



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

January, 2015

ENGINE EXAMINATION

WPR15LA067

This document contains 17 embedded photos.

A. ACCIDENT

Location: Perris, California
Date: December 21, 2014
Aircraft: Beaver RX-550, N105JF, Serial #: 105
NTSB IIC: Elliott Simpson

B. EXAMINATION PARTICIPANTS:

Elliott Simpson
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C. SUMMARY

Examination of the recovered engine was conducted by the IIC on December 24, 2014, with a follow up exam performed with the IIC and FAA and Rotax representatives on January 27, 2015. The examination was performed at the airplane owner's hangar in Perris, California.

D. DETAILS OF THE INVESTIGATION

1.0 Engine Examination

Initial Examination

Photos taken at the accident site indicated the airplane came to rest with the right wing low. In those photographs the right wing-mounted fuel tank appeared to be full and leaking blue-colored fuel out of its vent (Photo 1). The left fuel tank, which in the accident orientation was about 3 ft above the right tank, was about 1/5th full (about 1/2 gallon) with fuel. A clay plug had been installed over the right tank vent line by the HAZMAT team in an effort halt the flow of fuel at the accident site. Both fuel tank lines had been crimped by first responders, who reported that fuel was transferring from the right to left tank through gravity as the airplane rested in the field.

Following recovery, the fuel selector valve was observed in the OFF position (Photo 2), however according to the owner, this had been selected after the airplane was recovered. Movement of fuel between the tanks following the accident was consistent with the valve being set to the WING tank position at that time.

Fuel was observed in all supply lines, from the wing mounted fuel tanks, through to the selector valve, filter, electrical fuel pump, engine driven fuel pump, and carburetors (Photo 3). The main center "seat" fuel tank was empty, along with its fuel lines through to the selector valve. The engine fuel primer was in the closed position, and the single in-line filter contained fuel and appeared free of debris (Photo 4).

Internal inspection of the engine driven fuel pump revealed that it was almost full with fuel, and all internal seals and membranes were intact (Photo 5). Both carburetor bowls were removed, and the front (magneto side) bowl contained about 1 tablespoon of fuel (Photo 6). The rear bowl was about half-full, and the float appeared to be buoyant (Photo 7). The red sieve sleeves in both carburetors appeared to be crushed along their axis (Photo 8), and the float bracket for the front carburetor hung about 1/32 inch lower than the rear carburetor's float bracket (Photo 9). Neither float bracket was parallel the float chamber as required in the Rotax Repair manual (Photo 10). According to the Rotax representative, the sieve screens purpose was to separate foam/ air bubbles out of the fuel.

The radiator contained green-colored fluid up to its cap, and the expansion was about 1/8th full with fluid. The engine oil injection reservoir was about 1/2 full.

The engine rotated smoothly at the propeller by hand, and fuel moved through the lines during rotation. The throttle was initially observed in the full aft position, and engine control continuity was established. All three fuses in the instrument panel were not blown.

Follow-up Examination

The two carburetor vent pipe fittings for each carburetor were routed directly to open ambient air with plastic tubing, which passed underneath the bowl spring clip, and laterally outwards (Photo 11). According to the Rotax installation and parts manuals, rather than direct venting, each carburetor vent fitting should instead have been directly interconnected to each other with a continuous vent line (Photo 11), containing two small compensation bores. According to the Rotax Installation Manual:

"Equal air pressure conditions must prevail in the vicinity of the carburetor air intake and the carburetor float chamber vent pipes (i.e. the pressure must not be influenced by the propeller air stream). If necessary, the carburetor intake should be shielded against effects of the slipstream by a sheetmetal shield or air intake box, and the carburetor vent pipes should be routed to a calm air zone or connected to a vent chamber."

Furthermore, the Rotax Repair manual states:

"The vent duct openings to atmosphere are provided with a hose which prevents ingress of dust and water into the carburetor. Velocity pressure must never act upon venting ducts as it would influence pressure in float chamber, and therefore after the air/fuel mixture."

The exhaust muffler remained connected to the manifold, and appeared to be a Rotax original type, although it exhibited heavy corrosion (Photo 12) and was removed for examination. The internal components appeared intact, and nothing sounded loose when it was shaken.

The oil tank contained oil to the mid-level.

Examination of the piston skirts through the exhaust ports revealed that they were in good condition, with no scratches or indication of seizure (Photo 13). The piston rings were bright and clean with minimal carbon buildup on top of pistons. The engine rotated smoothly by hand at the propeller, and "thumb" was felt at both cylinders. The spark plug gaps were appropriate, and the spark plug electrodes were coated in golden-brown deposits (Photo 14).

