Helicycle N750G Lube Oil System

INTRODUCTION

Saturday 21 January 2012 -- The original Solar T62T-32 engine used a wet sump where the engine lubricating oil was stored inside the engine in the turbine and accessory drive sumps. The Helicycle uses an external oil tank and two scavenge pumps to remove oil from the sumps and return it to the tank. This works well, but needs improvement. Blake Estes at Eagle R&D explains:

"Too much oil in the gearbox causes excessive pressure, friction and heat. If your pump only makes 30 psi or less this means that you probably don't have the problem. If it makes more than this the problem is seen in excessive heat or increasing heat on the oil as you operate. The oil pressure and temp should be stable and give you the pilot a sense of security.

There is a small dump valve in the planetary gear set that is internal and can't be seen without engine disassembly. Its purpose is to relieve the pump if necessary and dump/ bypass excess oil inside the gearbox. This was a perfect solution to the original turbine gearbox which was a wet sump. If the dump valve dumped oil is simply splashed down into the bottom of the gearbox. In our application this is not appropriate since if it dumps is allows more oil into the gearbox than the scavenge pumps can handle. Therefore the oil builds up inside the gearbox and creates a lot of friction by being squeezed between the drive gears in the front of the gearbox. The first problems comes from the large amount of heat generated by this process and secondly by the fact that the turbulence in this area hinders the scavenge pumps even further which makes the problem even worse.

The solution is to install an external bypass/ regulating valve that regulates the pressure to less than 30psi. This external device bypasses all oil, above a certain pressure, back to the oil tank…"

MODIFICATIONS

Prior to modifying my lube oil system, my engine oil pressure ran at between 55 and 60 psi, jumped erratically, and the engine oil temperature slowly increased as the engine ran. That's a classic sign that my oil flow from the oil pump was overpowering the sump pumps. My original configuration also made it very difficult to change the filter. The filter housing was sitting on a small shelf which meant that I had to tear the ship half apart to get the filter out of the housing.

The answer was to regulate the oil pressure, return the excess oil back to the tank, and devised a completely different mounting scheme. Figure 1 and the pictures that follow show my final configuration.

