CHAPTER 10:
AILERONS & FLAPS

REVISIONS

From time to time, revisions to this assembly manual may be deemed necessary. When such revisions are made, you should immediately replace all outdated pages with the revised pages. Discard the out dated pages. Note that on the lower right corner of each page is a "revision date". Initial printings will have the number "0" printed and the printing date. All subsequent revisions will have the revision number followed by the date of that revision. When such revisions are made, a "table of revisions" page will also be issued. This page (or pages) should be inserted in front of the opening page (this page) of each affected chapter. A new "table of revisions" page will accompany any revision made to a chapter.

Arrows

Most drawings will have arrows to show which direction the parts are facing, unless the drawing itself makes that very obvious. **"A/C UP"** refers to the direction that would be up if the part were installed in a plane sitting in the upright position. In most cases the part shown will be oriented in the same position as the part itself will be placed during that particular assembly step. However, time goes on and changes are made, so careful attention should be paid to the orientation arrows. That old cartoon of the guy agonizing over the plans for his canoe, built one end up, one end down, should not happen in real life. Especially to you.

CONTENTS

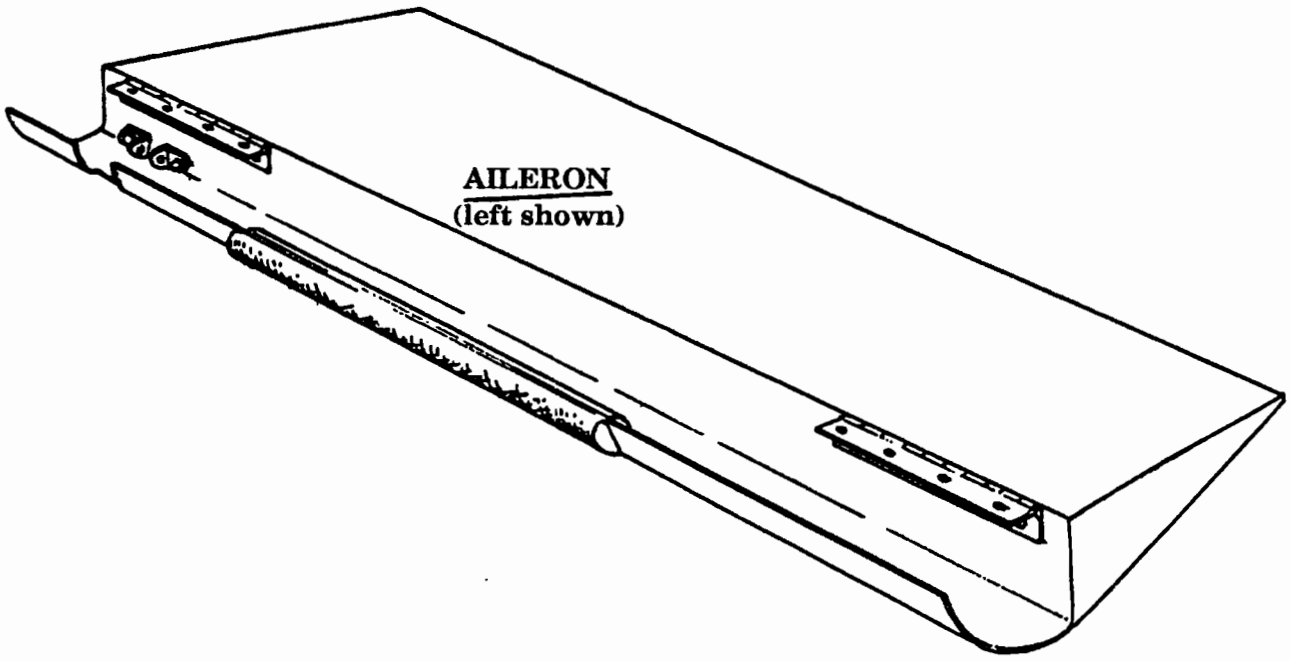
1. INTRODUCTION

With the outbd wing sections completed, the flap and aileron sections can be fitted.

The ailerons are two piece sections with the fwd web molded onto the upper aileron skin, they will require three ribs each. These ailerons will hinge from the top surface using two 6-1/2" hinge sections and must be 100% mass balanced.

The flap sections are also two piece. They do not have a web molded into them and require a simple spar near the fwd edge. Six ribs will be added and they will hinge from the bottom skin using three 10-1/2" sections. They do not require any mass balancing.

Aileron
Figure 10-1



2. DRAWING LIST

3. EQUIPMENT REQUIRED - SPECIAL PARTS, TOOLS & SUPPLIES

A. Parts

1 Airframe with outboard wing sections attached
1 AL-1 tubing
2 AL-2 tube
2 AL-3 tube
2 AL-4 tube
2 AL-5 idler arm
2 AL-6 phenolic
4 AL-7 bracket
2 AL-8 control horn
2 AL-9 bracket
10 AN3-10A bolt
4 AN4-13A bolt
8 AN3-5A bolt
4 AN3-6A bolt

B. Tools

- Dremel™ type rotary grinder
- drill motor
- drill bits:
  - #12
  - #30
- Straight edge, 6'
- Rivet squeezer

4. PROCEDURE
A. Ailerons

1. Place the airframe in the inverted position with the outbd wing sections attached.

2. Refer back to page 9-9, fig. 9-2 for wing skin dimensions at the aileron locations. With the additional BID ply schedules added and the upper skin trimmed, the ailerons upper skins can be fitted into position.

3. Make up the aileron hinge sections, 4 required @ 6-1/2" long each.
   NOTE: It is important to note that the hinge halves require a "reverse" fit from the assembled hinge as you receive them. Therefore, pull the hinge center pin before cutting the sections otherwise you'll waste two links when reversing them and reassembling.

4. Label each hinge section (i.e.: left outbd, left inbd, etc.)

5. Locate and drill (#30 bit) for the five (5) attach screws on each side of the hinge pc. Be sure to allow room on the end hole locations for the anchor nuts on the section that will attach to the wing.

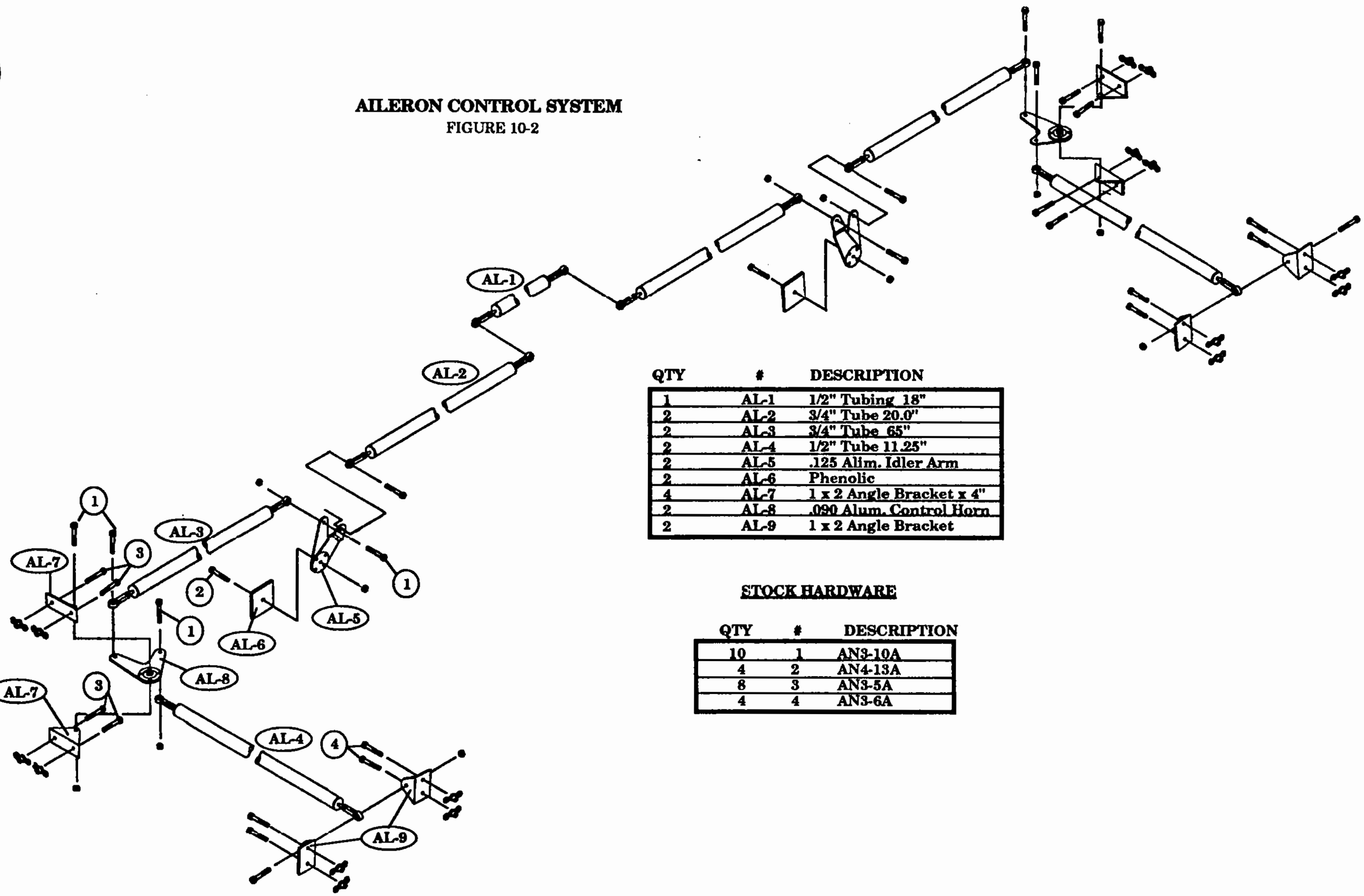
6. Position the hinge sections on the wing at the proper aileron hinge locations and attach only the middle hole with one cleco. Do this to each hinge section. Note that the hinge sections should inset into the upper wing skin to within 1/16" maximum of being flush with the wing skin T.E. This will produce a nice fine gap line.

