

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



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COOLING SYSTEM EXAMINATION NOTES

November 21, 2022

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A. ACCIDENT

Location: Hanksville, Utah
Date: August 16, 2021
Time: 1515 Mountain daylight time
Airplane: N133AC

B. COOLING SYSTEM EXAMINATION NOTES

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C. SUMMARY

On August 16, 2021, about 1515 mountain daylight time, a Europa Trigear, N133AC, was substantially damaged when it was involved in an accident near Hanksville, Utah. The pilot was not injured. The airplane was operated as a Title 14 Code of Federal Regulations Part 91, personal flight.

The pilot reported that during the preflight, he noticed that the fluid in the cooling system's expansion tank was low. He removed the cowling and did not observe a leak or pooling of coolant, and subsequently added about 16 ounces of water to replenish the coolant. The pilot completed the preflight and ground run without further incident and initiated the takeoff.

The pilot reported that he was in a "stair-stepped" climb out in an effort cool the engine. About 30 minutes after departure, he noted that the engine's cylinder head temperature (CHT) was in the red arc and immediately reduced the throttle setting to idle and prepared for a precautionary landing. While in the descent, the pilot cycled the engine off and on to reduce the CHT, but the temperature remained in the red arc. During the landing roll on an unimproved dirt road, the airplane impacted terrain.



Figure 1. View of cylinder head temperature gauge

Postaccident examination of the airplane revealed that the fuselage was substantially damaged.

D. DETAILS OF THE EXAMINATION

1.0 Cooling System

Description of System

The engine cooling system is designed for liquid cooling of the cylinder heads and ram air cooling of the cylinders. The cooling system of the cylinder heads is a closed circuit with an expansion tank and overflow bottle.

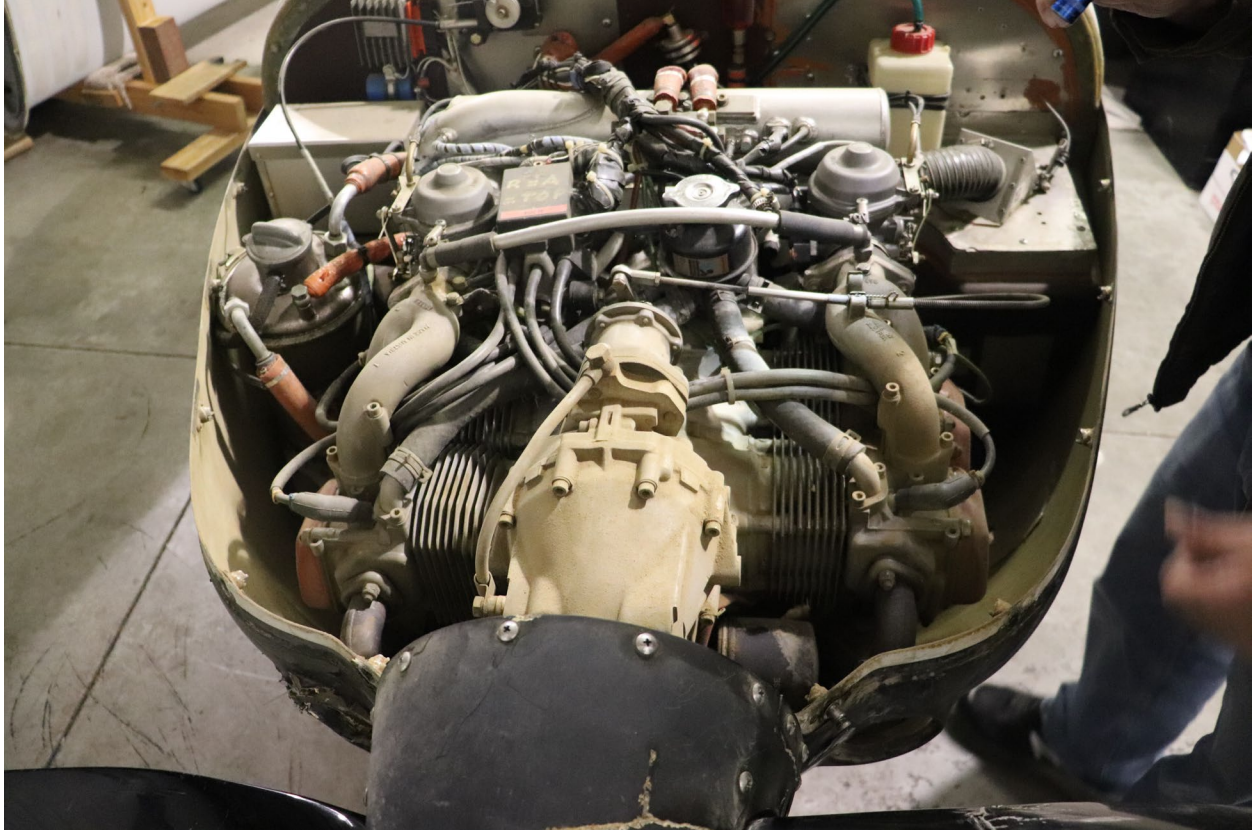


Figure 2. View of accident engine

The coolant flow is forced by a water pump, driven from the camshaft, from the radiator to the individual cylinder heads. The coolant flows from the top of the cylinder heads to the expansion tank. Since the standard location of the radiator is below engine level, the expansion tank located on top of the engine allows for coolant expansion.

