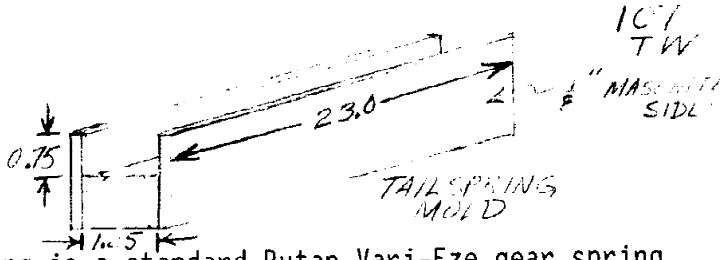


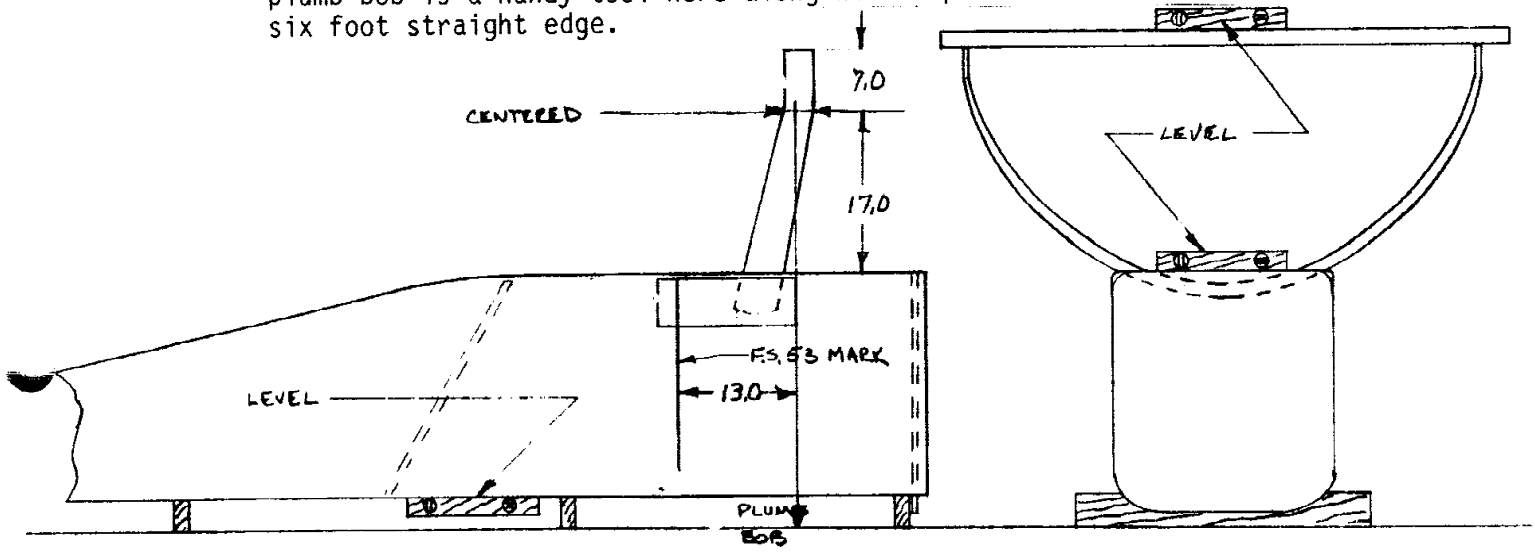
Landing Gear

The main landing gear spring is a standard Rutan Vari-Eze gear spring. A number of these units are available surplus from Eze builders who have been encouraged to install the heavier Long-Eze gear springs in their airplanes. If the gear spring was easily homegrown, I'd have you make it yourself. The main spring is best bought. The tail spring you can make yourself.

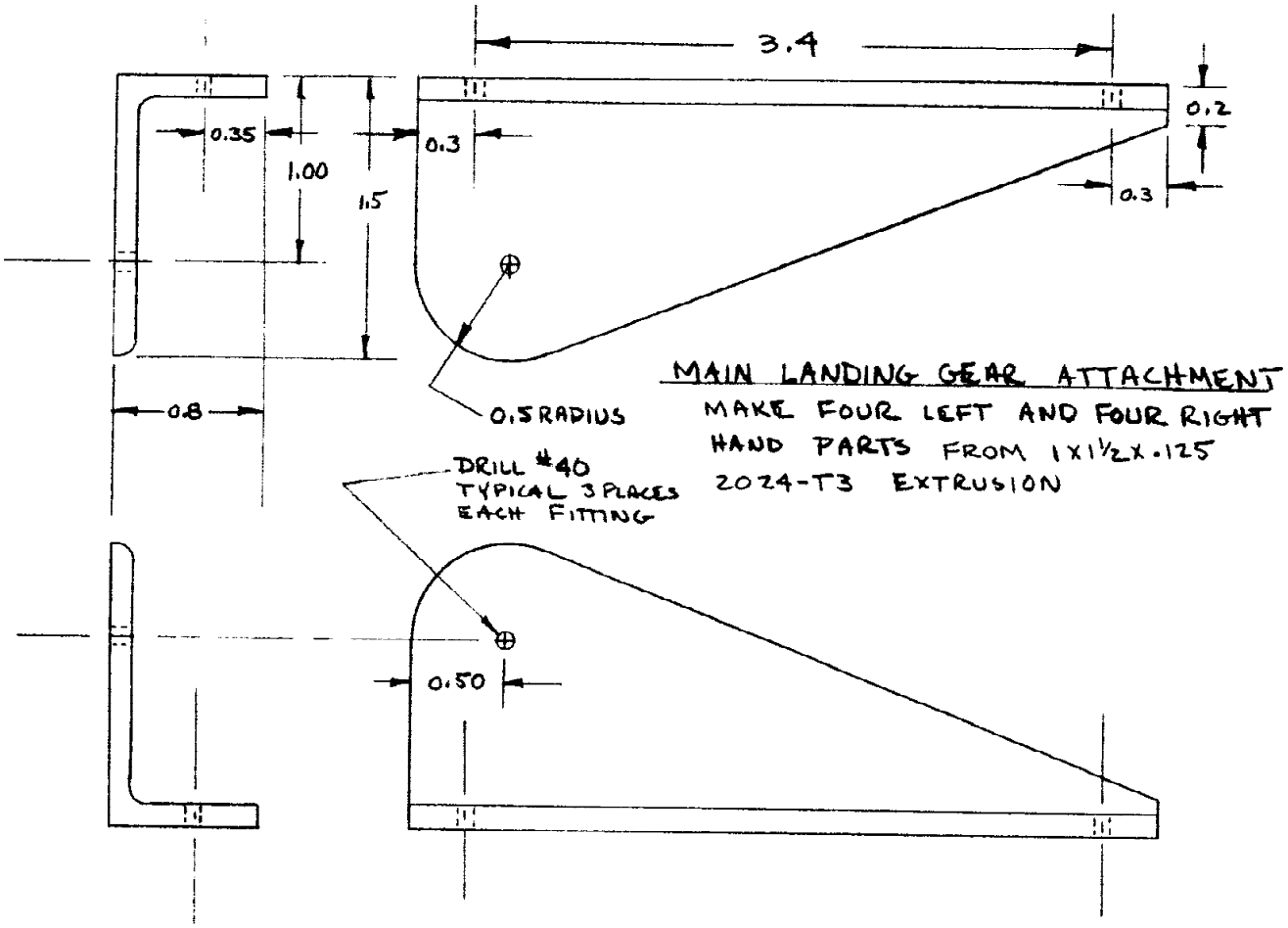
To lay up your own tailspring, first make the wooden mold shown in the sketch. Cover the inside surfaces of the mold with fine line paint striping tape or 3M "Mystic" tape. Use the tape to radius the bottom corners of the mold. Cut two pieces of unidirectional cloth 24 inches long and the full roll width (37½ inches). Lay masking tape along one 37½ edge of each piece and mark the tape each 1.25 inch along the width. Tape a sheet of plastic or a garbage bag to your working surface. Wet out the 37½ X 24 uni plies with RAES or safety poxy using your squeegee. Use your trim knife to cut the small crossfibers and masking tape along the 24 inch length at each mark. Lift the wet 1¼ wide strips of cloth off of the plastic and lay them into the mold. Lay about 10 strips into the mold and then sqeegee them down with a masonite strip that is just narrow enough to fit inside the mold. When all of your material is in the mold (60 to 62 strips) it should be 5/8 thick or slightly over. Add some extra strips if necessary.

