

CAUTION!!

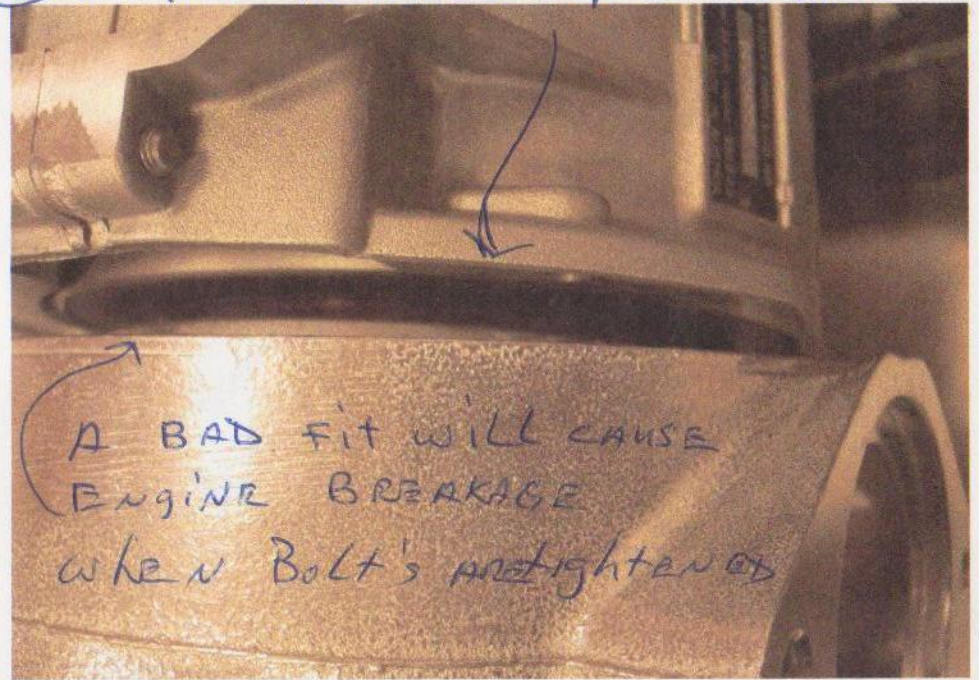
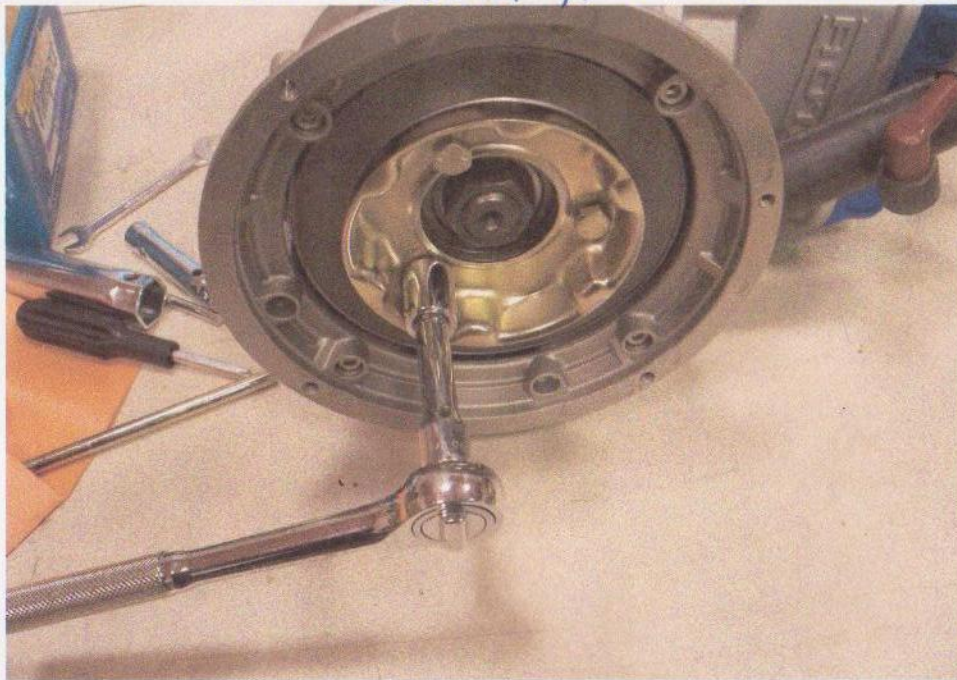
Do Not use any of the hardware provided with this kit anywhere else on your aircraft than it is intended to for. It is grade 5 hardware. It is not AN hardware.

⇒ **Make sure O-ring is on threaded portion of filler neck.**

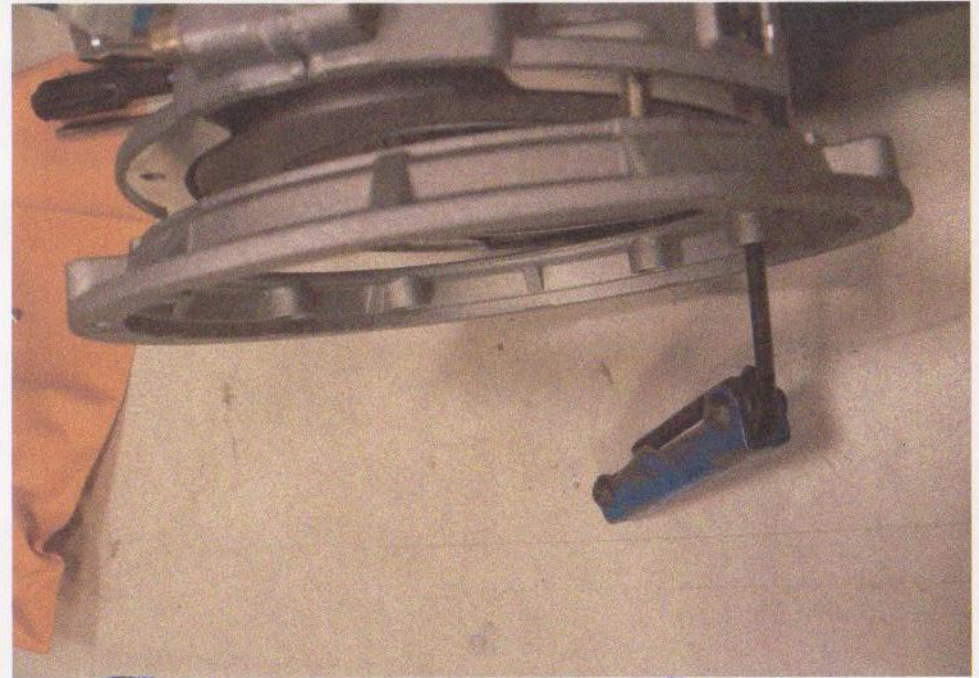
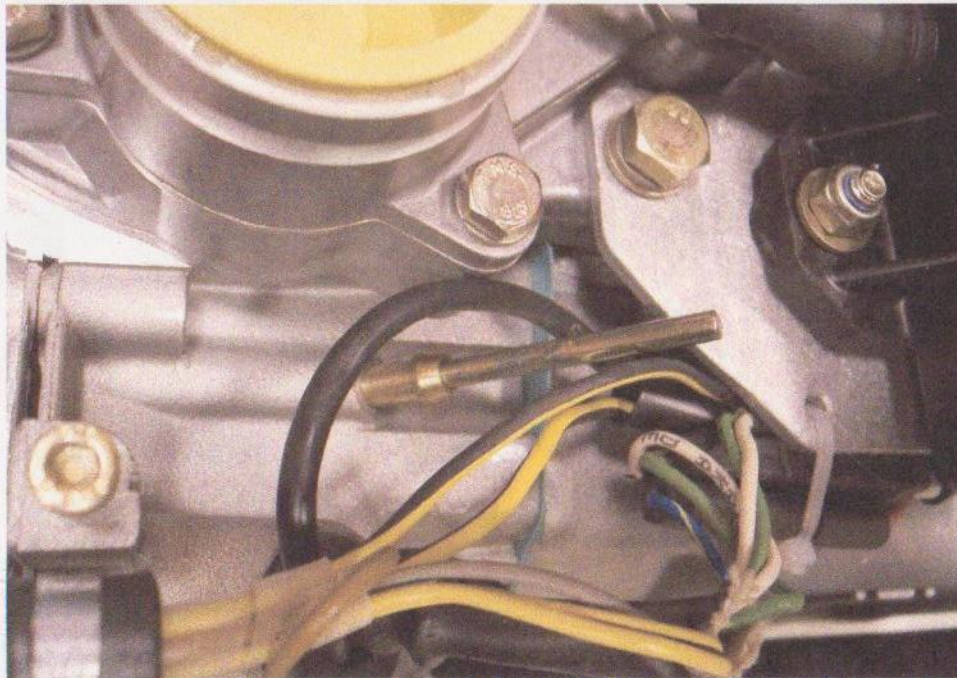
⇒ **Screw filler neck into radiator, turn with wrench until very tight, with filler neck facing opposite direction of radiator outlets.**

② REMOVE HANDLE UNIT, THEN 3 BOLT'S

!!! BE SURE GPL STARTER HOUSING WILL
④ FIT INTO MACHINED LIP OF MOTOR



Page 2



① Put tool supplied with engine into CASE NIPPLE, TURN CRANK UNTIL PIN DROPS INTO NOTCH ON CRANK IF IT WON'T FILE PIN TO FIT

③ REMOVE ADAPTER PLATE

G.P.L. STARTERS

WARNING!!!!!!

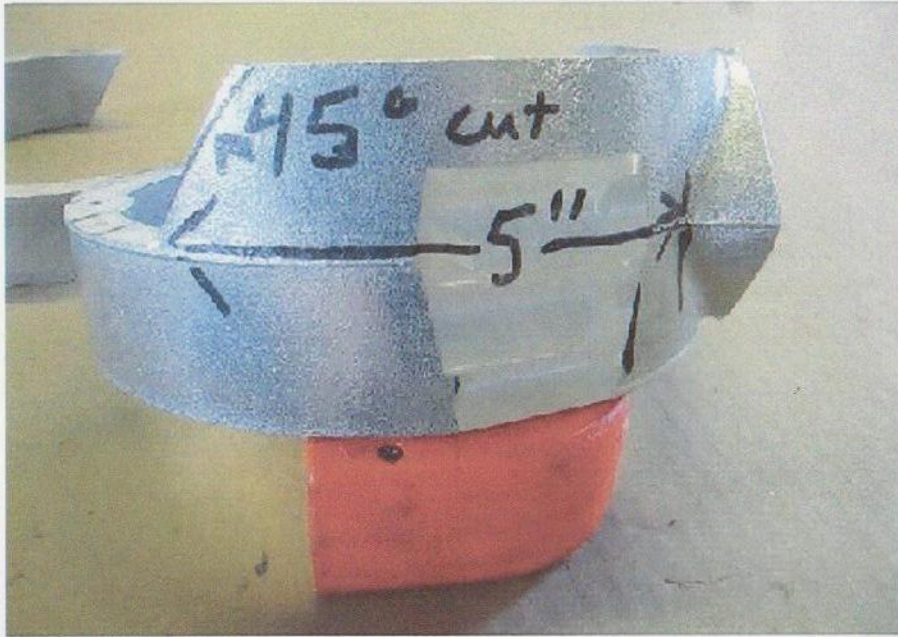
YOU MUST CHECK THAT THE BOLTS THAT ATTACH THE RING GEAR TO THE RED SPACER *DO NOT PROTRUDE AT ALL!!* (SUCH AS SHOWN IN THE PICTURE). EVEN USIN THE HIGH COLLAR WASHERS G.P.L. SUPPLIES IS NOT ENOUGH HEIGHT.

1. Fit the gear ring to the spacer and tighten the bolts. If they even come close to the edge, grind off 2-3 threads. Then, reinsert the bolts to assure a recessed bolt end. Also, I always grind off 2-3 threads of the 8mm bolts that hold the spacer to the engine. Bolts that are too long cause a complete ring gear and spacer failure, and possible severe engine damage).
2. *DO NOT over tighten the 6mm bolts holding the machined housing to the engine. (Too tight can cause breakage of the engine mounting ears).* YOU MAY NEED TO

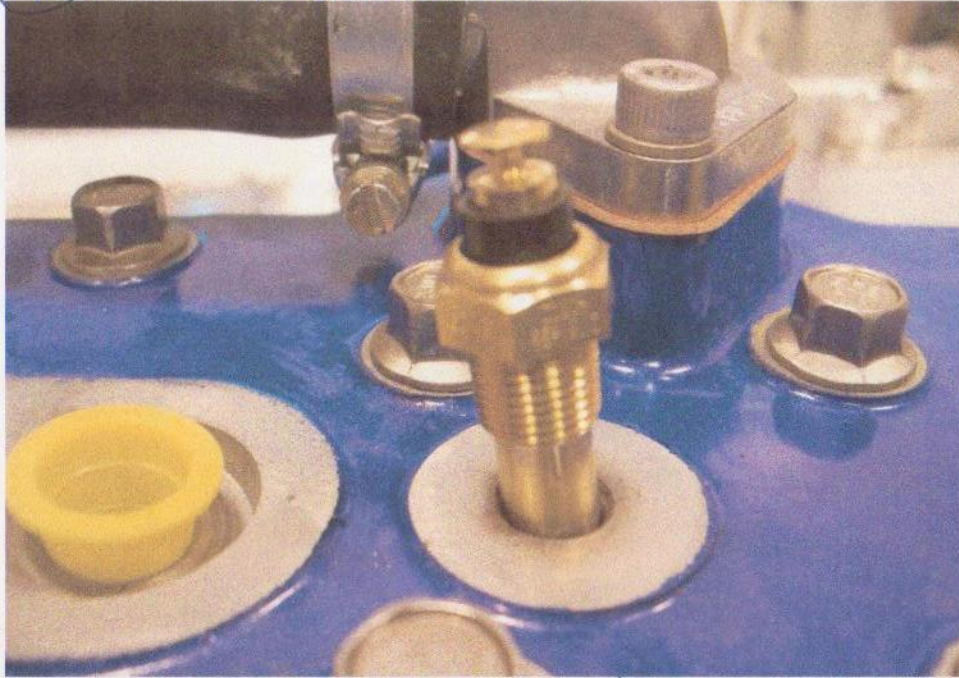
GRIND the casting Page 3 EDGES TO FIT THE ENGINE LIP

BOLT'S must NOT protrude THROUGH Ring as shown!

