

Engine Installation Lycoming O-320 into a Long-EZ



INTRODUCTION

Section IIL provides engineering information and documentation for the installation of any one of various models of the Lycoming O-320 aircraft engine into a Long-EZ.

THE ENGINE

As you become more knowledgeable about the Lycoming O-320 engine, you`ll soon discover that there are some model variations. The commonality of all models and dash numbers, etc., that makes it possible to cover their installation in one manual is this: all O-320's are dimensionally similar; the cooling characteristics are similar; the cowling fits them all;



The **Lycoming O-320** series engines are four-cylinder, direct-drive, horizontally opposed, air-cooled models. The cylinders are of conventional air-cooled construction with heads made from an aluminum-alloy casting and a fully machined combustion chamber. The cylinder barrels are machined from chrome nickel molybdenum steel forgings with deep integral cooling fins, ground and honed to a final specified finish. The O-320 series engines are equipped with a float-type carburetor. Particularly good distribution of the fuel-air mixture to each cylinder is obtained through the center-zone induction system, which is integral with the oil sump and is submerged in oil, ensuring a more uniform vaporization of fuel and aiding in cooling the oil in the sump. In addition, the IO-320 has a fuel injector. The fuel-injection system schedules fuel flow in proportion to airflow. Fuel vaporization takes place at the intake ports.

320 CUBIC INCH ENGINE SERIES

According to specific engine model configuration

					HEIGHT	WIDTH	LENGTH	DRY WT	REMARKS
MODEL	RATIO	HP	RPM	TBO	(IN)	(IN)	(IN)	(LBS)	
O-320-A	7.00:1	150	2,700	2,000	22.99	32.24	29.05-29.81	271-279	Conical Mounts

NOTE: O-320-A1A Same as O-320, model designation change only.

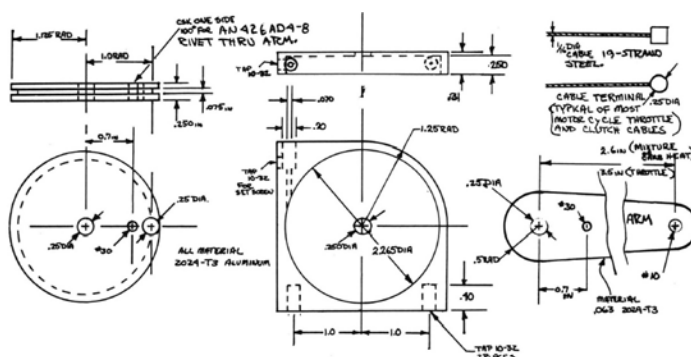
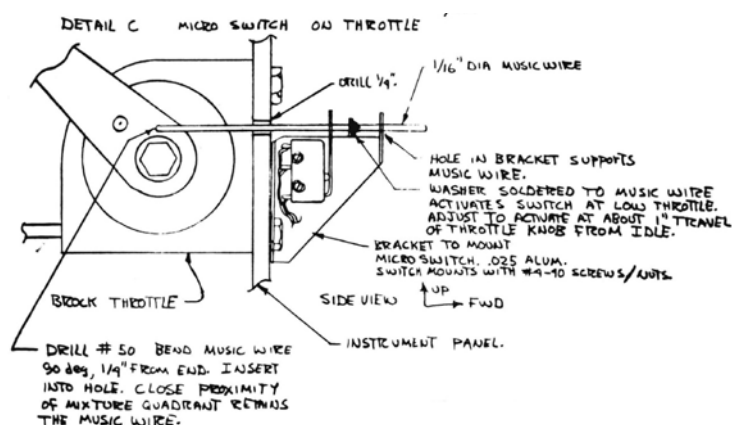
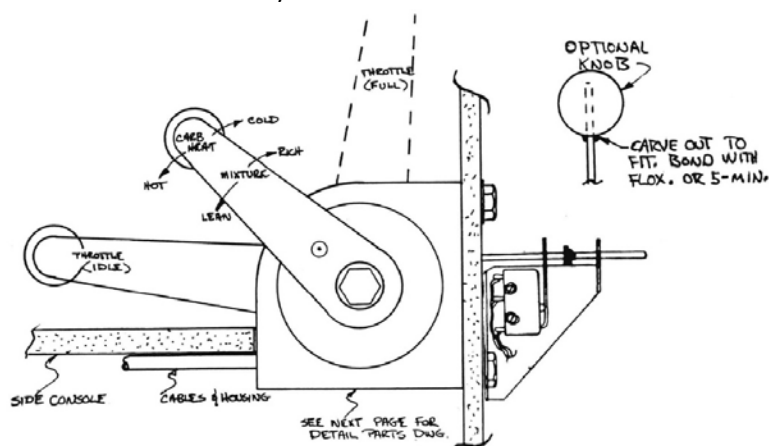
In most cases the O-320 case will be machined to accept a mechanical fuel pump. One more consideration is provision on the engine to be able to install an oil cooler. A relatively small percentage of these engines may not be machined to accept oil coolers. The original Long-EZ N79RA has a Lycoming O-235-C2C engine and is not equipped with oil cooler. On a hot day during an extended full throttle climb the oil temperature is marginally acceptable. We do recommend the installation of oil cooler.

IMPORTANT

The scope of these installation drawings does not include educating a home builder in all the disciplines leaned by an A&P mechanic to allow him to work on aircraft engine installations. Thus if you are not an A&P mechanic, you should have an A&P install your engine and accessories or at least have an A&P inspect and approve the work.

INSTALLING THE THROTTLE QUADRANT

eight inches or so. Pot the cables generously with RTV (silicone rubber) where they penetrate the firewall for chafe protection and to seal the firewall. Your cables will be too long still; coil them up and tape them to the firewall so they don't get damaged. Do not bend them too sharply.



STEP IIINSTRUMENTATION AND WIRING

In this step you will mount your engine instruments, switches and route all of the associated equipment to the firewall. All of the instrumentation called for in this step is available through a Long-EZ distributor.

Recommended Instrumentation:

Option 1. Analogical

Cylinder Head Temperature

Rochester gauge #3070-61 or VDO #310-909

Sender #3080-14 or VDO #323-701

Oil Temperature

Rochester gauge #3070-62 or VDO #310-014

Sender #3080-37 or VDO #323-057

Oil Pressure

Rochester gauge #3050-54 or VDO #350-044

Sender #3060-18 or VDO #360-004

Fuel Pressure

Rochester gauge #3050-58 or any direct

Sender #3060-17 reading pressure gauge

Tachometer

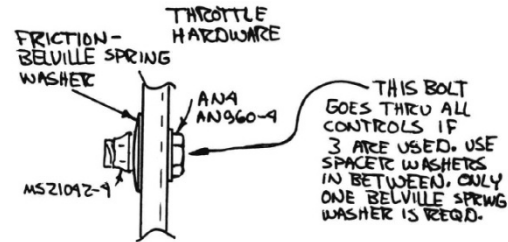
Carr 2 ¼" #CT42 DS

Carr 3" #CT 43 DS

First mount your engine instruments positioned as desired on the instrument panel. Any direct reading instruments must have lines at least 10 feet long. A mechanical tachometer is not really practical due to the long heavy cable required. The tachometer recommended above operates electrically through a small tach generator which screws directly to the tach cable mount on the accessory case of your engine. These Tachometers have proven to be reliable and reasonable accurate. A magneto-powered tachometer can be used, but do be certain that there is no way that a magneto failure could fail one or both magnetos. If you have a starter a standard key-type on-left-right-both-start switch works well. Without a starter, two miniature switches (micro 8A1011 or Alco MTF-106N) mounted as shown on page A1 or where desired, are required.

With all these mounted, take your dremel and clear holes through the instrument panel and front and back seat bulkheads (or use the holes cut in Step I). Now drill a ½" hole in the firewall directly below the hole drilled for the control cables (see page 13) and be sure to carefully deburr all sharp edges in the firewall so that they will not chafe your wiring. Now thread your instrumentation wiring, and direct reading lines (if used) through the instrument panel, both seat bulkheads and the firewall. Locate your wiring bundle against the left fuselage side making sure that there is no interference between the pitch trim cables, or the landing brake handle and associated cables.

This may require routing the wire bundle through the instrument panel then down towards the floor until aft of the landing brake pivot. Use grey tape strips to temporarily hold the wiring bundle in place, then pot the wire bundle to the fuselage side every 8" or so with RTV (silicone). Do go ahead and include a couple of spare wires in your bundle this can



save much grief later on should you decide to install a fuel flow indicator or whatever. Pot the wiring bundle generously with RTV in the firewall. Remember, the wiring bundle will vibrate with the engine and care should be taken to prevent any possibility of the wires being chafed where they come through the firewall.

If you have a full electrical system, including starter and alternator you will have a large bundle of wires. It is of course permissible to split the bundle up into two or more, and run half of them down the right side. In this case be sure that there is no possibility of interference with the control system, and bond the wiring bundle to the right fuselage side, preferably in the bottom corner with the fuel lines, using RTV.

All wiring should go through the firewall on the left side, so any wiring going down the right side, must be routed across the aft face of the rear seat bulkhead, (in such a way as to not interfere with rudder cables, and aileron torque tubes.

Be sure and label each wire, then coil the excess length of the bundle and tape it to the firewall so that it won't get damaged. If you solder any wires, (magneto switches) be sure and use good quality solder intended for electronics work.

Option II. Digital System.

SkyView SV-D1000

SkyView Displays utilize TFT active matrix LCD screens and LED backlighting technology for increased life span, more uniform brightness, and reduced power consumption.

Buttons and Joysticks: The SkyView System is designed for ease of use while flying. The most used functions are accessed via two rotary/multi-direction Joysticks, for fast intuitive commands. Almost all other in flight commands, using the widely spaced buttons, are only two button presses away. None or more than three button presses.

Redundancy: If two displays are in the system, either one can act as the Primary Flight Display, Moving Map, and Engine Monitor. The unlikely loss of either display will not affect the functionality of the other.

System Battery Backup: A system backup battery will provide over an hour of backup power to a Display and Modules. Each Display requires its own Backup Battery for redundancy.

- Connections:** Each display contains:
- 1 - 37-Pin DIN Connector for the main wiring harness
 - 2 - 9-Pin DIN Connector for the SkyView Networks
 - 2 - USB Connectors
 - 1 - Ethernet Connector (currently unused)



DETAILED FEATURE LIST

HARDWARE
SV-D1000 10" Display
SV-D700 7" Display
Backup Battery (SV-BAT-320)
ADAHRS - First (SV-ADAHRS-200)
ADAHRS - Additional (SV-ADAHRS-201)
EMS Hardware/Module (SV-EMS-220)
GPS Receiver Puck (SV-GPS-250)
Autopilot Servos
SYSTEM SOFTWARE
Clock - Local
Clock - Zulu
Screen Dimming

Master Power Voltmeter
Internal Battery Voltmeter
Charging Status
Backup/Restore
Measurement Units Setting
Messaging/Alerts
Multiple ADAHRS - Manual Switchover
Multiple ADAHRS - Auto Switchover

EXTERNAL DATA INTERFACES
USB Thumb Drive Firmware Updates
Altitude Encoder
NMEA Input (position, time, speed)

PRIMARY FLIGHT DISPLAYS
Split Screens
Synthetic Vision - Land
Synthetic Vision - Oceans
Synthetic Vision - Lakes
On/Off Toggle (Synthetic Vision - Artificial Horizon)
Airspeed Indicator
Airspeed Trend
Vx/Vy Markers
Altimeter
Vertical Speed Indicator
Artificial Horizon (pitch lines, roll scale, chevrons)
Angle of Attack
Turn Rate
Ball
Compass/Heading
Compass Rose on Horizon
GPS Ground Track Pointer
Outside Air Temperature
True Airspeed
Density Altitude
Flight Path Indicator

ENGINE MONITORING
Flexible Gauge Layout (layout editor)
Flexible Pin Assignments
Tachometer
Manifold Pressure
Tachometer
EGTs
CHTs
GP thermocouple
14 Fully Configurable Thermocouples
Oil Temp
Oil Pressure
Coolant Temp
Coolant Pressure
Fuel Pressure
Ammeter
Voltmeter
Fuel Flow
Fuel Level
Trim Position
Flap Position

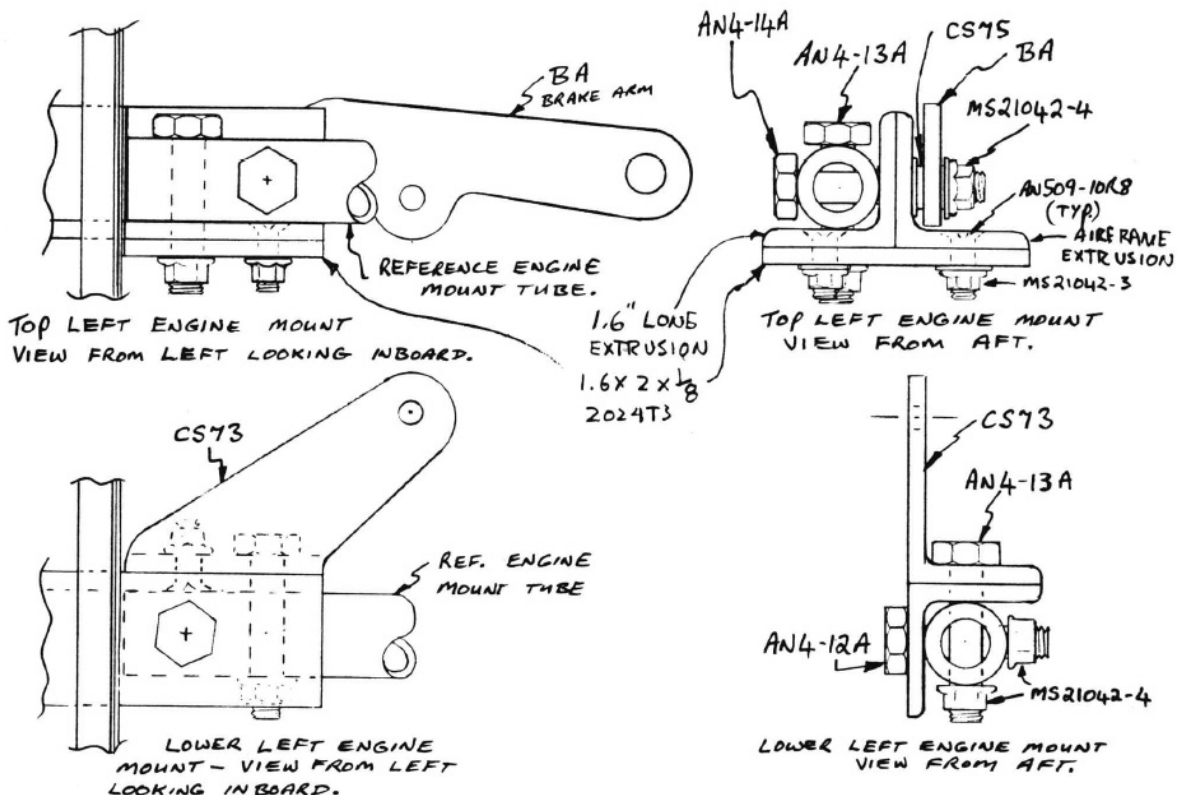
STEP IIIINSTALLING THE ENGINE MOUNT

Depending of the engine, we will require either a **conical** or **dynafoal** engine mount. Both of these are available as welded up, bolt on assembly from Ken Brock Mfg. or others.

At this point we will assume we do not have our engine mount aluminum extrusions installed into the fuselage. Cut the "L" shaped holes through the firewall in the correct places. Drill a couple of holes and use a saber saw or a dremel and pin router. Slide the four 8" long aluminum extrusions into place and verify that they are correctly located with respect to butt lines and water lines. Make the four wood wedges called out on page 14-4 (section I). Now cut two pieces of the same aluminum extruded angle 1.6" long. Cut some 1/8" thick aluminum sheet into two pieces 1.6" x 2". Carefully examine the full size drawings on this page to familiarize yourself with how the top extrusion mount assembly goes together. You should bolt the 1/8" x 1.6" x 2" pieces of aluminum to the 8" long pieces of extruded angle, and the locate the 1.6" long pieces of extruded angle in the correct position and bolt them into place. You will now have 4 AN509-10R8 screws bolted into each top engine mount extrusion which when viewed from aft, will look like an upside down 'T'. A 100° countersink is required. Now you are ready to install the extrusions into the fuselage. You should do this "dry" the first time, that is, using dry BID cloth where 10 plies are called for. Install all 4 extrusions and clamp your engine mount into place with "C" clamps. Check the fit of the extrusions and

wedges to the longerons, and adjust the number of plies of BID to obtain a good fit; add whatever plies are necessary, but do not end up with less than 7 plies under each extrusion. When you have an acceptable fit, dry, unclamp the engine mount, remove the top extrusions and dry glass and thoroughly sand the corners between the centersection spar and top longerons. Glue the wood edges in to position using wet flox. Layup the 10 plies of BID (or however many it takes) into each corner, sand the aluminum extrusion completely dull using 220 grit wet or dry. Paint pure epoxy on the extrusions and install them carefully so as not to disrupt the BID glass. Press them gently into place and clamp the engine mount back into position on the top extrusions. If you have done everything right, the top extrusions will now be held in position by the engine mount. Fill any voids under the extrusions, wood wedges, centersection spar, firewall or longerons with flox and allow the whole thing to cure undisturbed.

After a minimum of 24 hours, flip the fuselage over and repeat the above for the lower engine mount extrusions, with the exception that the lower extrusions do not get the additional pieces of extruded aluminum angle etc. Allow the lower extrusions to cure with the engine mount clamped in place. This assures you of a perfect fit between the welded engine mount and the aluminum extrusions.