7. Next, to assure proper alignment of the hinge sections, place a straight edge (carpenter's level or equiv.) along the hinge edges which will cause the two pcs to align. With that alignment checked, drill for the remaining holes and set two clecoes in each section. Refer to figure 10-3.

8. Position, trim and fit the upper aileron skins. Use a string along the T.E. to mark and set the T.E. of the upper aileron skin. Note that the aileron upper skin core material will extend fully to the T.E. of the aileron. Thus the aileron T.E. will be approximately 1/4" thick when finished.
   Note: it is helpful to position a long straight edge from inbd flap T.E. position to outbd aileron T.E. position. Use vise-grips or small C-clamps to hold in position. This will provide a ledge onto which the upper aileron skin can be rested at the T.E. Be sure to position the straight edge such that it does in fact represent the upper skin T.E. (i.e., if you had a straight edge that was too long, it would run up the inbd fslg fillet and would not accurately represent the true surface for aileron and flap T.E.'s).

AILERON CONTROL SYSTEM

FIGURE 10-2

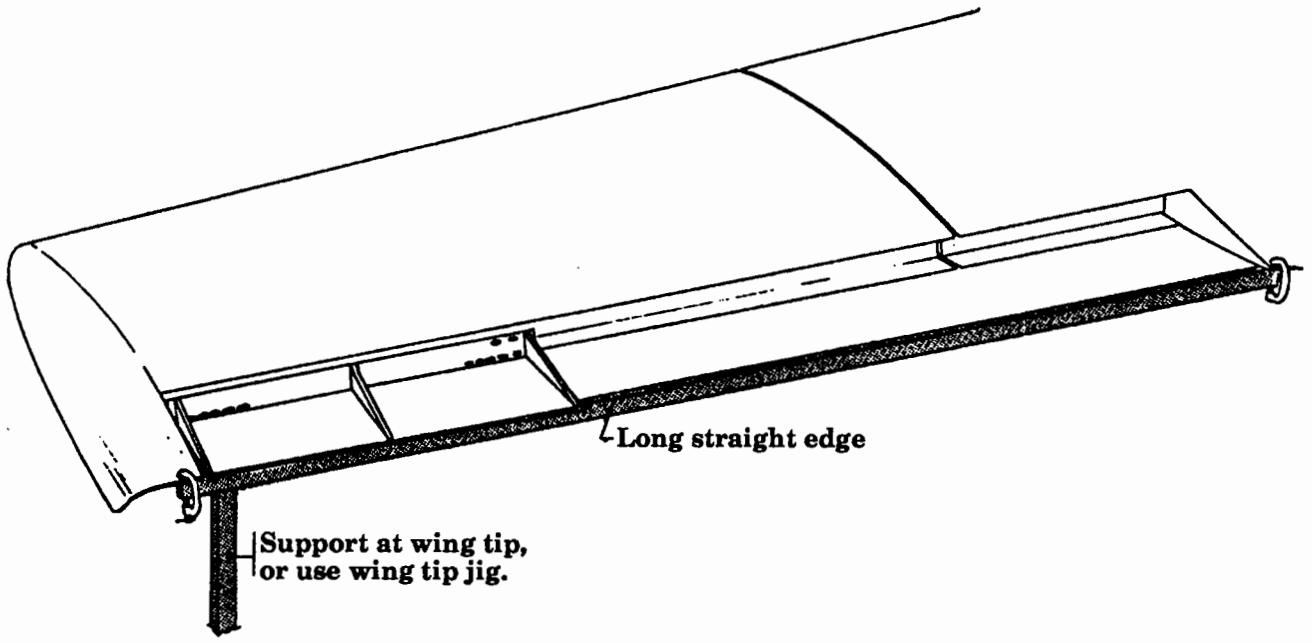


QTY	#	DESCRIPTION
1	AL-1	1/2" Tubing 18"
2	AL-2	3/4" Tube 20.0"
2	AL-3	3/4" Tube 65"
2	AL-4	1/2" Tube 11.25"
2	AL-5	.125 Alim. Idler Arm
2	AL-6	Phenolic
4	AL-7	1 x 2 Angle Bracket x 4"
2	AL-8	.090 Alum. Control Horn
2	AL-9	1 x 2 Angle Bracket

STOCK HARDWARE

QTY	#	DESCRIPTION
10	1	AN3-10A
4	2	AN4-13A
8	3	AN3-5A
4	4	AN3-6A

Assuring proper alignment of hinge sections
Figure 10-3



9. With the aileron skin trimmed to proper spanwise dimensions (T.E. dimensions and web dimensions are not critical at this time), place its T.E. on the straight edge and align with the upper wing skin so as to set the proper hinge attach locations. Reach underneath and run your hand along the juncture between upper wing skin T.E. and aileron. Verify that the transition is smooth. Adjust as required and set a clamp on the aileron hinge sections to secure them in this correct position.

10. Carefully drop the straight edge away thus allowing the aileron to swing downward exposing the hinge section. This will allow you room to drill for the cleco alignment holes through the hinge sections and through the aileron web. Set with one cleco per hinge section. Recheck the alignment by rotating the aileron up and down on the hinges.

11. At this time you can if you prefer, remove the hinge sections and attach the K1000-08 anchor nuts onto the hinge section which attach to the wing ski. Use AN426-3-5 rivets to attach these anchor nuts.

12. Reattach the hinge section.

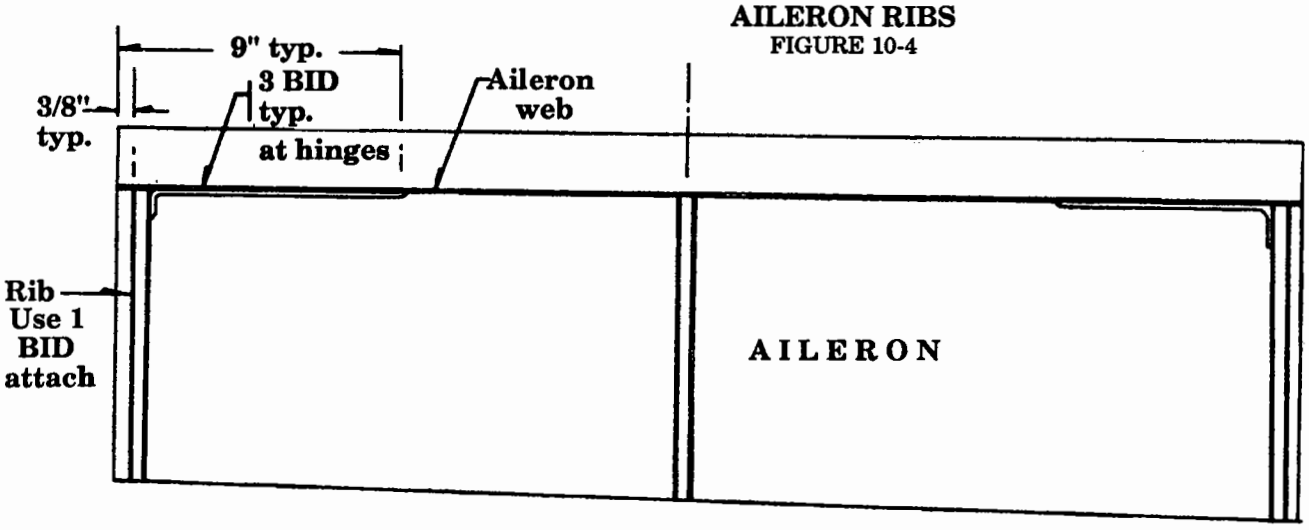
13. Trim the web to size per cross sectional drawings on blueprint "E". Check your actual dimensions against these cross sectionals and make any adjustments necessary to effect the best fit should your dimensions vary slightly.

14. Fabricate three rib sections for each aileron. See figure 10-4, and blueprint "E". These three small rib sections can be sized from the cross sectional views on blueprint "E". They are fabricated out of 1/4" foam with 1 BID per side (or from 1/4" honeycomb with 1 BID per side).

15. Attach these ribs using micro and 1 BID. Inset the end ribs 3/8" to allow surface on the exterior for a 1 BID attachment as well.

16. Add 3 BID along the web at the hinge positions. Roll these 3 BID aft approximately 1/2" onto the upper aileron surface (on the inner side).

AILERON RIBS
FIGURE 10-4



17. After the ribs have cured, fit the lower aileron skin into position per cross sectional views on blueprint "E". Swing the aileron up and down to check the alignment to the lower wing skin. By adjusting the aileron skin fwd or aft slightly, the gap uniformity can be established.