The air filter was removed and appeared free of obstruction, along with the carburetor air intake inlets. The carburetor pistons both moved smoothly and in concert with each other in response to throttle control movement; both pistons appeared symmetrical to each other.

The carburetor bowls were both removed, with the same observations noted as the prior exam. The fuel in the carburetor bowls was checked for the presence of water utilizing SAR-GEL Water finding Paste, no water was detected.

Both main jet orifices were the 158 types, and both were free of obstruction. The carburetor needles were the 11G2 type, which was correct per the Rotax Illustrated Parts Catalogue. Both needle circlips were in the No. 2 position (Photo 15), rather than the factory equipped No. 3 position, which, according to the Rotax representative would result in the engine operating at a leaner mixture. The carburetor plunger walls exhibited light scoring marks. The float needle valve was removed, and appeared pliable and undamaged.

The only fuel filter installed was a plastic-screen type (Photo 4), which was positioned on the "suction" side, just after the selector valve and before both the electrical and engine driven fuel pump. This installation was in deference to the Rotax Installation Manual which required that the filter be installed between the electrical fuel pump and carburetors. The manual also required fuel filters to be installed at each tank, none were located.

The Rotax Repair Manual, Section 10.2.4 "Examination of fuel line between tank and fuel pump:" states the following,

"This section of pipe is under considerable negative pressure when the engine is running hard, and the tiniest flaw in any joint will cause air to be sucked into the system, considerably reducing the capacity of the fuel pump. Air leaks are much more dangerous when the fuel tank is mounted below the fuel pump and carburetor."

Examination revealed that the wing mounted fuel tanks were positioned about 24 inches below the carburetor (Photo 16), and staining was present at the fuel primer handle (Photo 17), indicative of a fuel leak.

Electrical power was applied to the electrically driven fuel pump, and fuel was observed to travel up the fuel lines to the carburetors.

The engine was then configured for a ground run. It started on the second attempt, and was able to be operated throughout its speed range. Multiple runs were performed, and during one run the electrically driven fuel pump was engaged with no noticeable change in engine speed. During one run the engine temporarily "hesitated" while operating at high speed and on another, fuel was observed to flow out of the aft vent line of the magneto-side carburetor. Fuel flowed from the line with the electrically driven pump both on and off.

A fuel pressure gauge was installed into the magneto-side carburetor inlet utilizing a T-fitting, and pressures were documented during engine operation. With the electrically driven fuel pump off, 3 PSI was documented. With the electrical pump on, the pressure increased to 9 PSI. The installation manual states that the pressure should be between 3 and 7 PSI.