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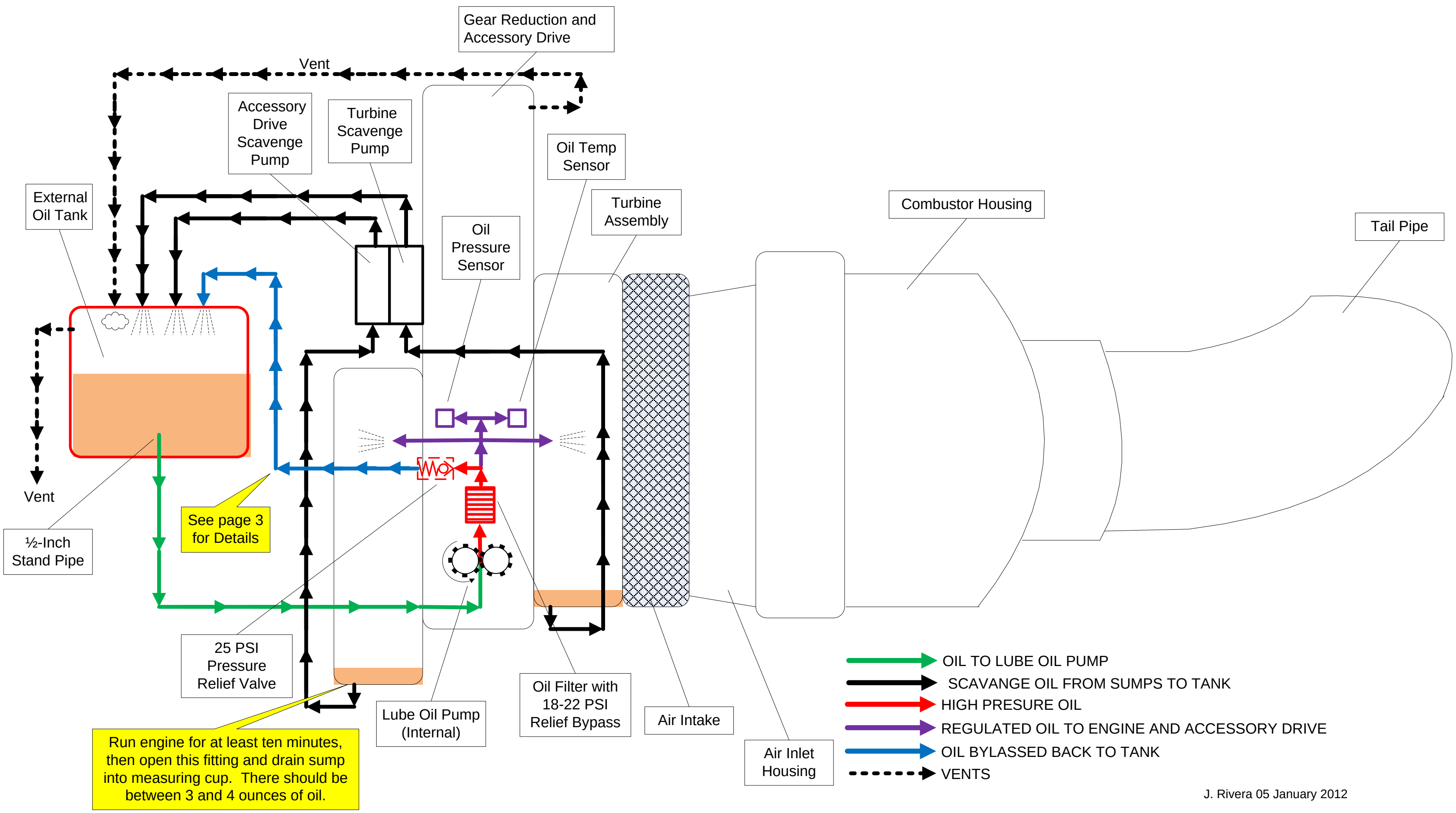
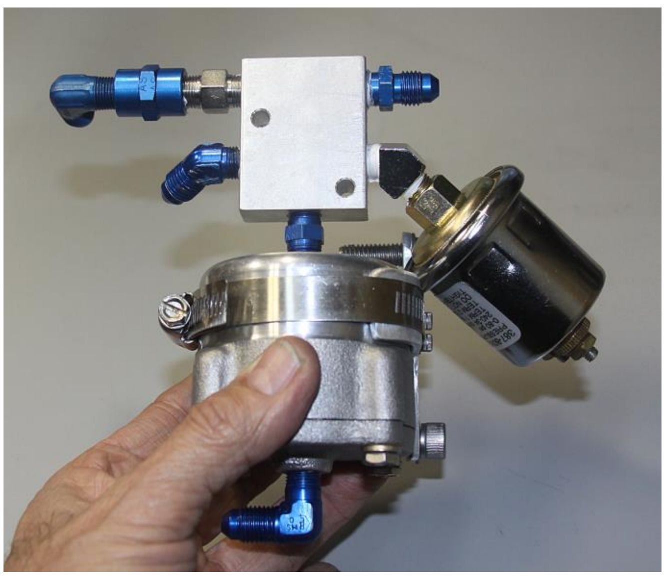


Figure 1 – Modified Engine Lube Oil System (Left Side of Engine

FILTER ASSEMBLY

After at least three unsatisfactory tries the pictures below show my latest, and I hope final design. Instead of the fuel filter sitting on a shelf, which blocks the bottom plate from being removed, I'm clamping it to a bracket that's attached to the gear case. Now I'll be able to pull the filter out from the bottom by simply removing the four AN-3 bolts that secure the bottom plate of the filter housing. In my haste to take these pictures I attached the bottom plate with the fitting pointing the wrong way. It really points to the right.