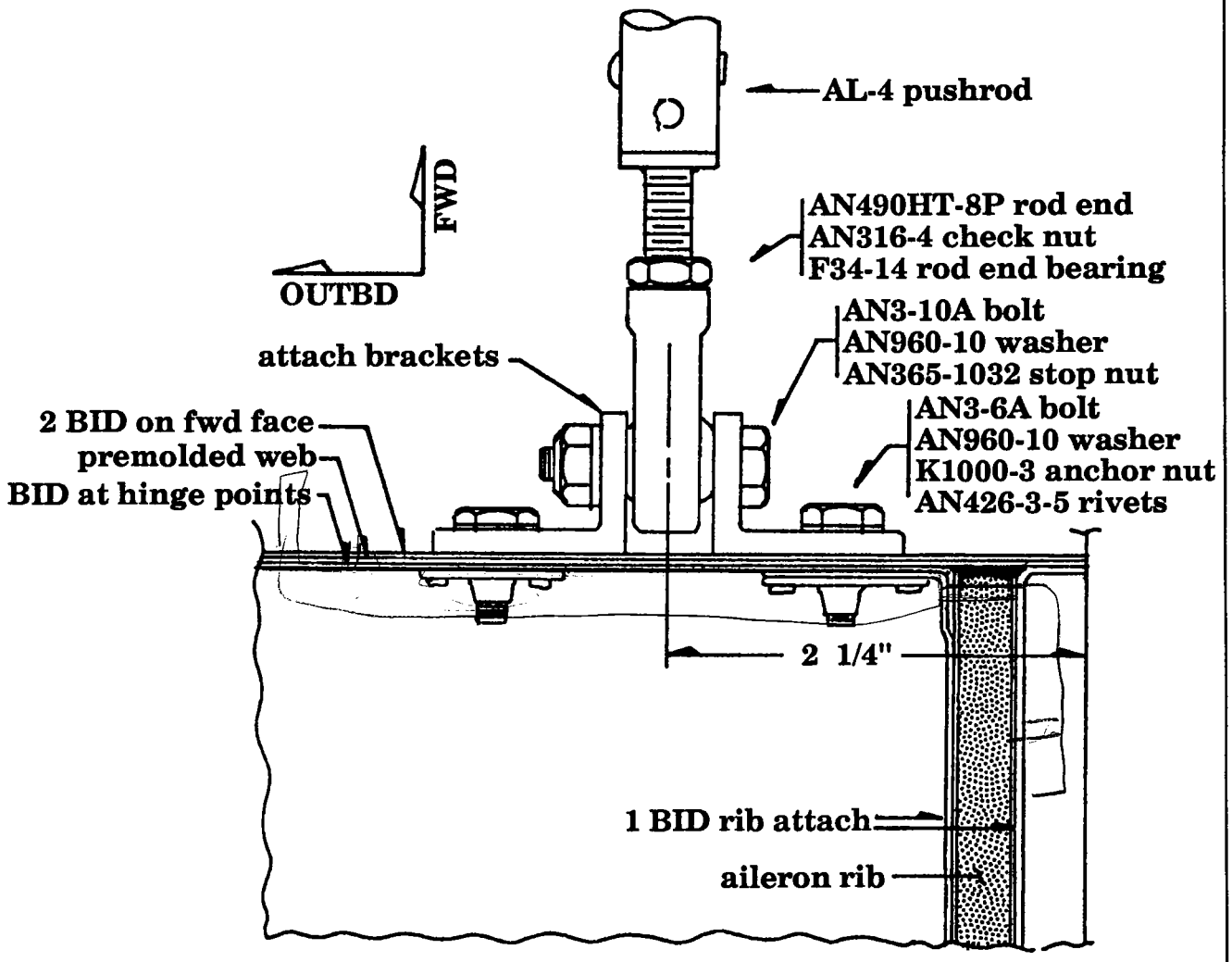
NOTE: The gap should be no more than 1/16". If there is any tendency for skin line deviations, the best fit will be when the aileron skin is either "in plane" with the lower wing skin or slightly thicker. The aileron should NOT be made thinner where it fairs to the lower wing skin.

The fwd, rolled surface of the lower aileron skin will require some trimming to achieve full down travel and full up travel, and should not expose the lower aileron skin L.E. Also note that the aileron lower skin is flat (the flap lower skin will have a cup shape in it).

18. Next make two aileron control horn attachments per figure 10-5. These will require one K1000-3 anchor nut on the inner side of the aileron web. See figure 10-6.

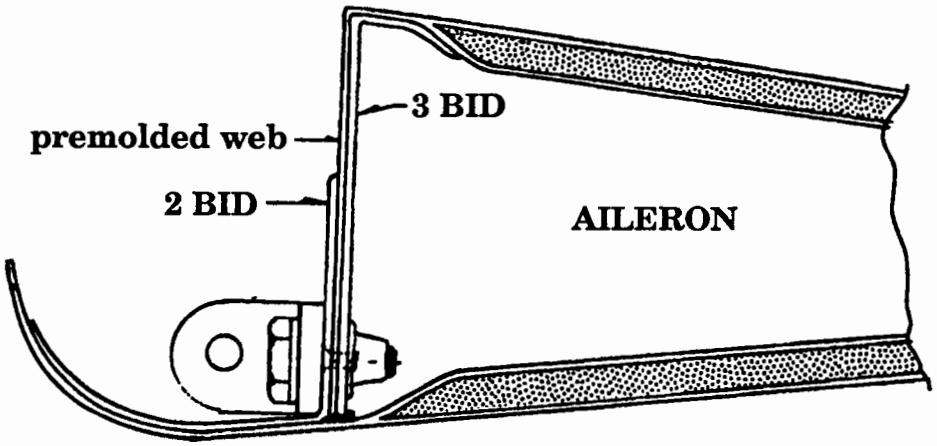
IF YOU PLAN TO INSTALL A COCKPIT CONTROLLABLE ROLL SERVO MOTOR, SEE SUPPLEMENTAL INSTALLATION BEFORE CLOSING OUT THE AILERONS, AT THE END OF THIS CHAPTER, BEGINNING ON PAGE 32.

AILERON CONTROL HORN ATTACH
(cut away view from top looking down, left aileron shown)
Figure 10-5



AILERON CONTROL HORN CROSS SECTIONAL VIEW

Figure 10-6

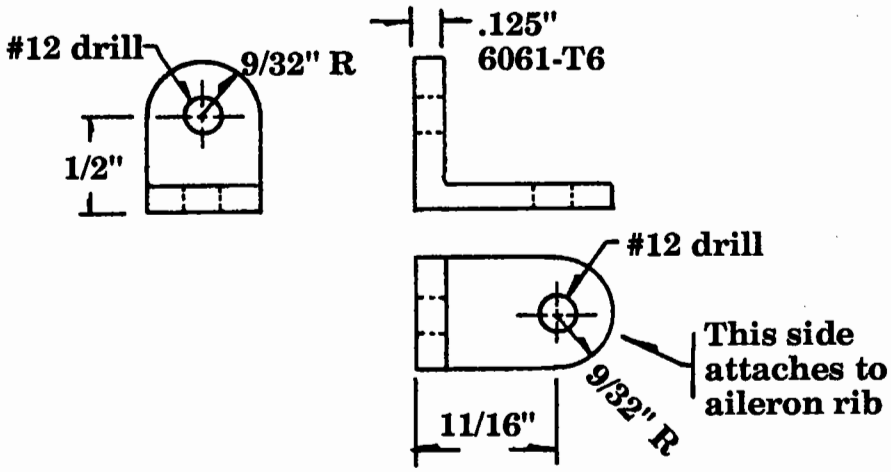


19. With the lower skin fitting well, it can be permanently bonded into position. Generally, due to the small size of the bonding areas, a good fit can be adequately established in advance. If there are any doubts about a good fit, then use the fit-release-bond approach used with the lower wing skin. If you are bonding using a one step procedure, use epoxy flox to bond the ribs to lower aileron skin. Use a small amount of structural adhesive with no more than 10% flox added to bond the T.E. Epoxy/flox can also be used on the T.E. Be sure that you achieve at least 1/4" - 3/8" contact along the T.E. This can be verified by placing a bright light under the part and viewing from above. The bond line contact will be easily visible.

    Lightly clamp the aileron T.E. against the straight edge during cure. Apply light weight along the fwd portions of the aileron. Mixing sticks placed between wing skin and aileron L.E. roll work well in establishing a good gap clearance. Allow to cure.

20. After cure, remove and add the 2 BID attachment along the fwd face of the web where it meets the lower surface. Also add the 1 BID attach to the outbd surfaces of the end ribs.

AILERON CONTROL HORN BRACKETS
TWO REQUIRED PER SIDE
Figure 10-7



B. Aileron mass balancing

The ailerons must be 100% mass balanced. That is to mean that the ailerons must, when suspended from their hinge lines, hang in what is a faired position relative to the wing. That is NOT to mean that the top or bottom aileron skin will hang level as they will not hang level. Thus you will need a reference for the wing tip to verify that they do hang in a "faired in" position with the wing when the fslg is leveled.

1. The L.E. of the lower sing skin will be used to anchor the half-round lead weights used to generate the mass balance. Select the half-round weights, they weigh 15 oz. each and generally about 2-2.5 lbs. are required for each aileron.

2. Use hot glue or equiv. to temporarily attach the lead weights to the lower skin L.E., approximately mid-span on the aileron.

3. By holding the aileron by the hinge sections, check for a faired in condition as the aileron suspends on the hinges. Make sure that the hinges work freely for this check.

4. By adding or subtracting weight, a 100% mass balanced condition will result when the aileron T.E. hangs in proper alignment relative to the wing tip.

   WARNING: It is acceptable to have a little additional lead weight, thus generating a T.E. UP condition. Primer and paint will add some weight to the aileron. Too little weight (i.e., T.E. DOWN) is <u>un</u>acceptable. If you generate a very slight T.E. up condition at this time (1/2", then you have plenty of excess balance weight to allow for the primer and paint.