1.1 Engine Examination Photos



Photo 1 - Airplane at Accident Site



Photo 2 - Fuel Selector Valve

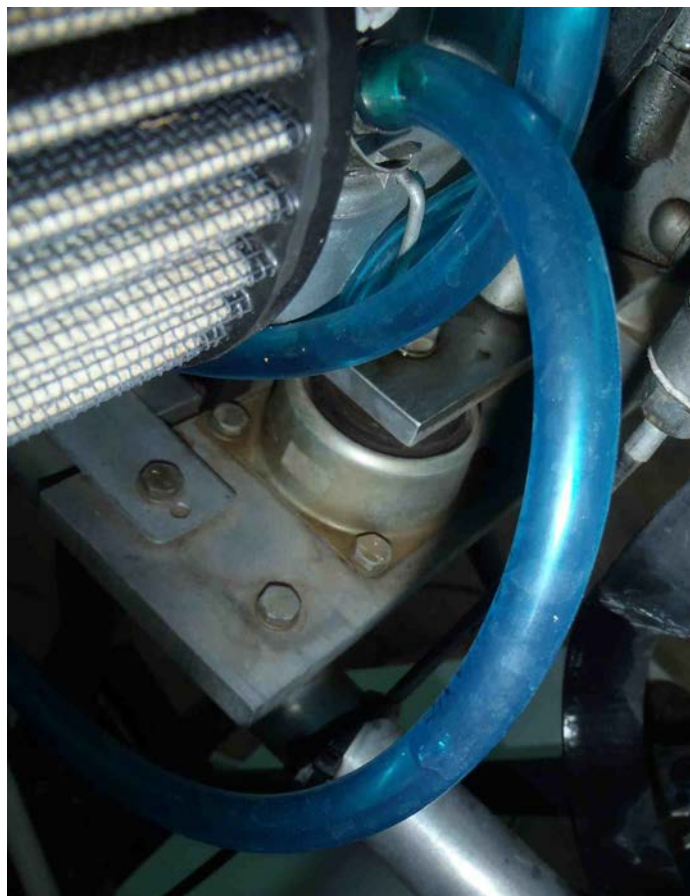


Photo 3 - Fuel in Lines



Photo 4 - Fuel Filter



Photo 5 - Engine Driven Fuel Pump