Cure at room temperature for 24 hours. Trim the ends flush with the mold. Remove the spring and discard the tape. Return the spring to the mold and bake in your household oven **(NO MICROWAVES!)** at 200°F for 2 hours.

Turn your fuselage belly up, with the top edges resting on some 2 X 4 lumber (on the floor). Position the main gear spring on the fuselage as shown in the sketches which follow. Carve the cockpit bottom hole's edge flange away to allow the springs leading edge to touch the outside (BL 12.5) edge of the side panel at the bottom outside contour of the fuselage (WL 0). Use a reasonably straight board to bridge the ends of the gear spring. Place a level along it and along the bottom of the fuselage to locate the gear in the roll axis. Tilt the spring forward so that the axle centerline marks are both aligned along F.S. 40.0 (13 inches forward of the reference line marked inside the side panels). A plumb bob is a handy tool here along with tape to mark the floor and a six foot straight edge.

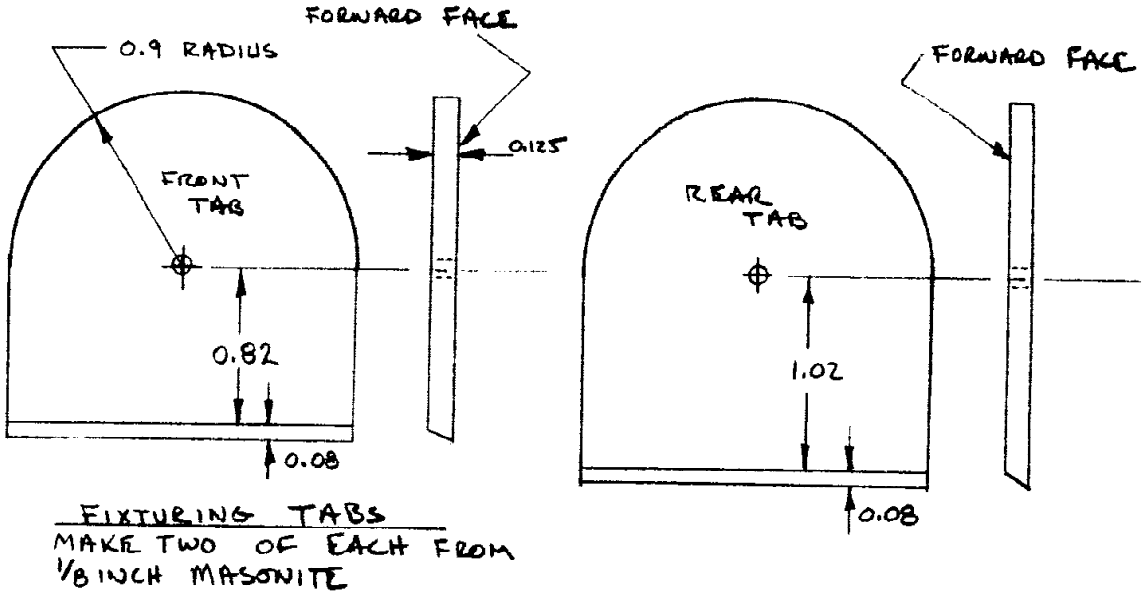


Clamp a pair of 1 x 2 firring strips (lumber) to the ends of the spring to form an "A" frame support to the floor while you work on the spring's mounting. Go make the gear attachment fittings and masonite tabs shown below.