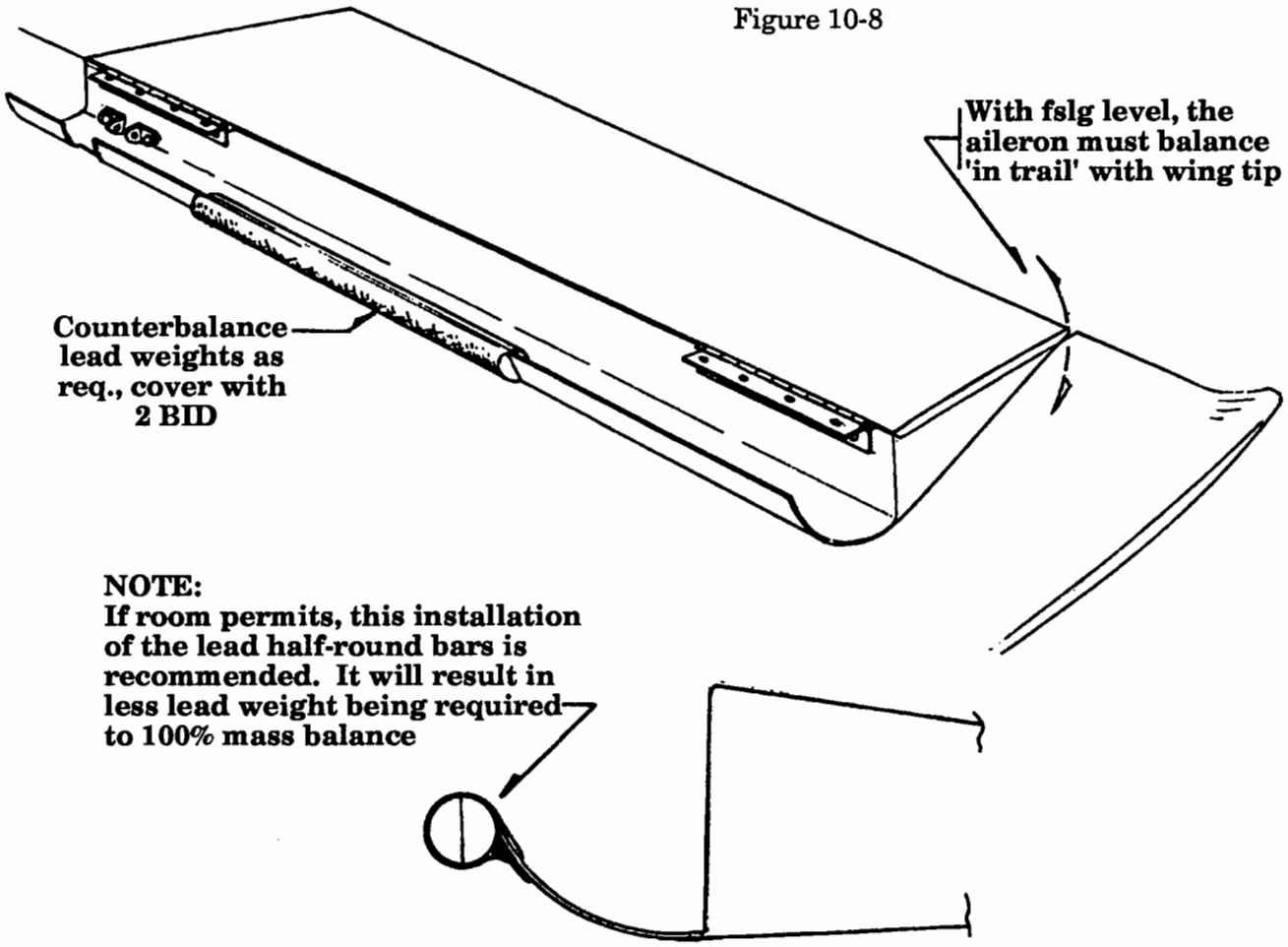
5. Now, with the lead temporarily attached, check that there is sufficient clearance room in the wing for full aileron travel. If the lead interferes, adjust its position as necessary. It is also possible that the rolled lower L.E. of the aileron skin requires trimming. See figure 10-9, for aileron travel limits required.

6. Next add 2 BID over the lead weights to attach them permanently to the lower L.E. skin of the aileron, see figure 10-8. This will add a little extra fwd weight but the aileron will get slightly heavier when it is painted.

7. After the aileron is painted (thus completely finished) recheck for an in-line condition. If your finishing process added too much weight, you may have to add a small amount of additional lead. If so, simply add a small pc and wrap 2 BID over it BUT BE VERY CAREFUL to fully clean the bonding surfaces since paint and primer will likely have been on them.

AILERON MASS BALANCE INSTALLATION

Figure 10-8



C. Aileron travel limits

The aileron travel limits can easily be established if you make sure that both left and right sides are identically set up. Otherwise, it will become a frustrating, back and forth exercise where one side won't go fully up (or down) because the other side has reached its limit stop thus preventing any further travel. If this should ever occur, it will be because the outbd bellcranks are out of alignment or possibly the inbd idler arms are out of alignment. Also, control horn pick up points on the ailerons themselves must obviously be the same distance from the hinge centers.

NOTE: This following procedure can be conducted at a later time when the plane is upright but for continuity it is described now.

1. With the plane upright, first center both control sticks and set the connecting pushrod to hold this alignment. This pushrod will be on the lower AFT side of the sticks.

2. Next set the aileron idler arms in a vertical alignment (i.e., the 1/4" pivot bolt is directly below a point equidistant between the two push rod attach holes). Connect the first aileron push rod from lower fwd side of stick, through cockpit closeout rib, to the idler arm. Set both sides but only connect one side. Leave the other side temporarily disconnected at the stick position.

3. Place the aileron bellcrank (in outbd wing) in a straight alignment with the main spar (i.e., the long arm on the bellcrank will be perpendicular to the spar web). Adjust and attach the second aileron push rod which spans from idler arm to this bellcrank. Be sure the control stick is still properly aligned (vertical) in the cockpit.

4. Next connect the 1/2" diameter push rod from short arm on bellcrank to the aileron control horns. Adjust so the aileron is in "trail". That's it.

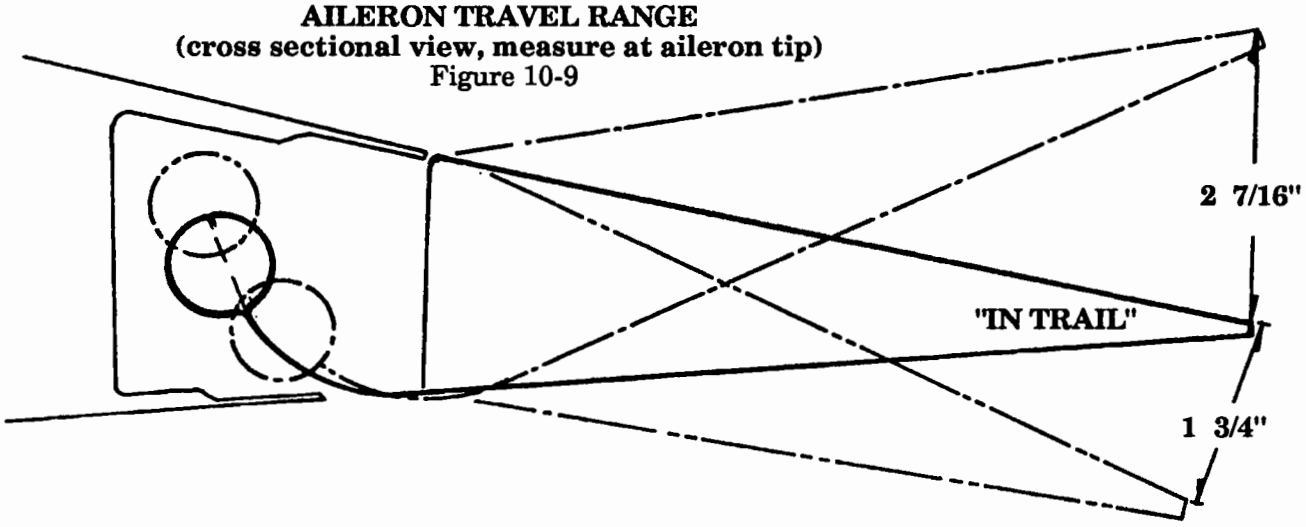
5. Move the aileron up and down to check the travel ranges possible, see figure 10-9. Note that the lower skin L.E. will require clearancing for the push rod. Use a rotary tool to cut this clearance, keep the notch as small as possible. Check also that there is no rubbing anywhere in the system.

ANY RUBBING IS UNACCEPTABLE AND MUST BE CORRECTED BEFORE FLIGHT.

6. With one side working well, connect the other side in a like manner. Disconnect the first side to check for free movement on the second side.

7. When the second side is working well, connect the system together. Now recheck for travel ranges. If there is any "new" restrictions in the travel ranges available, it is due to one of the following (listed in the most likely order):
a. The outbd bellcranks are not exactly symmetrical with each other (a small change makes a huge difference. Check first the alignment and secondly the adjustment of the push rod on the short arm when that aileron is in the down position. A slight adjustment there will allow a tremendous amount of additional travel to the other "up" aileron.
b. Idler arm orientation is off.
c. Distance between aileron control horns and their respective hinge lines is different from left to right. A small difference can be quite pronounced when measuring travel. If you have to adjust, it will require making two new control horn brackets for one side. If possible, maintain the side with the longest dimension and remake the short side.

AILERON TRAVEL RANGE
(cross sectional view, measure at aileron tip)
Figure 10-9



8. Finally, the ailerons, like all controls, must have positive limit stops. There are two provisions for this on the Lancair. The control sticks are such that they hit a limit stop created by the yoke on the crossover weldment. This generally works out well. Also, there is a small angled piece on each side of the crossover weldment which has a 1/4" hole in it. This is designed to hold a 1/4" bolt which can be adjusted to form a limit stop by its contact against the side of the control stick. Lock the adjustment by setting a check nut on both sides of the tab and tightening down against the tab.

D. FLAPS

The flaps are built in a somewhat similar manner as that used for the ailerons but with some obvious differences. Flaps are hinged from the bottom surface and will require six ribs plus a fwd spar. They are push rod actuated from the inbd end.

NOTE: The flap halves bond together at the T.E. in a different manner than other surfaces. You'll note a 1" joggle on the lower flap skin T.E. The aft edge of this joggle is the flap T.E. Trim to that line to establish the L.E. trim line. See blueprint "J" which illustrates how the T.E. bonds together. After completion, fill the joggle in the bottom T.E. with micro.

1. The fslg should be on the upright position with the wings attached. A level condition is not important.

2. See page 9-48, figure 9-23 for flap dimensions.
   Blueprint "B" for flap rib patterns.
   Blueprints "I" and "J" for flap linkage.

3. Trim and fit the lower flap skin.

4. Cut and fit all flap hinge sections to the wing first. These are 10.5" sections. These hinge halves will not be reversed.

5. In a manner similar to the aileron hinge installation, drill and set either one of the center holes first in each hinge section. Note that flap hinges require six (6) attach screws per hinge section. Align with a long straight edge and drill for the remaining holes. Attach the K1000-08 anchor nuts and machine screws.

7. With the long straight edge under the flap T.E., lay the lower flap down onto this straight edge and fit the fwd spar per figure 10-10. This spar is made of 1/4" foam with 1 BID per side or 1/4" honeycomb with 1 BID per side. Note that the inbd section requires a 1/4" phenolic insert into the web to pick up the flap control horn brackets, see blueprint "J". Use micro to bond the spar in position on the lower flap skin and allow to cure.

