

CHAPTER 5: LANDING GEAR INSTALLATION

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 When such revisions are made, you should immediately replace all outdated pages with the revised pages.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.

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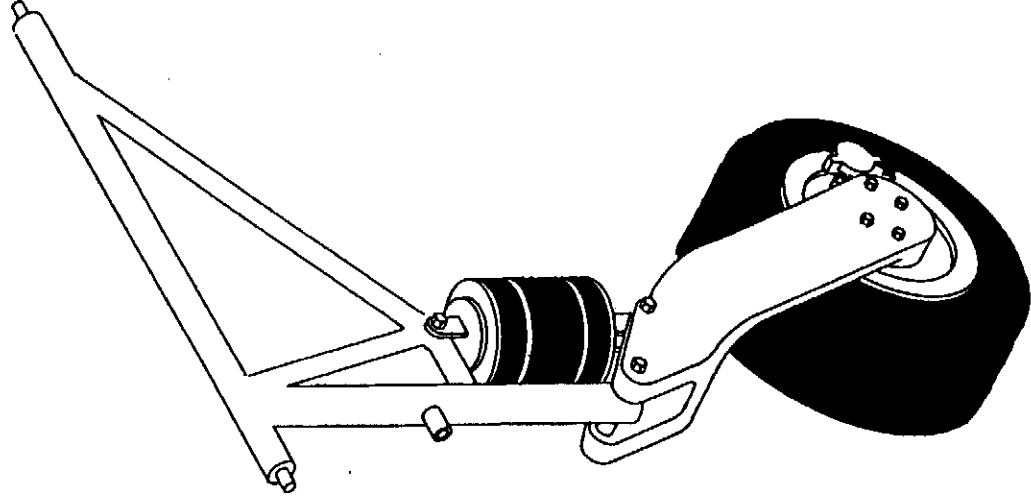
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LANDING GEAR INSTALLATION

1. INTRODUCTION

The landing gear of the Lancair is of the trailing arm type which is noted for its effective absorption of landing impact energies. This should help greatly to keep one's ego up during landing operations. It was once stated that the Lancair could not be bounced but that statement must reluctantly be stricken from the records. Perhaps it is now best stated that it almost requires practice to successfully get the Lancair to bounce and some pilots simply require less practice than others!!

Main Landing Gear Assembly

Figure 5-1



NOTE: The gear legs should be assembled per the LANDING GEAR BREAKDOWN drawing. The assembly is rather straight forward with only a couple of exceptions that require some discussion.

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3. EQUIPMENT REQUIRED

A. Parts

- all parts per "Main Gear Breakdown" drawing
- 1" x 2" aluminum angle stock (21.5" long pcs)
- Structural pop rivets
- 8 MS24694-S7 (or S5) countersunk machine screws
- 8 K1000-08 (8-32) nut plates
- 16 AN426AD-3-6 countersunk (3/32") rivets
- 3/8" x .058 aluminum tubing
- 1/4" aluminum rod
- 4 M34-14 rod end bearings with check nuts (316-4)
- 2 3/8" x .085 Aluminum tubing approx. 1.5" long
- 4 3/32" roll pins
- Main gear door cutout pattern
- 14" extruded aluminum hinge stock
- 3/8" x 8" steel rod

B. Tools

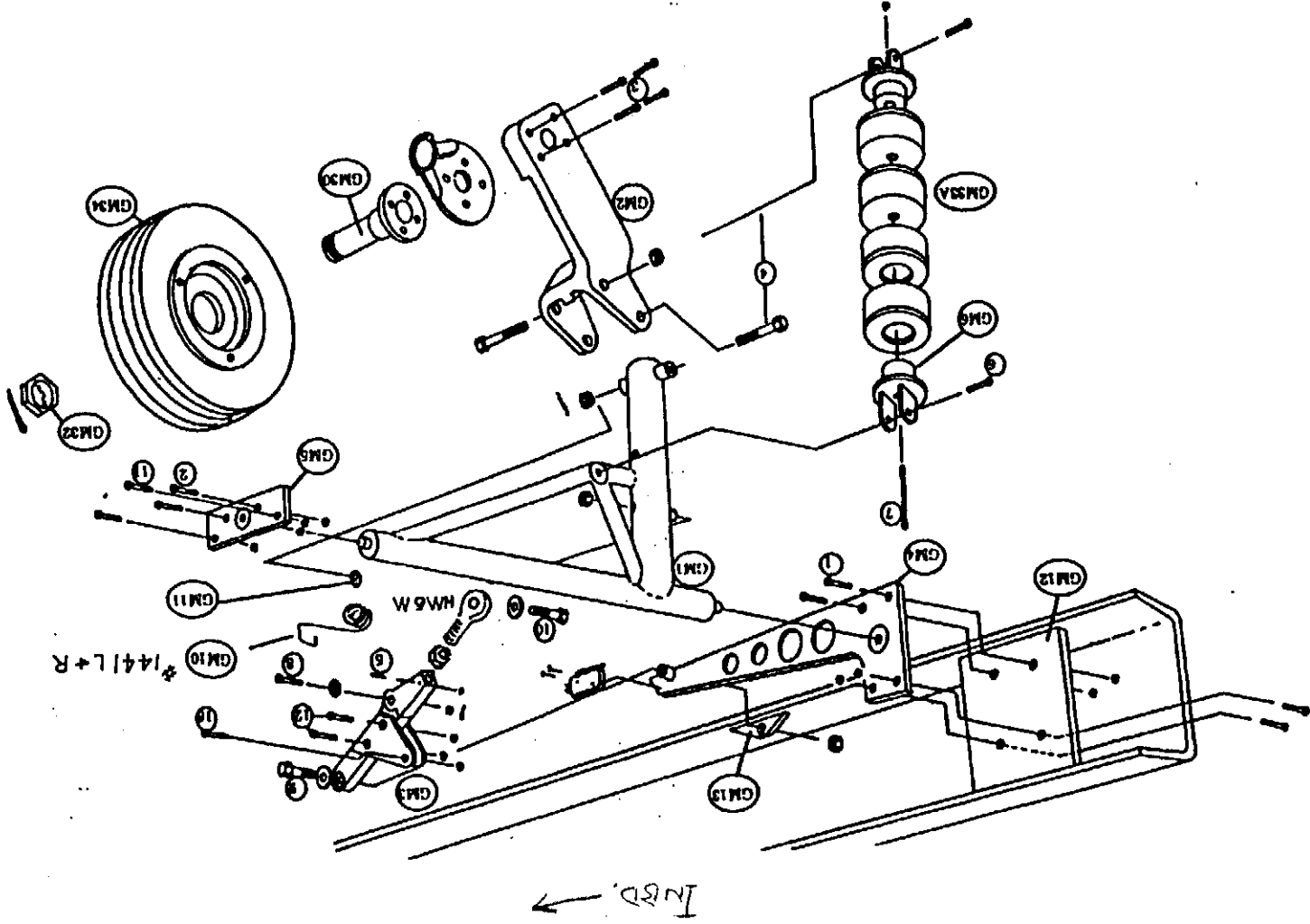
- Electric drill motor, 3/8"
- 3/32" drill bit
- 1/8" drill bit
- 3/16" drill bit
- 1/4" drill bit
- 3/8" drill bit
- #12 drill bit
- #19 drill bit
- #32 drill bit
- 100° countersink
- 1/4" transfer punch or similar
- Saber saw with fine tooth blade
- 3 C-clamp, small
- 2 C-clamp, large (6")
- carpenter's square
- Drill press (optional, but very handy with a drill press vise)
- hack saw
- Band saw, metal cutting (optional)
- Dremel™ type routing tool with 1/8" dia. cutter
- 1/4-28 thread tap
- tap handle
- tape measure
- gear door template (blueprint)
- carpenter's level
- tire pump or air compressor (for inflating tires)

C.

Materials & supplies

- duct tape or similar release material
- instant glue
- flox
- micro
- BID materials
- sandpaper, assorted grit
- #10 wire, electrical
- #18 wire, electrical

Main Gear Assembly Drawing
Figure 5-2



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BOLT LIST FOR FIGURE 5-2:

PART #	QTY	Description
1	8	AN4-13A $\frac{1}{4}$ -28 x $1\frac{3}{8}$ bolt
2	4	MS24694-S106 $\frac{1}{4}$ -28 x 2 1/4" bolt
3	8	AN4-22A $\frac{5}{16}$ -24 x 4 1/4" bolt, drilled
4	4	AN5-42 1/2-32 x 2 1/2"
5	2	AN3-7A $\frac{5}{16}$ -24 x 1 1/8" bolt, drilled
6	2	AN5-15 $\frac{1}{4}$ -28 x 3 1/2" bolt
7	2	AN4-34A $\frac{1}{4}$ -28 x 1" bolt, drilled
8	2	AN4-10 $\frac{3}{8}$ -24 x 3" bolt
9	2	AN6-30A $\frac{3}{8}$ -24 x 3 1/4" bolt
10	2	AN6-32A $\frac{1}{4}$ -28 x 1 1/2" bolt
11	4	AN4-14A $\frac{3}{8}$ -24 x 2 1/4" bolt
12	4	AN3-7A
14	2	HM6M rod end bearing
15	2	AN316-6R check nut $\frac{5}{16}$ -24
16	2	AN3-7a
	1	1441L & R Spring
	4	WS-6 washers
		1-1/4" Shrink tubing sleeve

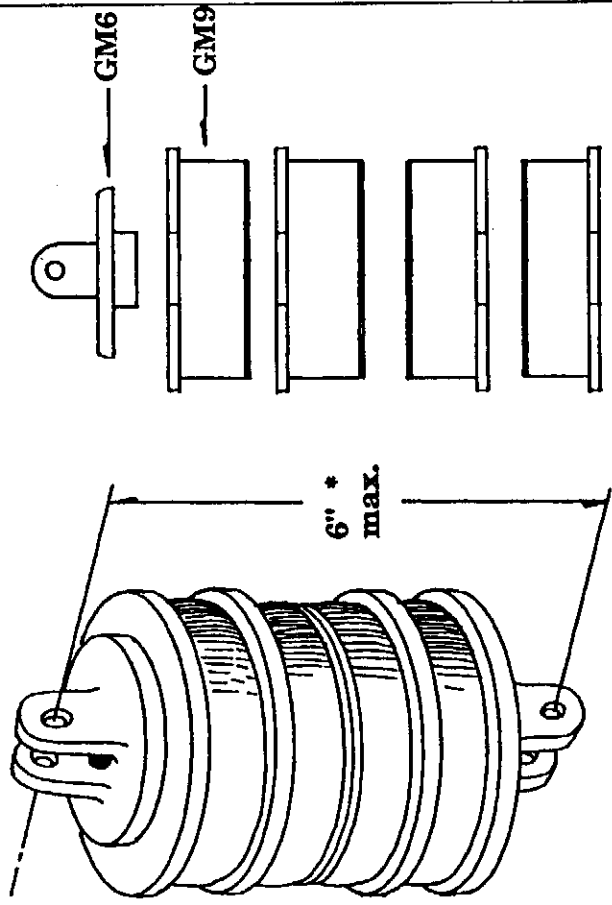
4. PROCEDURE

- A. Setting the main gear compression assemblies**
Our latest style of compression assemblies use a donut similar to that used on the Mooney aircraft. In fact, they are made by the same manufacturer. These units provide superior dampening properties. They also have the metal plates vulcanized onto the synthetic rubber-like material. This simplifies the assembly as well.
1. This assembly requires the GM33A (black compression donuts with attached metal plates). Also required are the GM6 compression cap casting and AN4-34A bolts with AN365-428 stop nuts.
 2. Note that all the biscuits have one plate with a 1/4" hole and one with a 1 1/4" hole. The large diameter hole will accept the GM6 castings at top and bottom. The middle two biscuits will be orientated such that the thicker plates (with the large diameter holes) are AWAY from the center. See figure 5-3.
 3. Slip the AN4-34 bolt through and align the pieces. Use a pair of large C-clamps or cabinet clamps to squeeze the biscuits until the AN365-428 nut can be screwed on. Set the "ears" of upper and lower GM6 casting parallel by twisting and making a visual inspection until a close parallel condition is established.
Set the amount of compression such that the holes in the GM6 castings measures 6" from center to center. Locate the nut to the bottom of this assembly. Mark that bottom end for later reference.

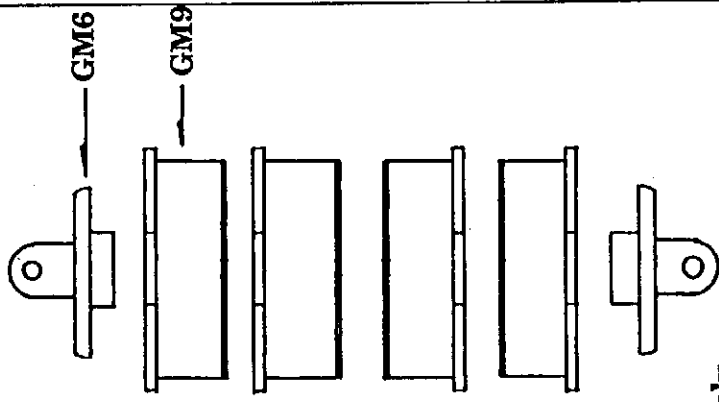
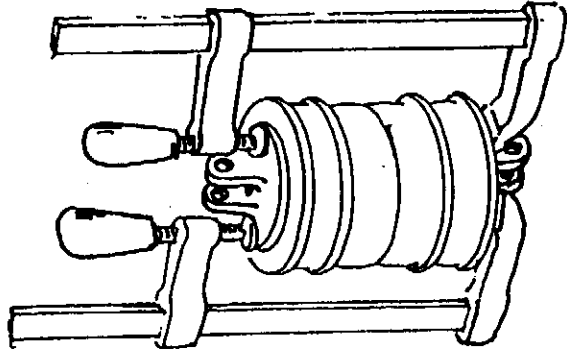
NOTE: When assembling the compression assembly, use two washers under the AN4-35A bolt head and one washer under the nut. Otherwise you will run out of threads.

Compression assembly

Figure 5-3



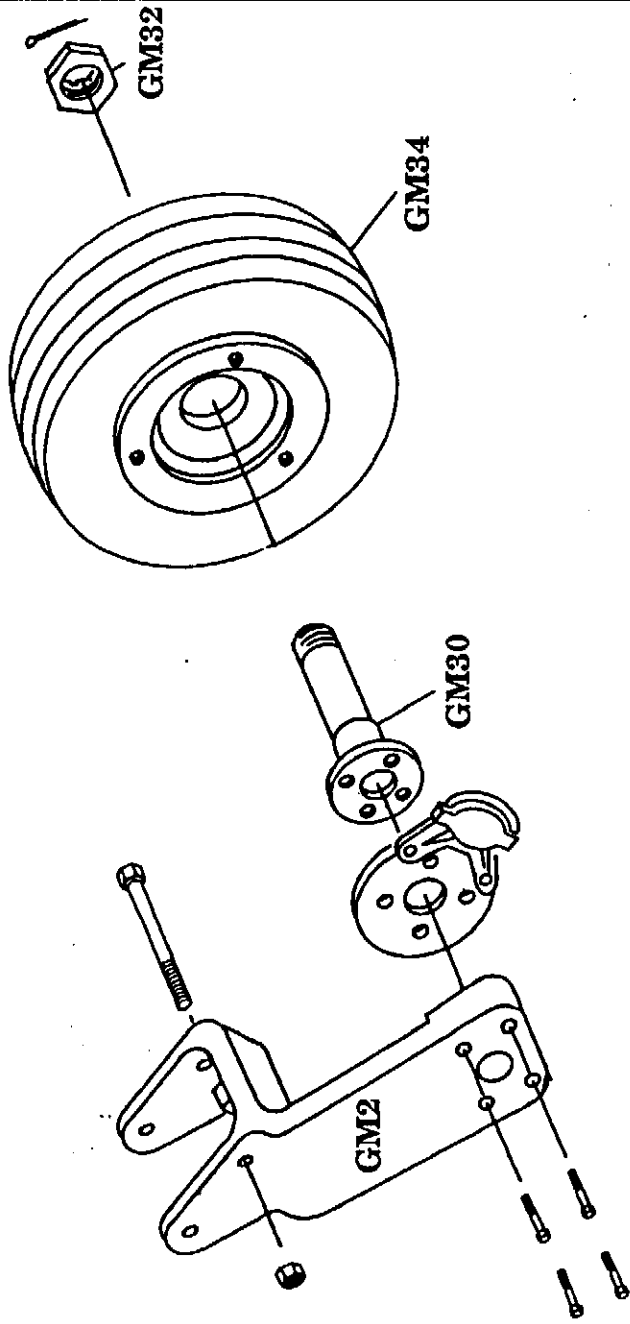
***NOTE:** This 6" dimension is ideal since it places the least amount of preload on the compression assembly. It also makes for a closer fit into the fwd portion of the gear well. If necessary, reduce this dimension to 5 7/8". This will have the effect of pulling the tire aft.



- B. Mounting the main gear brake assembly
This is also straight forward.

Main gear brake assembly

Figure 5-4



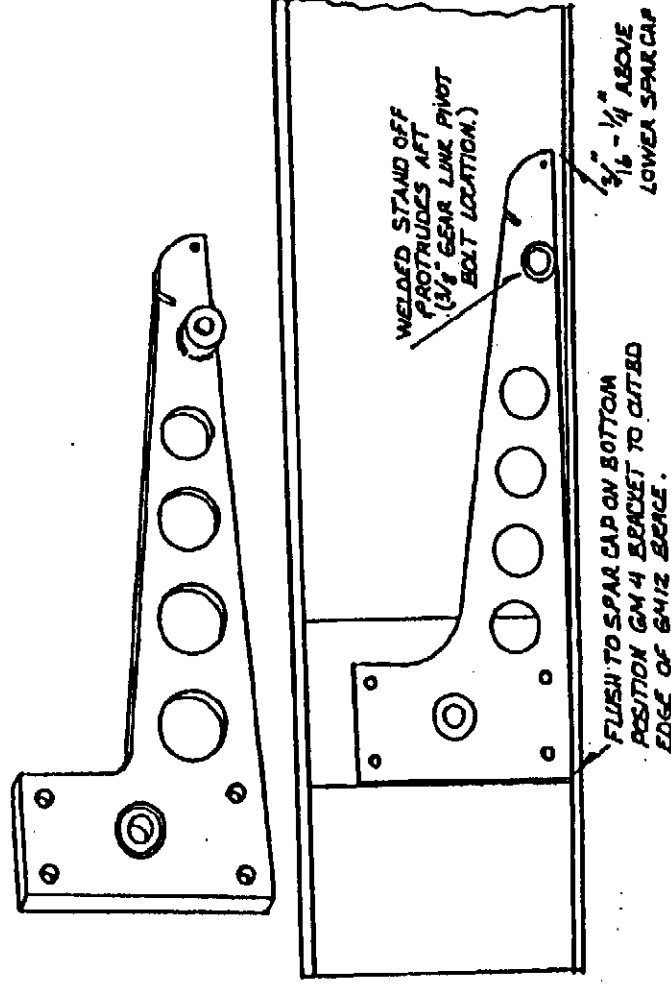
1. Assemble the brake/axle assembly onto the gear leg casting as shown in figure 5-4. The small 1/8" boss on the back of the axle will center into the brake alignment disk for mounting. Place the bolt heads outside of the gear leg casting for maximum gear door clearance.

C. **Main gear primary and secondary attach points**

1. Select the GM4 main gear alignment brackets. These aluminum machined parts will establish the proper alignment of the main gear pivot point with the overcenter link pivot point. They will be mounted to the GM12 phenolic which has been bonded into the center main spar.

GM4 alignment bracket

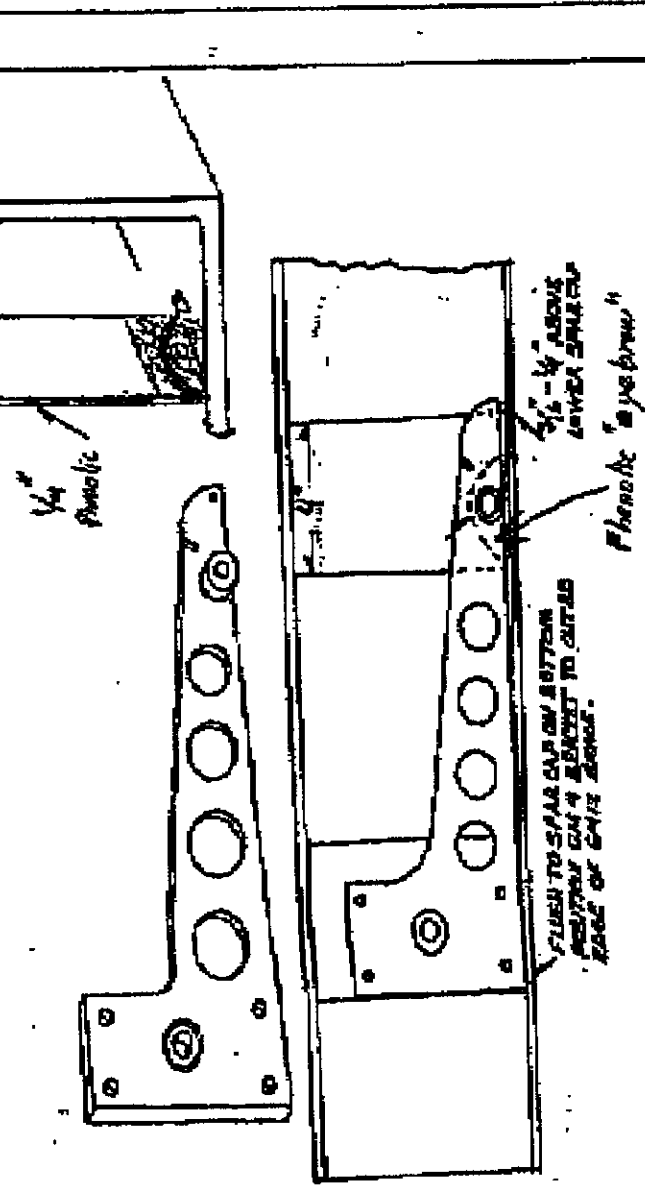
Figure 5-4.1



2. Position the GM4 bracket per figure 5-4.1. The lower edge of it will rest on the lower spar cap but the inbd end should be elevated slightly to provide adequate clearance for the 3/8" nut on the fwd face of the phenolic. Also note that the GM4 should have the welded standoff facing aft.

C1.
 1. Main gear primary and secondary attack points
 Select the GM4 main gear alignment brackets. These aluminum machined parts will establish the proper alignment of the main gear pivot point with the overcenter link pivot point. They will be mounted to the GM12 phenolic which has been bonded into the center main spar.

GM4 alignment bracket
 Figure 8-4.1



2. Position the GM4 bracket per figure 8-4.1. The lower edge of it will rest on the lower spar cap but the inbd end should be elevated slightly to provide adequate clearance for the 3/8" nut on the fwd face of the phenolic. Also note that the GM4 should have the welded standoff facing aft.