Now while the fuselage is upside down, drill the 1/4" holes through the extruded angle and center section spar, and short longeron. It is very handy here to have a right angle drill adapter, (the small aircraft type is best and is available from a distributor). A 10" long, 1/4" drill bit is required to drill in the engine mount, and works well to reach in to drill through the extrusions and centersection spar. See section I page 14-4 for bolt hole locations and bolt sizes.

Flip the fuselage back over and drill and bolt up the top engine mount extrusions per Section I page 14-4.

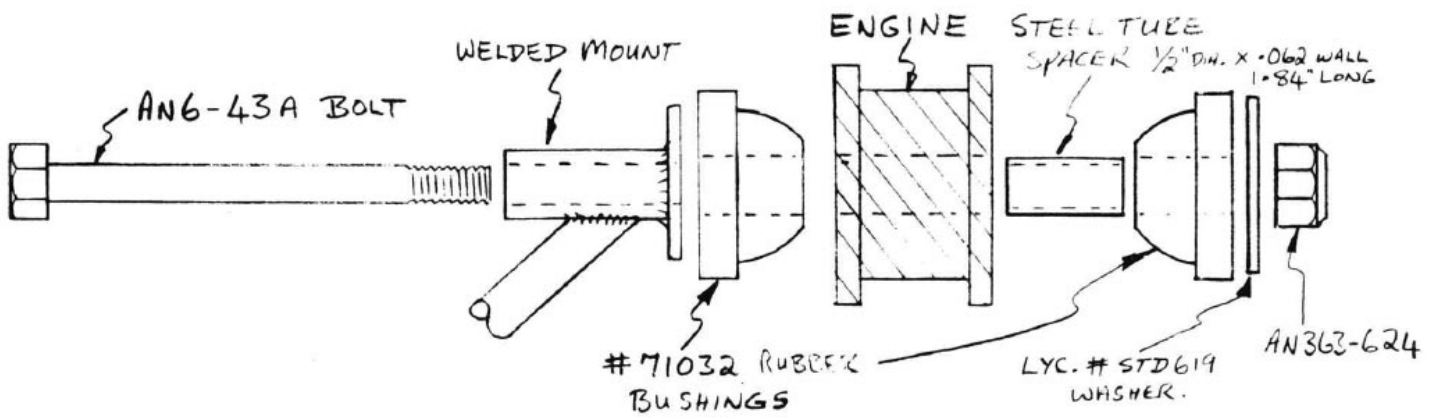
Now remove the engine mount and refer to Section I page 15-2 Step 3. Note that the full size view AA is not representative and you should use the full size drawing on page 7 of this section.

Make one left and one right hand CS73 bracket and install them on the lower engine mount extrusions using one AN509-10R-8 screw and one MS21042-3 nut per bracket as show

Long-EZ

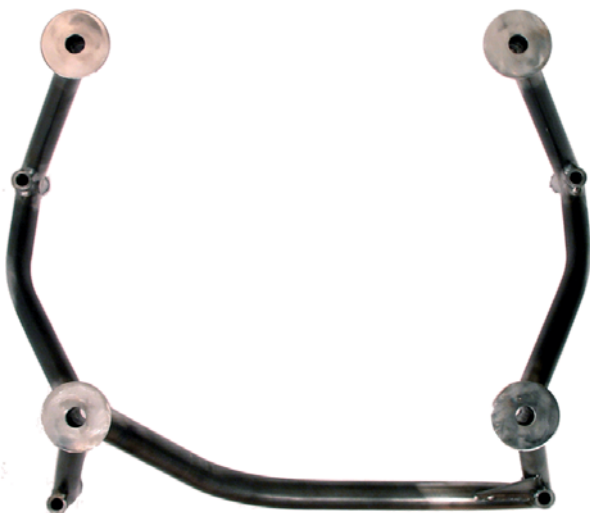
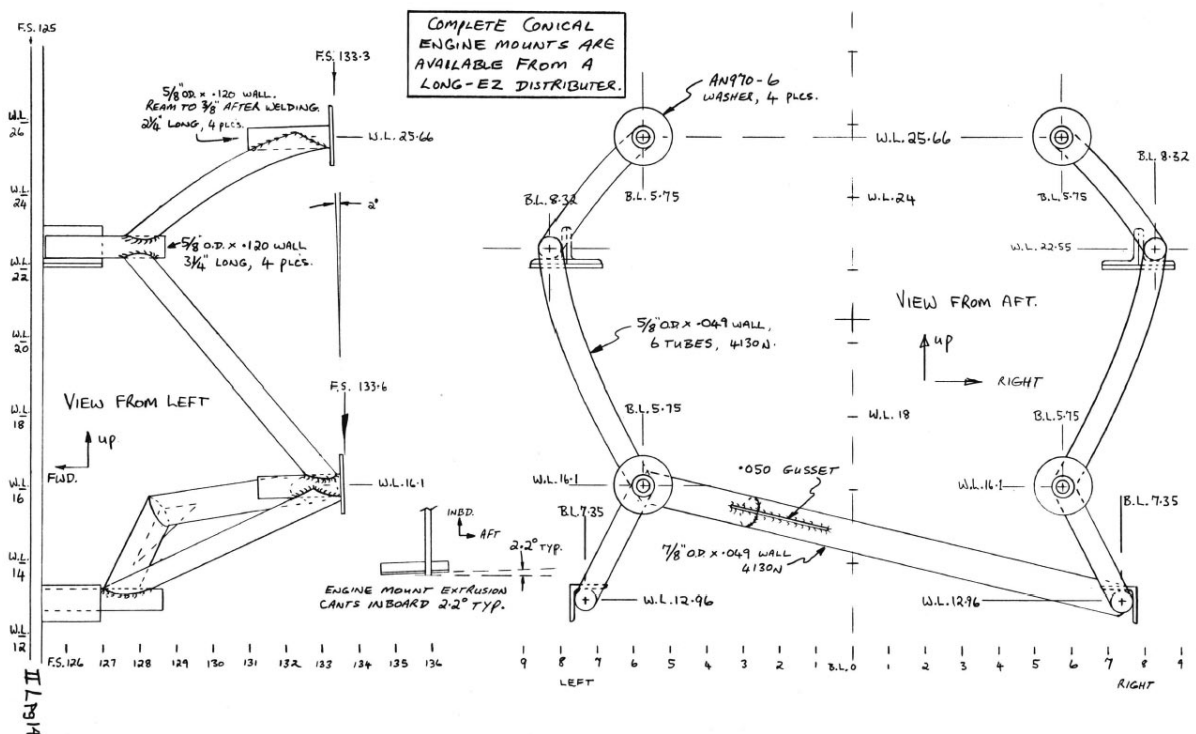
SECTION II LYCOMING O 320 ENGINE INSTALLATION

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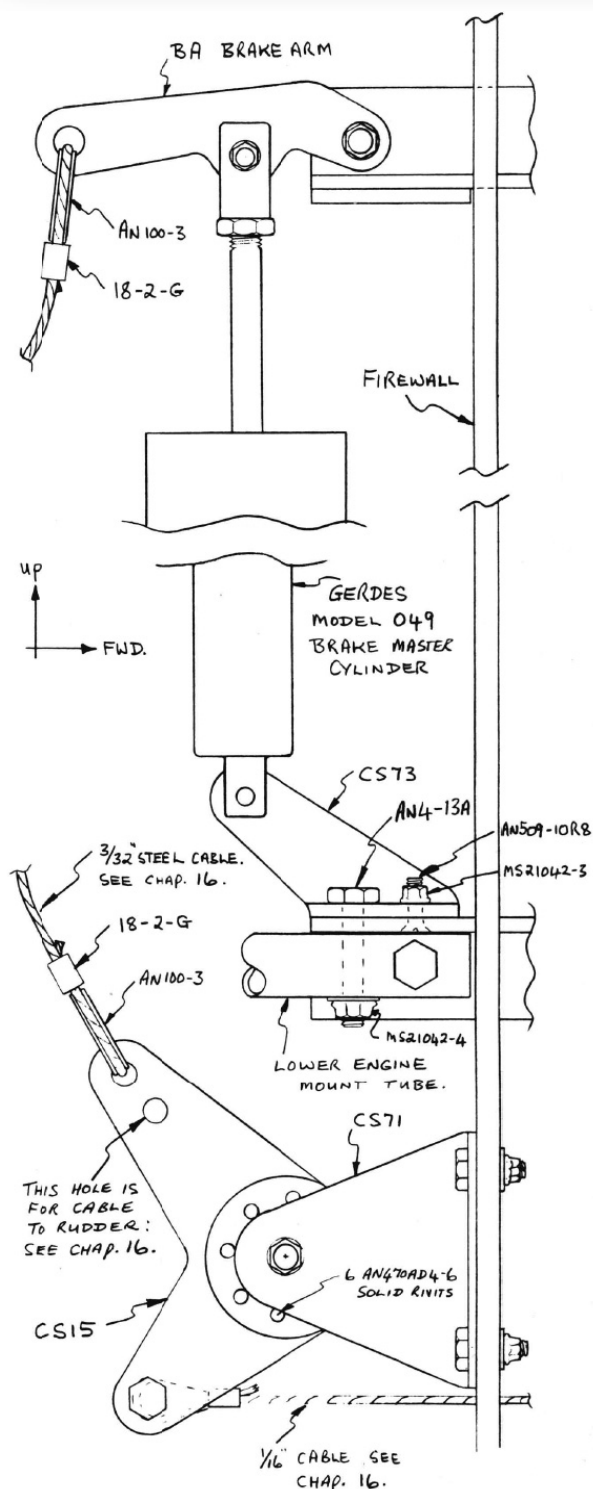
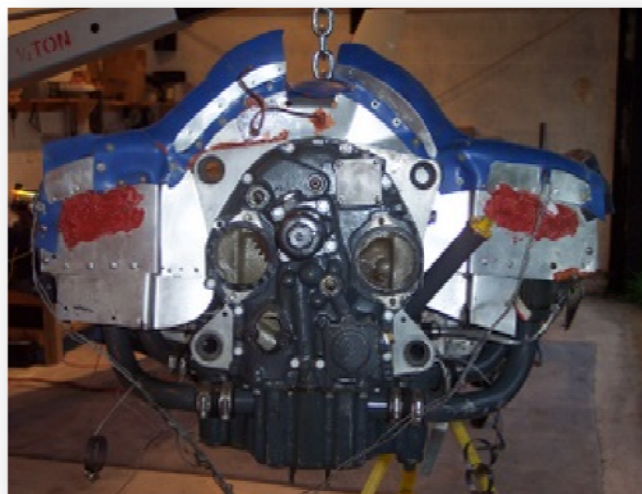


EXPLODED VIEW OF A LYC. O-235 CONICAL MOUNT AND ASSOCIATED PARTS.

We are using a conical engine mount, because the Lycoming O320 used on this airplane, require a conical.



BA BRAKE ARM. PATTERN.



STEP IV

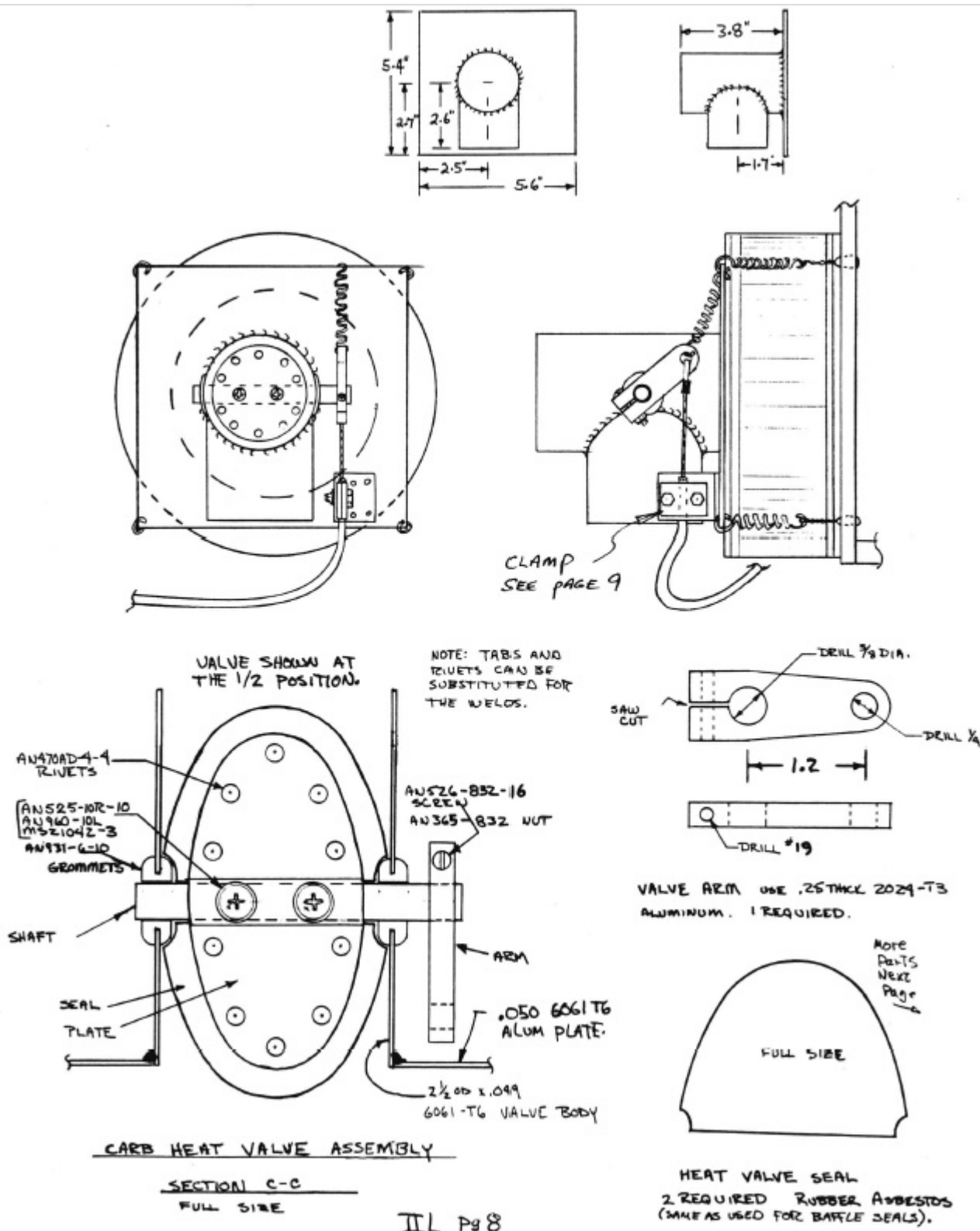
INSTALLING THE CARBURETOR AIR FILTER AND HEAT VALVE.

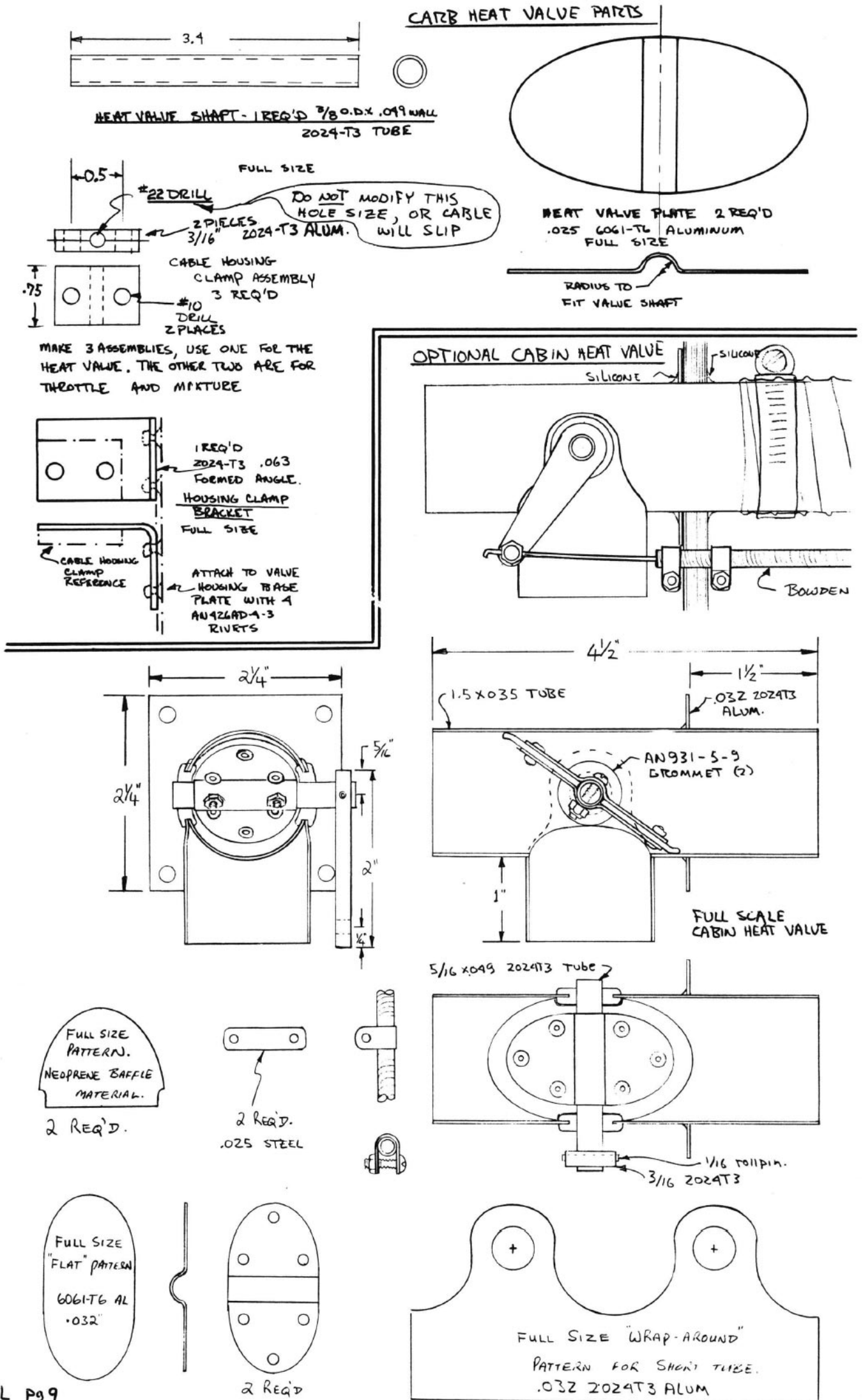
Before proceeding with air filter installation, if you do not have the CS123 bushing and CS124 belhorn installed, you should install them now (section 1 page 16- 5).