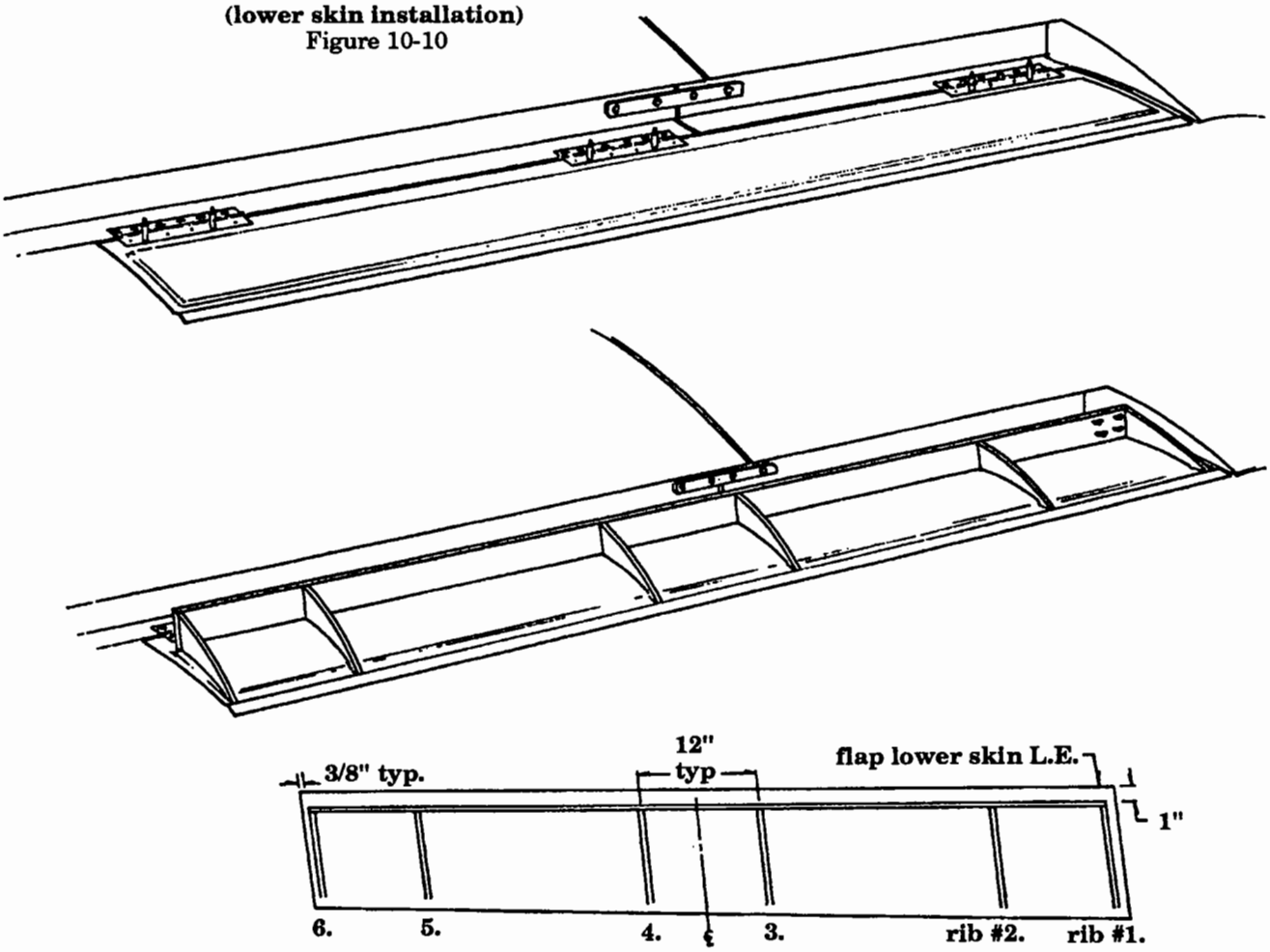
8. After cure add 2 BID to the aft face and roll 3/4" down onto the flap skin. Allow to cure.

9. Remove the flap and add 3 BID along the fwd face of the web and roll fully off the L.E. of the skin. At this same time, add 7 BID additional where the hinge sections attach.

10. Now reattach the flap and again rest it on the straight edge at the flap T.E.

11. Fit the six ribs. These are 1/4" foam with 1 BID per side or 1/4" honeycomb with 1 BID per side. Attach with 1 BID tapes on each side and allow to cure.

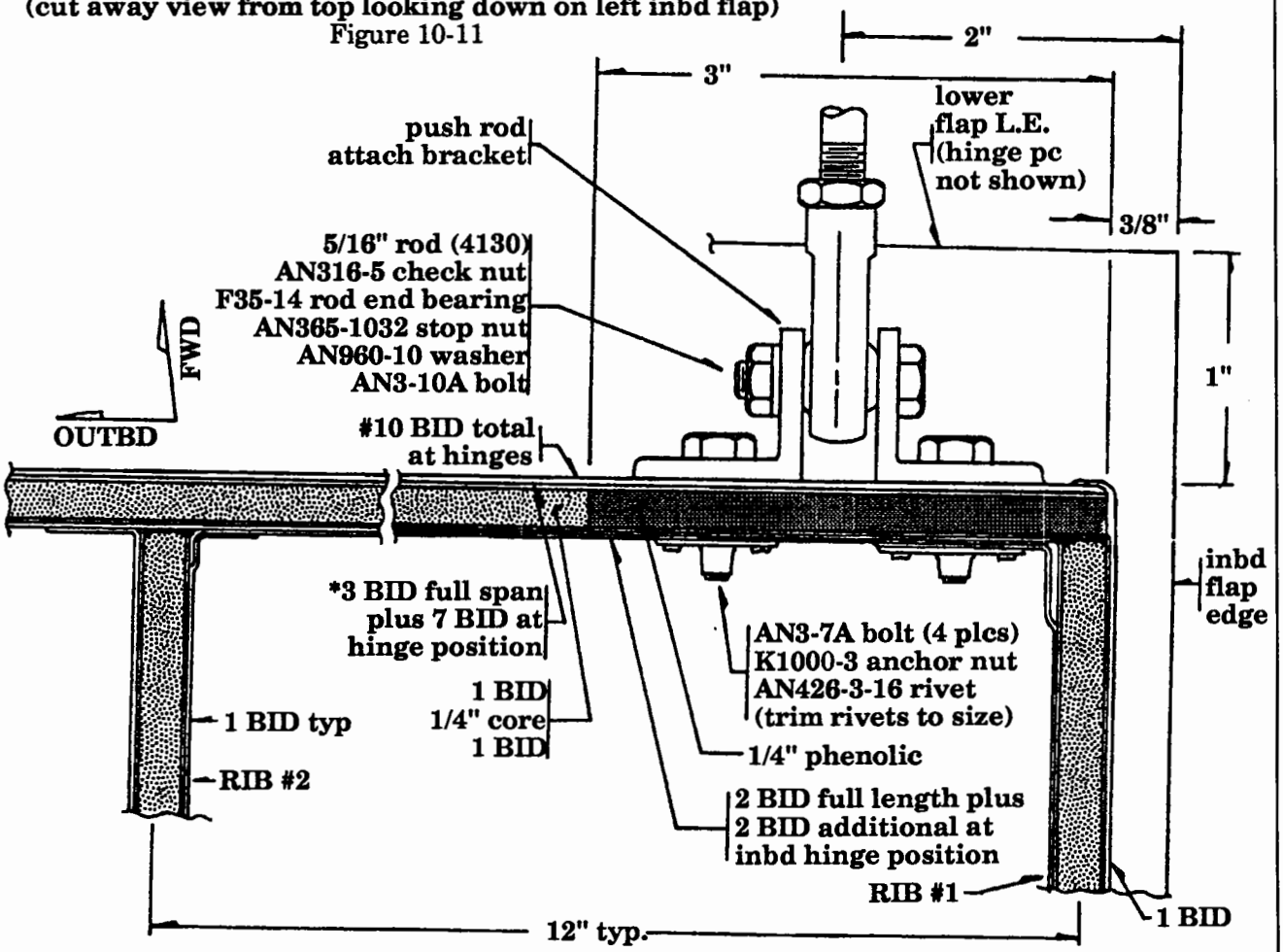
FLAP ASSEMBLY
(lower skin installation)
Figure 10-10



12. Next fit the upper skin into position. Locate the roll of the L.E. per cross sectional views on blueprints "I" and "J". Hold in relative position (a second set of hands will be helpful here) and rotate the flap up and down to check the gap alignment. The flap should have a travel range from 5/8" T.E. UP (from faired in position at inbd fillet) to full down. See figure 10-12. The gap clearance is only important in the upper most travel ranges since that is where cruise will be. As the flap drops down for landing, we really don't care if things start to get a little "dirty" since that's what we are desiring anyway when landing.

Trim the upper skin L.E. as required to allow clearance room when the flap is up. Adjust the vertical height of the spar and ribs to achieve a nice smooth faired in alignment with the upper wing T.E. The gap should not be more than 1/16".

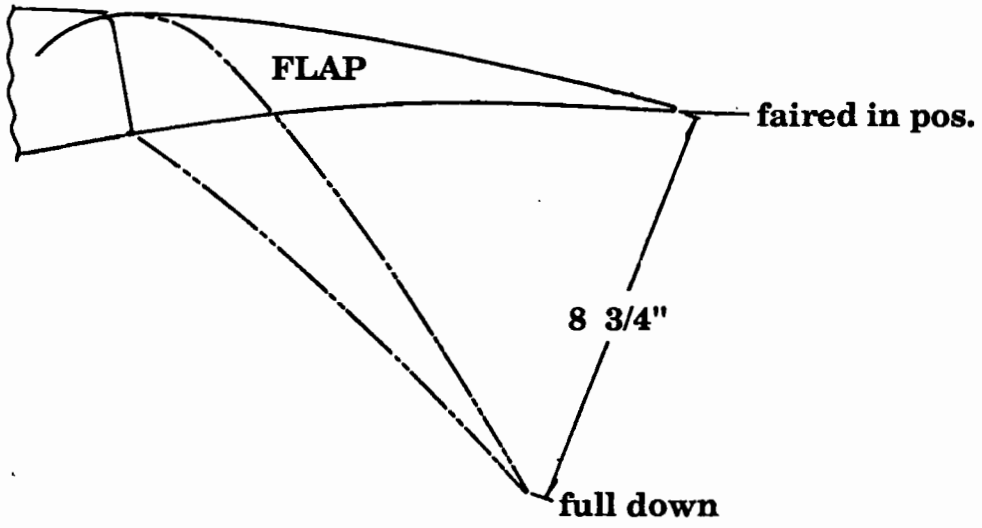
FLAP PUSH ROD INSTALLATION
(cut away view from top looking down on left inbd flap)
Figure 10-11



13. When the fit is correct, you're ready to permanently bond the top skin on.

14. Drill for the attach bolts which anchor the push rod brackets. These should be installed with K1000-3 anchor nuts.

FLAP MOVEMENT RANGE
Figure 10-12



15. Bond the upper skin in position, use epoxy/flox along all joints (structural adhesive can be used along the T.E. joint). Use light clamping pressure on the T.E. to set the gap.

