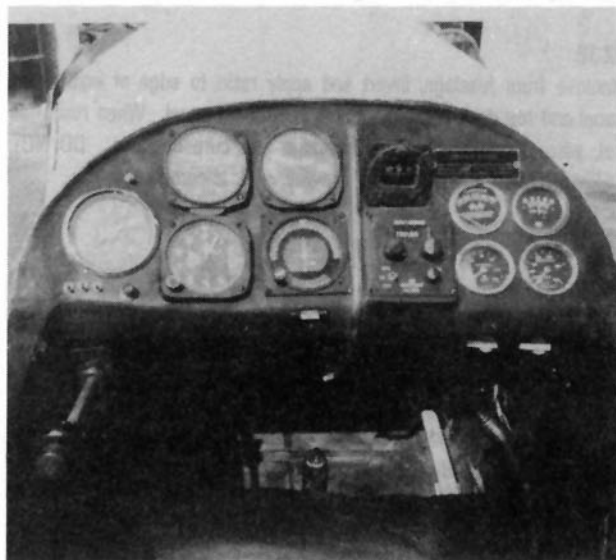


Photo No. 53: Instruments installed to dashboard, instruments may be placed according to your own preference.



Photo No. 54: Foam dashboard fitted into the top deck assembly.



Photo No. 83: Complete instrument panel located within easy view of pilot.

12.28

Mount instruments and locate mounting screws from instrument cases, see Photo No. 83.

12.29

Place top deck back on fuselage and check for satisfactory fit.

12.30

Remove from fuselage, invert and apply resin to edge of instrument panel and top deck channel. Install instrument panel. When resin has set, place assembly back on fuselage and cure in place. **DO NOT PERMANENTLY INSTALL** (until firewall work is completed).

13.0 CANOPY AND AFT DECK

Canopy height should be dictated by the seated height of the builder. Rear deck conformity is the result of the canopy location chosen.

13.1

Make a contour guide (¼ inch plywood will do) and clamp it to the top longerons aft of the seat back. Drill holes in the guide for the nails you will need later to hold the foam planks in place.

13.2

Lay the nose of the canopy on the forward deck and adjust the incline of the contour guide to the aft end of the canopy. The nose of the canopy should be several inches forward of the rear edge of the forward deck. See Photo No. 66. Be sure to leave room to cut out the canopy without cutting into the instrument panel.

13.3

Make a contour guide for the aft end of the top deck, from 1-inch pine board. Attach to angle brackets so that it may be clamped to the top longerons at the horizontal stabilizer leading edge. Drill a series of holes in the outer ½ inch of the contour guide for pinning the foam. See Photo No. 67.

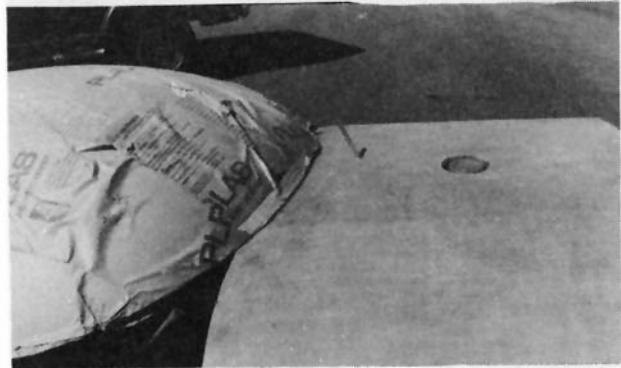


Photo No. 66: Nose of canopy in place on the forward deck, but aft of instrument panel.

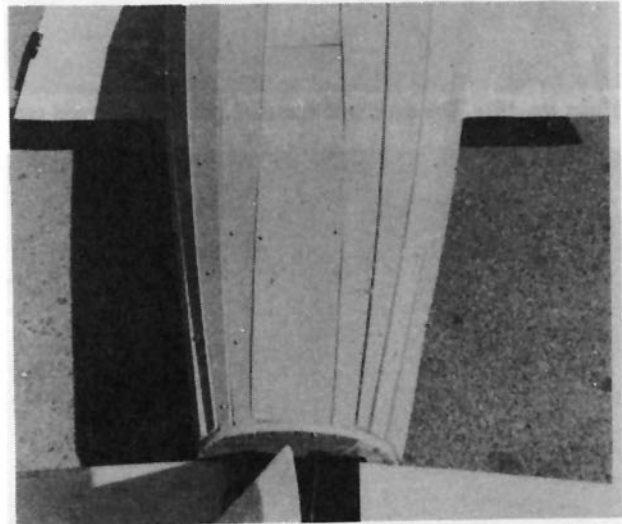


Photo No. 67: Aft deck rear contour guide with planking fitted. Note holding nails.

13.4

Cut and fit tapered planks to the contour guides. See Photo No. 67. Pin to each other with two-inch nails.

13.5

Remove planking; identify each piece, place waxed paper on foam side of contour guides. Re-install foam planks and glue in place.

13.6

When glue has set, sand to a smooth surface. Remove tail end contour guide and replace by gluing in a replacement of one-inch foam. Be sure to clear all controls. See Photo Nos. 68 and 69.

13.7

Fit and glue foam around junction of vertical and horizontal stabilizer. See Photo No. 69. When glue has set, sand into fillets.

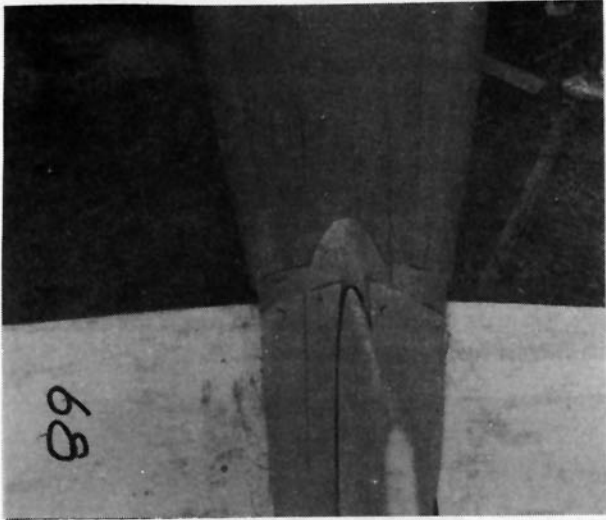


Photo No. 68: Deck foam sanded and ready for Dynel and resin.

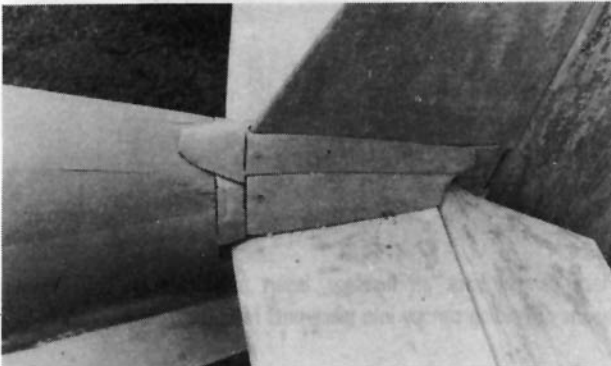


Photo No. 69: Contour guide replaced with foam and empenage fairing foam in place.

13.8

When sanding is satisfactory, cut and fit a sheet of Dynel to cover the aft deck. The application of the epoxy/resin must wait until the canopy plexiglass is fitted. See step No. 13.14.

13.9

Make the canopy sills from $\frac{1}{4}$ inch spruce. The sill on the right is bolted to the piano hinge. This sill is then tacked to the top longeron. Fold it into the closed position with waxed paper between the sill and the longeron. The left sill is located and shaped to the left longeron. Place waxed paper between sill and longeron. Hold in place with a couple of nails *lightly* driven into longeron. See Photo No. 70.