You can obtain an air filter from your local auto parts store. A Purolator #AFP-117 or and A.C. 448C or similar filter will work fine. See page and locate your filter as low as far right as possible on the right side of the firewall. Be sure that there is no interference with brake lines or rudder cable or belcrank.

Use a felt tip pen and mark around the filter then set it aside.

Next fabricate the carb. heat and air valve shown below and on page 9. This part is available prefabricated from Ken Brock Mfg. Locate your air valve over the outline you marked of the air filter so that the four corners over hang it roughly equally. Mark the location of each corner on the firewall. Check again for possible interference with brake line or cables. Drill two small holes (1/16" dia.) through the firewall and make a loop of .041" stainless safety wire through the holes as shown, at each corner. Cut four lengths of 3/8" screen door spring and install the air filter and valve assembly with the springs holding the valve and air filter tightly against the firewall at all four corners.



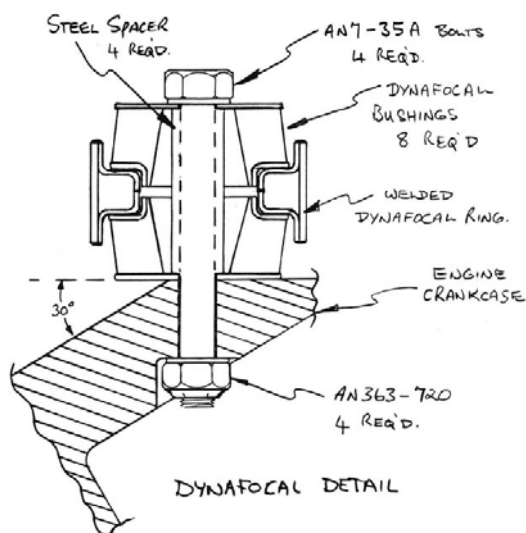


STEP V**INSTALLING THE GASCOLATOR, ELECTRIC FUEL PUMP AND OPTIONAL CABIN HEAT VALVE.**

Carefully examine page 13. This drawing is not to scale but clearly shows where to position the above parts on the firewall. Disregard the drawing showing position of gascolator, fuel pump and wire bundle on page 21-8 Section 1, although the method of mounting the gascolator is the same.

The gascolator is hung from the firewall such that you can easily reach through the cooling air scoop, and drain the gascolator during pre-flight inspection. The 3/8" dia. aluminum fuel line from the center of your fuel valve, see section I page 21- 5, should come through the firewall, just to the right of the throttle, carb, heat and mixture cables. Drill a 1/2" dia. Hole through the firewall, push the fuel line through. Pot the fuel line generously into the 1/2" hole with RTV silicone rubber. Mount the gascolator as shown on page 13 using two AN822-6D elbows screwed into the gascolator, two clamps, MS21919-DG11, two AN3-17A bolts with AN960-10L washers and MS21042-3 nuts and two 3/8 O.D. x 3/16" I.D. and 1" long spacers. Be sure to orient the gascolator correctly for fuel flow (in vs. out).

If your engine has an MA3 carburetor it will not have a built in accelerator pump. The MA-3 SPA carburetor has the pump. Without an accelerator pump, particularly in cold climates, the engine can be very difficult to start. This can be remedied by installing a primer. The primer pump should be installed on the instrument panel if you intend to hand prop-start. Fuel for the primer should be taken from the top of the gascolator using an AN816-20. 1/8" dia. soft copper tube should be used and you should drill a 1/4" dia. hole through the firewall and pot the 1/8" copper line in RTV silicone rubber. The electric boost pump is required on your Long-EZ and should under no circumstances be omitted. Mount it where shown on page 13 using two AN3-10A bolts, AN960-10L washers and MS21042-3 nuts. If you cut out the oval shape lightening hole in the plywood firewall bulkhead, you will need to position a small piece of plywood in the void in the area where these two bolts go to secure the electric fuel pump. Be careful not to drill through the firewall into your centersection spar cap! That would spoil your entire day.



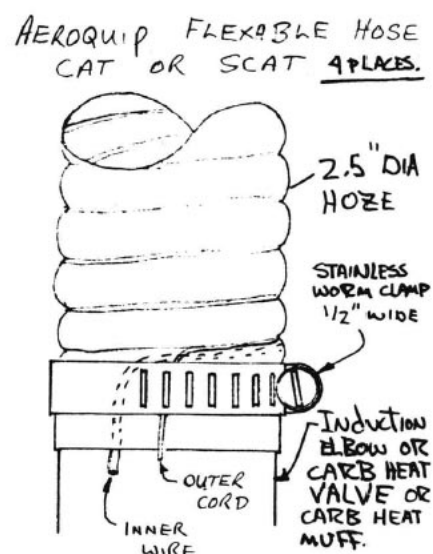
These two bolts will be accessible from inside the centersection spar box. Plumb the electric pump to the outlet of the gascolator with 3/8" dia soft aluminum tube. This tube must be bent such that it clears the aileron pushrod. It can not pass between the aileron pushrod and the firewall, but rather should curve away from the firewall to pass aft of the aileron pushrod. Note: the EFP fuel pump is drilled and tapped with a 1/8" pipe thread, as is the Bendix fuel pump, and you will require two special elbows, AN822-6-2D which are available from a Long-EZ distributor. Plumb from the electric boost pump to the mechanical pump on the engine using aeroquip flexible hose. #303 hose #491 hose fittings are called out, but you can substitute aeroquip # 601 hose and #816 fittings.

At this time you can mount the optional cabin heat valve available from Ken Brock Mfg. or you can easily build one yourself from the information on page 9. Be very careful not to drill in to the lower centersection spar cap, when mounting this valve. A good method of mounting the valve is to glue it to the firewall with RTV silicone.

STEP VIMOUNTING THE ENGINE

With the exception of the hardware, mounting the conical or dynafocal engine is essentially the same. You will require an engine hoist, or a block and tackle from a rafter, or several strong friends.

Load the front cockpit with ballast so that the airplane does not tip over when you mount the engine. Hoist the engine into position on the mount and hold it there. All four shock mounts, bolts and nuts are now installed. Be careful not to bash the engine or accessories against the mount, particularly the mechanical fuel pump. As you fit the engine up to the mount support the engine weight until all four bolts and nuts are torqued up. Torque requirements are:
3/8" - 24 bolts (conical mount) 220 to 320 inch pounds.
7/16" - 24 bolts (dynafocal mount) 430 to 580 inch pounds.



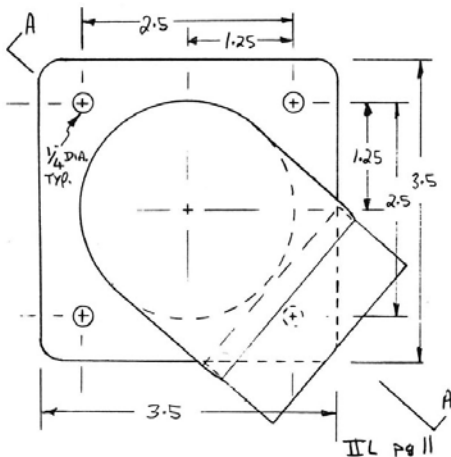
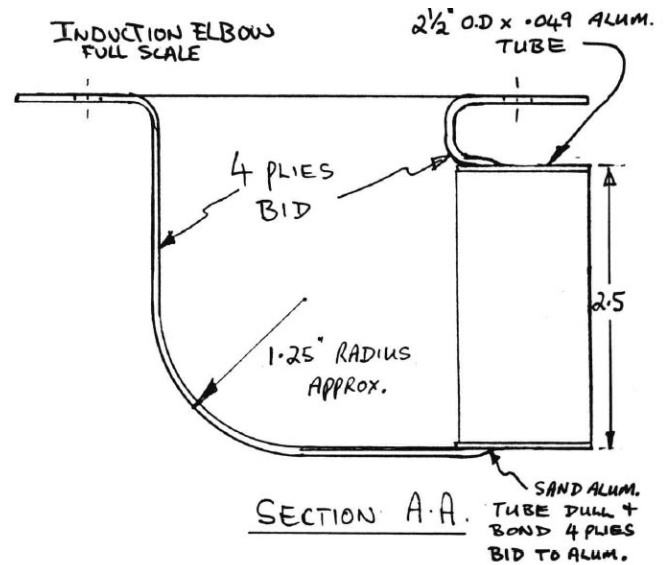
Note: or you can substitute a Brock vely 13 FLANGECAUTION Make certain that the outer cord and inner wire are both trapped under worm gear clamp exactly as shown. If this is not done the wire can unwind and collapse resulting in engine failure.

STEP VII

AIR INDUCTION SYSTEM

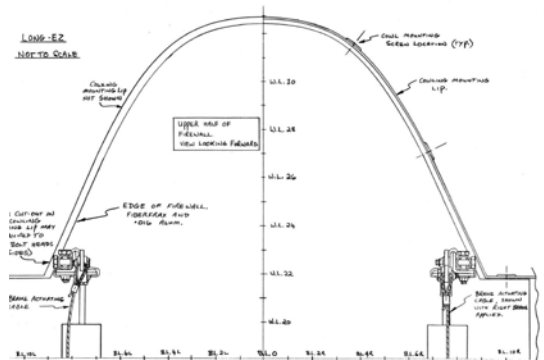
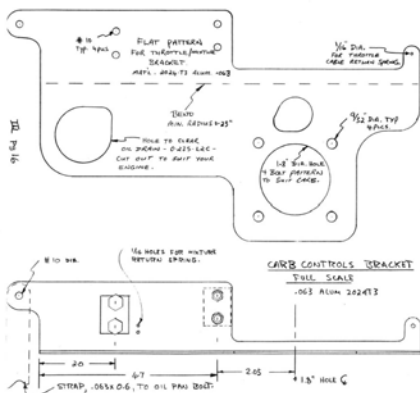
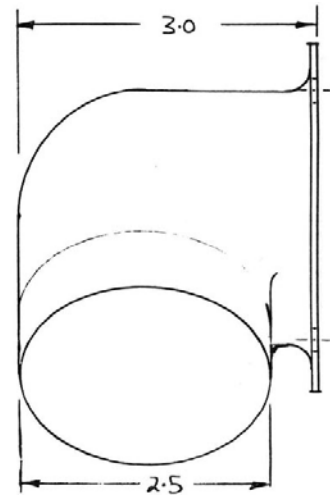
This page shows details on how to make the carburetor inlet elbow. This elbow will bolt to the inlet flange on the bottom of the carb. A gasket should be used, or sealant that is fuel proof (not RTV silicone). When you build the fiberglass elbow, be sure it is oriented correctly to point forward at the carb air/heat valve.

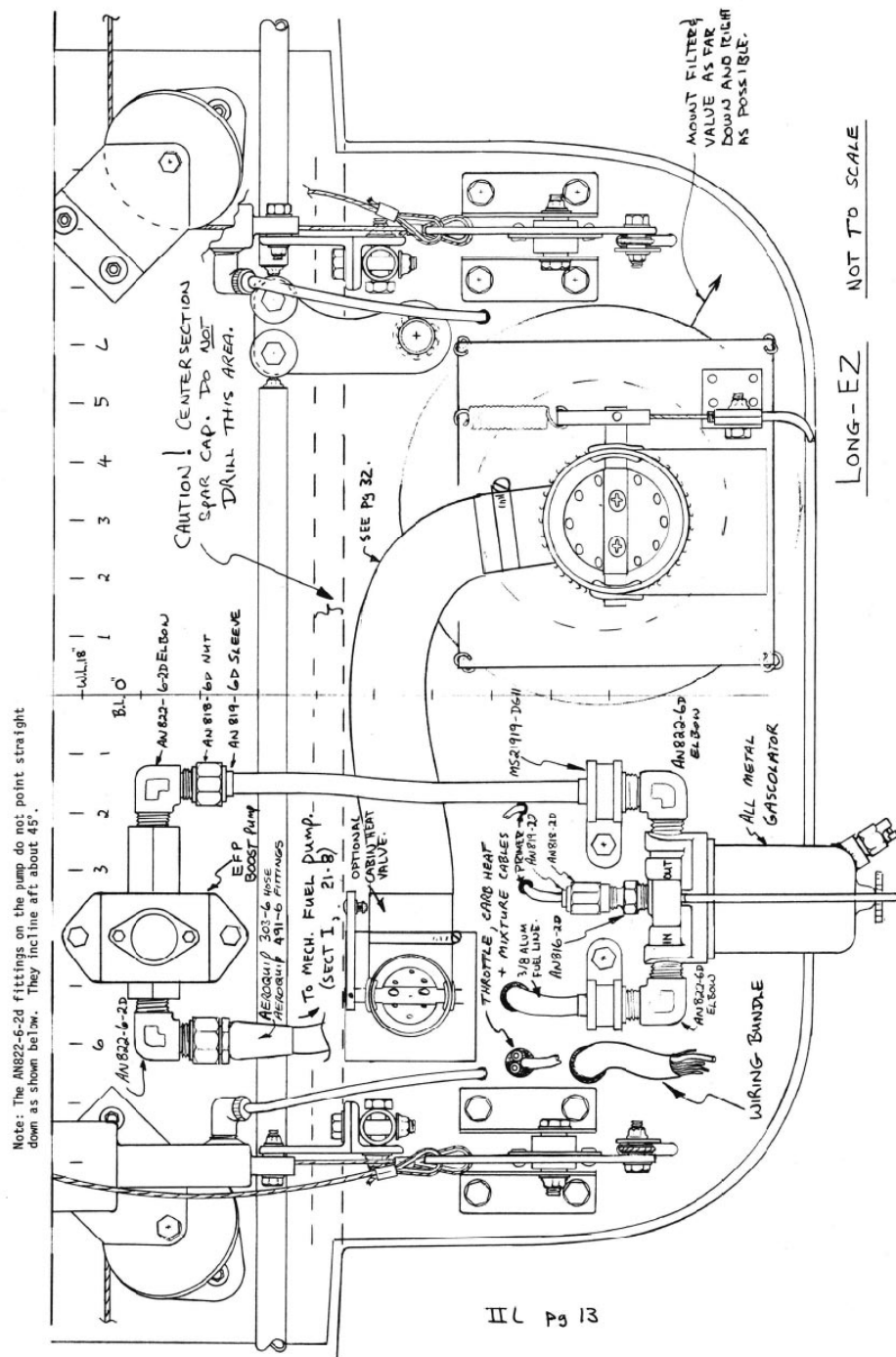
Next mount a length of CAT-10 (or SCAT-10) to the elbow. Pay careful attention to the clamping details shown. Do not substitute ceet or sceet hose. Route the inlet hose to the bottom of the carb air/heat valve and clamp it in place. The inlet how should not be stretched tight. A little slack is required to allow for engine shake during operation. Drill a 1/4" dia. Hole in the low point (nose gear retracted with no electric starter, and 3 point with a starter) of the air inlet how to allow excess fuel to drain for a flooded start.



To make this:

- 1) Carve a urethane foam block in the correct shape with the sanded 2.5" tube stuck over one end.
- 2) Mount the block on a flat surface covered with duct tape (release).
- 3) Layup the 4 plies BID overall, overlapping small pieces is ok.
- 4) After cure dig out the foam and drill 1/4" holes.



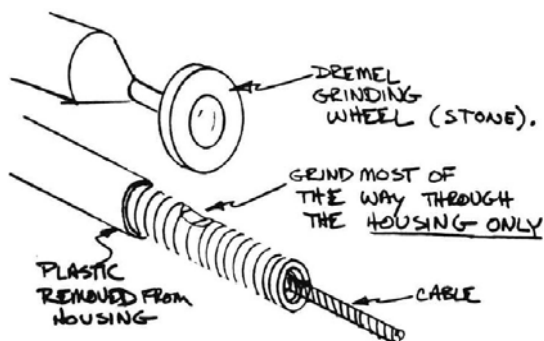


STEP VII
ENGINE WIRING AND CONTROLS

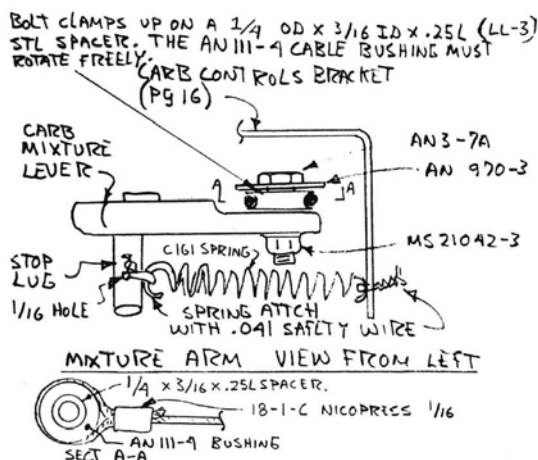
It is helpful to have an assistant to verify control positions and travel in the cockpit, while you work on the engine.

First make all the metal parts shown (page 16). Install the throttle/mixture bracket on carb studs. This bracket becomes a "gasket" between the carb and engine, and requires two normal gaskets (one each side), when installing the carb. The small tab on the aft end of the bracket should be bolted to a .063 x .6 alum strap. The strap should be bolted to an oil pan bolt. Apply additional damping by bonding the bracket to the oil pan with silicone rubber (RTV).