Here's how it works – high pressure oil is fed into the bottom of the filter housing and into the filter. Filtered oil exits out the top of the housing and into the manifold where it's distributed. Oil pressure is measured by the sensor attached to the 45 degree adapter at the lower right of the manifold. Filtered oil is fed to the engine and gear case by the two fittings at the lower left and upper right. The bright piece extending from the upper left port is the in-line 30 psi pressure relief valve that regulates oil pressure and returns excess oil back to the tank.



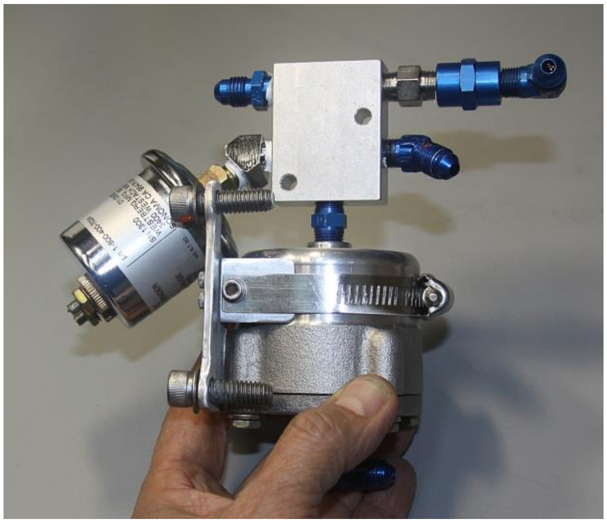
The lube oil filter assembly sits against the engine oriented as you see in this picture. There are several pieces involved in mounting this assembly to the gear case -- A plate that partially wraps around the filter and can be seen just under the pressure sensor, an aluminum wedge-shaped piece that is hidden from view, and a modified hose clamp which is cut into two pieces and attached to the plate and wedge at the back.

Here you can see the plate that's partially bent around the filter, one of the two cap-head screws that attach the assembly to the gear case, and one of the two 6-32 cap-head screws that attach one side of the hose clamp to the plate. These two screws also attach the wedge-shaped piece to the plate on the other side.

Notice that I had to angle the oil pressure sensor to make it fit without bumping into the filter or the plate.

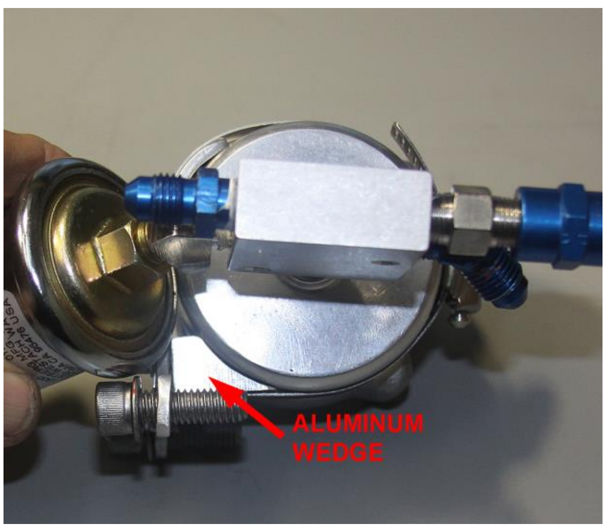
Here you can see both 5/16-18 cap-head mounting screws and the two smaller 6-32 screws that secure one side of the hose clamp. Notice that I had to very carefully cut material away from the right side of the plate to clear the gear case. A milling machine and a deburring machine are almost essential when making a complicated series of parts that all have to match.

The plate was fabricated from 0.125" 6061-T6 aluminum.