GRIND
Long
BOLT'S
DOWN
1 or 2
THREADS

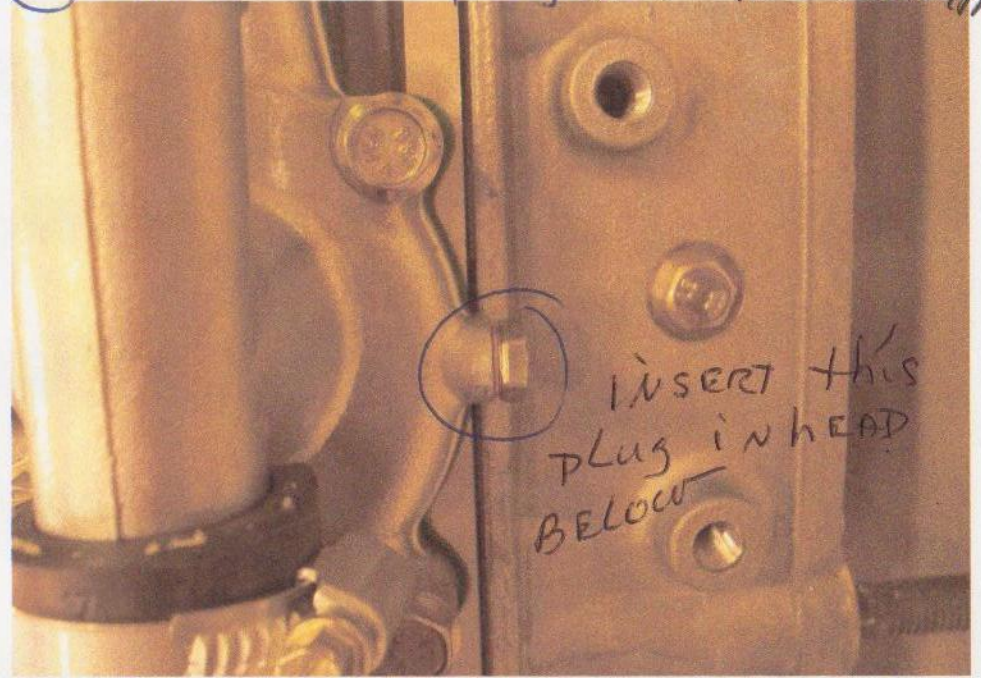


4. INSERT WATER TEMP SENDER



USE SEALANT ON THREADS

3. REMOVE this plug AND INSERT NIPPLE



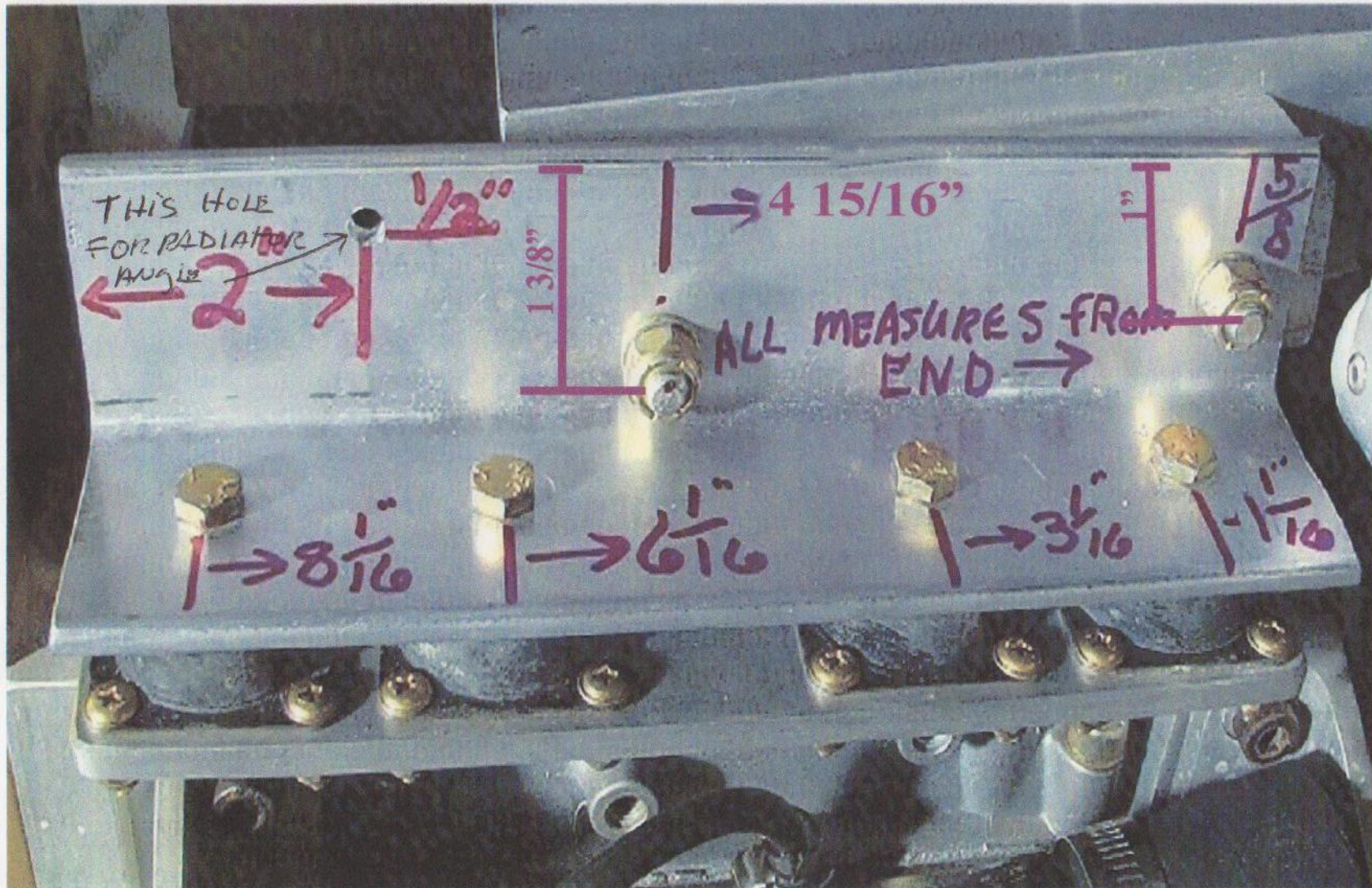
2. REMOVE this Plug



1. REMOVE this nipple AND INSERT INTO PUMP ABOVE

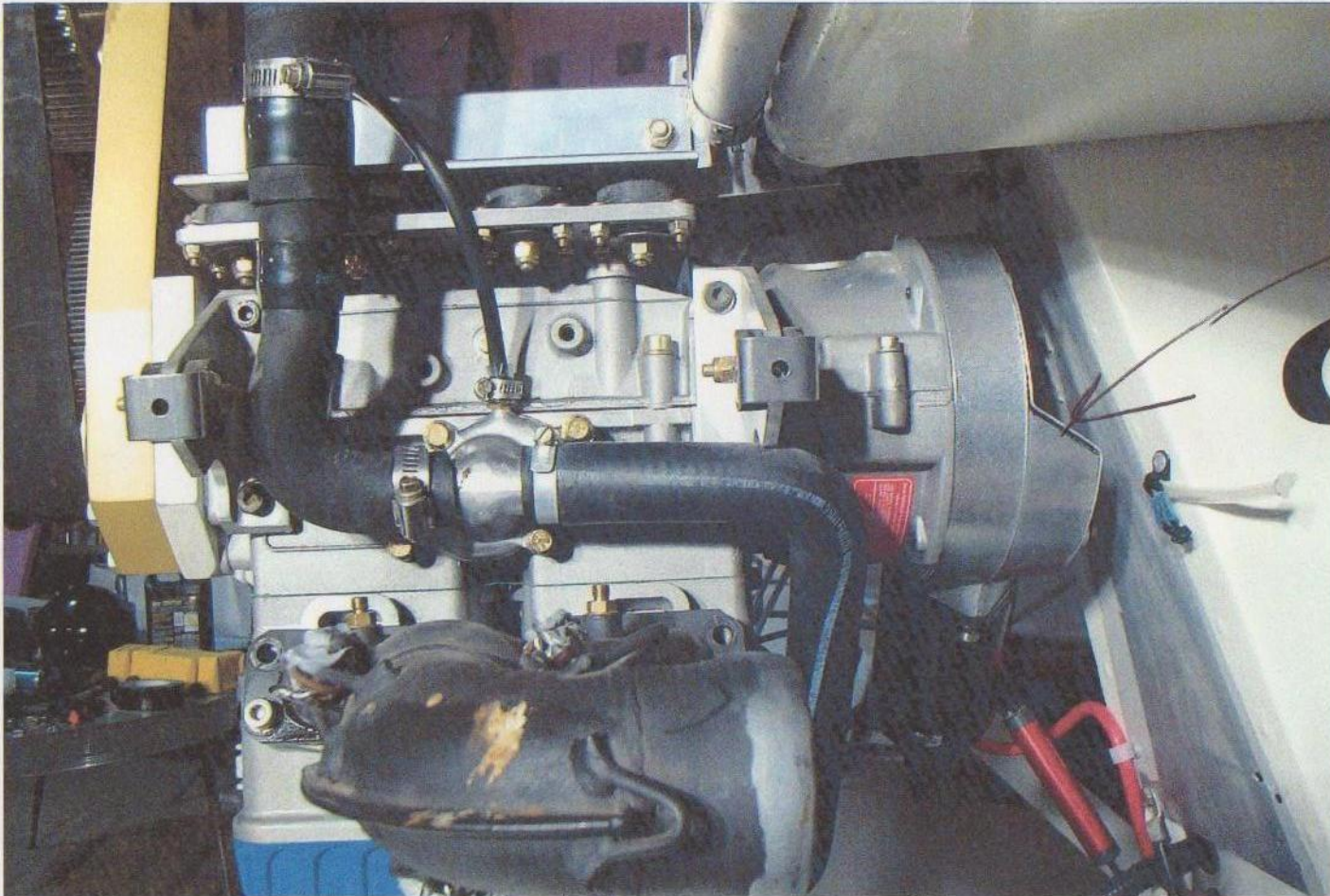
The 2 Root Tube mount holes should be pre-drilled from QCU. Temporarily mount the angles, place plate with Lord Mounts in position and mark holes to drill.

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1. Note spacer between engine and lord mount plate.
2. Burp tube on pump nipple with protective sleeve under clamp.

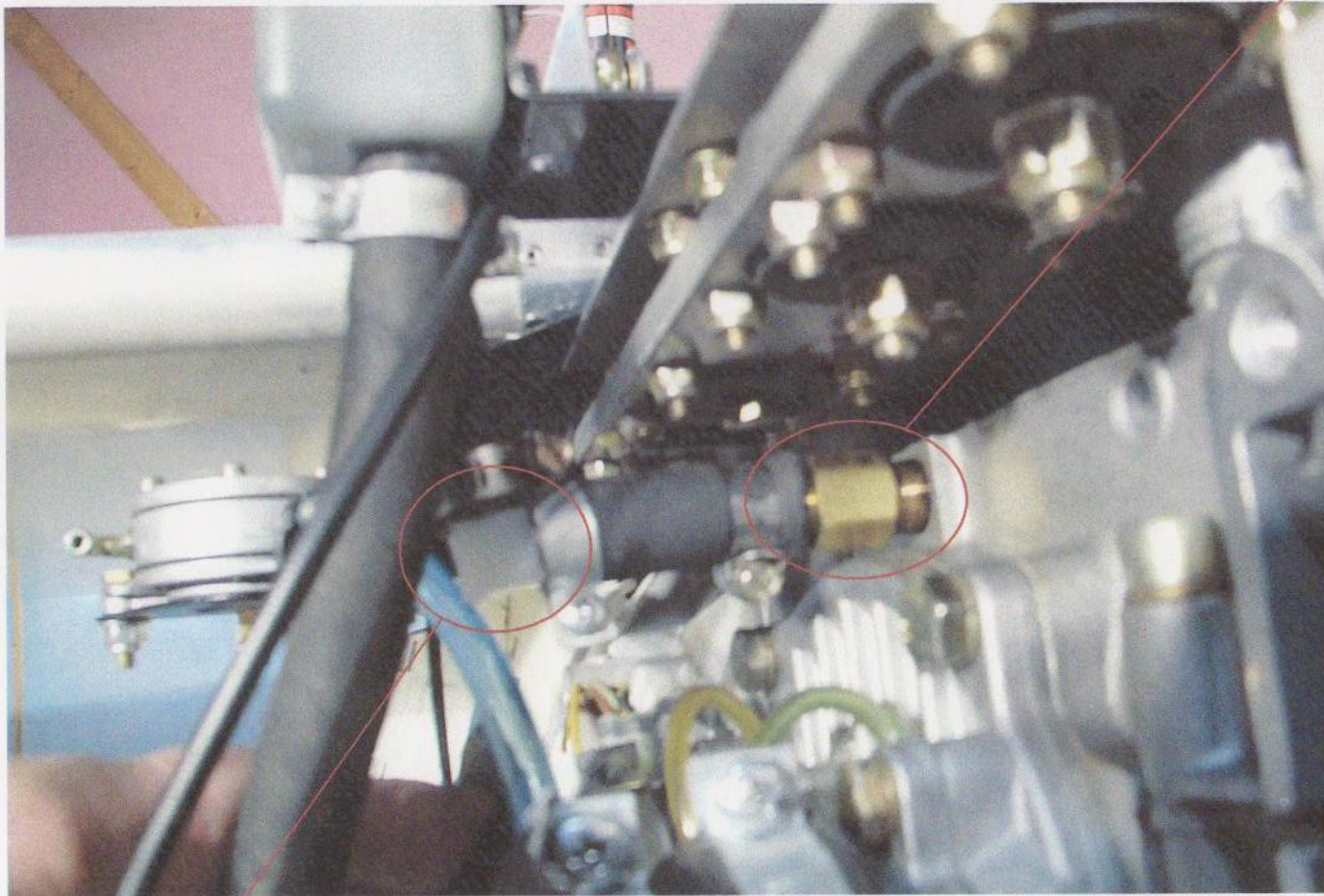
For Dust cover
Form plate
to fit GPL
Housing



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NOTE! Remove existing elbow - Replace with supplied 1/4" N.P.T. x 3/8" hose.

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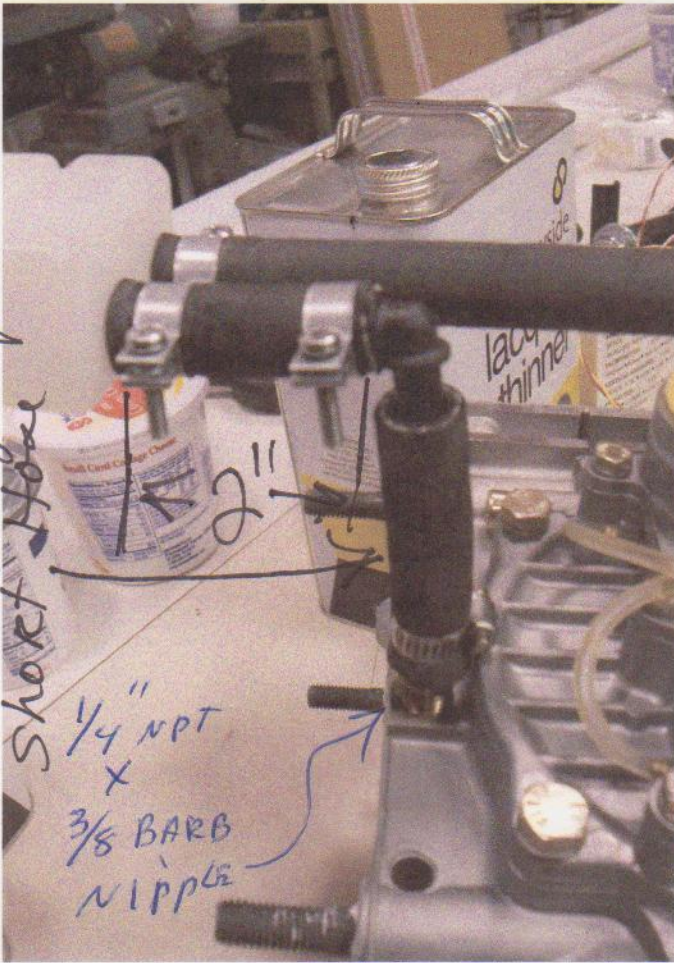
3/8" x 3/8" Elbow.

cut 3 1/4" length from OEM

Short Hose

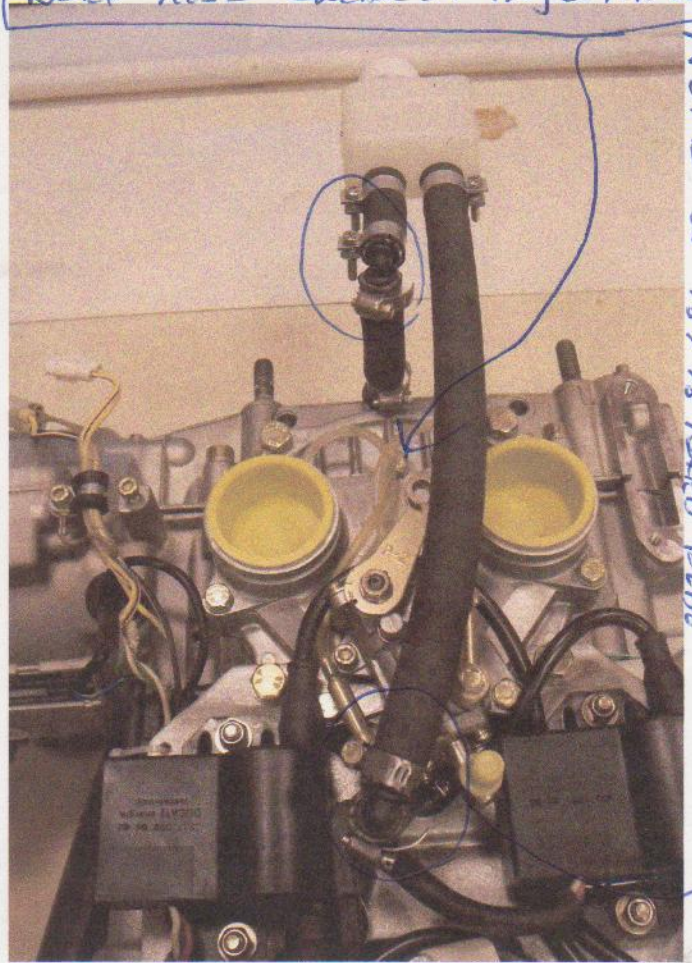
1/4" NPT
x
3/8 BARB
NIPPLE

2"

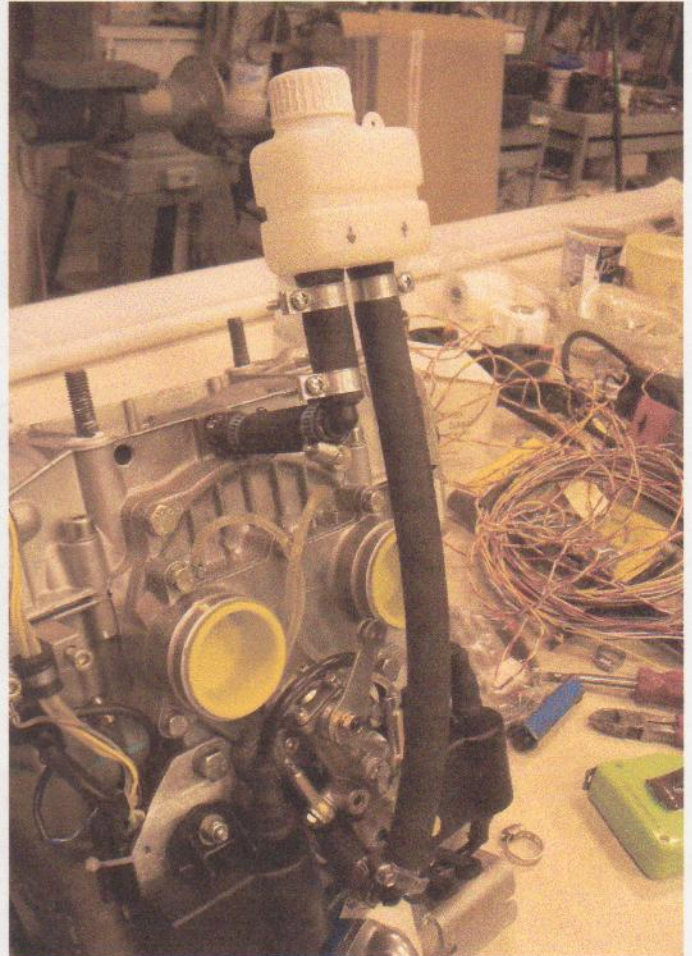
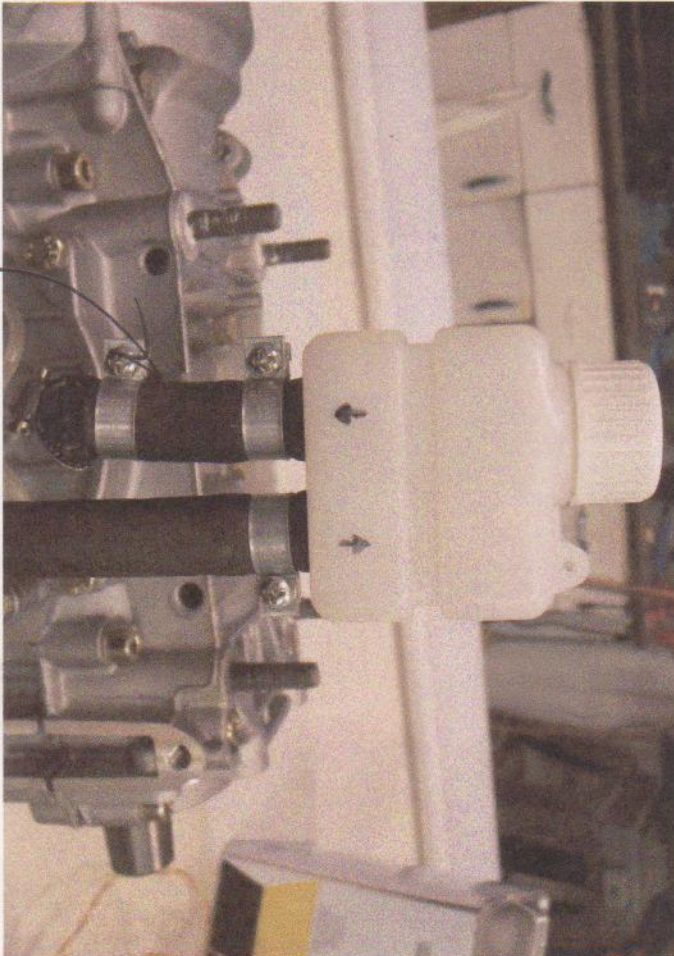