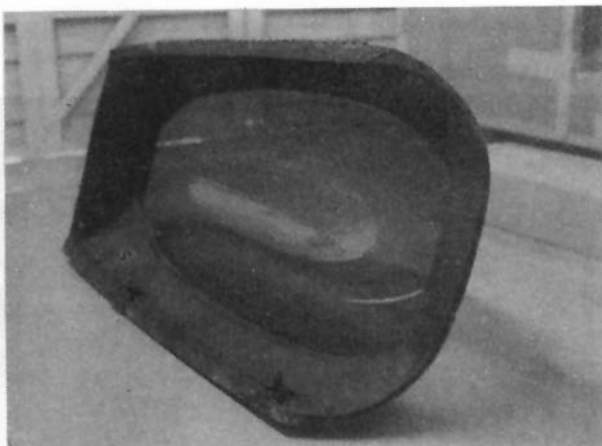


Photo No. 70: Canopy removed to show sills and hinge installation.

13.10

Peel the protective cover back from the edge of the canopy, approximately 1-1/2 inches all the way around and back from the edge $\frac{1}{2}$ inch. Tape plexiglass paper back onto masking tape. See Photo Nos. 71, 72 and 73.

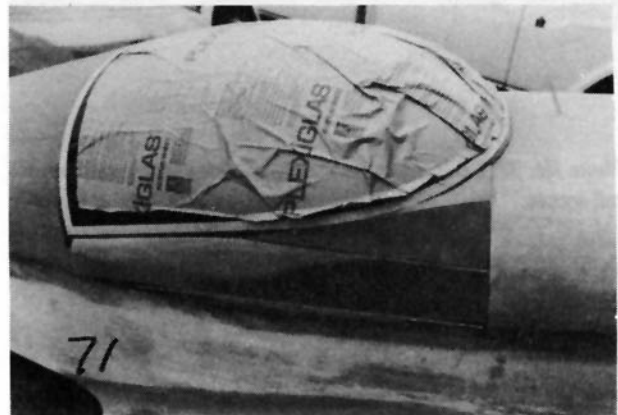


Photo No. 71: Masking tape has been placed at edge of Dynel/resin attachment to foam.

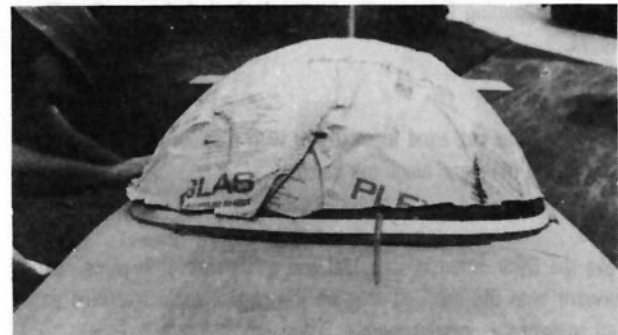


Photo No. 72: Tape around canopy. Note flush gas cap and location of vent.

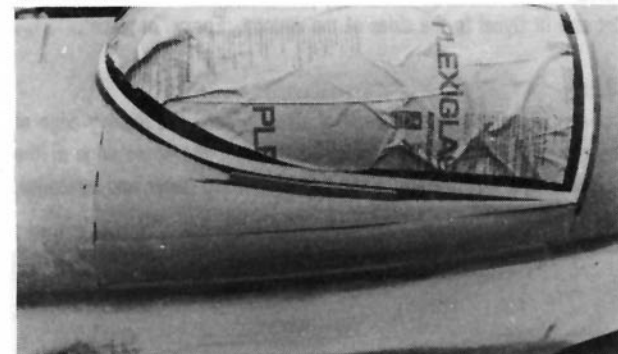


Photo No. 73: Foam being fitted between canopy and top longeron canopy sill.

13.11

With a sanding disc, rough the plexiglass between the edge and the masking tape.

13.12

Remove the aft deck contour board. From one-inch foam, make and fit a bulkhead approximately one or two inches aft of the top deck forward end and level with the top longerons. Glue into place, apply Dynel and epoxy resin to forward face. See Photo No. 77.

13.13

Replace the plywood contour guide. Take care the clamps are not getting to the longerons.

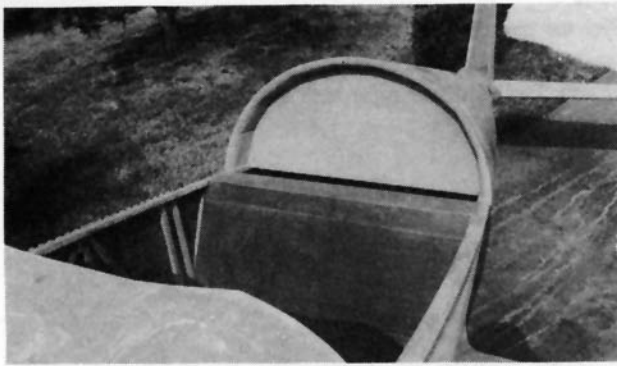


Photo No. 77: Canopy removed. Aft bulkhead before cutting out tail access.

13.14

When resin applied in step 13.12 has set, remove contour guide clamps.

13.15

Place canopy back on fuselage and cut and fit foam planking between the top longerons and the plexiglass. Glue these blocks in as you go. There is no satisfactory way to hold them without gluing. Glue the canopy supporting foam to the fore and aft deck foam. See Photo No. 71.

13.16

When glue has set, sand foam to fair with fuselage lines. Be careful not to sand the piano hinge too much.

13.17

Take the Dynel fitted in step 13.8 and epoxy/resin it in place. Lap it forward onto the masking tape on the plexiglass with waxed paper and squeegee as in prior work.

13.18

Cut and fit Dynel to the sides of the canopy. Epoxy "in place".

13.19

Cut and fit an overlapping band of Dynel around the leading edge of the canopy. Edge of Dynel must not go past the upper edge of the masking tape. Epoxy into place. Apply waxed paper and squeegee. See Photo No. 75.

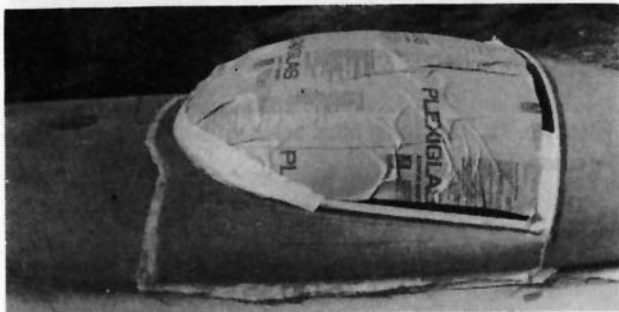


Photo No. 75: Dynel and resin after wax paper removed. Aft deck now cured.

13.20

When resin has cured, cut the canopy loose along the cut lines. See Photo No. 78. The forward section should be cut at approximately a 20 degree forward slope. Use a sabre saw. This gives the canopy a sort of "funnel" at the forward end to align it while closing. Remove the canopy with the aft deck contour board. Retain contour board in place to hold shape for further work.

13.21

With a sanding disc, trim foam on the inside of the canopy.

13.22

Cut and fit Dynel around inside of canopy foam. Cut a band "on the bias" to fit on the forward edge. Apply resin and waxed paper. Squeegee as necessary.

13.23

Apply resin to cut edge of forward deck and edge of rear deck. Cover with pieces of waxed paper. See Photo No. 78.

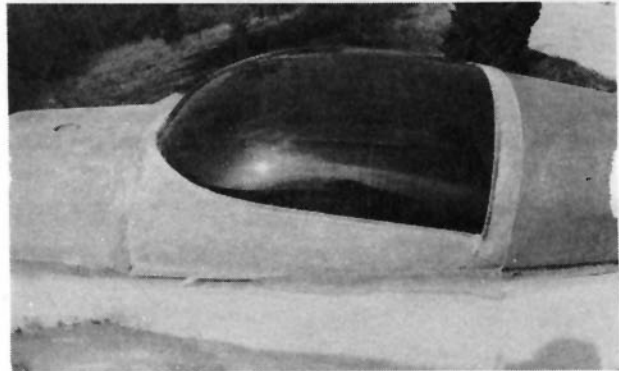


Photo No. 78: Canopy edges being finished.

13.24

Place canopy back on fuselage, insert pins in hinge and provide means of holding canopy into place until resin has cured.

13.25

When resin has cured, remove canopy and place airplane on its back.

13.26

Cut two strips of Dynel and epoxy into the aft deck to form deck stiffeners as required, on the inside.