The expansion tank is closed with a pressure cap (with pressure relief valve and return valve). As the coolant heats up and expands, the pressure relief valve opens and the coolant flows via hose at atmospheric pressure to the transparent overflow bottle. As it cools down, the coolant is sucked back into the cooling circuit.

The temperature sensors are in cylinder head 2 and 3.

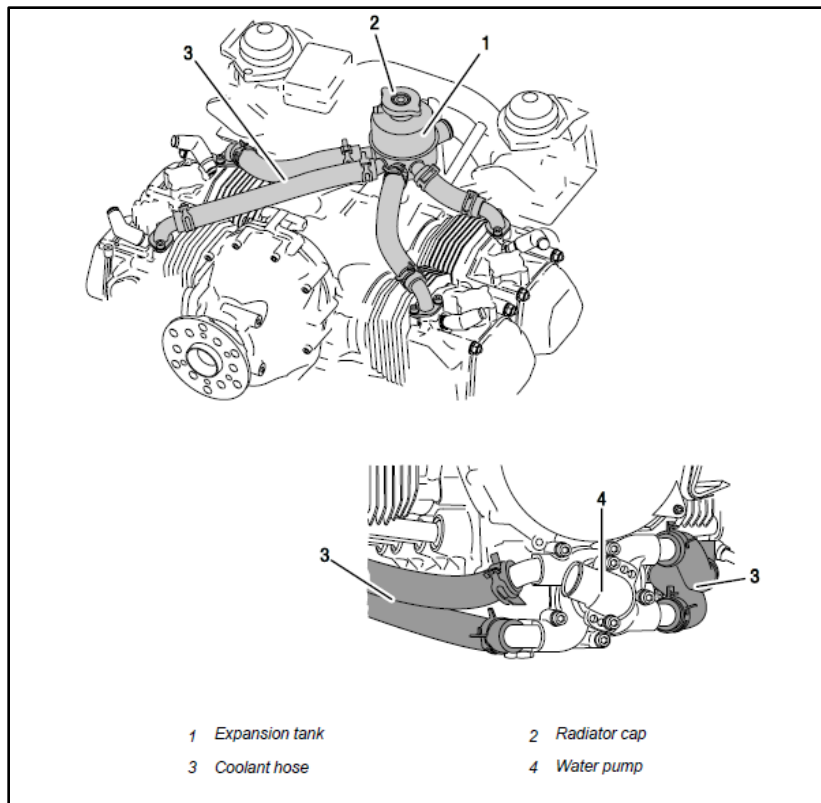


Figure 3. Rotax 914 Cooling System Exemplar

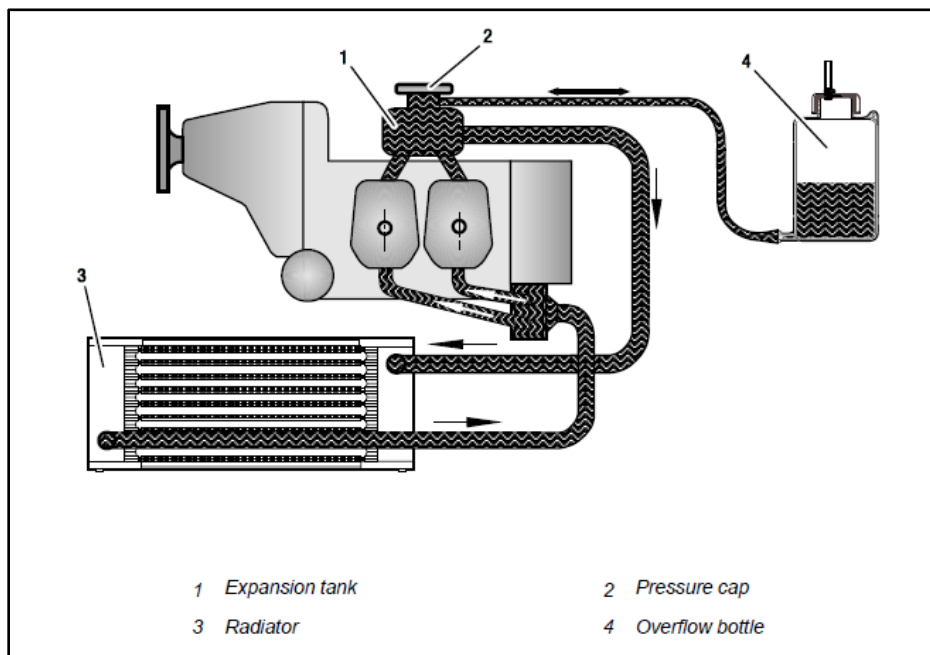