KEEP HOSE CLEAR OF INJECTOR ARM

NOTE 2-3/8" x 3/8" BARB ELBO



2" long

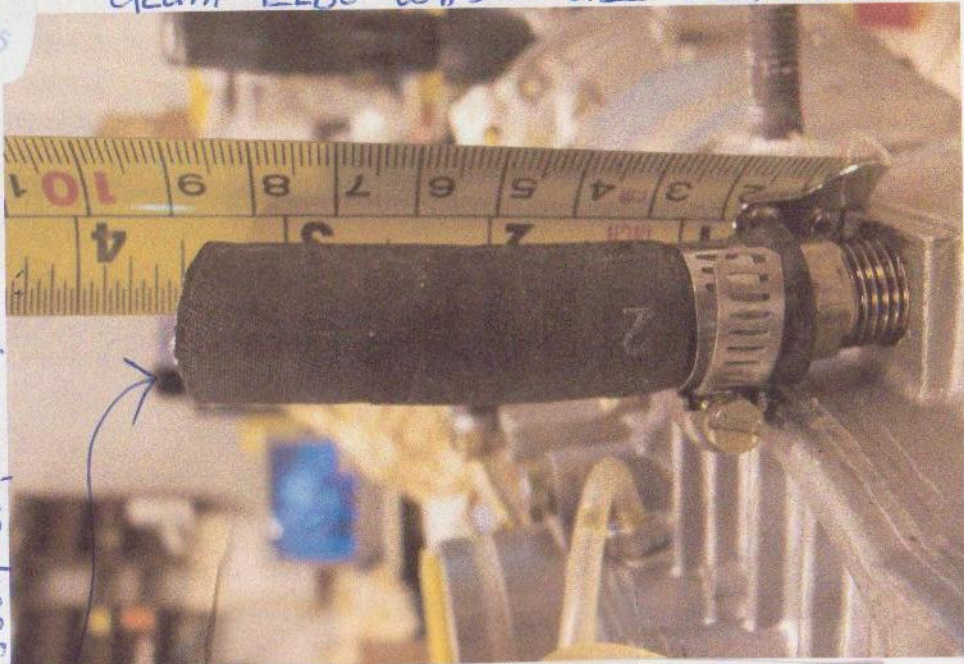




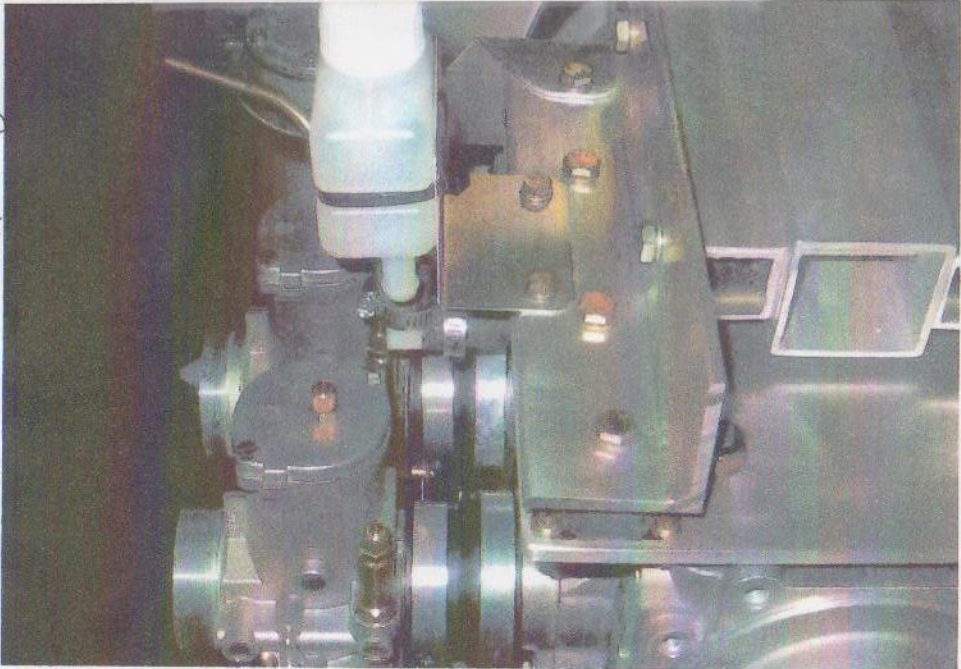
⑧ You won't have to remove the CDI unit's. if you cut the hose and install the ELBO as shown

ORIGINAL ENGINE HOSE

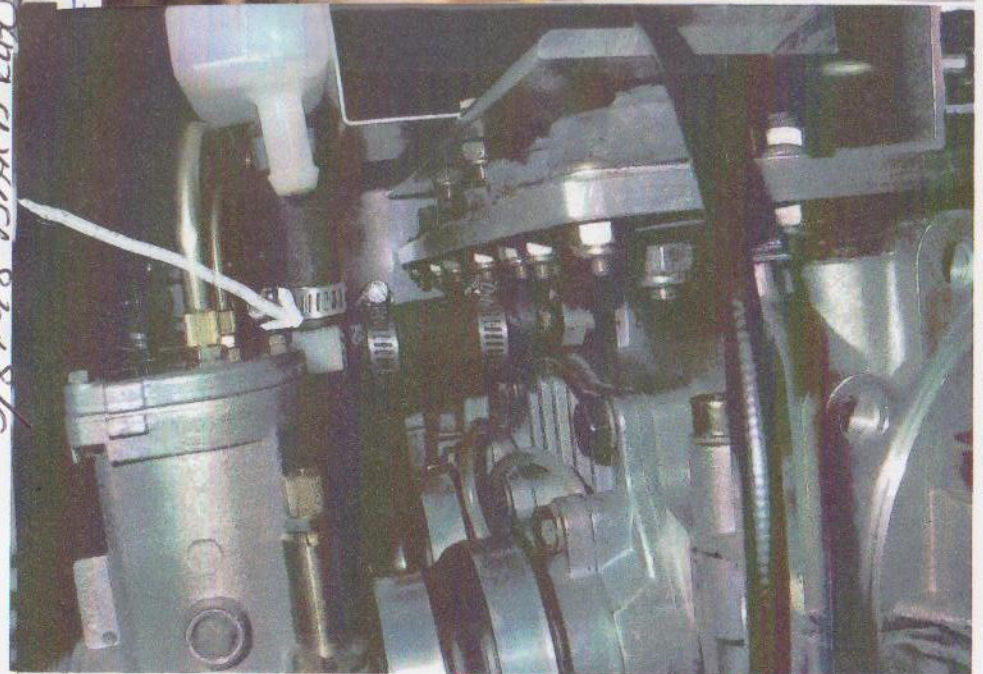
⑦ INSERT $\frac{1}{4}$ " M.P.T. X $\frac{3}{8}$ " BARB WHERE ALUM ELBO WAS. USE SEALANT



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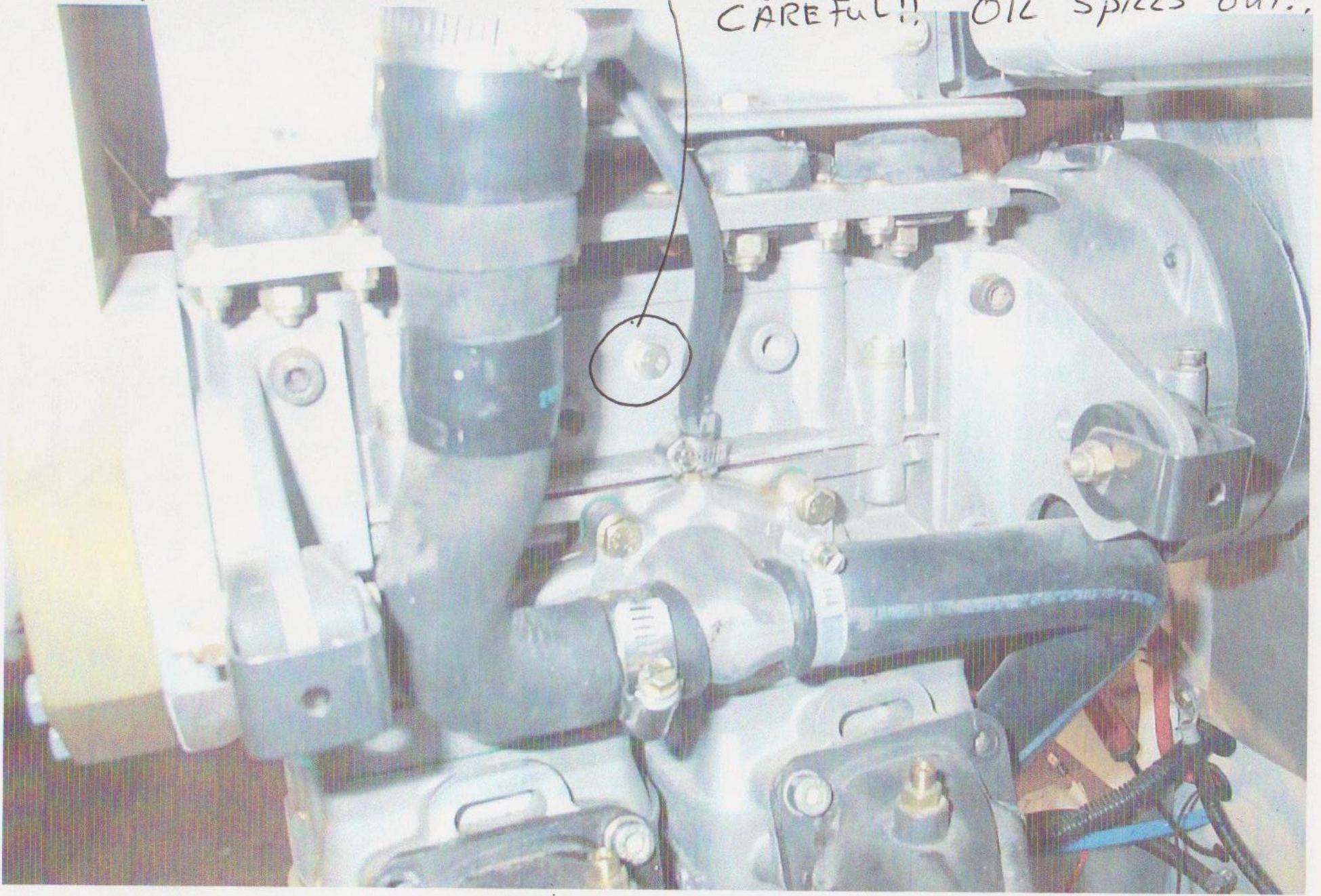


3/8" X 3/8" BARB ELBO



Remove ROTAX, nipple and install straight BRASS nipple cut hose to fit - install $\frac{3}{8}$ " X $\frac{3}{8}$ " BARB ELBOW in tube

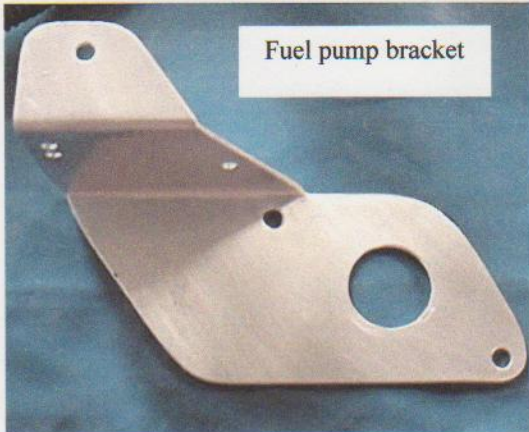
THIS OPEN THIS SIDE OF
AFTER SWITCHING HOSES, AND ENGINE IS INSTALLED ON PLANE,
CAREFUL!! OIL SPILLS OUT!!



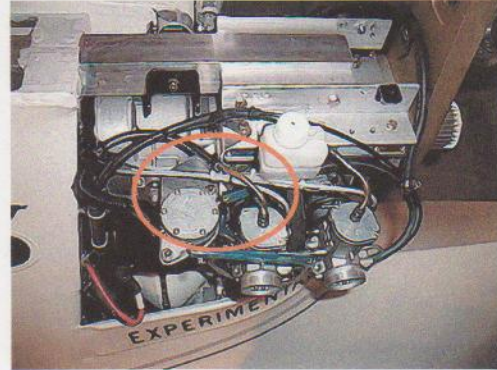
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Fuel Pump Bracket Installation

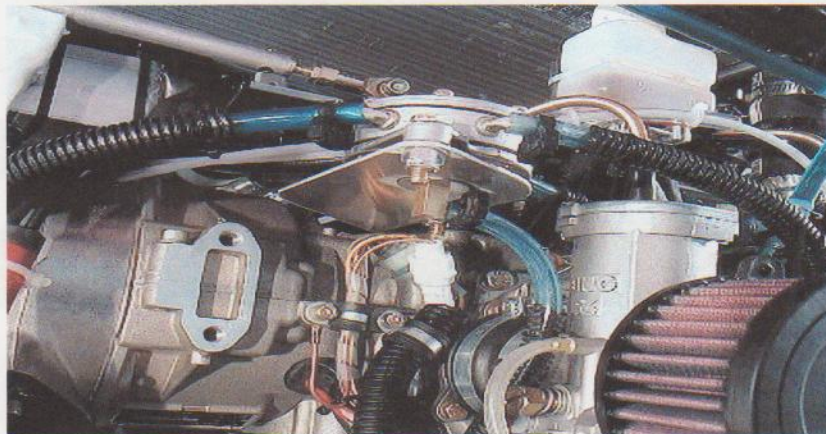
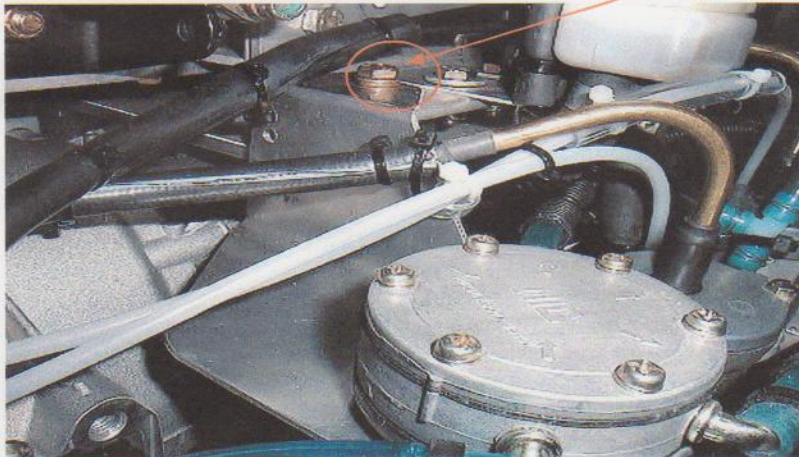
Relocating fuel pump by using fuel pump bracket allows room to mount the