- Use 1/4" phenolic 4" wide
- align the outboard edge of the phenolic with the outboard edge of the small phenolic "eyebrow" that holds the 3/8" bolt
- apply 3 bid front to back of the phenolic to the top spar cap and 3 bid on the back of the phenolic to the bottom spar.
- bond in the phenolic with Hysol

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Call: Mark or Doug for clarification.

3. Drill and mount the GM4 bracket using the four 1/4" bolts. Set them with the nuts on the aft side to provide clearance for the aileron push rod which will operate on the fwd side. Drill for the 3/8" pivot bolt on the inbd side of the GM4. Be careful not to rock the drill bit when drilling through the GM4 because that could wobble out the hole and make for a sloppy fit. The overcenter link will attach to this position later.



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D. Main gear over center link assembly

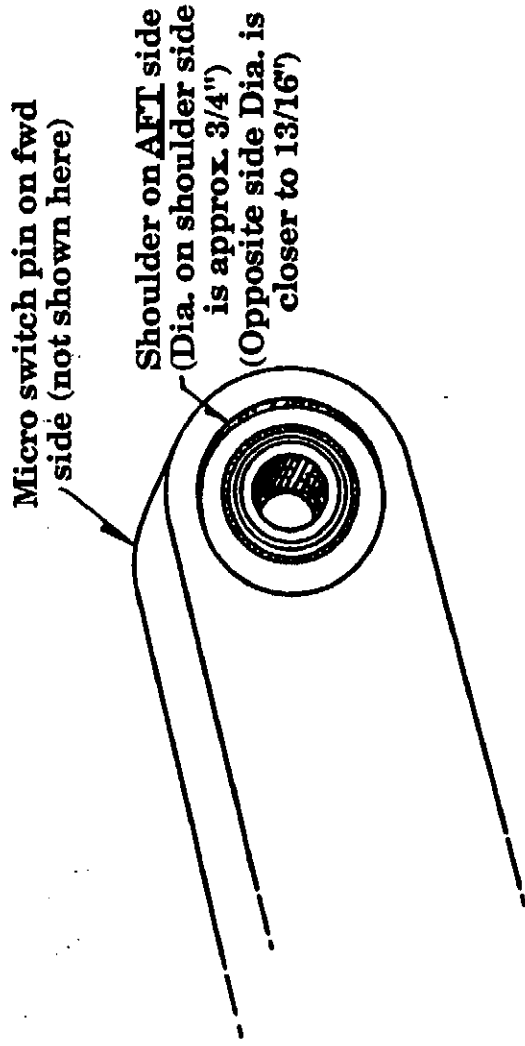
1. Per figure 5-6, press the roll pin to trip micro switch into position. **BESURE YOU PUT IT IN THE CORRECT SIDE OF THE LINK. IT MUST BE ON THE FORWARD SIDE (THE SIDE OPPOSITE THE SHOULDER WHERE THE GM4 MOUNTS).**
2. Assemble the over center links per figure 5-6. Use care to position the nuts on the appropriate sides of the links, since this is important for clearance purposes.

IMPORTANT: It is mandatory that the side of the upper arm with the shoulder be positioned so as to be on the **AFT** side of the assembly when fitted to the airframe.

FAILURE TO ACCURATELY ESTABLISH THIS ABOVE CONDITION COULD RESULT IN A JAM WHEN CYCLING THE LANDING GEAR.

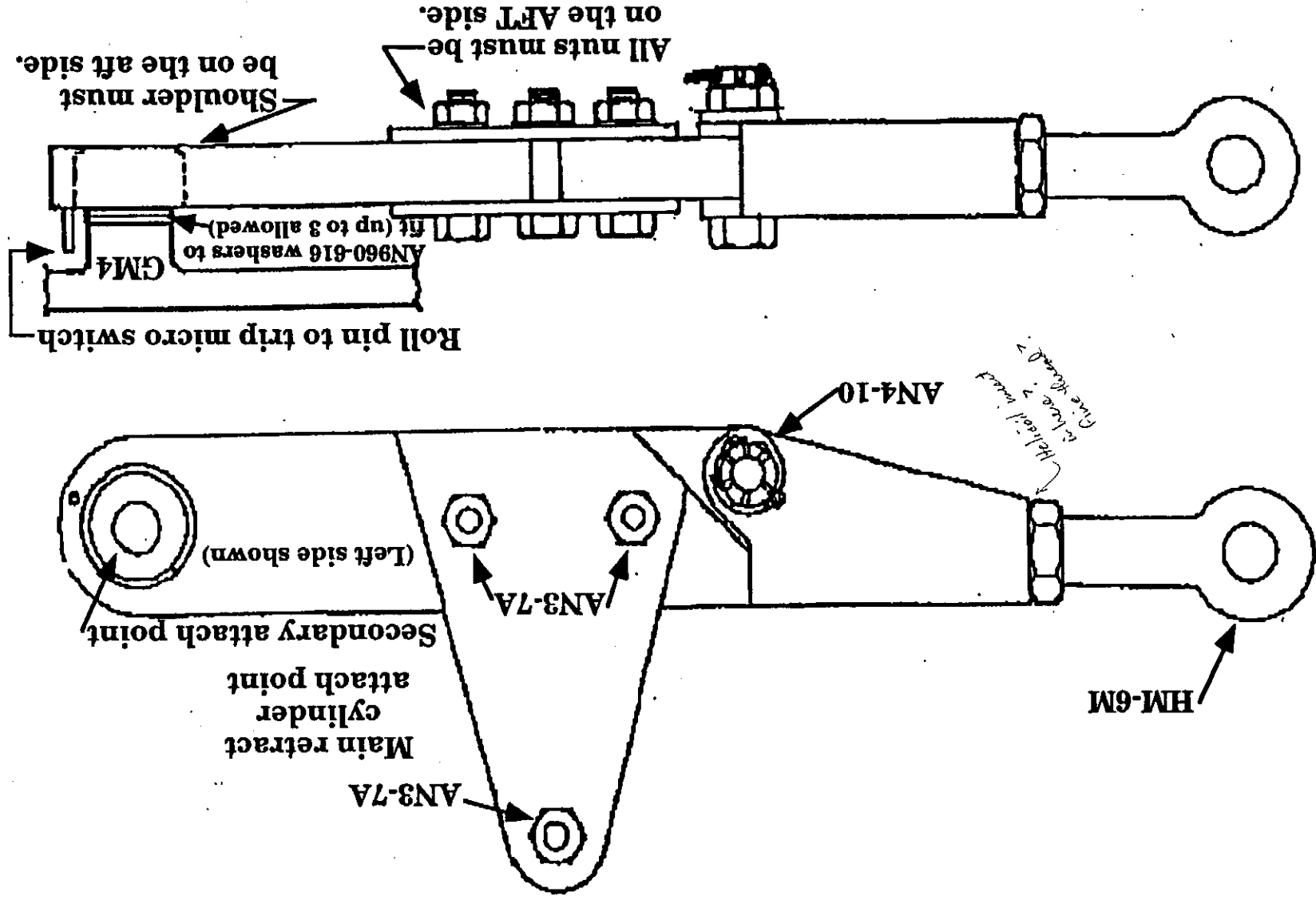
Upper arm bearing location determination

Figure 5-5



Main Gear Over Center Link Assembly

Figure 5-6



E. Main gear door cut outs

1. The main landing gear cut outs must be made before the landing gear itself can be aligned. Select the gear door template which was used during the cockpit closeout rib installation. You will note the alignment indicators from the blueprint which show the aft face of the main spar. The BL 50 position is not critical and may vary from one builder to another.

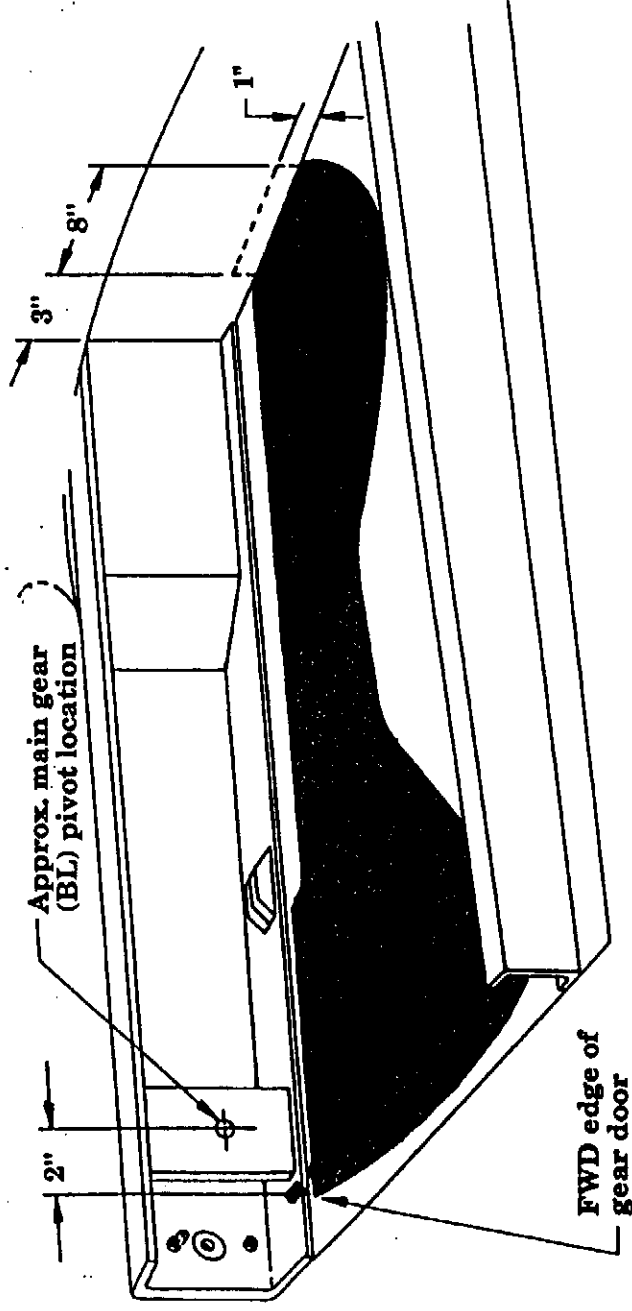
Position the gear door template on the lower wing skin and trace off its contour. The door will be cut out of the skin. It is perhaps easier to perform this task with the plane in the inverted position. Since the plane is quite easy to flip it is recommended that you do so. The traced off contour of the gear door should be made to both the inside and later the outside (bottom). The inside tracing will help assure that it's in the proper position, the bottom tracing is the one you will actually cut to.

Position the complete landing gear, with wheel, in its proper position which will simulate the retracted position. Sight along the contour to verify that the cut out is in proper position.

You can check to be sure that both top and bottom tracing are in alignment with each other by placing a bright light on one side and sighting the mutual alignment of the tracings on each side.

Main gear door cut out location

Figure 5-7



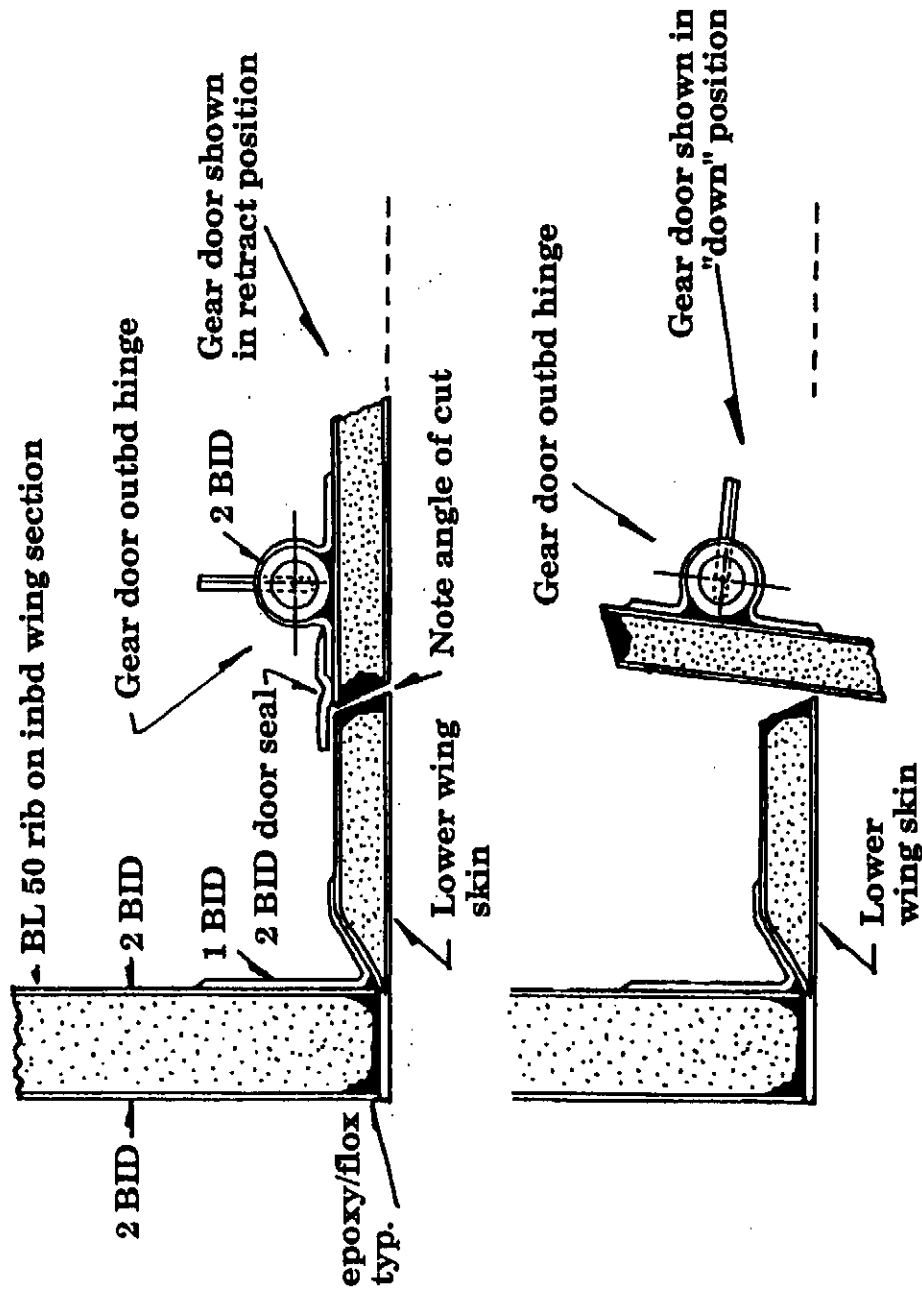
2. With the plane in the inverted position, cut the full gear door shape out of the bottom skin. (GULP!)

NOTE: The main gear door cut lines can be straight (perpendicularly) through the core but the outbd cut mark (the one along the outbd hinge line, fwd to aft) will produce a tighter fit if it is cut at the angle shown on figure 5-8.

This is quite simply done with a fine toothed blade in a sabre saw. Simply angle the sabre saw for the outbd hinge line cut to achieve the above noted angularity.

Gear door cut angles

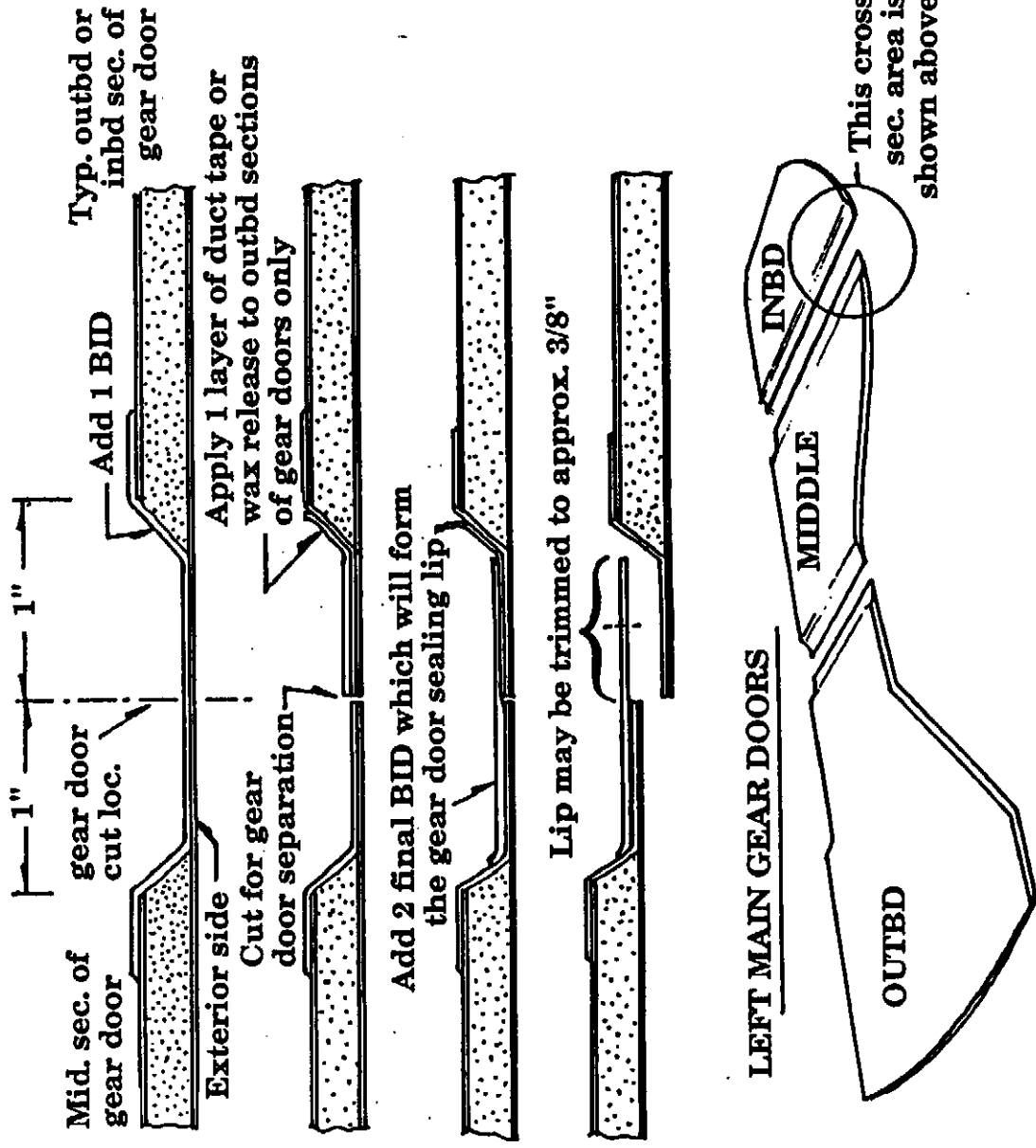
Figure 5-8



Do not make the two cuts yet which will separate the door area into its three separate pieces. This can be made after the full door piece is removed from the bottom skin.

3. With the doors cut out, return the plane to the upright position.
4. On the inside of the full gear door cut out piece, mark the location of the two separate cuts and on each side of the mark draw a line 1" away and parallel, see figure 5-9.
5. Scrape away the core material from the inside of the gear door per figure 5-9.
6. Add a 1 ply BID across this area and allow to cure.

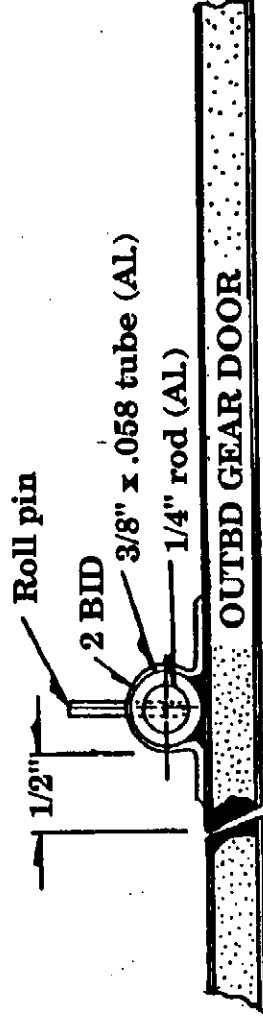
Gear doors
Figure 5-9



7. Next cut the doors apart on the original cut lines.
8. Cover the two outbd doors and inbd doors with duct tape along the just cut edge.
9. Add a 2 BID tape 1.5" wide across the area per figure 5-9. These tapes will permanently bond to the middle gear door and form an extending lip onto which the other two doors will seat.
10. When the 2 BID tape has cured, pop the door apart, remove the duct tape and smooth the edges. You now have a custom made lip to seal the three piece door together when the gear is retracted.
11. Now place the outbd door in position and secure with tape or similar.
12. Position the 3/8" tubing per figure 5-11 to form the hinge. This hinge is made of 3/8" x .058 outer tubing with a solid 1/4" inner rod which will extend into similar 3/8" tube sections mounted on the wing skin.
13. To properly align the 3/8" tube, position it so that there is a 1/2" distance from the edge of the gear door to the edge of the tubing (see figure 5-10 for clarity).