13.27

With a rotary sanding disc, trim the Dynel/resin attachment at the lower edge of the masking tape on the plexiglass. Be careful, don't cut through the masking tape or you will scratch the plexiglass.

13.28

Place airplane on wheels, place canopy back in place and retain until Dynel and epoxy applied in step 13.26 is cured. See Photo No. 76.

13.29

Fit and install latch.

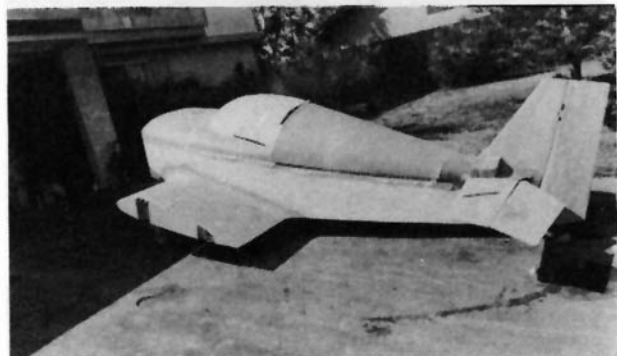


Photo No. 76: Canopy and aft deck Dynel curing empenage fillet fairing in work.

14.0 FIREWALL, ENGINE, PROPELLER SPINNER AND COWLING

14.1

Make firewall from 1/4 inch plywood. Trace fuselage and top deck lines on the plywood and cut to fit. Remove the forward deck.

14.2

Place engine mount on the forward face of the firewall and mark locations on the aft side for the "backup" plates. See Drawing No. 13.

14.3

Trim asbestos to fit forward face of firewall. (To be held in place with approved high temperature adhesive.) To be installed later.

14.4

Fit and trim the metal face of the firewall. Leave in place until steps 14.5 and 14.6 are completed.

14.5

Drill holes for attaching the engine mounts with the backup plates in place. (See Photo No. 84.)

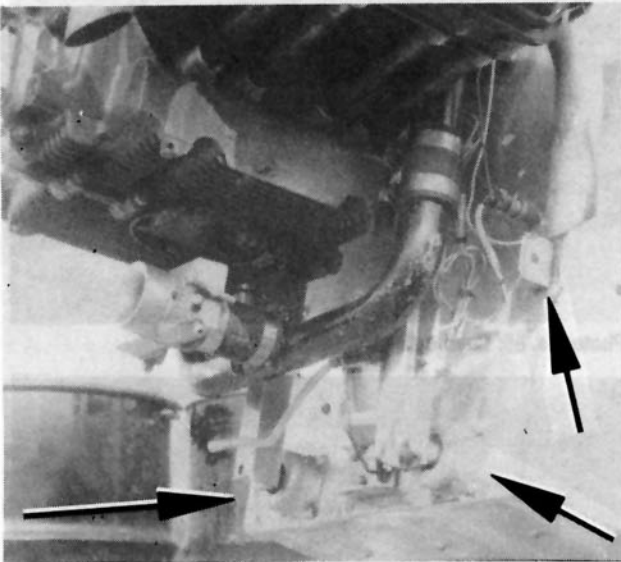


Photo No. 84: Engine mount and cowl bracket installation.

14.6

Install engine mount bolts temporarily to check fit.

14.7

Clean any grease (from lots of handling) from the front face of the fuselage. Then sand it thoroughly.

14.8

Apply glue to the forward face of the fuselage and the matching area on the aft side of firewall plywood. Staple in place. Use plenty of pressure on the staple gun before you pull the trigger.

14.9

When firewall glue has set, install the engine mounts, tighten and secure mounting hardware. See Drawing Nos. 13 and 14.

14.10

Install forward deck with epoxy. This is for good, so be sure you're ready.

14.11

Install engine on mounts. Secure hardware and tie down tail of airplane.

14.12

Locate and drill holes in firewall for the fuel line fitting, oil pressure line and oil temp tube and fitting.

14.13

Locate and drill holes in firewall for throttle, carb heat control, magneto (tachometer) and alternator wiring.

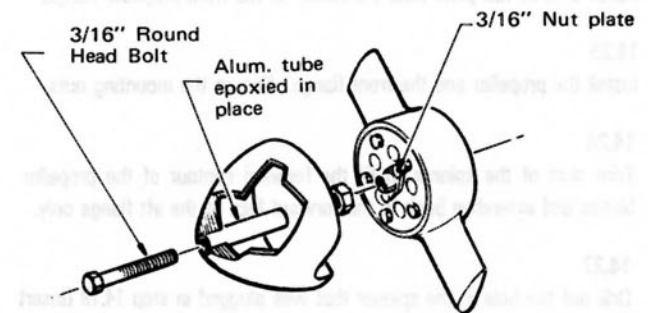
14.14

Install exhaust pipes and any support bracketry.

SPINNER

14.15

Make a 9-inch (MAX) diameter disc with hole in center for mounting in a lathe or drill press chuck. See Drawing No. 12.



DRAWING NO. 12

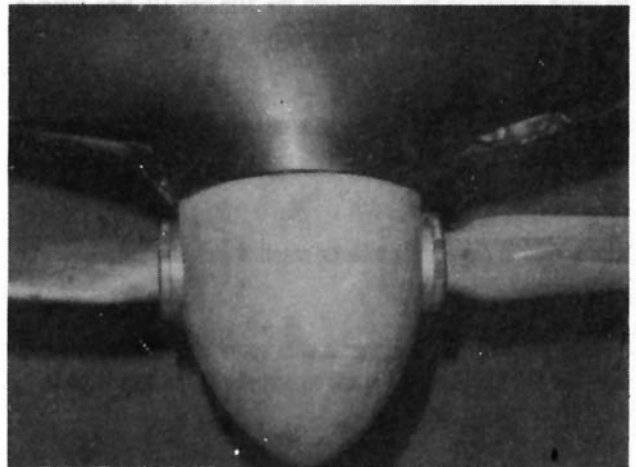


Photo No. 95: Completed spinner and variable pitch propeller assembly.

14.16

Glue blocks RIGID POLYSTYRENE FOAM, at least 6 inches long, to the plate. DO NOT USE POLYURETHANE FOAM.

14.17

When glue has set, chuck in a lathe or drill press and turn at low speed. Carve to desired shape with sandpaper.

14.18

While holding in chuck, drill a hole in the center to fit a piece of 3/16 I.D. tubing.

14.19

Remove from lathe or drill press. Set spinner in a bench vise. Cut and fit a single layer of Dynel, in two pieces, with the overlaps exactly opposite each other. Plug end of hole with a piece of foam.

14.20

Coat foam with epoxy resin. Lay on the Dynel and additional resin. Take care that Dynel overlaps are equal and opposite.

14.21

When resin has cured, chuck spinner back into lathe or drill press and sand smooth.

14.22

When sanding is completed, cut the spinner loose from the disc.

14.23

Hollow out the foam to beyond the depth of the propeller hub section.

14.24

Install a 10-32 nut plate onto the center of the front propeller flange.

14.25

Install the propeller and the front flange. Secure the mounting nuts.

14.26

Trim skirt of the spinner to fit the forward contour of the propeller blades and extending back to the forward face of the aft flange only.

14.27

Drill out the hole in the spinner that was plugged in step 14.19 (Insert the 3/16 I.D. tube as a drilling guide.)

14.28

Re-install spinner on the flange with the 3/16-inch I.D. tube trimmed slightly long.

14.29

Insert a long 3/16 bolt into the tube and screw it into nut plate in front flange.

14.30

With spinner in place, mark tube for cutoff ¼ inch short.

14.31

Remove the 3/16 I.D. tube, coat it with epoxy and re-install. Grease head and thread of bolt and install on propeller. Cure tube in place.

14.32

When tube installation is cured, install spinner on a long bolt and chuck into lathe or drill motor. Turning at low speed, hollow foam concentrically forward into spinner a couple of inches. Take care not to get caught in skirt cutouts.

14.33

Remove from the lathe. Make "orange peel" segments of Dynel and epoxy to the inside of the spinner, completely covering all foam.