Next run your mixture/throttle cable out and around to the right and mount to the bracket as shown. Be sure the clamps aim the cables directly at the actuated arm, with as little flexing as possible. The controls must work without the return springs. Check this before installing the springs. The springs take all of the "slop" out of the system for smooth throttle and mixture control, but do not depend on the springs. The springs will return the throttle to full open and mixture to full rich in the event of a cable failure.



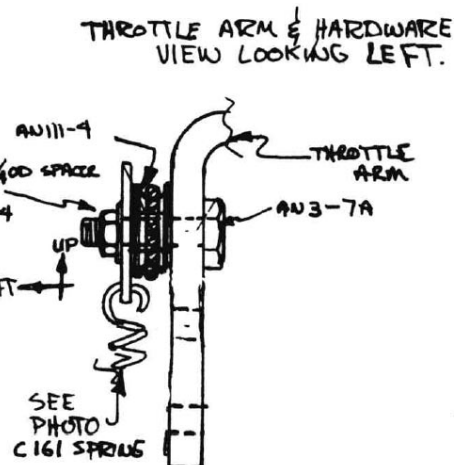
Mark the cable housing to be trimmed so that it protrudes about 1/2" beyond the housing clamp. Before you try cutting the cable housing to final length try a practice cut way out on the end of the housing. The idea is to use your dremel (stone grinding wheel) to grind part way through the housing wire, not into the cable (see sketch), and then break the wire with a twist (using pliers). Don't damage the cable inside. With the housing cut to length you can use your dikes to cut the cable. Be sure you have enough extra cable to make a loop around the AN111-4 thimble. Install the mixture arm bracket on the carburetor mixture as shown:



Clamp the cable between your thumb and finger and verify that you have full mixture travel at the carburetor when the mixture control is cycled in the cockpit before you swage the sleeve. If you don't get it perfect an adjustment can be made at the housing clamp. Tighten the bolts on the cable housing clamp. Add a dab of silicone rubber

over the cut end of the cable; it will save sane pain and expletives later.

The throttle cable is installed in a fashion similar to t he mixture. A Centry Spring Corp. C-161 spring is used to preload the throttle in the full (open) position (see photo).



The throttle cable is swaged with an AN111-4 cable bushing and 18-1-C sleeve as s own. The cable is attached to the throttle arm with an AN3-7A bolt 3/16 ID x 1/4 OD X .25 long spacer, AN970-3 washer, and MS21042-3 nut as shown in the sketch. The AN111-4 must rotate freely on tile spacer. Double check the throttle travel in the cockpit and at the carburetor before swaging. Dab the cut cable end with silicone rubber.

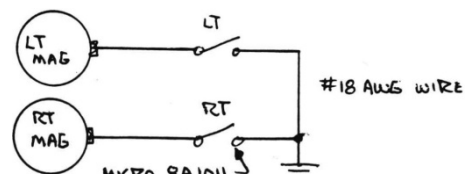
The carburetor heat cable housing damp, cable, and return spring are installed as shown on page 8. Don't force the cable and housing around tight corners; leave enough slack for a gently loop to the cable housing clamp.

Next attach each magneto ground to the electrical wires running forward to the mag switches. A schematic diagram is shown for the installation of mag wiring below,

Connect the switches to the aircraft ground as shown. Connect the aircraft ground wire to one of the engine mount bolts. Install a short length of braded strap from the mount to a convenient stud on the engine .

Install your CHT probe on the number 4 cylinder, top side. During your initial runs and initial flights you should move the probe to other cylinders. Once the hottest cylinder is determined, leave the probe in it. All cylinders on N79RA run within 20°F of each other. If you have a wide variation the probable cause is mixture distribution. Follow your engine service manual and route the ignition wiring (spark plug leads) to each plug.

Snug the plug caps (shielded harness only) using a 3/4" wrench; don't over tighten. Be sure to guard the ignition wires against chaffing on the cylinder cooling baffles using rubber grommet as shown. The exhaust gas temp probe should be installed on number 4 cylinder exhaust pipe.



Oil pressure sender: Install as shown. The sender mounts to an engine mount tube using two Adel-type clamps (MSS21919-DG10), bolted together – one around mount tube and one around the AN910-1D coupling. The orifice fitting is normally supplied with the engine. It has a tiny hole, which prevents massive oil loss in the event of hose or sender failure.

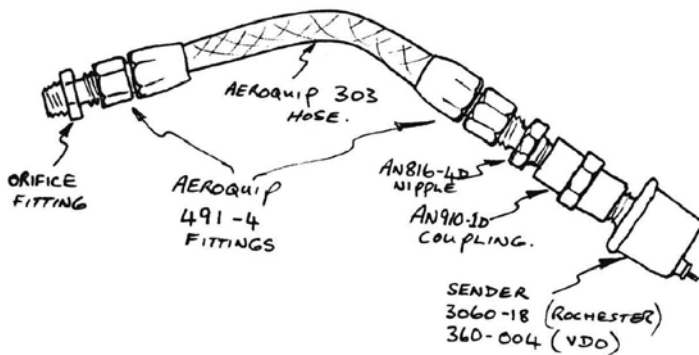
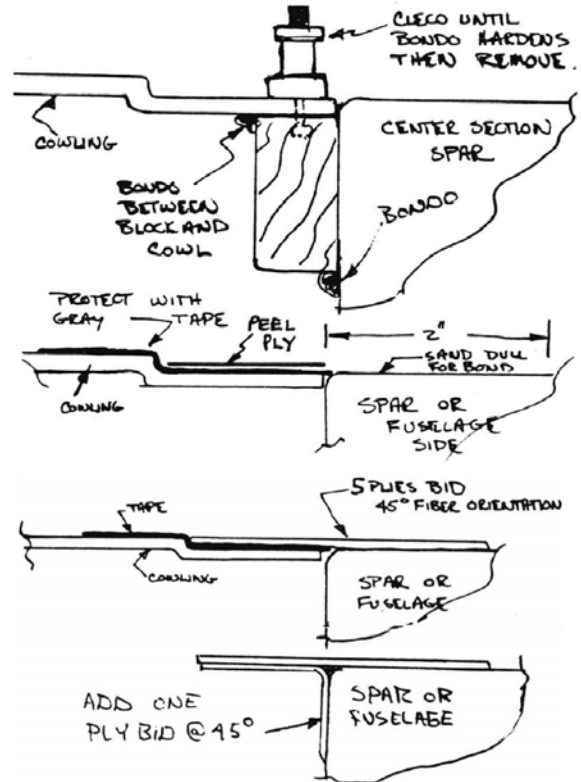
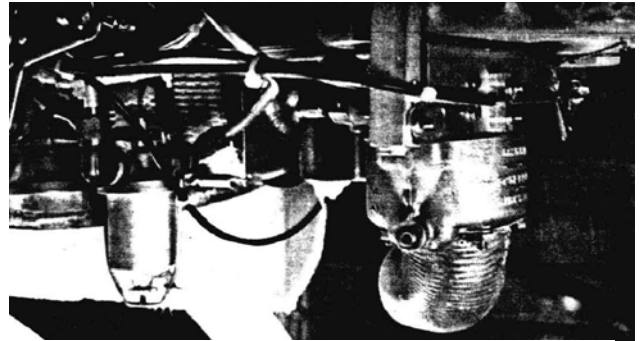
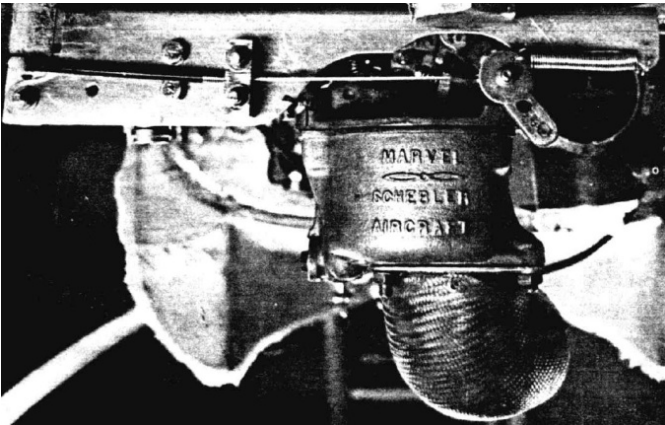


Photo of carb and carb controls bracket. View from aft, looking forward. Note: The throttle clamp block is too far to the left on this photo. Make yours exactly per page 16 to assure positive throttle actuation in the event of spring failure. Note: The black plastic does not go into the clamp blocks.



STEP IX

COWLING INSTALLATION

Long-EZ cowl halves are available from Long-EZ distributor. These parts will require some additional work as part of the installation on your airplane. You will have to trim the outboard ends of the cowl halves to fit the wing roots; layup a closet rib in the trailing edge of the cowl; layup fiberglass attaching flange along the centersection spar, fuselage and wing roots and attach the ram air inlet to the lower cowl. You will also fabricate a sheet metal oil check door, and install the upper baffle ribs.

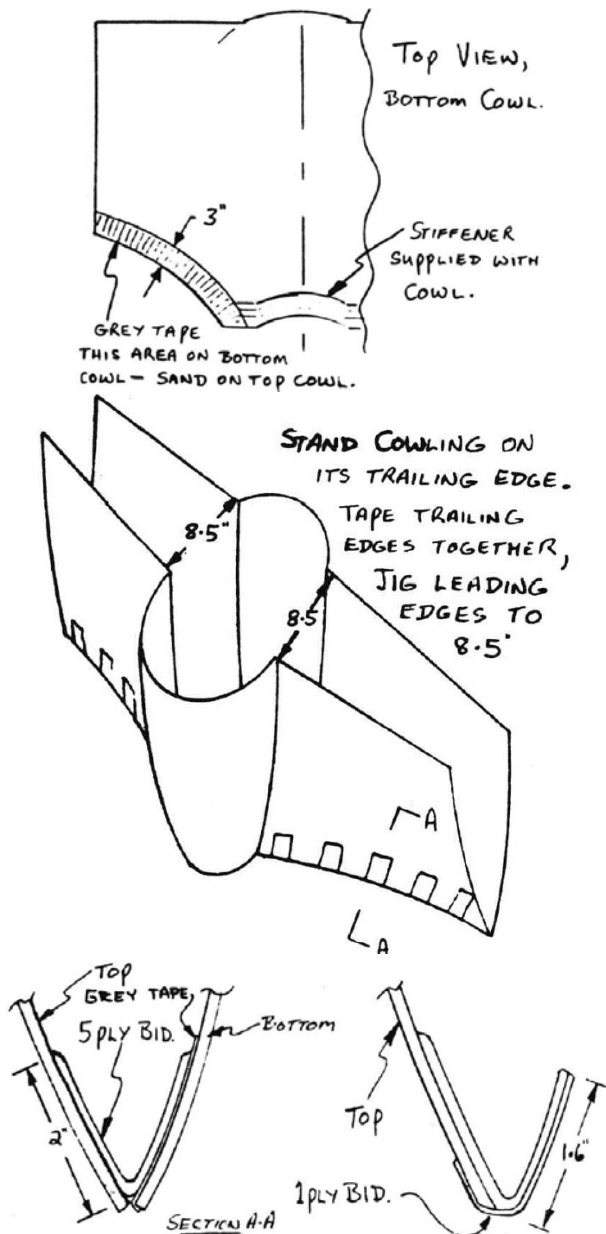
The cowl is attached to the airplane with #10-32 screws (AN507-1032R10), nut plates (K1000-3) and countersunk washers (A3235-028-24A). Camloc fasteners may be substituted as a quick disconnect feature along the wing roots, top, bottom and along the cowl trailing edges. Camlocs along the centersection spar and fuselage are not recommended due to the requirement to physically remove the camloc before the cowl can be pulled out from under the attach lip. Dzuz type fasteners should not be used as they do not provide adequate shear load-carrying capability.

The vendor supplied cowl halves are intentionally supplied a little too wide. Hold your cowl in position against the firewall aft edge of the center section spar and mark along the wing roots. It is much easier to install the cowl with both wings mounted on the aircraft and with the engine cowl and spinner at least located on the prop flange. Trim the cowl span wise to fit. Now sand the inside trailing edge of the top cowl half, and apply shiny surface grey duct

tape on the inside trailing edge of the bottom cowl as shown. Jig your cowl on the floor, trailing edge down, with the trailing edge taped together with grey duct tape and the leading edges opened apart 8 1/2" as shown. Cut 10 strips of 45° BID glass 4" wide x 15" long, and 2 strips of BID glass 3" wide X 15" long. Now layup a 5 ply BID glass rib into the trailing edges of the Cowl. Allow this to cure, then drill 3 #30 dia holes evenly spaced along each trailing edge, through the bottom cowl, grey duct tape and cured trailing edge rib. These holes will be used to cleco the cowl valve s together when jiggling the cowl to the fuselage. Later on they will be opened up for screws or camlocs. Now pop the two cowl halves apart and sand the 5 ply closeout rib and top of the top cowl and layup 1 ply of BID as shown. After cure, trim the closeout rib to 1.6 " as shown.

Thoroughly sand the top and bottom aft edges of the centersection spar, also around the aft edge of the fuselage. Sand inside the wing roots, top and bottom.

Cut some short pieces of 2x2 lumber about 2 1/2" long. Bond these to the aft face of the centersection spar, and fuselage both top and bottom edges as shown. Spacing should be the same as the screws or camlocs, approximately 9 blocks along the top cowl and 10 blocks along the bottom cowl. Position these blocks so that the cowl lip rests on the blocks, the lip is level with the spar or fuselage as shown.



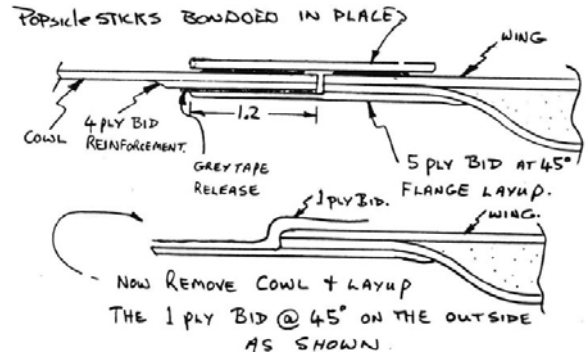
Apply a strip of grey duct tape to the inside surface of the outboard edges of the top cowl. This will allow you to release the cowl edges from the glass attach flanges in the wing roots.

Remove the exhaust system, if installed, and with the spinner in place, jig the cowling into position, such that the spinner roughly centered in the trailing edge opening. If you intend using starter the ring gear should be positioned so that you have no less than 0.4" clearance between the top cowl and the teeth on the starter ring gear.

The cowling trailing edges should match pretty close to the wing root trailing edges. The cowl leading edge lips should rest on your wood blocks. Drill #30 dia holes through the leading edge lip of the top cowl into the wood blocks. Space and position these holes so that they can later be enlarged and used for the 10-32 screws to attach the cowling.

Remove the bottom cowl, lift the top cowl and put a small blob of Bondo on each wood block and cleco the top cowl into position. When the Bondo hardens, remove the clecos, and apply a strip of grey duct tape to the leading edge lip of the cowling. This will allow you to release the cowl after you have layed up the cowl attach flange. Position the outboard edges of the top cowl so that they accurately follow the contour of the wing roots. Locate the top cowl edges in this position by glueing popsicle sticks across the wing root/cowl joint with small dabs of Bondo.

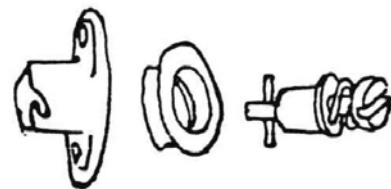
Now lay up 5 ply BID flanges across the center section/fuselage as well as under the top cowl out board ends, into the wing roots. This last layup is an upside down operation, but is easy to do, particularly if you do the 5 ply layup off the airplane on a piece of visqueen (plastic) first, then while it is wet, lift the visqueen and 5 ply layup and place it in position under the cowl edge, lapping under the edge of the wing root. Squeegee it well through the visqueen and allow ure. The plastic will easily peel off later.



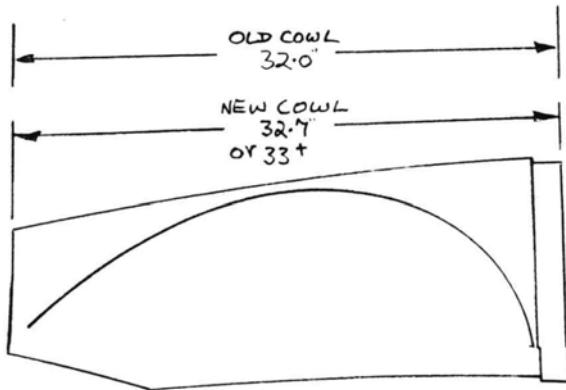
When all top flanges are cured, drill 130 #holes through the flanges and cowling where you will later on install screws or camlocs. This will allow you to cleco the top cowl back into exactly the position it is in now, after you have removed it. Knock the 2" x 2" wood blocks off the centersection and fuselage and remove the top cowl.

Repeat all of the above and lay up the flanges around the bottom cowl. This entire operation can be done without turning the airplane over. If your work area does not allow you to install both wings at the same time, you can install one wing, lay up the wing root flanges for top and bottom cowls, remove that wing, then install the other wing and do the wing root flange layups on it. It is a big help to Bondo a rib to the aft face of the centersection spar, to define accurately, the wing root trailing edge, of the wing that will not be installed while you are installing the cowling. Be careful when you are removing the cowling halves, not to peel the flanges up off of the spar, fuselage or wing roots. With both cowl halves off the airplane you need to layup one ply of BID under each flange, lapping down onto the spar or wing as shown. Of course you must thoroughly sand the shiny surface under the flanges and wipe a small amount of dry micro into the corners to give a smooth transition as shown (or better yet use peel ply before the 5-ply layup).