16. Check the flap travel for clearance freedom. There should be no rubbing or interference.

    NOTE: Make a special note to check the aileron through full travel ranges with the flap in all positions, there must be no contact between the two.

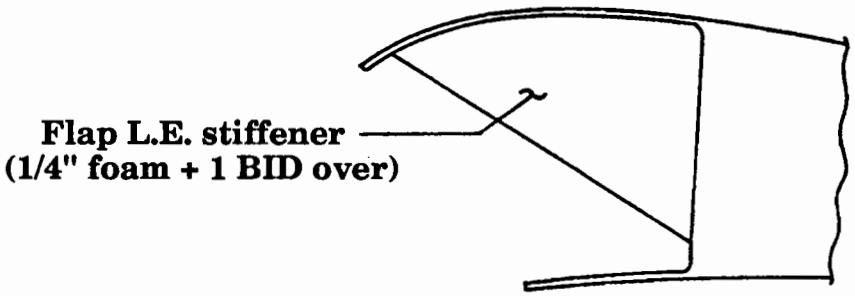
    WARNING: Adequate clearances must be established and sufficient stiffness established such that the flaps upper rolled L.E., when fully deployed, will not have a tendency to flex upward and snag on the upper wing skin T.E. Such a condition could jam the flap and thus not allow retraction of the flap. This could be dangerous on an aborted landing and subsequent "go-around". Check this closely.

17. If the above warning condition exists, a little extra roll can be induced into the extreme FWD section of that roll. Note any amount of added roll desired and remove the flap from the wing.

18. The juncture between upper rolled skin and spar web requires a 2 BID layup. When applying this layup, a slight roll increase can be set in if it is desired. To do this, clamp the flap down securely (without crushing any surfaces) and immediately after the layup is made, apply pressure to induce the desired additional roll. Hold in position until cured. Post cure with a heat gun.

19. With full flap down travel, the fwd L.E. of the upper skin will often just start to open up (i.e., the upper flap L.E. will not remain tucked into the wing skin). If this condition exists with full flap down, then the upper leading edge must be stiffened. The ends are of most concern. This stiffening is an easy procedure.

Stiffening flap L.E.
Figure 10-13



a. From some 1/4" foam, make several small wedge like pieces to fit between flap spar web and fwd into the rolled L.E. Micro these pcs into position, placing one approximately every 12". Set the end pcs inbd by 3/4". Do not place any stiffeners directly in line with the hinge sections.

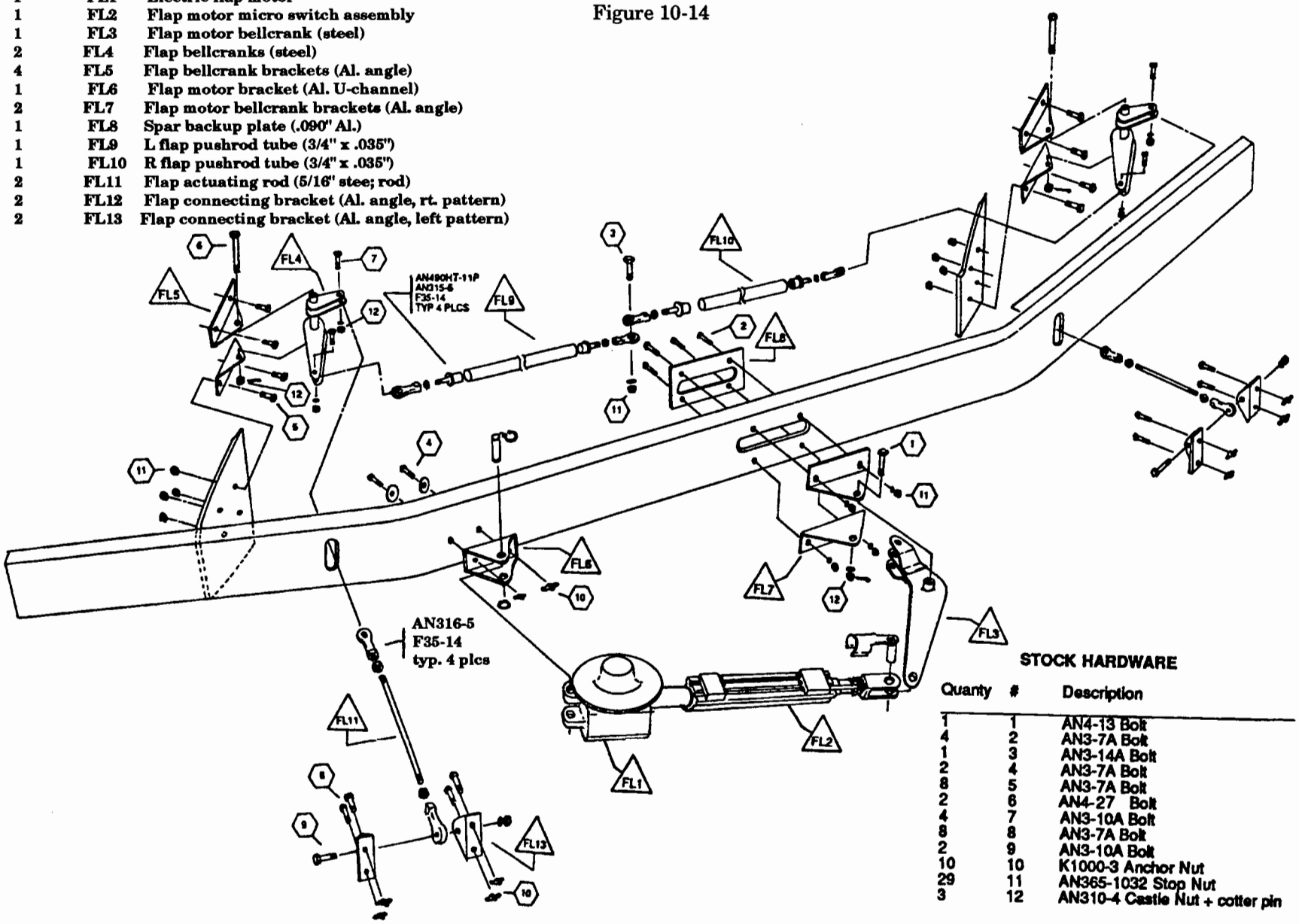
b. Next lay a 1 BID ply over them in a "draping" like manner. Contact 1/2" minimum onto the flap all around the pcs. This will sufficiently stiffen the rolled L.E.

FLAP ASSEMBLY BREAKDOWN DRAWING

FOR MODEL 320

Figure 10-14

Quantity	#	Description
1	FL1	Electric flap motor
1	FL2	Flap motor micro switch assembly
1	FL3	Flap motor bellcrank (steel)
2	FL4	Flap bellcranks (steel)
4	FL5	Flap bellcrank brackets (Al. angle)
1	FL6	Flap motor bracket (Al. U-channel)
2	FL7	Flap motor bellcrank brackets (Al. angle)
1	FL8	Spar backup plate (.090" Al.)
1	FL9	L flap pushrod tube (3/4" x .035")
1	FL10	R flap pushrod tube (3/4" x .035")
2	FL11	Flap actuating rod (5/16" stee; rod)
2	FL12	Flap connecting bracket (Al. angle, rt. pattern)
2	FL13	Flap connecting bracket (Al. angle, left pattern)



STOCK HARDWARE

Quanty	#	Description
1	1	AN4-13 Bolt
4	2	AN3-7A Bolt
1	3	AN3-14A Bolt
2	4	AN3-7A Bolt
8	5	AN3-7A Bolt
2	6	AN4-27 Bolt
4	7	AN3-10A Bolt
8	8	AN3-7A Bolt
2	9	AN3-10A Bolt
10	10	K1000-3 Anchor Nut
29	11	AN365-1032 Stop Nut
3	12	AN310-4 Castle Nut + cotter pin

Flap bellcrank assembly into fslg and stub wing

For systems uniformity purposes, this procedure is described here however, it should be performed prior to installing the stub wing skins. Refer back to the beginning of Chapter 6, page 6-2.

Lancair flaps are full electric actuated. They are designed to run from +45° down to -10° up (reflex). Note that the "faired in position" for flaps and ailerons on the plane is actually a -7° reflex position. This is unique to the model 320 Lancair. Flap position checks are by visual means (look out the window).

The flap bellcrank installation consists of three basic sections:

a. Flap motor installation with flap motor control horn in fslg ctr,
b. Left flap bellcrank installation in left stub wing,
c. Right flap bellcrank in right stub wing.

E. Flap motor bellcrank installation

1. Locate center line on aft center spar. It will have a depression in the fwd face of the spar web where the core material is deleted and a web prepreg build up has been pre-installed. Locate center both vertically and spanwise.

2. Measure 1-7/16" (spanwise) from ctr in both left and right directions. Mark and drill a 5/8" diameter hole.

3. Using a sabre saw, cut out the remaining slot by cutting along a line connecting the top of the two holes and the bottom of the two holes. See blueprint "I". You will end up with a through hole measuring 3-1/2" x 3/4".

   NOTE: Since the flap motor bellcrank pivot center measures 3/4" high, you'll need the slot in the aft spar web to be that same 3/4" high in order to get the bellcrank through it and in position. If you have the hardware bracket kit, a slight notch will have to be filed through the backup plate in order to pass the bellcrank since the backup plate is made with a 5/8" wide slot. If you are making your own brackets, you may also choose to follow this format since it allows for a slightly easier alignment vertically for this assembly.