14.34

Put heavy grease on prop hub flange and the shank of the blades. Install the spinner and cure in place for approximately 2 hours. Then remove spinner. If left on propeller, the epoxy will bleed through the grease.

COWLING

14.35

From 1-inch by 1-inch .032 aluminum angle, make cowling attach bracket. Fit and attach with 8 bolts to the left, right and bottom of the firewall. Set edge of the angle back to accommodate the type of fastening you use. For a -7 cam lock set angle brackets ½ inch from outer edge.

14.36

Locate and bolt a 2-inch section of aluminum angle to the top centerline forward face of the firewall. Add one each midway between the center line and the fuselage outside line. Set down angle below the top deck contour (same as step 14.35).

14.37

Install the propeller onto the hub using two bolts only with the heads forward. **Do not install the nuts.** Make a collar from two inch foam and wedge it against the prop and/or spinner. Cover the engine with a sheet of plastic. (See Photo No. 85.)



Photo No. 85: Cowl collar.

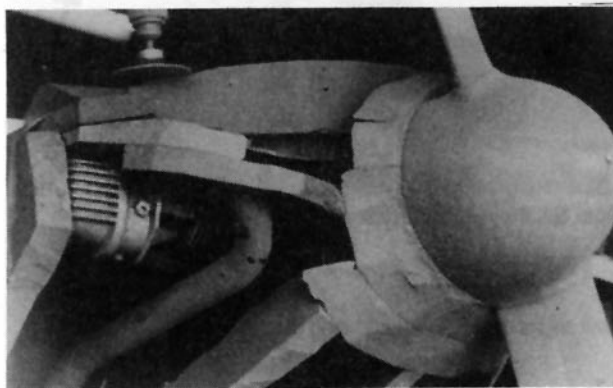


Photo No. 86: Start of cowl carving.

14.38

Chuck a sanding disc in the drill motor and start shaping the foam away from the spinner. Glue stringers of one-inch foam to the firewall and the foam collar. Note "build down" AROUND THE VALVE COVER TO ACQUIRE THE BASE LINE FOR THE AIR INLETS. (See Photo No. 86.) The foam is pushed onto the firewall clips and glued and taped forward. (This is "eyeball" work to stay inside of imaginary contour.) See Photo No. 87.

14.39

Glue a 1-inch sheet of foam from the cross engine sheet, installed in step 14.38, in line with the valve cover spring retainer back to the firewall on each side of engine in a horizontal plane. (See Photo No. 87.)

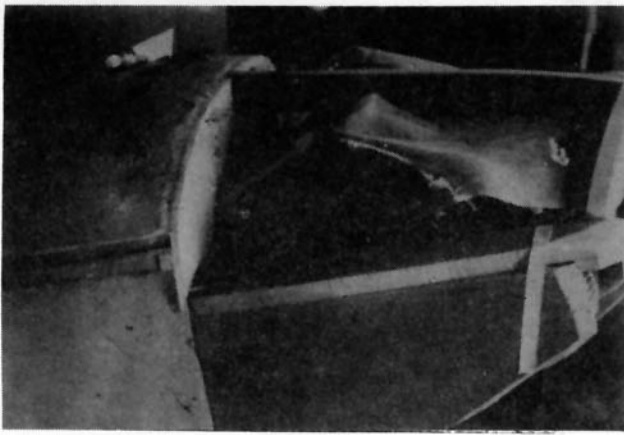


Photo No. 87: Cowl profile foam ribs.

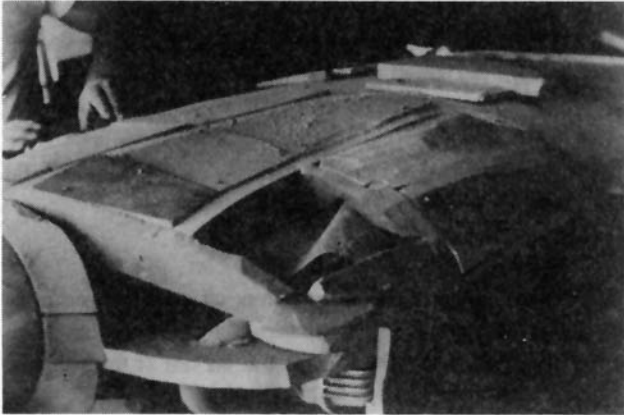


Photo No. 88: Filling in and shaping top of cowling.

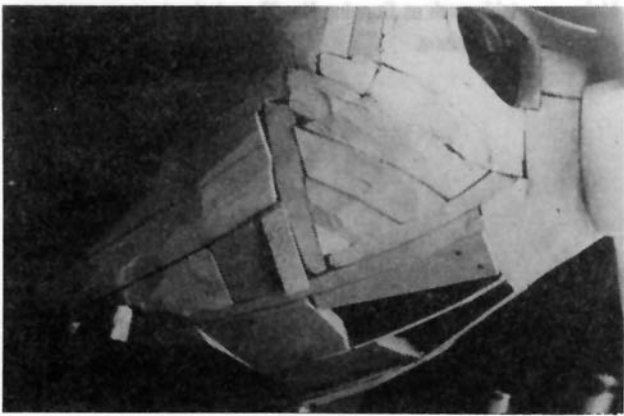


Photo No. 89: Shaping up bottom of cowling and forming air inlets.

14.40

Glue blocks together all over the top of the engine, sanding down in stages as you go. Cut out and fill until top cowl contour is achieved. (See Photo No. 88.)

14.41

Cut a slot 2-1/2 inches by 5 inches long from the engine centerline "up" and in front of each forward cylinder, forming the air inlets. (See Photo No. 89.)

14.42

Glue on additional foam and sand to desired shape.

14.43

When satisfied with shape, cut and fit Dynel, use two coats. (See Photo No. 90.)

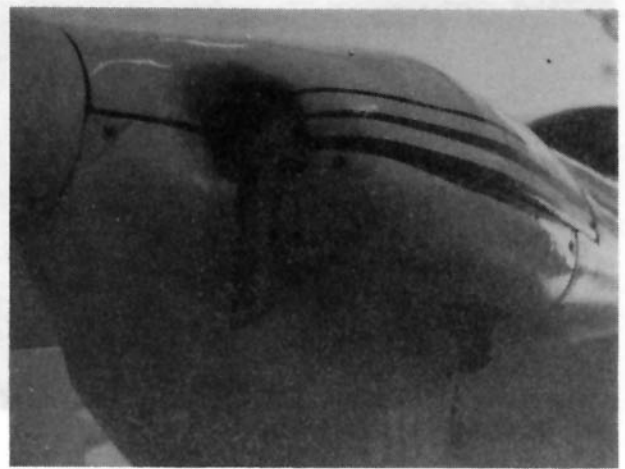


Photo No. 90: Cowling after cover.

14.44

Coat foam with epoxy/resin and lay on Dynel. Add epoxy/resin and squeegee as necessary. Cover with waxed paper and squeegee for smooth finish.

14.45

Maintain clearance of 1/8 inch between cowling and the prop spinner, remove prop and spinner by just pulling off. (See Photo No. 91.)



Photo No. 91: Prop removed.

14.46

When the resin has cured, sand and fill as necessary for smooth surface.

14.47

Separate upper and lower cowling into two sections with a rotary saw. Separate horizontally, in line with valve cover springs. Cut loose from firewall and remove from engine. Use prior described technique. Cut should be at center of side firewall clips.

14.48

Sand the foam on the inside of the cowling segments to 3/8 inch thick. Do not remove all foam. It is required as sandwich to stiffen the cowling.

14.49

Remove all foam that may be attached to the engine.

14.50

Cut and fit Dynel to the inside of both upper and lower cowling segments. (See Photo No. 92.)

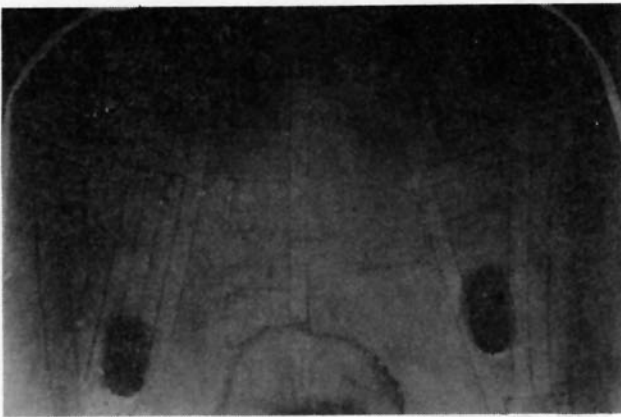


Photo No. 92: Dynel on inside bottom.

