NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

ENGINE EXAMINATION

WPR16FA115

This document contains 18 embedded photos.

A. ACCIDENT

Location:	Santa Monica, California
Date:	May 22, 2016
Aircraft:	Czech Aircraft Works SPOL SRO, SportCruiser, N1111X
NTSB IIC:	Eliott Simpson

B. EXAMINATION PARTICIPANTS:

Eliott Simpson
Senior Aviation Accident Investigator
National Transportation Safety Board
Los Angeles, California

Jordan Paskevich
Rotech Flight Safety
Rotax Aircraft Engines
Vernon, British Columbia
Canada

C. SUMMARY

Engine Type: 912-ULS
Serial Number: 6782388

Examination of the recovered engine was conducted at the accident site by Eliott Simpson on May 22, 2016, with a follow up exam at a storage facility at Chino Airport in the presence of Eliott Simpson, and Jordan Paskevich on July 6, 2016. An engine run was then performed at the facilities of Rotech Engineering in Vernon, British Columbia, Canada, on September 27, 2016 in the presence of Eliott Simpson and Jordan Paskevich.

D. DETAILS OF THE INVESTIGATION

1.0 Examination: Accident Site

The airplane sustained substantial damage to the firewall and lower fuselage structure during the accident sequence, and both wings along with their integral fuel tanks were intact and undamaged (Photo 1). Both tanks contained fuel to at least half of their capacity when viewed through the filler necks. The upper cowling was removed, and all fuel lines were intact throughout the engine compartment through to the gascolator fitting (Photo 2). The gascolator fitting remained attached to the lower firewall, however the bowl, which sustained crush damage, was located along with the screen at the initial ground impact point in the debris field. The inner surface of the bowl was free of debris, and the screen was clear. The fuel lines from gascolator fitting through to the engine driven fuel pump contained no fuel. The fuel line from the fuel pump through to the carburetors contained residual fuel drops. The air induction scat tubes for both the filtered and carb heat air lines were intact and free of internal blockage, and the carb

heat “flip flop” valve within the inlet manifold was intact and operated with movement of the carb heat control in the cabin. The engine throttle and choke controls were intact, continuous and operational through to their respective cockpit controls, which were both in the aft position (Photo 3).

Both carburetor bowls were removed at the accident site, and contained fuel to about 3/4 of their capacity. Both floats were present in each bowl, and were floating such that their float pins were at the fluid surface (Photo 4,5).

1.1 Examination: Chino Airport

Both wing fuel tank vent and supply lines were free of obstruction.

The lower canopy was removed and the engine examined further. All oil and coolant lines were intact, and no indication of catastrophic engine failure, or oil/coolant loss was noted. The air filter remained attached to the lower cowling, and exhibited an oily dark coating to its exposed lower surfaces (Photo 6).

The upper and lower spark plugs were removed and examined. All exhibited light grey deposits, and appropriate plug gaps of between 0.027 and 0.028 inches. The top plugs for cylinder number 1 and 4, along with the bottoms plugs for cylinder number 3 where DCPR7E types, which according to the Rotax representative were incorrect (specifically the wrong heat range). The remaining plugs where the correct type, DCPR8E. The plug caps for the top spark plugs on cylinder 2,3 and the bottom plugs for 1,3,4 appeared to be newer than the remaining plug caps.

The engine oil filter was the reuse/cleanable type, and remained safety wired and firmly in place. The fuel line from the tanks through to the flow transducer behind firewall had separated adjacent to the crumpled cabin floor. The transducer was removed, and no blockage was observed (Photo 7). Air was applied to the input side, and the internal vanes could be heard spinning.

The engine was rotated by hand at the propeller shaft, and thumb compression was present at all cylinders.

The propeller gearbox was clean and appeared to have been recently installed. The incorrect sealant (orange silicone-type) was noted extruding from the gearbox seal at the case halves (Photo 8).

The induction manifold was removed and the carburetor pistons examined, air inlet venturi was free of obstruction.

The carburetor jets were removed and examined for both carburetors. Both jets exhibited markings indicating that they were the correct size for the engine application (2.7mm). The left carburetor (cylinder 2/4) lower bore of the mixing tube exhibited a series of brass burrs on the

countersunk surface adjacent to the main jet (Photo 9, Figure 1). One burr projected into the bore of the mixing tube upon disassembly, and was removed for further examination (Photo 10).

The carburetors were reassembled, and the engine was further secured to the airframe. A composite 2-blade propeller was installed, and a fuel canister containing the fuel recovered from the left wing tank was connected to the fuel line at the gascolator. The engine was then started, and a short operational check was performed. The engine operated smoothly at idle and high power settings.

1.2 Examination: Rotech Engineering, Vernon, British Columbia

A secondary engine examination was performed. The carburetor floats were removed, and soaked in fuel for 15 hours. The float buoyancy was checked in accordance with Rotax Service Bulletin SB-912-065 R3. The right carburetor (cylinder 1/3) and left (cylinder 2/4) floats weighed 5.8 and 5.6 grams respectively, which was in compliance with the service bulletin which required a weight of less than 7 grams.

The coolant system was drained, and contained about 2 liters of red-colored fluid, consistent in appearance and texture with the approved 50/50 Dexcool fluid and water combination. The coolant overflow pipe appeared to have been pinched in multiple locations, and the material type was not appropriate for the installation, and had become brittle (Photo 11). About 3 liters of dark-brown colored oil was drained form the engine crankcase.

Multiple indications of chaffing were found throughout the engine compartment including the fuel line to the engine driven fuel pump, and the cylinder 3 rocker cover (Photo 12, 18, 13), along with the forward surface of the oil cooler (Photo 14). Both the yellow fuel pressure gauge line and the blue inlet manifold pressure gauge lines were intact and free of leaks. The balance tube did not exhibit indications of blockage.