Photo 6 - Front/Magneto Side Carburetor Bowl



Photo 7 - Rear/Propeller Side Carburetor Bowl



Photo 8 - Sieve Screen

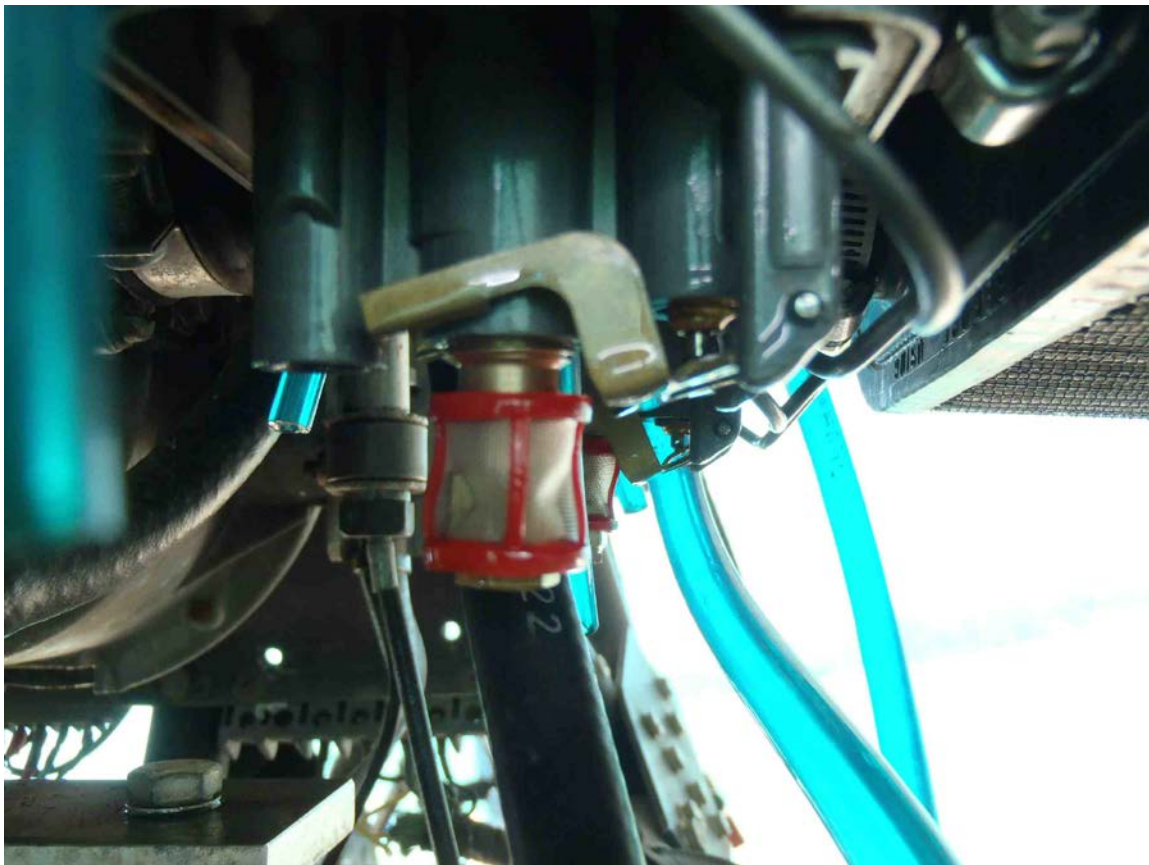


Photo 9 - Carburetor Float Bracket

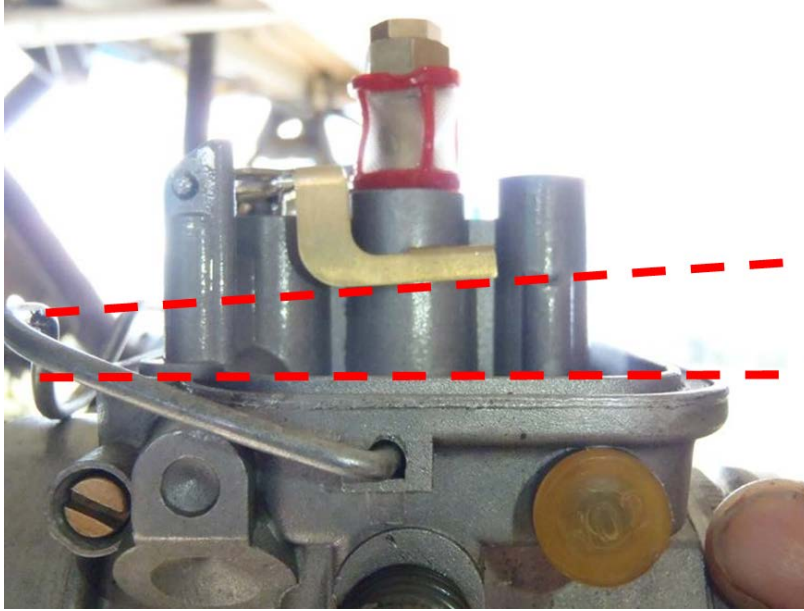