MAIN LANDING GEAR ATTACHMENT

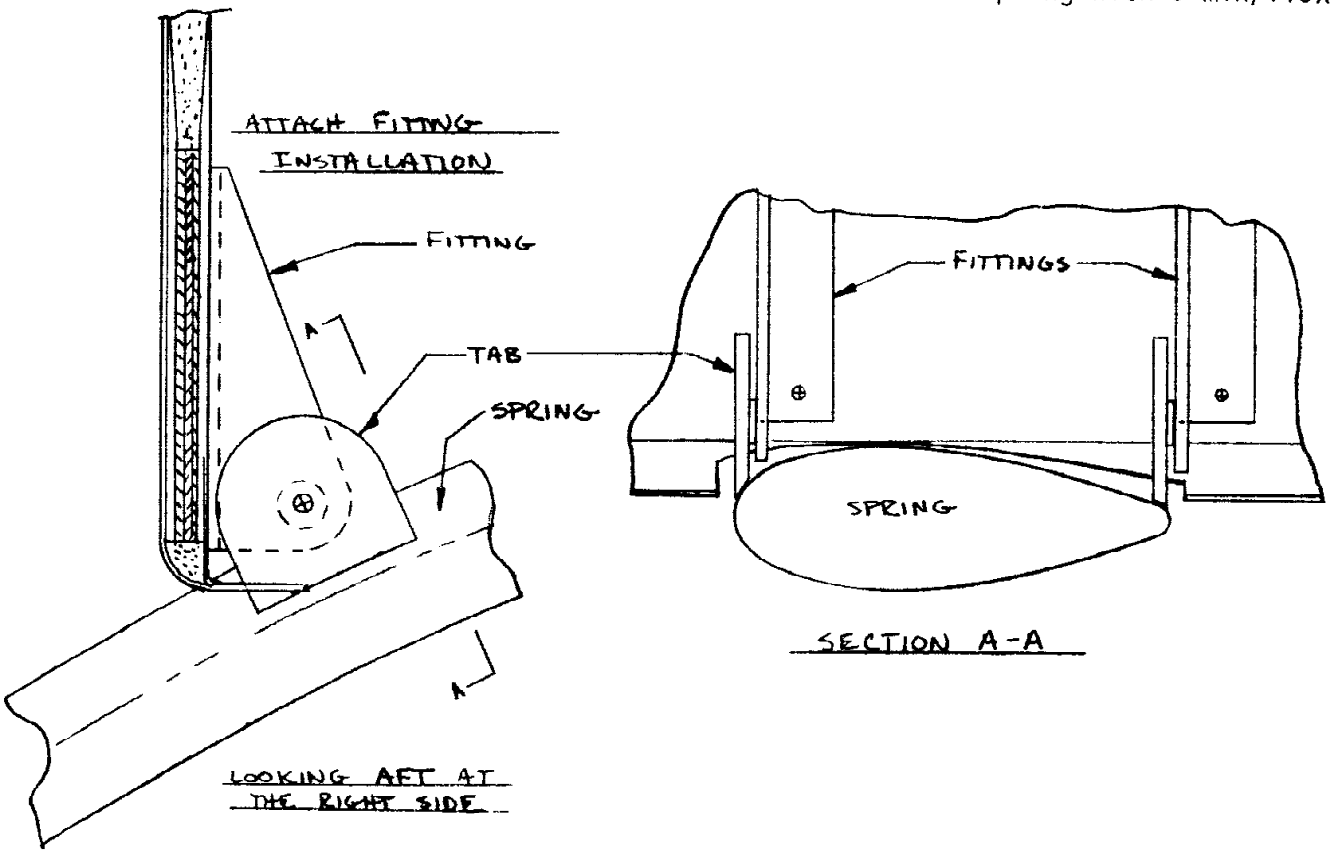
MAKE FOUR LEFT AND FOUR RIGHT HAND PARTS FROM 1 X 1½ X .125 2024-T3 EXTRUSION



FIXTURING TABS

MAKE TWO OF EACH FROM 1/8 INCH MASONITE

Cleco the fixturing tabs to four of the fittings (2 left, 2 right) with an AN960-10 washer between the tab and the fitting. Without disturbing the gear spring's positioning fit the four tabs to the curvature of the leading and trailing edges of the spring at the fuselage sides. Once you have the tab fit up to the spring reasonably well it will be bonded to the spring with 5 min/flox.



First, note that in order for the tabs to be parallel to the springs leading and trailing edges, the attach fittings must be inclined aft at the top. This is normal. Brighten the base of the fitting for bonding, mix 5 min/flox bond the fittings to the fuselage and the tabs to the gear leg. Allow an hours cure time.

The 5 min/flox isn't very strong so go slow and be careful. Remove the Cleco's from the tabs and fittings and carefully remove the spring and tabs from the fuselage. Rest the spring on your table bottom side up with a foam block pad to keep the weight off of the masonite tabs and use your firring strips "A" frame for stability. Sand the spring area from front tab to back tab dull (extra dull, even) for bonding. This sanding operation is important. A silicone mold release is used in the high temperature tooling that these parts are made in and nothing bonds to that release agent, so sand the socks off of that spring in a strip 2 1/2 inches wide between the tabs. Removing some of the spring material is acceptable practice here.

Go cut glass cloth and peel ply for both sides of the spring.
45° BID: 10 strips 2 inches by 10 inches
0-90° BID tape: 12 strips 2 x 10
0° UNI: 20 strips 2 x 10
Peel ply: 8 pieces 2 x 2
Wax paper or saran srap: 8 pieces 2 x 2 1/2

Also find four spring clamps and four scraps of masonite 2 x 2 inches.

Remember the wing spar lugs? Well, here we go again. Protect the outside (forward and aft) faces of the tabs with waxed paper (tape in place). Also, protect the 2 x 2 masonite scraps, peel ply the tabs, then lay up glass in the following sequence from tab to tab around the spring: 45° BID, UNI, 0-90° BID, UNI, 45° BID, UNI, 0-90° BID, UNI, 45° BID, UNI, 0-90° BID, UNI, 45° BID, UNI, 0-90° BID, UNI, 45° BID, UNI, 0-90° BID, UNI, and finish up with the last 0-90° BID strip.

Lay the remaining peel ply patches over the completed lay up, then clamp the masonite squares over the tabs. Carefull not to delaminate the lay up on one end while applying the clamp to the other. Expect copious squeeze-out so protect your work bench. Cure 24 hours then saw trim and sand to the masonite tab outline. Remove the outside masonite block, waxed paper and peel ply. Darken your shop and use a pen light to find and mark the location of the #40 pilot holes in the tabs. Drill the glass to #40. Now, some artful hacksaw work is required to break the 5 min/flox bond between the masonite tab and the spring. Remove the tab and use your rotary file to clean up the corner of all masonite and 5 min. Sand the top side of the spring dull to super dull as you did the bottom side. Remove the peel ply from the inside of the glass tabs. Use your file again if necessary to get all of the little peel ply strings off. Go cut more glass and peel ply.
45° BID: 20 patches 1 1/2 x 2
0-90° BID tape: 12 strips 2 x 9
0° UNI: 10 strips 2 x 9
Peel ply: 4 patches 2 x 2
Waxed paper to protect the 2 x 2 scraps

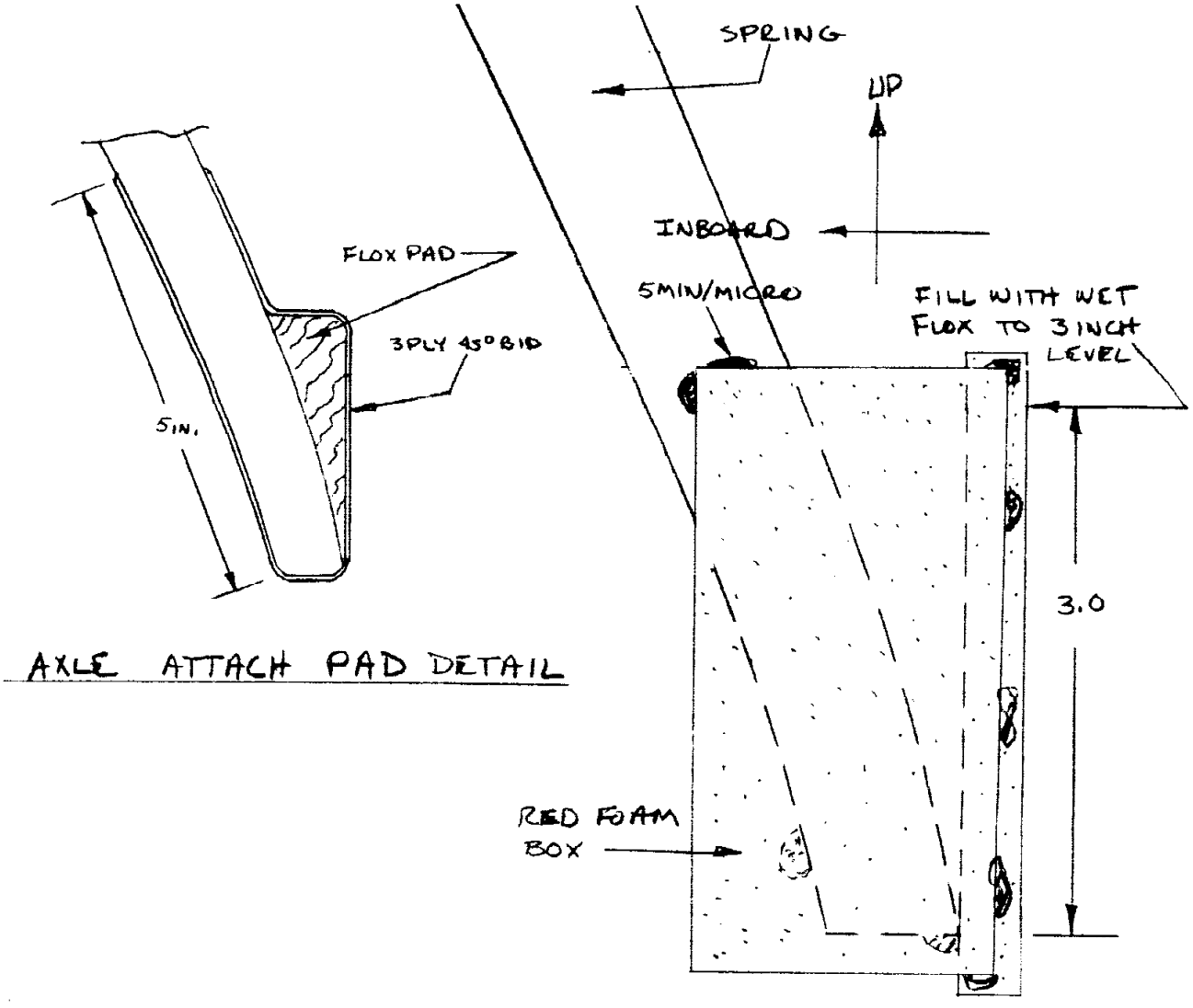
Now take your 2 x 2 scraps of masonite used to clamp the wet lay up and radius one edge generously. The radiused edge will go down against the top of the lay up in the corner. On this lay up the 45° BID patches cover only the tabs and do not lap onto the top side of the spring. Stuff a little foam plug into the #40 hole to keep resin squeeze-out from refilling it. Put a dab of flox in the corner. Lay up the glass in the same sequence as before. Make sure that you remember to put a 45° BID patch on both tabs each time it's called for. Peel ply the inside surface only and clamp. Use the clamping blocks to assure yourself that the glass is pressed into the corners and isn't delaminated. Cure and saw trim. Drill the #40 holes through the new lay ups. Remove the peel ply from the inside surfaces.