14.51

After cure, epoxy in wood filler blocks between the cowl skins where each camloc fastener is going to be used. (See Photo No. 93.)

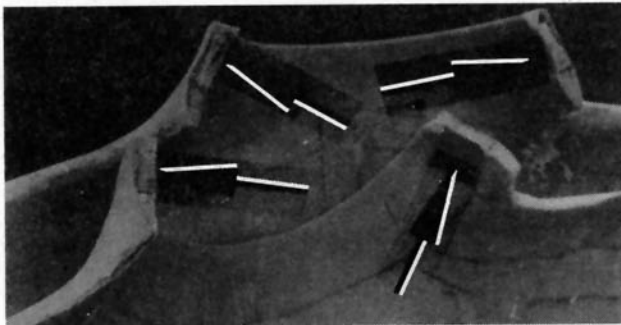


Photo No. 93: Wood filler blocks for cam lock fasteners.

14.52

Reinstall the cowl segments, adjust for alignment and restrain. With a sharp drill, make the pilot holes for each fastener location. Remove the cowl. Bring the holes up to size and install the fasteners.

14.53

Bolt four 1-1/4 x 3 x .030 aluminum pieces to top inside part of the cowl, one on each side of the air inlet holes in front of the cylinders. Use flat head bolts flush with the outer skin. Epoxy over them so they won't show after finishing. (See Photo No. 94.)



Photo No. 94: Cowl bracket for cam lock nut plate.

14.54

Whenever the cowl is removed, particularly if it is hot, join the two segments and place in the shade. The cowl will take quite a while (weeks) to permanently cure to where all strains are eliminated. If it should get out of contour or alignment, use a propane torch to locally heat it (don't get the surface hotter than your hand can tolerate). Then join the two segments, preferably attached to the firewall, and allow to cool "in-place".

14.55

The male fasteners are of the Camloc 2600 type. The female fasteners are of the Camloc 312-12 type. The length required is strictly a function of how well you control the cowling thickness. See table for grip length of stud with female part properly mounted on cowling clip. Add thickness of clip material.

Total Grip Range	2600 Dash No.
.540-.569	-6
.570-.599	-7
.600-.629	-8
.630-.659	-9

N1436 used 2600 -7, with 312-12 nut plates.

15.0 WEIGHT AND BALANCE

A weight and balance sheet will be required by the FAA on final inspection day. The following is a method of calculating it.

15.1

With the airplane level, weigh each main gear and the tail wheel. The tail wheel weight may be negative in this attitude.

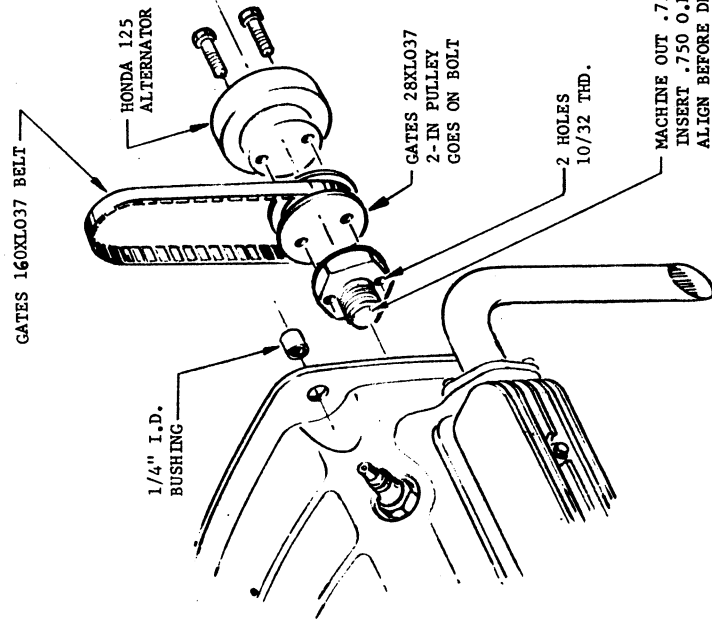
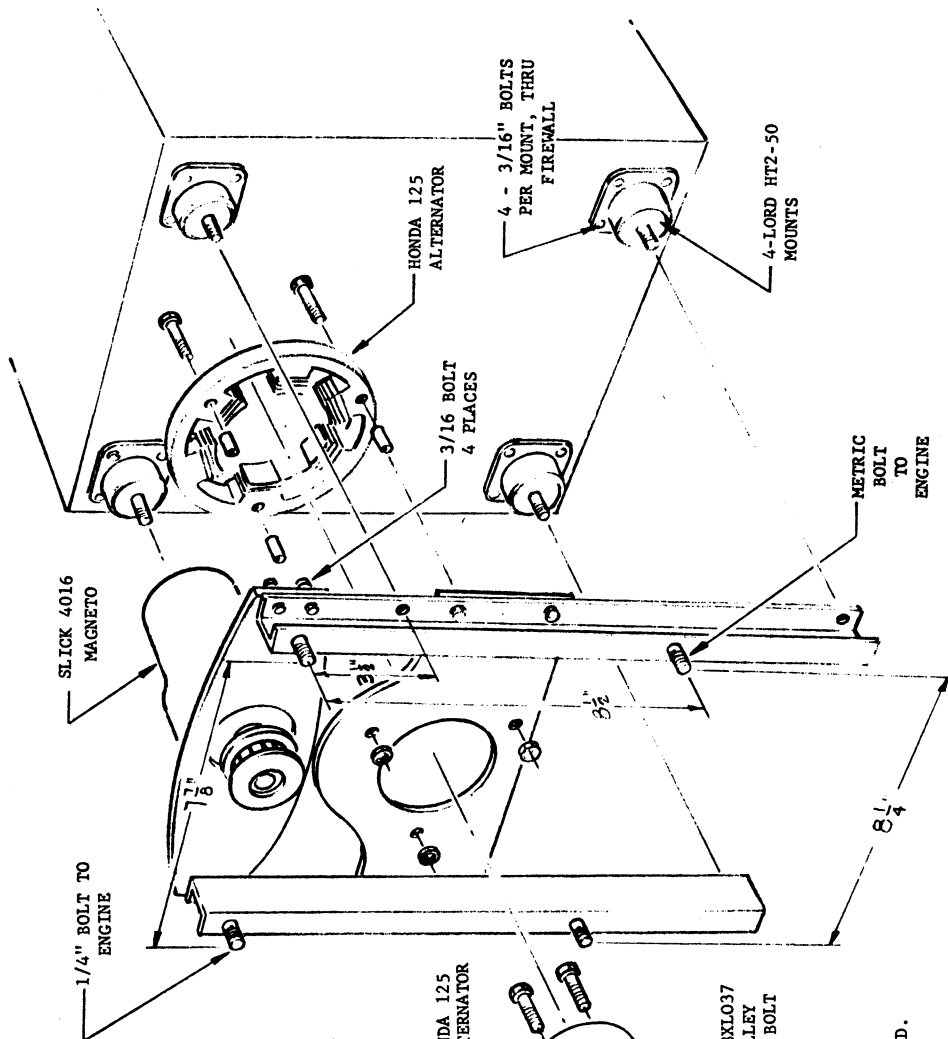
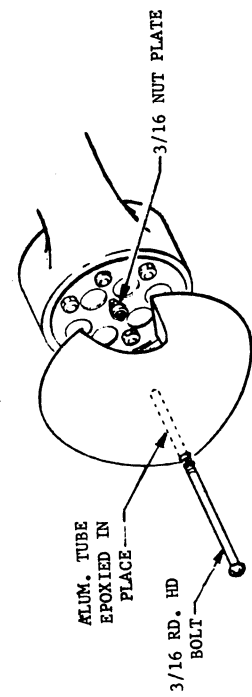
15.2

With a side drawing of the airplane, mark off stations in inches by measuring the airplane. Use a convenient starting point as zero such as the tip of the prop. The C.G. range is the rear of the front spar plus and minus four inches.

