

SECTION 10 - BIPLANE WINGS

Here are the biplane wing drawings for FLY BABY, presented as a supplement to the existing monoplane drawings. While no new name has been used other than "BIPLANE FLY BABY" or "FLY BABY 1B", AIR PROGRESS MAGAZINE dubbed it "FLY BI-BABY" in its writeups and the name seems to have caught on.

Since FLY BABY was designed from the start to be easily converted to a biplane, airplanes already built as monoplanes can take the biplane wings with very little additional work on the fuselage. Once the alterations have been made, an individual can, with a couple of helpers, change from one configuration to the other in approximately an hour. For air show demonstrations with the prototype, three people have made the conversion in 35 minutes.

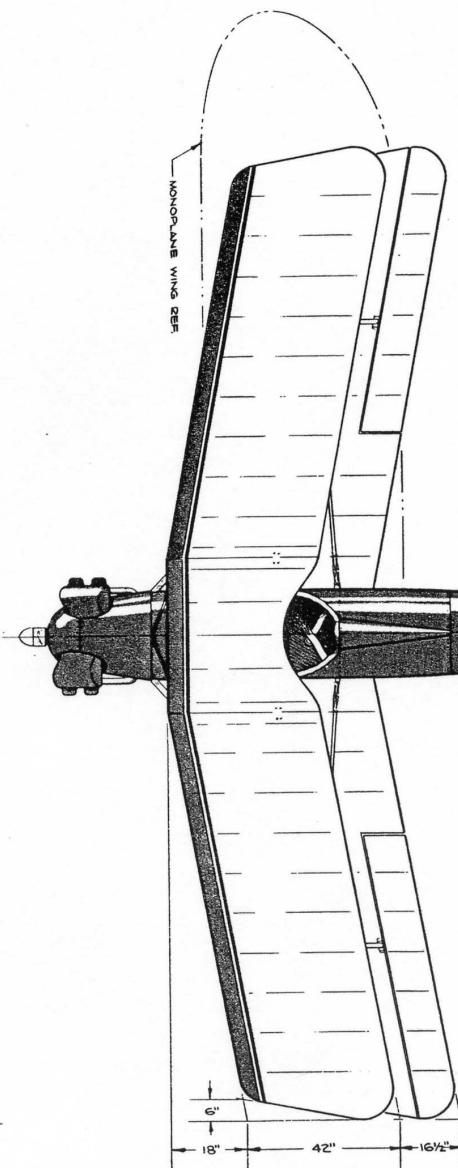
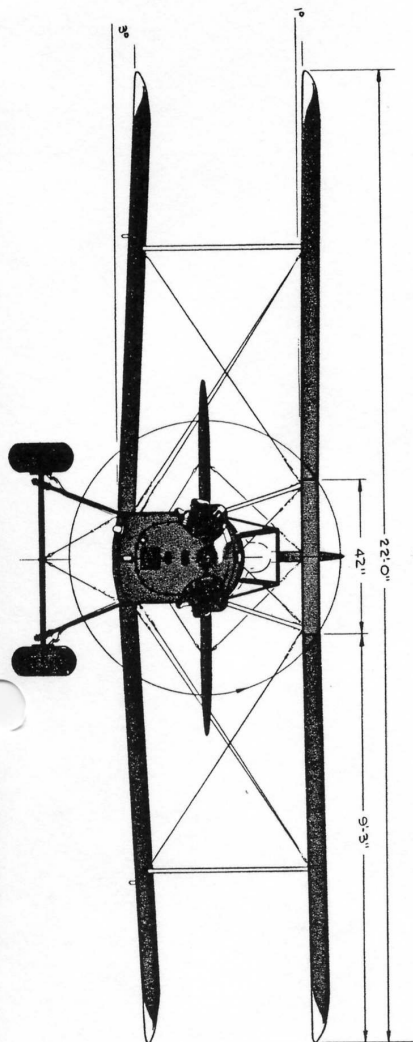
The conversion is not a simple case of putting an extra wing on the monoplane FLY BABY. Biplanes do not need double the wing area of equivalent monoplanes; actually, the biplane wings have only 24% more area than the monoplane wing. This allows a reduction of wing span from 26 feet to 22. Even so, the biplane has more span and area than its single-seat contemporaries. The generous wing area is mainly responsible for the docile handling characteristics of the Fly BABY biplane.

Another reason for using a separate set of biplane wings instead of merely adding one is the problem of pilot access. Since, in the monoplane, the pilot sits right on the center of gravity, adding another wing would mean that the new wing would have to be directly over the existing straight wing to maintain the same center of gravity and center of lift. However, a wing right over the cockpit would make it nearly impossible for the pilot to get in unless a door were cut in the side of the fuselage. Since this is undesirable, it was necessary to move the center section of the upper wing ahead of the cockpit. This puts a lot of lifting area ahead of the existing center of gravity and makes the airplane tail heavy. The solution to this problem was to sweep the wing back to move the center of lift aft. Since the necessary sweepback for the upper wing alone would be too great, BOTH wings were swept.

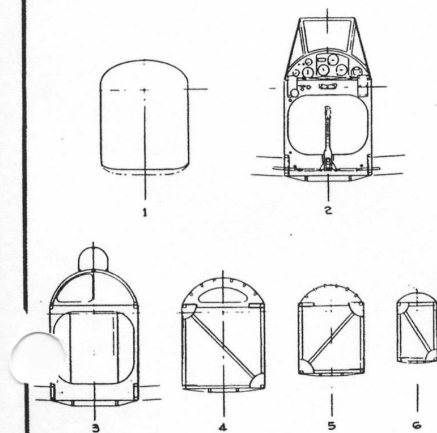
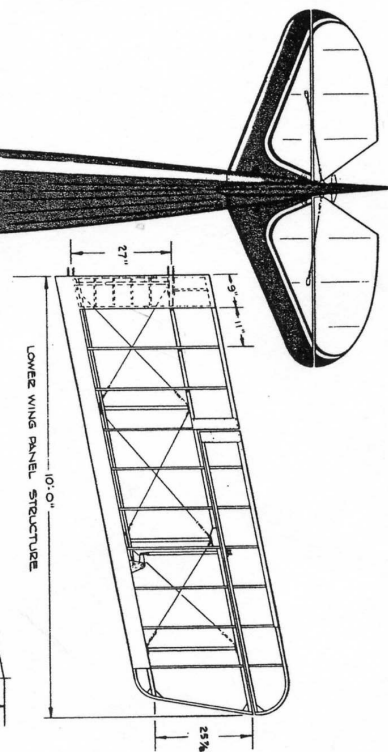
The biplane wings are similar in layout, detail, and instructions to the monoplane wings of Section 4. To avoid needless repetition, some assembly procedures for the biplane wings are merely referred to Section 4 of the monoplane plans rather than repeating them at length.

Some slight differences in minor details and rib spacing will be noted between the drawings and the photos. This is the result of desirable improvements introduced since the prototype biplane wings were built. The principal change has been to revise the lower wing rib spacing so that both the upper and lower wing panels can be built on the same layout. Originally, the wings had different rib spacing throughout. Now they are the same for the first eight ribs inboard from the wingtips,

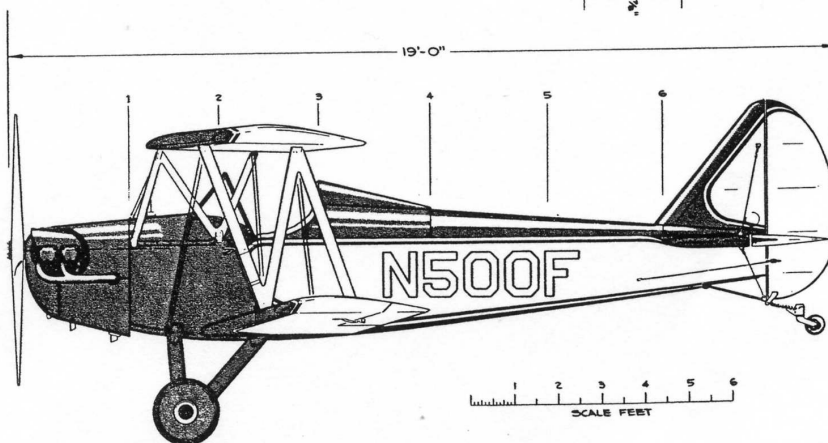
FLY BABY I-B



— DIMENSIONS —	
WING SPAN	22'-0"
CHORD	3'-6"
AREA	130 SQ. FT.
GAP AT CENTER SECT.	48"
INCIDENCE UPZ.	3°
DIHEDRAL UPZ.	10°
SWEEPBACK	3°
LENGTH	19'-0"
HEIGHT	7'-1"
— WEIGHTS —	
EMPTY	651 LBS
GROSS	972 LBS
— PERFORMANCE —	
MAX. SPEED (65 H.P.)	92 MPH
CRUISE	80 MPH
STALL	42 MPH
INITIAL CLIMB	650'/MIN.
POWER - H.P.	65 - 85



FUSELAGE STATIONS - REAR VIEWS



R. PARKS 11-69

NOTE

The biplane wing supplement drawings and instructions for FLY BABY are not quite complete at this time. However, there is enough here for you to get 95 percent of the way, and a few individuals have been able to complete the job on their own.

The main reason for the incompleteness is the loss of the services of the excellent illustrator that made the original drawings. I am no draftsman, as you can see from Sketches 1 through 12. These are what I work up to pass on to the draftsman. However, with-so little demand for the biplane wings, I cannot afford to invest the \$30.00 per hour that other draftsman are asking these days and still keep the plans price reasonable. So, I hope that you can work from these, too. The essential details have been added here after Page 10-24 in their original form for your guidance.

The missing pages 10-3 and 10-4 that should occupy this space are not "plans" and are not essential to your work. They were reserved for photographs and for the materials list that already appear on the wing rib drawing. The final pages will be sent later. In the meantime, if you have problems, write to:

Peter M. Bowers,
10458 16th Ave. So.,
Seattle, Wash., 98168
or call
(206) 242-2582

A few notes to go with this digital version.

- Pete makes several references to “will be updated later” or “Final version is forthcoming.” No updates were ever made...what you see here is all Pete ever sent.
- Pete also makes mention of old FAA procedures, such as contacting the FAA for a “pre-cover” inspection. This is no longer required, but builders should take advantage of the EAA Technical Counselor program to have their work checked.
- Pete intended, originally, that the parts drawings in the manual could be used as templates. However, no copier ever produces a “true size”...they all distort the image slightly. It’s even worse in this scanned version. In short, DO NOT USE THE TEMPLATES IN THE PLANS. Redraw them on graph paper or on your computer.
- Similarly, the Rib Templates were originally done on 11x17 paper. I’ve shrunk them down to fit in here, and moved them toward the end.
- I have attempted to maintain Pete’s formatting through this re-creation, and to keep the same page numbers for the same materials. This sometimes makes pages end at odd points, since the line spacing, character spacing, etc. differs slightly from the original.

Ron Wanttaja April 2011

BIPLANE WING LAYOUTS

Since the biplane FLY BABY wings are considerably smaller than the monoplane wings, they are better suited to assembly on the flat surface of a work bench or floor instead of "in space" on top of a pair of sawhorses as shown in the monoplane plans. The sweep angle of the outer panels makes the "in space" procedure quite undesirable from the standpoint of maintaining accurate assembly angles.

The center section, which has no sweepback, is the easiest wing unit to build. For this reason, it is recommended that this unit be built first. The spars are laid out parallel to the edge of the work bench or other working area. The ribs are laid out at 90 degrees to the spars. If the 42-inch chord is greater than the width of the workbench, the portion of the ribs behind the rear spar can be projected over the near edge of the bench.

The outer wing panels are a bit more complicated because of the sweepback angle. For the builder, the complication results from the fact that the airplane is designed to the airplane center line (or longitudinal axis) and to the lateral axis which is 90 degrees to it. For the monoplane and most other homebuilt biplanes, the wing spars parallel the lateral axis so the wing structure is laid out "square". With swept wings, the spars do not parallel the lateral axis but the ribs do parallel the longitudinal axis.

Another complication is the fact that if the sweep angle is used when the wings are being laid out, a wider work area will be required. A method of laying the wings out with the spars parallel to the work area is shown in Figure 10-6.

A single layout is used for both wings on the same side of the airplane. Except for the aileron cutout and the position of one compression rib, the upper and lower wings are identical from the tip in to the 8th rib. The upper (shorter) wing panel is built first; the spar lines are then projected inboard an additional 9 inches and revised inner end rib spacing is laid out for the longer (lower) wing panel.

The only "jigging" necessary for center section and outer wing panel assembly is six pairs of 1" x 1" x 3" position blocks to hold the spars in place on the layout. These are similar to the blocks used to hold the fuselage longerons and uprights in place as shown in Figures 1-1 and 1-2 of the monoplane plans.

LAYOUT AND CONSTRUCTION

The logical way to start wing construction is to make the ribs and primary metal fittings. Full-size layouts for the three sections of each rib are on Figure 10-1; Figures 10-2 and 10-3 show fittings. Some rib corrections appear on Figure 10-1A. Note that all sections of certain ribs are to be trimmed 1/8" at the ends to allow for the plywood reinforcement plates on the inner ends of the spars. Also, the center portions of the two inner ribs of the lower wing will be a little longer at the rear spar end; this because of the bend in the rear spar near the fuselage. These two ribs are built in place after the rest of the lower wing has been assembled.

The method of construction is the same as for the monoplane ribs except that the plywood webs are 1/16" instead of 1/8" and the bottom cap strips do not fit into notches in the nose ribs. Mahogany plywood is preferred, but Birch is all right.

1. Cut 360 feet of 1/4" x 3/8" capstrip and groove to fit your particular supply of 1/16" plywood.
2. Assemble ribs per Figure 4-3 of the monoplane plans, allowing the bottom cap strip to project a little ahead of where the lower curve of the nose rib begins per detail of Figure 10-1A. This will be trimmed off later.
3. For Ribs 10 and 11 on the upper wing and CC-1, 2, 6 and 7 of the center section, thin the depth of the mid-section and trailing edge plywood webs 1/16" inch along the upper and lower edges prior to gluing on the cap strips. This is because these rib pairs are bridged with 1/16" plywood per Figures 10-3 and 10-7 to stiffen the panels against fabric tension.

NOTE

It will be necessary to thin the inner face of each cap strip 1/16" per the detail of Figure 10-1A to allow the cap strips to pass over the spars and match to the nose ribs. The extra 1/16" needed on the outside of the cap strip at the nose ribs can be applied by gluing on a 1/16" strip.

4. For ribs 22 and 23 on the lower wing, trim the TOPS of the webs 1/8". This is to take the heavier 1/8" plywood for the wing walks. Correct cap strips accordingly. For the bottom surface of these ribs, trim only 1/16" per (3).
5. When building Rib 23, end the rib at the front face of the rear spar. The trailing edge portion will be built on later.
6. Make the metal fittings of Figures 10-2, -3, and -10. Note that the 1/4" holes are left off of four of the eight "D" fittings on Figure 10-2.