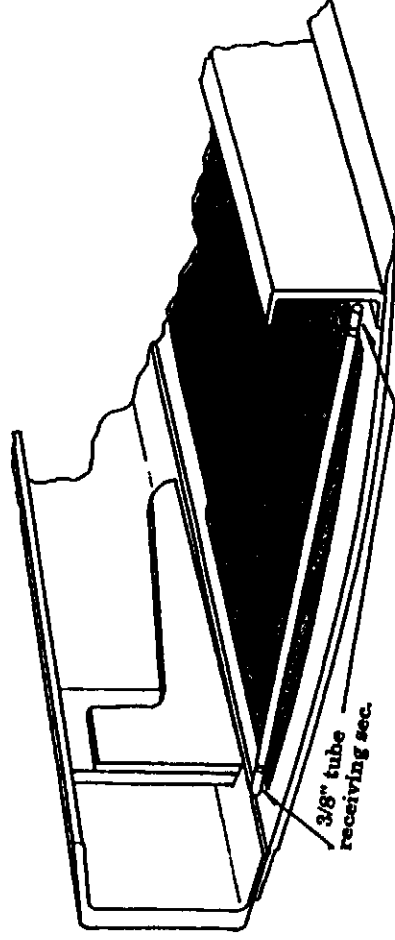
Positioning gear door hinge tube

Figure 5-10



Location of gear door hinge

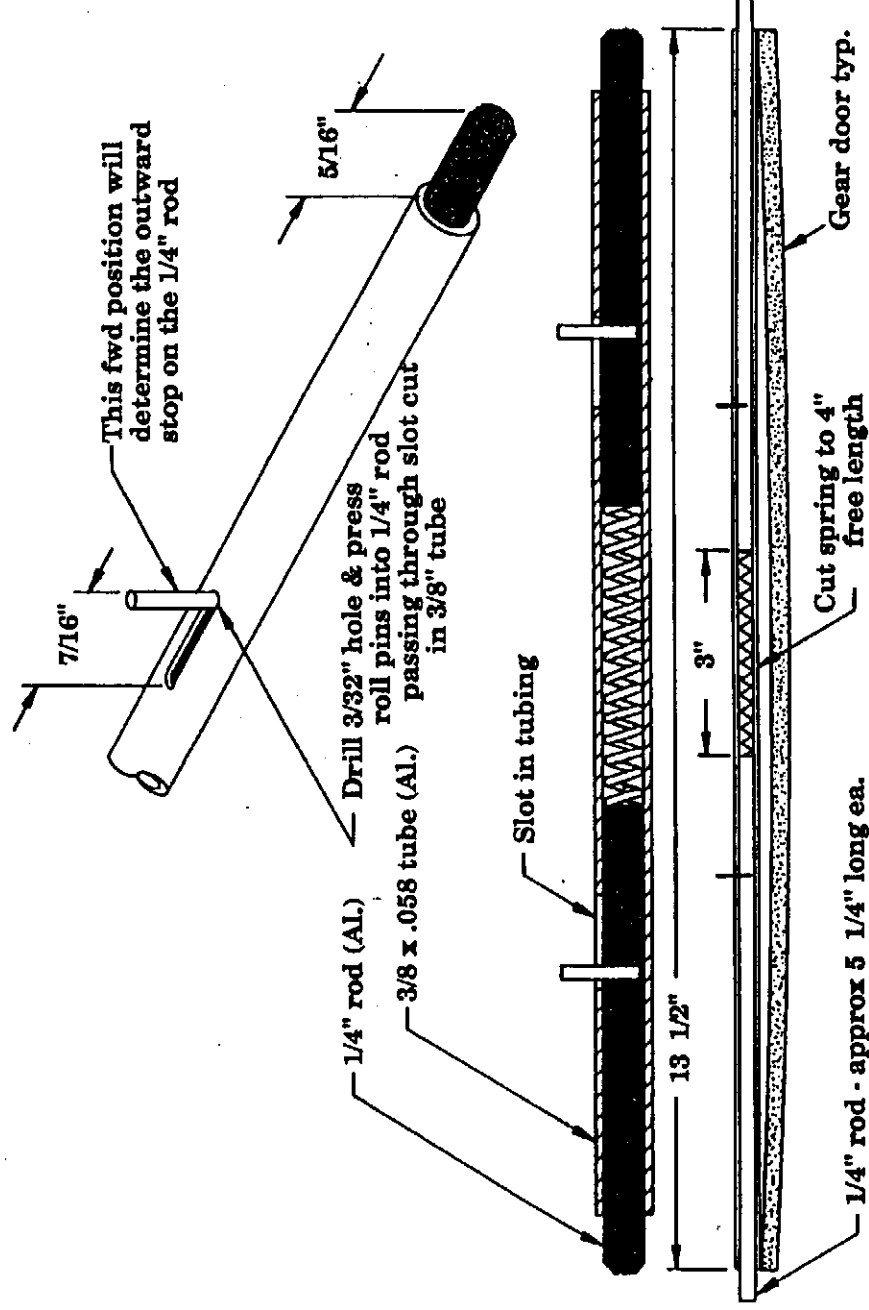
Figure 5-11



14. To check the alignments, use either instant glue or hot glue dabs at each end to temporarily secure the 3/8" tubing in position. Do the same with the small receiving 3/8" tube sections on the wing skin. Insert the 1/4" rod segments and rotate the gear door through a 110° swing check for adequate clearance.
15. When the fit is OK, flux in the area under the 3/8" tubing where the arc of the gear door creates an opening under the tube. Next add a 2 BID layout over the tube contacting the door itself with at least 1/2" of contact per side, where possible.
16. Next cut the slots into the 3/8" tubing with a Dremel or similar small cutter. This slot should extend about 3/4", see figure 5-12.

Outbd gear door hinge assembly

Figure 5-12



17. Drill the 1/4" rod pieces with a 3/32" drill bit to receive the 3/32" roll pin.
18. Slip the rod into the tube until the hole appears in the slot of the tubing. Then pound the roll pin into the rod through the slot.

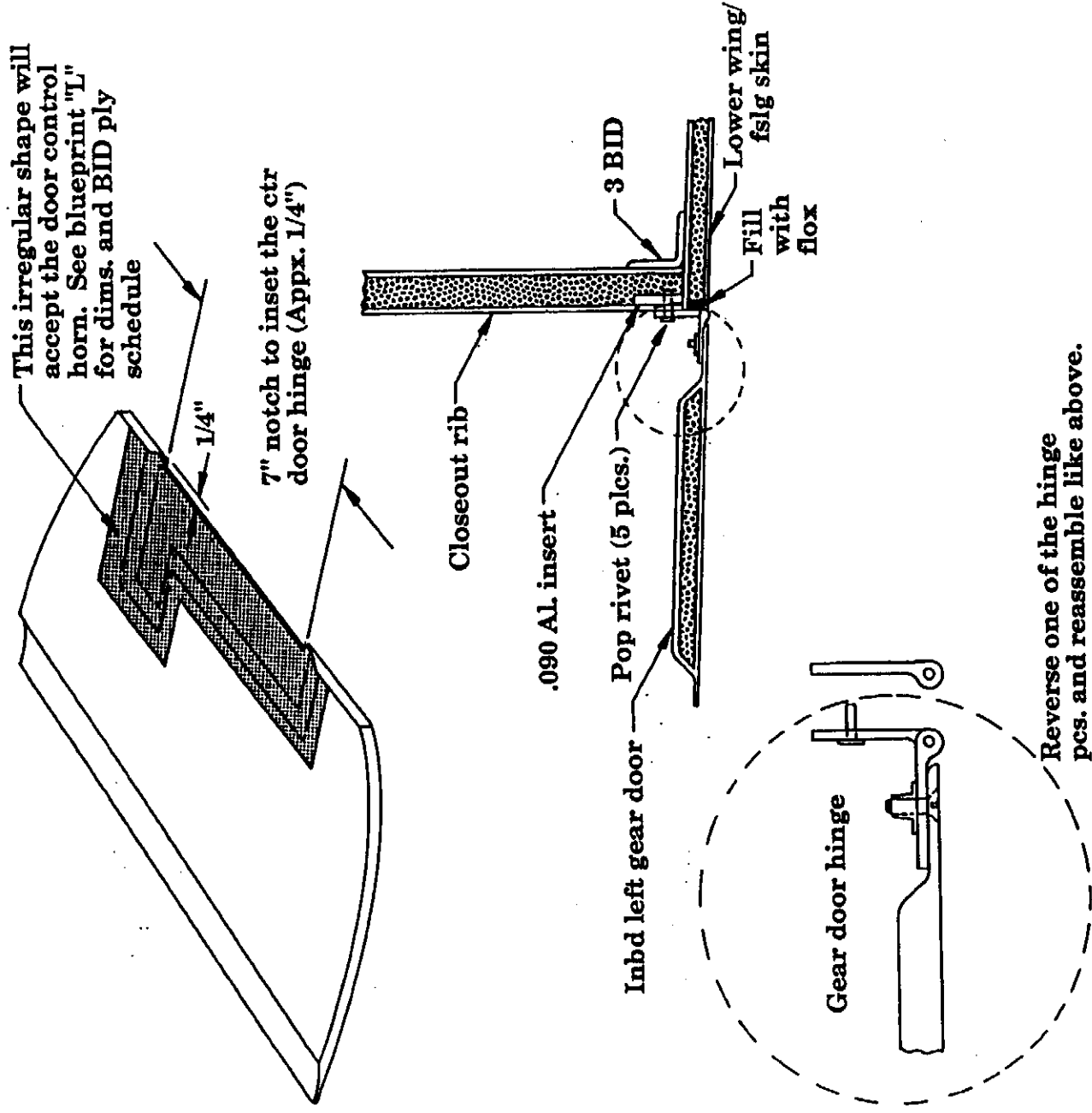
19. Slip the ^{spring} ring into the other end and follow with the rod and roll pin insertion as above. Check that there is adequate spring load on the rods - it doesn't take much, just enough to keep the rods from ever vibrating out. This now forms the spring loaded hinge system which is easily removed from the bottom wing whenever necessary (primarily during wing insertion and removal to provide more working room).
20. Position the inner gear door in preparation for attaching the piano hinge.
21. This door will receive a 7" section of piano hinge as a means of attaching it to the plane. Locate this per figure 5-13.
22. Make the glass-to-glass bond area for the hinge per figure 5-13.
23. Notch the inner gear door and attach the hinge to it using four (4) 8-32 counter sunk machine screws, MS24694-S5, with nut plates. See figure 5-13.

NOTE: The hinge halves must be turned around to establish the proper "pin" orientation shown in figure 5-13.

24. Position the door with the hinge and drill for the attachment to the cockpit closeout rib where the aluminum insert was earlier positioned.
25. This half of the hinge will be pop riveted in 5 places to the closeout rib, see figure 5-13.
26. Adjust/trim for any necessary clearances. The inner door should swing 90°.

Installing gear door hinge

Figure 5-13

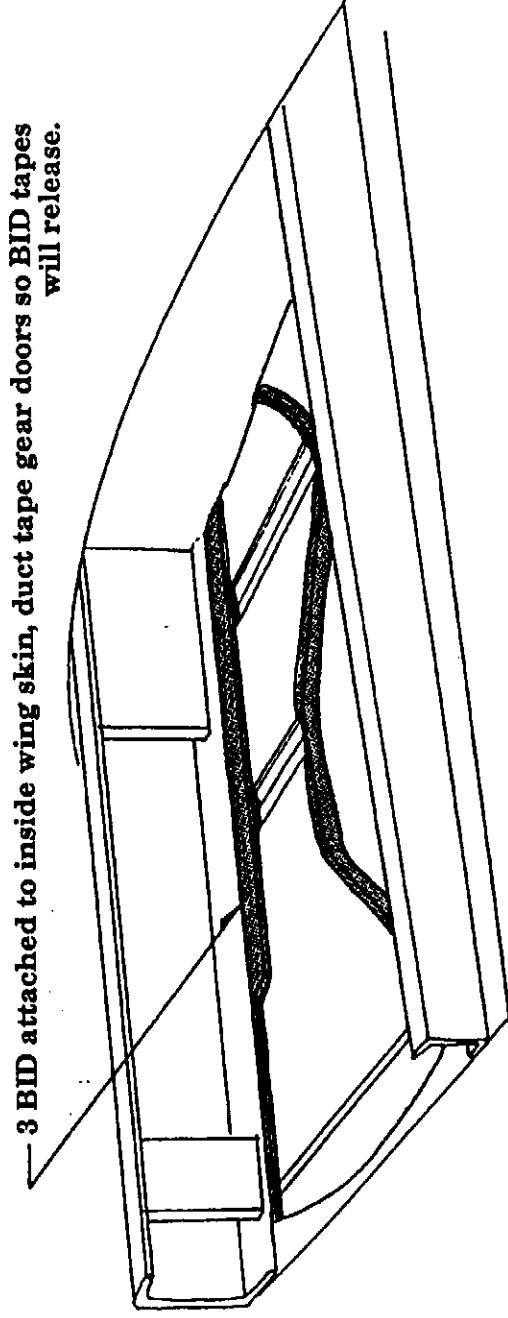


27. Next, place the gear doors in the closed position having first covered their entire edges with duct tape as a release. The doors can be duct taped from the bottom into position or held by any suitable means. They should be in a good flush fitting position.

28. Add a 3 BID tape all around the perimeter of the gear doors creating a permanent bond to the inner wing skin. The duct tape will allow a full release where contact is made to the gear doors themselves. See figure 5-14.

Forming glass lip for gear doors

Figure 5-14

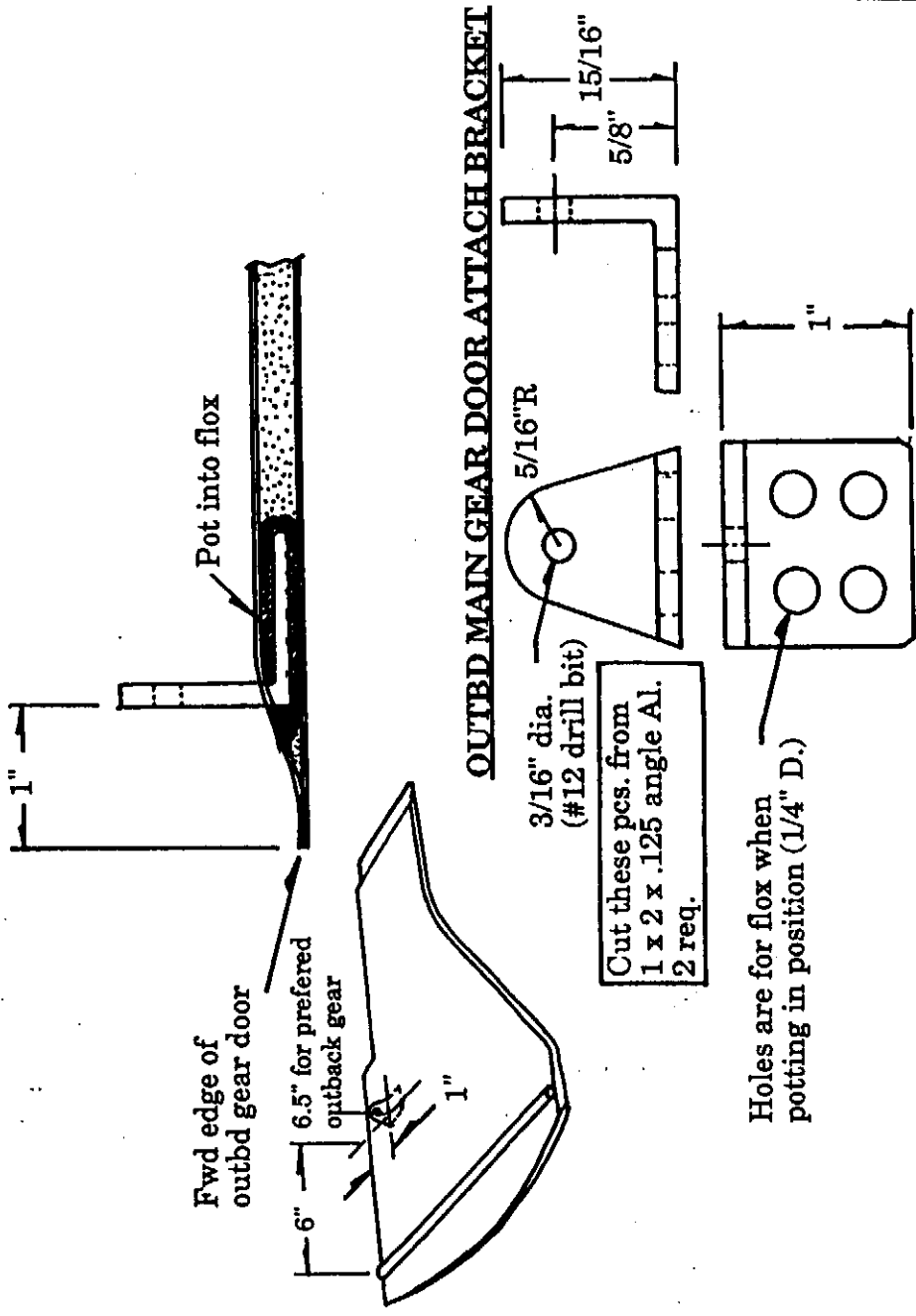


29. When cured, pop the gear doors out and finish off the glass lip which will now form the custom seal all around.
- Note: The seal lip will have to be trimmed out for clearance around the over center links - just clearance where necessary. The lip need not extend more than 1/4" to 3/8" onto the gear doors.
30. Finally, finish off the gear door and wing cut out areas by digging out about 1/8" of core material and filling with flox. Sand this smooth after cure.
- NOTE: The ctr section of the main gear doors will be fit later. It will bolt directly to the gear leg casting.

1. On the outer gear door, mark the position which is 6" from the hinge point. This is where the aluminum angle bracket will be potted in to receive the gear door push rod, see figure 5-15.

Potting angle bracket in main gear door

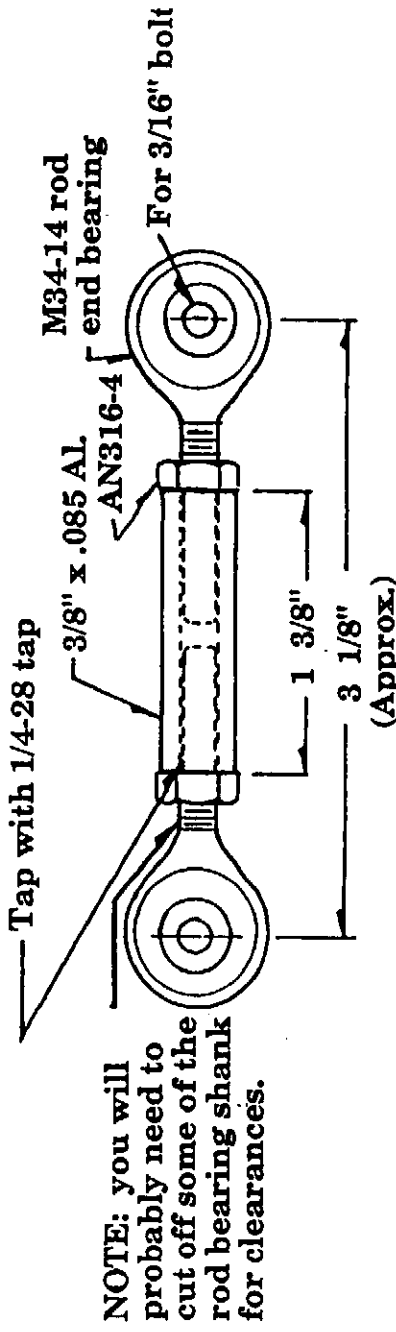
Figure 5-15



2. Make sure the push rod and bracket are per figures 5-15 and 5-16.
3. Insert the bracket by slicing the inner gear door skin and pushing the aluminum bracket into the core material area.
4. Pot the aluminum bracket into the gear door per figure 5-15.

Outboard main gear door push rods

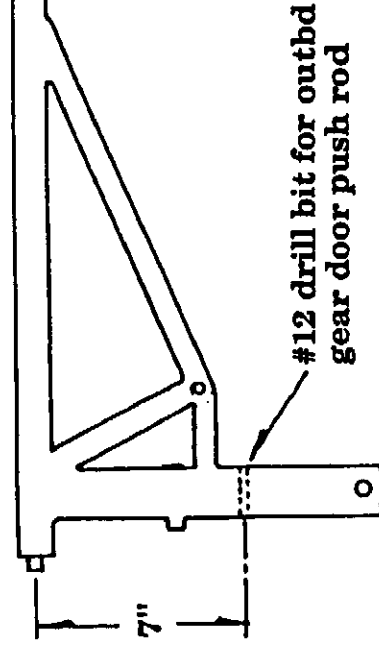
Figure 5-16



5. Mark and drill the main gear leg at the 7" position measured down from it's pivot center. Use a #12 drill bit. This is where the rod end bearing on the push rod will attach to the fwd face of the gear leg.
6. It is best to wait to adjust the gear door push rod until the upper wing skin is positioned since it will establish the actual gear stop in the retracted position and this will in turn establish the proper length adjustment of the outer gear door push rod. Later, when the plane is inverted and the inner top wing skin is mounted, you will have an easy time of adjusting this push rod and also mounting the remaining ctr door to the gear leg casting.

Drilling main gear leg for rod end bearing

Figure 5-17



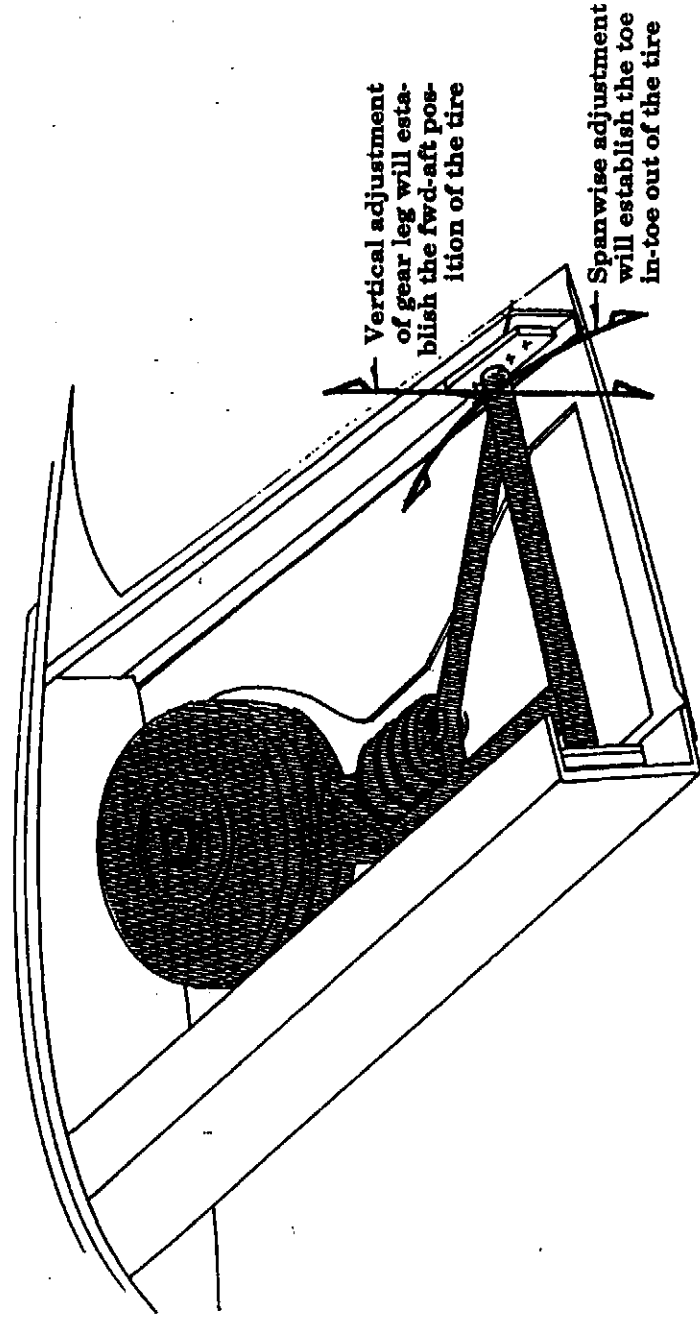
G. Main gear aft attach point

The final main landing gear alignment will be established by the positioning of this aft attach point. There will be two machine screws which will be permanent installations per aft attach point and also two AN4 bolts which will serve to hold both the aft attach plate and the outbd wing attach plate to the ctr aft spar, see figures 5-21 and 5-22.

1. First level the fslg in the upright position. Leave room for the landing gear to swing through its 90° arc from full retract to full down.
2. Position the landing gear with brake and tire assembly in place at the fwd primary attach point by inserting the pivot stub on the upper gear strut (black weldment piece) into the GM4 plate.
3. Slip the aft attach plate onto the aft end of the upper gear strut and place this end in approximate position against the ctr aft spar.