4. Make a plate per blueprint "I" which measures 3-3/4" x 2-3/8" that has the above cut out through its center but do not yet drill the attach bolt holes. This plate will be used as a backup for the attach bolts and will mount on the fwd face of the web.

5. Make the two identical flap motor bellcrank attach brackets out of 1" x 2" angle aluminum, see blueprint "I".

6. Assemble the flap motor bellcrank onto its two attach brackets. Check rotation for free, unobstructed travel.
•The correct travel range allows the fwd facing short arms to swing 1-3/8" each way from center. See blueprint "J".

7. Position the assembly on the aft face of the spar web in proper alignment with the slot in the web. Mark one of the holes and drill through the spar web.

8. Place a bolt through to hold the assembly in position and drill for the remaining holes.

9. With the holes all drilled, position the flap backup plate on the fwd face of the web and transfer the hole locations. Drill those holes through the backup plate.

10. Paint or anodize the aluminum pcs and install permanently using AN3-7A bolts with AN365-1032 stop nuts.

Be sure to orientate the flap motor bellcrank properly. When viewed from the top with the fwd section aligned down centerline, the aft (long) arm will be to the left (pilot) side.

The flap motor bellcrank can be installed per blueprint "I", also see blueprint "J".

F. Flap motor installation

The flap motor is mounted on the left side using a piece of U channel aluminum. It is attached to the aft face of the aft spar web. See blueprint "J".

1. Locate BL 18.25 on the left side of the aft ctr spar. Locate the vertical centerline as well.

2. Make the flap motor attach bracket out of a piece of U-channel. See blueprint "J".

3. To achieve a nice snug fit of the flap motor attach pin through the bracket, drill a 3/8" hole and use a rat tail file to open it up to .400", this will require removing .012" all around the diameter.

4. Drill the two attach bolt holes through the U-channel.

5. Assemble the motor onto the bracket and position this unit into the fslg against the aft spar web, attach the clevis pin to the flap motor bellcrank. Now check for a good alignment so that the clevis does not bind on the bellcrank. Mark that resultant position of the motor attach bracket on the spar web.

6. Position the bracket along the vertical ctr line marked at BL 18.25 and drill through the web for the two attach holes. Attach two K1000-3 anchor nuts to the inside of the U-channel and attach it to the web with two AN3-7A bolts. Use large area washers on the fwd face of the web.

8. Connect the flap motor to the motor bellcrank with the clevis pin. This clevis pin must be inserted from the top. It has a locking clip on the side which also must be snapped over the shaft of the motor.

G. Right flap bellcrank assembly

The left and right flap bellcrank assemblies have identical bellcranks but totally different installations. One side can not be installed to match or even be a mirror image of the other.

The right side bellcrank will attach using a small rib-like bulkhead which angles off from the right cockpit closeout rib.

1. See blueprint "J" for the rib-like bulkhead template. Make a paper or cardboard pattern of this template first and check it for a good fit into your stub wing section since small variations are common. This rib can be made out of 1/4" foam (or honeycomb).

   NOTE: it is important to set this rib such that it has an approximately 3° - 4° aft lean. This will help for alignment with the flap actuating rod.

2. With the rib pattern fitting snug, remove the core material and replace it with the phenolic (1/4"). See template pattern on blueprint.

3. This bulkhead will require 8 BID per side (it has to be stiff). It is easiest to apply the 8 BID to the bulkhead before it is installed. (The attaching BID ply schedule is less.) This will allow you to position and drill the four bolt holes before permanently installing the bulkhead. It would be difficult to align and drill these holes once the bulkhead was permanently installed.

   So, apply the 8 BID to each side (note the type of core closeout used, this is required for strength). After cure, position the bulkhead and clamp the bellcrank/ bracket assembly into position on it. Check for clearance of bellcrank to spar web through full rotation. When the position is good, remove the assembly and drill for the 4 bolt holes which will hold the brackets to the bulkhead.

   NOTE: The 63° angularity between a fwd / aft reference line on the airplane and the bulkhead is VERY IMPORTANT. Without this, proper flap travel may not be possible. You can set this by making a simple wedge of cardboard which represents this angle as traced off blueprint "I". Also note that if you are using your cockpit closeout rib as a reference, it must have been installed along a true fwd / aft axis line. If it is off, adjust accordingly to achieve the required 63° from fslg centerline axis.

   Be sure to mark the location of the bulkhead onto the lower skin so you can get back to it later. Be sure to mark the brackets (left top, left bottom) for later reference in case the assembly is taken apart.

4. Next bond the bulkhead back into permanent position using epoxy/flox. It may be easiest to allow this to cure before adding the attach BID tapes.

5. Add the 4 BID attach tapes. They should contact 3/4" onto the bulkhead and 1" onto the mating surfaces of stub wing / closeout rib and spar. Allow to cure.

6. Per blueprint "I", also see page 4-20, figure 4-12, cut the cockpit closeout rib through-hole for the FL-10 push rod (see flap breakdown drawing 10-14, page 10-23). The edges must be closed out with micro after you've checked for a no-interference passage of the 3/4" push rod.

   NOTE: The cockpit closeout holes are not the same size. See page 4-20, figure 4-12 for dimension differences from left to right.

7. Per blueprint "I", also cut a through hole through the aft spar web.

   WARNING: This through hole must go through the portion of the spar web which is solid glass to glass. This area is easily visible from the fwd face of the web. The 5/16" steel actuating rod which will pass through this hole should align approximately 2" outbd of the inner edge of the flap. Use the fslg fillet as a guide. For the time being, simply cut a small hole (1/2" dia.) through and enlarge as required when checking for flap travel. Use a rotary tool and 1/8" carbide cutter. KEEP THIS THROUGH HOLE AS SMALL AS POSSIBLE. It should not exceed 5/8" across and 1" in height.

H. Left flap bellcrank assembly

The left side is similar except the rib-like bulkhead is entirely different. Also the closeout rib through hole position is slightly different.

1. From blueprint "J", trace onto cardboard a copy of the bulkhead and fit it into the stub wing section of the fslg at BL 31.5. This bulkhead will be positioned true vertical about the bellcrank assembly will be mounted such to be leaning aft by 3° - 4°. Again, this is important for the best alignment with the flap.

2. Next make the bulkhead from 1/4" foam or honeycomb with the 1/4" phenolic insert and 8 BID per side. Be sure to make the bracket mounting side flat thus inserting the phenolic from the opposite side. Allow to cure.

3. Position the bellcrank assembly with attach brackets onto the bulkhead and position the assembly into the stub wing. Establish the 63° orientation of the bulkhead as referenced to the aft spar. Check for clearance at the aft spar web (the clearance should not be more than 1/4". Otherwise the 3/4" push rod (FL-9) would be too far fwd into the seating area as it passes through the cockpit. Lean the bellcrank assembly aft to the 3° - 4° position and clamp to the bulkhead. With the fit checked as OK, carefully mark the location of the bulkhead onto the skin and remove the assembly.

4. Drill for the 4 bracket attach bolts.

5. Now permanently bond the bulkhead in with epoxy/flox and allow to cure.

6. Add 4 BID attach tapes around all perimeters contacting 3/4" onto the bulkhead and 1" onto the adjacent surfaces. Tapes must be applied to both sides of the bulkhead.

7. Cut the through holes in cockpit closeout rib and through the aft spar web. Be sure that the web is solid glass to glass and reference the fslg fillet for the through hole, see blueprint "J" and page 4-20 figure 4-12.

I. Flap push rod installations and adjustments

There are two 3/4" push rods which travel just in front of the aft spar fwd web face. They attach to the flap motor bellcrank (the portion that protrudes fwd through the web into the cockpit area). These push rods then attach to the long arms on the FL-4 bellcranks in the stub wing section. The short arms will attach the (FL-11) 5/16" solid steel actuation rods that link directly to the flaps.

The alignment of these bellcranks is quite critical for uniform travel of each flap relative to the other. If alignment is off, one flap will move at a faster rate than the other which is obviously not acceptable.

1. Set the flap motor bellcrank such that it is 1" to the right (passenger side) of center, the motor will be nearly fully retracted. This is a good position to start with for the flap "neutral" or "in trail" condition. See figure 10-15.

2. Position the FL-4 flap bellcranks (in the stub wing) in a uniformly square manner per blueprints "I" and "J". The pushrods should now be set to these resultant dimensions.

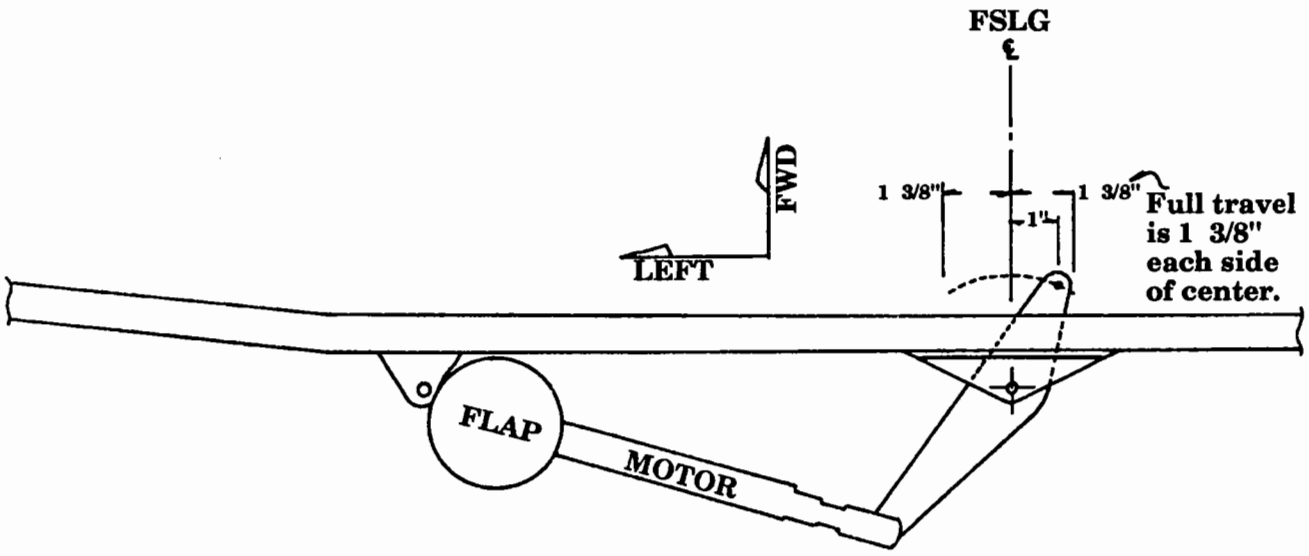
3. Cut the 3/4" x .035" aluminum rods to length and set the AN490HT-11P rod ends with two AN470AD-4 rivets. You must "peen" these rivets, DO NOT USE A RIVET SQUEEZER. This is, by the way, typical of all push rod tube riveting on the Lancair.