CENTER SECTION

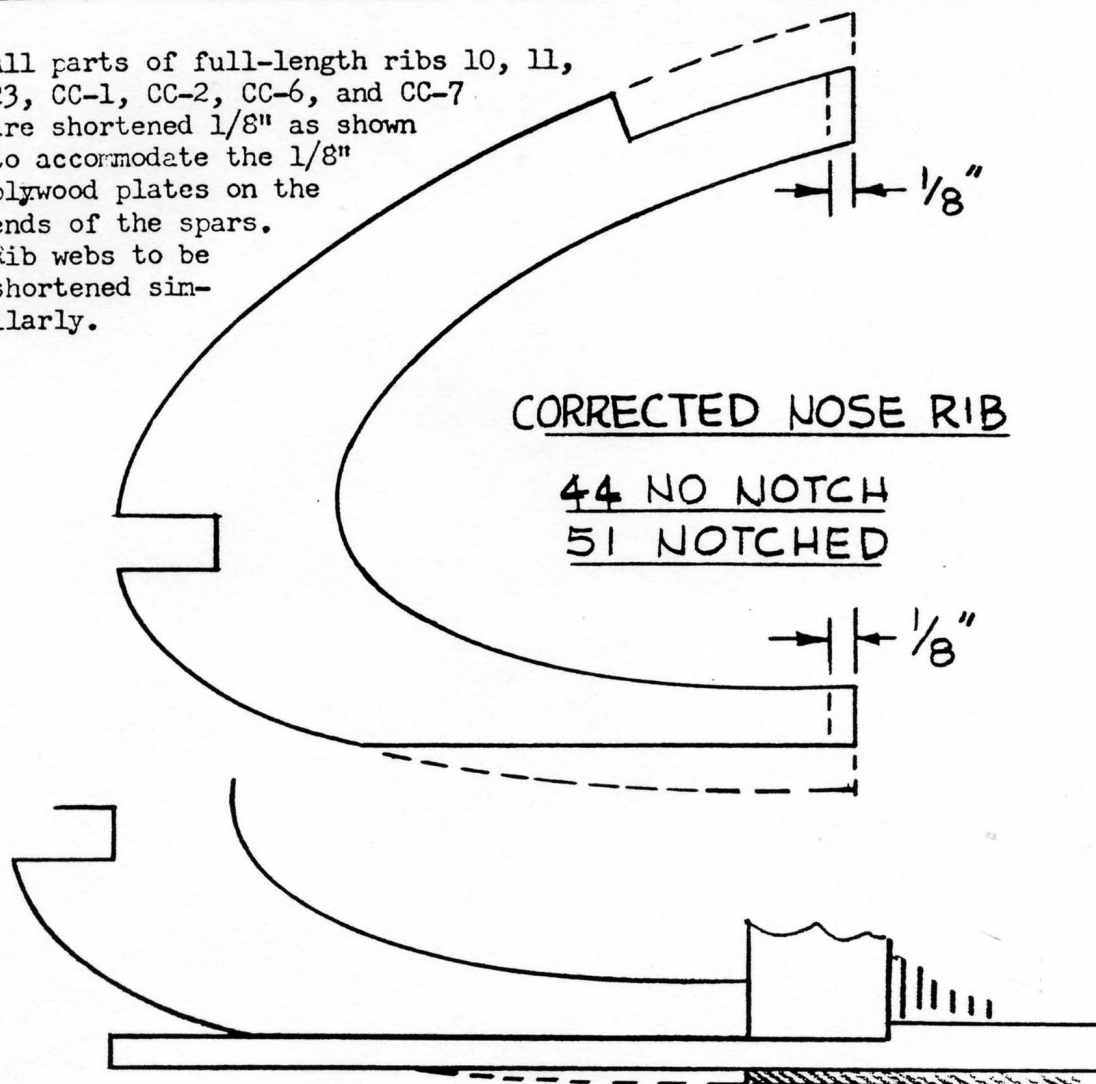
1. Lay center section out on work area per Figure 10-3.
2. Cut front and rear spars, bevel per Figure 10-1, and cut to exact length.
3. Drill vertical and horizontal holes in spars per Detail 2 of Figure 10-4.
4. Glue 1/8" plywood reinforcements on ONE SIDE of ONE END of both spars only with face grain vertical. Back-drill through open side of spars through the plywood and then glue plywood on opposite faces of spar. Back-drill through the drilled plywood.

NOTE

Do NOT put plywood on either side of opposite end of the center section spars at this time.

5. Laminate trailing edge bow per Figure 10-3 and Detail 1 of Figure 10-4 or build it up from scrap plywood per Figure 10-4A.
6. Trim Ribs CC-3, 4, and 5 to lengths that will fit 1/2" into the trailing edge bow per detail 5 of Figure 10-4A, slide them onto the spars from the no-plywood ends, and lay the spars down on the center section layout. Use position blocks to hold the spars in place not so tight that the spars

All parts of full-length ribs 10, 11, 23, CC-1, CC-2, CC-6, and CC-7 are shortened $\frac{1}{8}$ " as shown to accommodate the $\frac{1}{8}$ " plywood plates on the ends of the spars. Rib webs to be shortened similarly.



CORRECTED NOSE RIB

44 NO NOTCH
51 NOTCHED

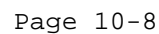
DETAIL OF SHALLOW END RIBS

Cap strip detail for the end ribs. Note the need to build up the bottom of the lower cap strip to fair the leading edge into the $\frac{1}{16}$ " plywood between the ribs. The filler pieces, shown dotted above, are to be added AFTER the lower plywood is installed per Step 30 of Page 10-11.

Drawing 10-1 is incomplete in that it does not show that some of the $\frac{1}{4}$ " plywood nose ribs are solid, as indicated by the dotted lines in the top detail on this page, instead of being notched for the cap strips. Make 44 notched and 51 un-notched.

Also, some corrections to the numbers of middle and trailing edge parts: Make 53 large center pieces instead of 51 and make 42 trailing edge pieces instead of 38. This is because the number of ribs in the lower wing has been changed since Figure 10-1 was printed.

FIGURE 10-1A
NOSE RIB CORRECTIONS



cannot be lifted out easily. Put stop blocks across the ends of the spars to keep them from sliding sideways.

NOTE

When laying out the center section, all rib measurements are to the centers of the ribs except for the end ribs. These have their outer edges flush with the ends of the spars.

7. Tack ribs in proper positions with aircraft nails through the top cap strips into the spars. Do not drive the nails in all the way as they will be pulled out later.
8. With the ribs in place, repeat Step 4 to add plywood to the other ends of the center section spars. The plywood can be applied in place or the center section can be lifted off of the layout.
9. Install Ribs CC-2 and CC-6 over spar ends and tack in place per Step 7.
10. Bolt in two compression ribs T-5 per Detail 2A of Figure 10-4. Tighten bolts only to the point of a snug fit. (Compression ribs on Figure 10-5)

NOTE

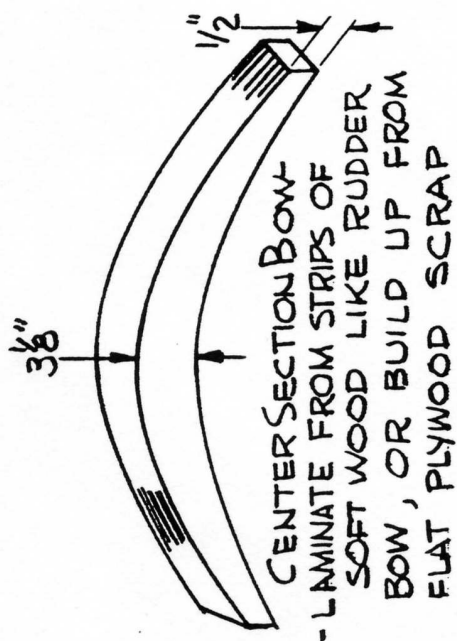
When installing fittings "C" during this operation, install them upside down; that is, projecting above the spars instead of below them as in Detail 2A.

11. Using the methods of Step 6, Page 4-14 of the monoplane plans and the dimensions of Detail 2, Figure 10-4, mark the locations for the 1" holes in the ribs for the drag wires.
12. Bridge from front to rear spar with strips of scrap plywood or other wood strips about 4" wide between Ribs CC-2 and 3 and CC-5 and 6. Use several nails along each spar. This is to hold the spars in rigid alignment for Step 15.
13. With spars secured, pull out nails holding rib cap strips to spars. Slide spars about 1/2" to one side and place mark on face of each spar at bottom where the rib is to be on final assembly.
14. Mix a small batch of glue, enough for attaching the ribs to the spars,
15. Pull the whole center section assembly off of the layout, turn it over, and apply a dab of glue to the bottom edges of the spars at the points marked.
16. Put the center section assembly back in the blocks on the layout and apply dabs of glue to the top edges of the spars at the marked rib positions.
17. Slide ribs back into position and nail into place with nails now driven full depth through the cap strips.
18. Pull center section assembly out of the layout again before glue begins to set, turn it over, and nail ribs to spars through the bottom capstrips. Reinstall center section in layout blocks.

19. Cut triangular corner blocks and nail and glue them in place per Detail 3 of Figure 10-4. These go on the rear side of the front spar only for Ribs CC-2, 3, 5, and 6 and on both sides of the rear spar for all ribs but CC-4.
20. Nail and glue 1/4" x 3/8" cap strip material to top of front spar per Detail 3 of Figure 4-25 between Ribs CC-2 and CC-6. Turn center section assembly over and repeat on the bottom of the spar.
21. Install slightly over-length leading edge strip then install intermediate nose ribs per Figure 10-5.
22. Remove compression ribs and "C" fittings. Apply varnish to spar areas under "C" fitting. Fit 1/8" stranded steel wire to rear tabs of compression ribs per Step 5 of Page 4-14, monoplane plans.
23. Drill 1" holes previously marked on ribs for drag wires and drill at least two holes in trailing edge portion of Ribs CC-2 and CC-6 to ventilate the box structure that will be built there.
24. Reinstall compression ribs, this time with the "C" fittings in their proper positions. Add filler blocks to back side of front spar and both sides of rear spar at "C" fittings per Detail 4, Figure 10-4A.
25. Complete drag wire and turnbuckle installation and trammel center section to square per Steps 8 through 10 of Page 4-14, monoplane plans.
26. Add trailing edge filler strips to both sides of Ribs CC-1 and CC-7 per Detail 6 of Figure 10-4A. Install ribs on spar ends with outer edge of cap strip flush with ends of spars. Use corner blocks only on inner sides, nailing the blocks to the SPARS FIRST then nailing through the rib webs from the outer sides into the blocks. Be sure to back up the blocks well when nailing so they don't loosen from the hammering on the rib web.
27. Trim, notch, and fit trailing edge bow per Details 5 and 6 of Figure 10-4A. Note the 1/16" step-down between the two end ribs for the plywood. Glue the trailing edge bow in place; final trim to cross-sections of Figure 10-3 can be done after the glue sets.
28. Glue 3/16" x 1" filler blocks on spars between pairs of end ribs per Detail 3 of Figure 10-4.
29. Cut 1/16" plywood strips to fit on TOP of Ribs CC-2 and 2, CC-6 and 7 from front edge of front spar to trailing edge. Tack in place and mark outline of glue areas with pencil from bottom of wing. Remove plywood.
30. Cut 1/16" plywood strips to fit BOTTOMS of end rib pairs per (29) but glue and nail permanently in place.
31. Varnish all wood except that which is still to be glued or which will have fabric cemented to it. Varnish underside of top plywood strip and glue it in place after the varnish dries.

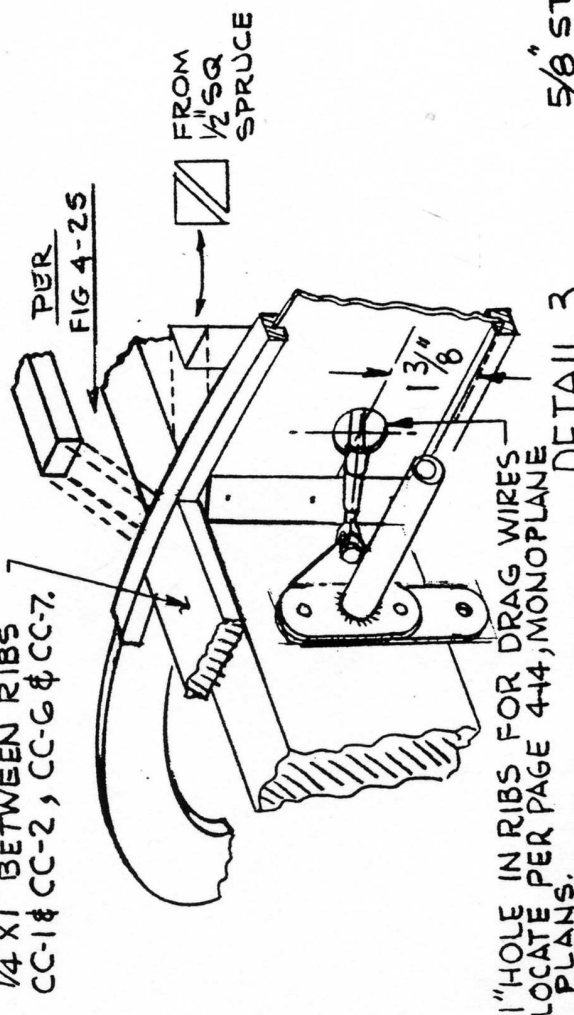
NOTE

The leading edge aluminum is considered part of the covering and should be left off until after the FAA's pre-cover inspection.

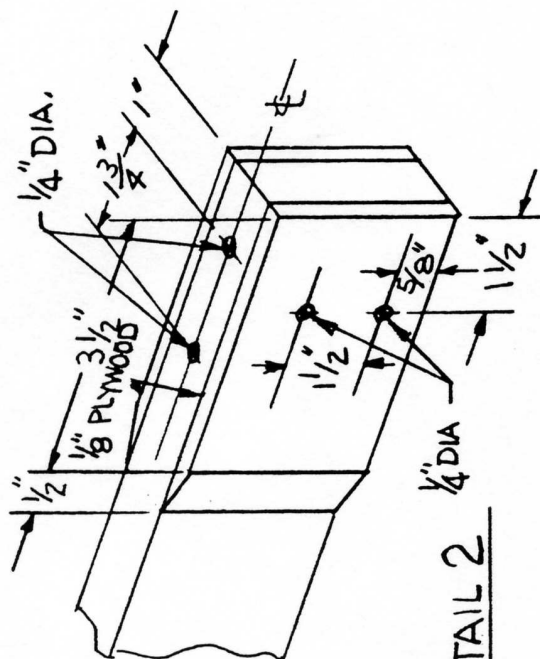


DETAIL 1

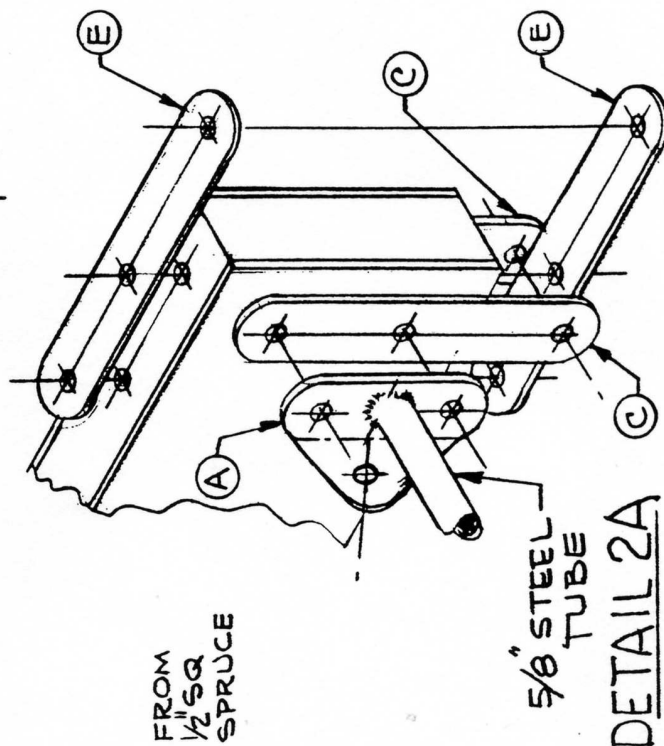
1/4" x 1" BETWEEN RIBS
CC-1 & CC-2, CC-6 & CC-7.