Positioning landing gear

Figure 5-18



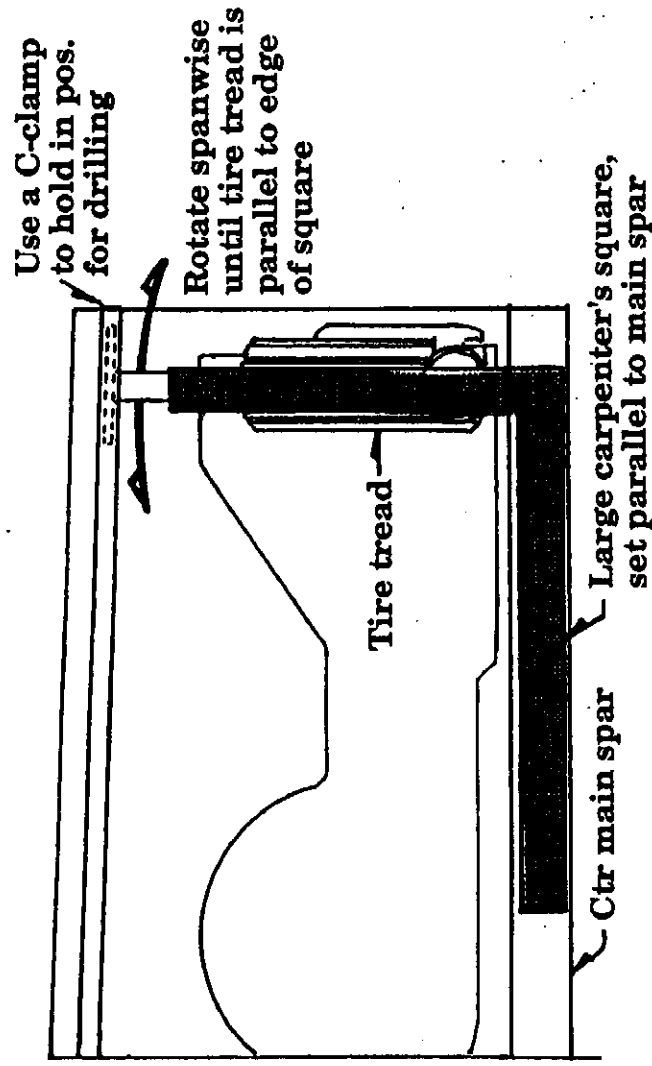
4. Using a carpenters square (the larger the better), check the alignment of the TIRE by sighting down from above while the gear is in the down position, see figure 5-19.

The carpenter's square should have one side in alignment with the center main spar and the other (perpendicular) side used to align with the tread of the tires. When this alignment is achieved between the tire tread and the square, the tire will be tracking parallel to the center line of the aircraft.

Use a C-clamp to lightly clamp the aft attach plate against the center aft spar.

Checking TIRE alignment

Figure 5-19



5. Now swing the gear through its 90° arc to the retract position. Since the top wing skin is not yet on, this retract position can not be found with absolute precision but it doesn't matter at this point in time.

Check that the gear has adequate clearance from the center main spar while in the retract position. The upper gear strut should be "relatively" parallel to the spar cap and a couple of inches aft of the spar itself.

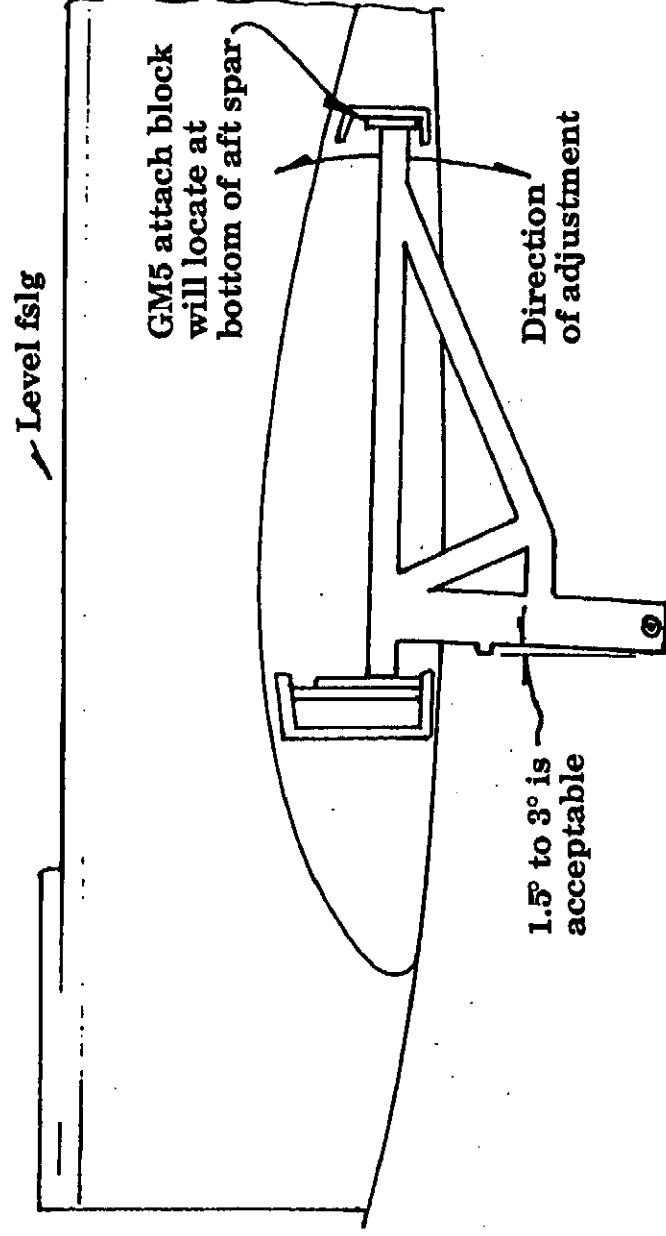
6. Next, swing the gear back down. Sighting from the side, the gear strut should be approximately vertical, see figure 5-20. It is acceptable if the gear is swung forward slightly but it should not be aft of vertical.

Also check this fwd to aft condition (in the down position) between the two gear struts. This can be easily accomplished by standing at the approximate position of under one wing tip spar and sighting across the plane. Note the relative angle between the two gear struts; they should be in a parallel condition. Make any adjustments necessary to achieve these above conditions.

7. When the positioning is achieved, clamp the aft attach plates securely in preparation for drilling.

Positioning gear strut to vertical

Figure 5-20



8. Using a 1/4" drill bit, mark off the first two attach locations per figure 5-22 and drill from the aft side of the ctr aft spar. Once the drill has reached the aluminum aft gear attach plate and left a mark, the attach plate may then be removed and the drilling completed in a bench which may prove to be easier. You must obviously be sure that you are drilling "straight" through the assembly or else the holes will not align properly.

There is also a 1/4" piece of aluminum inside the ctr aft spar web at this outbd gear attach position so be patient while drilling and don't allow the drill to lean back and forth while drilling or the holes will become elongated and sloppy.

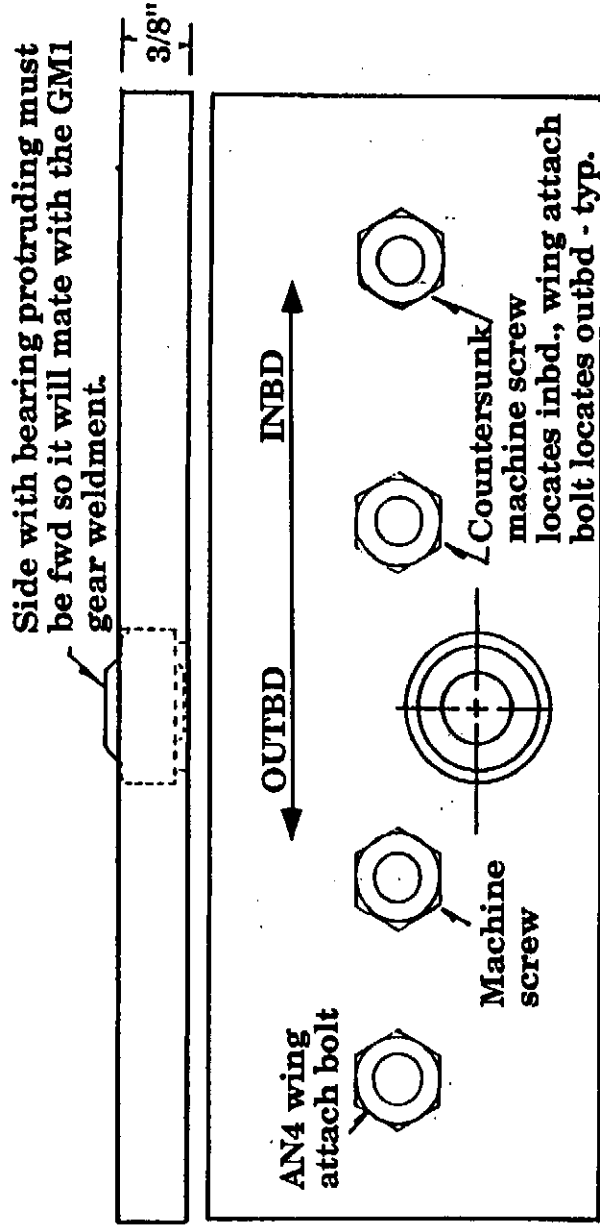
These first two attach holes will be closest (on either side) to the gear strut itself. They will receive the 1/4" machine screws. They will require a 100° counter sink from the aft side of the ctr aft spar, see figure 5-22.

These machine screws should be positioned as close as possible to the gear strut in order to leave the most possible room for the second set of AN4 bolts which will follow later as the outbd wing attach bolts for the aft spar.

NOTE: Make a spot check now to verify that there will be sufficient room for the two remaining 1/4" attach bolts. They must be solidly through the aluminum web insert and GM5 gear attach plate.

Main gear aft attach plate

Figure 5-21



NOTE: GM5 plate orientation is such that the pivot bearing will mount outbd and to the bottom of the plate. The bearing block shoulder should be to the aft side.

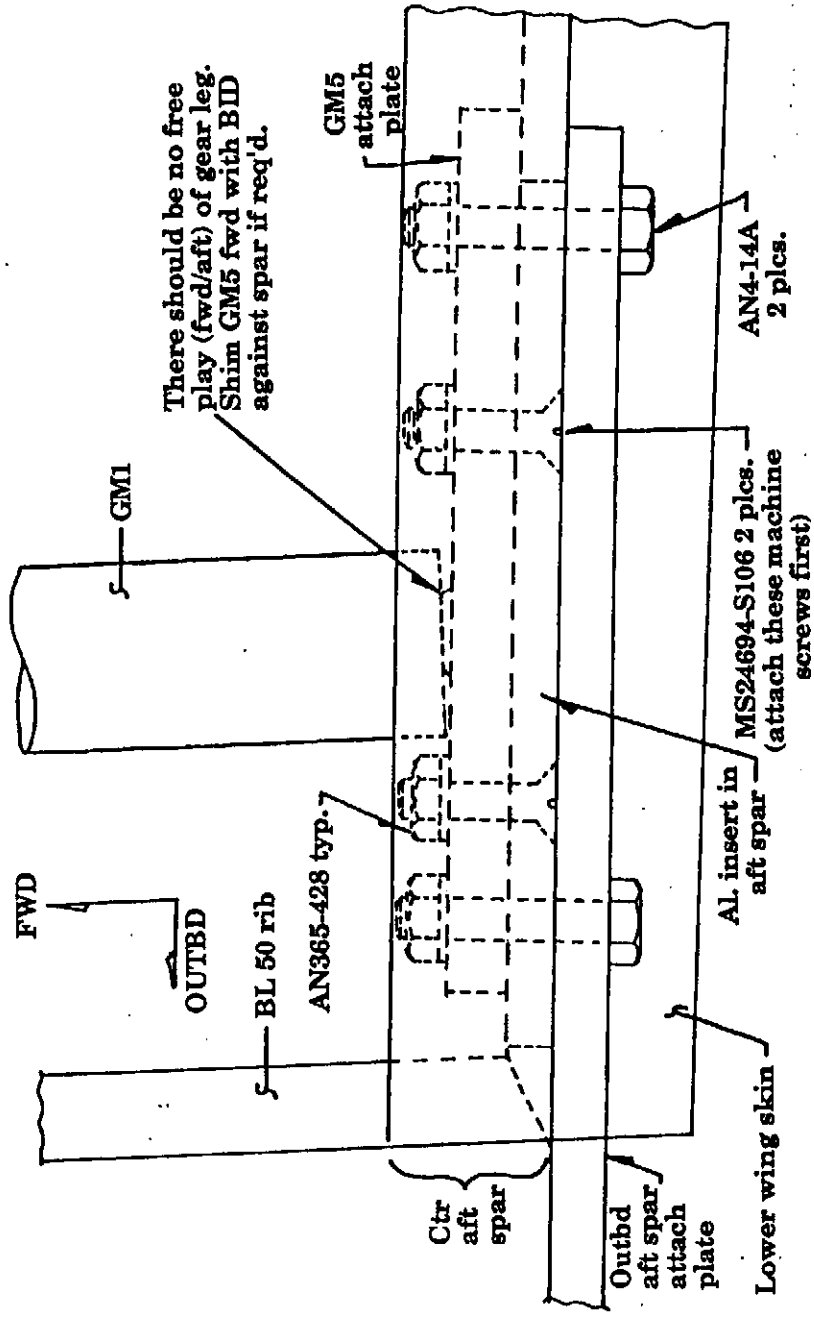
NOTE: The four 1/4" bolt attach points are not critical regarding location.

9. With the first attach holes drilled and countersunk, the machine screws may be bolted in position thus locking the gear to the wing.

Main gear aft attach

(top view, left side)

Figure 5-22



H. Main gear over center links

1. With the gear in position, assemble and attach the over center links using the 3/8" bolts (see figure 5-6 and 5-2. P5-14 + P5-6

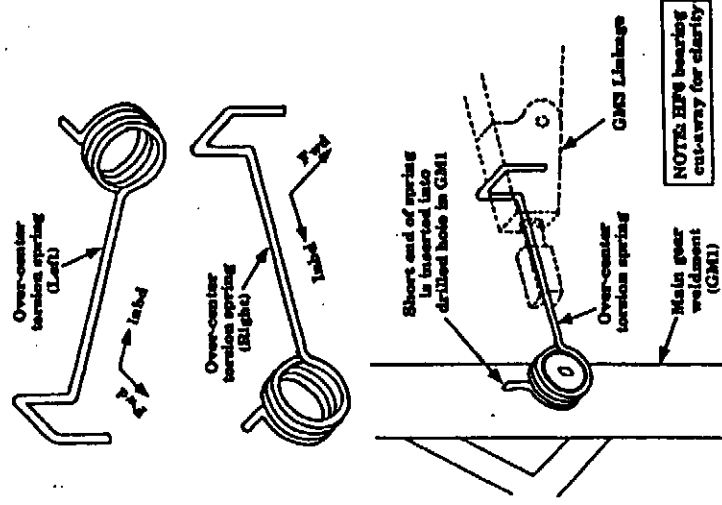
Be absolutely sure that you have the correct link assembly on the correct side (refer back to over center link assembly drawing). The pin must be on the FWD face of the upper link and the shoulder of the bearing hole **must** be on the AFT face of the link for proper operation. The pin will later be adjusted to trip the micro switch to indicate "down and locked".

Check the clearances by cycling the gear up and down several times by hand. Be sure that the slight rocking motion allowed for on the over center link assemblies is within limits by not interfering with the GM4 attach plate, see figure 5-24.

2. Adjust the lower rod end on the links until the tire/wheel is in the vertical position relative to the ground. Tighten the check nut against the rod end bearing. Do not sight vertically against the lower wing as a reference since it has a three degree dihedral in it.
3. Install the overcenter torsion springs. These maintain pressure on the links and assist in a free fall mode.

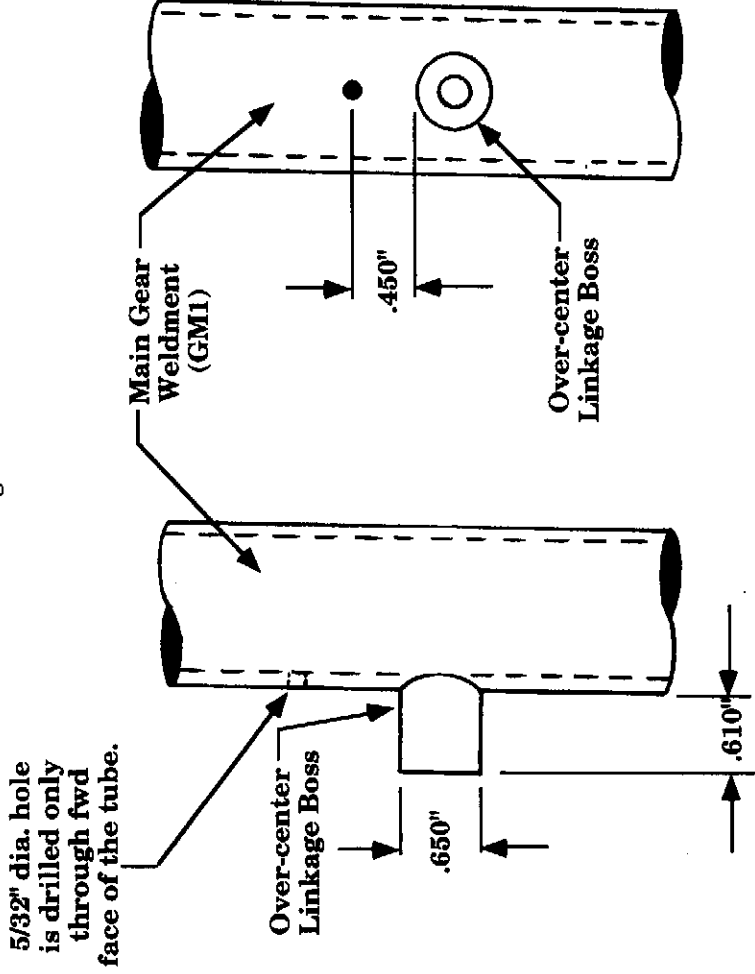
Overcenter link springs

Figure 5-22.1



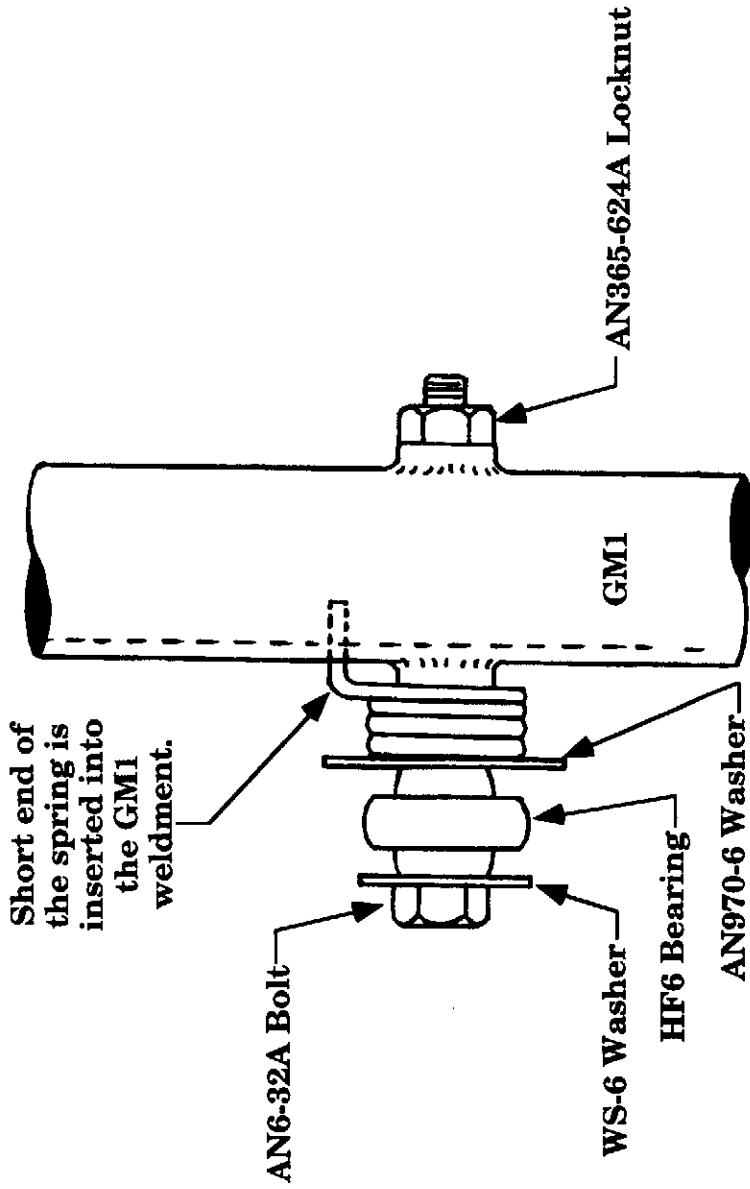
Springs Attach to Gear Weldment

Figure 5-22.2



Spring/Gear Weldment x/c

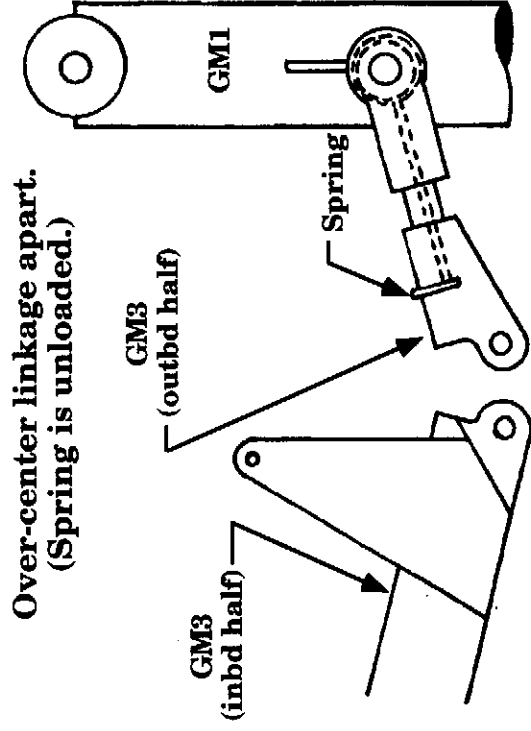
Figure 5-22.3



4. Locate and center punch a spot on the gear weldment per Figure 5-22.2 and drill through only the fwd wall of the tube with a 5/32" bit. The hole position is somewhat critical so measure accurately.
5. As a chafe guard, cut and install a 1/2" length of heat shrink tubing over the boss on the gear. Use a heat gun to shrink the tubing until it's tight on the boss.
6. Slide the torsion spring onto the weldment boss with the short end of the spring in the 5/32" hole. The other end will be spring loaded over the lower end of the overcenter link assembly. The WS-6 and AN970-6 washers, also secure the position on the boss.

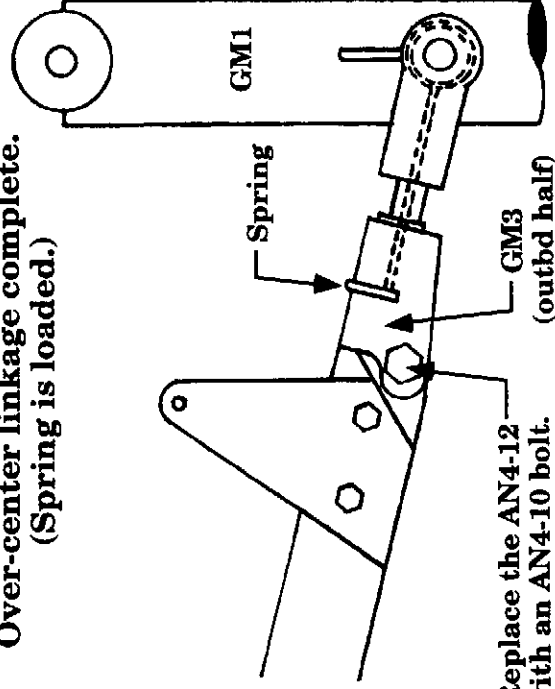
Spring Attach to Overcenter Links

Figure 5-22.4



**Over-center linkage apart.
(Spring is unloaded.)**

**Over-center linkage complete.
(Spring is loaded.)**



Replace the AN4-12
with an AN4-10 bolt.
Put an AN960-10
washer under the
castle nut.