Go drill the #40 fitting mount hole pilots through the fuselage side panels and then drill them up to #11. If you own a countersink (aircraft type with a pilot pin) you can counter sink the outside of the fuselage to accept AN509-10R-16 screws. If you can't muster the correct countersink tools, then stick with good old hex head AN3-10A bolts like the prototype has. Install the eight screws or bolts using MS21042-3 locknuts. Now, fit the spring back into position and cleco in place. Hook your "A" frame up again to make sure that you don't have one cleco all sprung out of position under the weight of the gear spring (about 18 pounds). Recheck the axle center position. Now, add the four remaining spring attachment fittings to the forward faces of the glass tabs with the clecos. The fittings should mate to the glass tabs well. If necessary, you can elongate the pilot holes to make the side panels and tabs all agree (not more than 1/8 inch elongation please). You can build up between the fitting and side panel with flox or glass patches if required. Only use glass if the gap is greater than .050.

Sand the fuselage side if required, brighten the fitting and bond in place with 5 min/flox (unless you've got a big gap). Wait a while then remove the gear spring and drill the other eight mounting holes and install the bolts or screws (AN3-10A or AN509-10R-16) and locknuts. Reinstall the gear spring and its "A" frame support. Now, drill both fittings and the glass tab up to .250 inch (in a couple of steps) you purists can ream if you like, but it's wasted effort. My $7.77 Black and Decker cheapo special single speed 1/4 inch drill motor will just fit next to the fuselage side panel close enough to drill the holes up to full size. My red hot super deluxe 3/8 variable speed drill will not get closer than 1 1/8 inch from the side panel so I don't use it. You tool conesuers who only have the finest in shop equipment will have to stoop to borrowing the cheapo special that your wife bought for household use. Install four AN4-11A bolts with AN960-416 washers and MS21042-4 locknuts. Structural attachment of the main gear spring is complete.

Next, saw 5.5 inches off of each end of the spring. Make a box as shown in the sketch from 1/8 masonite or 6 lb/ft^3 (red) foam scraps. Protect the inside surfaces of the box with tape and automobile paste wax. 5 min/micro the boxes to each gear leg after sanding the gear spring deadly dull over the whole area. Remove the gear leg once more. Turn it right side up and fill the boxes with wet flox. Cure.

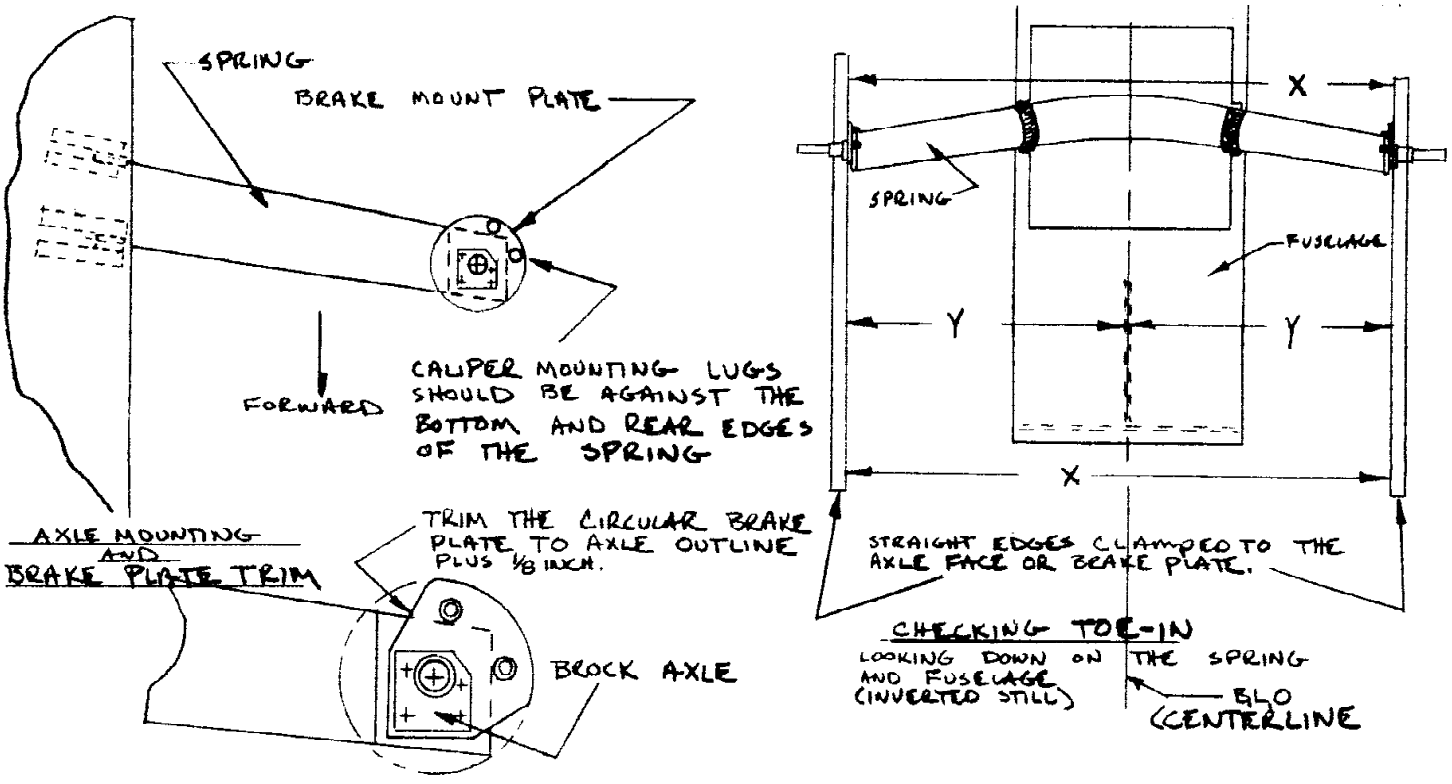
Remove the boxes after the cure, sand the cured surfaces dull for bonding and lay up 3 plies of 45^0 BID from the inside surface of the gear leg (5 inches up) around the bottom edge, up the new flox pad, across its top and up the spring two inches. You can cheat the edges slightly. Peel ply the vertical face of the pad. Cure.