Photo 10 - Float Bracket Compared to Float Chamber

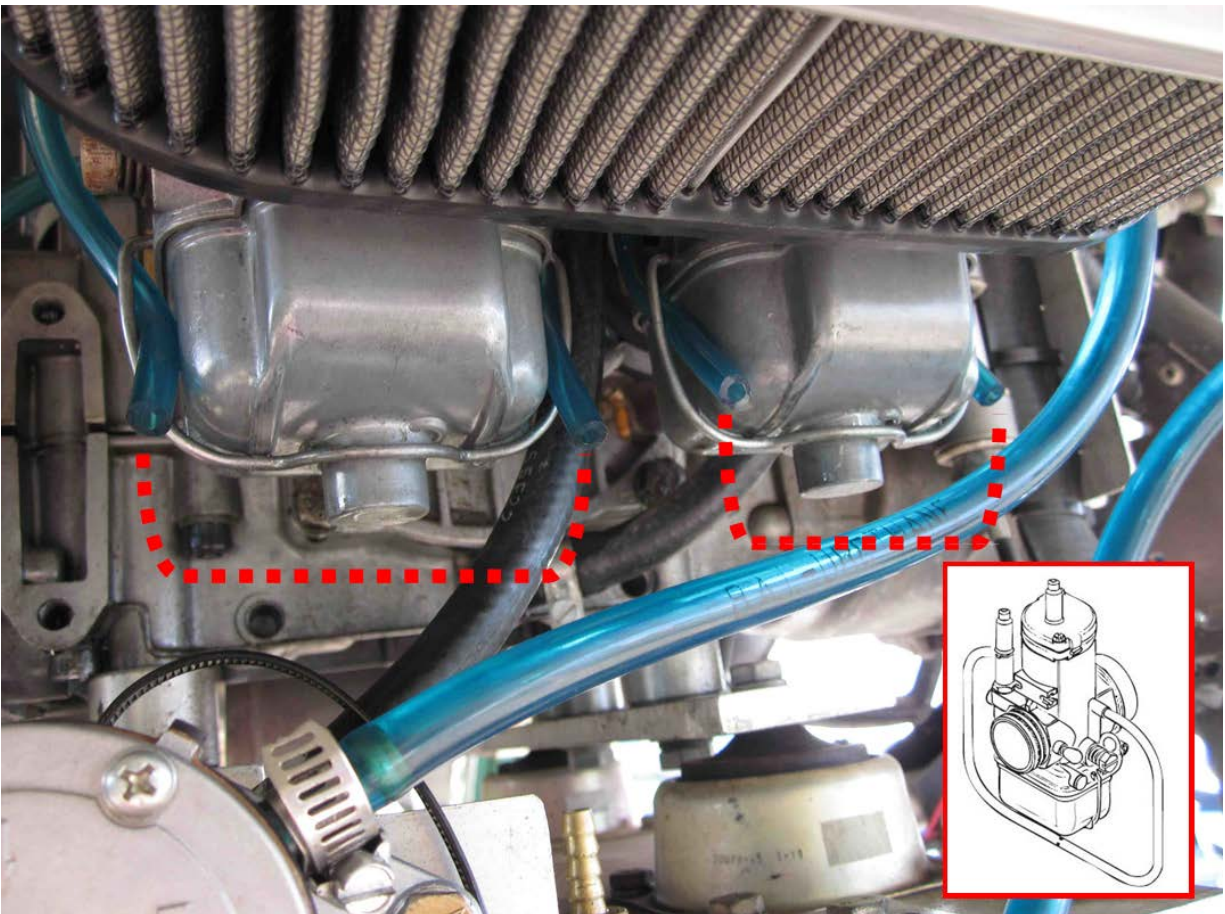


Photo 11 - Vent Tubes as Found - Versus Exemplar



Photo 12 - Muffler

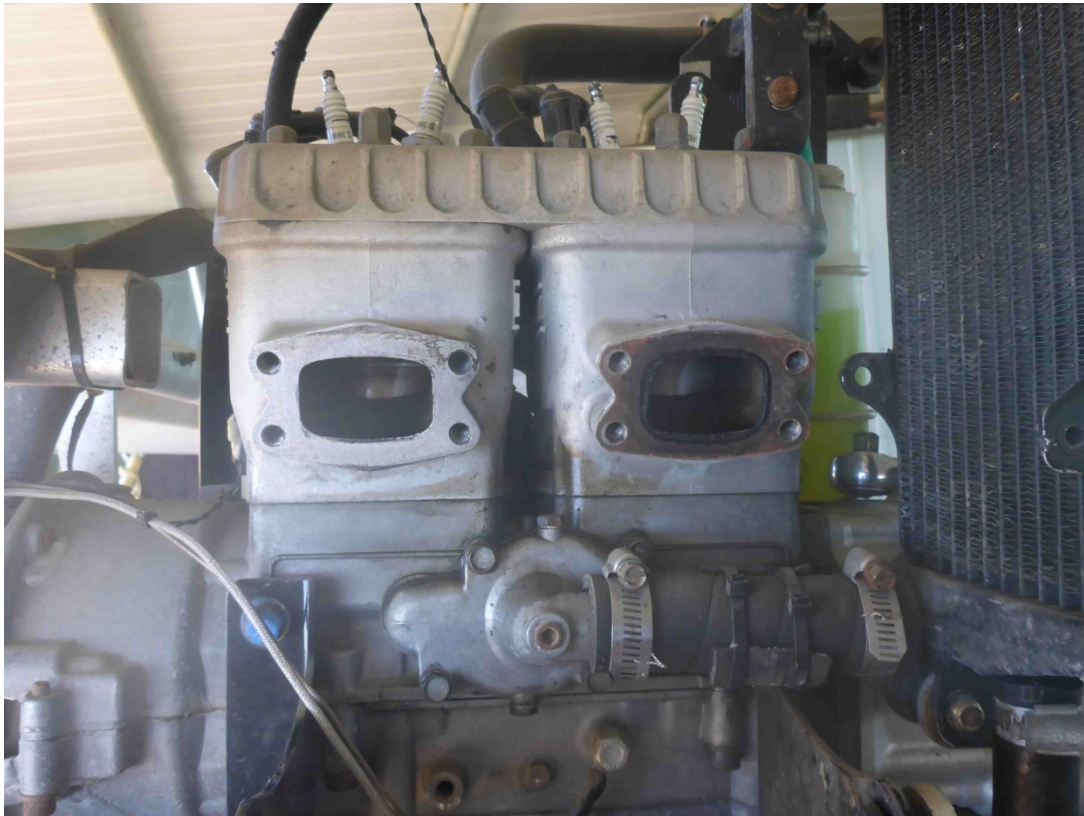


Photo 13 - Exhaust Ports