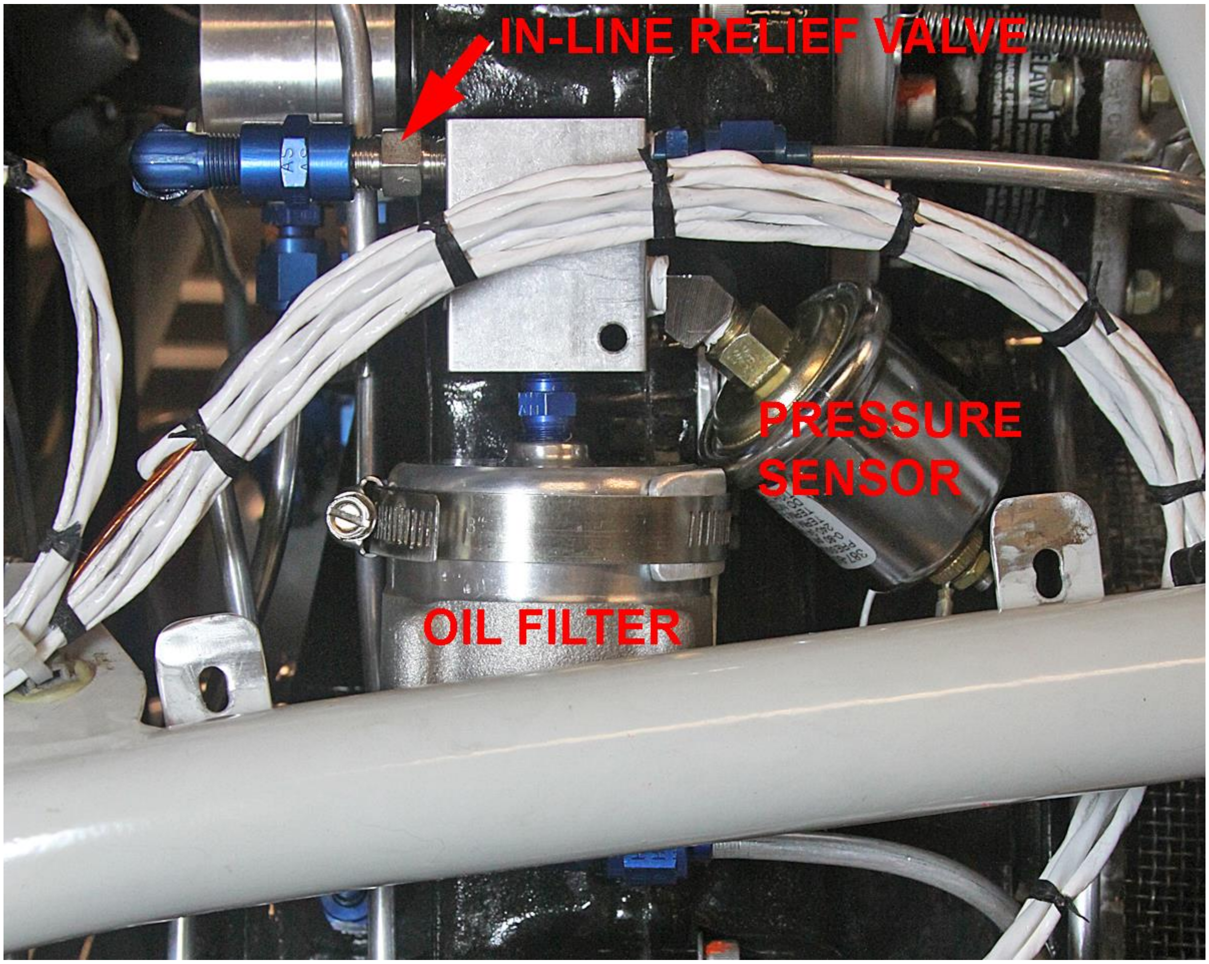


This is the side of the assembly that faces the gear case. Here you can see the back of the wedge-shaped piece and how the second half of the hose clamp is attached with an 8-32 cap-head screw. The hole for that screw is drilled between the two 6-32 screws coming in from the left. The spacing of these three holes is dictated by the width of the hose clamp and didn't leave any room to spare.