AXLE ATTACH PAD DETAIL

The trailing edge of the gear leg has a recess molded into it to accomodate a 3/16 OD nylon brake line. Sand the depression lightly and sand for good bonding one inch forward of the trailing edge on both surfaces. Cut two 5 foot lengths of 3/16 OD x 025 wall polypenco nylon tubing. Break the gloss on its surfaces with some light sanding (60 grit) over all but the last 15 inches of one end. Mix a batch of 5 min/flox and bond the tubing to the trailing edge. Leave the last 5 inches free at the axle end and quit bonding at the gear spring attachment pad. Use lots of tape to hold the tubing in place, it has a mind of its own. Cure an hour or so, then remove the tape file down any rough edges, and mix epoxy. Pack the length of the tube with micro to fill the little corner area and lay up one ply of 0-90° BID tape (2 inches wide) down the length of the trailing edge. Again, stop at the attach pad and 5 inches shy of the end. Add an additional BID patch over the two ends of the tape. Coil the remaining length at the inboard end for later connection to the brake master cylinders. Cure.

Now install the main gear spring for the last time. It stays with the airplane from here on out. Unpack your axles and brake mounting plates. Fit the mounting plates to the axle mounting pad as shown in the sketch. Trim the circular plate as shown. Clamp the axles and mounting plates in position on the pads with a tight pair of "C" clamps. Check for toe-in by using two long straight edges as shown in the sketches which follow. Shoot for zero toe-in but if you are going to miss, stay slightly (less than one degree) toed-in.

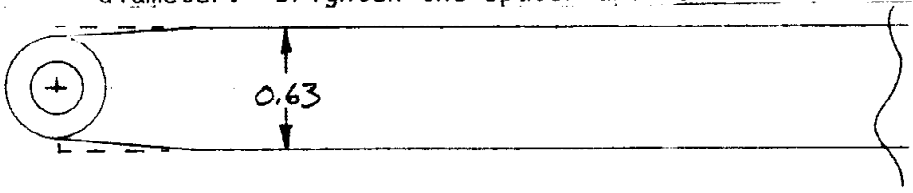


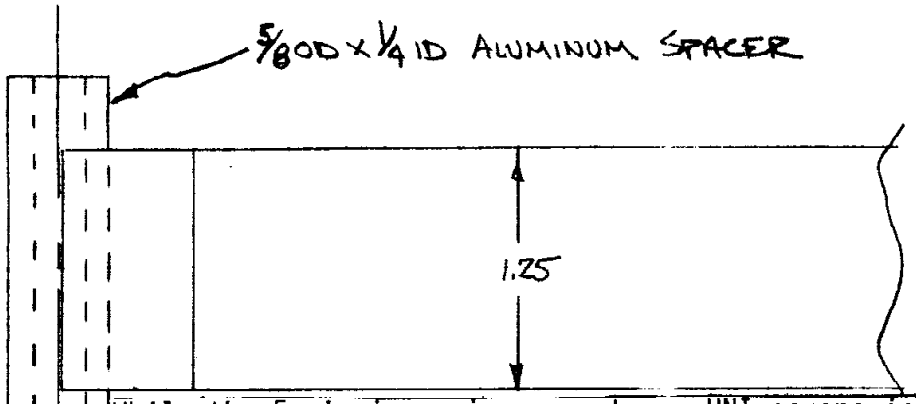
You can shim the axle and brake plate with sheet metal strips under the front or rear mounting bolts as required to set the toe-in. Check the camber (roll) of the axle by checking the axle mounting face with a bubble level. If any, camber should be such that the bottom of the tire is inboard more than the top. Zero to 3 degrees camber (bottom in) is OK. Bottom edge out camber is not acceptable and toe out is also a no-no.

Drill the four (each axle) #11 mounting holes through the brake plate and spring. Make tapered washers from 1/2 X 1/2 X 3/16 pieces of 2024-T4 aluminum bar which will allow the attaching bolts (AN3-20A bottom and AN3-25A top) to have a flat surface for the nut to seat against while mating with the sloping spring. A file and a lot of patience are required to do this right. With bolts and nuts installed, recheck the toe-in carefully and eyeball the camber. Shim as required. Bond the axles, brake plates, bolts and tapered shims in place with flox when everything is set.

Install the brakes and wheels. Install a bleeder fitting in the bottom port (1/8 NPT) of the brake caliper (teflon tape to seal threads). Install a hi-duty #89-LA 3/16 X 1/8 male elbow in the upper caliper port (more teflon tape). Trim the 3/16 OD nylon tubing to jamb into the end of the elbow and torque the compression nut down to attach the tubing to the elbow. The torquing swages a collar around the tubing for a leak proof high pressure connection. While you're at it you can fit the brake master cylinders into position and install the same hi-duty connectors, size the length of the tubing and torque. The caps will stay attached to the brake lines following this operation and the master cylinders can be stored away until final assembly. Mount the 3:40 X 3:00 X 5 tires and tubes on the wheels, install the wheels on the axles (don't forget to pack the wheel bearings with grease). Install the castle nut and cotter pin and your mains are ready to roll.

Take the tailwheel spring and cut the bevels shown below. Make one 2.0 inch long X 5/8 OD X 1/4 ID spacer from 2024-T3 rod. File a semi-circular groove in the top end of the tail spring to fit the spacer's outside diameter. Brighten the spacer and bond it into the groove with 5 min/flox.





TAIL SPRING
UPPER ATTACHMENT

While the 5 min is curing go cut one UNI scraps into the following lengths of 1 1/4 inch wide (start wider to allow for some frazzles) 0^{0} UNI strips: one 6 1/2 long, one 6 long, one 5 1/2 long, one 5 long, one 4 1/2 long, one 4 long, one 3 1/2 long, and one strip 12 inches long. Lay up the 7 UNI strips starting with 3 1/2 long and working up to the 6 1/2 inch strip around the spacer's diameter and overlapping equally on to the top and bottom of the spring. Lay up the twelve inch strip by wrapping it (and wetting) around the spring just below the spacer. The strip will go around the spring about three to four times before it is used up. Cure.

Tailwheel Assembly

The tailwheel is a full swivel, non-steerable, lockable device. The idea is to offer minimum drag and minimum sensitivity. The locking tailwheel is a good approach to the problem.

Fabricate the parts on page 114A (TW) and 115 (TW). The assembly drawing should be fairly explanatory. The assembly sequence goes this way:

1) Put the latch pin spring onto the locking pin.

2) Put the locking pin in the pivot block.

3) Put a dab of 5 min in the 8-32 tapped hole in the locking pin and screw in an AN526-832R6 screw. The screwdriver slot in the bottom of the locking pin enables you to tighten up the screw. **Do not** allow epoxy to squeeze out and get on the locking pin. If dissassembly is required, heat the locking pin (hair dryer will do nicely) to break the epoxy bond and unscrew the assembly.

4. Push the locking pin up and place the release cam in under it.

5. Bolt the pivot block into the tailspring channel.

6. Install an AN3-17 bolt through the tailspring channel and release cam tube. Install a 3/16" washer and castellated nut. **Do not** tighten this bolt up on the tailspring channel. The release cam is a loose fit on the bolt.

7. Install the fork assembly in the pivot block. Put the pivot plug in the top of the tube and hold everything together with an AN4-35 bolt, washer and castellated nut.

8. Test the assembly for complete freedom from binding and absolutely positive locking.

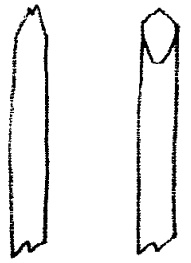
Tailspring Installation

Cut a hole under the aft closeout bulkhead (see page 62TW) to thread the tailspring through. Trial fit the tailspring in place. Remove the spring and line the hole in the bottom with 2 BID plies and flox corners. A loose fit of the spring in the hole will be easier to work with than a close fit. Cure. Wrap and tape a piece of Saran Wrap around the tailspring in the area where it will go through the hole in the bottom of the fuselage. Put flox around the hole and permanently install the tailwheel spring. Install the AN4 bolt, washer and locknut holding the tailspring to the tail attach bulkhead. The purpose of the flox is to restrain sideways motion (no bond) and to provide a larger area seat at the aft closeout bulkhead. After cure remove as much Saran Wrap and tape as you can.