DETAIL 3

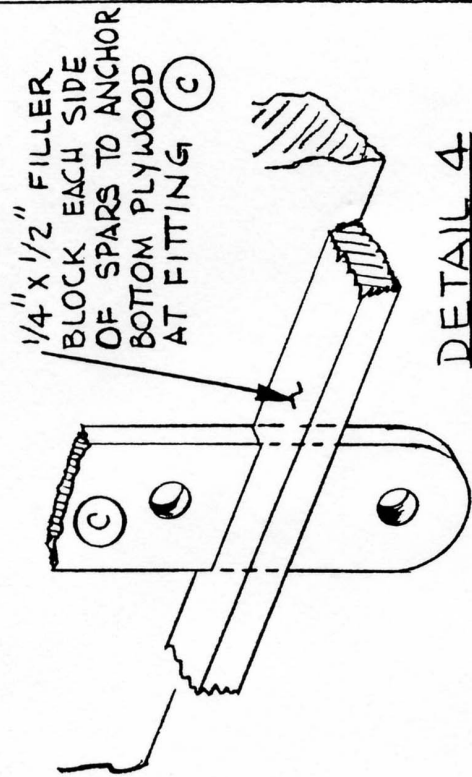


DETAIL 2

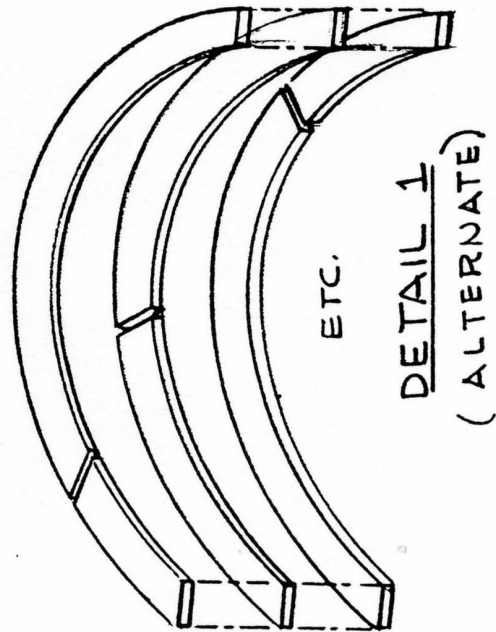


DETAIL 2A

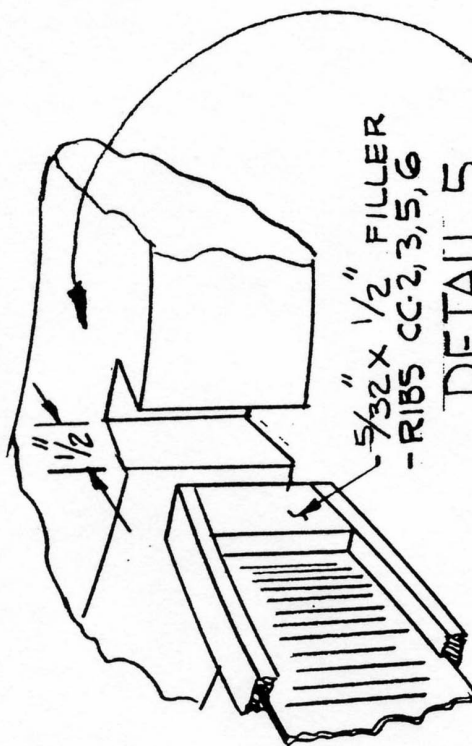
FIGURE 10-4
CENTER SECTION DETAILS



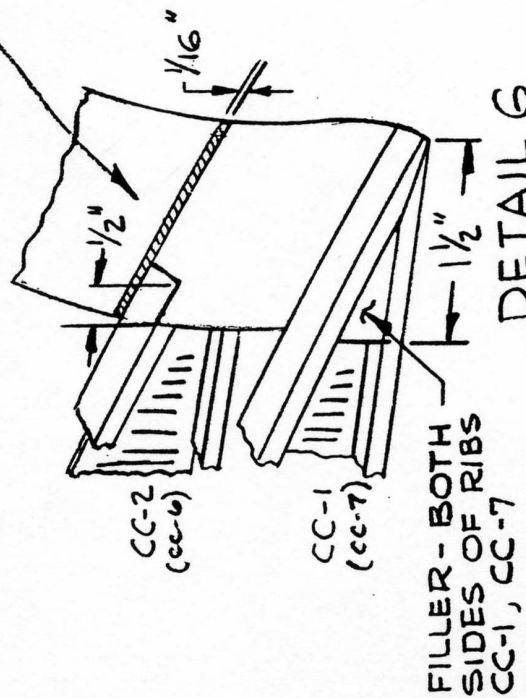
DETAIL 4



DETAIL 1
(ALTERNATE)

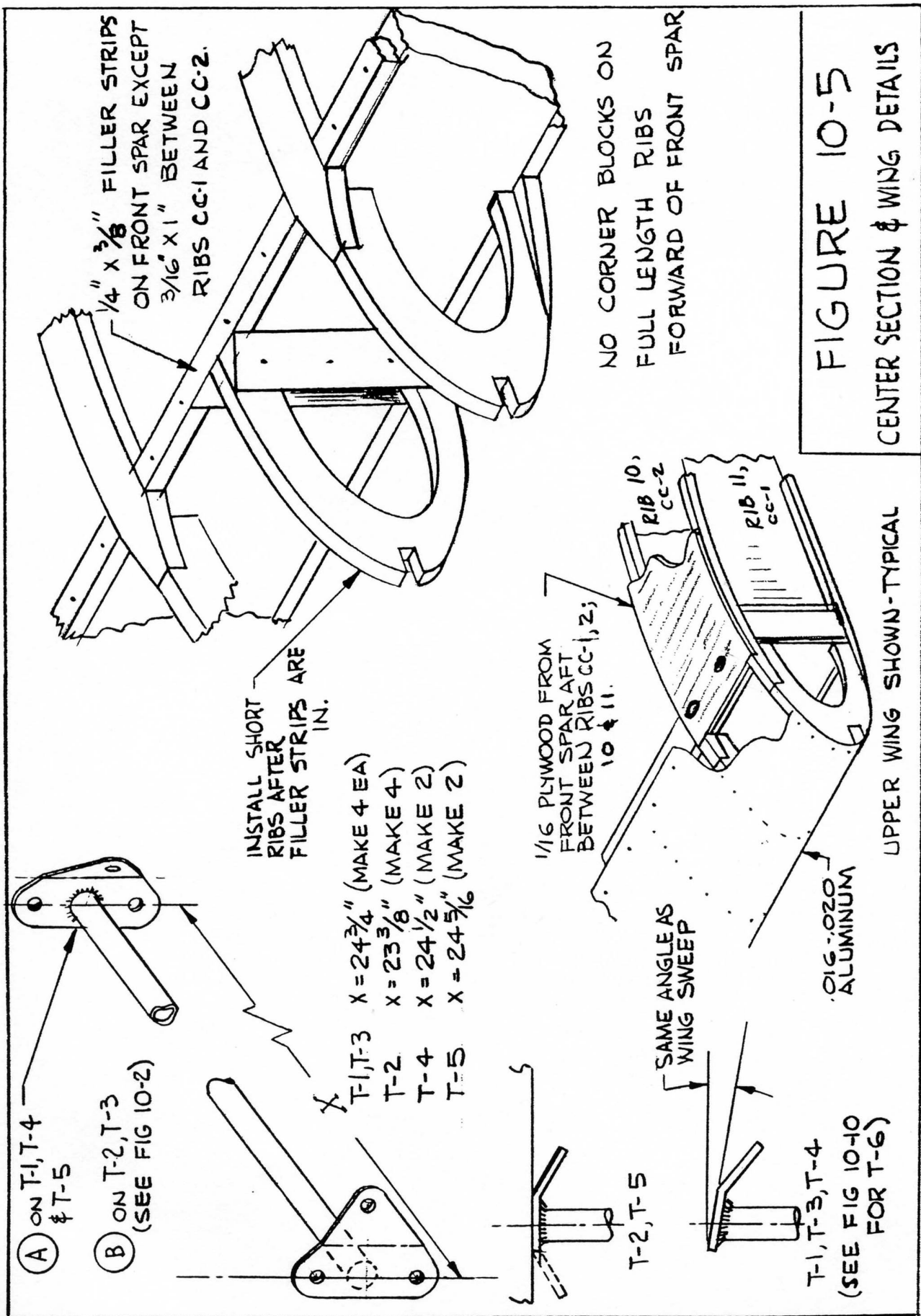


DETAIL 5



DETAIL 6

FIGURE 10-4A
CENTER SECTION DETAILS



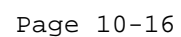
SWEPT WING LAYOUT

If work space allows, it is easiest to lay the wings out with 9 degrees of sweep relative to the edge of the work area just as the wing layout Figures 10-7 and 10-9 are angled relative to the borders of the drawings. Since such space is seldom available, the wings are laid out square relative to the work area by the following procedure and Figure 10-6. Numbers match written steps.

1. Lay out rear spar center line A-A* at least 11 feet long and at least 32 inches from the far edge of the work area. The left edge is to be at least 6 inches in from the left end of the work area.
2. Erect a perpendicular line at the left end of A-A'.
3. Erect a second perpendicular at A'.
4. Draw a line through A that is 9 degrees from the perpendicular (if you don't have a protractor, establish Point B by measurements shown and connect points A and B).
5. Duplicate the angle through Point A'.
6. Extend both angled lines to Points C and C', D and D' at distances shown.
7. Connect C and C' for leading edge line.
8. Connect D and D' for trailing edge line.
9. Measure back 18" from Point C' to establish Point E.
10. Connect Points C and E for basic rib layout line. This line is parallel to the lateral axis of the airplane.
11. Lay out the rib spacing of Figure 10-7 along line C-E. Use square as shown to erect perpendiculars for ribs. Extend from both sides of line C-E to leading and trailing edges. Line C-D should coincide with Rib No. 11.
12. Measure back from Rib No. 11 to locate compression ribs per Figure 10-7.
13. Measure forward from line A-A' along lines A-C and A'-C' 25 1/2" to locate front spar centerline.

NOTE

It is important that the front and rear spars be spaced 25 1/2" apart as measured along the ribs, not along a line perpendicular to both spars.



WING PANEL ASSEMBLY

Upper and lower wing panels are both built on the same layout, starting with the left upper wing and then the left lower. After those are built, the layout is reversed and the right wings are built in the same sequence.

The spars are held in place on the centerlines laid down in Figure 10-6 by the same kind of position blocks as used to hold the longerons in place. To prevent glue from dripping on the layout, it is a good idea to lay a strip of waxed paper along the spar lines before nailing down the position blocks.

NOTE

Scale of wing drawings is 1" = 1'

UPPER WING

1. Starting with slightly over-length spar stock beveled per Figure 10-1, nail and glue 1/8" plywood inner end plates per Detail B of Figure 10-7. After glue has set, bevel ends of spar one degree for dihedral angle and nine degrees for sweepback angle. Do this for the left wing first.
2. Shape the outboard ends of the spars (tips) per details of Figure 10-8.
3. Drill 3/16" holes for compression rib and safety bolt holes per Figure 10-7 and Detail B except at Compression Rib T-2.

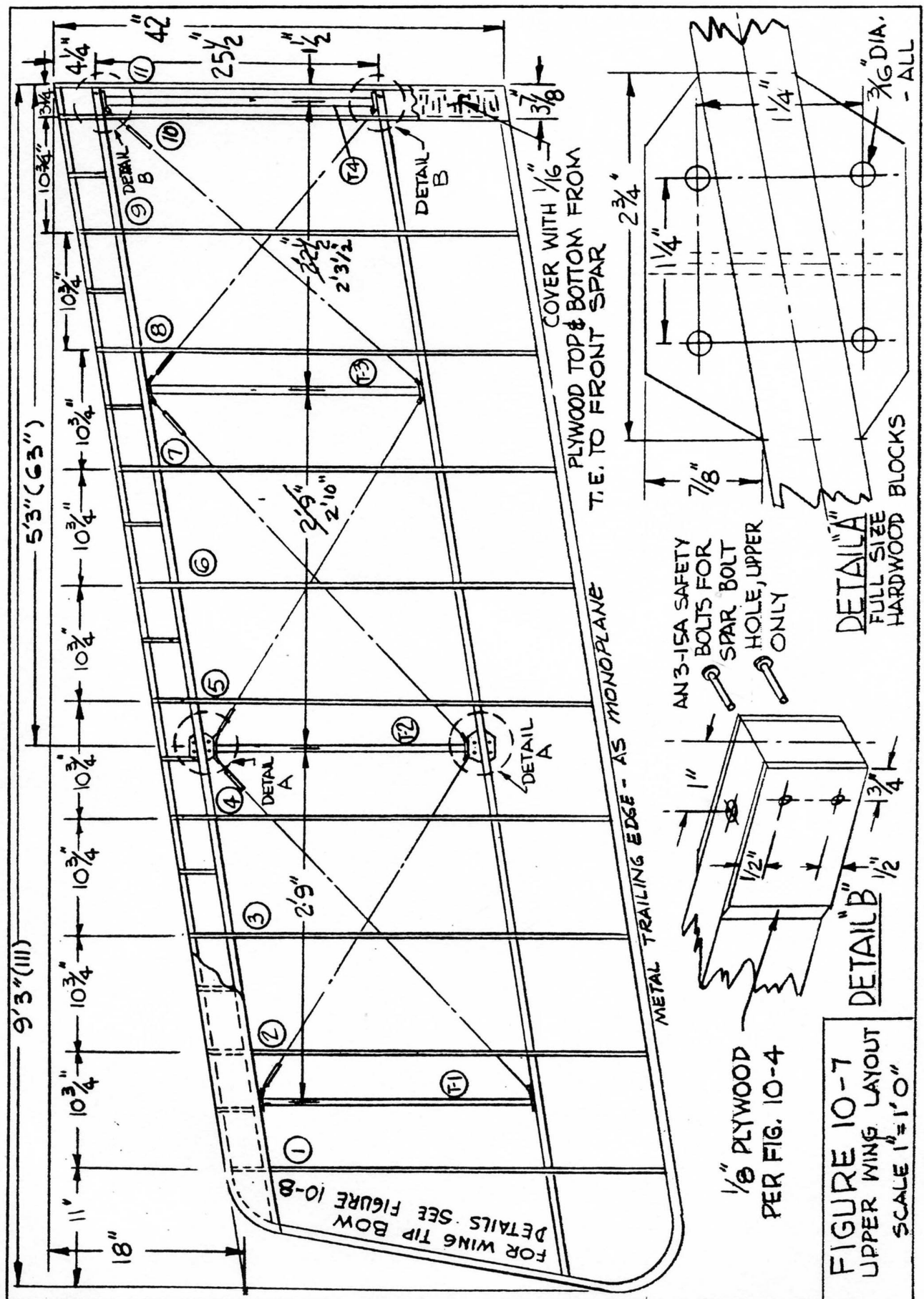
ATTENTION TO DRAWING CORRECTION

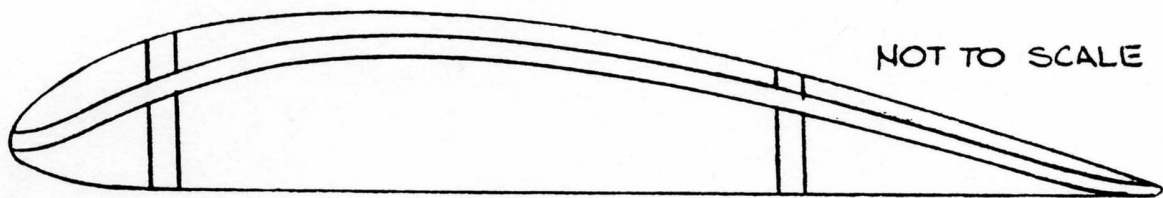
On Figure 10-7 > the spacing of the compression ribs, T-1, T-2, and T-3 is incorrect as drawn and dimensioned, T-4 is correct, at 1 1/2" outboard of the butt end of the wing. The distance from T-4 to T-3 should be 2' 3 1/2" as marked below the original 2' 2 1/2" dimension, and the distance from T-3 to T-2 should be 2' 10". These changes move T-3 outboard one inch and move T-2 outboard two inches. With the same 2' 9" distance between T-2 and T-1 as shown, T-1 moves outboard two inches,

NOTE

DO NOT drill the vertical hole of Detail "B" at this time. Bolt holes for compression ribs T-1, 3, and 4 are drilled at right angles to the spar.