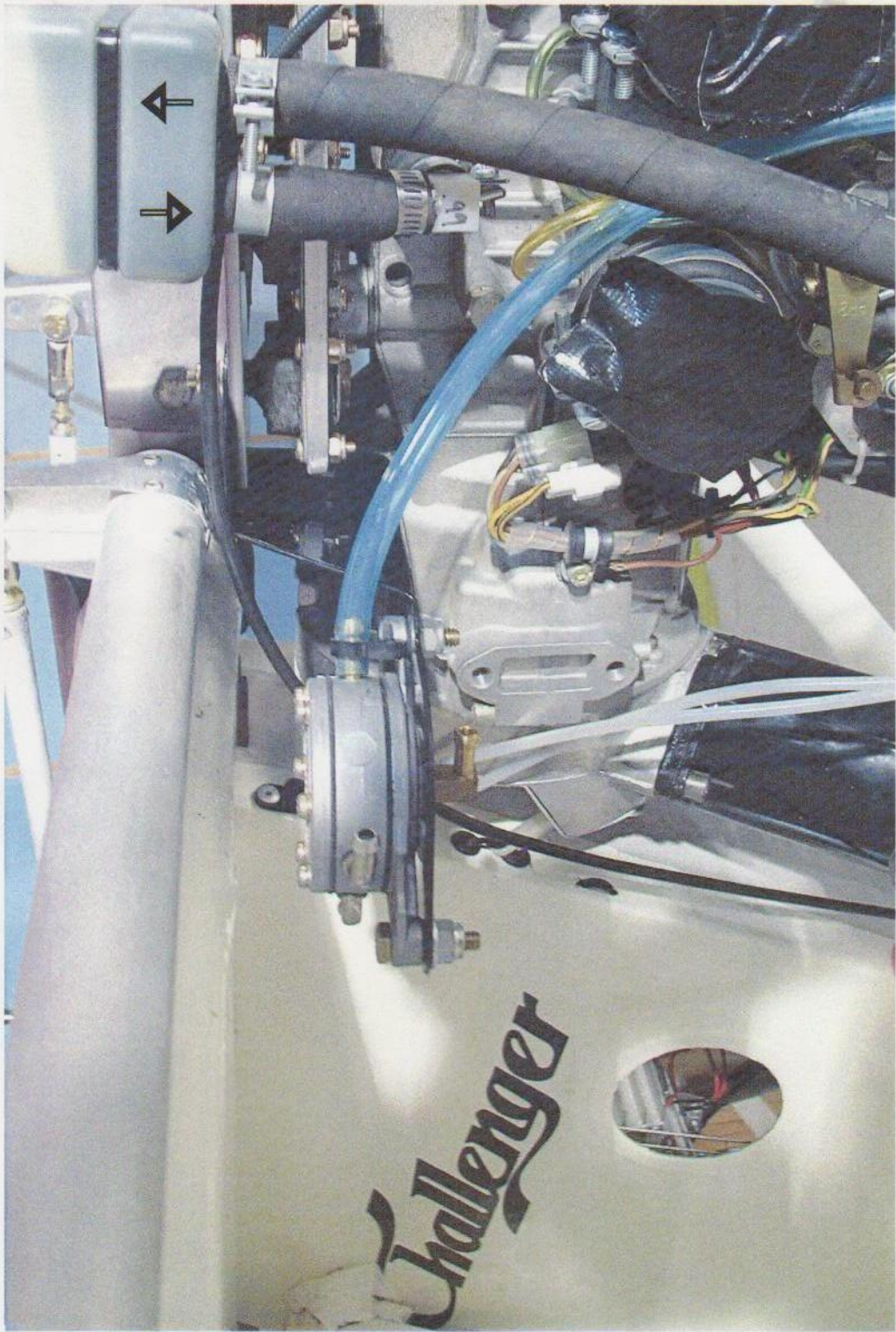


Top view of fuel pump after installation

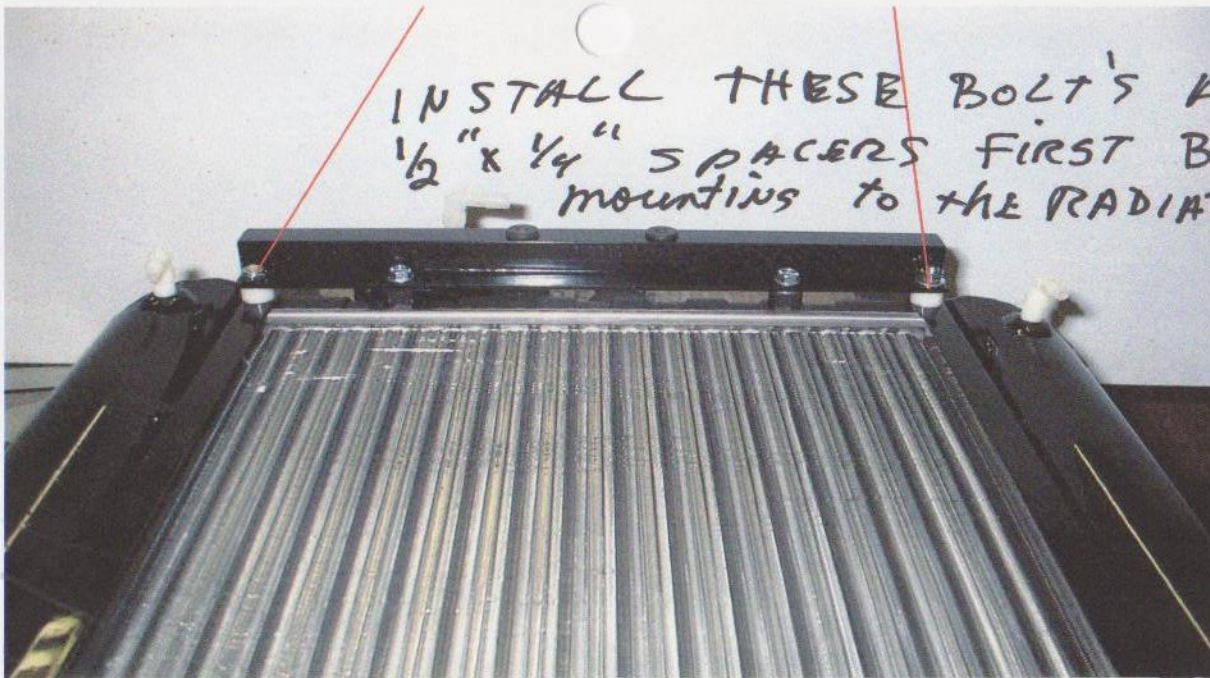


Mount the fuel pump bracket using the longer AN bolt supplied with kit.





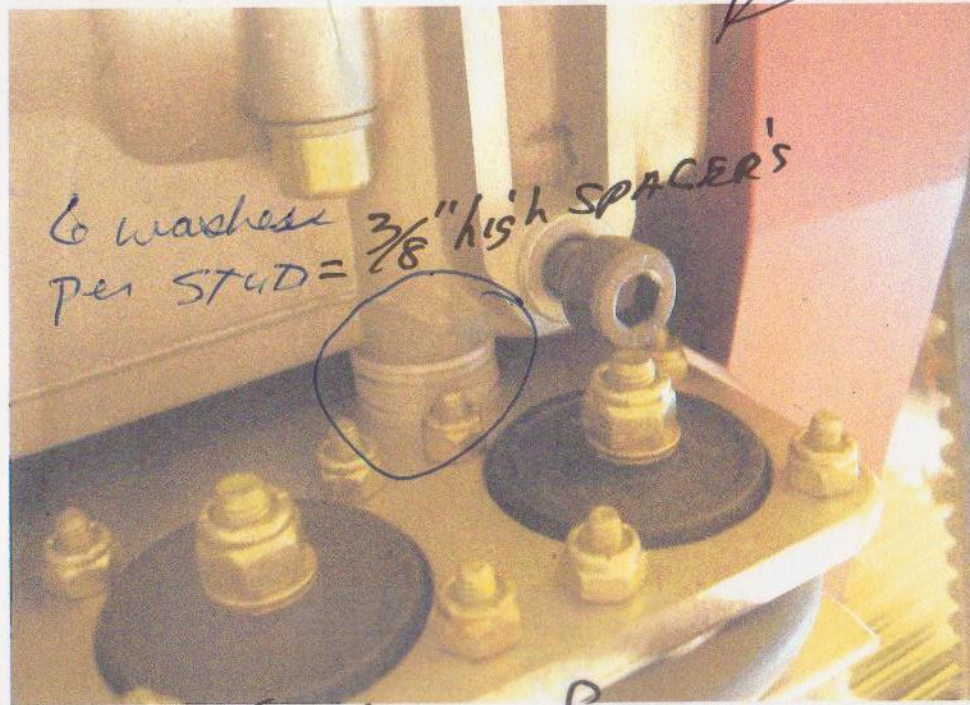
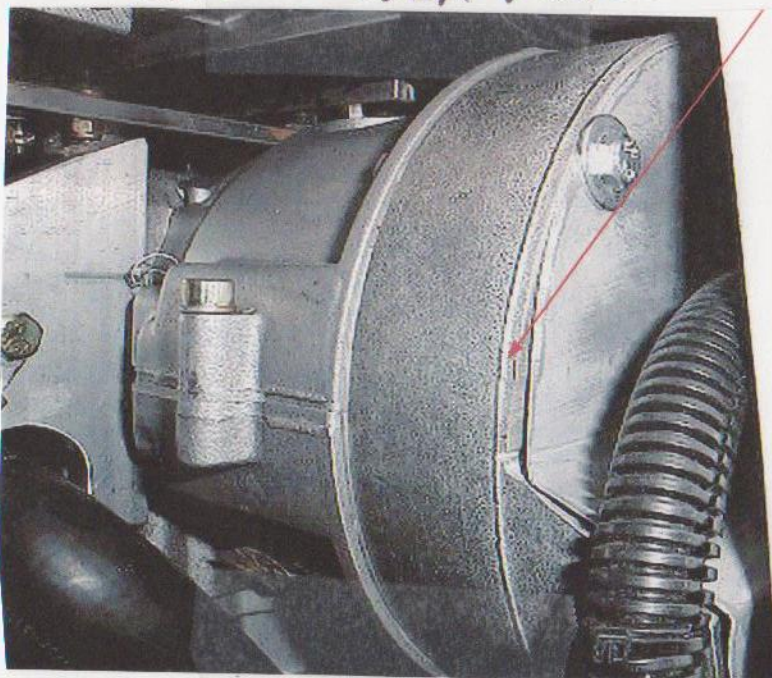
INSTALL THESE BOLT'S AND
 $\frac{1}{2}$ " x $\frac{1}{4}$ " SPACERS FIRST Before
mounting to the RADIATOR & SIDES



BE SURE TO
INSTALL WASHERS
BETWEEN ENGINE
AND MOUNT
PLATE

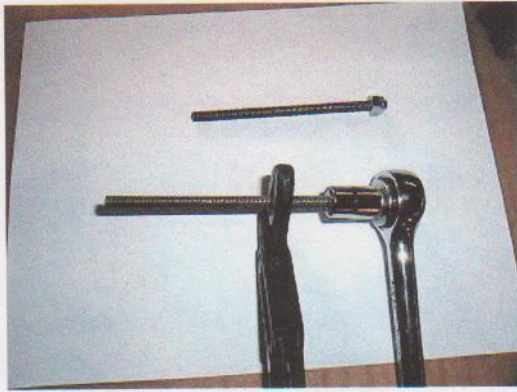
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GPL COVER PLATE



6 washers $\frac{3}{8}$ " high SPACERS
PER STUD =

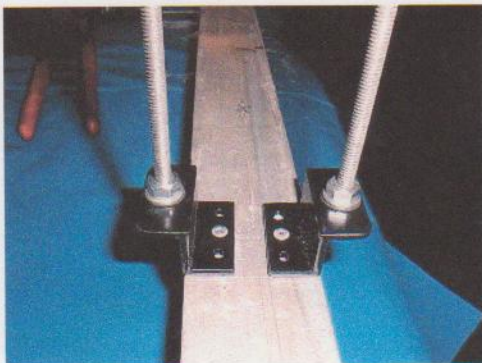
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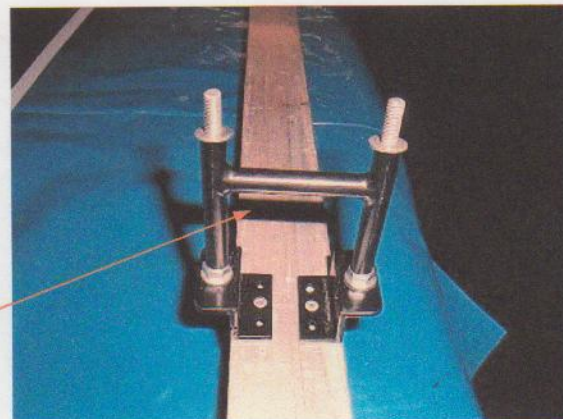
Screw ny-lock nut onto threaded rod using a pliers or vise grip and 7/16" wrench. **Do not hold on end.**



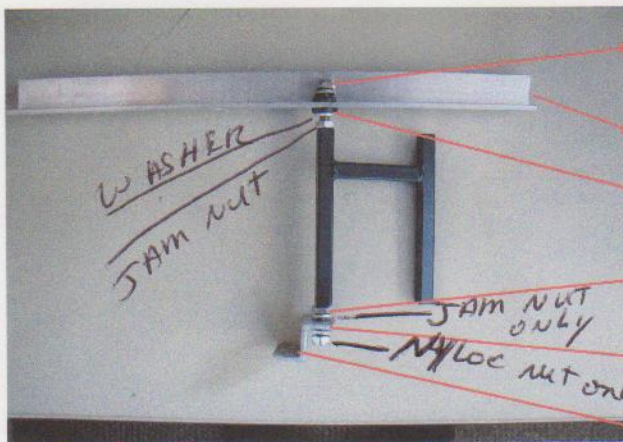
Be sure grommets are installed in Z-brackets. Use a #12 washer on top and bottom of each grommet. **Note:** Apply a little dish soap to grommet before inserting threaded rod.



Add #12 washer and jam nut. Tighten jam nut (snug). Do not overtighten.



Install H-bracket. Be sure to install with cross member up and angle to the back. Install #12 washers.



Nyloc Nut, Washer & Rubber Grommet.

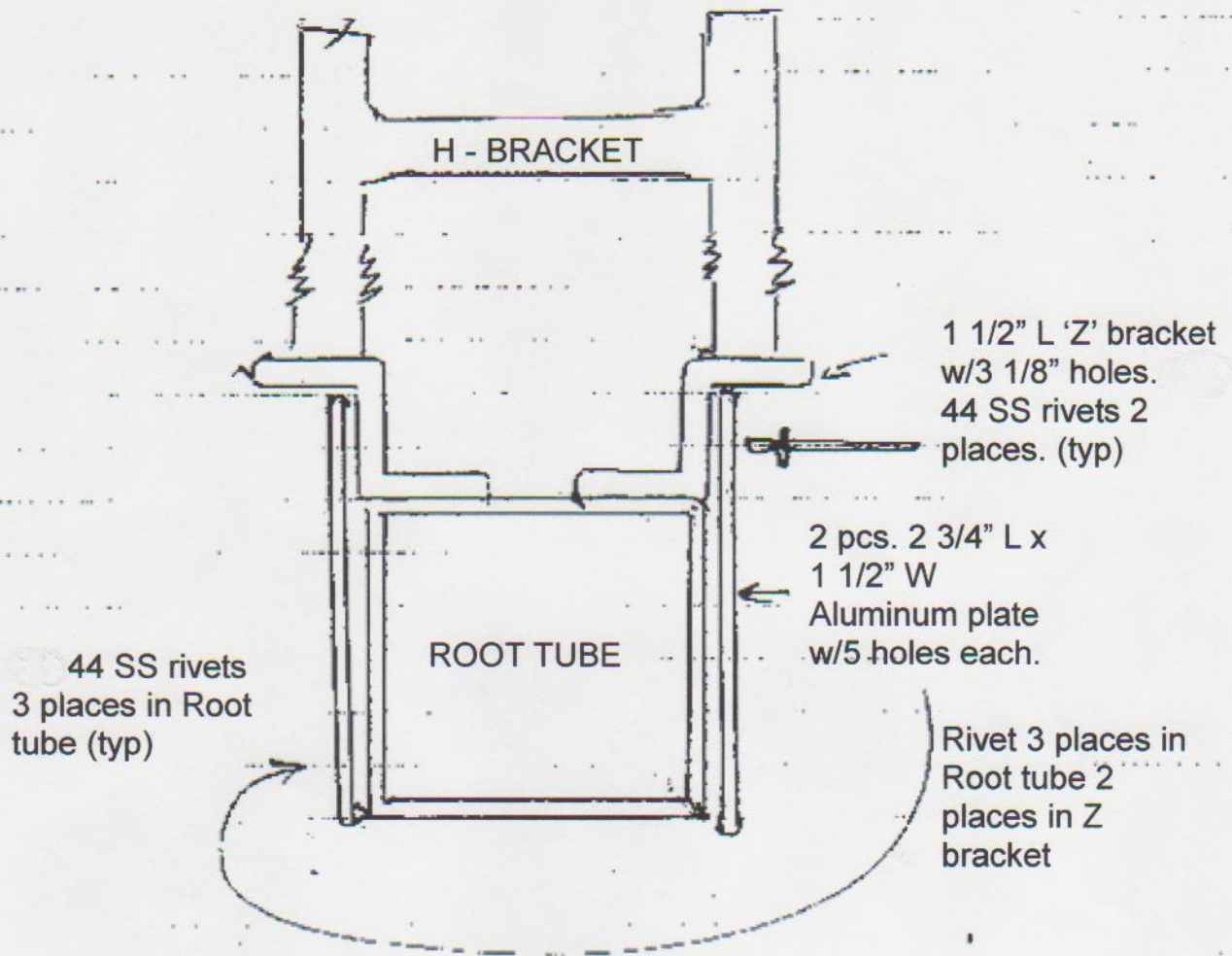
13" Long "Z" Bracket.

Washer & Washer

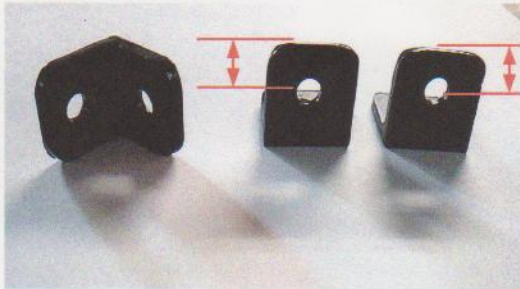
"Z" Bracket.

THIS IS THE MEASUREMENT FOR A CHALLENGER - YOUR PLANE MAY BE DIFFERENT



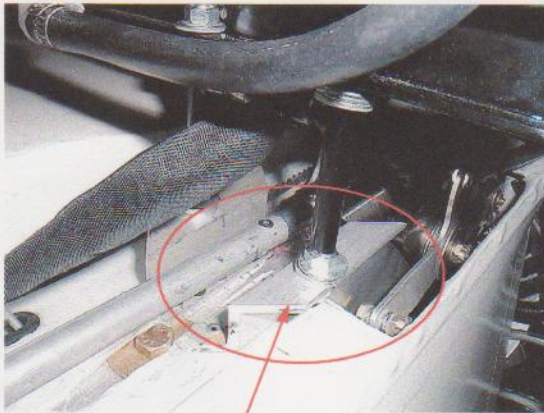
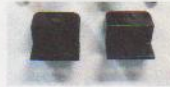


By flipping the L- bracket from one hole to the other will allow for some adjustment. Start by using hole furthest out on L bracket to bolt thru to motor mount bracket.