Tailwheel Installation

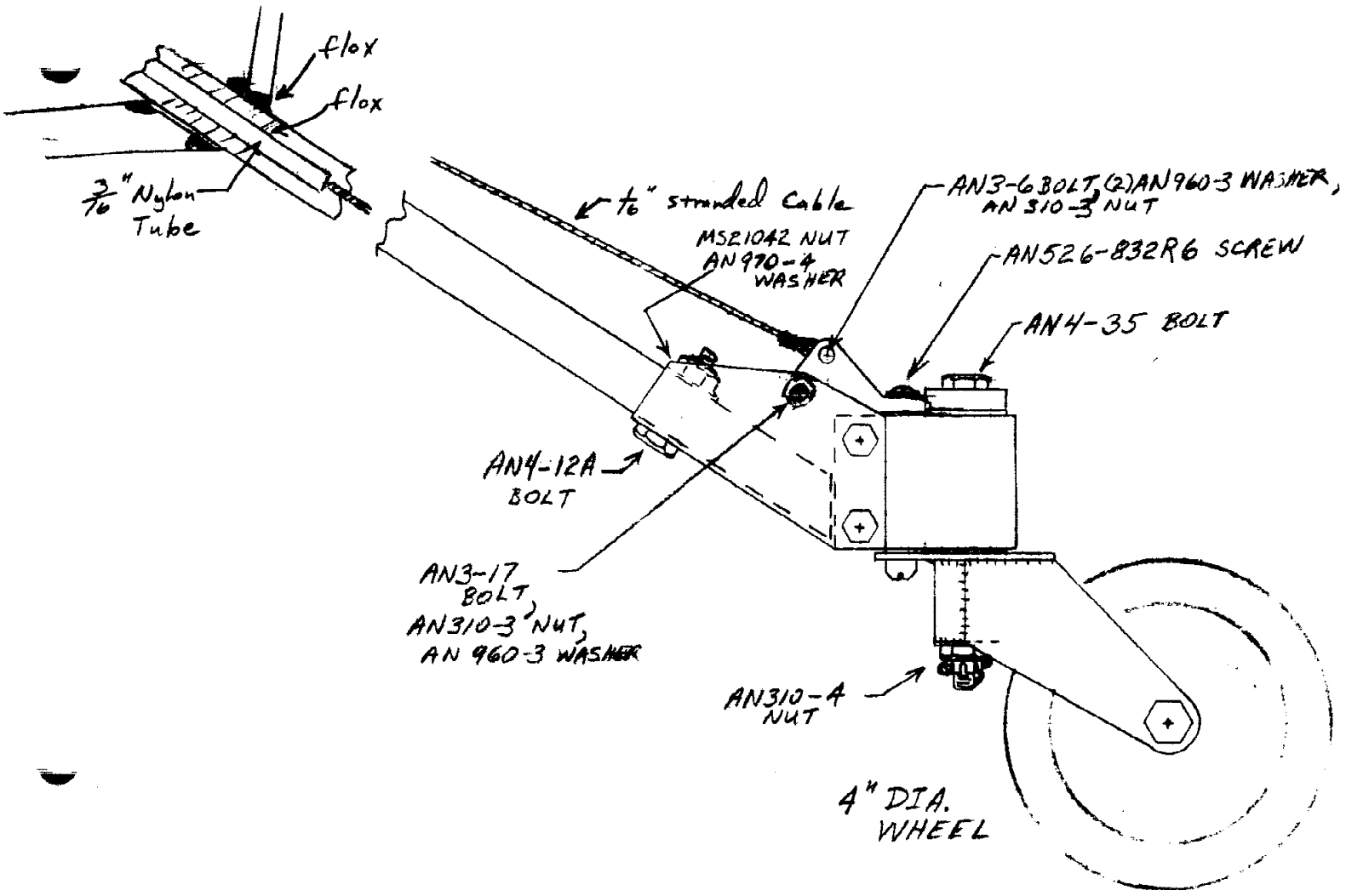
Cut the bevel on the end of the tailspring and trial fit the tailwheel assembly. Grind and hack on the tailspring until it fits down into the tailspring channel. When you're satisfied, clamp the tailspring in place and drill a 1/4" hole through the channel and tailspring. There should be about 3/8" edge distance on this hole. Unclamp, degrease the channel, prep the tailspring, mix wet flox and reinstall everything with an AN4-12A bolt,AN970-4 washer and locknut holding the tailwheel assembly to the spring. Wipe off all the squeezeout and let cure. Make an aluminum spacer 1.8" long, 1/4" ID, and an OD to match the bearing ID of your wheel. Bolt the wheel, spacer, washers to center the wheel, and the 1/4" axle (AN4-23 bolt) in place and secure with a castellated nut.

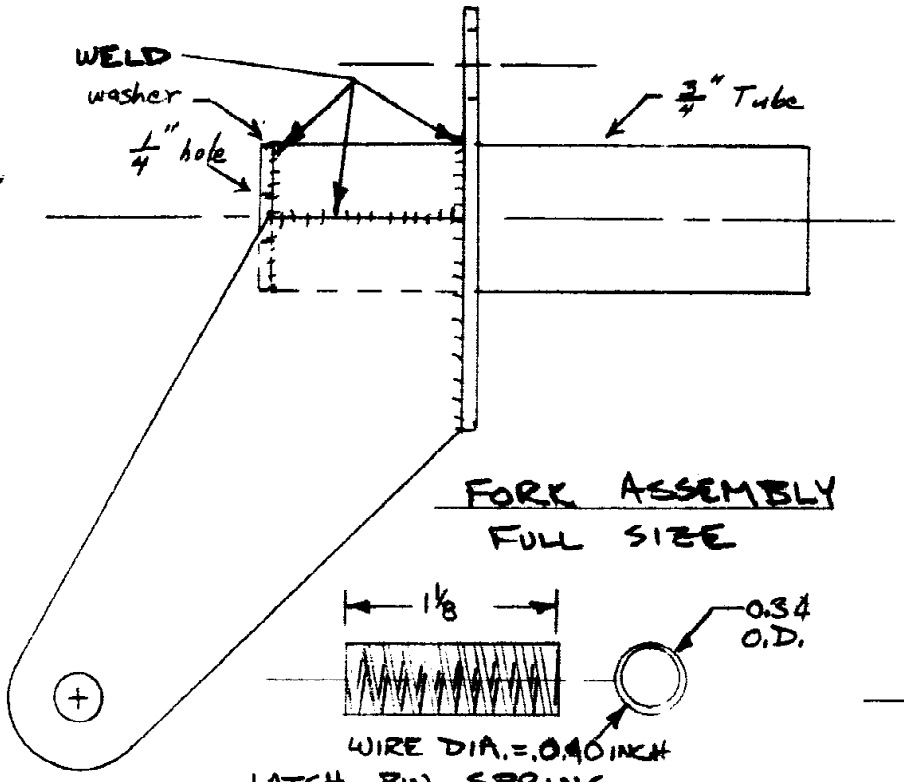
Tailwheel Lock Cable



The tailwheel lock cable is 1/16" or 3/32" stranded steel running inside a 3/16 OD hard nylon tubing. Drill a 3/16" hole through the fuselage bottom parallel to and on the centerline of the side of the tailspring. Use a long drill bit for this--in fact I like to make a "one shot" drill bit by grinding a flute on about a 3' piece of metal rod. If you are precise you can make a darn good drill bit that will drill a nice round hole. A nice round hole is not required. Being 3' long the bit can be "snaked" into very close proximity to the tailspring. Run the 3/16" nylon tube through the hole, rough up the tube and flox in place where it goes through the fuselage. The tube should be about 8' long. Coil the tube up for now. You can't flox it into place until the left console is installed.