4. Cut hardwood blocks for strut fittings per Detail A of Figure 10-7. Clamp or nail lightly in place and drill through blocks and spar AT RIGHT ANGLES TO THE FACES OF THE BLOCKS for compression rib T-2 bolts. Dotted line of Detail A lines-up with compression rib T-2.
5. Bolt hardwood blocks in place WITHOUT GLUE and drill vertical 3/16" bolt holes on a drill press. Mark the blocks so that the same ones will go back in the same places then remove them from the spars.
6. Set spars down on wing panel layout and hold in place with three pairs of





$\frac{3}{4}$ " ALUMINUM TUBE TIP BOW APPROACHES TOP CONTOUR OF RIB. BOW CAN ALSO BE LAMINATED IN PLACE FROM SIX $\frac{1}{8}$ " \times $\frac{3}{4}$ " WOOD STRIPS

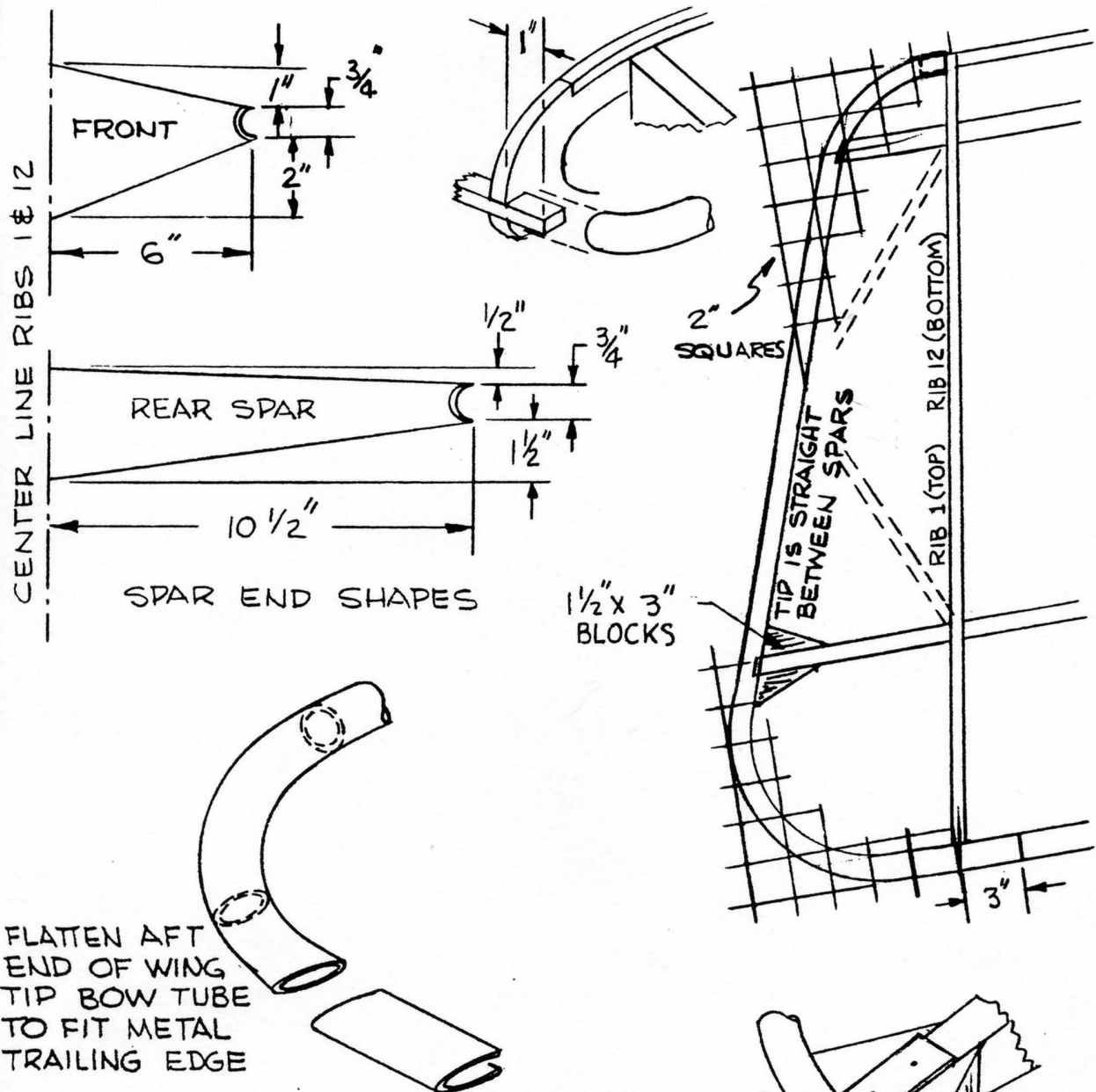
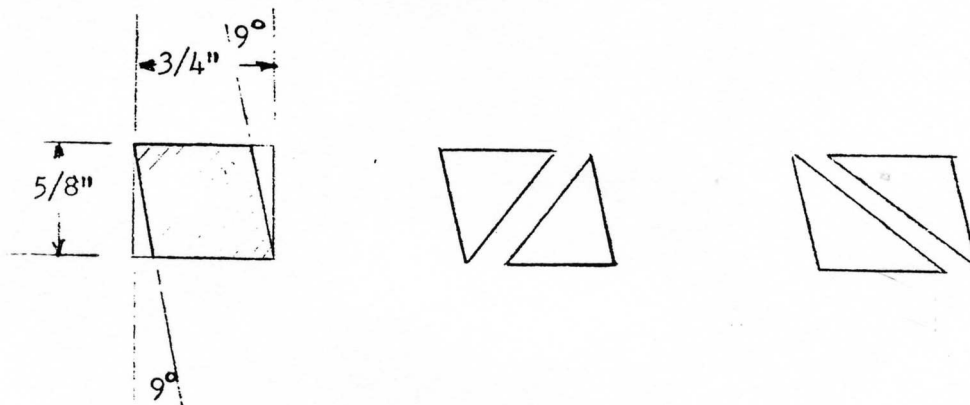


FIGURE 10-8
WING TIP DETAILS

.016 - .020 ALUMINUM STRIP NAILED TO SPAR TO ANCHOR TIP BOW

position blocks each. Lift spars out of blocks high enough to slip Ribs 1 through 9 onto spars from the tip ends. Drop spars back into blocks and glue hardwood blocks into place, bolting them as well as clamping. To keep glue from sticking the bolts in place, it is a good idea to wax the bolts heavily before inserting them.

7. Slip Rib No. 10 in place from butt end of spars and bolt all compression ribs lightly in place. Do not remove bolts through hardwood blocks for installation of Compression Rib T-2 until the glue has set.
8. Repeat Steps 7 and 11 through 18, center section instructions on Page 10-9.
9. Cut 41 pairs of rib corner blocks. These are for the SWEPT WING panels; do not cut from square stock as Detail 3, Figure 10-4. Cut them from $5/8"$ x $3/4"$ spruce bevelled to parallelogram cross-section on the $5/8"$ edges as shown below. Bandsaw the beveled strips lengthwise along the short diagonal for the acute-angle corners and along the long diagonal for obtuse-angle corners. The bevel angle is 9 degrees but is exaggerated on the drawing below for emphasis.



10. Install corner blocks on both sides of rear spar for Ribs 1 through 10; install corner blocks only on rear side of front spar.
11. Remove wing from layout then nail and glue $1/4"$ x $3/8"$ cap strip material to top and bottom of forward edge of front spar from Rib 1 to Rib 10 per Figure 4-25.
12. Install leading edge strip then install nose ribs per Figure 10-5.
13. Install Rib 11 and then nail and glue $3/16"$ x $1"$ filler blocks to top and bottom of spar between Ribs 10 and 11.
14. Bridge Ribs 10 and 11 with $1/16"$ plywood per Steps 29 through 31 of center section instructions, Page 10-11. This is done at this time so that trailing edge material can be installed to protect trailing edges of ribs during further work that will be done with the wing off the layout.

NOTE

Drill some ventilation holes in the rear portion of Rib 10 to ventilate the closed box structure. Since this instruction was not given for the center section, drill vent holes in the rear portions of Ribs CC-2 and CC-6 also.

15. Install metal trailing edge of Figures 4-1 and 4-30 from a point one inch inboard of Rib No. 1 to Rib No. 11 (varnish rib ends before T.E. goes on).
16. Bend wing tip bow from 3/4" steel or aluminum tubing to contours shown in Figure 10-8. Note that the bow fits over an extension of the leading edge strip outboard of Rib No. 1 and is flattened to fit into the bent metal trailing edge just inboard of Rib No. 1.
17. Install tip bow per Figure ID-8. Fill in between bow and front spar outboard of Rib No. 1 with balsa wood block or Styrofoam and contour block to blend rib curve smoothly into tip bow.
18. Remove compression ribs and install drag wires on rear fittings per Step 5 of Page 4-14, monoplane plans.
19. Drill previously-marked holes in ribs for drag wires and varnish spars at points where compression ribs will be reinstalled.
20. Reinstall compression ribs and complete drag wire installation.
21. Varnish all wood that will not have fabric attached to it. leave leading edge aluminum off until wing is signed off as OK to cover by FAA inspector.

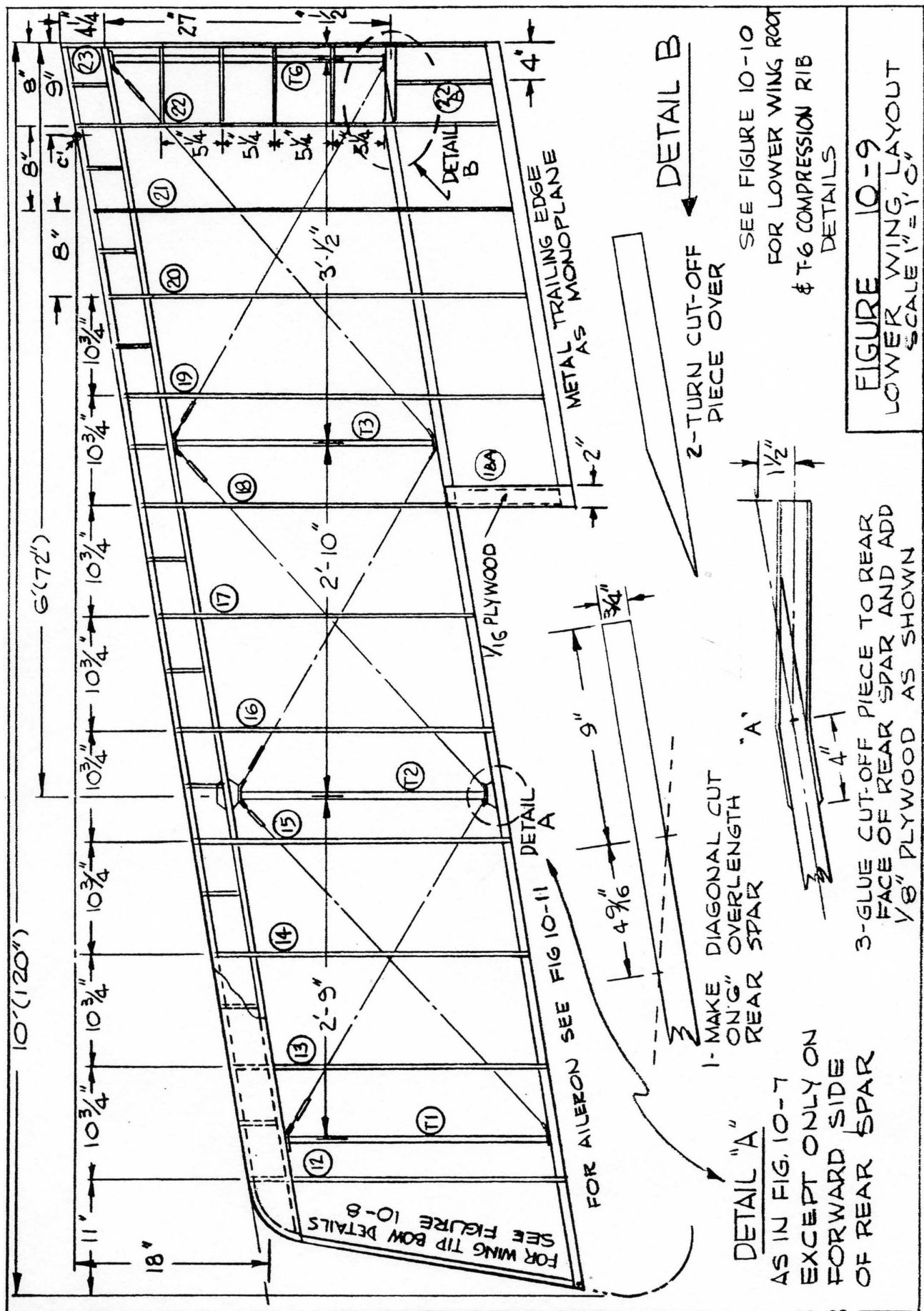
LOWER WING

The lower wing is the same construction as the upper but has essential differences that affect the assembly procedure as noted below. The same layout is used for the lower wing as for the upper, but the lower is 9" longer and is projected inward from Layout Point C' of Figure 10-6. The rib spacing for both wings is the same from the tips inward to Rib No. 8 on the upper wing and Rib No. 19 on the lower. See Figure 10-9 for lower rib spacing and other differences.

BENT REAR SPAR. Build "Bent" rear spar per Detail "B" of Figure 10-9, using slightly over-length spar material. The cut-off piece is turned over and the cut face is glued to the back side of the spar. Before adding the 1/8" plywood, round off the point at "A" slightly so that the plywood will bend around the curve without cracking. Do not try to force plywood into the corner on the rear face of the spar; let it bend naturally and then fill in the gap with a mixture of epoxy glue and sawdust.

CORRECT BUTT-END SPAR SPACING. With the spars in the holding blocks, slide the rear spar through the blocks until the center lines of the front spar and the angled portion of the rear spar are exactly 27 inches apart along the spar butt line. With the rear spar held in this position, mark the ends for cut-off and shape the tip end as for the upper wing. Bevel butt ends of both spars 3 degrees for dihedral,

ATTACHING WING SPAB END FITTINGS. Before assembling the lower wing, install the end fittings "D" of Figure 10-2 ON THE REAR SPAR ONLY. Add the filler pads for Compression Rib T-6 to the front face of the spar before varnishing the fitting area and bolting the fittings in place. On the front spar, add an extra 1/8" plywood end plate to the FRONT face of the spar. Round the inboard end of this to a gentle curve over a distance of



two inches until it feathers out at the edge of the 1/8" plywood closest to the spar per Detail "A" of Figure 10-10. The front-side fitting will be bent along this curve.