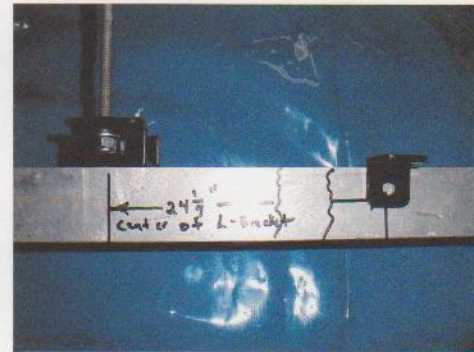


Bolt this side of the L-bracket with the shortest distance here, to the motor mount

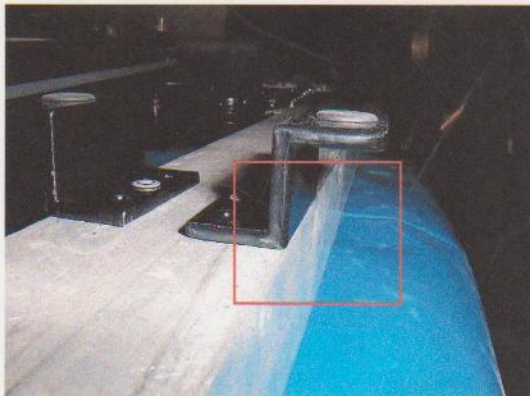
Mount front Z-bracket 24 1/4" center to center using the L-bracket as reference.



Note: your Z-bracket will be black and not cut on an angle as depicted here.

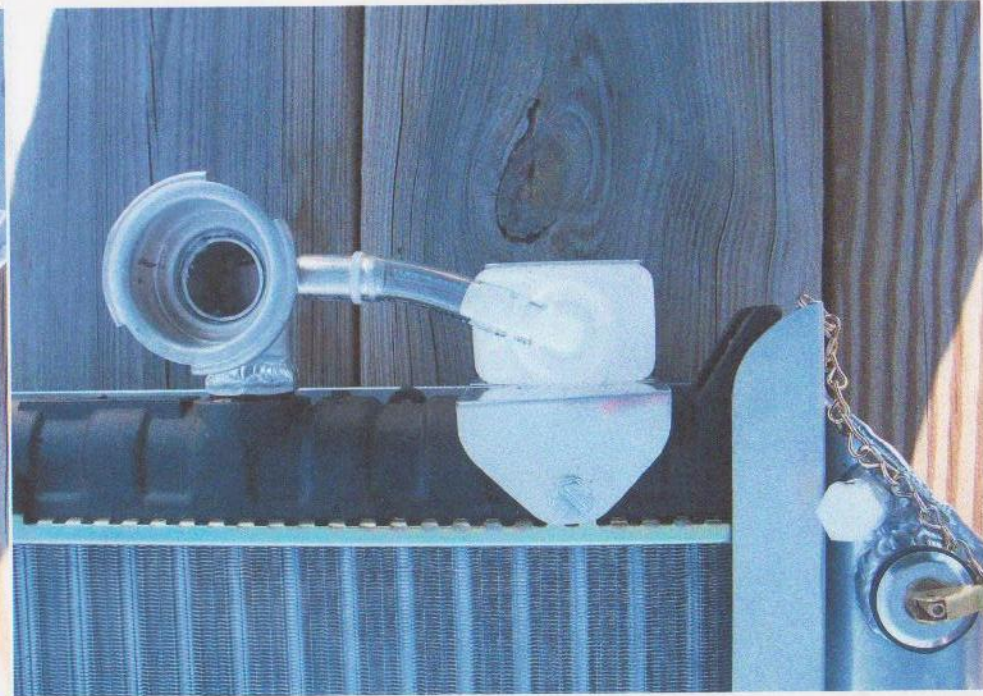
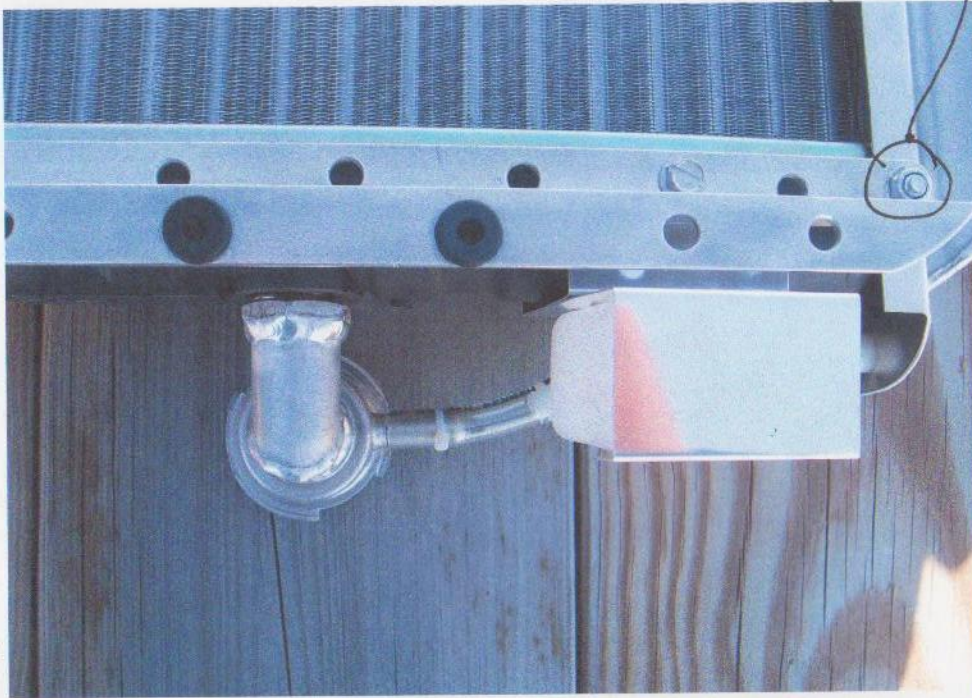


FOR CHALLENGER INSTALLATION
 This picture is an illustration only. Not actual size.
 THIS IS FOR MEASUREMENT OF ANGLE BRACKETS AFTER "Z" BRACKETS ALL INSTALLED



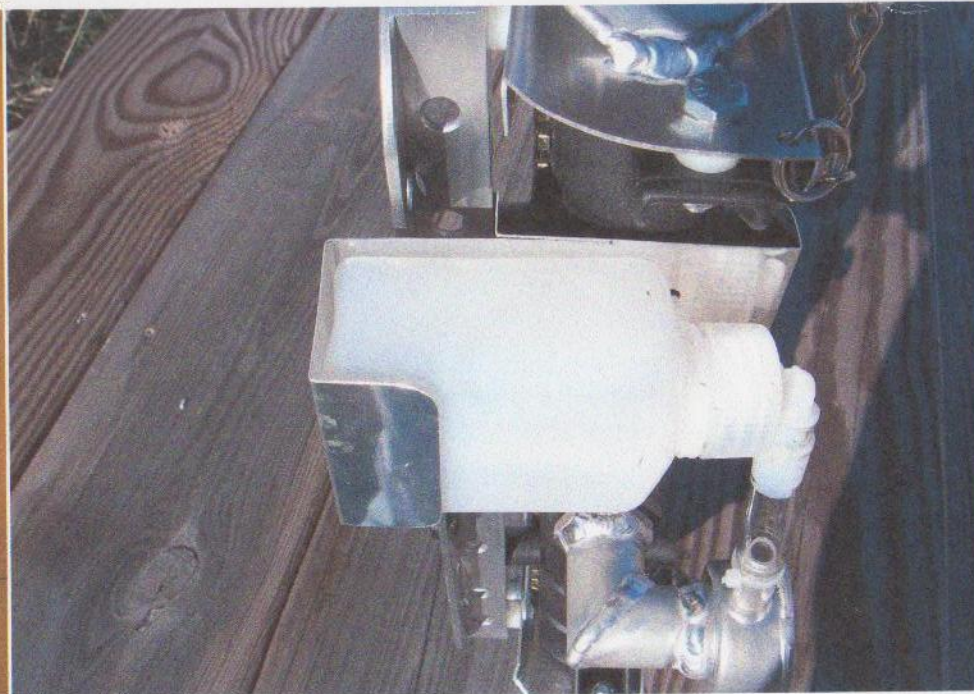
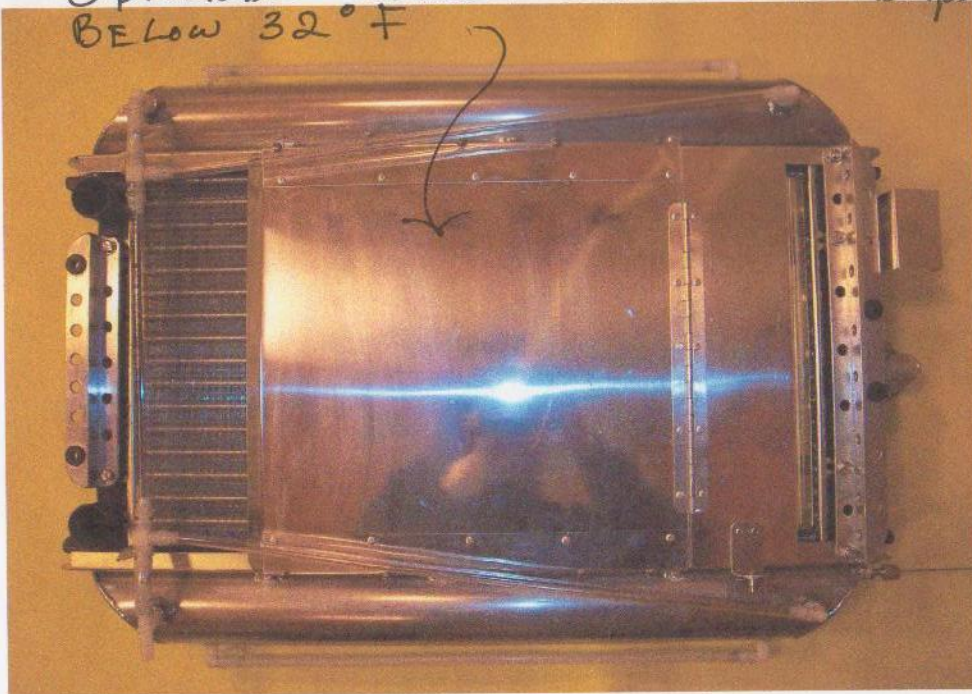
It is important when mounting the Z-bracket that the outside edge is flush with the Keel tube, also that they are square. Use 1/8" SS rivets.

mount this Bolt FIRST BEFORE ATTACHING to RAD. SIDES



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OPTIONAL Bottom Louver FOR TEMPS BELOW 32° F



INSTALL these BOLT'S FIRST



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Rear angle



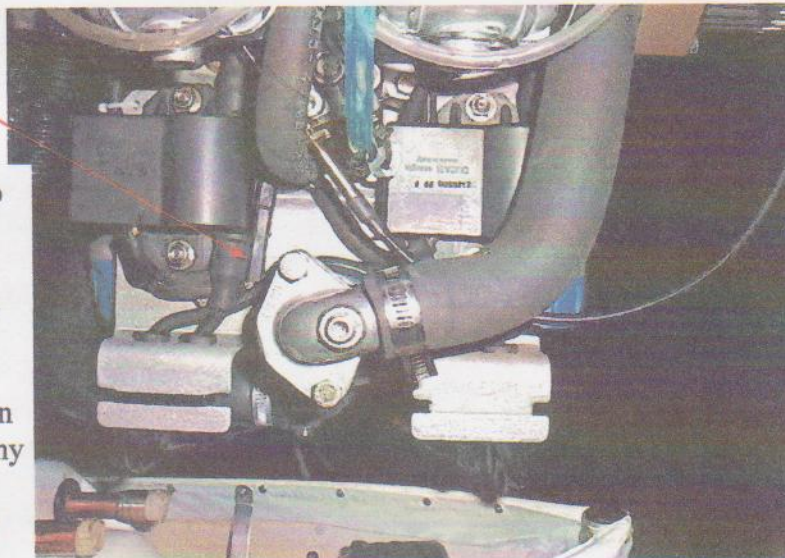
WHEN NOT INSTALLING HEATER

Portside Radiator Hose Assembly



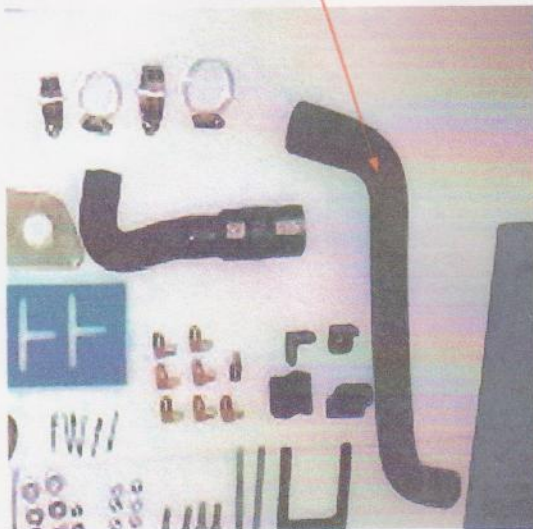
Portside transition flange

Begin assembly of radiator hoses installing the portside transition flange. **Caution:** When disassembling the bent outlet socket, observe position of the thermostat. Reinstall the thermostat in the same position it was originally installed.

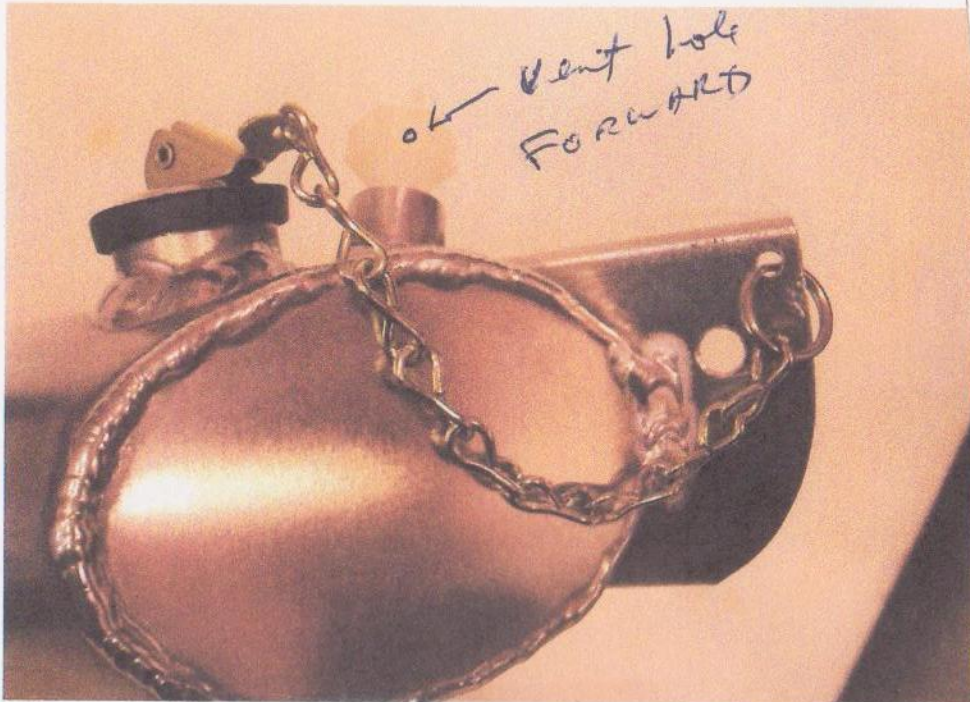


Use the transition flange to change the position of the bent outlet socket. **Note:** You may need to cut holes in the gaskets provided. Permatex 300 recommended. If you use silicon be careful not to allow any to dislodge inside of the flange—may result in thermostat malfunction.

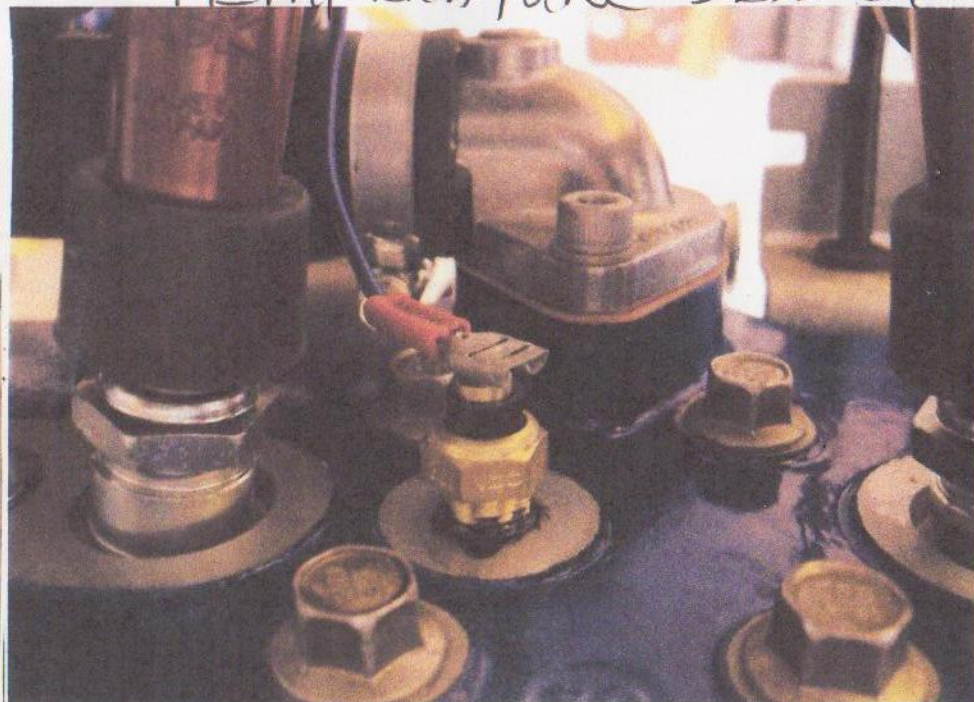
Install portside radiator hose. Connect upper 1 1/4" end of the hose to radiator, secure with hose clamp. The hose should protrude to the back. You will have to bend hose, against the formed arc, straightening the curve. Connect to the bent outlet socket using hose clamp. When installed, the hose should bow slightly back. This is intentional.