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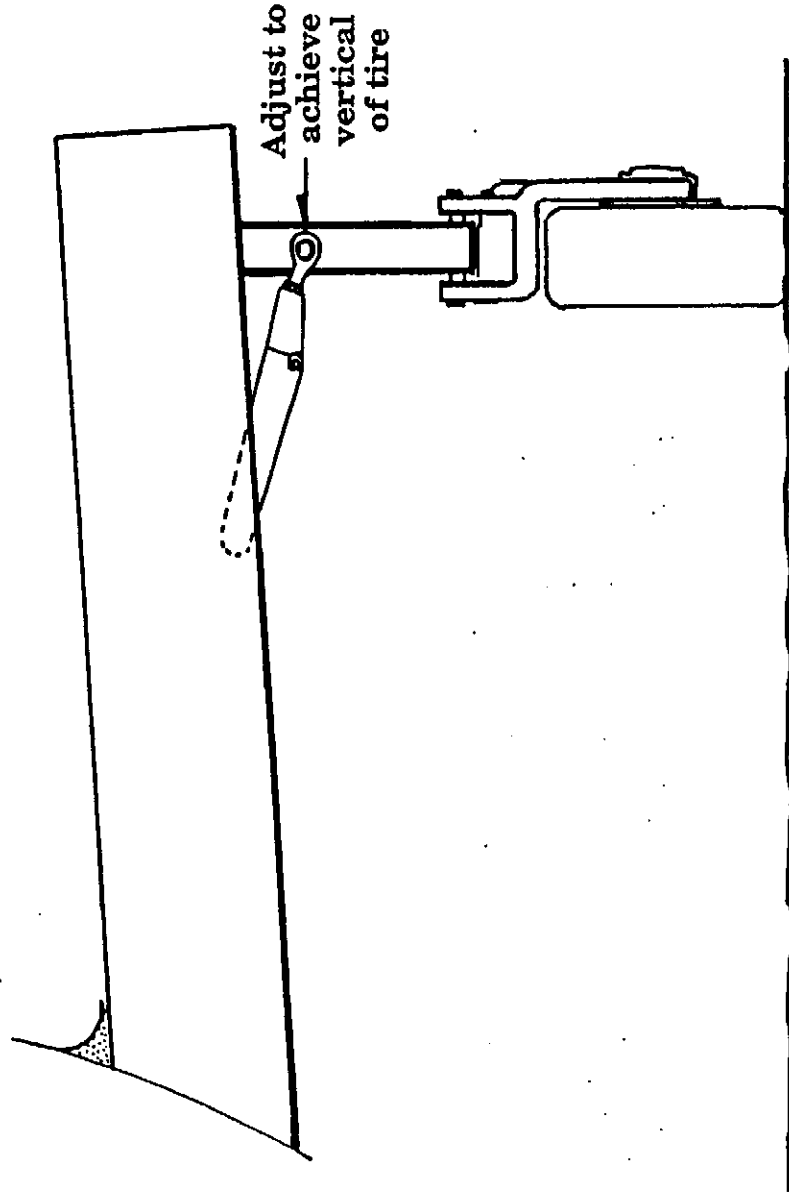
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LANDING GEAR INSTALLATION

7. Secure the outbd half of the GM3 to the weldment boss with a WS-6 washer on each side of the bearing. Tighten the AN6-32A bolt.
8. Hook the long end of the torsion spring over the outbd half of the GM3. Connect the halves of the GM3 assembly with the AN4-10 bolt. Be sure that there is a little lube in the swivel area of the GM3 assembly and that there is no binding.

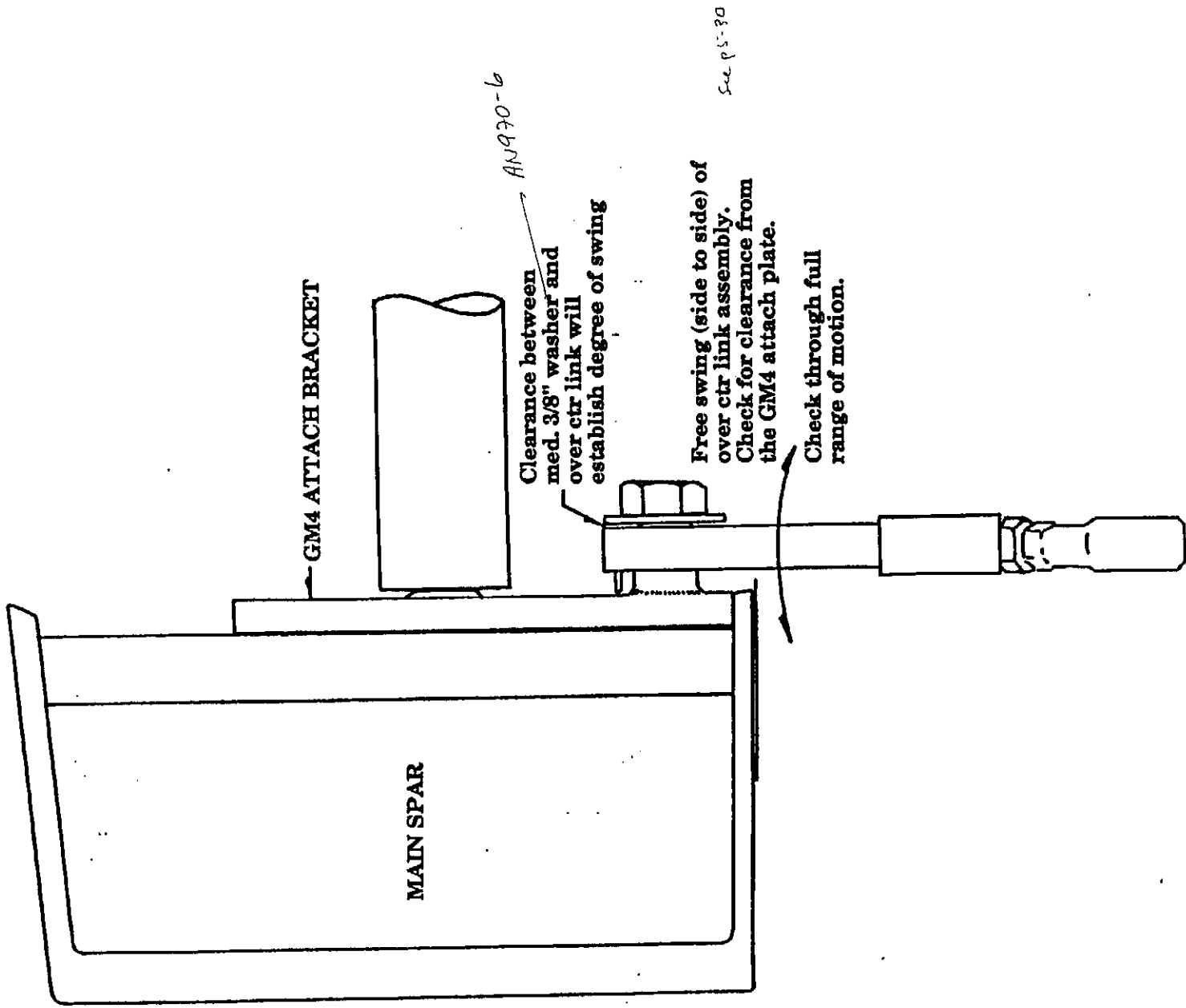
Attaching springs to gear leg

Figure 5-23



Strut clearance and travel

Figure 5-24



Nose gear assembly drawing

Figure 5-25

Description	Qty	Pt. #
3/8" steel pin	1	1
AN970-6	2	2
AN3-12A	2	3
AN4-12A	1	4
AN4-17	1	5
AN3-5A	2	6
AN4-11	1	7
AN4-11A	2	8
AN4-11	1	9
Steel sleeve	1	10
AN4-45A	1	11
AN4-64A	1	12
AN365-103Z	4	13
AN365-428	5	14
AN310-4	3	15
AN526-103ZR6	4	16

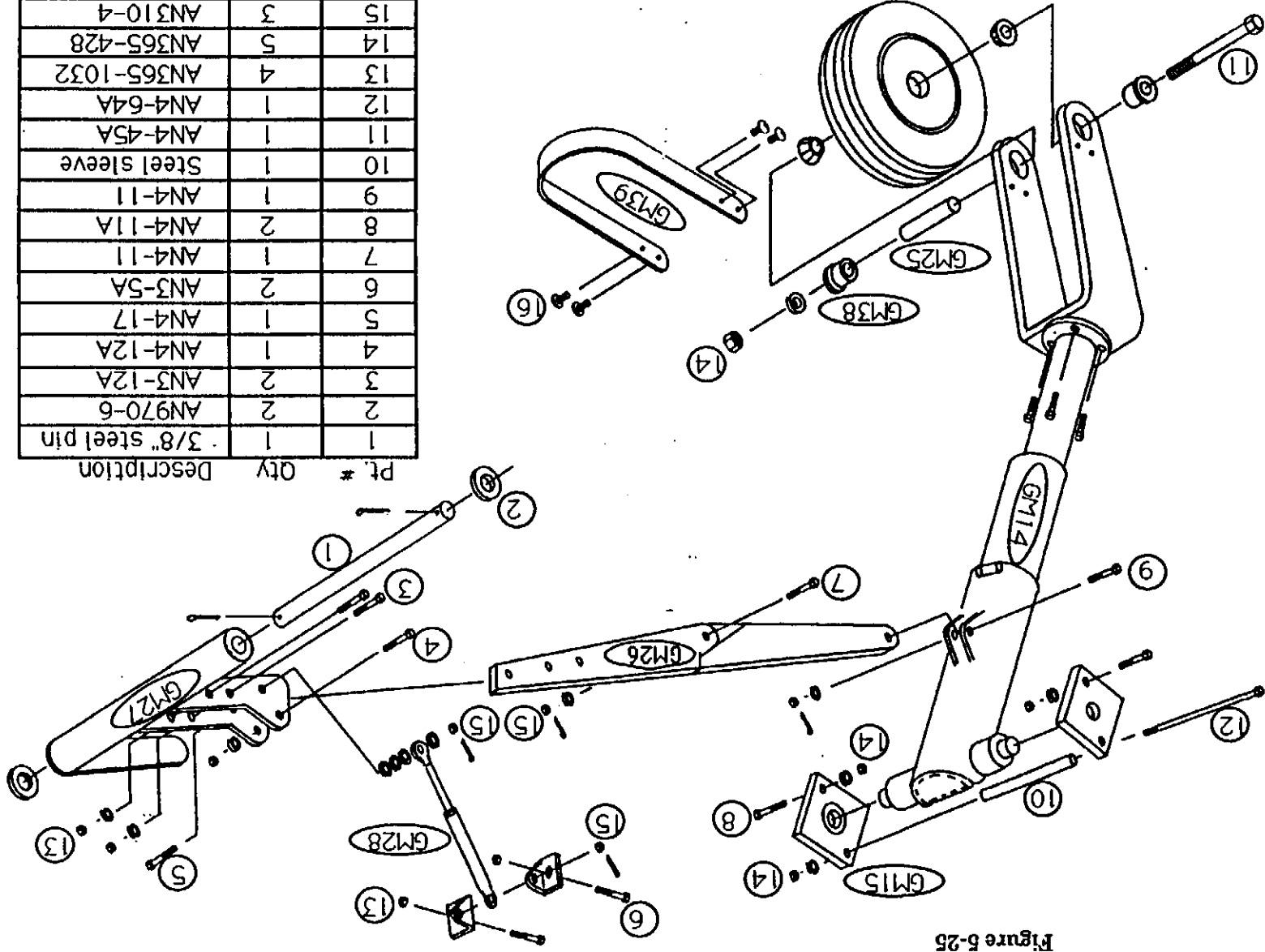


Figure 5-25

NOSE GEAR ASSEMBLY BREAKDOWN

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Nose gear assembly / engine mount

This section will contain assembly information for the model 320 nose gear and engine mount installation.

I. Nose gear strut assembly

1. The Lancair 320 nose gear strut is the air / oleo type and will arrive fully charged with all kits. The internal pressure setting may be adjusted depending on type of prop used (and the resultant airframe weight) etc. but we suggest that no changes be made until the plane has been taxi run for a few hours. The strut will likely remain in its fully extended position during airframe assembly, even after the engine has been installed. This will result in a pronounced nose up ground attitude. With the weight of the constant speed propeller (about 58 lbs.), along with a "break in" of the internal seals, the strut should end up compressing about 3/4" - 1" when in the static load condition.

2. This strut has no scissors links and is fully internally shimmy dampening.

WARNING: This strut assembly must not be taken apart. It is considered to be NON field repairable. Should adjustments other than the air charge be deemed necessary, it should be returned either to Neico Aviation or directly to Esco, its manufacturer. Any disassembly of the shimmy dampening chamber at the bottom will ruin its internal integrity and allow the possibility of a shimmy condition, thus the plane must not be flown until Esco has re-assembled the unit. There should be no reason to disassemble this unit.

3. Select the nose wheel halves and their three bolts along with the two timken bearings. Install the inner tube into the tire by first applying just a small bit of air into the tube. Just add enough to get the wrinkles out of the tube. Too much air will make assembly difficult.

4. Push one side of the wheel through the tire / tube.

5. In order to prevent the chance of getting a pinched tube during assembly of the second wheel half, use a piece of thin cardboard (cereal box type) as a liner. This piece should be about 3" wide and long enough to go around the interior of the wheel, between it and the tube. See figure 5-26.

6. With the cardboard insert in position, the second half of the wheel can be pushed into position with it inside of the cardboard piece that is sticking up. This will prevent a pinched tube.

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Chapter 5

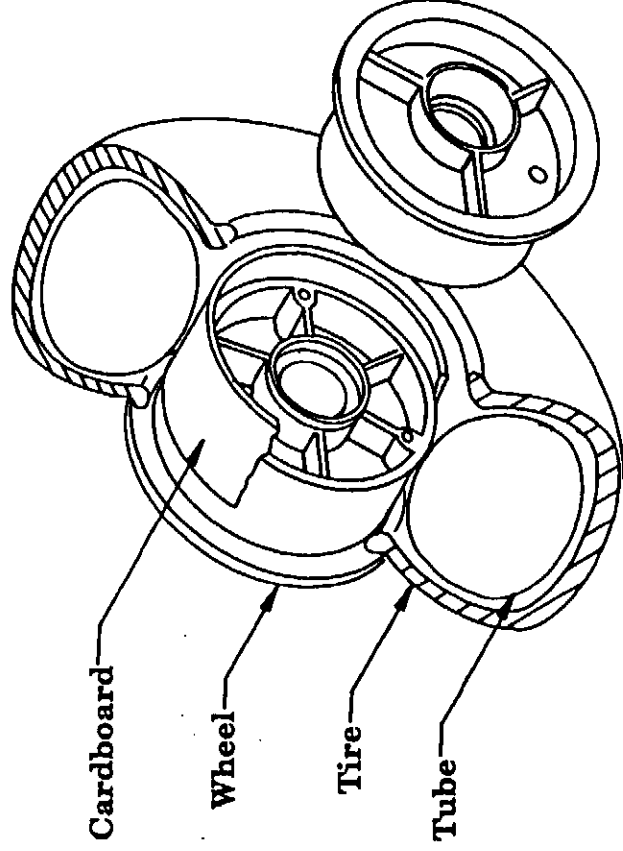
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LANDING GEAR INSTALLATION

Wheel & tire Assembly

Figure 5-26



7. Install the three nose wheel connecting bolts and tighten them securely. Then inflate the tire to 35 lbs.
 8. Slip the timken bearings into position on the wheel and insert the steel tubular nose gear axle, GM25. The bearing must have axle grease packing prior to assembly.
 9. Position the above assembly into the fork and insert the two axle plugs, GM38. These plugs will slip over the axle.
 10. Insert the AN4 bolt and tighten it up until the wheel drag becomes such that with a good spin on the tire, not more than one free revolution results. (However, you should first install the tire strap before tightening the through bolt, see step 11 since it will align the two axle plugs and prevent them from spinning.)
 11. Place a small dab of paint or equiv. over the nut and end of bolt. This provides a visual check to verify that the nut is not loosening during flight operations.
- WARNING:** The nose gear wheel must have sufficient friction (as described above in step 10) to prevent possible shimmy. Failure to keep the wheel properly snugged could result in shimmy. This must be checked on a regular basis by having someone push the tail down momentarily while you check the rotational resistance on the wheel.

12. Install the tire strap that fits around the back of the nose gear tire and attaches to the fork on each side. Note that this fork is the means by which the GM38 axle plug is prevented from rotating. Align the flat spot on the side of the GM38 axle plug with the tire strap.

This strap will help guide the wheel into the nose gear tunnel in the unlikely event of a turned wheel after lift off.

Called Orin at Lancair 17.XI.99. He said the new self centering struts do not use the tire straps. The tire tabs that are with the strut are used to lock the GM38 axle plugs.

J. Engine mount / nose gear attach & align

1. The firewall has been marked for engine mount primary attach points (the 4 perimeter points). Note that there are two additional attach points (one on each side of the tunnel), see figure 5-27.
2. It is best to first drill only 1/8" pilot holes for the primary mount attach holes in the firewall. Use the mount itself as a final hole position check. The holes could easily be off just a little since, even with stress relieving, some "pull" will result in the engine mounts. Do not force the mount to attempt to align with the markings, simply average the differences and drill accordingly. The holes should not be off by more than 1/4" in any plane or direction though.

The mount may be bolted into temporary position. The final installation will require the fiberfrax and stainless over the firewall before the mount is attached permanently. The fwd deck should be clecoed into position and the 2 BID attach tapes applied such that they are bonded to the firewall and "released" from the fwd deck lip. Use duct tape or plastic tape as a release. You will thus have a mating flange bonded to the firewall which will allow you to proceed ahead and add the fiberfrax, stainless and mount. Later the fwd deck can be permanently attached using structural adhesive along the flange on the firewall. The fwd deck should not be bonded on until the wiring is completed, etc. Also, you may wish to make te fwd deck removable as is outlined in chapter 11.

3. Trim and fit the fiberfrax and stainless steel. These materials can be mounted using high temp. silicone squeegeed on between layers.

NOTE: Save the left over pieces, you'll need them in chapter 21 for shielding in the nose gear tunnel.

GM15

4. Position the nose gear assembly on the mount using the GM5 attach plates. Clamp into temporary position with small C-clamps to make ready for final adjustments.

* 3 BID ? see 11-11

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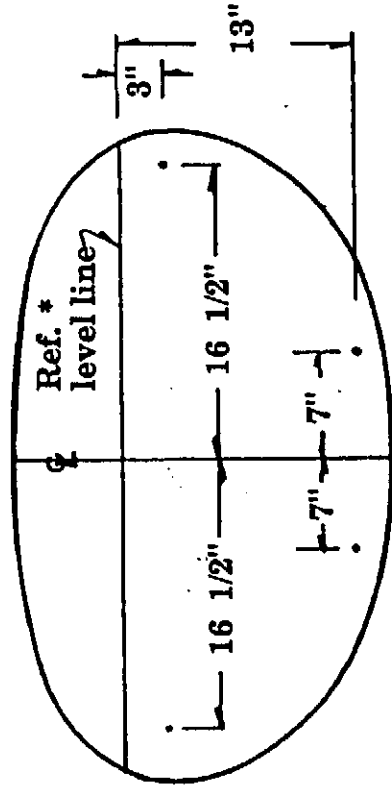
Chapter 5

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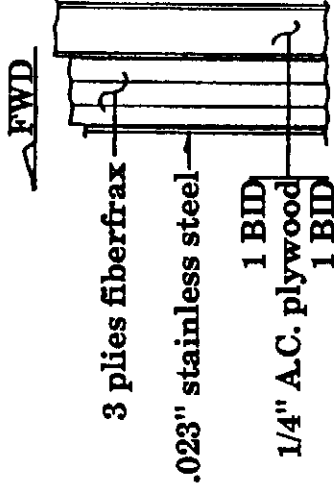
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LANDING GEAR INSTALLATION

Firewall layout
Figure 5-27

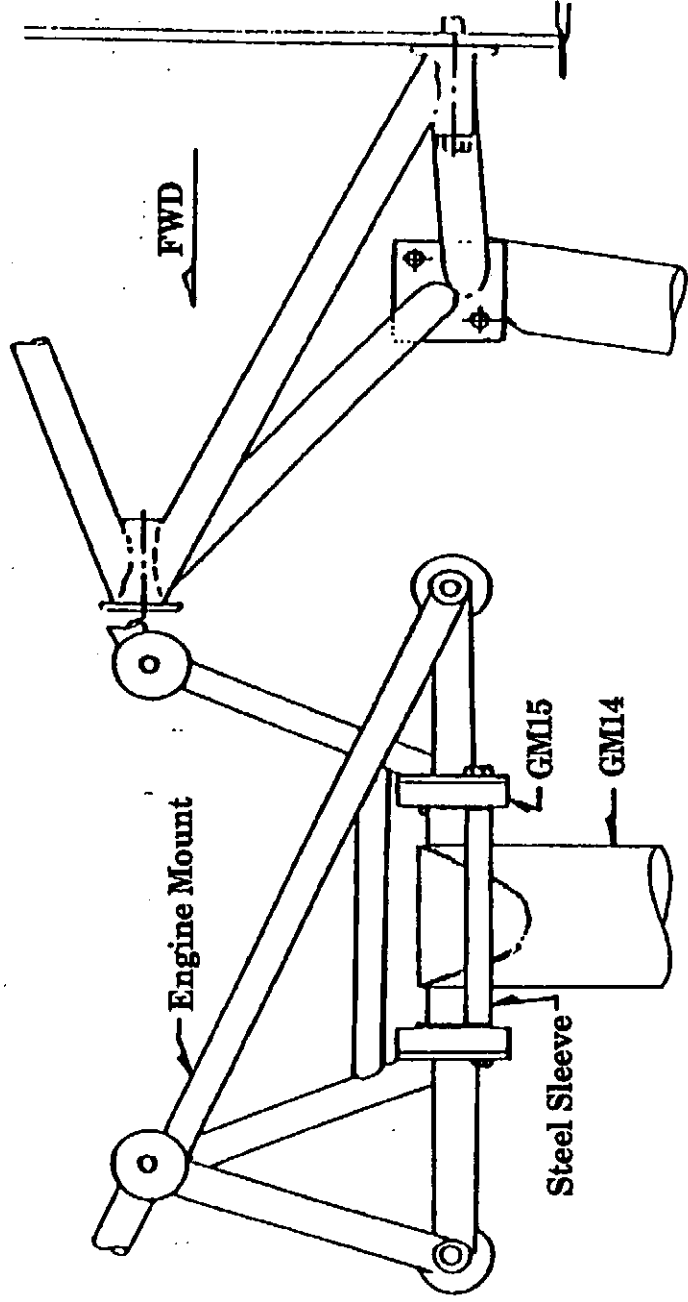


**FIREWALL DETAIL
CROSS SECTIONAL VIEW**



*NOTE: Level line is for reference purposes only.
It does not align with longerons, etc.