Using a 1/2" dowel or piece of tubing to ensure accurate alignment per Detail "B" of Figure 10-10, bend one of the "D" fittings with the 1/4" bolt holes in it to fit the curved plywood on the front face of the spar and clamp it in place. Remove the spar from the layout and drill 1/4" bolt holes through the spar using the clamped-on "D" fitting as a drill jig. With the spar back on the layout and again using the dowel or tube as a guide, bend the undrilled "D" fitting for the rear face of the spar and clamp it in place. Remove spar from the layout again and drill through the existing spar holes to properly locate the bolt holes in the rear fitting, which will not match the front fitting because of the different curvatures. Add filler pads to back face of spar per Figure 10-2 before varnishing under fitting and bolting fittings in place permanently.

RIB INSTALLATION. Because of the bend in the rear spar and the presence of the fittings. Ribs 12 through 22 will have to be slid onto the spars from the tip ends. The first eight slid on should have the 1 1/2" holes for the aileron push rods. Root Rib No. 23 is built separately only to the rear spar; because of the spar bend, it has the central section extended aft 1 1/2".

Note that Ribs 12 through 17 in the aileron area have their cap strips cut off flush with the rear face of the spar and that the rear section of full-length' Rib 18 is doubled and bridged with -1/16" pi-wood per Fig. 10-9. Drill one or more 1" ventilation holes in Rib 18A to ventilate the closed box structure between Rib 18 and 18A. Do not install Rib 22A at this time.

FURTHER ASSEMBLY DETAILS. Assembly of the wing from this point is the same as that for the upper wing except that the trailing edge section of Root Rib 23 and the adjacent Rib 22A are not installed at this time. Compression Rib T-6 differs from the others and is shown in Detail "C" of Figure 10-10. Since the area between Ribs 22 and 23 will be closed box, drill 1" ventilation holes in the rear portion of Ribs 22 and 22A before installation. Walkway supports are built in place per Figure 4-25 of the monoplane plans.

NOTE

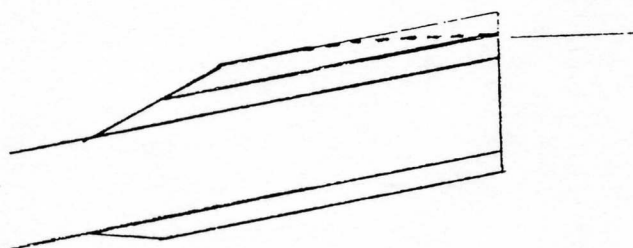
Since instructions were not given to ventilate the box structure between Center Section Ribs CC-1 and CC-2 and CC-6 and CC-7, add 1" vent holes to CC-2 and CC-6 at this time.

The trailing portion of Root Rib 23 is made to fit the curve of the fuselage and is attached to the wing when the wing is fitted to the fuselage at the proper angle. The wing can be held in position by jiggling or can be suspended by the landing wires after the center section is in place.

If the biplane wings are being fitted to an existing fuselage, build the trailing edge box at the root per Figure 8-6 of the monoplane plans. Add 1/16" plywood to the bottom, then build rear Rib 22A in place to fit the curve of the plywood then add the 1/8" top plywood.

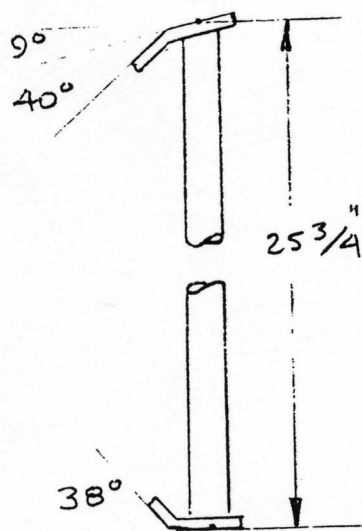
If biplane wings are to be fitted to a new fuselage, follow the complete procedure starting on Page 8-4 of the monoplane plans.

Add 1/4" x 3/8" cap strip fillers to the front spar per Step 11 on Page 10-20. Add similar fillers to the rear edge of the rear spar from the tip to Rib No. 18. For ease of forming the lower wing tip bow, make it in one piece as done for the upper wing and then cut off the rear portion later for the aileron.



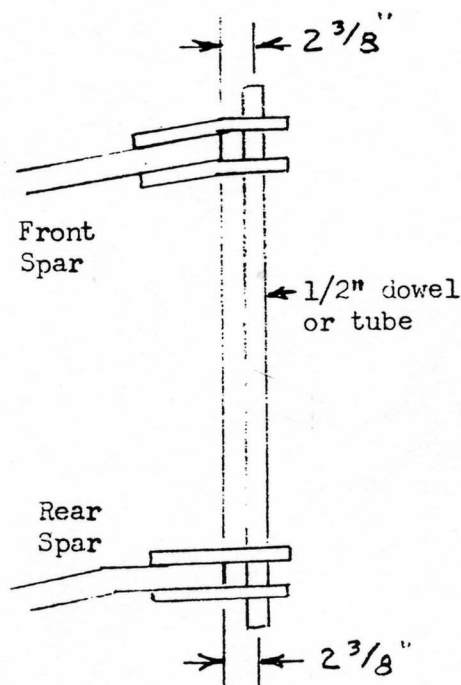
DETAIL "A"

Extra 1/8" plywood on front spar butt curved to support bent forward fitting.



DETAIL "C"

Compression Rib T-6. See Figures 10-2 and 10-5 for details.



DETAIL "B"

Showing use of a 1/2" dowel or tube to align the wing spar fittings during attachment procedure.

NOTE

This is a temporary page with this revision only to supply details for the previously described construction. A new Page 10-24 and Figure 10-10 will be supplied with the next installment.

[Pete never did issue a "Next Installment"]

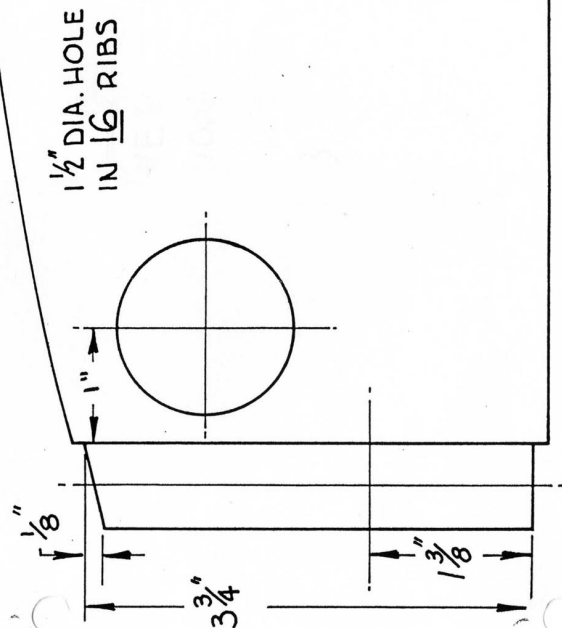
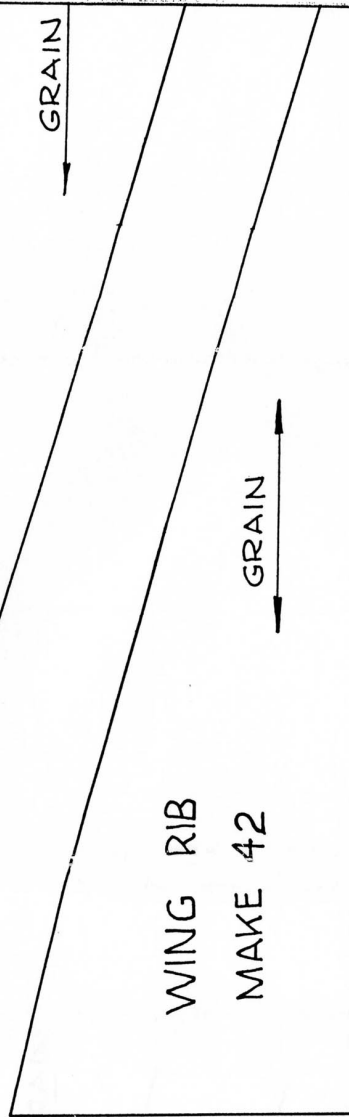
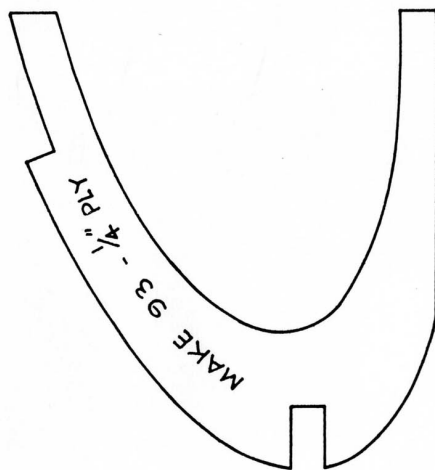


FIGURE 10-1

FULL SIZE RIB WEB
ALL 1/16" PLYWOOD

MAKE 53

GRAIN
ALL RIBS

WING WOOD (MINIMUM REQ'TS-TRIM TO FIT)

UPPER FRONT SPAR	$\frac{3}{4}$ " x $3\frac{3}{4}$ " x 8'10"
LOWER FRONT SPAR	$\frac{3}{4}$ " x $3\frac{3}{4}$ " x 9'7 $\frac{1}{2}$ "
UPPER REAR SPAR	$\frac{3}{4}$ " x $2\frac{3}{4}$ " x 9'4"
LOWER REAR SPAR	$\frac{3}{4}$ " x $2\frac{3}{4}$ " x 10'2"
FRONT CENTER SECTION SPAR	$\frac{3}{4}$ " x $3\frac{3}{4}$ " x 4'2"
REAR CENTER SECTION SPAR	$\frac{3}{4}$ " x $2\frac{3}{4}$ " x 4'2"
WING & AILERON TRAILING EDGE RIBS	17 SQ.FT.~ $\frac{1}{16}$ " PLY
MAIN RIBS	62 SQ.FT.~ $\frac{1}{16}$ " PLY
NOSE RIBS(EXTERIOR OR WATERPROOF)	15 SQ.FT.~ $\frac{1}{4}$ " PLY
CAP STRIPS ~(SPRUCE)	$\frac{1}{4}$ " x $\frac{3}{8}$ " x 353 FT.

NOTE: ALL $\frac{1}{16}$ " PLY IS AIRCRAFT GRADE BIRCH OR MAHOGANY

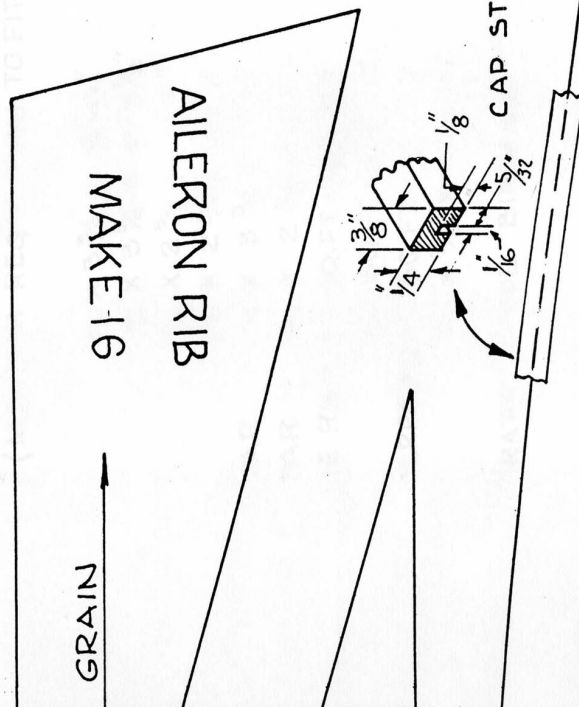
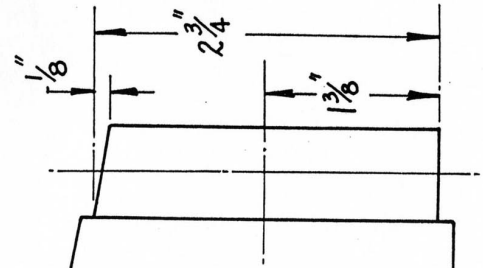


FIGURE 10-1A

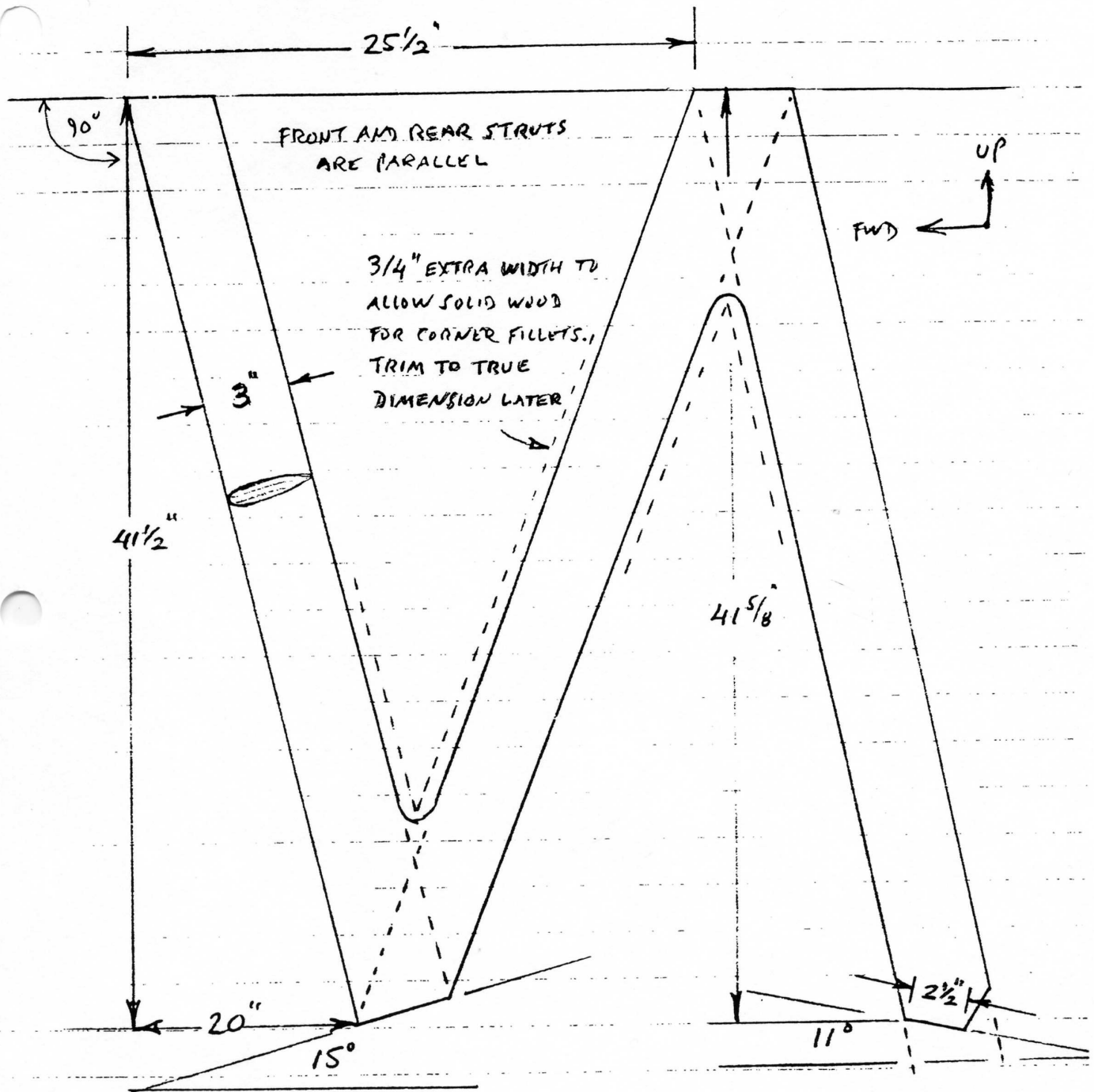


Apologies for running the full-size rib drawing on two sheets instead of one. This is an example of the effort to keep prices down. Printers now want \$6.00 PER SHEET for printing the rib drawing on a single sheet of paper.