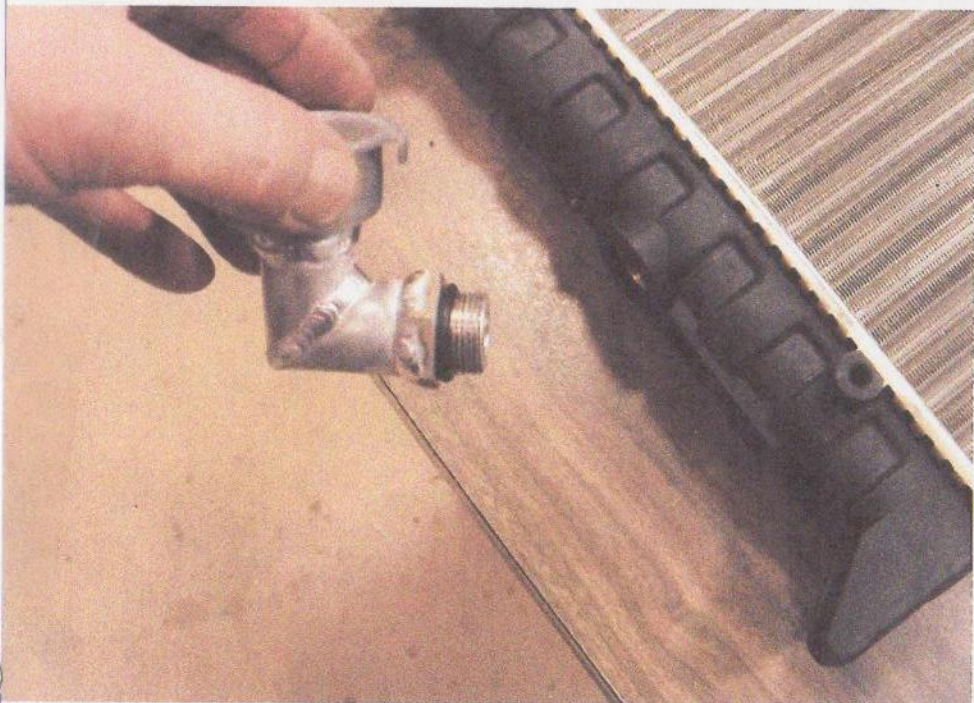
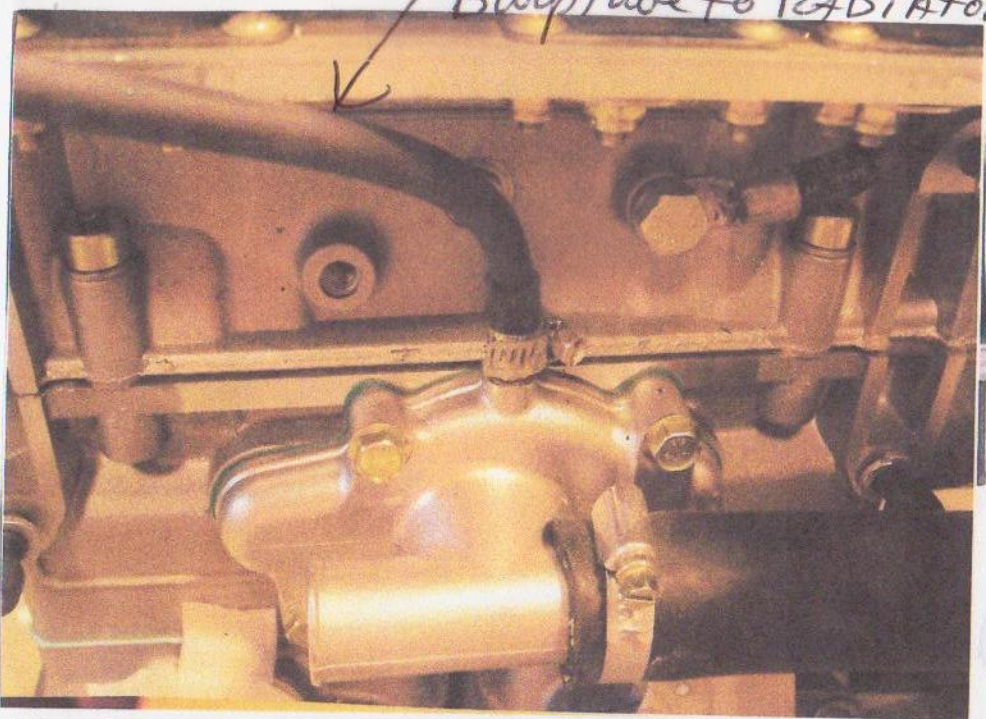
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TEMPERATURE SENDER

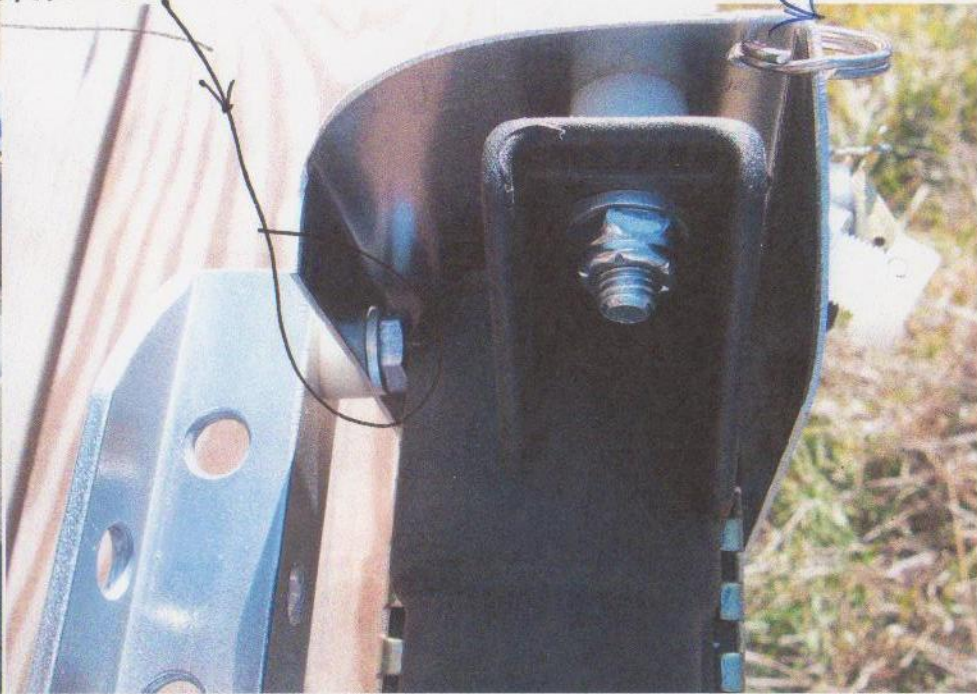
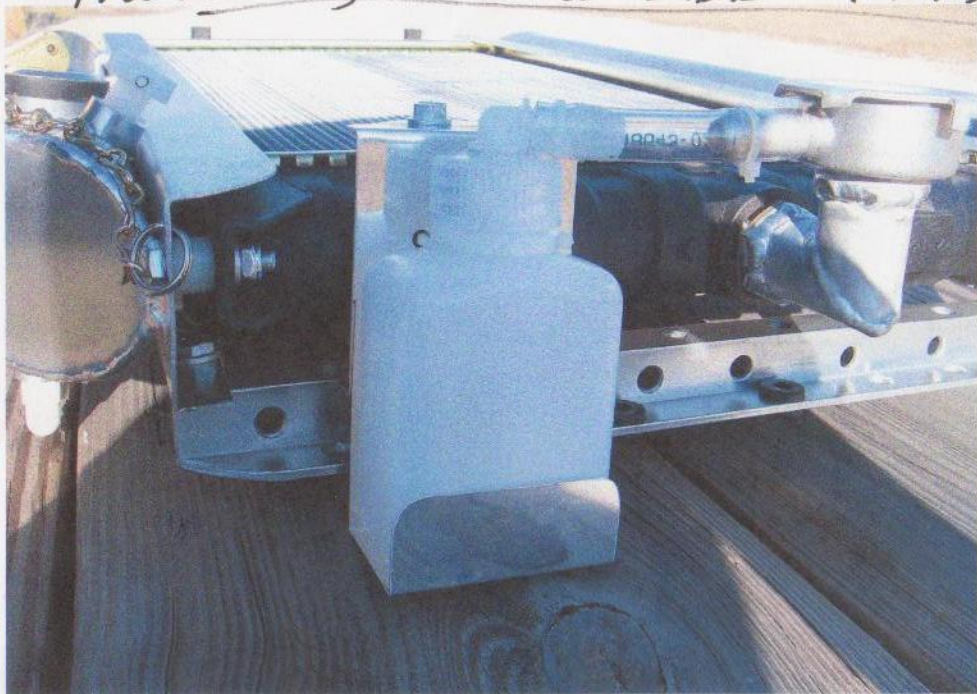


Burptube to RADIATOR



INSERT THIS BOLT FIRST BEFORE
MOUNTING RAILS TO SIDE OF RADIATOR

SPLIT RINGS

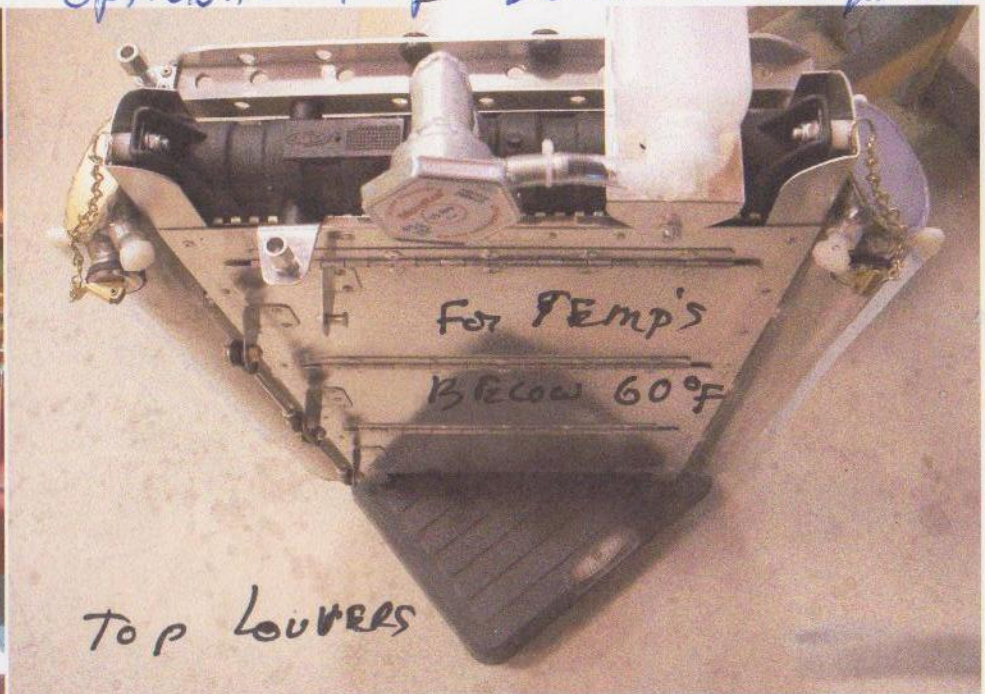


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INSERT
THIS BOLT FIRST

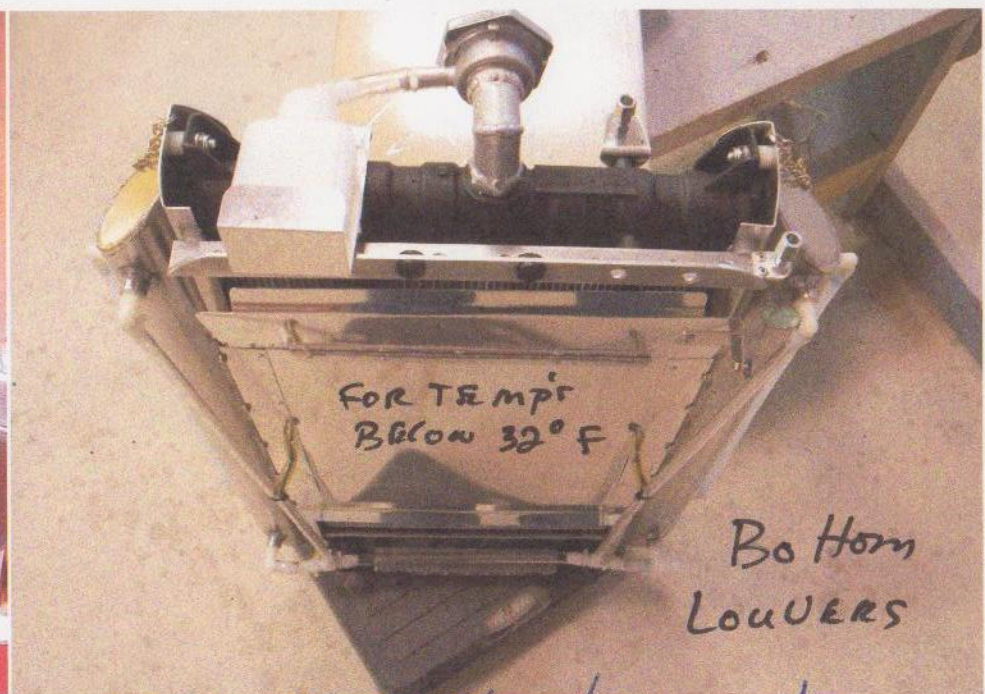


OPTIONAL Top Louvers for temp to 32°



TOP LOUVERS

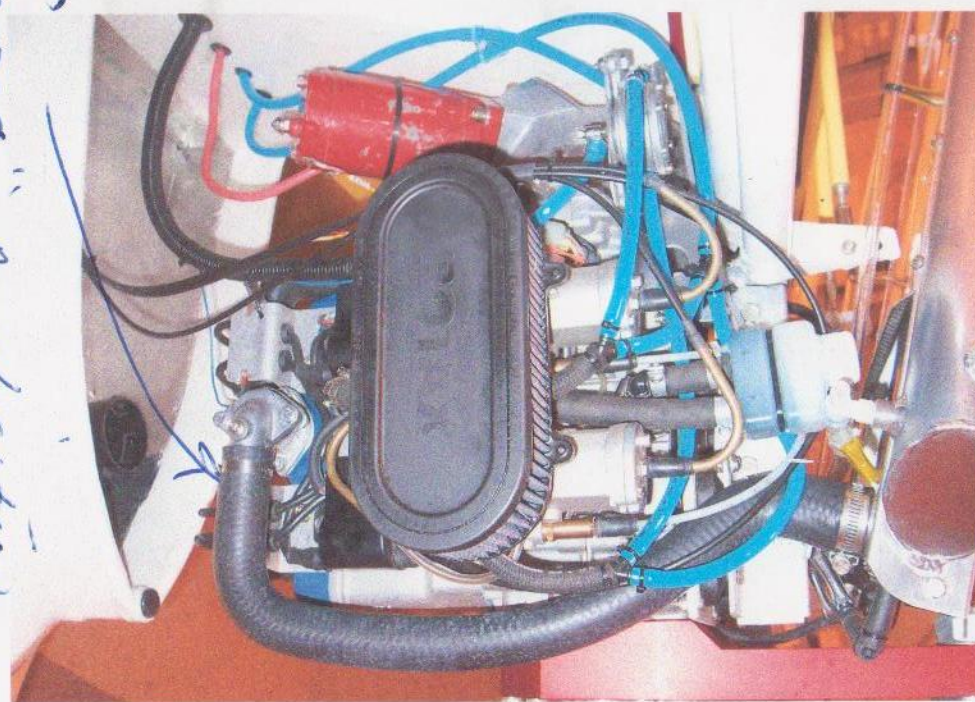
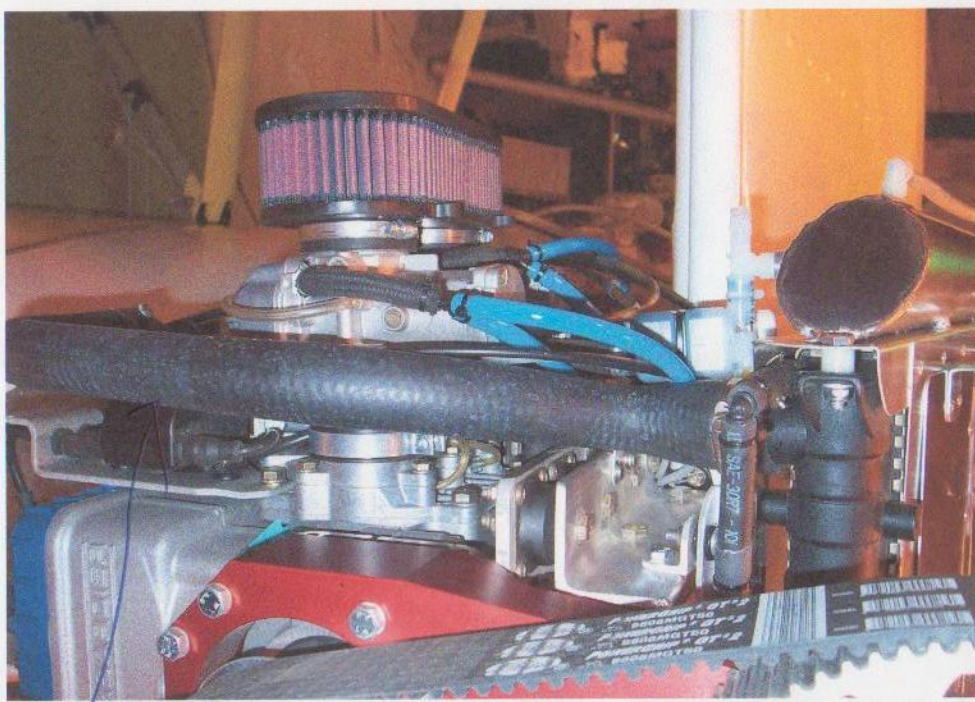
FOR TEMP'S
BELOW 32° F