Nose gear / engine mount
Figure 5-28



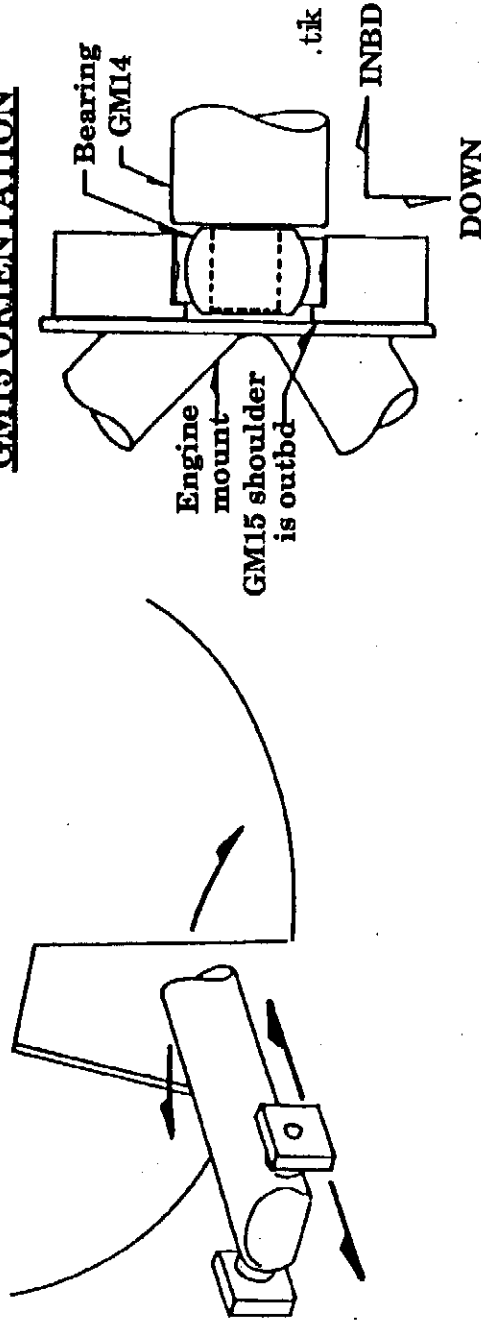
NOTE: There are two directions which affect the positioning of the nose gear for proper alignment on the engine mount.

5. FWD to aft adjustment (see figure 5-29).

This will align primarily the side to side positioning of the assembly for proper retraction into the nose gear tunnel. It should be set with the gear held up into the tunnel in the retracted position. Adjust it until the wheel is centered in the tunnel. If there were to be any direction off at center preferred, it would be to the left (or pilot's side) since that will move it farther away from the gear door and its hinge.

Nose gear adjustment

(As it relates to proper alignment in the tunnel)
Figure 5-29



a. When installing the GM15 attach blocks onto the nose gear strut (GM14) note per figure 5-30 that the shoulder portion of that attach block should be toward the outside of the strut and against the engine mount.

(Also, early model 320 struts will require washers as shims to achieve a snug fit into and between the engine mount pick up pads. Use the supplied AN960 washers. These should be slid onto the GM14 pivot ends prior to installing the GM15 bearing blocks on the strut for a snug fit into the engine mount.

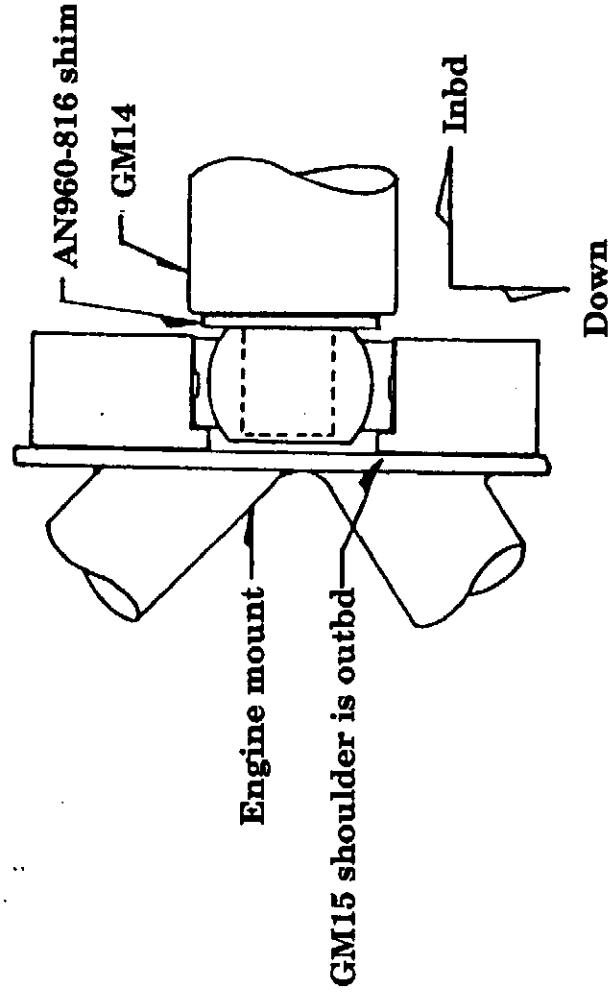
WARNING: No more than two washers per side can be used as shims. Additional spacing could create excessive bending loads and possible failure.

b. Also, when first clamping the nose strut into approximate position on the engine mount, verify that the AN4 through bolt and its steel sleeve will have adequate clearance room across the front of this assembly. Slight adjustments of GM15 positioning on the engine mount pads can affect this clearance so do make a visual check before drilling for the attach bolt holes.

c. If you were to drill the attachment holes in error, you will have one additional chance to get it right since the GM15 bearing blocks can be rotated 90° thus providing new, un-drilled surfaces for attachment.

Installing GM attach blocks onto the nose gear strut

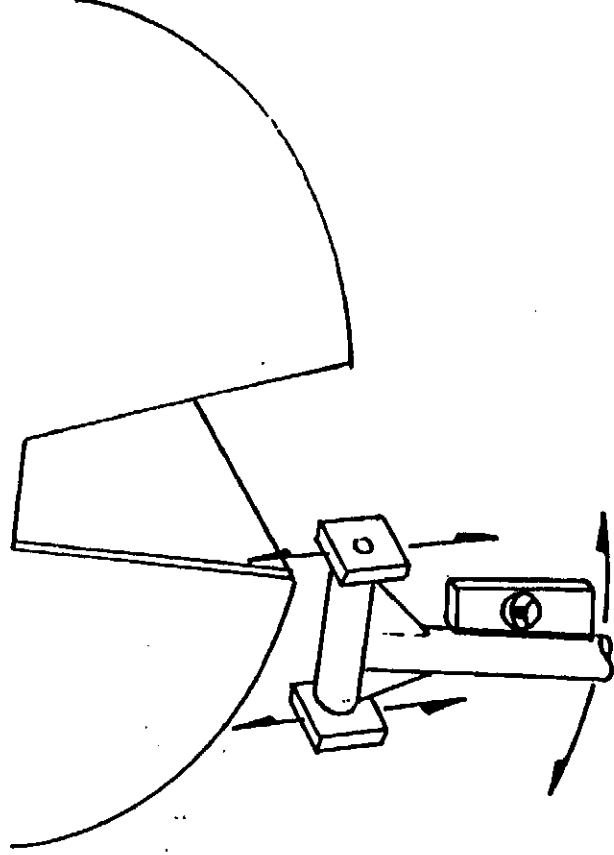
Figure 5-30



Note: Late model Lancair 320's are equipped with "ESCO" manufactured nose gear air/oleo strut assemblies. These struts do not require the above described AN960 washers as shims.

6. Vertical adjustments, see figure 5-31. This will align the vertical (side to side) positioning of the assembly while in the DOWN position. This should be checked with a level while the fuselage is in a level position. To make this check best, hold the gear strut in a down position that is true vertical. This will not be to the fully extended position which is approximately 4° farther fwd.

Nose gear adjustment
(as it relates to vertical alignment)
Figure 5-31



Each of these directions of adjustment will have a cumulative effect on the other. It is therefore necessary to make several small adjustments, checking the total effect after each adjustment.

Alignments are best made by first clamping the GM15 plates with a small C-clamp and then gently tapping these plates with a small hammer in the desired direction of adjustment. Check the effect of the movement after each tap.

Proper alignment will be achieved when the strut is in a true vertical alignment and the assembly swings into the nose gear tunnel with equal clearances on each side.

7. With the proper alignment achieved, tighten the clamps and drill through for the AN4 attach bolts.
8. Note that the engine mount must already be pilot drilled to a 3/16" diameter. The final adjustment location of the GM15 blocks must also be such that these pilot holes are solidly aligned with the GM15. It is best to first drill on through with a 3/16" or #12 bit, then follow with the final .250" drill bit.

9. The forward two attach bolt holes will be secured with one long attach bolt that spans across the mount pick up points. A steel sleeve is supplied with the engine mount which must be installed between the two GM15 plates. Then slip the long AN4 bolt through the entire assembly and tighten down. The sleeve will require some filing to fit. The final fit must be tight between the two GM15's.

10. The two aft bolts are small AN4's that individually hold each GM15. See figure 5-28. P5-40

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K. Nose gear drag link installation

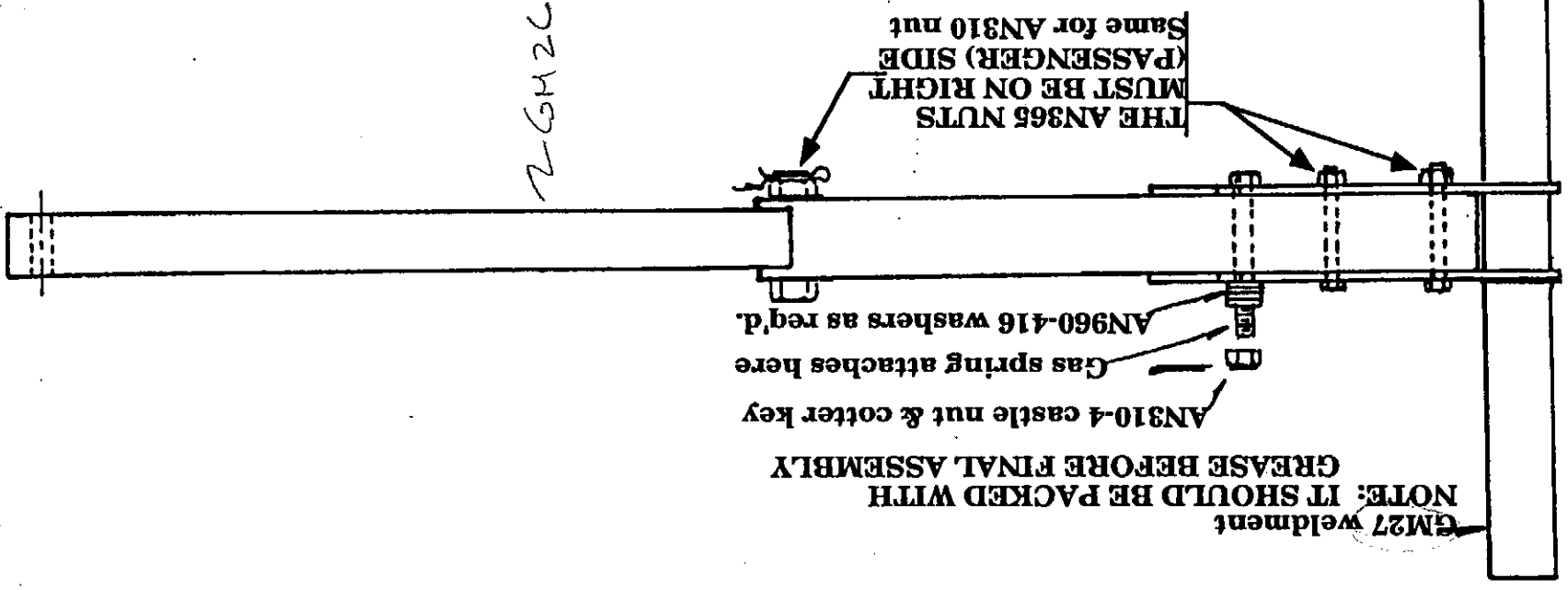
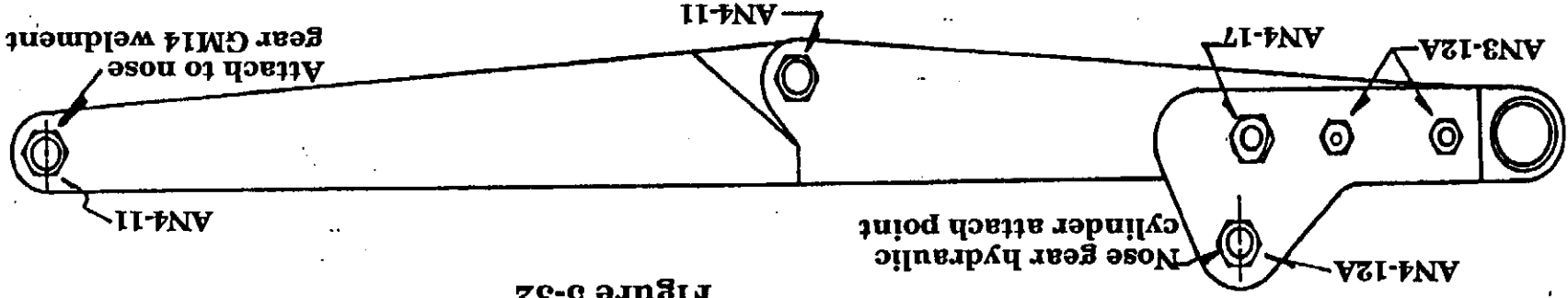
1. Assemble the nose gear drag link per figure 5-32. Once again, it is important to have the bolts arranged properly for adequate clearances during retraction.
2. Attach the lower link section to the gear strut with the AN4 bolt (#6). The location of the attachment holes in the tunnel is shown in figure 5-33 but this is a good way to check and verify through a second means that the locations are indeed accurate for your installation since minor differences can result due to a variety of builder variations.
3. With the fuselage level, the proper position for the nose gear assembly will be achieved when the strut assembly is in a 4° positive angle, i.e., the base of the strut is fwd of the top and a 4° angle off of vertical is realized along the strut's centerline.
4. With the gear strut properly aligned and held in position at the approx. 4° position, place and mark the nose gear tunnel for the location of the 3/8" steel pivot pin that inserts through the GM27 weldment and attaches into the tunnel walls. Use the drag link assembly to locate this point by simply swinging it up into the tunnel and checking against attachment marks that should be according to the location shown in figure 5-33. Also see figure 5-35.

WARNING: Be sure to verify that the location of the 3/8" pin is indeed into the central portion of the phenolic. There should be at least 3/4" of phenolic all around the pivot hole. Failure to secure the pivot pin properly into the phenolic will result in gear failure.

5. You'll have to use an angle head drill to drill the first hole through one of the tunnel sides for this 3/8" pin. It is best to use a slightly smaller size drill bit and use a .375" reamer as a final bit, this will leave a nice, snug fitting hole. A standard 3/8" drill bit can however be used with satisfactory results, but be careful to not wobble the bit back and forth while drilling.
6. With one side of the tunnel drilled, slide the 3/8" steel pin through and level it across the tunnel interior. (The fuselage must also be levelled at this time.) When levelled, mark and drill the other side.
7. Cut the steel rod to length and drill the small holes for the cotter pins at each end, see figure 5-35. Use AN970-6 area washers under the cotter pins, against the outbd tunnel walls.

NOSE GEAR DRAG LINK ASSEMBLY

Figure 5-32



NOTE: IT SHOULD BE PACKED WITH
GREASE BEFORE FINAL ASSEMBLY

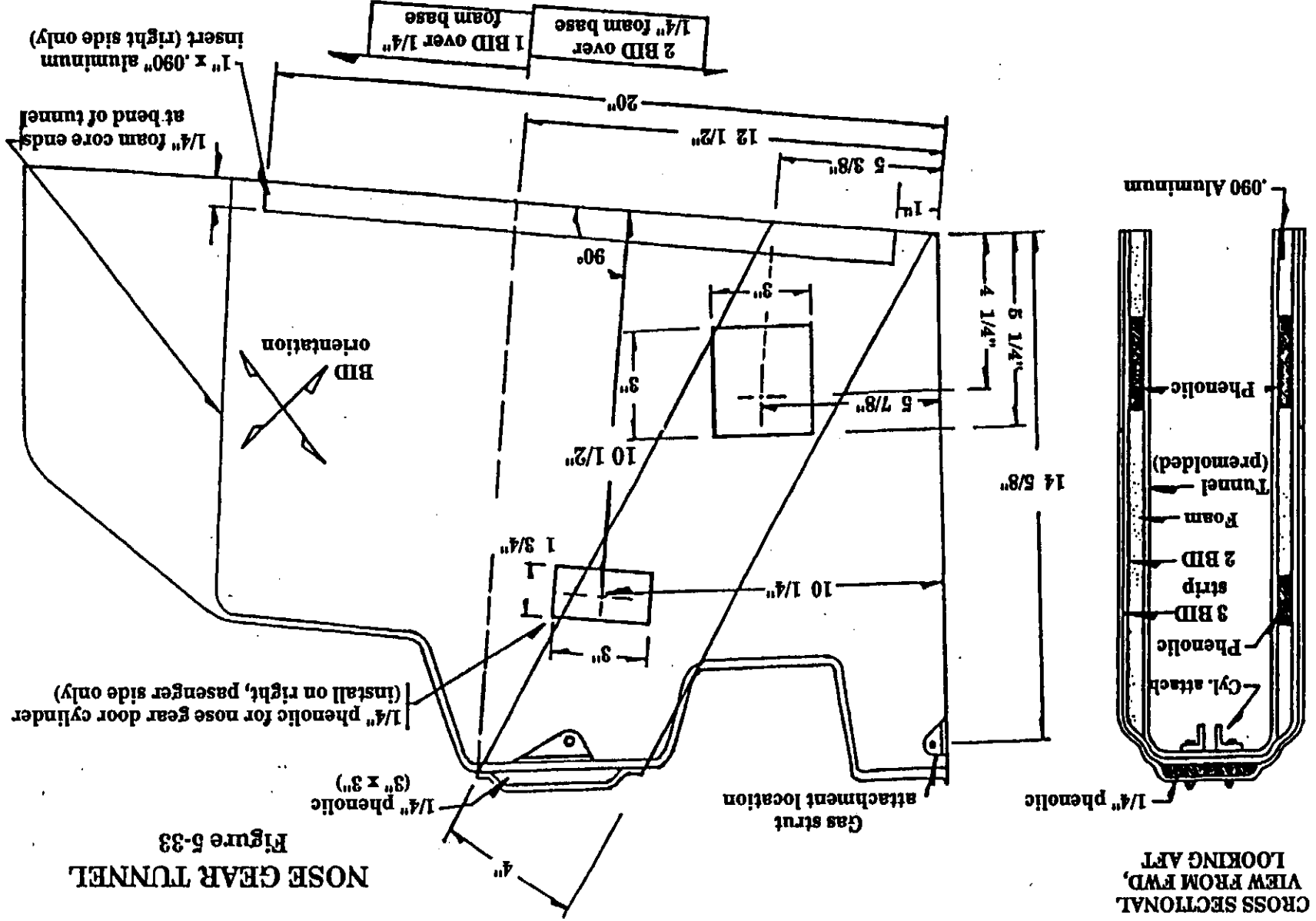
AN310-4 castle nut & cotter key

Gas spring attaches here

AN960-416 washers as req'd.