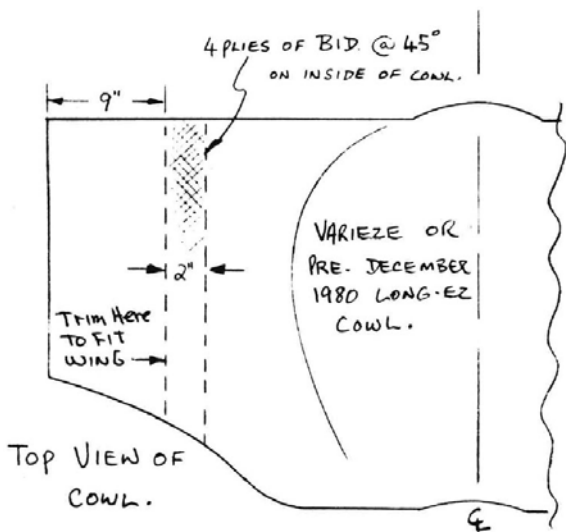
When everything has cured, trim all rough or sharp edges, and drill out the #30 holes to #10 for AN507 screws along the leading edges of the cowling and install K1000-3 nut plate s on the inside of the cowling lips. Install screws or optional camloc along the outboard edges and trailing edges of the cowling. Camloc part numbers are as follows:
Stud - #4002-6 or #4002-7 (depends on thickness of your cowling lip and flange).
Grommet #4002-N, grommet retaining
Snap ring #R4G, receptacle #214-16N



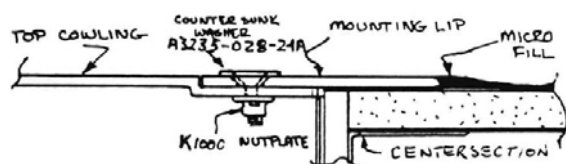
Some builders may have a VariEze cowl or a real early production Long-EZ cowl. If you do, it can be used on your Long-EZ. The cowl on the prototype N79RA is a VariEze cowl. In order to find out which cowl you may have, measure the length of the top cowl along the centerline as show



The VariEze and early Long-EZ cowl is 32". The new Long-EZ cowl manufactured after December 20th, 1980 is 32.7". The VariEze cowl is also approximately 9" wider than it needs to be for a Long-EZ. This means that it will be necessary to reinforce this area for screw or camloc mounting. Sand the inside face and layup 4 ply BID @ 45° on inside of cowl. Trim the inside face and layup 4 ply BID reinforcement on the inside of the cowl halves, 2" wide and 4 places as shown. After this cure, trim approximately 9" excess off the outboard ends to fit your wing roots.



With the old style shorter cowl it will be necessary to space the cowl halves 0.7" aft of the firewall and centersection spar. Use wood block, Bondo'ed to the aircraft, thick enough to extend aft far enough so that you can cleco the cowl to the aircraft, see photos on page 35. After the cowl is jugged and cleco'ed in to place, the 0.7" gap should be filled between the wood blocks with scraps of urethane foam. These can be jammed into the gap and sanded level with the cowl lip. Then cover the urethane foam and excess wood blocks with shiny grey duct tape for a good release. Now do the layups as called out above for the Long-EZ cowl, including the inside lip to centersection layup (Pg. 18 & 19)

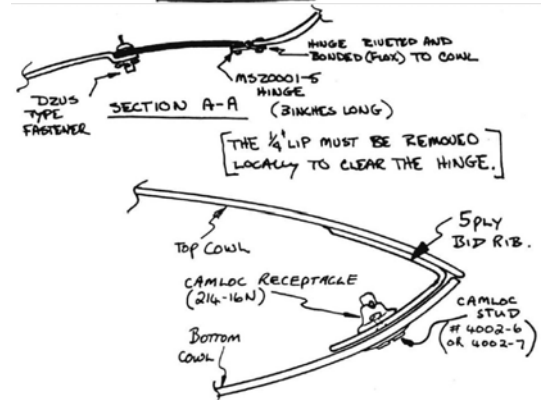
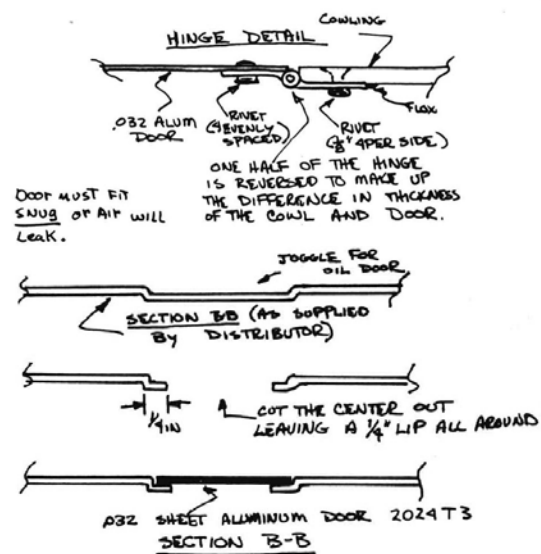
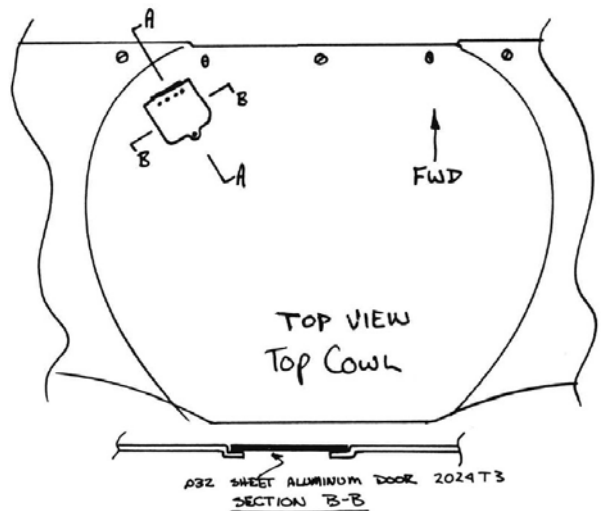


STEP X

OIL CHECK DOOR

You will need to fabricate a door from .032 thick 2024-T3 aluminum sheet to fit into the recess provided in the distributor supplied cowl. This door is attached to the cowl along its lower edge with 3" long aluminum hinge. One half of the hinge should be reversed to make up the difference in thickness of the cowl and door as shown.

Note that the supplied cowl is reinforced around the area for the oil check door. You will cut out the center of the recessed area leaving a 1/4" lip all around, with the exception of the lower edge, where the 1/4" lip must be removed locally to clear the hinge, a Dzus type fastener should be used to hold the door closed.

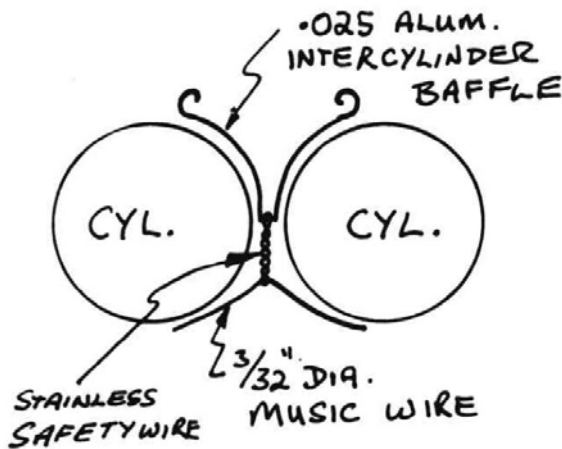


STEP XICOOLING BAFFLES

We have provided full size pattern drawings to assist you to make the baffles to direct cooling air to the cylinders on your engine. These drawings are on pages 22-29. Note that for the forward and aft baffles, you will need to glue 3 pages together to get the full size baffle due to paper size. While it is possible to make these two baffles in one piece, you would find it much easier to fabricate them in 2 or 3 pieces. Join them at the narrowest point by allowing some extra material (0.6"), overlapping and riveting them together with no prop rivets.

The baffles are bolted to the engine wherever a hole is shown and further secured in place by applying a generous bead of RTV silicone (the red or silver high temp RTV is best and is generally available at auto parts stores) along the edges of the baffles wherever they touch the engine, or to seal imperfect fits, and as an anti-chafing material.

Fabricate all the baffles shown, using .025" thick 6061-T6 aluminum sheet. The inter cylinder baffles are fitted into place and secured in addition to high temp RTV, by safety wiring them down to the stiff piece of music wire which is bent and fitted between cooling fins as shown.



With all engine baffling in place, install the cowling one half at a time, and measure the distance from the top of the aluminum baffles to the cowl. This dimension should be from 1/4" to 3/4" except along the cylinder head baffles where it should be 3/4" to 1 1/4". Make up neoprene asbestos strips as shown in the photos and rivet them to the aluminum baffles as shown.

With the top cowl in place, mark the inside surface of the cowl adjacent to the outboard edge of the cylinder head baffles. This mark will help you locate the two glass "baffles" that have to be lay up into the top cowl. See page 22 for full size templates for these baffles. Lay these out on a piece of 1/8" plywood, or something similar, cut them out and stick grey duct tape to the out board faces of the plywood. Now Bondo these pieces into the top cowl, along your marks. When the Bondo is hard, trial fit the top cowl to be sure the neoprene asbestos cylinder head baffles rest nicely against the grey duct tape on the plywood. Remove the top cowl and sand the inside adjacent to the grey duct tape. Layup 2 plies of BID at 45° and allow to cure. Knife trim to the edge of the plywood at the appropriate time and allow to cure.

Carefully remove the plywood pieces and sand the shiny surface of the glass rib, and adjacent to it on the cowling. Layup 2 plies of BID at 45°. Knife trim to the previous glass layup and cure. This gives you two permanent fiberglass "ribs" in the top cowl that the cylinder head baffles seal against, which allows you to remove the rocker covers for periodic maintenance, without disturbing the baffling.

With all the baffling in place, carefully check for any potential leaks. All possible leaks should be sealed or you may have unacceptably high cylinder head temperatures.

Now install the exhaust system available from Ken Brock Mfg. and measure from the wing root trailing edge to the exhaust pipe each side. Transfer that to the bottom cowl and cut out a hole large enough to clear the exhaust with aluminum of 1/4" around the pipe to allow for engine shake.

STEP XIIOIL COOLER

The prototype N97RA does not have an oil cooler installed. During a full power climb to 12,000 ft the oil temperature will climb almost to the red line. During cruise flight oil temp runs between 200° and 220° which is marginally acceptable.

A second Long-EZ with a flush NACA inlet was found to be unacceptable for oil temp-temperature, although cylinder head temperature was excellent. This air plane has been equipped with an oil cooler which is simply bolted to the lower cowling on the left side, and a 2 1/2" dia. Hole was cut through the cowling directly under the oil cooler. This allows high pressure cooling air to escape through the oil cooler. A small reverse scoop, fabricated by laying up 3 plies of BID over a carved piece of urethane foam, is riveted to the bottom cowl. This system provides good oil cooling, (180° - 200°F) at cruise and 220°-230°F in a long climb. Of course the 2 1/2" dia opening can be varied to suit. People living in extreme climates may need a large opening in summer, and smaller or completely sealed opening in winter.

FINISHING UP

Install your prop, 3" prop extension and spinner. Follow the instructions supplied by the manufacturer. Do not install a prop extension without drive lugs to locate in the forward face of the prop. Proper torquing of your prop bolts is important. The prop is driven mainly by the friction developed between the prop hub and the engine flange or prop extension. Extensive testing has shown that wood props generally should be compressed about 0.006" per inch of hub thickness. That is to say that a Long-EZ prop, normally about 3 3/4" thick at the hub, should have the bolts torque up such that the wood in the hub is compressed 3.75" x .006" = .0225". Since your prop bolts are 3/75" x 24 threads, you can readily figure that you must turn each bolt .54 of a turn after the front face plate, the prop hub and the prop extension flange are in contact. (.0225" x 24 = 0.54 turns) the difficulty here is in knowing exactly when the prop and flanges are in contact, particularly if you have bolts that are tight in their holes. Generally you can achieve the same prop hub compression, assuming your threads are clean, and dry, and in good condition, by torquing your 3/8" dia bolts to approximately 200 inch lbs. (± 25 inch lbs.)

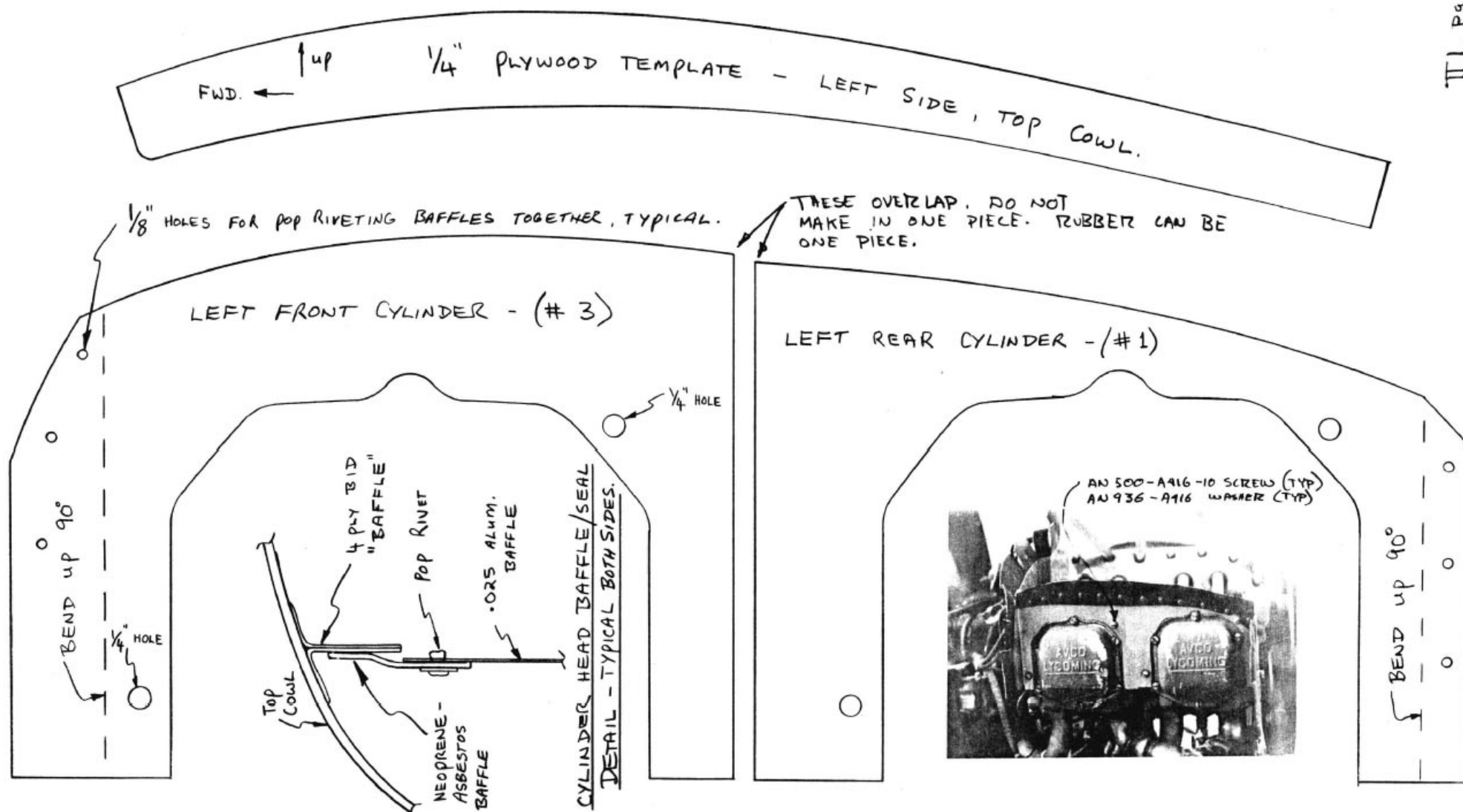
Caution: over-tightening prop attaching bolts will cause the wood in the hub area to crush. This could crack the finish and allow moisture, to enter the wood and will reduce the drive-torque capacity of the installation.