BOTTOM
LOUVERS

OPTIONAL Bottom Louvers for
32° - ZERO and below temps

THIS HOSE FOR "NO HEATER" APPLICATION
NOT NEEDED IF USING HEATER Page 24



1. Screw elbow into 1/8" N.P.T. tapped hole tight.
2. Face barbs toward each other.
3. Swipe oil over barbed end.



4. Warm end of opaque line to soften material and slide fully onto barb.
5. Note, curvature of hose against oil tank.

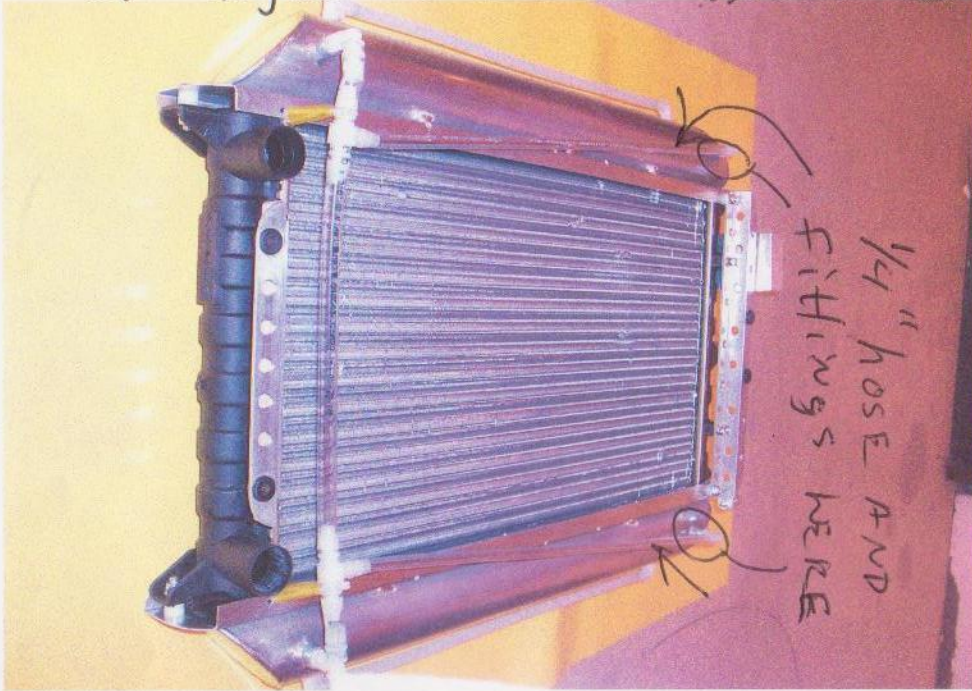


6. Lay hose against tank, measure exact length.
 7. Cut with razor.
 8. Oil barb; warm hose end and slide hose on barb.
- Keep line tight between elbows.**

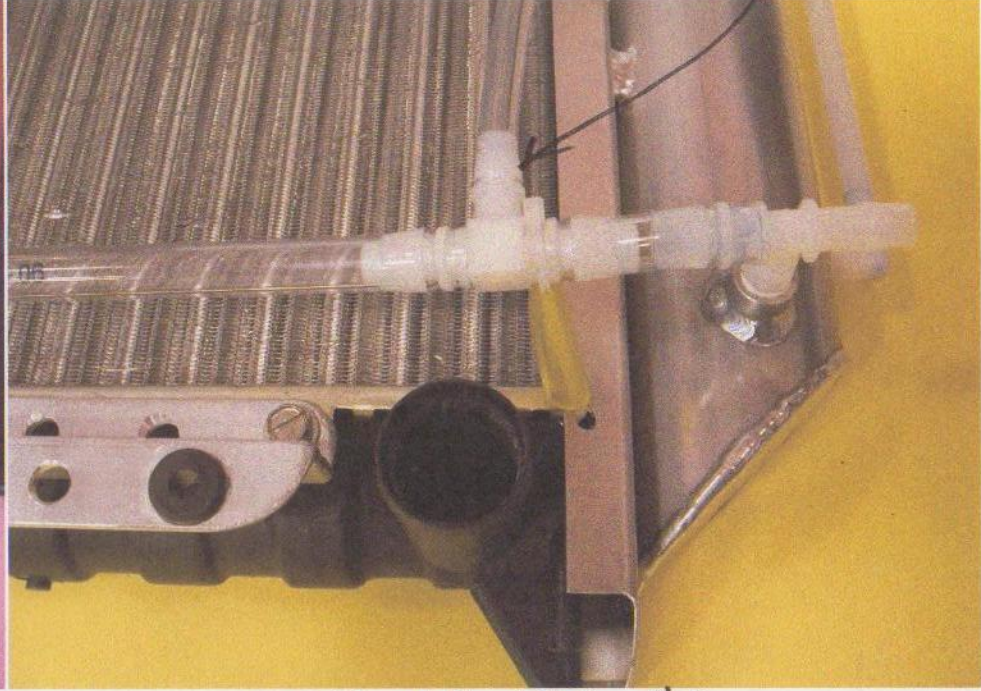


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OIL INJECTION TANKS INSTALLED



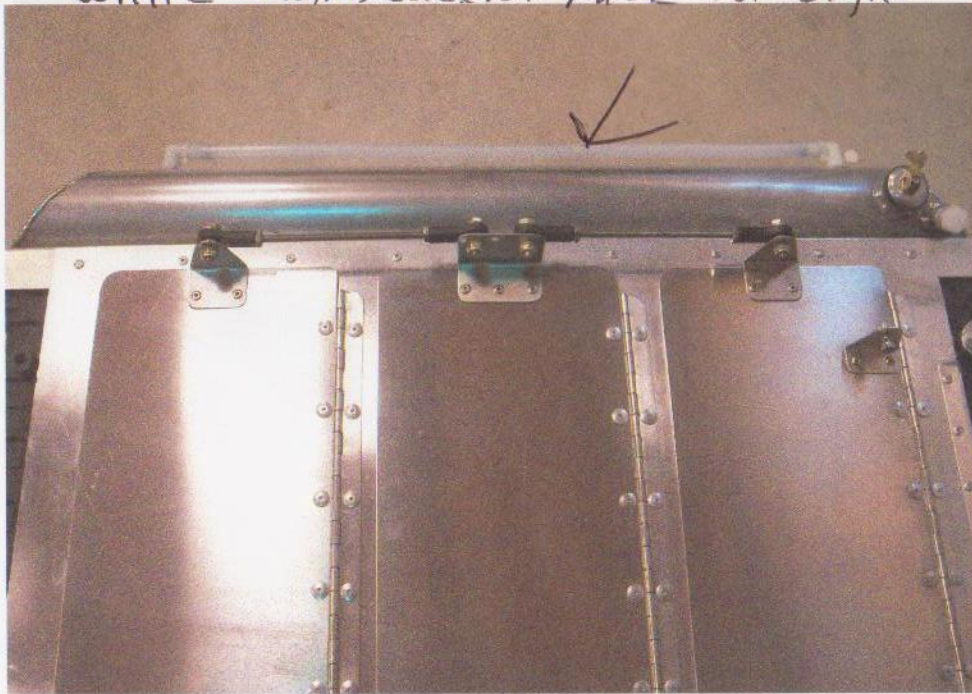
3/8" X 3/8" X 1/4" "TEE";



1/4" HOSE AND FITTINGS WERE

1/4" I.D. OIL HOSE

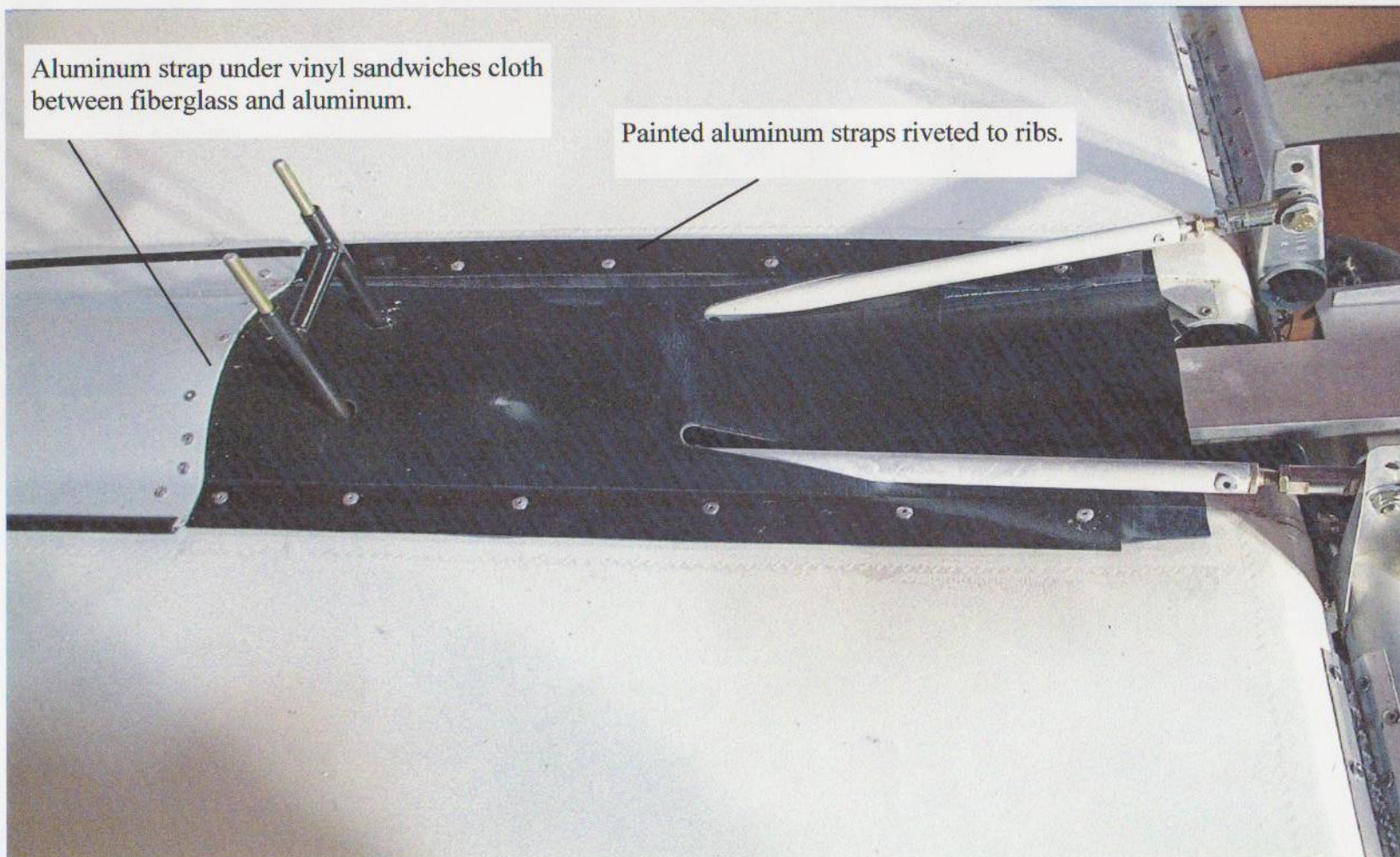
WHITE TRANSLUCENT TUBE FOR SIGHT



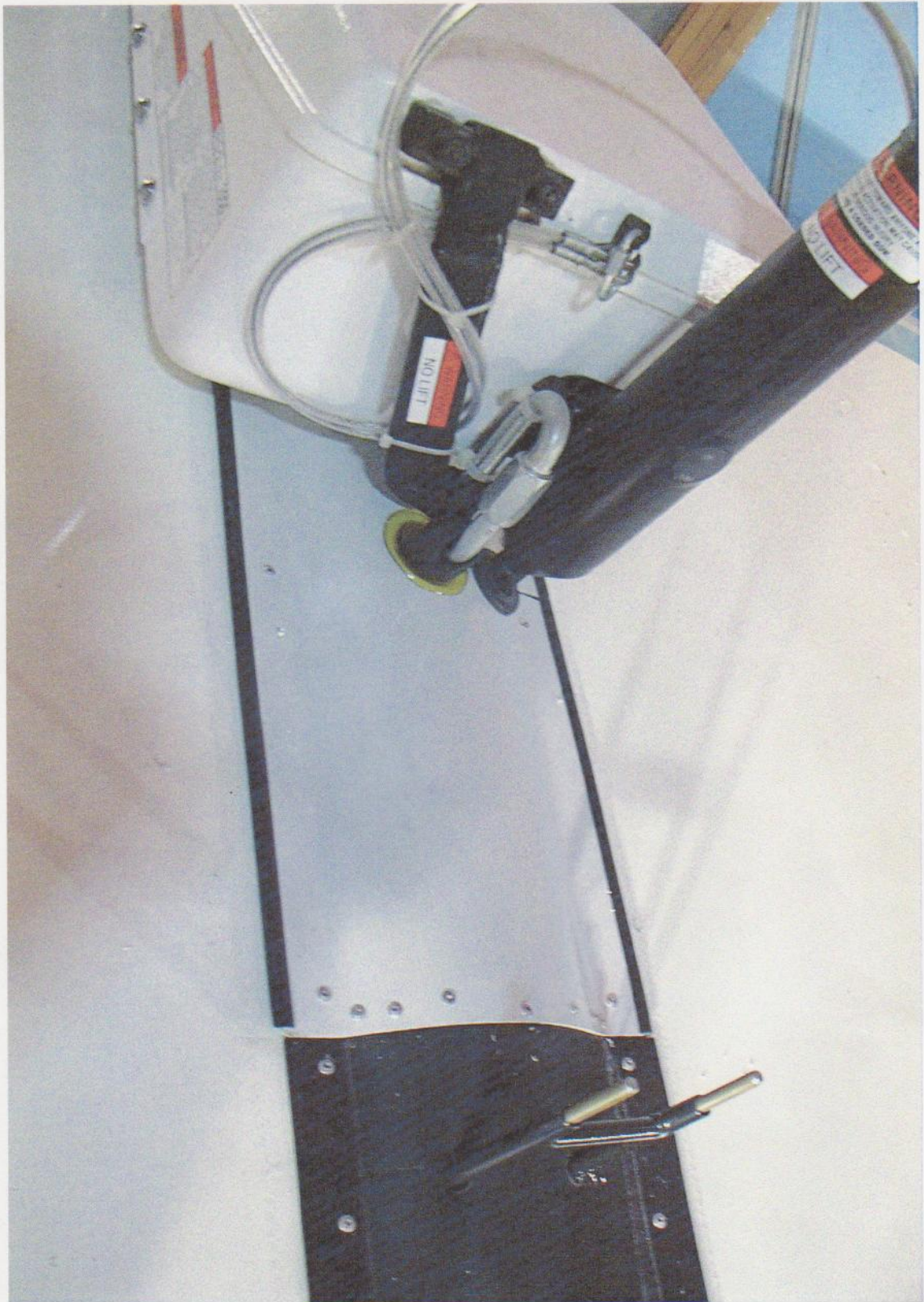
WHITE (TRANSLUCENT) HOSE FOR SIGHT TUBE.



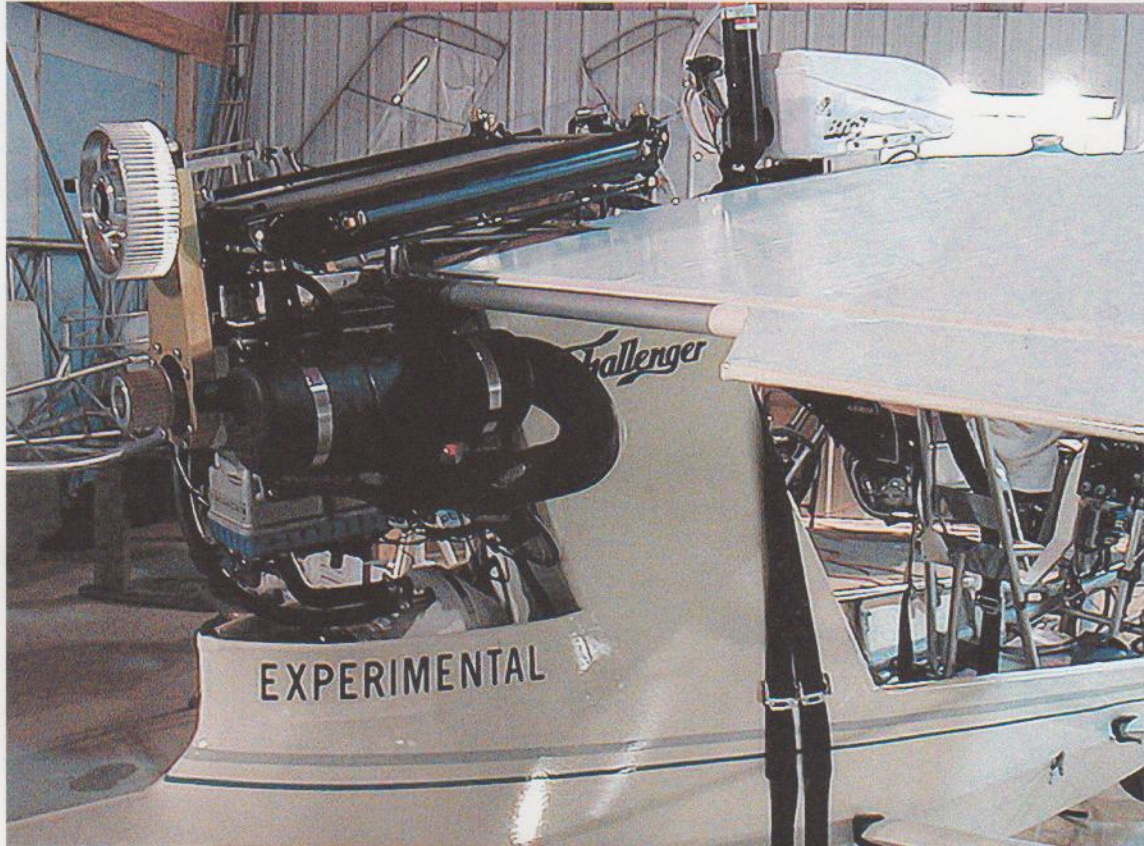
Suggested Vinyl Wing Gap Cover under Radiator