4. Install the push rods and adjust the F35-14 rod end bearings as required. Lock them in final position with the AN316-5 check nuts. Mark the tubes for left and right.

5. Check the clearances where the push rods transition through the closeout ribs. Adjust if necessary and use micro to close out the rib holes.

6. Assemble the flap actuating rods with the F35-14 rod end bearings and the AN316-5 check nuts. Attach the flap and attach the actuating rod to the flap first. Then, from the gear well, reach up and set the bolt to attach the actuating rod to the FL-4 flap bellcrank.

Flap adjustment
(shown for the neutral position)
Figure 10-15



7. Set for the neutral position. Then run the flaps to the full down position (measured as 8-3/4" from the fillet T.E. to flap inbd tip). The motor does not have to be connected to perform this adjustment.

Measure both flaps in the down position, they should measure the same. If they do not, then there is some degree of difference in the relative alignment between the FL-4 flap bellcranks. Adjust them until flap throws are identical. Then set the check nuts on all push rods and actuating rods. Mark the actuating rods as left and right.

WARNING: During this adjustment and any other adjustment, the minimum amount of threads allowed in the rod end bearings is equal to the diameter of the thread shaft (i.e., a 5/16" shaft must penetrate 5/16" into the bearing body). Some bearings will have a small hole drilled into the shank of the bearing near the open threaded end. This is to check for thread penetration. If you can stick a fine wire through this hole all the way to the other side, then there are not enough threads inserted and an adjustment must be made such to achieve greater thread penetration or a longer shaft is required.

If this should ever occur, check to see if you can back the other end of the shaft out of the bearing at all, this may save you from having to make another, longer push rod.

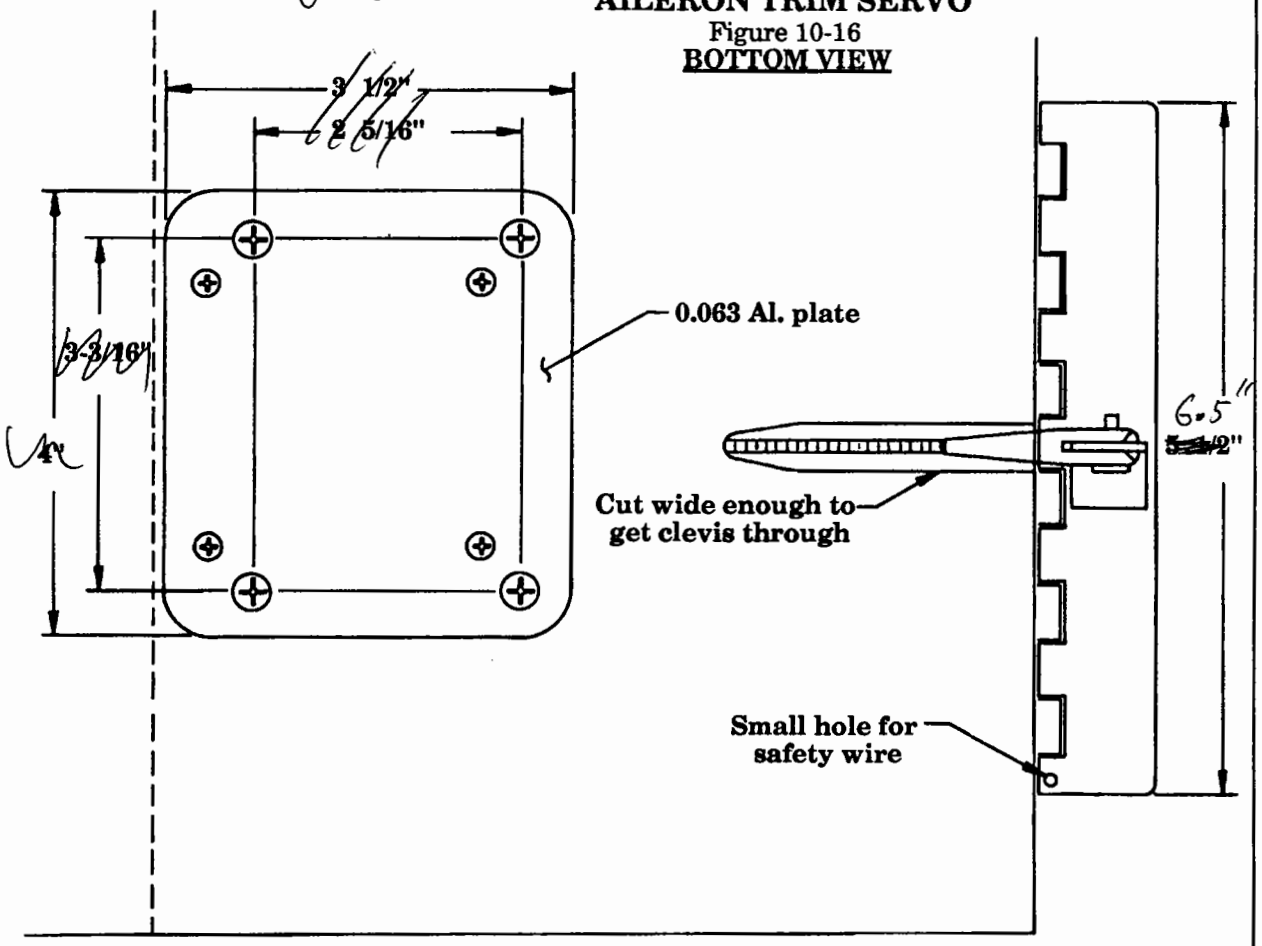
Final small adjustments are often required after initial flight testing results.

Use actual 59 servo for dimensions

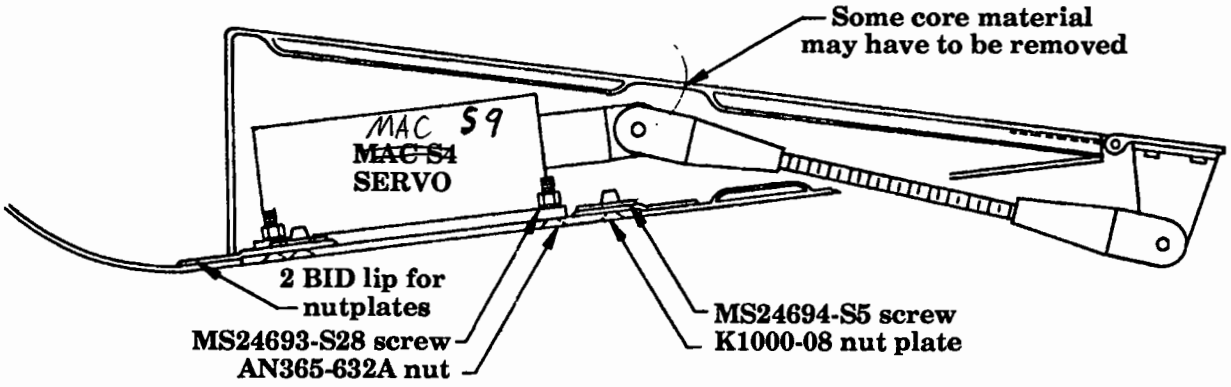
AILERON TRIM SERVO

Figure 10-16

BOTTOM VIEW



SIDE VIEW



Use MAC 59 servo

J. Aileron roll trim servo installation (optional)

It is a very good idea to install an aileron trim control servo in your Lancair. The common approach is to simply attach a fixed trim tab and while that's not too bad, it just can't handle all the trim needs (i.e., if you rig your plane to fly hands-off solo, put a passenger in the right seat and he or she will establish a respectable right rolling moment). And of course, fuel is the other big variable. So if you want to be able to balance out the roll mode, perfectly, all the time, you'll need a servo that is controllable from the cockpit. Even if you have an auto pilot, it won't always be engaged, and also it is a bad idea to have to rely on the autopilot system for roll trim all the time. What follows here is a nice installation similar to that we've made on several 235's and 320's (the installation is the same). We use (and stock) the MAC S4 servo kits, a complete set with servo, control rod assembly, control rocker switch and an LED light unit that indicates the two travel limits and the middle point (the limit LED is virtually useless since we never travel to the limit stops however, the middle point could, with a bit of trial and error, be set up to indicate a basic takeoff position. The "look out the window" approach works very well and even if you were way off, the stick loads are easily managed until proper roll trim can be driven in. The kit is the same price with or without the LED, so you'll get that LED whether you use it or not.

Refer to figure 10-16. The inspection door is used as the mounting plate for the servo, making it a very clean and easy installation. We used an 8" tab on the T.E. of our company plane, and found it to be a "hair trigger". About a 5-1/2" tab should be just about right.

The servo can now be installed by attaching the clevis rod to the servo, and sliding the rod into the aileron first, guide it to and out through the slot to the tab. Screw the inspection plate into place, install the clevis pin in the clevis/tab, cotter pin it, and you're done. Removal is accomplished by reversing the order - removing the clevis rod from the tab, removing the screws from the inspection plate and removing the inspection plate with the servo attached. Pretty neat, huh?.

You will need a bit more balance weight to offset the installation, but it is a relatively light system, so the weight penalty is quite minimal.

As a final note, we do recommend that the tab be positioned on the left side simply for improved visual inspection purposes.