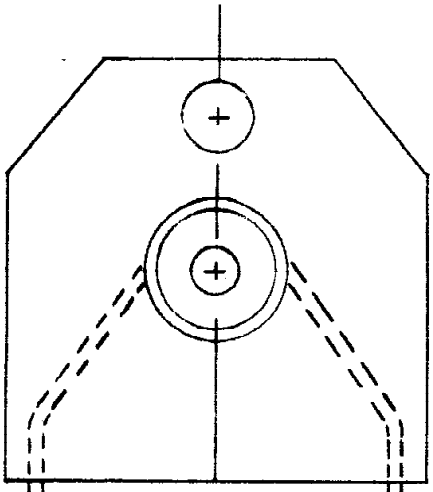
113C
TW

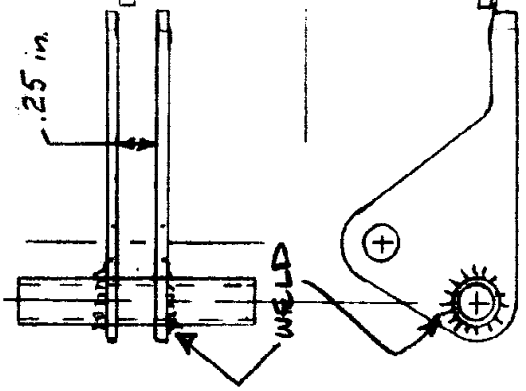

flox
flox
3/16" Nylon Tube
1/16" stranded Cable
MS21042 NUT
AN970-4 WASHER
AN3-6 BOLT (2) AN960-3 WASHER, AN310-3 NUT
AN526-832R6 SCREW
AN4-35 BOLT
AN4-12A BOLT
AN3-17 BOLT, AN310-3 NUT, AN960-3 WASHER
AN310-4 NUT
4" DIA. WHEEL



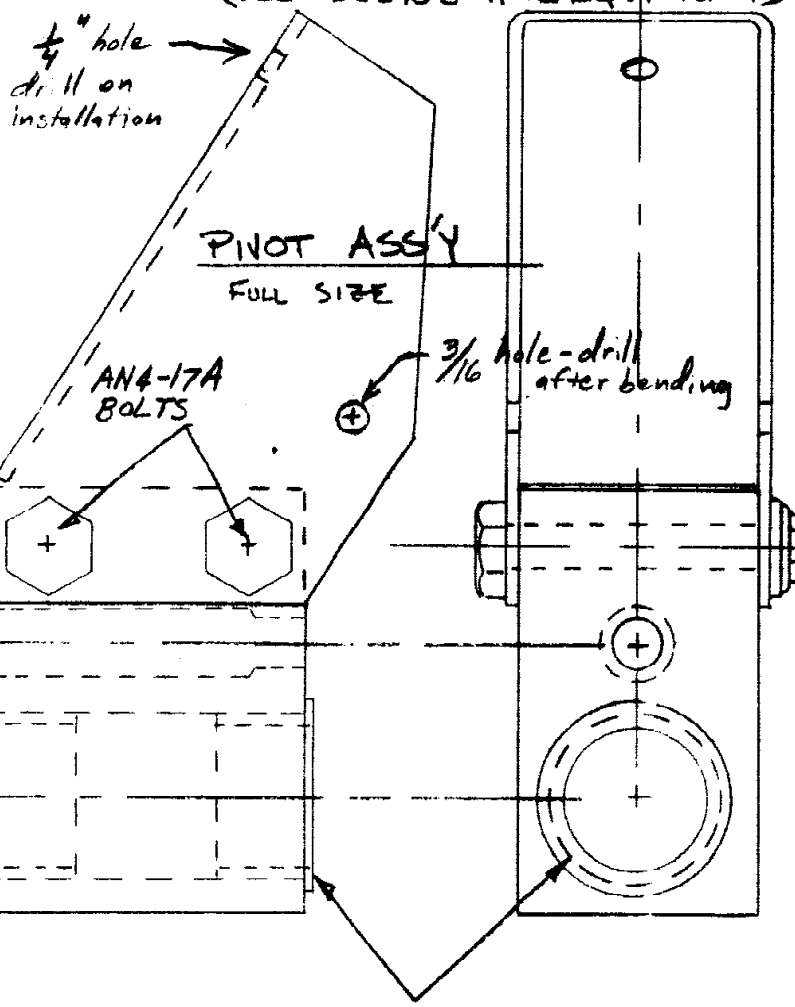
FORK ASSEMBLY
FULL SIZE

LATCH PIN SPRING
(LEE #LC 040E-11 OR EQUIVALENT)