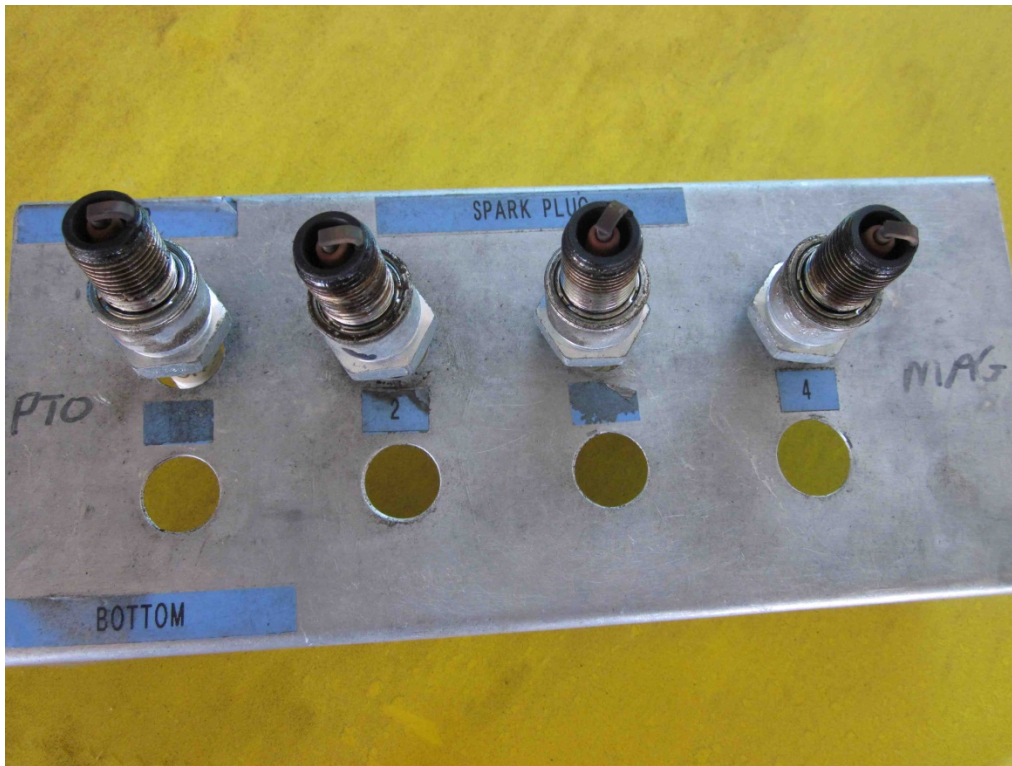


Photo 14 - Spark Plugs



Photo 15 - Needle and Circlip



Photo 16 - Fuel Tank Position Relative to Carburetors

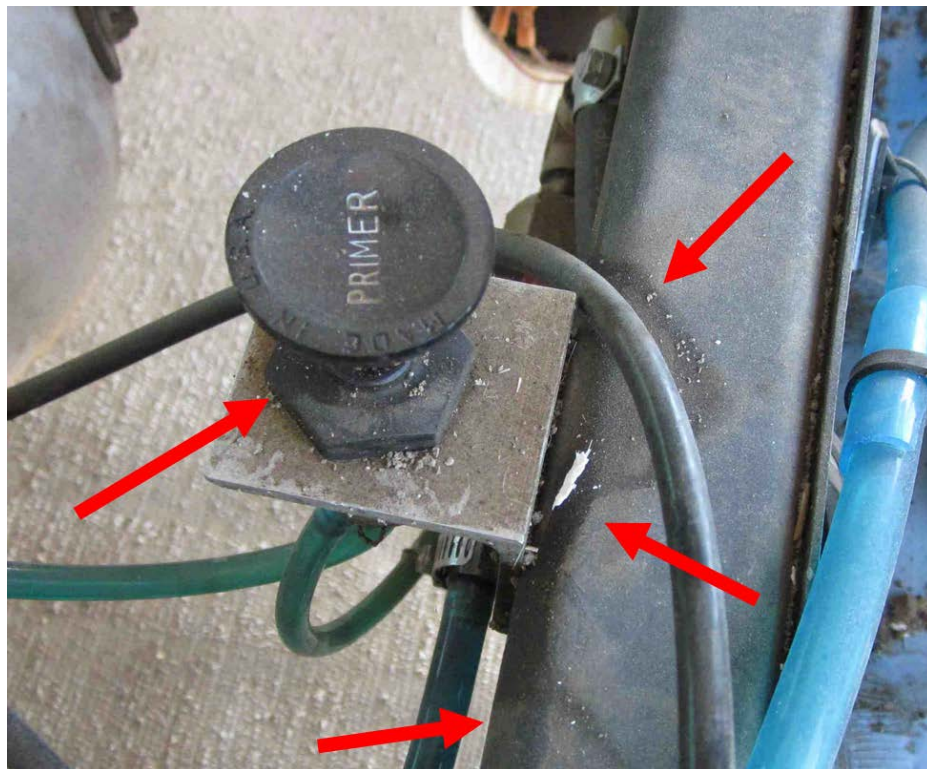


Photo 17 - Primer Valve

Submitted by: Elliott Simpson