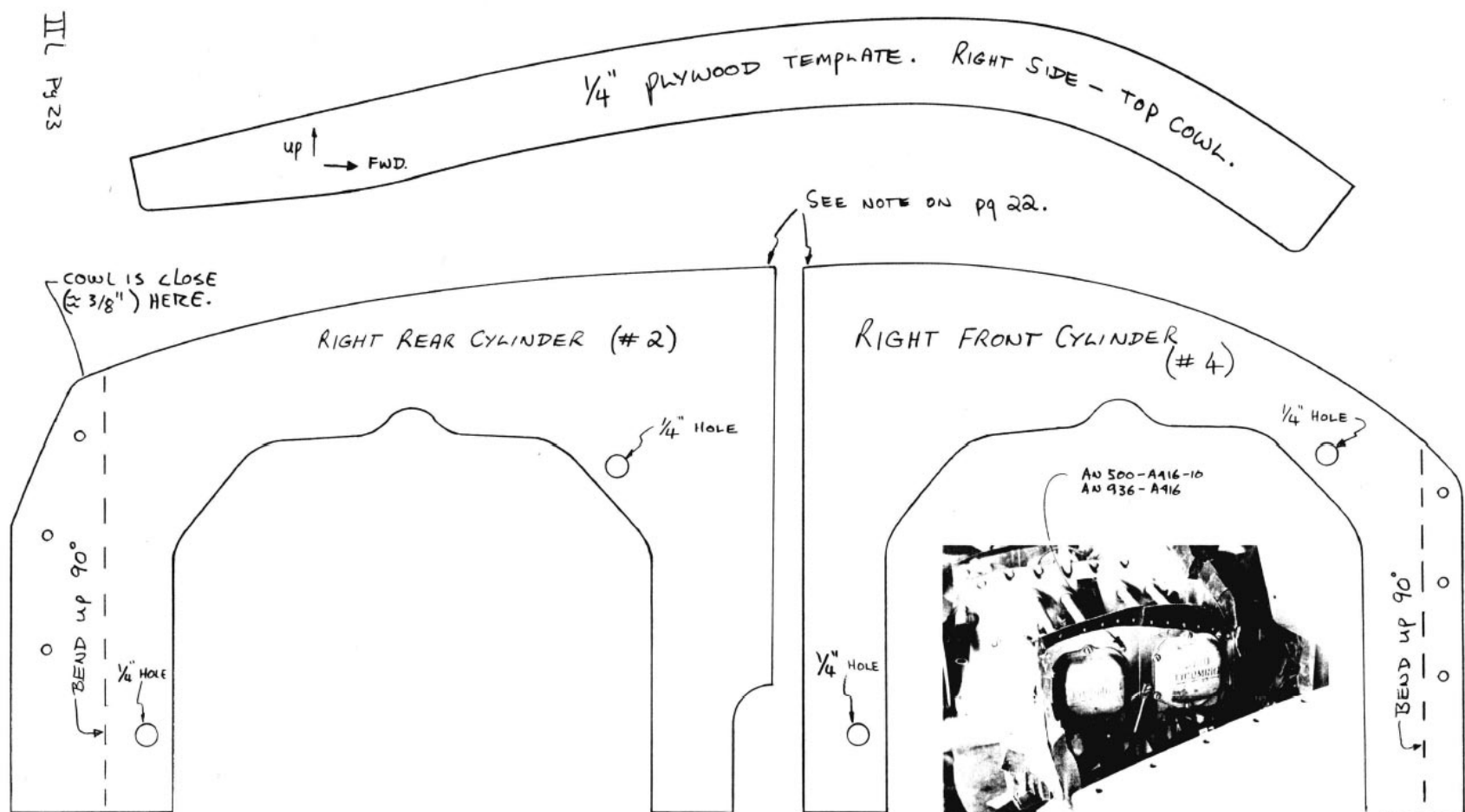
Check "track" of the blade tips by rotating the prop past a fixed object mounted on the floor. Prop tips must track within 1/16" of each other when the installation is completed.

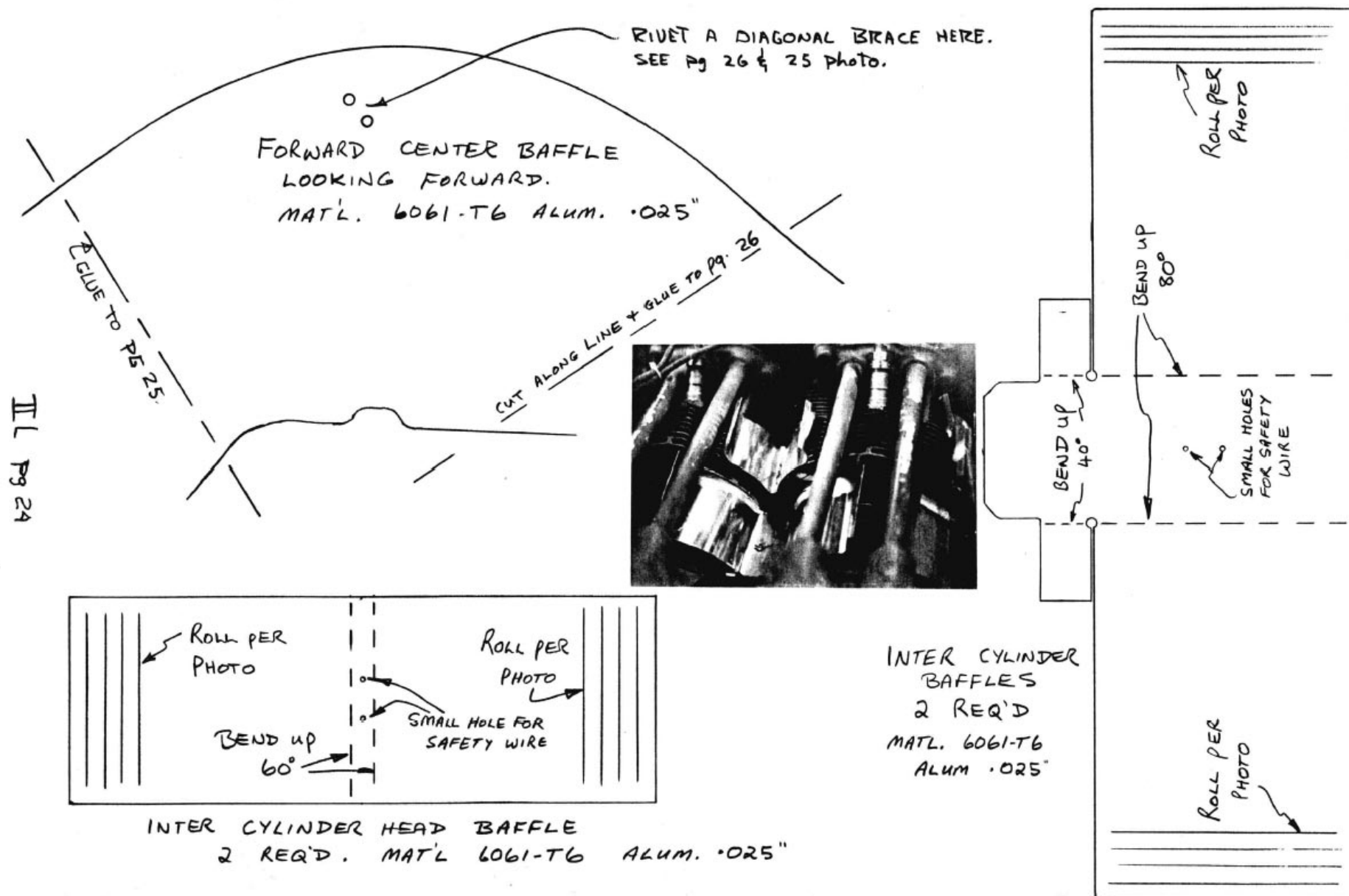
Protect your prop by waxing with a good quality paste wax, and place prop in a horizontal position when parked.

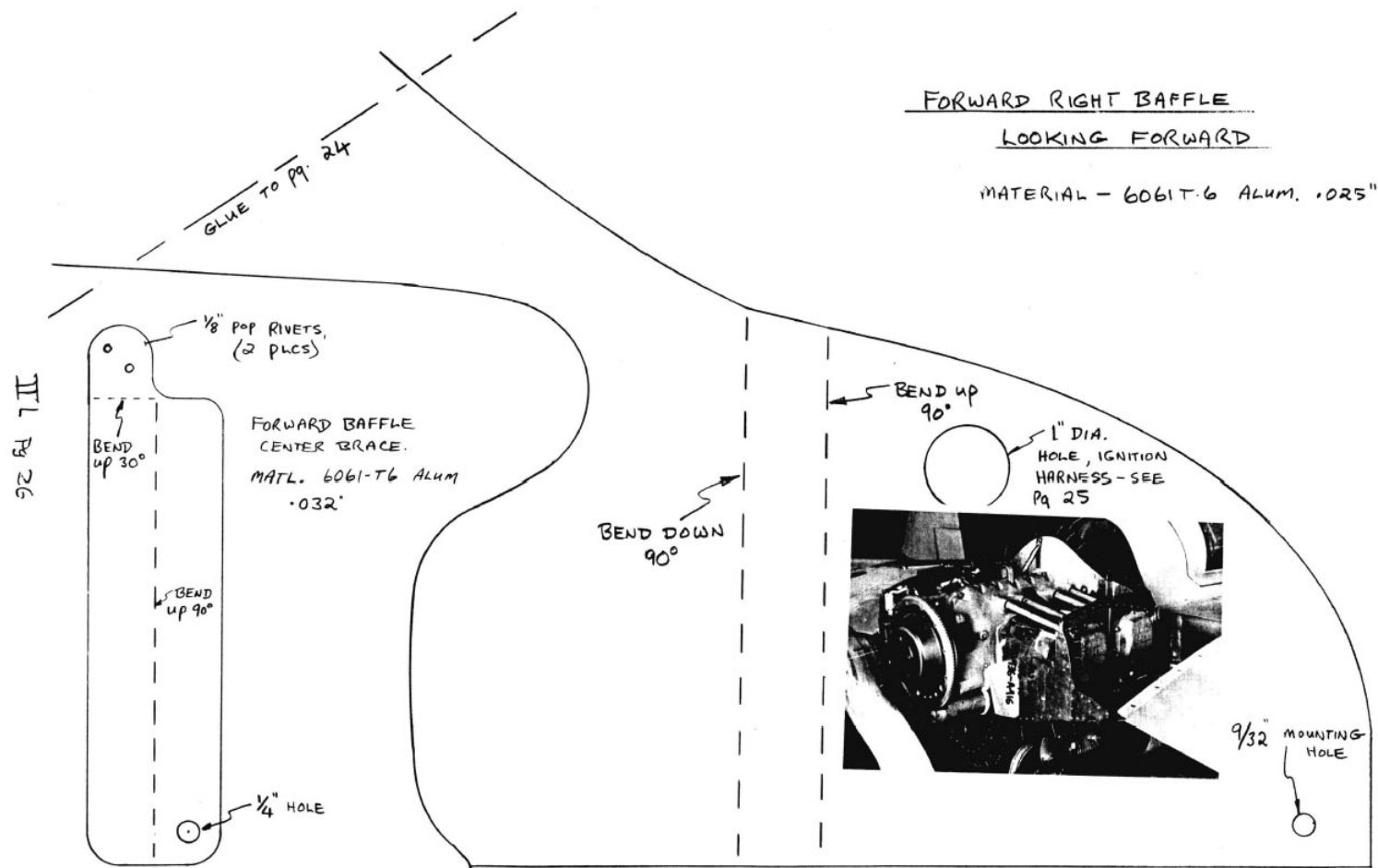
Inspect and check prop bolts for tightness at least every 100 hours or annually. More frequent inspection may be necessary when climate changes are extreme.

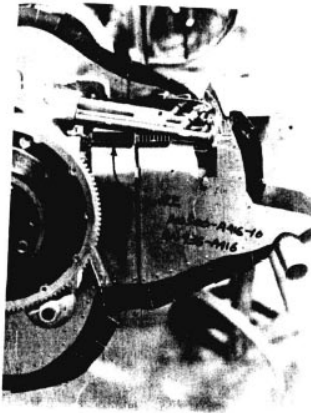
Properly cared for, your wood propeller is a safe and reliable part of your airplane.

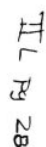


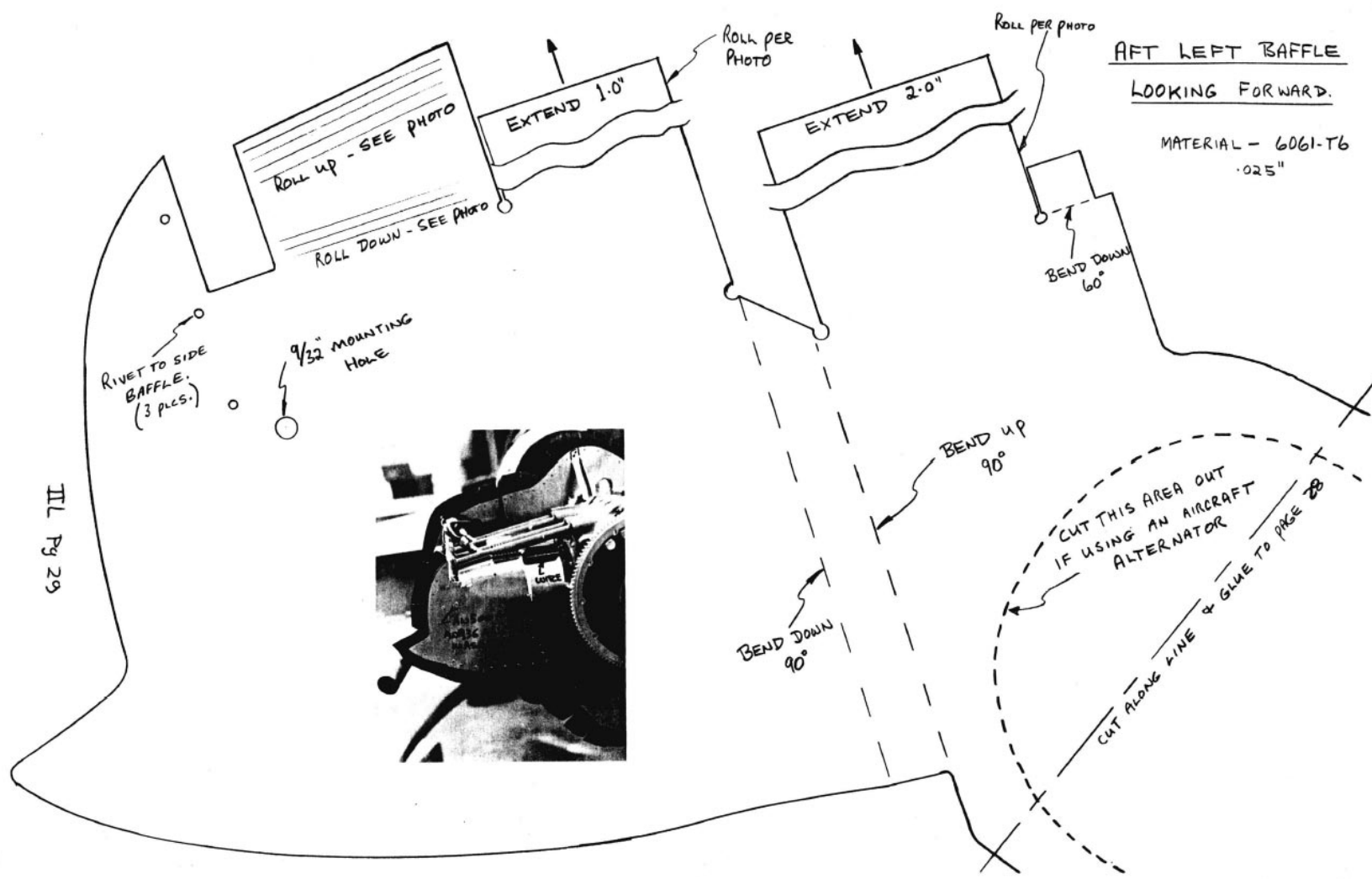












BJX-1HM
EXHAUST SYS

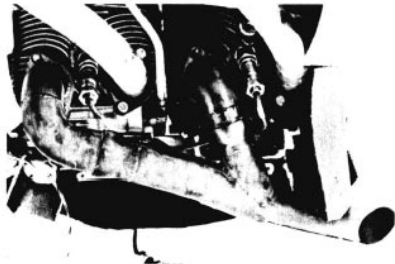
IL 1930

NOTE: THE KEN BROCK BALL
JOINT IS FORMED AS A UNIT
AND DOES NOT REQUIRE
HARD WARE OR SPRINGS.
IT IS AVAILABLE FROM
BROCK IF YOU DECIDE TO
HOME BUILD THE EXHAUST.