15.3

Make up a table such as Drawing No. 26, and plug in the numbers for your particular airplane.

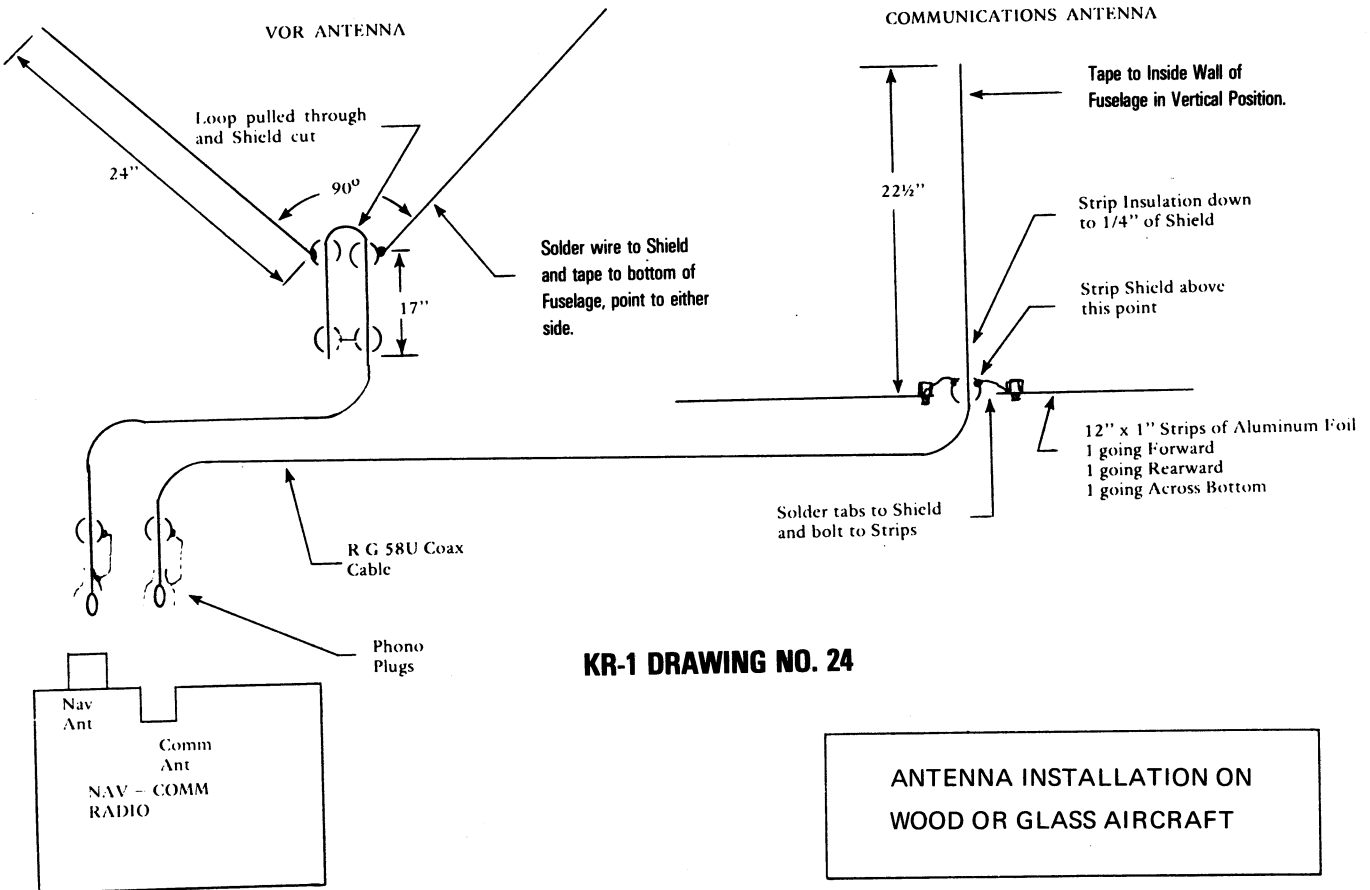
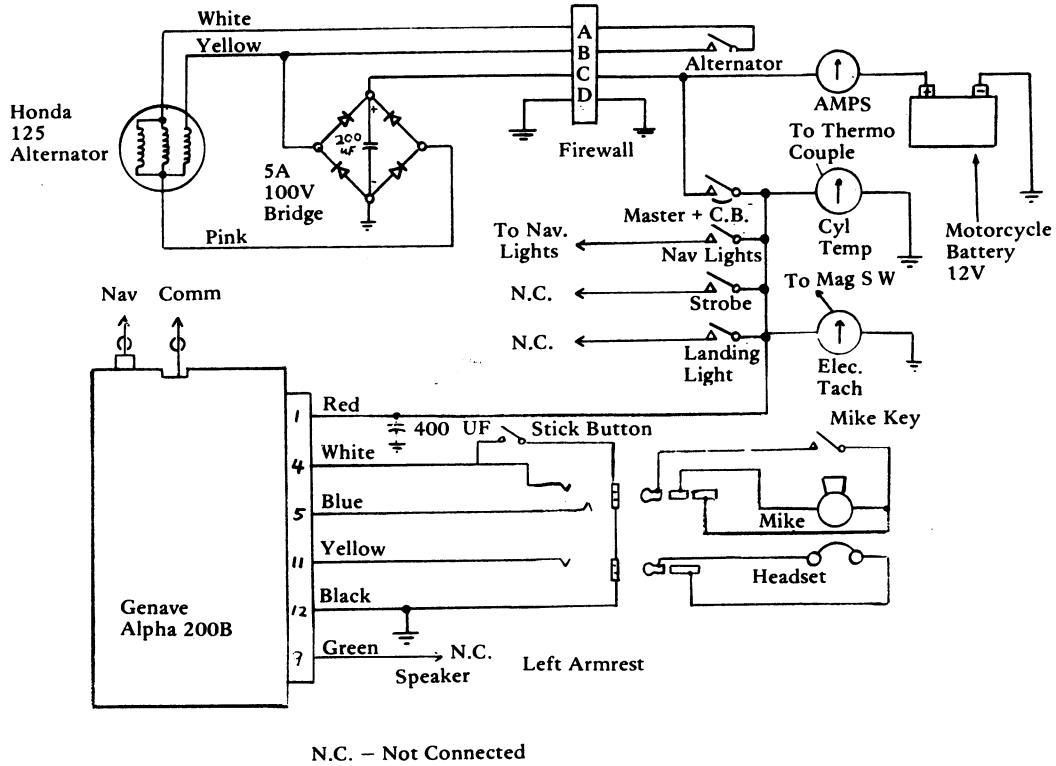
PROP SPINNER DETAIL