Figure 4. Rotax 914 Cooling System Flow Diagram

2.0 Cooling System Examination

The system's internal pressure was set to 1.2 bar (18 psi) using a pressurization kit. Pressure testing revealed that there were no leaks throughout the cooling system.

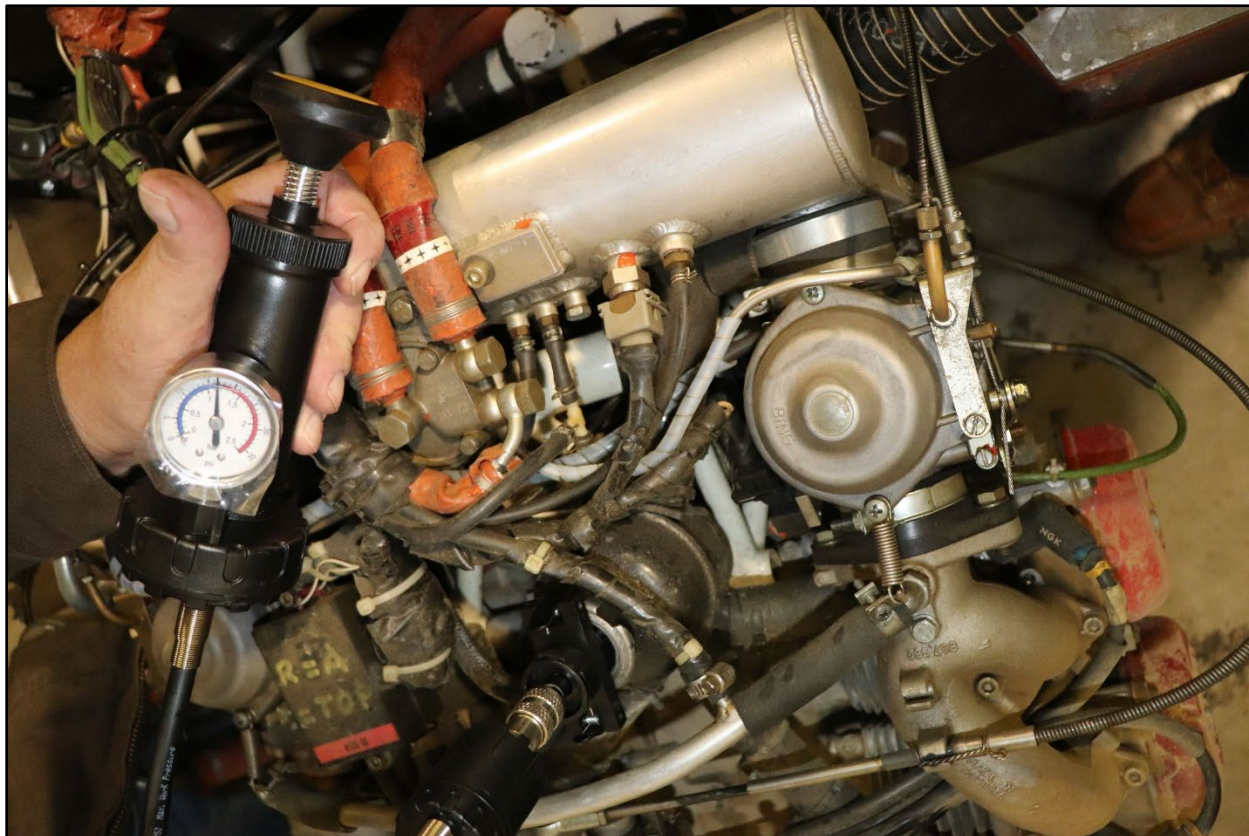


Figure 5. View of pressure test of cooling system

2.1 Radiator, Water Pump & Coolant Hoses

The radiator, water pump, and all corresponding coolant hoses were unremarkable and secured.