TOP VIEW, RIGHT
EXHAUST. HALF SCALE.
ALL TUBES 1 3/4" OD
STAINLESS

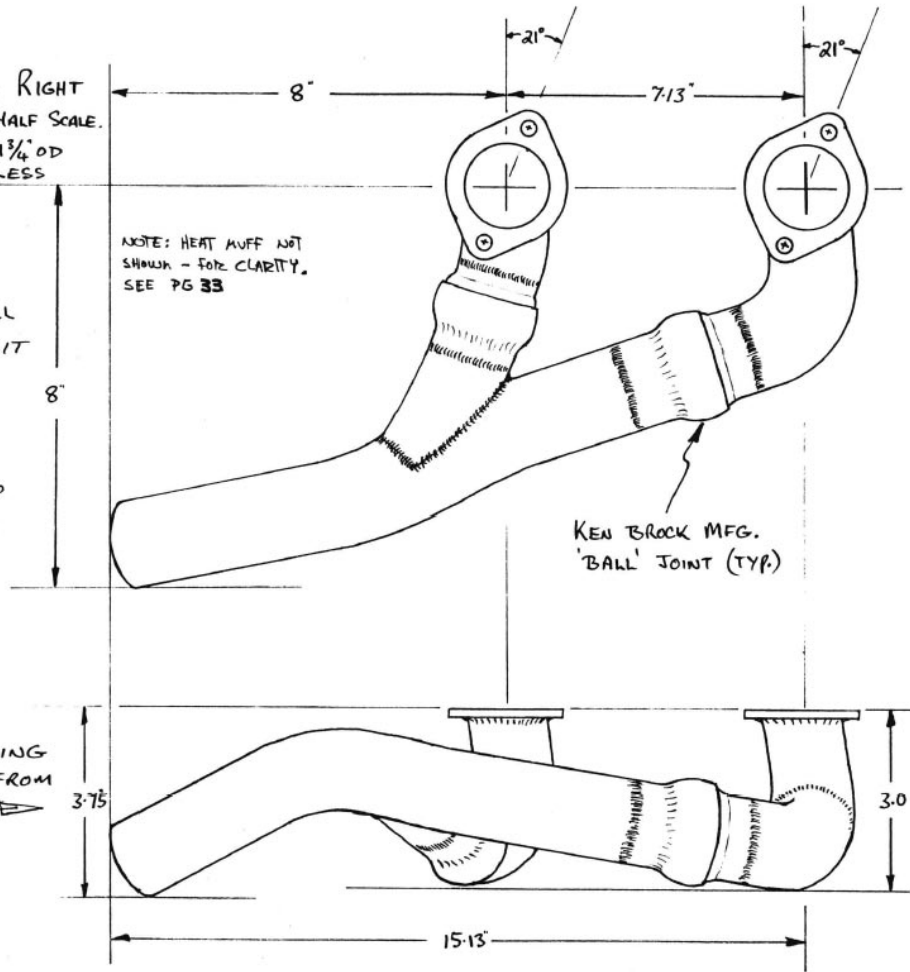
NOTE: HEAT MUFF NOT
SHOWN - FOR CLARITY.
SEE PG 33

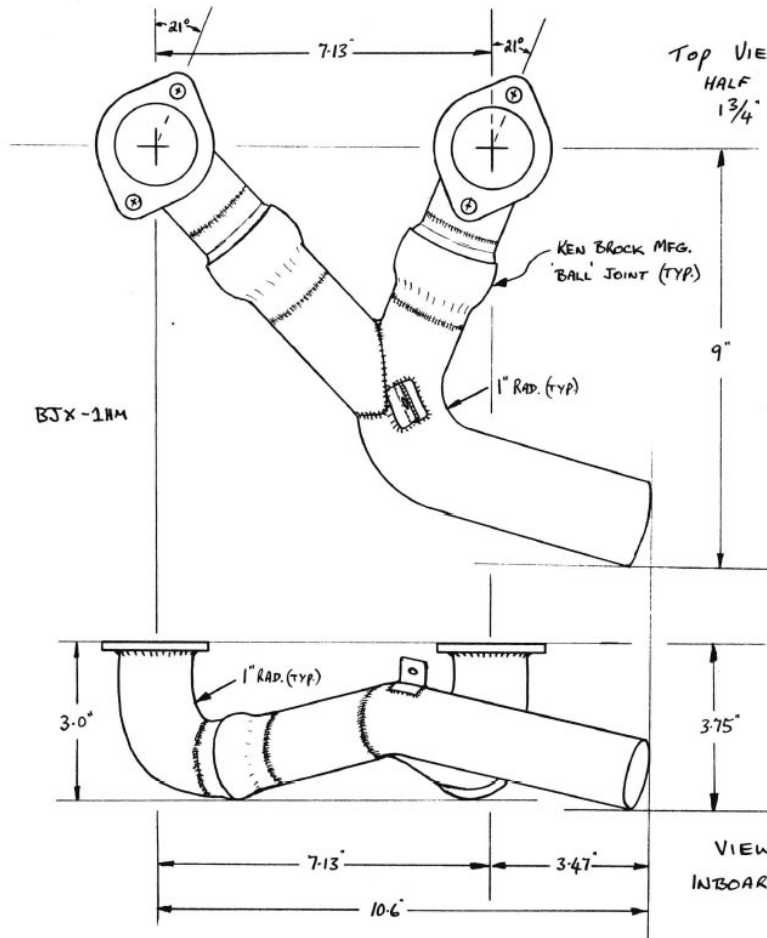
KEN BROCK MFG.
'BALL' JOINT (TYP.)



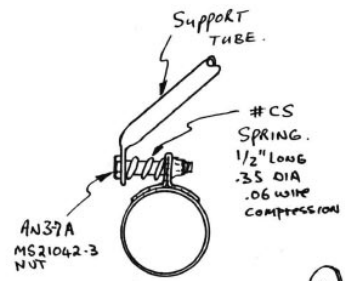
RIGHT SIDE, LOOKING UP.

VIEW LOOKING
INBOARD FROM
RIGHT. →

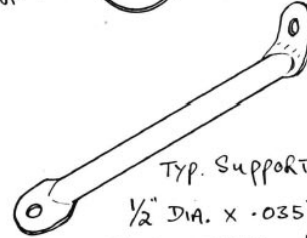




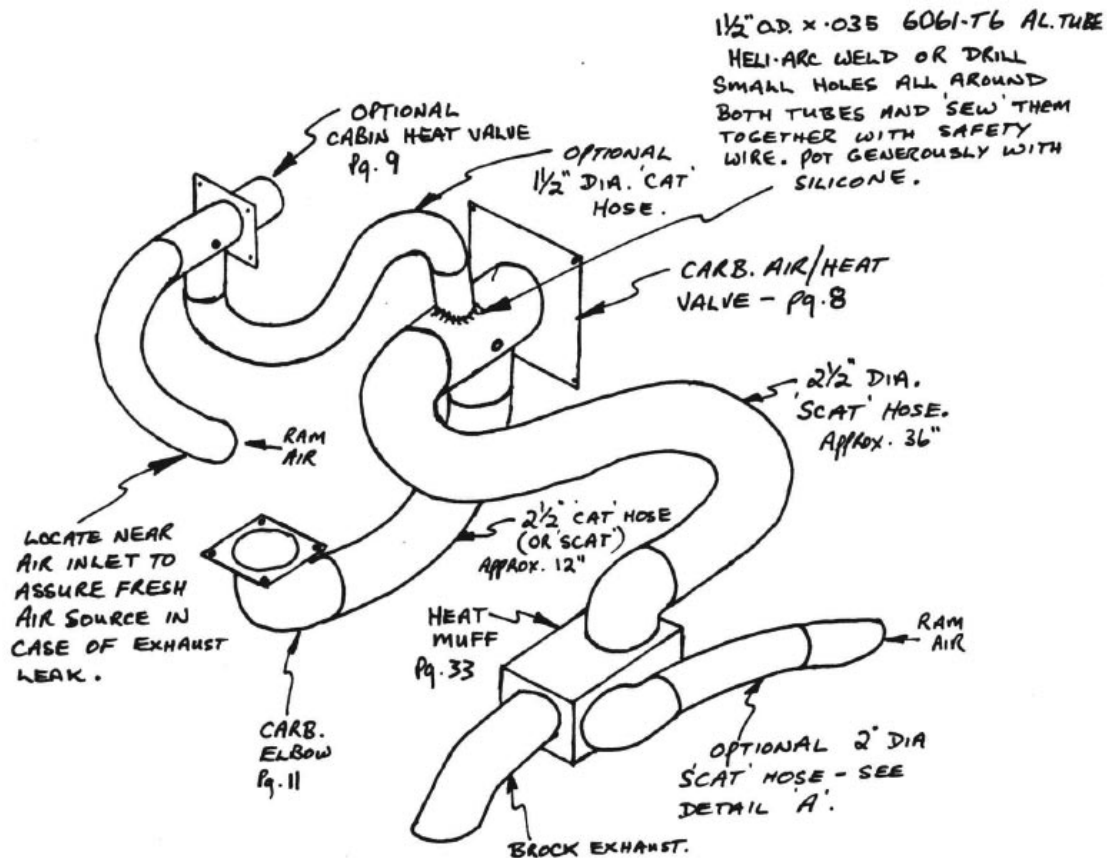
NOTE: BATTLES IN THIS PHOTO
ARE OBSOLETE.



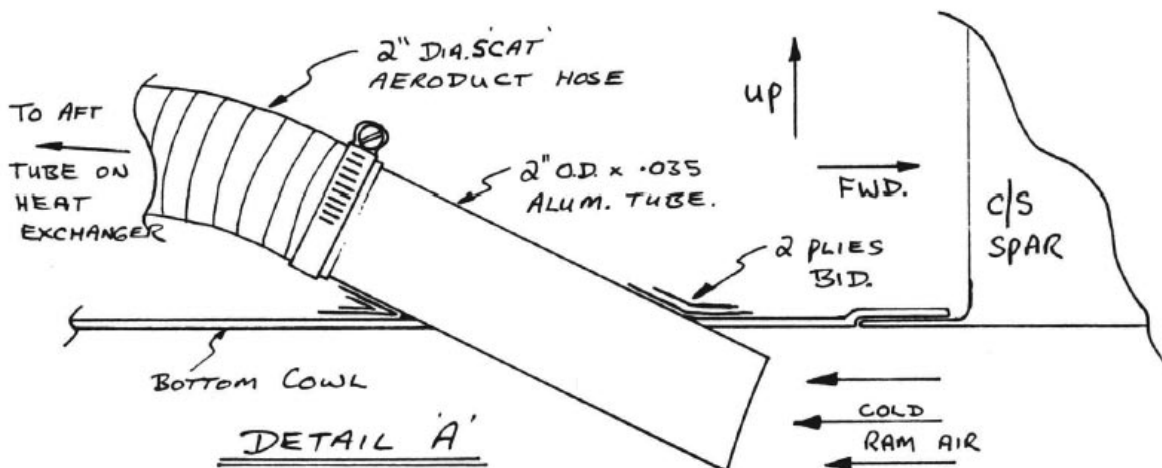
LEFT SIDE,
LOOKING UP.



TYP. SUPPORT. (2PLCS)
1/2" DIA. X .035" WALL, 4130N
STEEL TUBE. HEAT & FLATTEN
ENDS. FABRICATE TO FIT.
BOLT ON TO A ROCKER COVER
SCREW.
(SEE PHOTO PG 34).

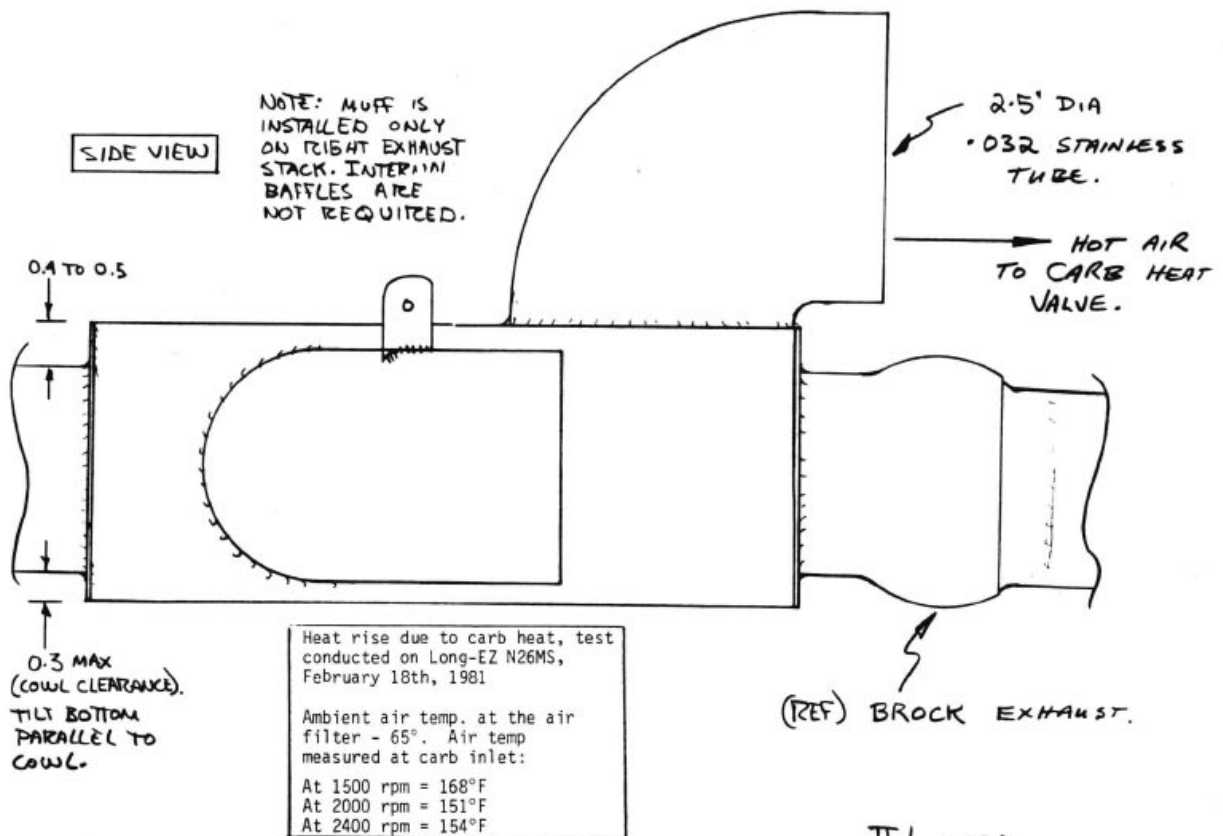
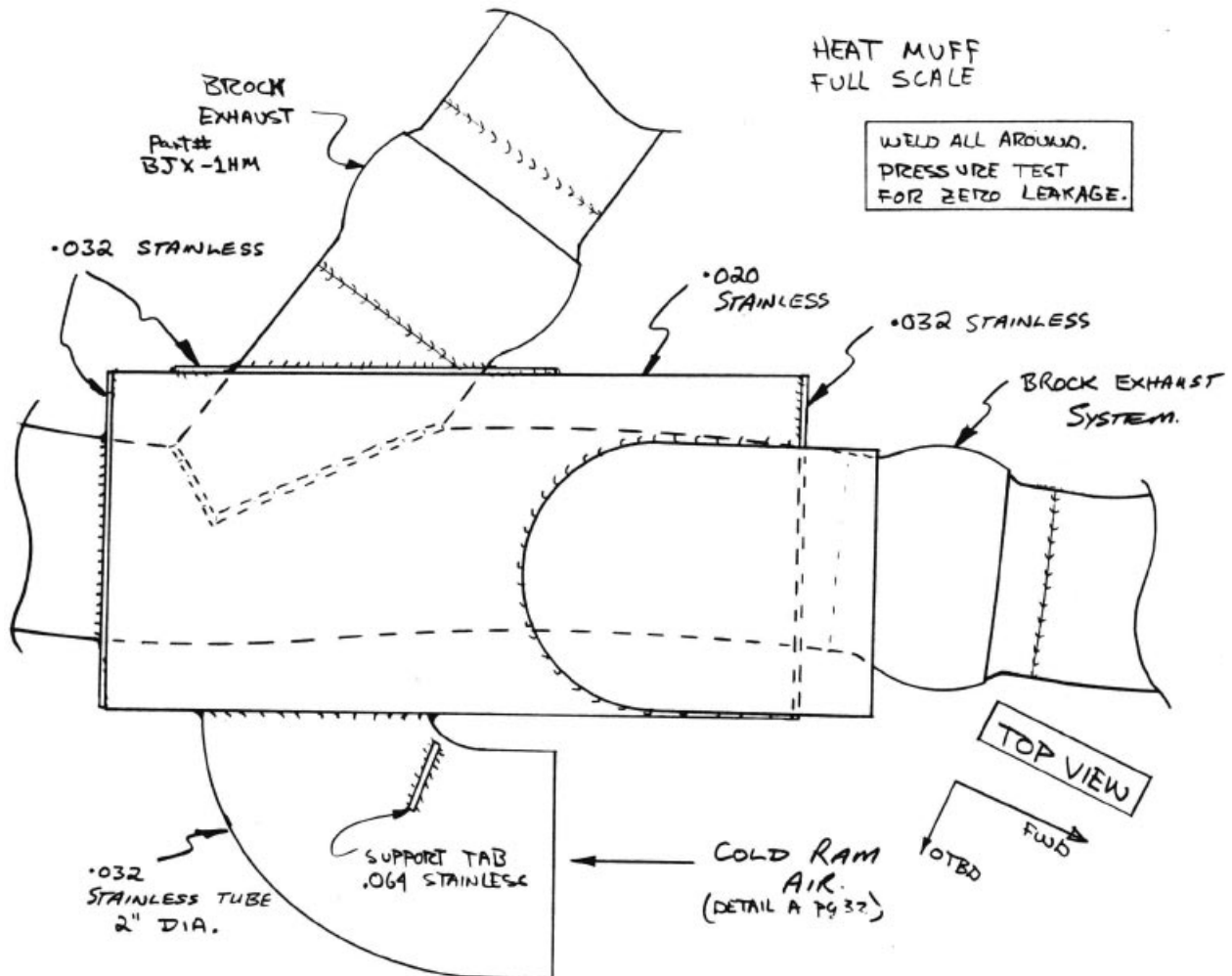


NOTE: CARB HEAT IS
RARELY NEEDED WITH
LYC O-235. CABIN HEAT
IS OFF WHEN CARB
HEAT IS SELECTED.

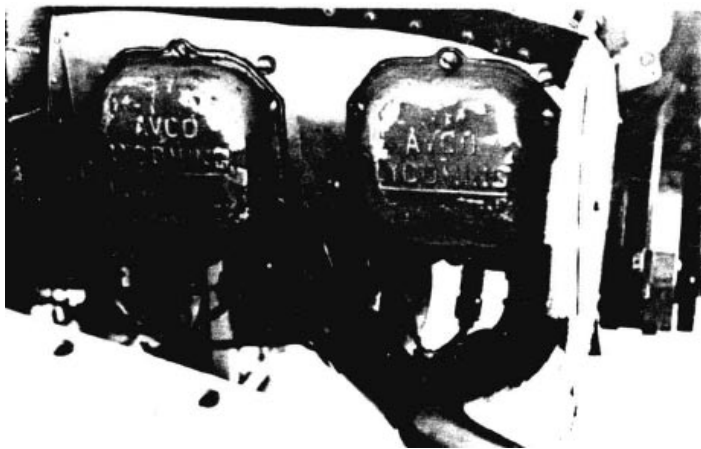


The carb/cabin heat exchanger shown on pg. 33 is available as an integral part of your Long-EZ exhaust system Ken Brock Mfg. sells these parts and they are welded up on the exhaust and pressure checked for leaks prior to being sold. If you intend using the heat exchanger to provide heat in the cockpit it is absolutely mandatory that you install a fresh air ram scoop in the lower right cowl and connect it to the aft 2" dia tube on the heat exchanger. This clean cold air then is heated up by the hot exhaust and is forced forward by ram pressure through a length of 'scat', red high temperature aero duct hose to the carb air/heat valve as shown. This is the source of carb heat if or when required. If you decide to install the optional cabin heat valve as shown on page 9, you should cut a 1 1/2" dia hole in the carb air/heat valve and install a short 1 1/2" dia tube, welded or sealed as shown. This is connected to the cabin heat valve with 'cat' black aero duct hose. Thus, you have a clean source of hot air for the cockpit.