Revised May, 1991

N-STRUTS - MAKE TWO SETS - FOUR LAMINATIONS OF
 $\frac{1}{4}$ " SPRUCE PER FIGURE 2-1 PAGE 2-4

①

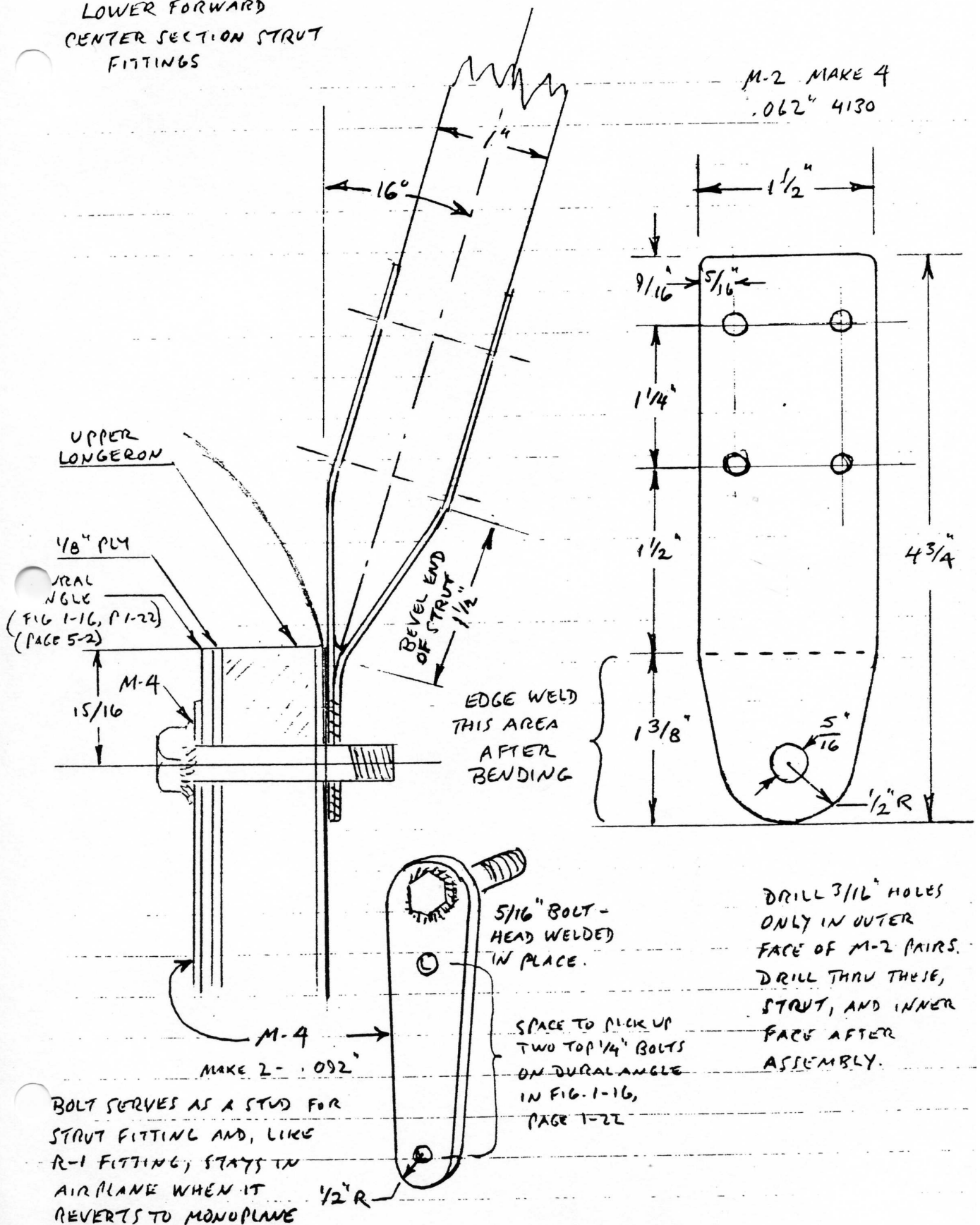


FRONT AND REAR STRUTS
 ARE PARALLEL

MAKE LOWER REAR
 EXTRA LONG THEN
 TRIM TO FIT

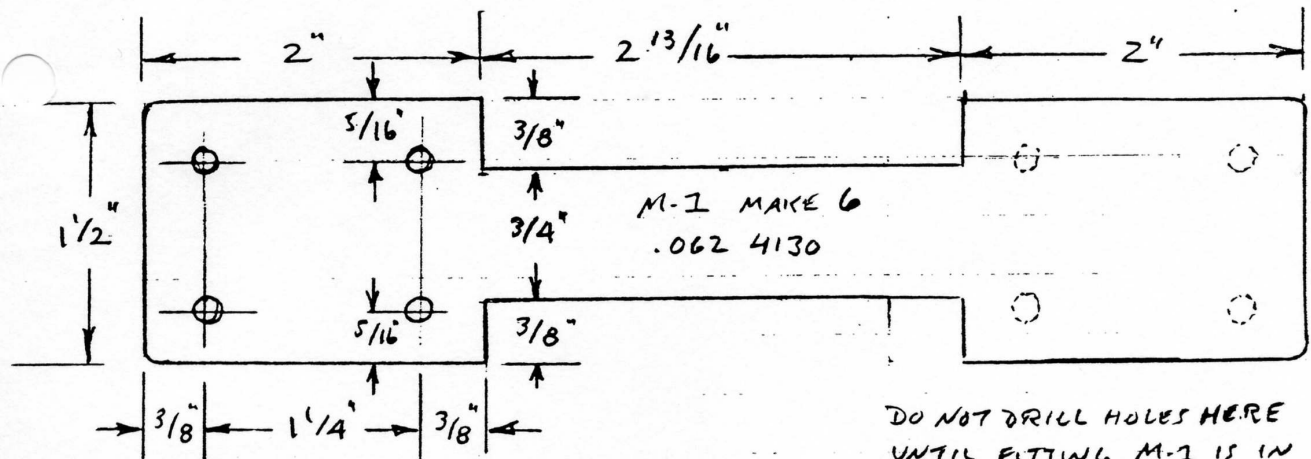
2

LOWER FORWARD CENTER SECTION STRUT FITTINGS

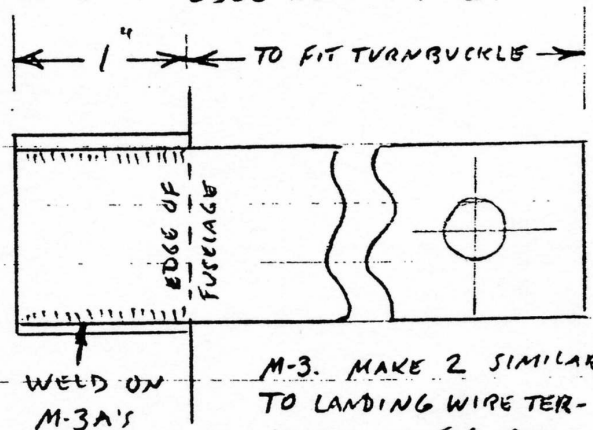
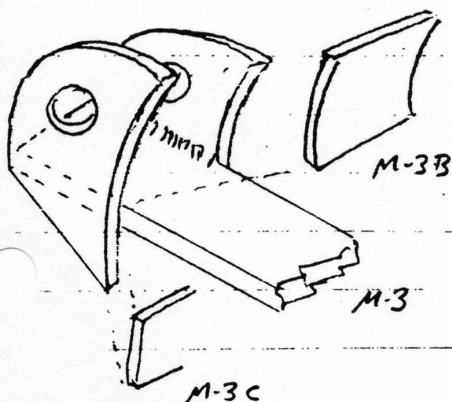
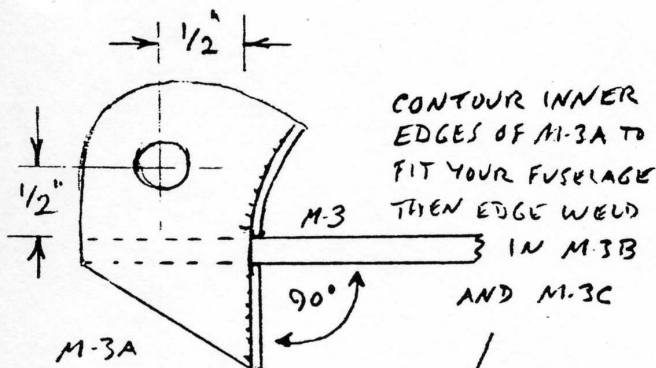
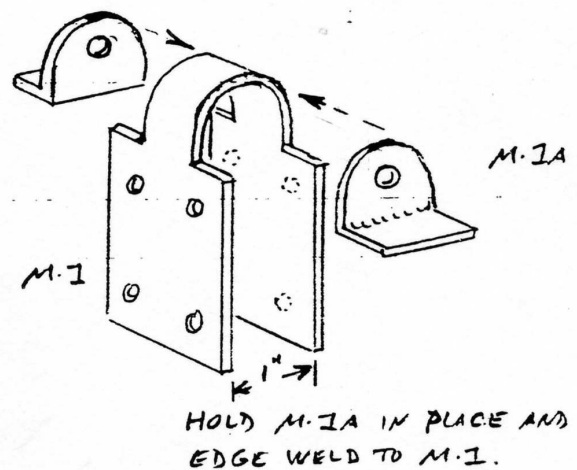
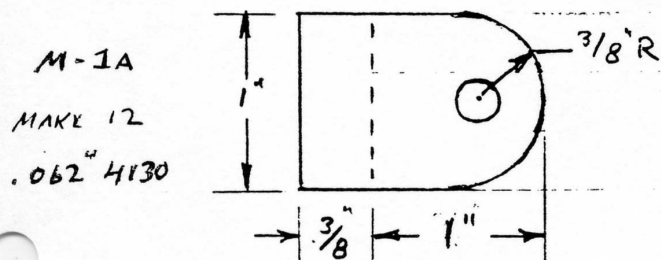


CENTER SECTION STRUT FITTINGS

3



DO NOT DRILL HOLES HERE
UNTIL FITTING M-2 IS IN
PLACE ON STRUT ASSEMBLY.
DRILL THRU OPPOSITE HOLES
AND WOODEN STRUT

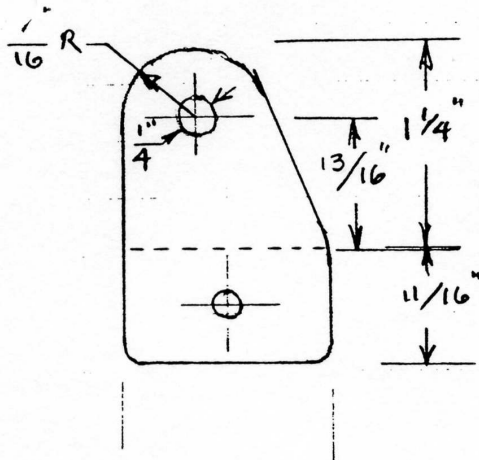


M-3. MAKE 2 SIMILAR
TO LANDING WIRE TER-
MINAL OF FIG. 8-1
EXCEPT OUTBOARD END.