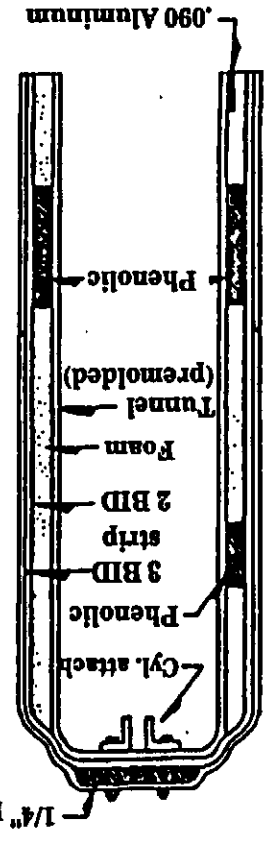
THE AN365 NUTS
(PASSENGER) SIDE
MUST BE ON RIGHT
Same for AN310 nut

GM27 weldment



NOSE GEAR TUNNEL
 Figure 5-33

**CROSS SECTIONAL
 VIEW FROM FWD,
 LOOKING AFT**



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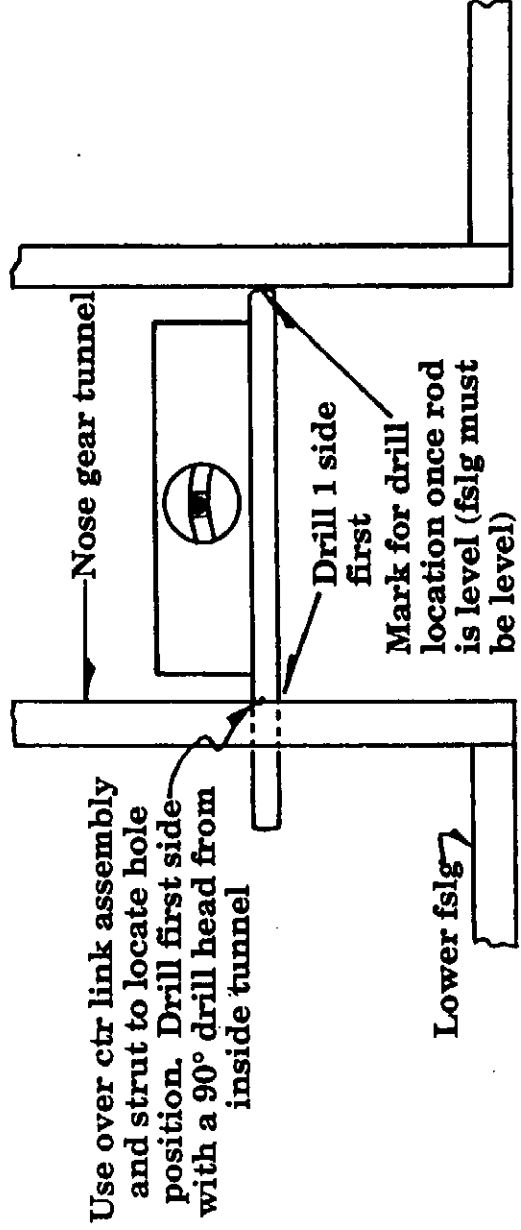
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LANDING GEAR INSTALLATION

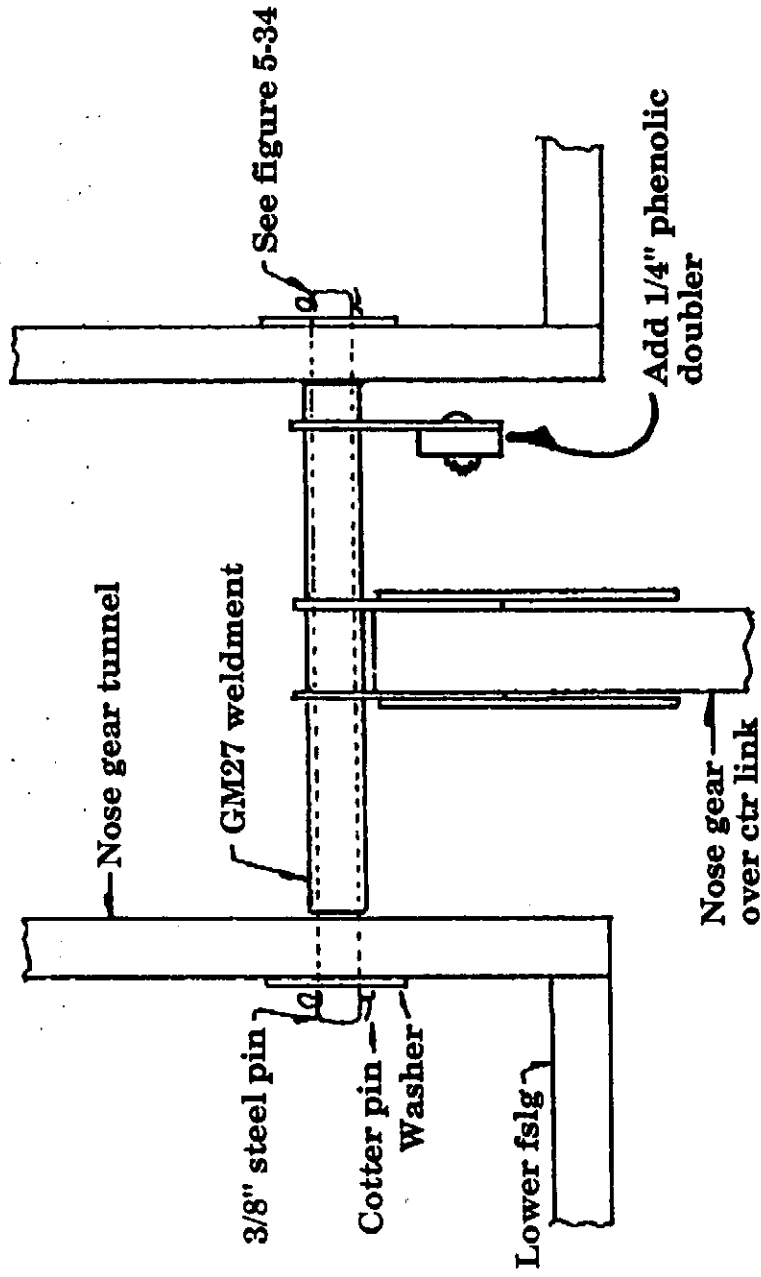
Nose gear pivot pin installation

Figure 5-34



Drag link / tunnel installation

Figure 5-35



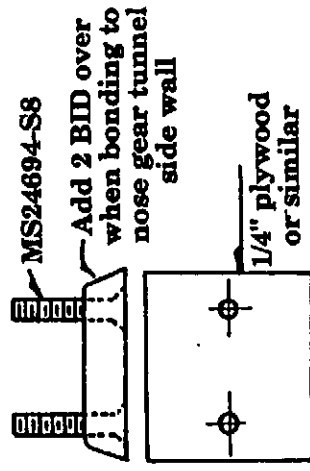
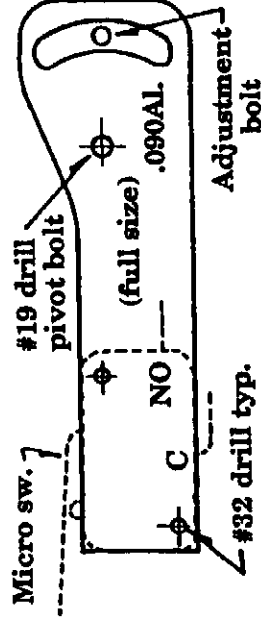
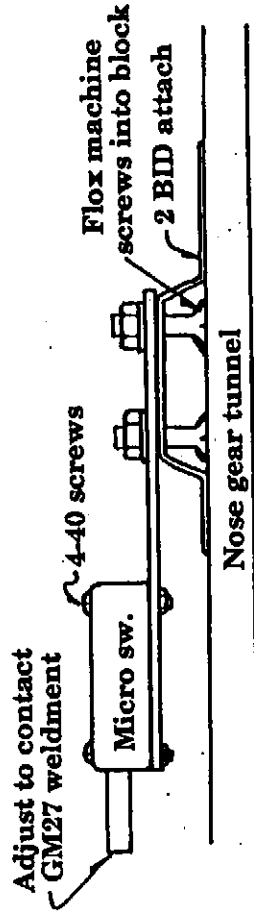
8. From figure 5-36, make the micro switch attach plate from the .090" aluminum sheet.

9. With the gear in the down locked position, mount the plywood or phenolic 1/4" attach block with the micro switch so that there will be adequate adjustment range for the micro switch. The switch should be positioned so as to solidly contact the swing arm on the GM27 weldment. Shim if necessary. Note also that the GM27 tab has a small 1/4" phenolic doubler added to enlarge the contact area.

The micro switch assembly must be mounted such that the GM27 tab or striker hits the trigger on the micro switch in a movement direction that does not place any bending or pinching motion onto the switch trigger. The trigger should also be contacted by the GM27 tab about 1/2" outbd of the edge of the micro switch body. This is not critical but if it contacted at the very tip of the trigger arm, the arm might simply bend and not depress the activating mechanism properly or reliably.

Nose gear micro switch

Figure 5-36



L. Nose gear strut installation

The gas strut is there to insure that the nose gear will free-fall out into the airstream without hydraulic assistance. This must be checked during flight on a regular (monthly) basis.

1. Out of 1" x 2" aluminum angle stock, fabricate the two attach brackets per figure 5-37. ^{5-38.}

2. Bolt these attach brackets to the firewall per figure 5-37 and blueprint "N". Note that the gas strut does not align in the center of the tunnel, it is to the pilot's side (left). This is for adequate clearances from the drag linkage.

The easiest method of attaching this strut to the firewall is to first assemble the brackets temporarily onto the top of the strut. Position the end up into the nose gear tunnel such that there is about 3/8" of compression required in order to get the other end of the strut onto the GM27 weldment when the gear is down and locked.

With this confirmed, mark the location of the brackets onto the inside of the firewall and then drill for their attach bolts.

3. It is a good idea to pot the bolt heads onto the firewall (fwd face) so that you can merely tighten the nuts from the aft side (or tunnel side). Otherwise the bolts will be either under the stainless which would make removal impossible or you would have to drill through the stainless steel firewall facing and insert the bolts through the entire firewall assembly. That too is acceptable. If you choose to pot the bolts into the firewall, simply apply a small mound of epoxy/flox over the bolt head and cover with a 1 BID patch about 2" square. Either method is OK.

4. Attach the gas strut using the AN4 bolts with castle nuts and cotter pins.

5. The attachment of the gas strut to the drag link will require approximately four (4) AN960-416 washers to be used as shims to move the strut outbd of the GM27 weldment for clearance purposes. The minimum amount of shim stock washers should however be used as this will reduce the bending loads on the 1/4" attach bolt. Push the gear through full travel to confirm adequate clearances through full travel.

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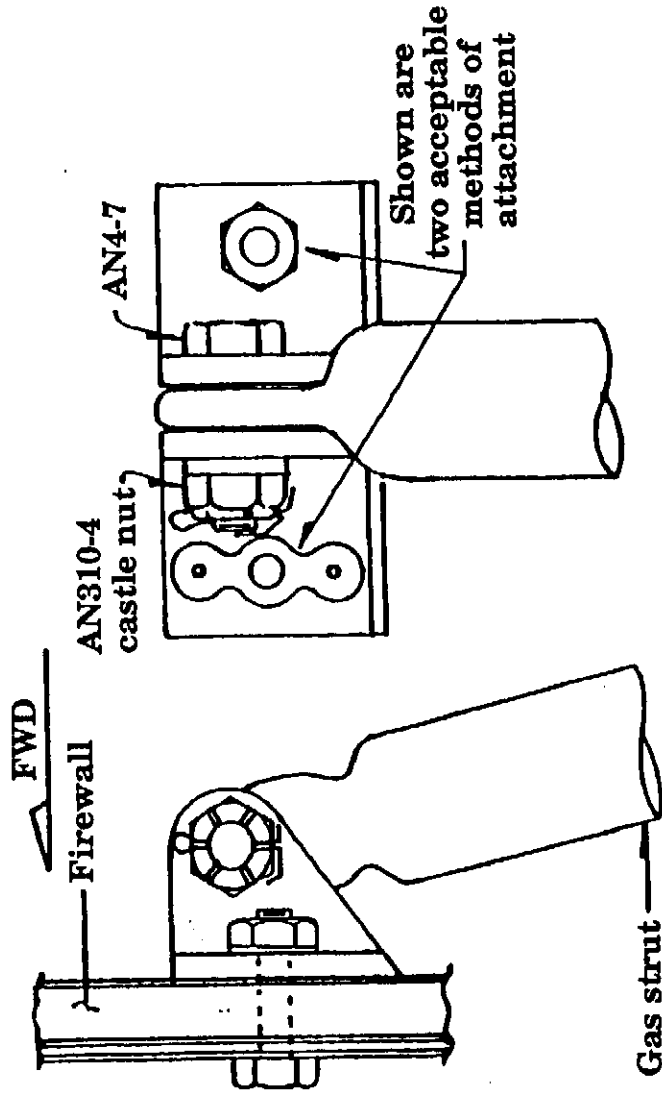
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Nose gear strut
Figure 5-37

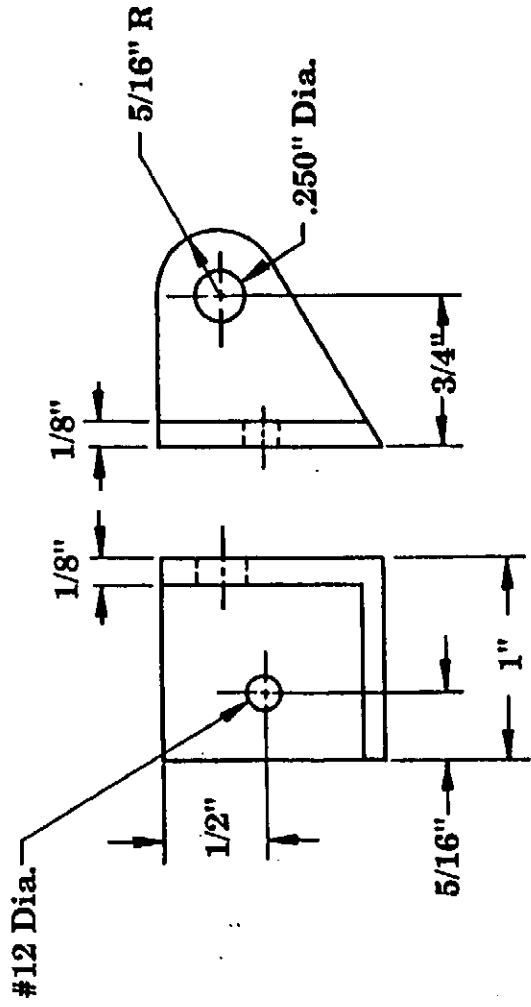


NOTE: The gas strut is quite stiff (about 100 lbs.) so you would have a difficult time trying to compress it the 3/8" in order to mount its end to the GM27 weldment. This is easily overcome. First loosen the micro switch and swing it downward (away) from the GM27 tab. Then remove the attach bolt where the lower arm of the drag link attaches to the nose gear strut. Now the drag linkage can be lowered to where the gas strut can be easily slid onto the attachment bolt. You can then easily push the drag link arm up (you'll have easy leverage now) and re-attach the 1/4" bolt through the nose gear strut.

NOTE: Once the nose gear retract cylinder is attached, you may have to remove it as well in order to allow the drag link assembly to be rotated down past its normal position when mounting the gas strut.

Gas strut attach bracket

Figure 5-38



Gear Hydraulics

The hydraulic system is actually very simple and straight forward. Basically there is a cylinder attached to each gear; these cylinders will each have a high pressure line and a low pressure line attached to them. The power pack will have a high pressure port and a low pressure port. **The high pressure port is on the LEFT (as you face the pump), the low pressure port is on the RIGHT.**

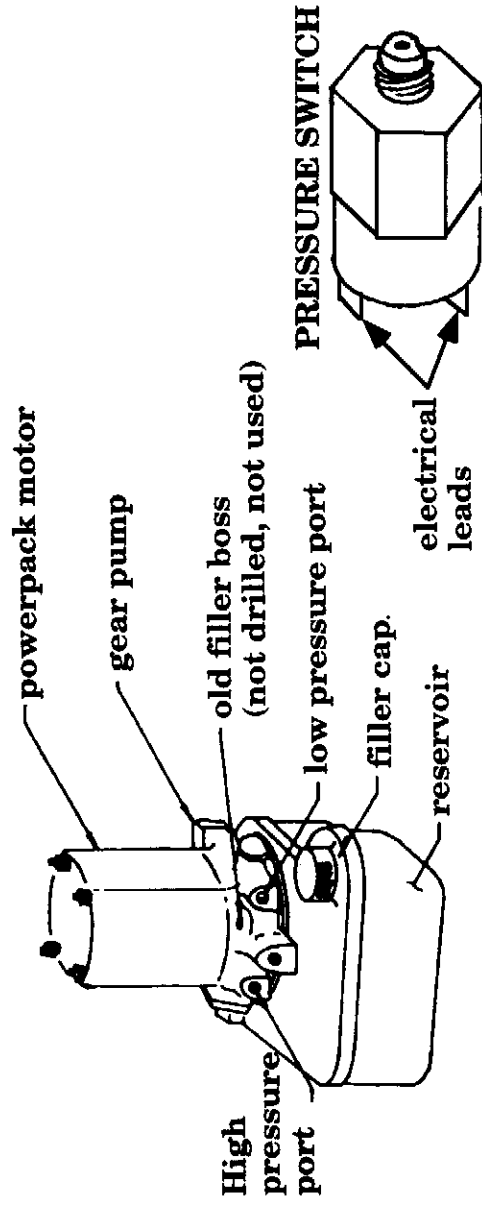
HIGH PRESSURE (UP): 1200 PSI LEFT SIDE PORT
LOW PRESSURE (DN): 550 PSI RIGHT SIDE PORT

There is also a small pressure switch for high and low pressure sides. Be sure to not mix these switches up since they look the same. These switches will control the shut off of the pump motor. Hydraulic pressure alone will hold the gear up, the gear will self lock into the down position and hydraulic pressure will simply follow as a backup.

There is also one mechanical valve placed in the system which will connect the high pressure side to the low pressure side. This dump valve will allow the gear to free fall into the down and locked position when opened.

Power pack and pressure switch

Figure 5-39



NOTE: The pressure switches will have two leads.

M. Nose gear hydraulic cylinder

1. From some 1" x 2" angle stock, cut the two cylinder attach brackets and mount to the top inside of the tunnel per figure 5-40.
2. To assure proper fit, assemble the cylinder with rod end bearing screwed on to the mid position on the threaded shaft of the cylinder.
3. Position the cylinder into the tunnel with the gear in the down position. The cylinder should be fit as far fwd as possible on the tunnel without actually contacting the contour of the tunnel itself. Check that the cylinder will attach to the link assembly with cylinder shaft fully extended. Then retract the nose gear and check that the cylinder is still in satisfactory alignment.
4. Mark the cylinder attach location and drill the four #12 holes. Attach the two aluminum brackets (2 bolts each) with the bolt side down (put the nuts on the top side of the tunnel). Otherwise you'd have trouble getting the bolts out from the inside once the header tank is installed.

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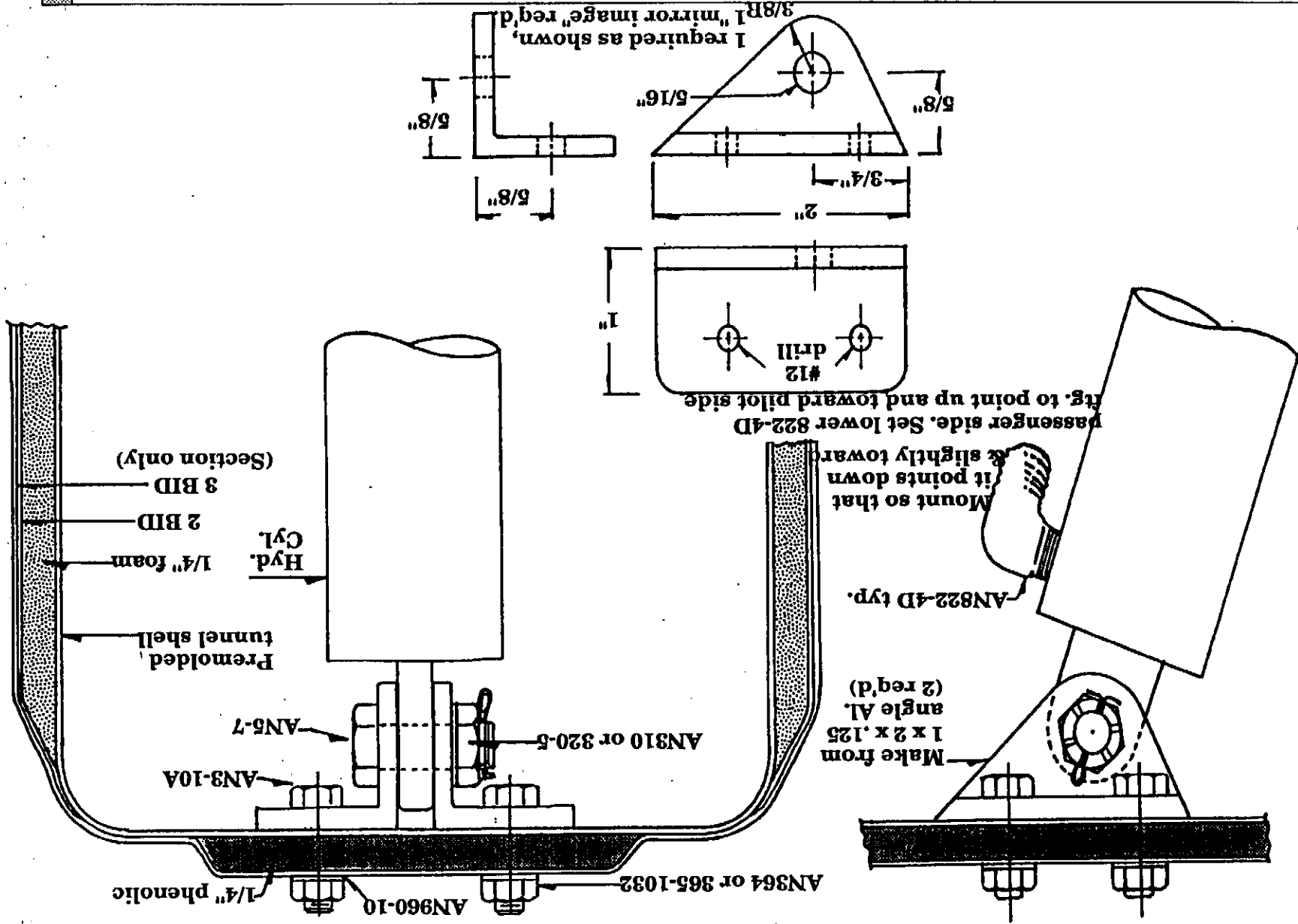
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NOSE GEAR HYDRAULIC CYLINDER ATTACH

Figure 5-40



5. Insert the two 90° fittings into the cylinder body per figure 5-40. Use pipe thread sealer (Recoseal™ works well). Do **NOT** use teflon tape, as it can shred and get into the lines.
6. The cylinder will attach to its attachment brackets with the AN5-5 bolt shown in figure 5-40, and it must be cotter keyed.

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Builders' Corner

Seats for the Dimensionally Challenged? (ES and IV)

Take a look at Chapter 26, C1: "Some builders may wish to install the seat slightly aft of the bulkhead...." This sentence should read: "Anyone over 5'6" must install the seats aft of the bulkhead...." (or you'll have your shins hard against the panel and your knees in your chin). In order to get the proper leg room to the rudder pedals and the proper seat travel for an average height sort like me, I ended up rebuilding both bulkheads to provide seat attach points about 4 1/2 inches aft of the location called for in Chapter 17. It would be a lot easier to do this the first time around, rather than having to cut into perfectly nice bulkheads that you thought were finished in order to get it right. (This probably applies to both the ES and the IV's since the fuselage is essentially the same for both series.)

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360 Trunion Hole Misalignment

After many hours (approximately 90) of not being able to get a proper toe in-out alignment, I discovered the holes in the two tabs on the GM001-3LR-T trunion were slightly misaligned by approximately .020. These holes mount the trunion to the upper gear leg. The tabs are the two outer tabs not the center tab that the donuts bolt to. This will create either a toe in or toe out when the gear leg is near center. Trying to correct for this 4 or 5 degree error would bring the gear leg too close to the spar, or too far back. In either case, there was some slight binding in the overcenter link. In my case on one side it would rotate the main bolt holding the overcenter link to the GM004 bracket on the front spar, in a direction that would loosen the nut holding it on. I knew something was off when I put a nine foot straight edge horizontal from front to front of the left and right main tires with a square off of the straight edge to the side of the tires.



Dale's clever alignment tool

I was able to verify the tab misalignment by laying the trunion flat side down on a flat surface and inserting a straight 3/8 rod about three feet long through the holes and laying a square on the table next to the rod. The rod would go up at an angle of about 4-5 degrees. I contacted Lancair for replacements. They were not aware of this problem. When they checked their stocked trunions using my method, they were unable to provide me with aligned tabs at that time. I then contacted their subcontractor who reviewed their manufacturing process and they indicated they have found the problem and are in the process of correcting it and will soon be able to provide me a straight trunion. Some misalignment would be acceptable as long as adequate clearance and no binding is maintained. This was not the case for me.

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320/360 Main Gear Retraction Cylinder Anchors

I had a hard time following the instructions in the manual for building the 320/360 main gear retraction cylinder anchors. (These are the phenolic sheet behind, and the phenolic block glued to, the aft face of the front spar, through which the bolt which anchors the cylinder passes.)

The manual says to glass in the phenolic sheet first (that's not hard) and then, as a subsequent operation, C-clamp the 1.25" tall phenolic block to the aft face of the front spar while the epoxy cures. I couldn't get a C-clamp on the block very well, and I was concerned about my ability to keep the block centered and the sides vertical if I jammed a spacer block between the two to act as a surrogate clamp.