If you decide to home build this heat exchanger it is very important that no carbon monoxide can get into the cockpit. Fresh, clean air must be brought into the heat exchanger, do not use the high pressure cooling air in the cowl for cabin heat. This air could easily be contaminated by any small exhaust gasket leak or undetected exhaust leak. Because the possibility always exists of carbon monoxide getting into the system, it is highly recommended that you install a carbon monoxide indicator in the cockpit. Route a 1 1/2" dia 'cat' aero duct hose from the cabin heat valve forward across the aft face of the back seat bulkhead to the right side of the fuselage. This hose should run forward along the fuselage side to the instrument panel. Be sure to secure the hose so that it does not interfere with the control sticks, pushrods, etc. Do not allow this hose to come into contact with the fuel lines, which also run up the right side. Allow a minimum of 1/2" clearance between the hose and the fuel lines.



Baffles before installing neoprene lips.
Note lip to seal around alternator and
silicone sealant.



Note Exhaust support attached to the baffle bolt.

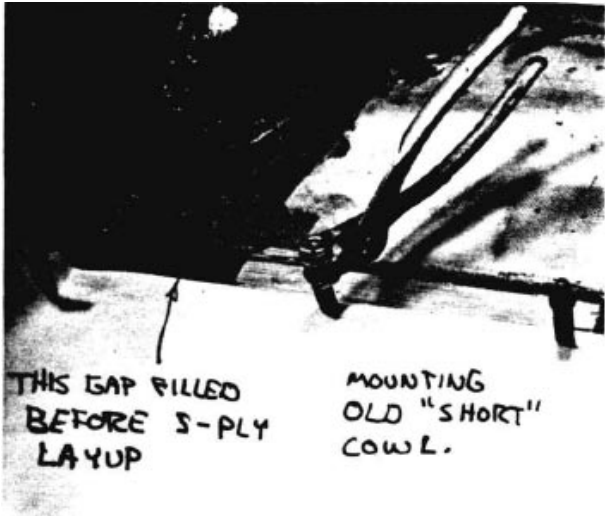


Breather: Bond a flattened $\frac{3}{4}$ " alum tube to cowl stiffener.
Attach a $\frac{3}{4}$ " I.D. x $\frac{1}{8}$ wall tygon plastic tube from it to the
breather.

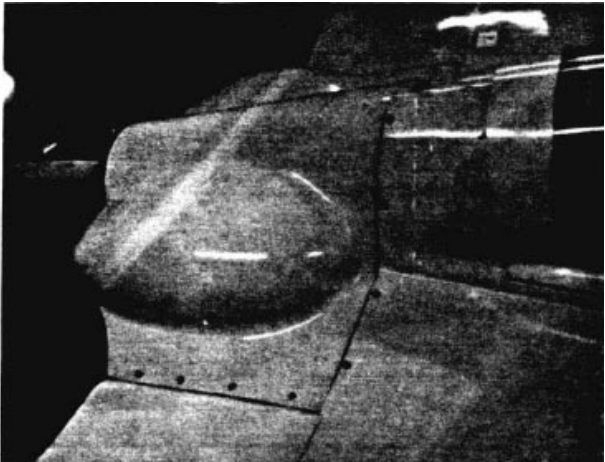
Long - E3

SECTION II LYCOMING O 320 ENGINE INSTALLATION

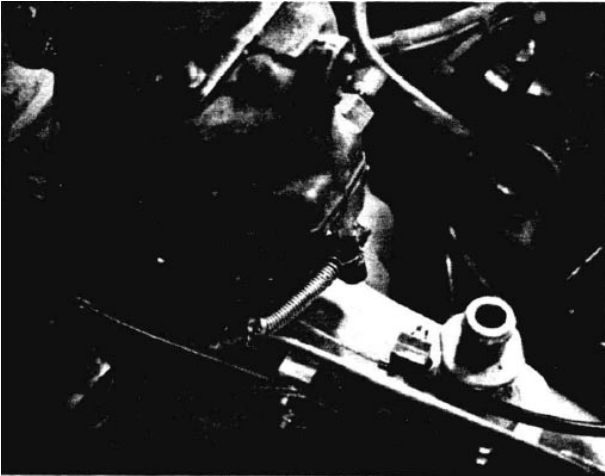
SN JOF-67



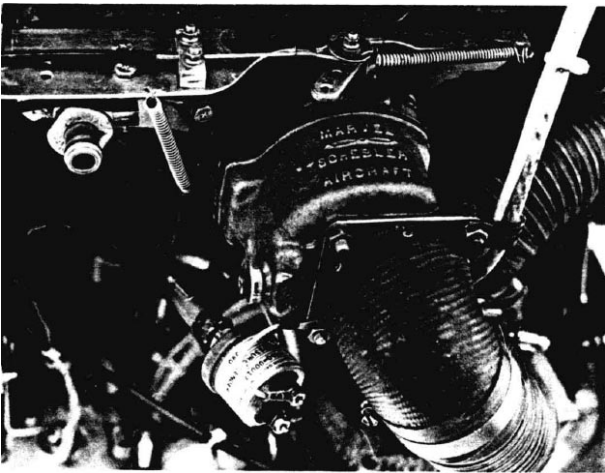
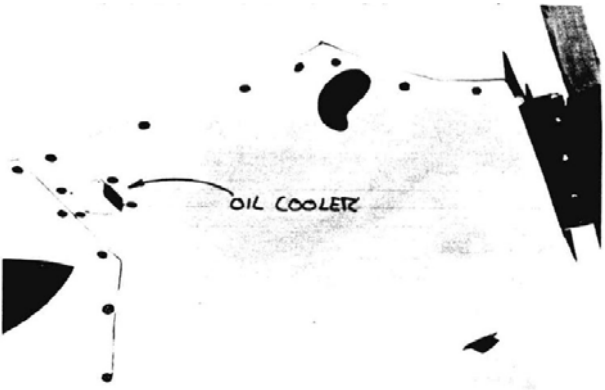
Jigging cowl to fuselage and centersection spar, using clecos and wood blocks. If cowl does not fit satisfactorily it can generally be urged into place after application of heat from a hair dryer or industrial heat gun.



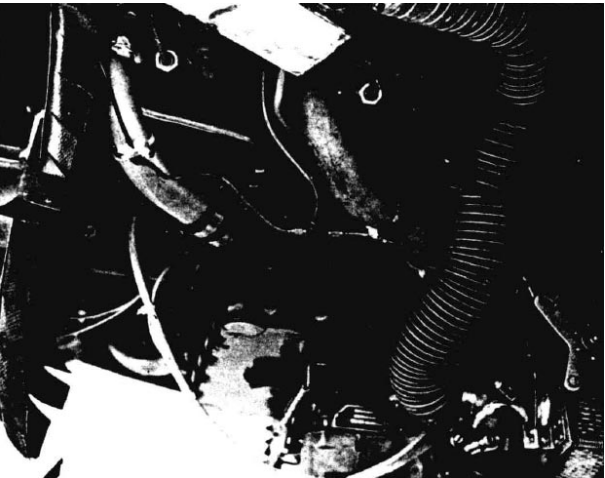
Use these photos to determine spacing of screws and cowl flanges (approx. 16 top cowl and 24 bottom cowl), note the 4 screws and exit scoop for optional oil cooler installation. The oil cooler is held in place by 4 # 10 screws & nutplates. The exit scoop is held on the cowl with 4 pop rivets.



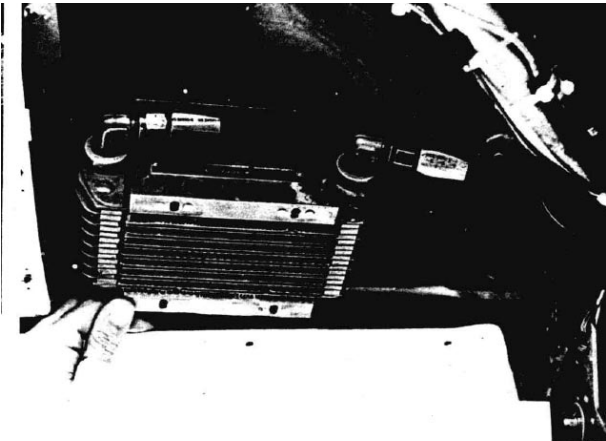
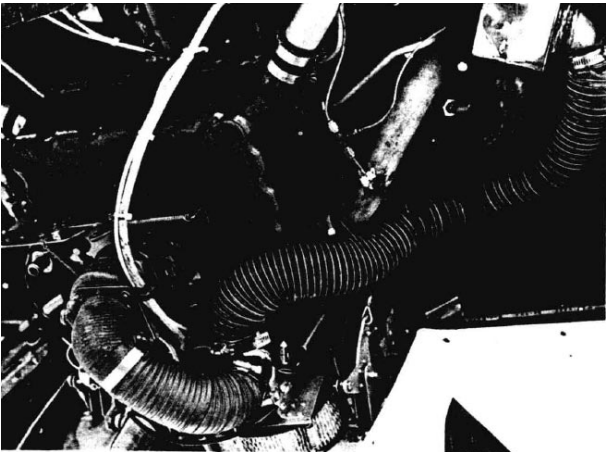
This photo shows installation of mixture arm cable and return spring.



This photo shows installation of mixture arm cable and return spring, fiberglass carb inlet elbow and fuel pressure sender



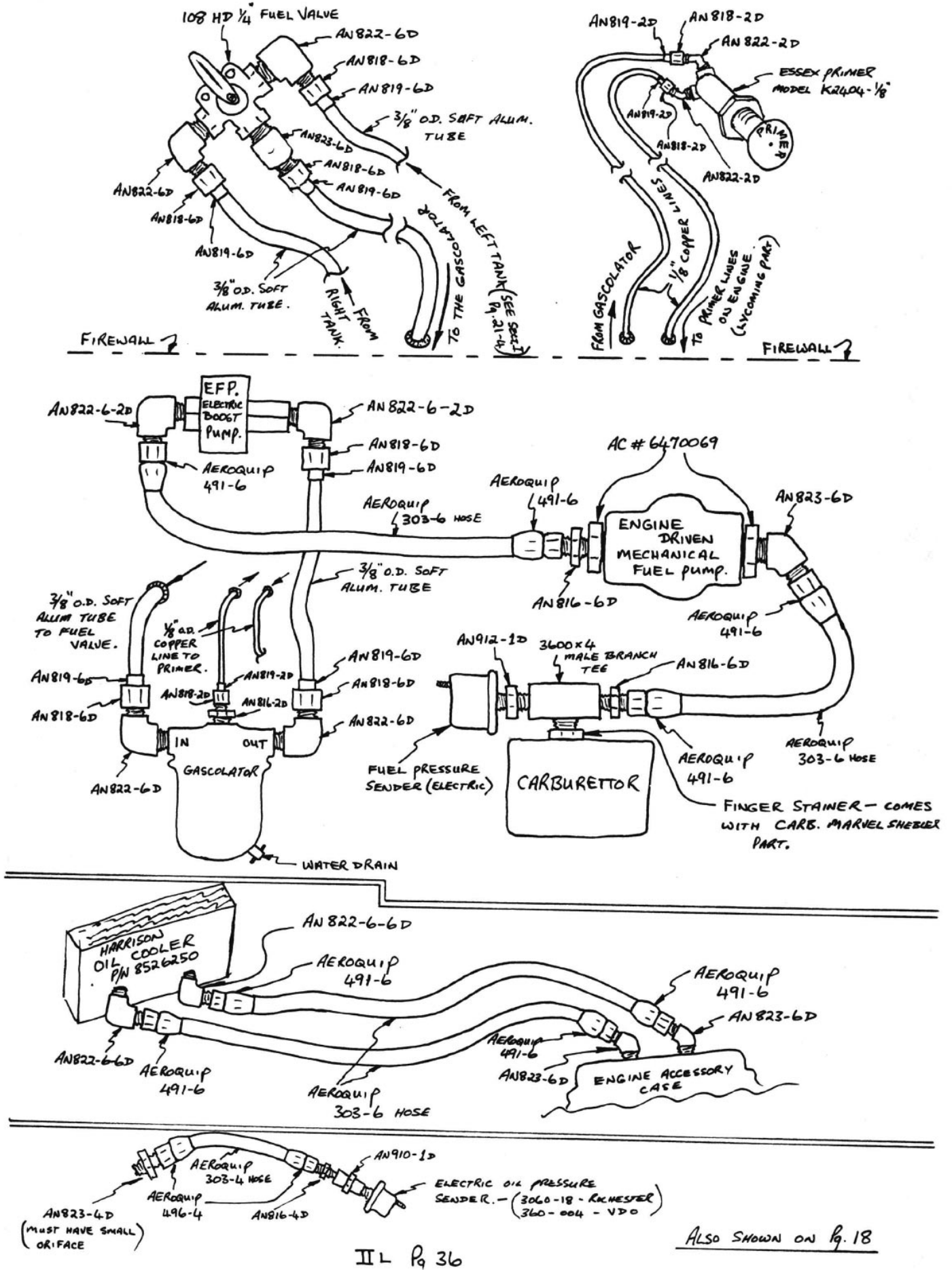
Note sliced neoprene baffle lip, and carb heat hose routing. This hose is bound to the engine mount using a 1" wide strip of neoprene asbestos material to prevent the safety wire from cutting into the hose



Oil cooler on left side. Note K-1000-32 nut plates installed with rivets.

PLUMBING SCHEMATIC AND PARTS CALL-OUT.

INFORMATION ON THIS PAGE SUPERCEDES ANY INFORMATION
SUPPLIED IN LONG-E2 PLANS, SECTION I.



BILL OF MATERIALS

6 AN3-7A Bolts	1 Micro switch type V3 or Radio Shack 275-1102
2 AN3-14A Bolts	
2 AN4-12A Bolts	<u>Engine Mount Hardware</u>
4 AN4-13A Bolts	
2 AN4-14A Bolts	For Conical Mount:
18 MS21042- 3 Nuts	4 AN6-43A Bolts
8 MS21042-3 Nuts	4 AN960-616 washhers
10 AN509-10R8 Screws	4 Lyc. # std 619 Washers
2 AN111-4 Cable bushings	4 AN363-624 Nuts
*3 AN818-2D Nuts	8 #71032 Rubber Bushings.
*3 AN819-2D Sleeves	
6 AN818-6D Nuts	<u>OR</u>
6 AN819-6D Sleeves	For Dynafocal Mount:
*2 AN822-2D Elbows	4 AN7-35 A Bolts
4 AN822-6D Elbows	8 AN960-7616 Washers
2 AN822-6-2D Elbows	4 AN363-720 Nuts
**2 AN822-6-6D Elbows	8 Dynafocal Bushings
*1 AN816-2D Nipple	(for 2 3/4" I.D. Retainer)
1 AN816-4D Nipple	4 Steel Spacers.
2 ANB16-60 Nipples	
4 AN823-6D Elbows	<u>Baffle Material</u>
1 AN910-1D Coupling	5" of 1/8" x 1" x 1 1/2" 2024 T3 Alum Angle
1 AN912-1D Bushing	1 pc. .025 – 6061T6 Alum Sheet 30" x 48"
1 3600 x 4 Weather- Head Male Branch Tee.	1 pc. 1/16" x 12" x 40" Neoprene - Asbestos
2AC #6470069 Adapters	200 Avex 1601-0410 Pop rivets
2 Aeroquip491-4 Fittings	200 AN960-4L Flat Washes.
4 Aeroquip 491-6 Fittings (**8)	12 AN500-A416-10 Baffle Screws
33" Aeroquip 303-6 Hose (**84")	12 AN936-A416 Lock Washers
6" Aeroquip 303-4 Hose	2 AN931-6-16 Rubber Grommets
4 Blow proof exhaust gaskets Lyc. #77611	48" of 2 1/2" dia. 'Scat' aeroduct
8 Lock Washers MS 35333-41	12" of 2" dia. 'Scat' (optional cabin heat)
8 Exhaust Manifold Nuts Std. 1410 5116 - 18 Lyc.	12" of 1 1/2" dia. 'Cat' (optional cabin heat)
	4 Stainless worm clamps #136 (2 1/2" dia.)
18" - 3/8" O.D. x .035 wall 4130N steel tube.	
18" - 3/4" 1.D. x 1/8" wall tygon plastic tube.	2 each #CS springs (1/2" long x .35" O.D. x .06 wire
6" - 3/4" O.D . x .049 wall 6061-T6 alum. tube.	compression).
8" - 3/16" x 3/4 " 2024T3 alum. bar.	2 each Century #C-161 Springs.
24 Nylon ty-raps (6"long) TY-525M	Optional
24 Nylon ty-raps (12" long) TY-528M	
1 tube high temp RTV (silicone) (red or silver)	
** Only required if an oil cooler is used.	*1 Essex Primer #K2404-1/8"
* Only required if a primer is used.	** 1 Harrison Oil Cooler P/N 8526250
<u>Electrical</u>	

<u>Brock – Supplied Components</u>	
Carb heat – mixture – throttle quadrant assy.	
Long-EZ Spinner	VESPI
Prop Plate	KM01068
3- inch Prop Extension	KM06018
Exhaust System with heat muff	BJX-IHM
Cabin heat valve (optional)	
Carb. heat valve assy.	VECHVA
Electric fuel pump	EFP
Carb. Heat flange (optional)	VELY13
Long-EZ Lyc. O-320 Conical engine mount.	
2 Steel Bushings	LL-3
2 Alum Bushings	LL-4