M-3A, B, C ARE .062 4130

E. HARRIN
8178 BEECHER RD
FLUSHING, MICH 48433

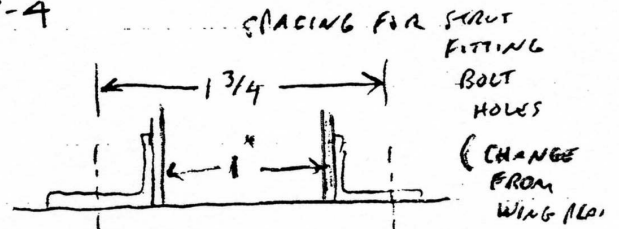
4



MAKE 4 .062 4130

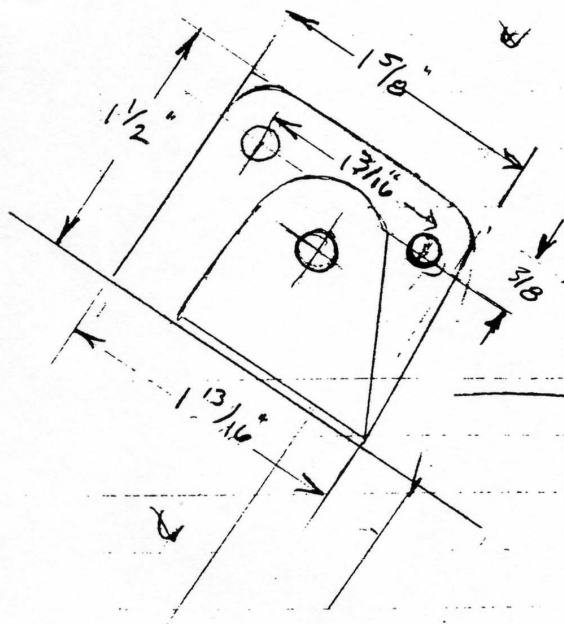
2 RIGHT, 2 LEFT

S-4

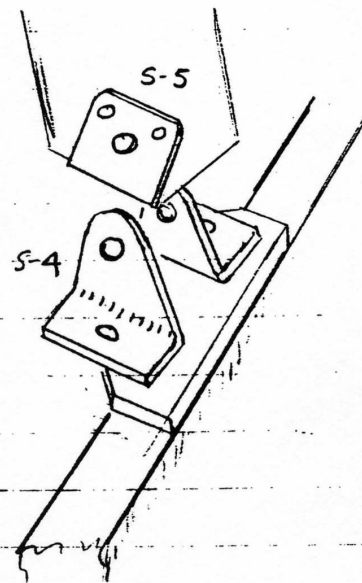


MAKE 4 .062 4130

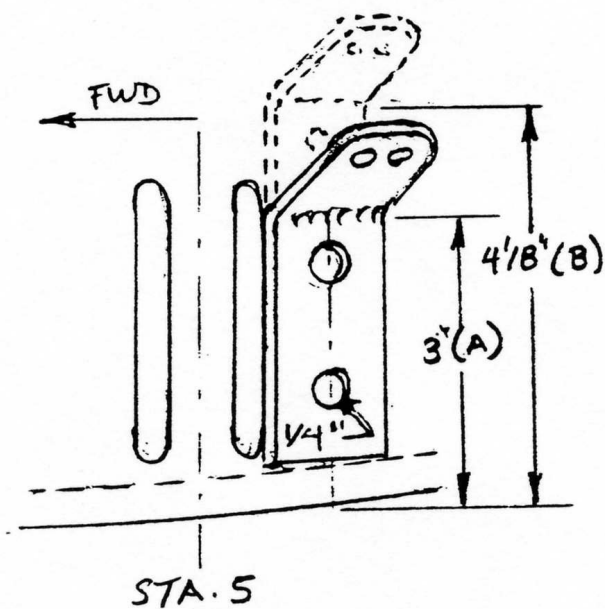
S-5



MAKE 4
S-5



5



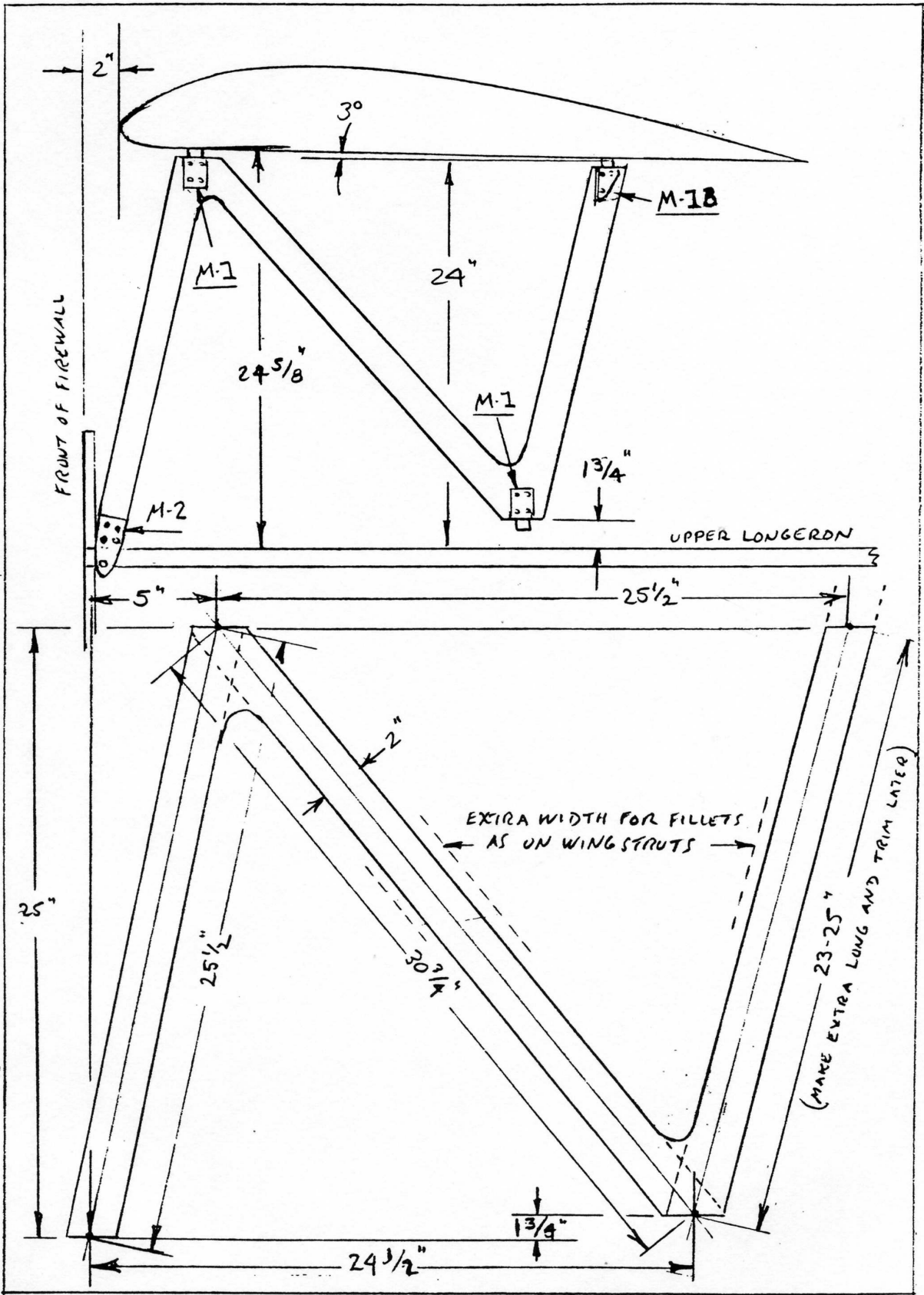
MAKE 2 .125 4130

(A) FOR BIPLANE ONLY

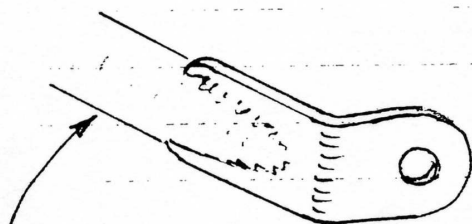
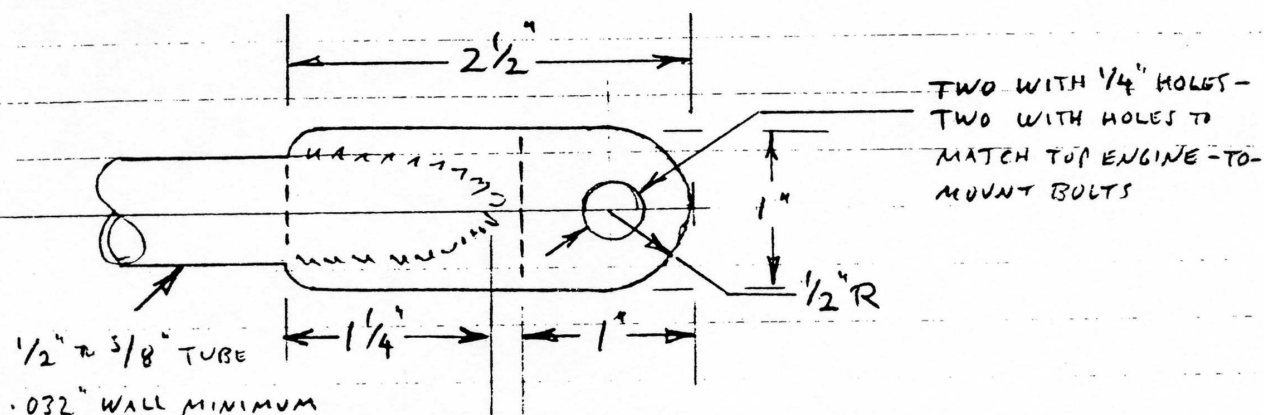
(B) IF MONOPLANE WING
TO BE USED OCCASIONALLY

REAR FLYING WIRE ANCHOR

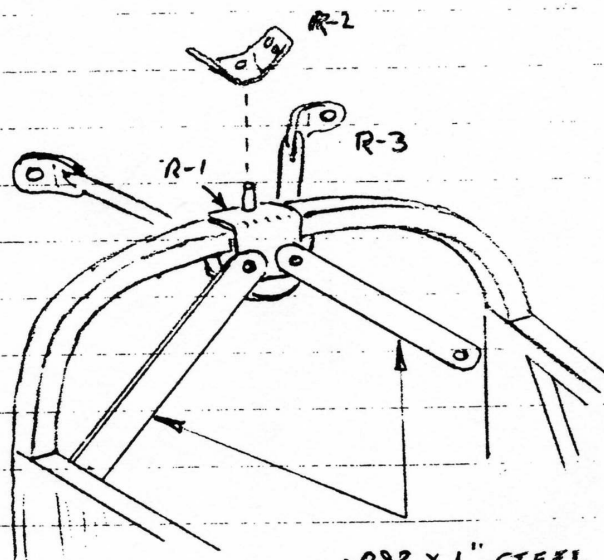
⑥



R-3 MAKE 4 - -093 4130



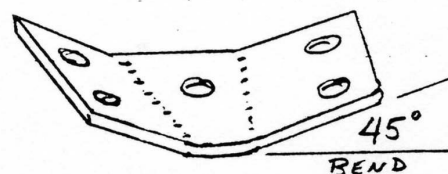
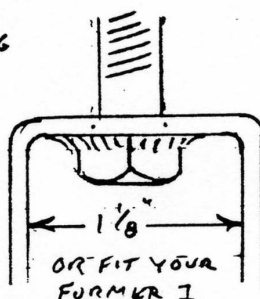
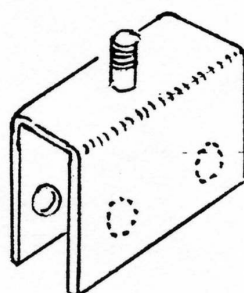
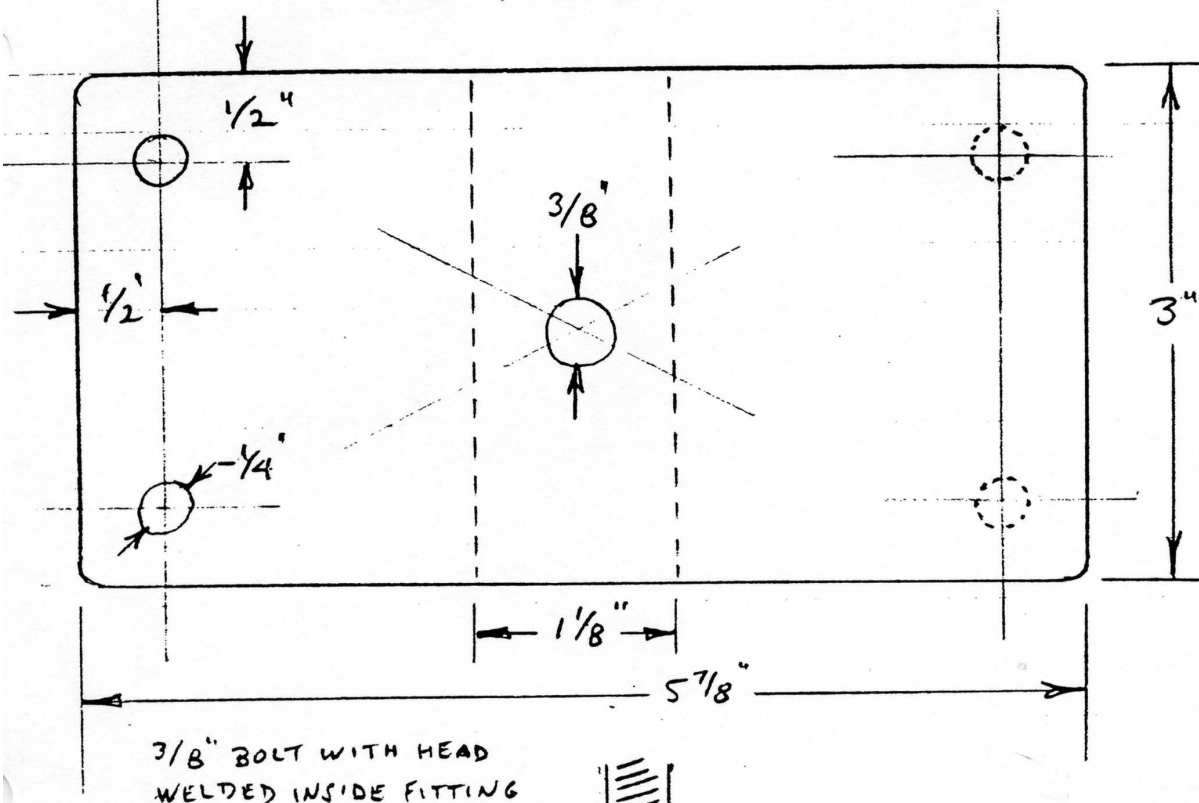
TUBE LENGTH TO ALLOW
ASSEMBLY TO FIT BETWEEN
R-1 FITTING ON FORMER NO.1
AND TOP ENGINE-TO-MOUNT BOLTS



.093 X 1" STEEL
TENSION STRAPS
FROM R-2 TO TOP
ENGINE-MOUNT-TO
FUSELAGE BOLTS

8

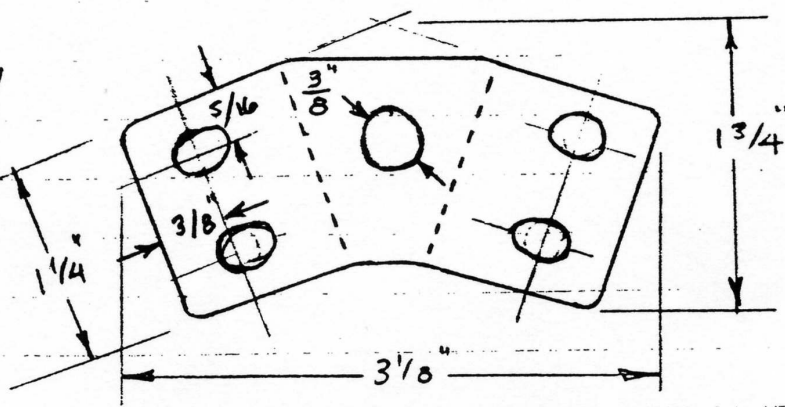
R-1 - MAKE 1 - .125" 4130



NOTCH TOP OF FORMER NO. 1
FOR R-1 AND BOLT
HEAD TO FIT.

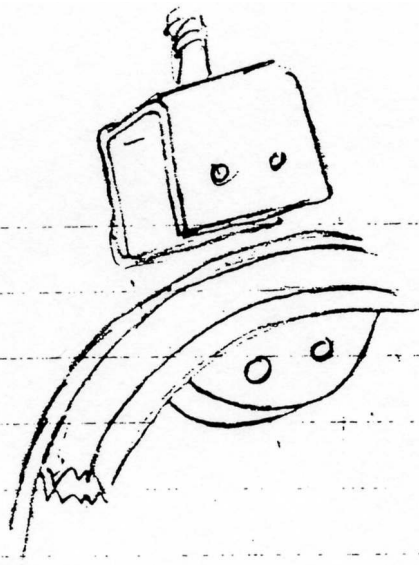
DRILL ONLY "FRONT"
HOLES BEFORE BENDING

R-1. HOLD FIRMLY IN
PLACE AND DRILL THRU
FRONT HOLES AND INTO
FORMER NO. 1 AND BACK
SIDE OF R-1.