My solution was to locate the hole in the phenolic sheet and drill a 1/8" pilot hole. I then drilled another 1/8" pilot hole through the center of the end of the block. I bought a small compression spring from the hardware store. As the picture shows, a transfer punch (could have been a drill bit, I suppose) goes through both pilot holes and the compression spring applies the clamping pressure to the phenolic block.

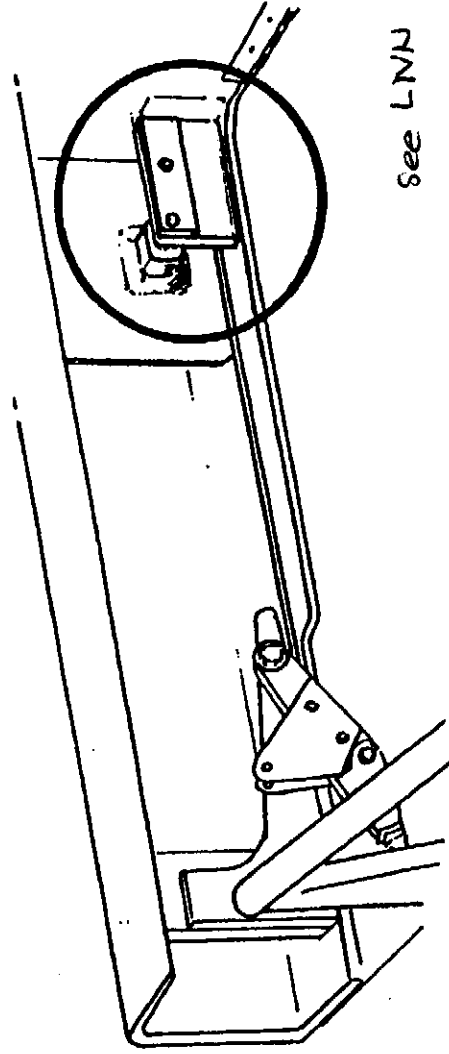
When the epoxy cured, I just withdrew the transfer punch and the spring (no epoxy touches these in this process).

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- N. **Main gear hydraulic cylinder and attach point**
This attachment will secure the main gear cylinder to the airframe.

Main gear hydraulic cylinder attach point

Figure 5-41



see LNN P492

1. Locate and mark the attach bolt location for the cylinder per figure 5-42. Check that it does position through the phenolic insert earlier placed into the spar closeout web.
2. Cut a piece of 1/4" phenolic that will fit to the closeout rib surface. Also cut the .090 aluminum and phenolic spacer block per figure 5-42.
3. To establish proper fwd to aft position of the hyd. cylinder base (5/16" bolt), place either a 1/4" rod or the retract cylinder itself (this is best) through the pickup point on the overctr link and extend it inbd to the approximate attach point. Hold in position while cycling the gear up and down. Position the cylinder base so that there is no bond at any point during retract cycle. (Should be approx. parallel to main spar, see figure 5-43.)
4. Fit the 1/4" phenolic into position and apply BID per figure 5-42. Be sure to allow some added dimension for the inner BID plies (about .050"). Keep the aft side BID smooth since there will be a pc. of .090 aluminum later attached.
5. Fit and install the phenolic spacer block. It can be held in place with either a small clamp or by simply wedging a suitable block in position and lightly clamping across the whole assembly, see figure 5-42.
6. Build a small fillet out of floc and add the BID around this spacer block per figure 5-42.

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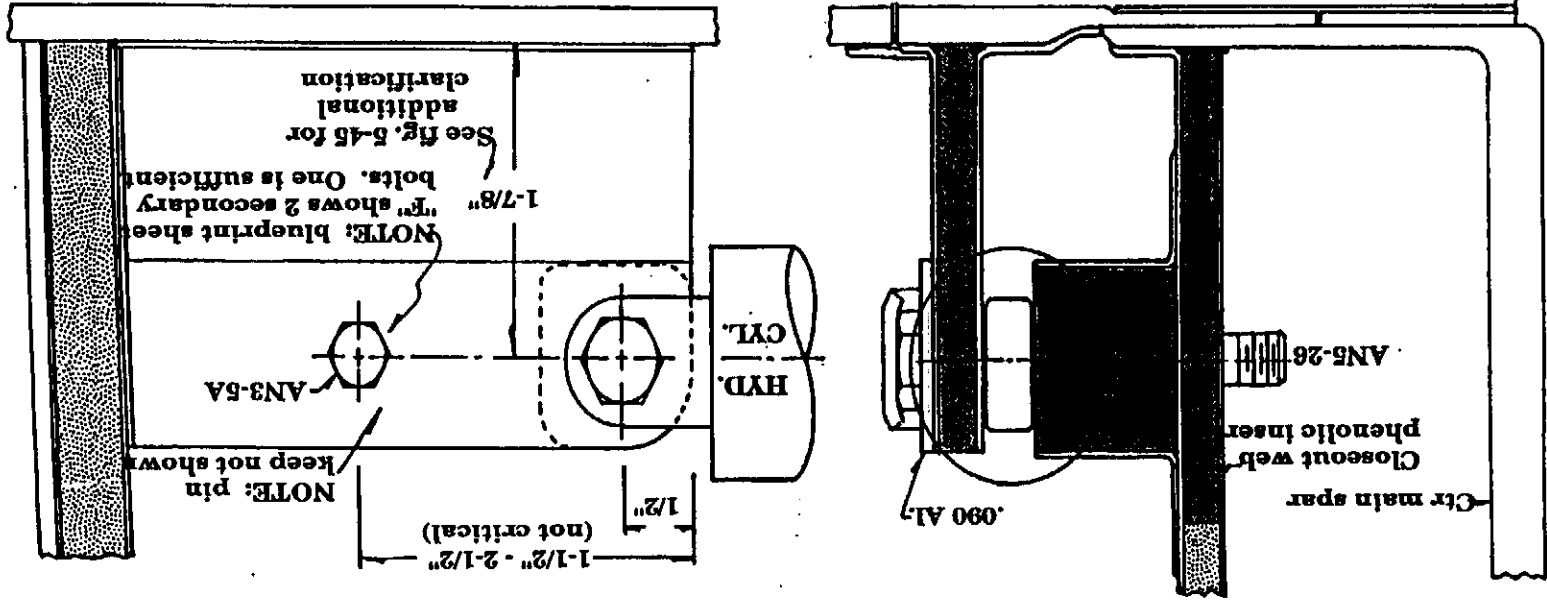
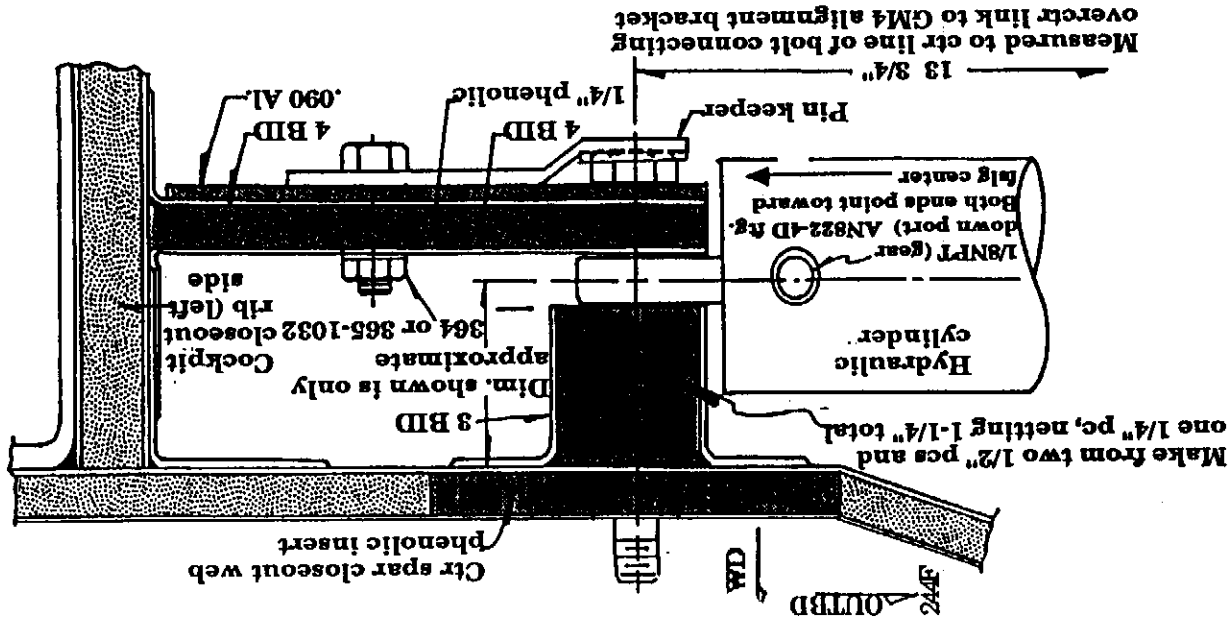
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Hydraulic cylinder attach

Figure 5-42



7. Cut the aluminum plate from .090 aluminum. Bond this to the aft face of the 1/4" phenolic using structural adhesive.
8. Drill (#12 bit) for the secondary attach bolt (AN3-7A) per figure 5-42. The bolt is permanently attached and helps carry the cylinder loads. It can be used to help clamp the aluminum during the above step 7 cure.
9. After cure, check alignment and position of the cylinder, then drill the 1/4" through hole for the attach bolt. This bolt will attach all the way through the spar closeout web. This completes the attachment.
10. Install the hydraulic fgs. into the cylinder and install the cylinder per figure 5-42.

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O. **Main gear cylinder attach - pin keeper**

Refer to figure 5-42. The top illustration shows the AN5 bolt extending through the entire structure. The means to "keeping" this bolt (or pin as we will use it) in position is with a "keeper" plate over the top. The AN3-5A bolt will locate the keeper plate.

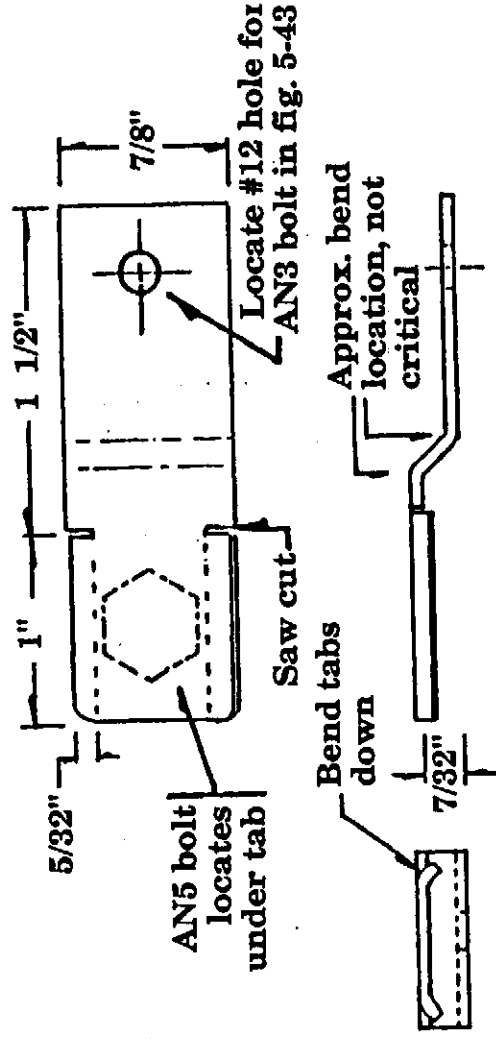
Follow the drawing below for fabrication of this keeper plate.

NOTE: As a point of safety, after drilling the 5/16" hole for the AN5 bolt, you should make a quick check that you've drilled through the entire closeout web (and no farther). This will be easy with a short piece of wire having a small hook bent onto the end. Slip the wire into the hole and locate the innermost surface of the closeout web. This should be easy using the hook on the end of the wire.

Verify that the bolt shaft does fully penetrate and extend the full distance by checking it against the measured wire length.

Pin keeper

Figure 5-43



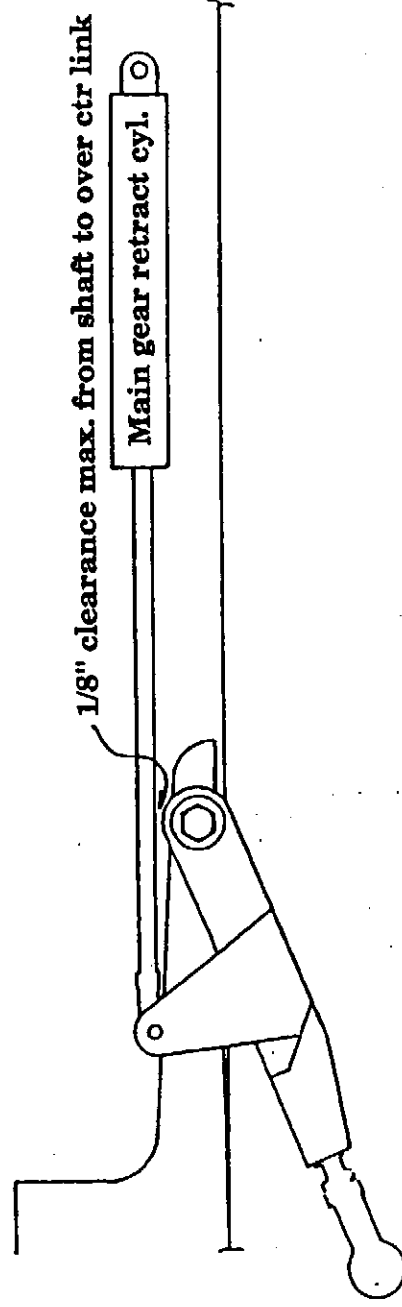
P. Main gear hydraulic cylinder attach point

When positioning for the main landing gear hydraulic cylinder attach point, it is best to use the actual cylinder itself as a guide. Check that there is the proper clearance between the cylinder shaft and the over ctr link assembly, see figure 5-44, below. There should be about 1/8" clearance.

If the cylinder is mounted too low, it will contact the over ctr link assembly, which is not acceptable and would have to be corrected by relocation of the cylinder attach point (rather messy). If the cylinder were mounted too high, it could interfere with the aileron push rods which will be running above it (equally messy and unacceptable). See blueprint "F" for additional clarification.

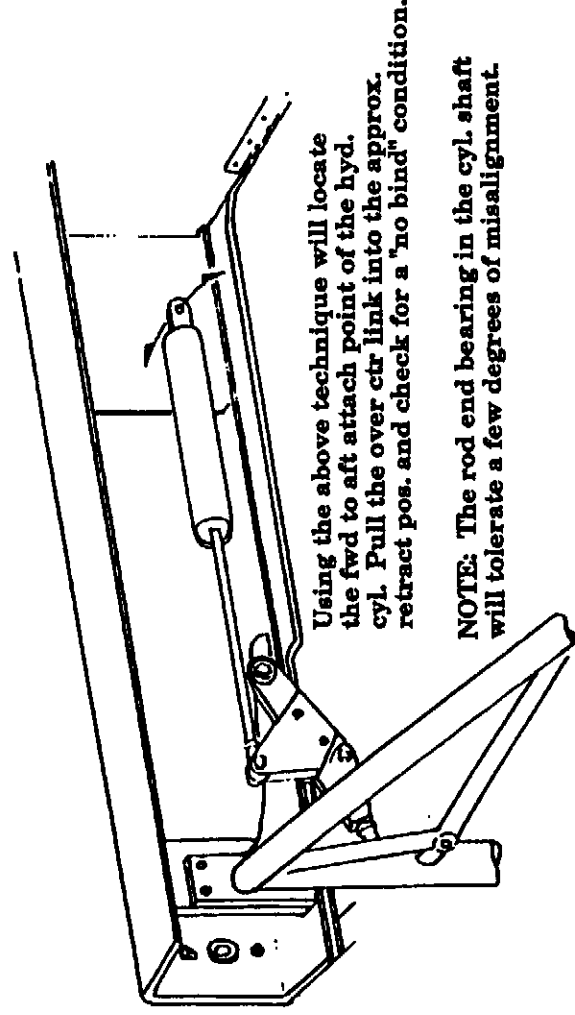
Main gear hydraulic cylinder attach point

Figure 5-44



Locating hydraulic cylinder attach points

Figure 5-45



Using the above technique will locate the fwd to aft attach point of the hyd. cyl. Pull the over ctr link into the approx. retract pos. and check for a "no bind" condition.

NOTE: The rod end bearing in the cyl. shaft will tolerate a few degrees of misalignment.

See Chap. 14, p14-7

Q. Hydraulic power pack installation

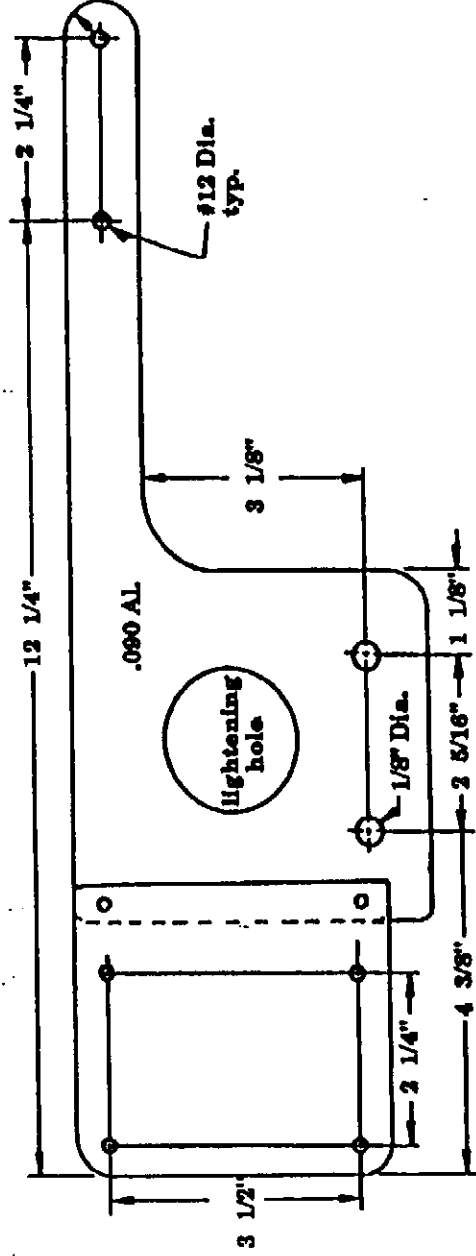
The power pack is a self contained unit comprising motor, gear driven pump and reservoir. The unit is generally mounted behind the baggage bulkhead. It can be attached to an aluminum plate which, when combined with a phenolic side plate, also attaches the two electric relays which activate the motor. This makes for a tidy installation.

1. Make an aluminum attach plate with phenolic side panel per figure 5-46.
2. Locate and insert three 1/4" phenolic pcs into the baggage bulkhead. Two must align with the two 3/8" motor attach bolt holes and a third is used to further anchor the aluminum plate.
Be sure that the pump adequately clears the top of the bulkhead and the cutout for the elevator push rods.
3. Install the pump and master relay to the aluminum panel. Install the two relays onto the 1/4" phenolic piece which serves as an electrical isolator.
4. The pump and relay wires can be attached prior to installation of the complete unit. You'll need to run three wires (#18) fwd: Gear up, gear down and motor transition light.

Aluminum mounting plate

Figure 5-46

also see Fig 14-3, p14-10



1/4" PHENOLIC TO
ELECTRICALLY ISOLATE RELAYS

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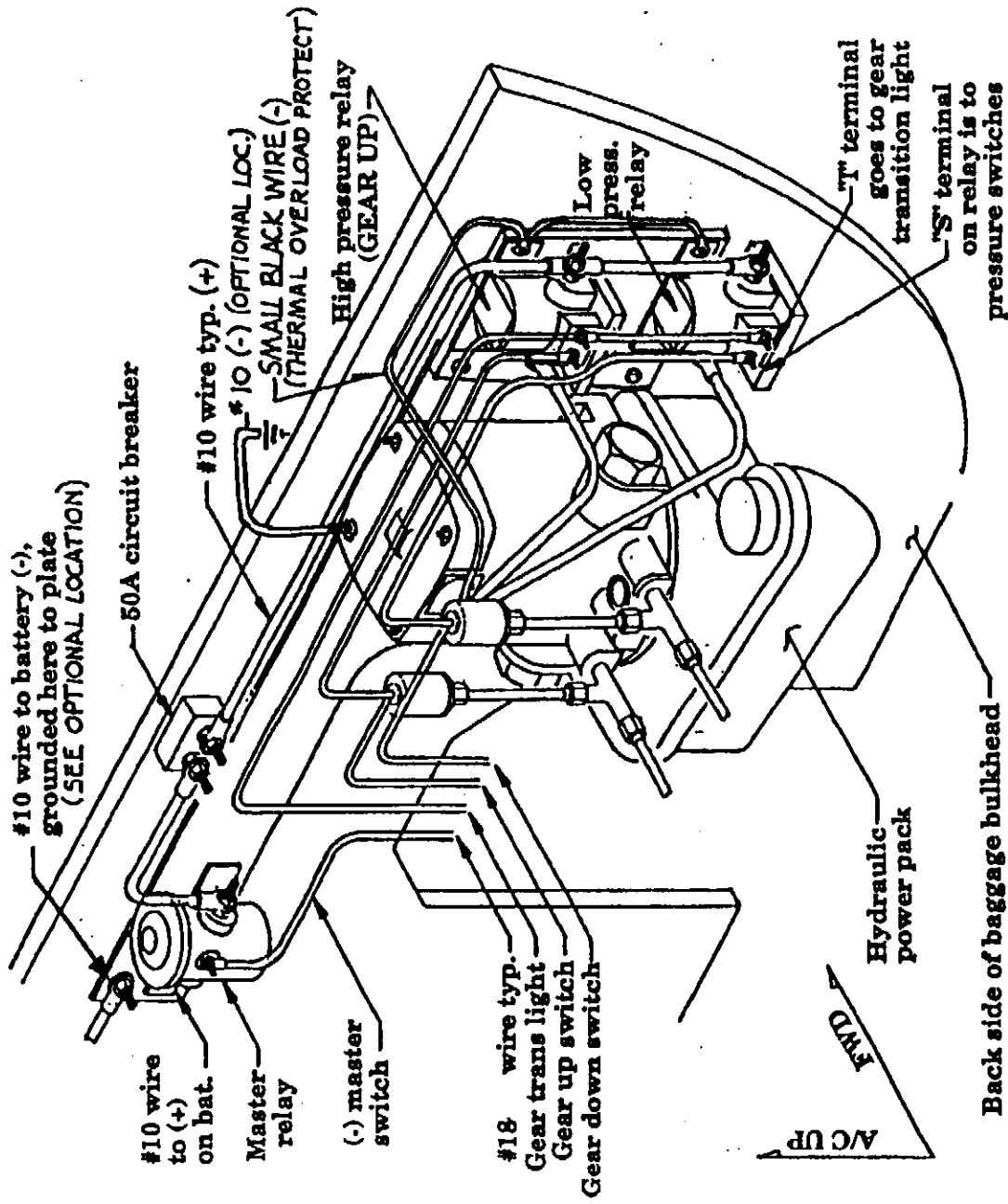
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Hydraulic power pack installation

Figure 5-47



Gear electrical wiring reference

Figure 5-48