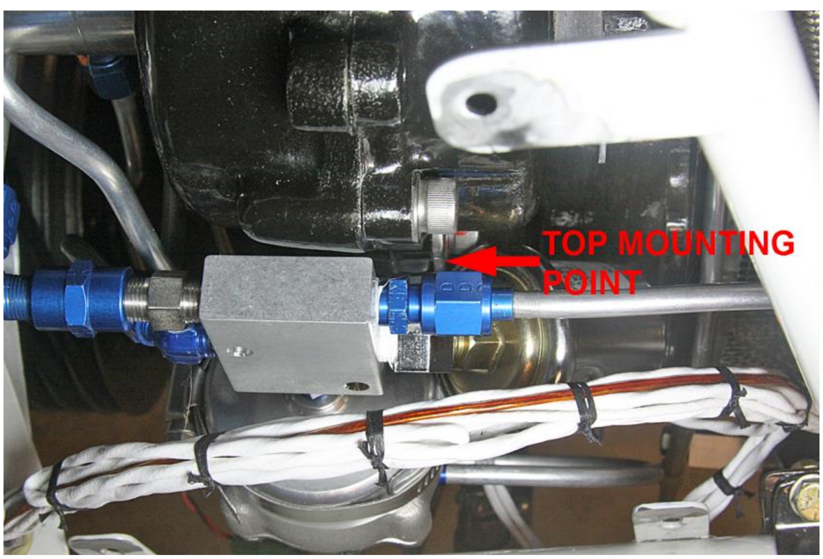
The filter is secured in position by the wedge and the partial bend in the plate.



Here's one last picture showing how the wedge and the bend in the plate help hold the filter assembly in position. That wedge was the most difficult piece to fabricate.



Here's the assembly mounted to the gear case. The engine electronic governor enclosure mounts in front of this on four taps. Two are visible extending up from the bottom rail.



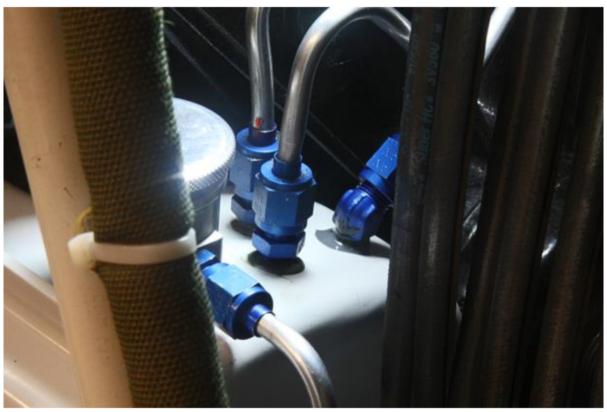
Looking down you can see how everything is tucked into place with very little clearance. In this shot you can just see the top mounting point attached to the gear case.

This assembly is critical to flight and it can't fail. It's a very solid mount and I think it will work well.

PLUMBING

To prevent any debris that may sink to the bottom of the tank from being sucked into the oil pump I modified the AN fitting at the bottom of the tank by adding a ½-inch section of ¼-inch tubing to act as a standpipe. The fitting was drilled out and the tube epoxied in place.

The argument against this approach is that it will result in some loss of oil capacity and the stand pipe can still suck suspended debris into the pump. The alternative is to use screen mesh as a filter. It's unlikely that the oil level would ever drop to within a half-inch of the bottom. I like this approach.



Here's a view of the top of the engine oil tank showing three of the four return lines. The one to the far right is the new return line from the in-line pressure relief valve. The line at the far left is a vent. The two in the middle are the scavenge pump return lines.

13 October 2012 – I've been slowly lowering the pressure in an effort to keep the engine from overheating. Each engine seems to be different, but I finally reached that point at 27 psi. Now the engine runs fine and no longer overheats.

If one was available I'd switch to a gauge with a lower maximum pressure to get the green band into the middle of the range, but 80 psi is all there is in a dual needle gauge as far as I can tell.

I think I'm done.

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17 June, 2018 – I take it back. You're never "done". I added the next page.

This is the stock dual Engine Oil Pressure and Temperature indicator. It’s just about impossible to read, especially in flight, and without adding these ugly stick-on colored arcs you’ll need to divert your attention away from flying while you interpret what you’re seeing.

These are my custom 1.25” custom Uma indicators – more or less to scale. Even though the instruments are small, the needles are huge by comparison, the colored arcs are silkscreened on the dial faces, and the green arcs are much larger.