MACHINE OUT .750 THRU ALL 3.
INSERT .750 O.D. TUBE TO
ALIGN BEFORE DRILLING BOLT HOLES

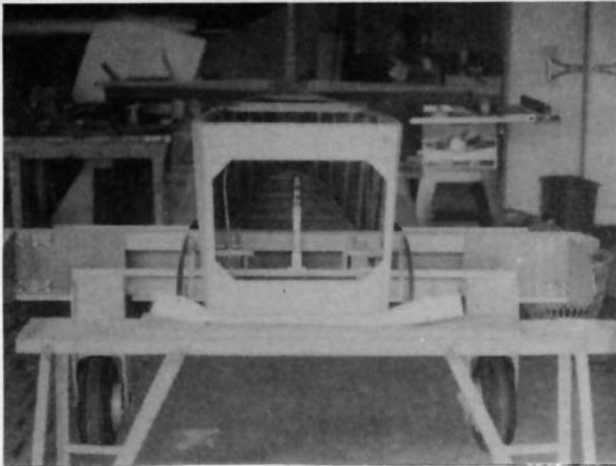
KR-1 DRAWING NO. 23

**WIRING DIAGRAM
KR-1 S/N 001 N 1436**

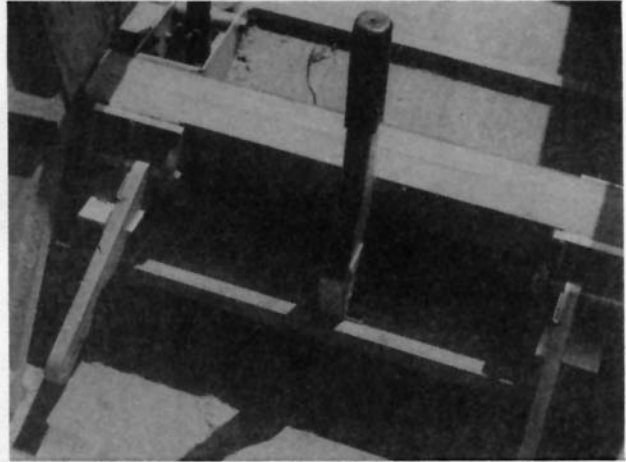


KR-1 CONSTRUCTION DETAILS

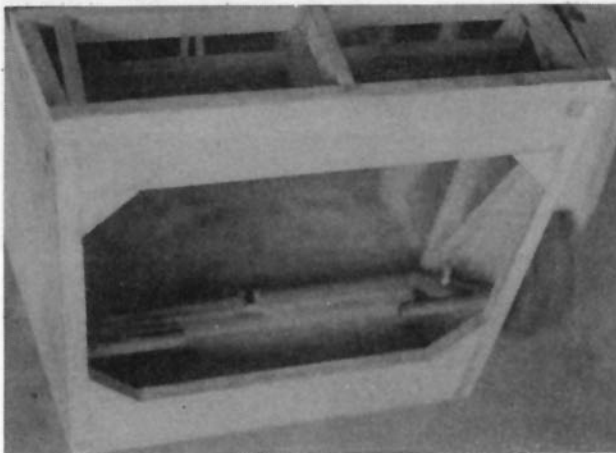
AIRCRAFT ALL OVER THE WORLD ARE NEARING COMPLETION



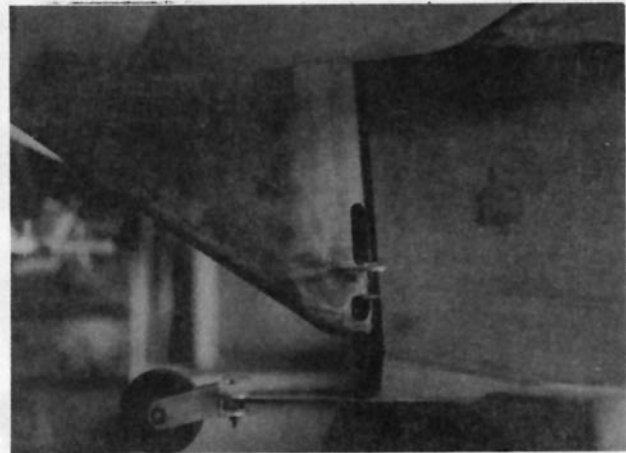
Fuselage, center section wing spars and landing gear completed.



Landing gear handle and latch assemblies installed.



Forward bulkhead and rudder pedals.



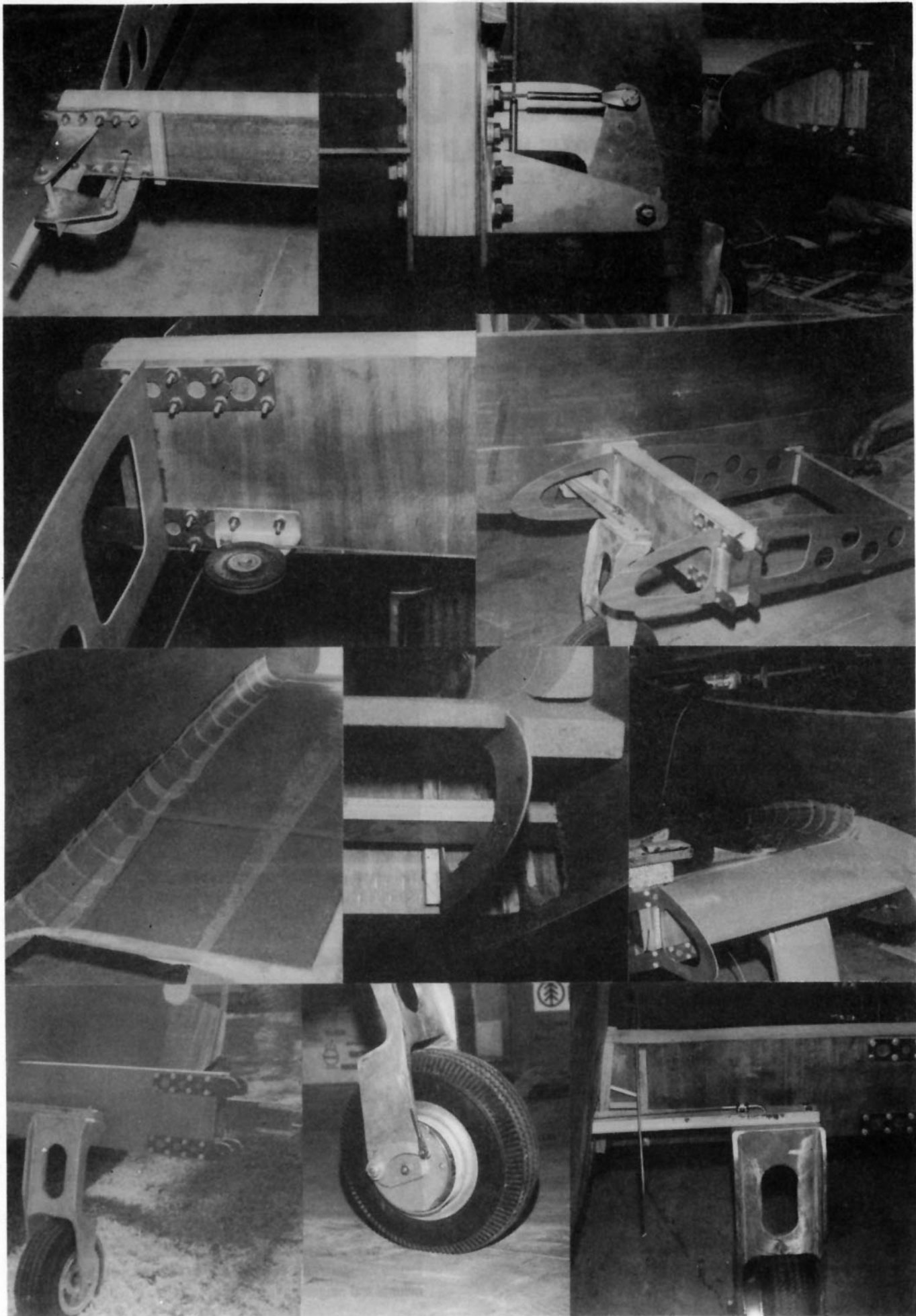
Tail wheel and rudder control horn installed.