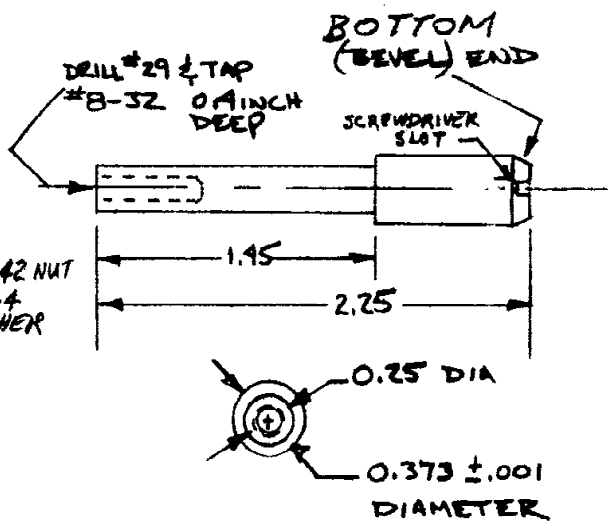




RELEASE CAM ASS'Y
FULL SIZE



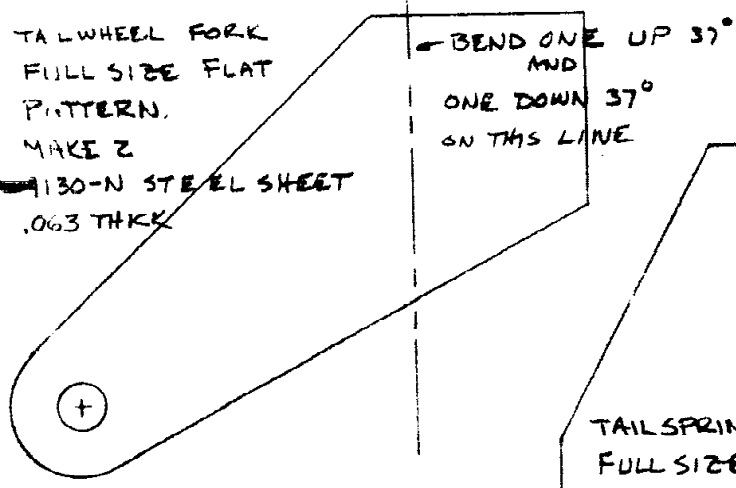
PIVOT ASS'Y
FULL SIZE

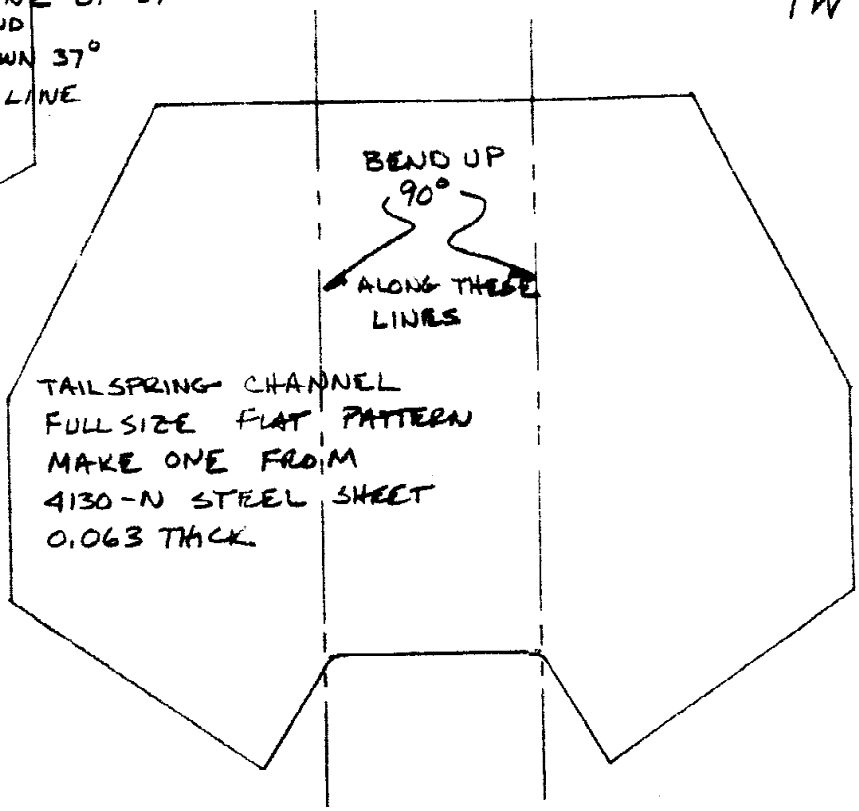


LOCKING PIN
FULL SIZE MAKE ONE
4130-N ROD

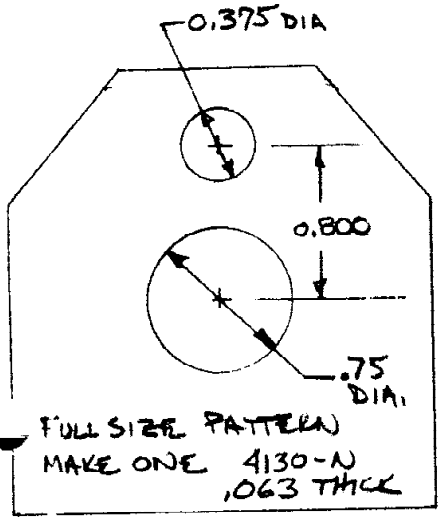
3/4 I.D. FLANGED OILITE BRONZE
BUSHINGS - LIGHT PRESS FIT
2 REQ'D

TAILWHEEL FORK
FULL SIZE FLAT
PATTERN.
MAKE 2
4130-N STEEL SHEET
.063 THICK

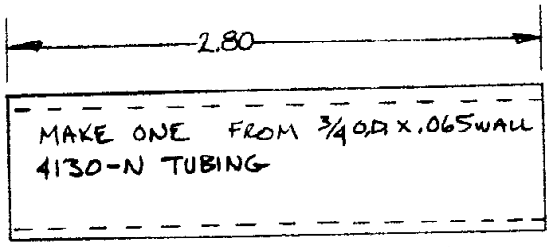




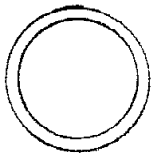
TAILSPRING CHANNEL
FULL SIZE FLAT PATTERN
MAKE ONE FROM
4130-N STEEL SHEET
0.063 THICK



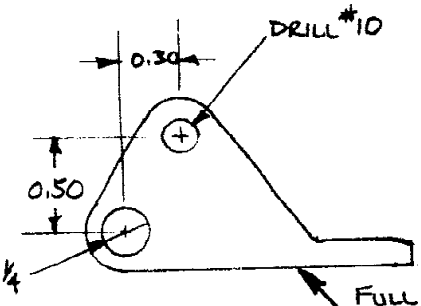
FULL SIZE PATTERN
MAKE ONE 4130-N
.063 THICK



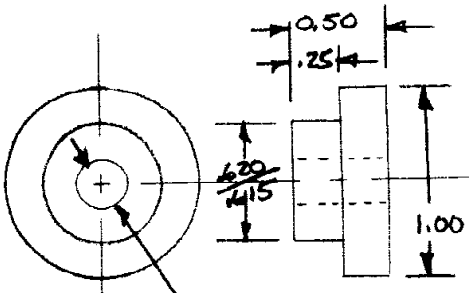
MAKE ONE FROM 3/4 O.D. x .065 WALL
4130-N TUBING



MAKE ONE WASHER
3/4 OD x 1/4 ID
.063 THICK
4130-N

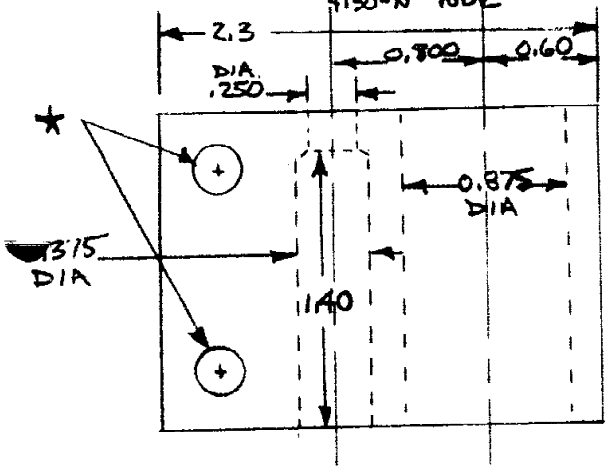


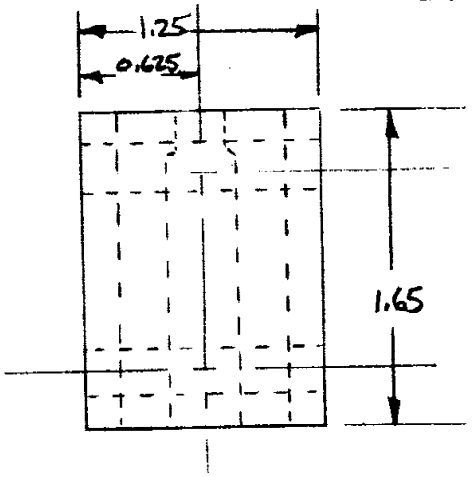
FULL SIZE PATTERN
MAKE 2 FROM .063
4130-N SHEET



PIVOT PLUG 1 REQUIRED
2024-T4 OR 7075-T6 ALUMINUM

MAKE ONE FROM
1/4 OD x .028 WALL
4130-N TUBE





PIVOT BLOCK
FULL SIZE - MAKE ONE
2024-T4 OR 7075-T6
OR 6061-T4 ALUMINUM
★ TWO .250 DIA MOUNTING
HOLES FOR ATTACHING
THE TAILSPRING CHANNEL
DRILLED ON ASSEMBLY.