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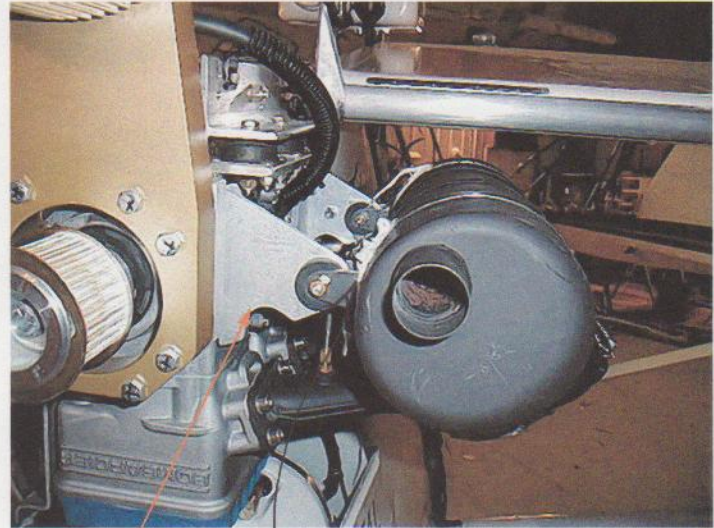
Final Assembly



Muffler Mount Assembly



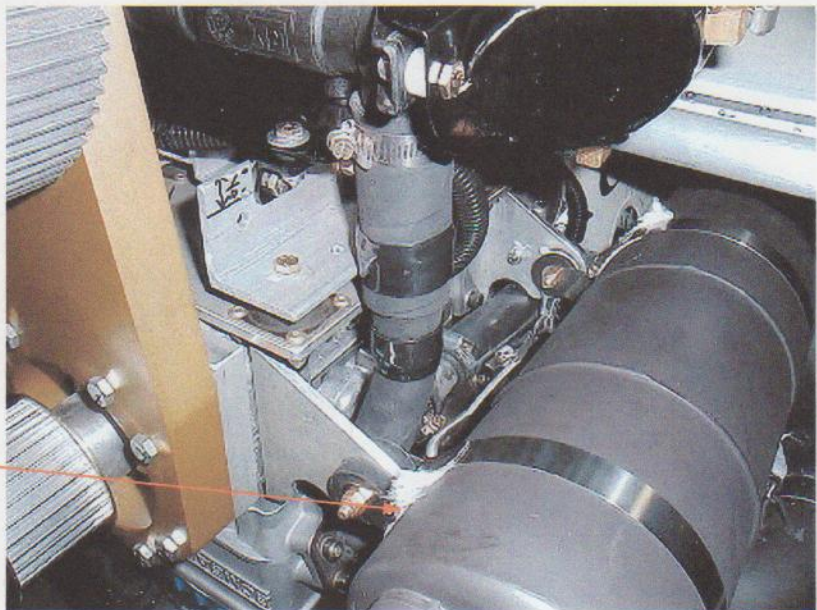
The following pictures depict the muffler mount assembly included with your kit. They are mostly self explanatory.



use abrasion belts

The mounting brackets face each other with the cutout down. Attach mounts with bolts and lock washers.

Remove bolts and rubber dampeners from U clamps. Install the U-clamps over the muffler clamps before sliding them over the muffler. (the clamps should be installed with tightener down.) Finish assembly by installing U-clamp to mounting bracket using rubber dampeners and hardware. Before tightening clamps install insulation under clamp. Tighten clamp to the point that you see the muffler start to bend in. (Do not over tighten inspect during pre-flight) **Note:** Be sure that the clamps wear shipped with split lock self locking nuts. Not ny-lock.



Care of Actuation Cables, Part I

Some sort of cable or pushrod actuates most everything on our flying machines. Some ultralights or certified aircraft use the Teleflex® cable system which accomplishes its action by both pulling and pushing. They are heavier than a conventional cable system but they are quite reliable and generally don't require pulleys. This month I'll discuss cables that pull only, and how we may make them more reliable.

Most throttle systems use a pulling cable against a return spring in the carburetor. With this system the cable pulls the

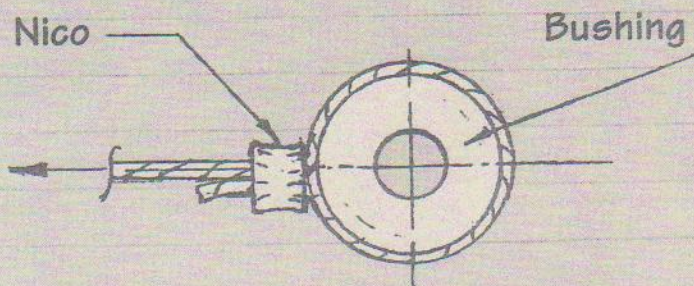


Figure - 1

throttle open and should the cable fail the throttle will go to idle. I have witnessed or read of many throttle cable failures. My flying buddy, Larry, had his throttle cable fail one day when he was getting prepared to join a group going to a nearby fly-in.

What a jolt that was when Larry realized what could have happened had it failed in flight. He was flying an S-9 Chaos, which has a fairly high wing loading and a high sink rate. The

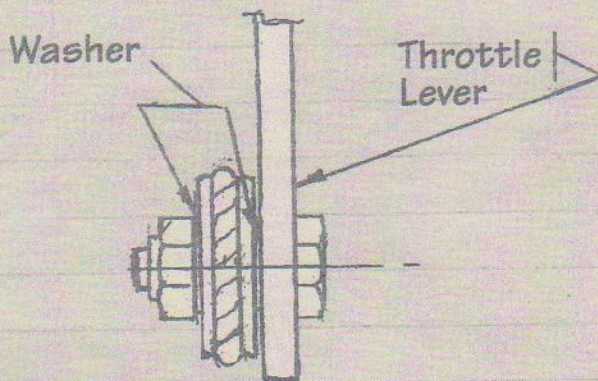


Figure - 2

cable was held to the throttle lever by a setscrew that caused the cable to flex next to the setscrew whenever the throttle was actuated. The cable was 1/16-inch, 1x19 stainless steel, which is very flexible. The flexing, in this case, actually resulted in kinking, which caused the cable to fatigue and fail. Bear in mind that when a material is caused to yield each time it is bent, that material will fail quickly.

Larry was so upset he wanted to go to the next larger cable. I assured him that the rated strength for the 1/16-inch cable was 480 pounds so it was stronger than he could impart to the cable by the throttle lever. Rated strength indicates the maximum load to which the cable can be subjected in its application with a margin of safety. Most cable failures occur at a defective termination and we can solve that problem.

To correct the problem I took a small pulley-like fitting called a cable bushing* and brought the cable around its groove. The cable loop was swaged with a nicopress oval sleeve, per Figure 1. The cable bushing has a 3/16-inch hole in it that allows a 10NF32AN bolt to pass through. By the use of washers and a Nyloc® nut the cable can be connected to the throttle lever with just enough freedom to allow the cable bushing to rotate (see Figure 2). When the throttle is actuated, the cable is now able to rotate around the bolt without kinking.

Larry and I visited another S-9 owner and described the throttle cable failure and how we fixed the problem. We examined his throttle connection and found the same problem developing and warned him what was going to happen, but he waved away our comments. The S-9 was subsequently sold and some time later the cable failed in flight which resulted in a forced landing in very rough country, destroying the machine. This reminds me of an old Chinese proverb: "Some would rather guess at much than to take time to learn a little."

The carburetor end of the cable also needs attention, although this was not part of the problem Larry had. On a carburetor with a carburetor piston, such as the Bing or Mikuni, the cable needs a cable stop to connect to the carburetor piston. In addition to swaging the cable stop, I recommend that a short length of cable be allowed to extend out of the stop about 1/32 of an inch and be splayed out after swaging. Next, using a soldering flux that will allow soldering to stainless steel, apply one drop of flux to the end of the cable. Then, using a soldering iron apply heat to the cable stop and apply soft solder to the splayed end of the cable until the solder melts and flows into the stop until it is barely visible on the cable side of the stop (see Figure 3).

By using this method properly, the strength of the cable-to-

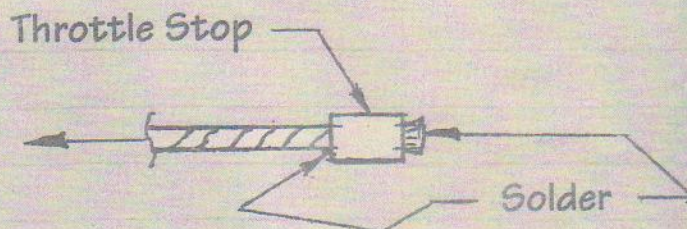


Figure - 3

stop junction will be greater than the cable and the cable will not have been degraded by excessive heating from silver brazing. I mention this because some mechanics make it a practice of silver brazing a blob on the end of the cable to function as a cable stop. The temperature used in the silver brazing process discolors the cable and may cause its strength to be degraded. In looking at the way the cable stop is fastened onto the cable per Figure 3 and evaluating the source of its strength, it becomes apparent that in order for the cable stop to fail the solder within the cable stop must shear over a fairly large area. Remember, stress is force divided by area. In addition, the solder on the splayed end has to pull through the cable stop before failure can occur.

In my early days working as a commercial fisherman to get money for college, I was made aware of how a cable for the mast rigging was fastened to the clevis. The cable was one inch in diameter and swaging, at that time, was not available to the rigger. The cable was passed through the hole in the clevis and splayed out. Then molten lead or solder was poured into the clevis where the cable was splayed out. A cavity was provided there where the solder could form a pool. The cable never ever pulled through the clevis and I have seen cables so tight they appeared to be stretching. That is proof enough for me.

More about this subject next month. ♪

ARNOLD C. ANDERSON has been flying ultralights since 1982, logging more than 300 hours in his Kasperwing. After 37 years in the engine and aerospace industry as a mechanical engineer, designing electro-mechanical equipment and solving reliability problems in equipment for unmanned deep space missions, Arnold is now retired. He lives in Bellevue, Washington, where he pursues his hobbies, including aerial photography and flying RC airplanes and gliders.

*LEAF part number 15-271

HOW & WHY OF COOLANT TEMPERATURE GAUGES

The majority of the ROTAX engines in use today are air cooled engines. The new kid on the block, since 1984, is the liquid cooled engine, such as the UL, 582 Mod.90/99. These engines use a 50/50 mixture of Dexcool (antifreeze) and distilled water. DO NOT use tap water or garden hose water. The chemicals in tap water will cause corrosion of the internal metal parts. In addition, it will leave a deposit that can eventually inhibit the transfer of heat from the metal to the water jacket. Even though these engines offer an improved temperature control over the operating range, it also requires an instrument to monitor the temperature of the liquid in the cylinder head and radiator circuit.

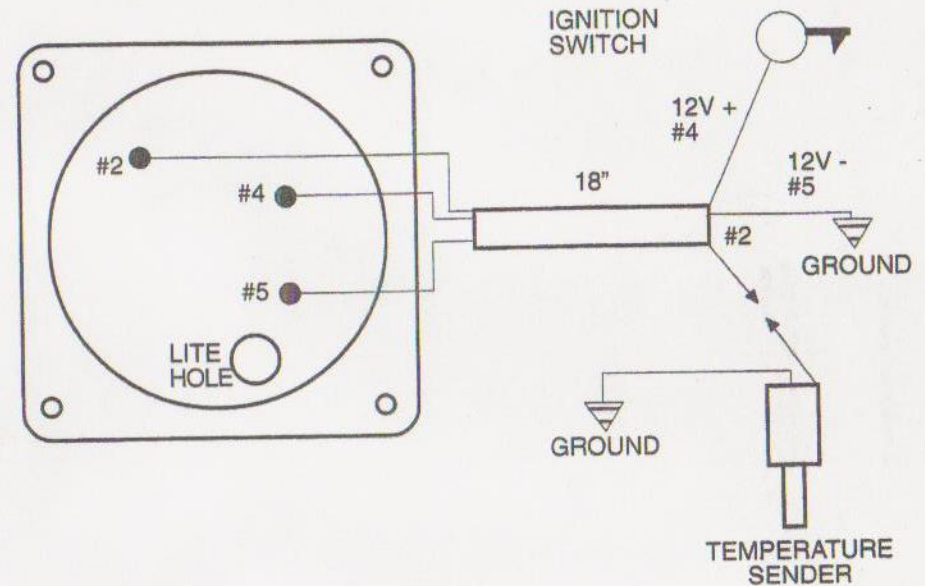
The Water Temperature Gauges accurately measure the temperature of the coolant, so as to prevent serious internal problems. The gauges use a thermistor -- a resistor that varies its resistance according to the temperature of the coolant -- that is attached to an external power supply. This provides the necessary 6 to 12 volts required to operate the gauge. The water temperature range should be between 140°F (60°C) and 176°F (80°C) with the maximum being 203°F (95°C). Low water level will indicate a low water temperature.

To install the Water Temperature Gauge and sender, connect the wire from pin #4 of the gauge to the ignition switch or other 12V positive area. The wire from pin #5 is grounded to a 12V negative ground. Take one of the wires from the sender and connect it to the wire from pin #2 of the gauge. The other wire of the sender is grounded. Since the sender has no polarity it does not matter which sender wire is attached where.

Be sure to route all wires away from the hot manifold and other pipes. Tie the wires to other wires bundles, if they are available, and support the wires at 12" to 15" intervals. When going through metal, use rubber grommets to prevent the metal from tearing the wire's insulation.

Once installed, if the needle pegs right, the gauge is not grounded properly or the temperature sender has been shorted out. If the needle pegs left, the sender has not been grounded properly. If there is no needle movement, there is no power to the gauge.

If you are not using a battery in your electrical system, this instrument can be powered by either G4155 Low Power Adapter or G 4158 Mag Adapter.



TO BREAK ENGINE IN:

1. Start and let idle at approximately 2,200 to 2,400 RPM for 2 minutes. Shut engine off. Let cool for 30 minutes. Shake engine and squeeze radiator hoses to eliminate all air bubbles in system... Repeat this procedure 3 times. Make sure all air is out of system, and add coolant if necessary.
REMEMBER: USE ONLY DEX-COOL COOLANT IS FACTORY RECOMMENDED AND DISTILLED WATER FOR ALUMINUM ENGINES! (DEX-COOL IS DIFFERENT THAN THE NORMAL ANTI-FREEZE/COOLANT).
2. After the initial 2 minute warm-ups and coolant check, break in the engine to Rotax specifications. If, when breaking in the engine, any of your E.G.T. or coolant temperatures exceed the recommended temperatures, shut the engine down to cool, and resume the break-in procedure where you left off. If, in the course of flying, you experience water temperatures above 195 degrees, attach a reverse mounted air scoop on the radiator with the opening toward the prop. Air comes from under the radiator and out the top. To keep the top of the radiator protected, you may want to install a light weight screening material. Do not raise the radiator for additional cooling. It doesn't help. Utilize the air scoop.

For maximum efficiency, the coolant temperatures should be between 140-180 degrees Fahrenheit.

RECIPES

by Harry & Pat Whiting

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LEAKING ROTARY VALVE SEALS

OLD BEFORE BLUE HEAD

We have been concerned about the Rotax rotary valves and leaking seals for some time. The repair costs, whether Rotax parts or the aftermarket replacement unit, are considerable, but there may now be a new solution, literally, available to all of us.

I was reading Mike Stramari's article in the June 2002 issue of *Ultralight Flying* magazine when something he said clicked with other thoughts I have had bouncing around inside my head. Mike's excellent article covered the replacement of the rotary seals using Rotax parts and tools, and an explanation of the aftermarket rotary valve replacement unit (which, by the way, we have flown for more than 100 hours with no leaks developing). Mike's last paragraph mentioned the use of Dex-Cool antifreeze products, and this was the catalyst, in my case, to do some checking.

The day after I read the article, John Watson, a master mechanic, and I were discussing changing the water pump on a rather exotic auto engine on which we were changing the timing belt. Changing the timing belts on cars today necessitates quite a disassembly, and it made sense to change the water pump now, too, and save more maintenance later. John remarked that if everyone would switch to "this new family of antifreeze products," they would save themselves a lot of grief. He was referring to Dex-Cool.

John said the big advantage of Dex-Cool is the absence of any silicone compound in the solution. Apparently, after varying times and temperatures the silicone begins to be abrasive to seals and shafts, and the solution should be replaced before this happens...but predicting when

that will happen is difficult because of varying patterns of use of the equipment involved. John mentioned that Honda, Toyota, and other foreign automotive manufacturers went to Dex-Cool around 1978, and that General Motors started using it about five years ago.


My thoughts immediately went to the Rotax liquid-cooled engines. Even though the new blue head Rotax 582 engine has different seals, it sure wouldn't hurt to use this new technology product even in the new 582s. Now, our air-cooled Rotax engine friends are snickering, but just think of the cost and engine work we could save—not only on our water-cooled Rotax aircraft engines, but also on our cars, trucks, motorcycles...anything with a radiator and a water pump.

Dex-Cool's original trade name was Ambitrol, and it was first used in critical function heavy-duty industrial water-cooled engines like offshore oil rigs. When Dex-Cool was first introduced, it cost \$20 per gallon, but now Wal-Mart and Kmart sell Havoline Dex-Cool at \$5.95 per gallon, which is only about \$1 more than the green antifreeze solutions. It takes about 2 gallons of antifreeze and 2 gallons of distilled water to change the radiator in the average luxury-size car, but really very little to fill our aircraft engines (and, don't forget the four-cycle engines either).

This compound is red, and is not to be mixed with the yellow-green antifreeze solutions that most of us are using. You must drain your cooling system completely before introducing Dex-Cool. Prestone has a cooling system fitting that fits on the hose and flushes the entire cooling system. It costs about \$3 (see photo).

I know you've heard this before, but be sure to take your old antifreeze solution to a recycle garage or some safe place to discard it. The solution tastes sweet, and it will poison children or animals if they drink it...and they will!

Emptying your cooling system takes only a few minutes, and then you'll be ready to refill, but be sure to use distilled water, not tap water or mineral water. All grocery stores carry distilled water. Mix it to a 50/50 solution with the antifreeze and fill your radiator.

When you finish making the switch, you'll be able to fly and drive with a little less worry. 



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Radiator with Louvres