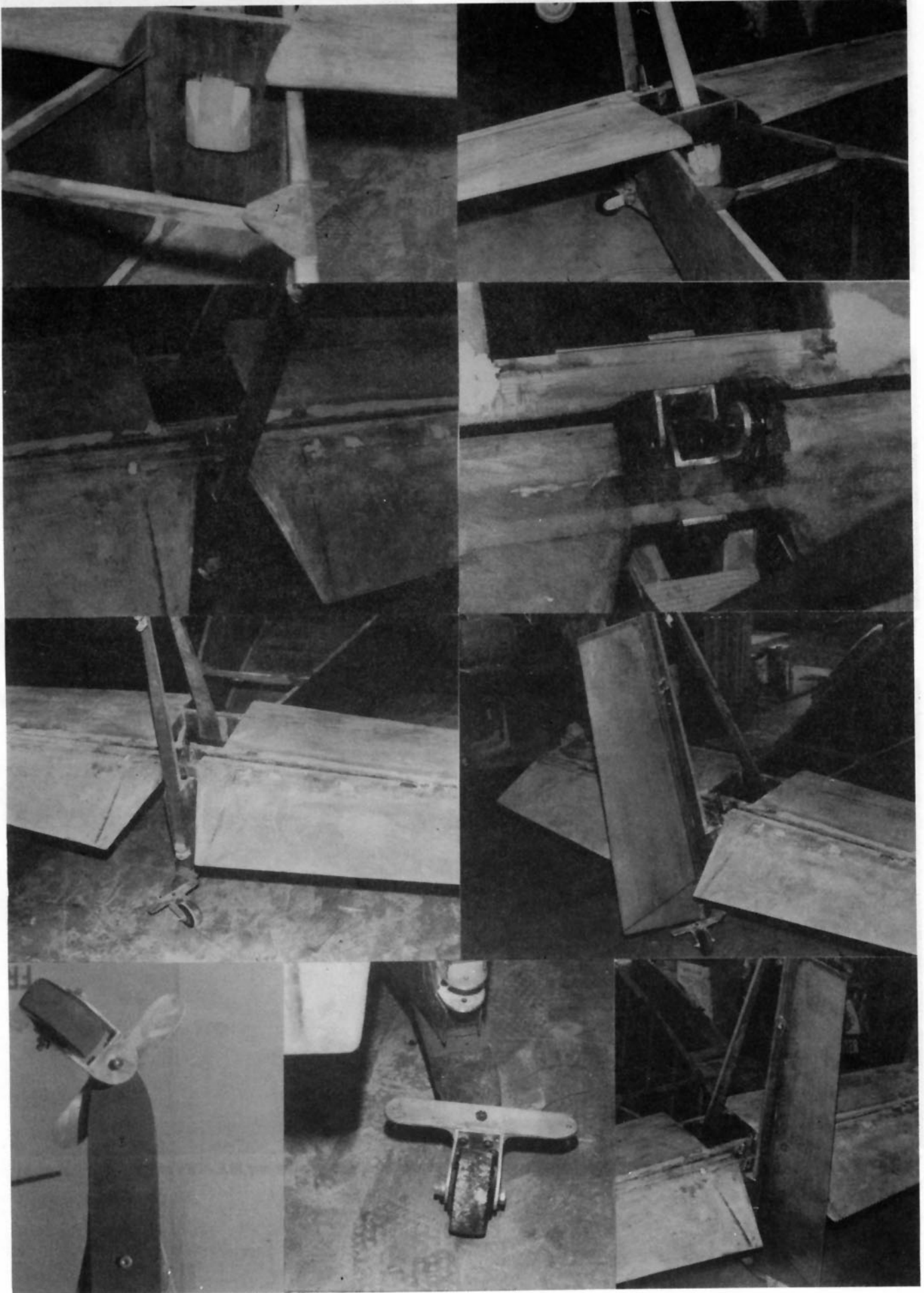


Side mounted control stick installed.



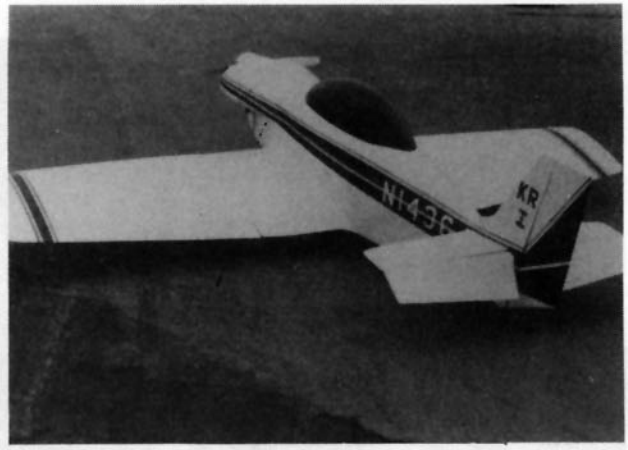
Engine compartment with top cowl removed; note upper engine mounts and magneto.







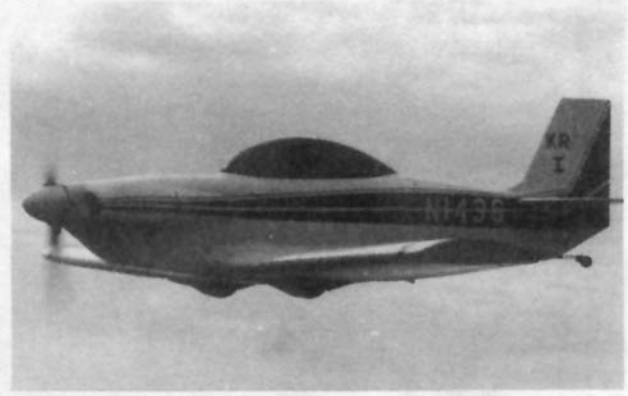
Ken Rand "running in" a new engine.



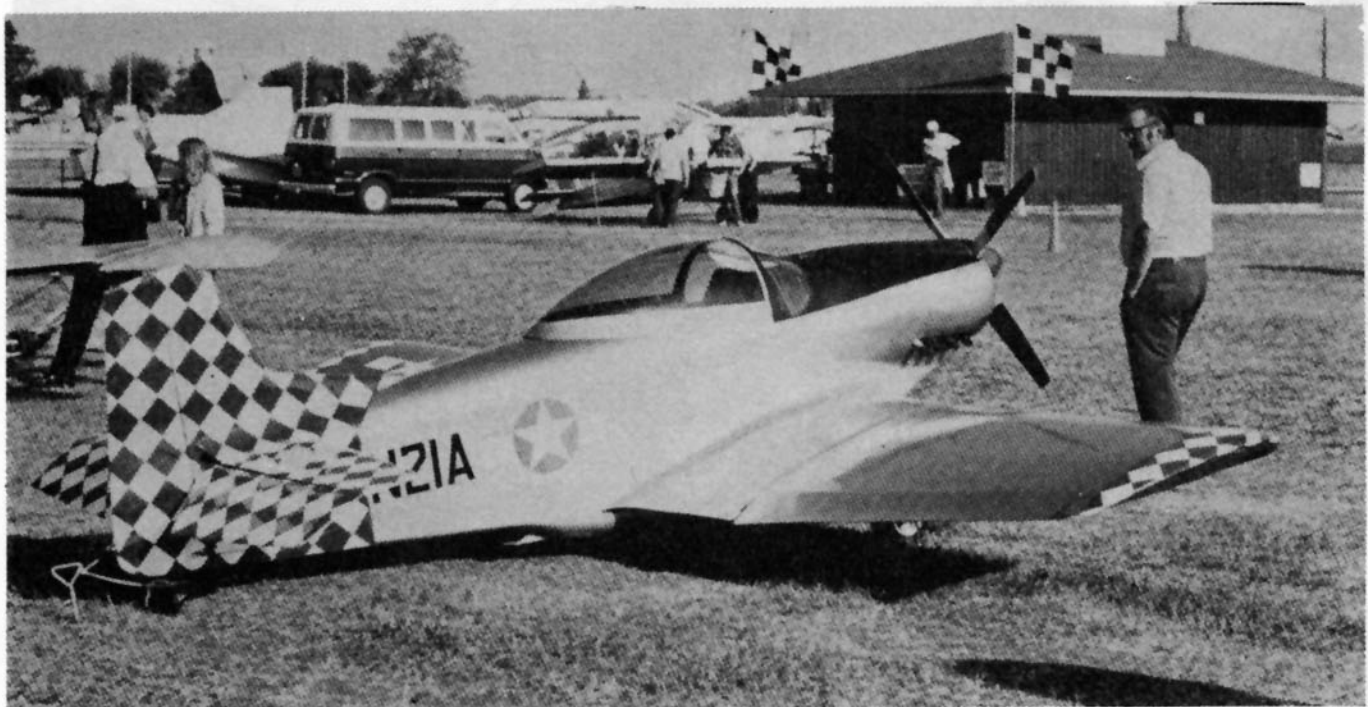
The KR-1 on the ramp ready to go.



The KR line-up at "Oshkosh '75".



Cruising along in the KR-1.



The George Andrews KR-1: P-51, with his own four bladed propeller, on the ramp ready to go after any M.E.-109's or F.W.-190's that might show up.