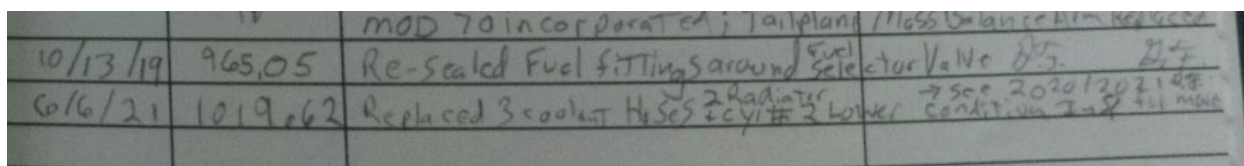


Figure 6. View of logbook entry for coolant hose replacement

2.2 Expansion Tank with pressure cap

The expansion tank was intact and unremarkable but void of any fluid. The pressure cap installed on the accident engine was a non-Rotax (non-OEM) pressure cap, with a 1.2 bar pressure rating, identical to the OEM cap. Visual examination of both

removed and replaced radiator caps revealed that the upper seal, lower seal, pressure relief valve, return valve, and spring were intact.



Figure 7. View of non-OEM installed on expansion tank comparing with the removed Rotax radiator cap

The pilot reported during the examination that he replaced the original cap because the original cap was worn. He purchased the non-OEM part from an online motorcycle supply shop and installed it about 2 weeks prior the accident airplane. The caps were retained for further testing.

2.3 Overflow Bottle

Bottle was intact and unremarkable but void of any fluid. The venting bore, screw cap, bracket and hose connection were all intact and unremarkable.

3.0 Additional Information

Testing of the Radiator Caps

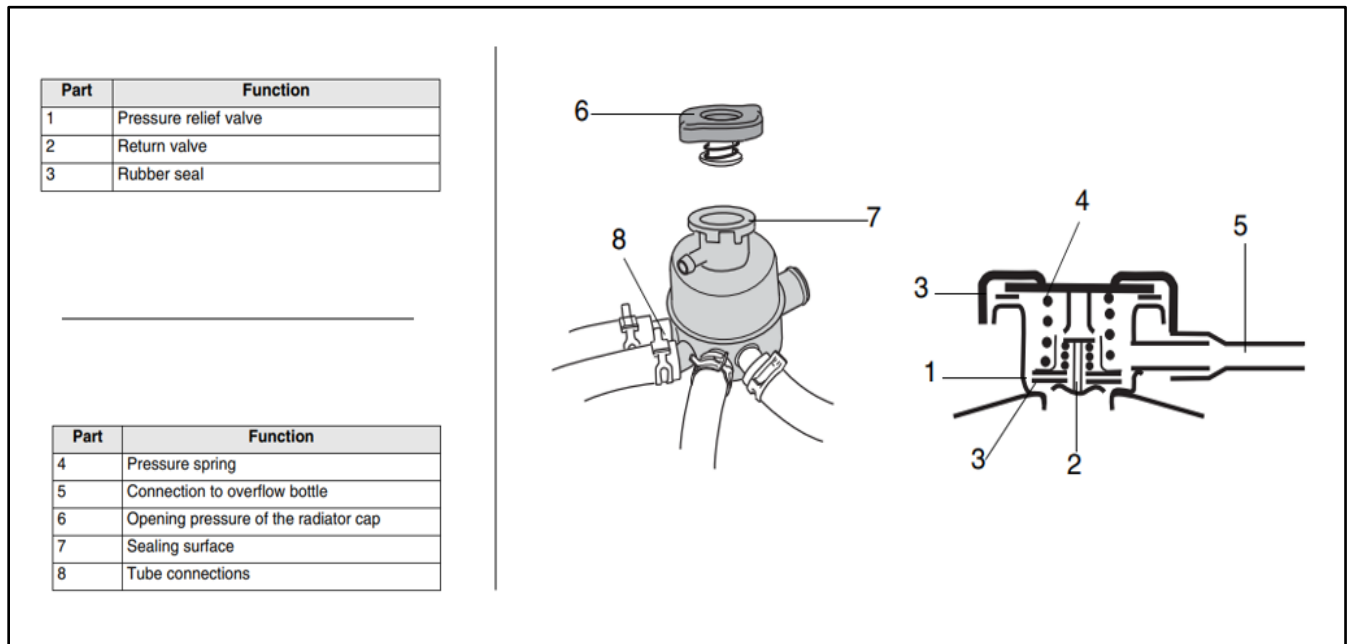


Figure 8. Diagram of Rotax Radiator Pressure Cap

The radiator caps were tested at an automotive radiator shop in Federal Way, WA in June 2022. The radiator caps were screwed onto an adapter, which connected to a compressor line. Compressed air was introduced to determine what the opening value was for the pressure relief valve. An audible air leak would be heard and according to the manufacturer, the pressure relief valve was to open at 1.2 bar or 18 psi. The test revealed that the original Rotax cap opened the valve at 12 psi with a corresponding audible air leak; conversely, the non-OEM accident radiator cap revealed that the valve opened at 3 psi, also with an audible leak.



Figure 9. View of radiator cap return valve test result

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