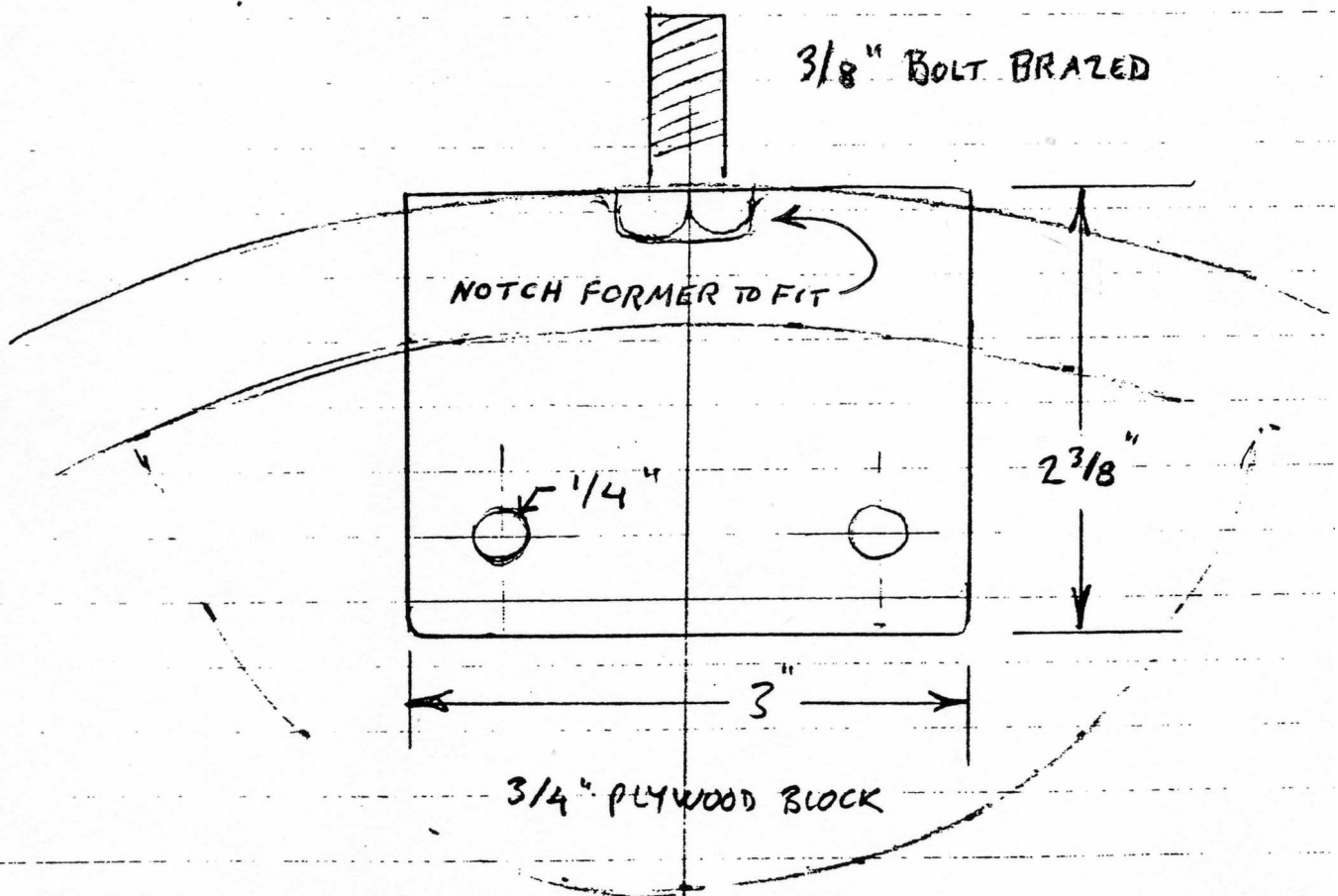
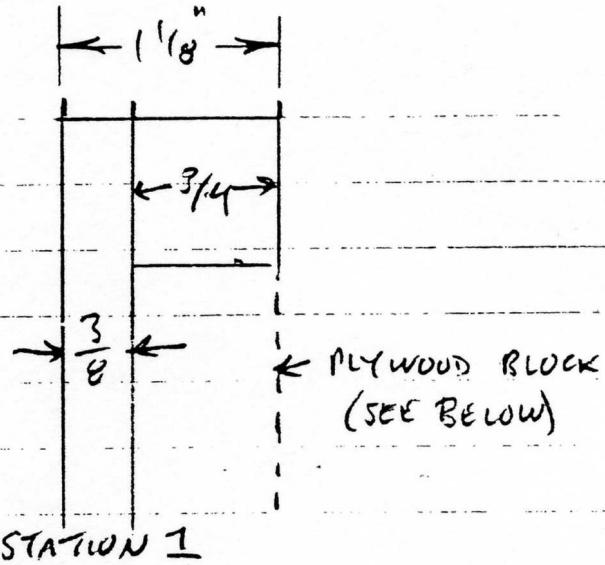


R-2 MAKE 1 - .125" 4130

(9)



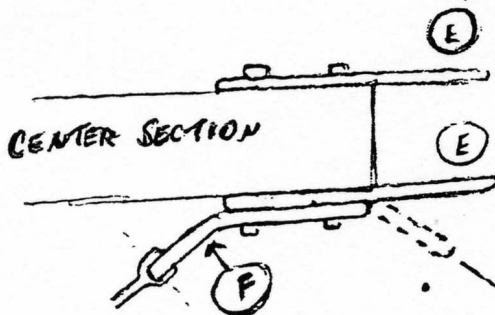
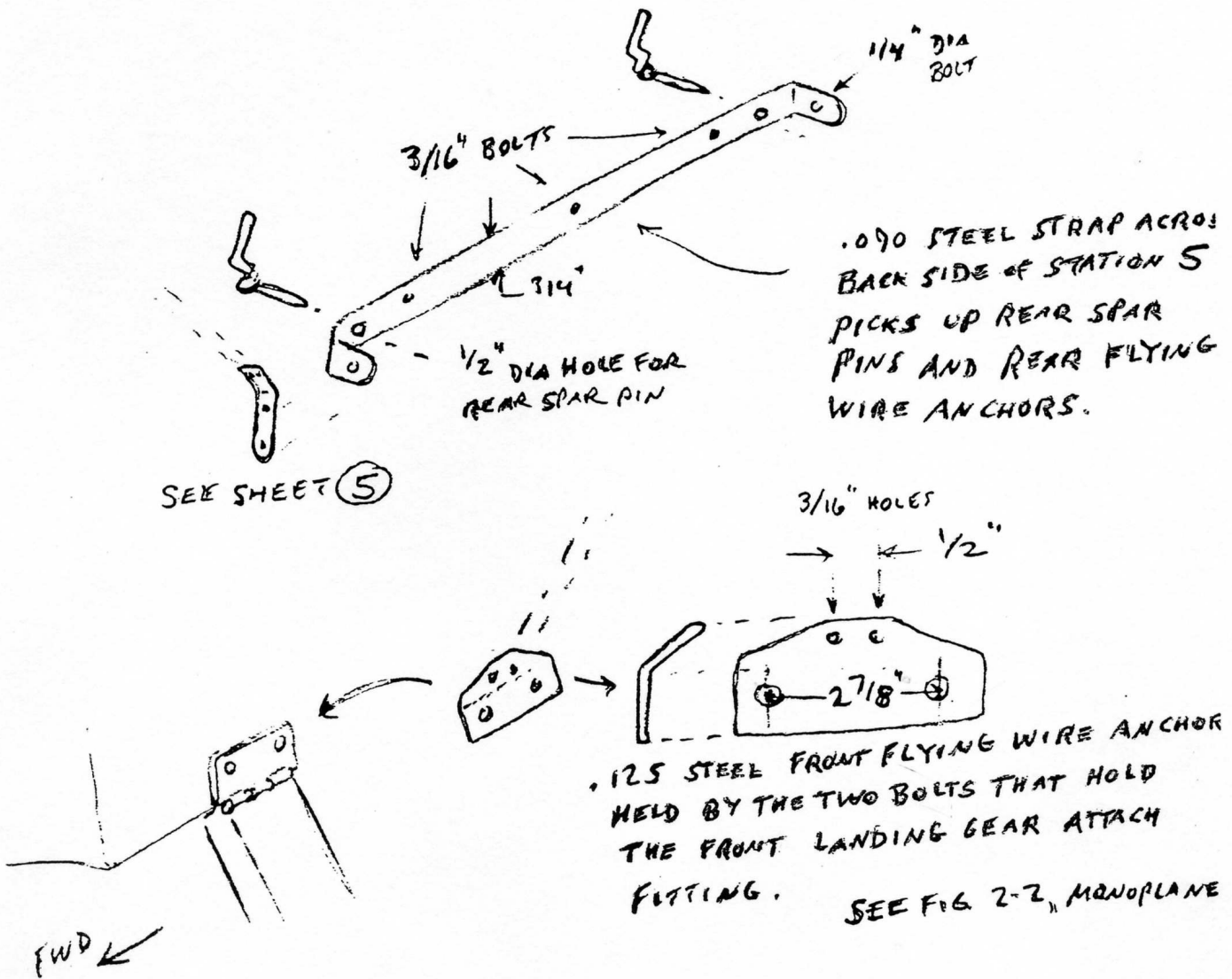
BACK SIDE OF
STATION 1



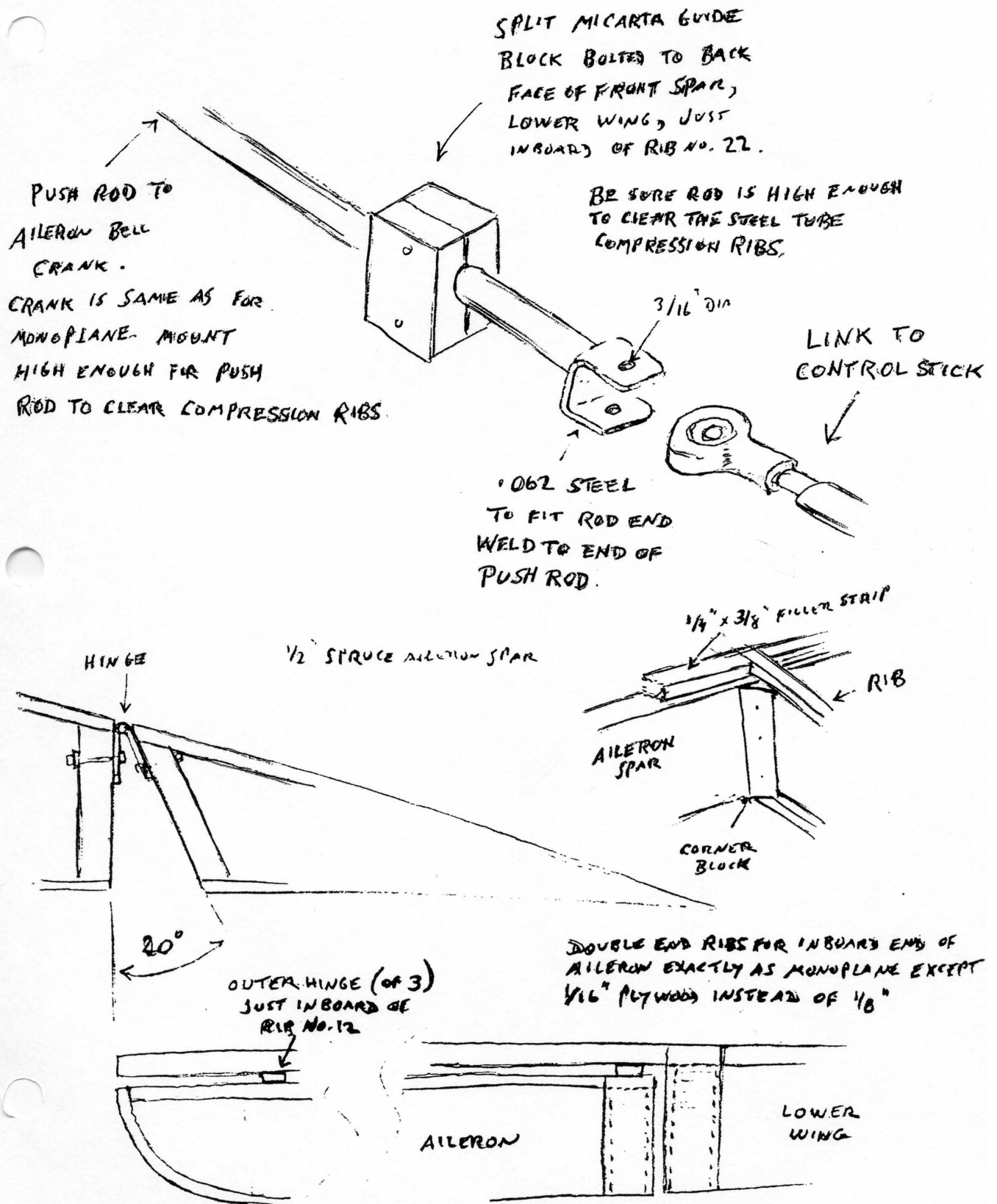
FULL SIZE

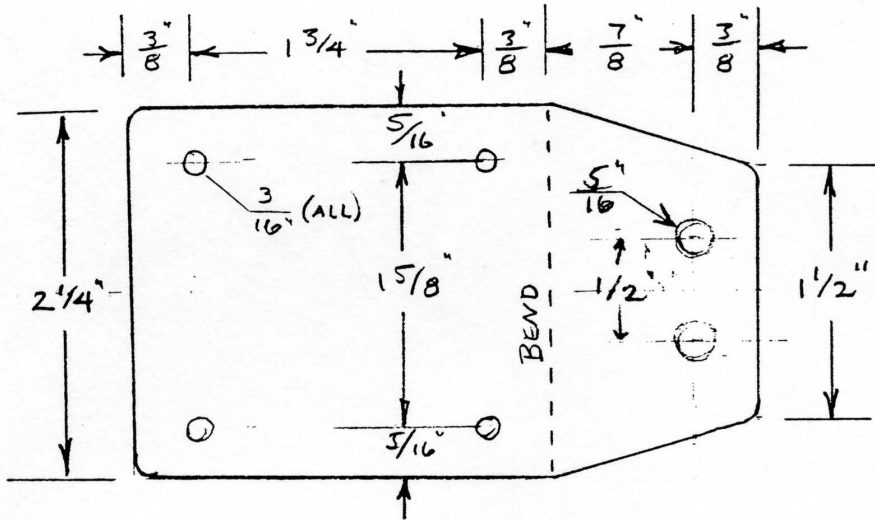
BIPLANE ROLL WIRE ANCHOR
AND MOUNTING BLOCK

10

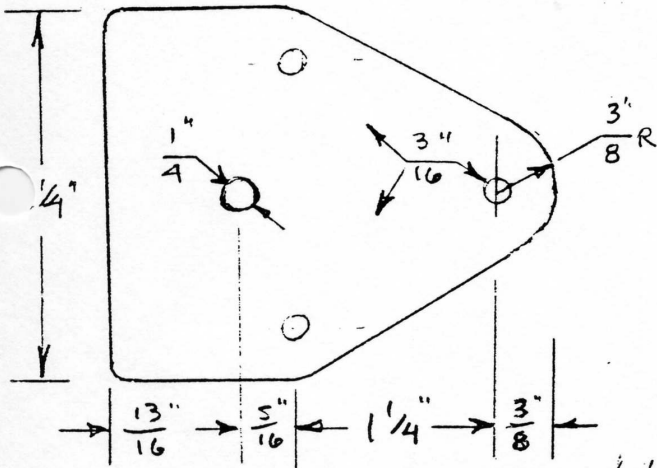


CENTER SECTION - FITTING (F) POINTS
INBOARD AT FRONT SPAR TO TAKE THE
ROLL WIRES. (F) POINTS OUTBOARD
AT REAR SPAR TO TAKE LANDING WIRE
BENT PORTION SHOULD LINE UP
WITH THE WIRES.

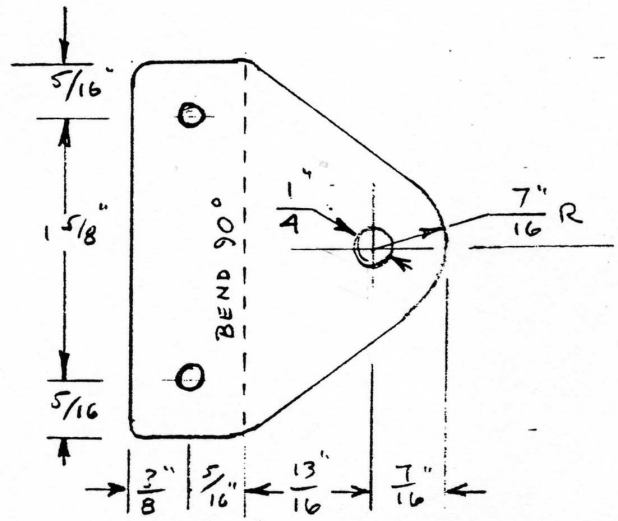




S-1
MAKE 6
.125" 4130
ALL BOLT HOLES $\frac{3}{16}$ "
EXCEPT AS NOTED



MAKE 12 .062" 4130
S-3



MAKE 12 .062" 4130
S-2

TYPICAL
ASSEMBLY

BOTH SPARS, UPPER
WING AT COMPRESSION
RIB T-2. FRONT
SPAR LOWER WING
AT COMPRESSION
RIB T-2.