The bore of the left carburetor mixing tube was then reexamined. The bore diameter was 3.5 mm wide at multiple locations throughout its length and up to the area of the burrs. An exemplar bore was measured and found to be 3.51 mm wide along its length. The brass burr which projected into the bore was then measured and found to be, 1 mm wide, and 2.7 mm long. (Photo 15)

The exhaust pipes, along with the radiator and oil cooling assemblies were removed, and the engine was attached to an engine test stand, and configured with a two-blade composite propeller configured for the pitch appropriate to the engine (Photo 16).

The engine was then run utilizing 92 octane automotive fuel. It started immediately, and was operated at a series of speeds from 3,000 rpm through to 5,700 rpm. Cylinder head temperature, exhaust gas temperature, fuel pressure, oil pressure, and oil temperature values were recorded throughout the engines operating speed range (Figure 1). The test stand fuel flow gauge was inoperative. The engine ran smoothly throughout the operating range of 3,000 to 5,700 rpm (Figure 2). In an effort to duplicate the accident scenario, the engine was then operated at idle (4,000 rpm) for 20 minutes, and then advanced to takeoff speed (5,700 rpm) for 3 minutes. The

engine operated smoothly throughout the test, with no discernable change in speed when the auxiliary fuel pump was engaged (at all tested speeds).

Both carburetors were removed and disassembled. The right carburetor (cylinders 1/3) jet needle exhibited two score marks on its shank, indicating it was the appropriate needle for the 912ULS engine application. The jet circlip was at the second clip location from the needle end (position number 3), which according to the Rotech representative was the factory-installed position. The diaphragm was intact, pliable, and undamaged. The carburetor piston exhibited light scoring to its surfaces with corresponding light abrasions on the adjacent wall of the carburetor housing. The internal surfaces of the chamber top and corresponding piston were coated in a film of dark oily residue, with no indication of binding between the two components. The throttle valve spring was intact and appeared undamaged. All carburetor gaskets were in good condition, and could be removed without leaving any residue on their component mating surfaces. The float valve bracket moved freely on its hinge pin, and the float needle valve assembly was disassembled. The valves Viton tip was pliable and undamaged, its internal spring mechanism could be compressed, and the corresponding valve seat was free of debris. The throttle (butterfly) valve remained attached to the throttle shaft, and could be freely rotated by hand at the throttle valve lever.

The left carburetor (cylinders 2/4) exhibited similar characteristics, except that the needle valve could not be removed because the fixation screw appeared to have frozen within the carburetor piston. Closer examination revealed that the fixation screw head had surfaces had become smeared, consistent with a previous attempt to remove the jet needle (Photo 17). The needle was therefore examined in place; it exhibited the same two score marks on its shank, and an extension from the piston consistent with a circlip in position 3.

The spark plugs for cylinder 2 was removed, and the chamber was examined utilizing a borescope. The valves were intact, and the piston crown was coated in light-grey deposits. The cylinder walls were bright and shiny, and exhibited crosshatching marks and no visible indication of scratches or piston markings.

2.0 Examination Photos

Photo 1 – Airplane at Accident Site

Photo 2 – Cowling Removed

Photo 3 – Engine Controls in Cockpit

Photo 4 – Right (Cylinders 1/3) Carburetor at Accident Site

Photo 5 - Left (Cylinders 2/4) Carburetor at Accident Site

Photo 6 – Air Filter

Photo 7 – Fuel Flow Transducer The air filter remained attached to the lower cowling, and exhibited an oily dark coating to its exposed lower surfaces

Photo 8 – Gearbox Sealant

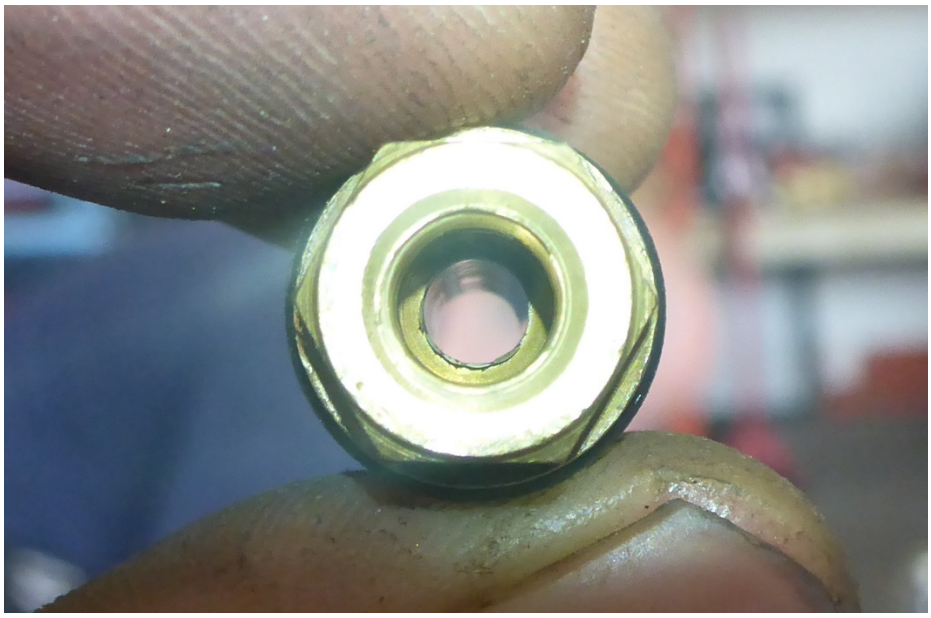

Photo 9 – Left (Cylinders 2/4) Carburetor Mixing Tube Bore

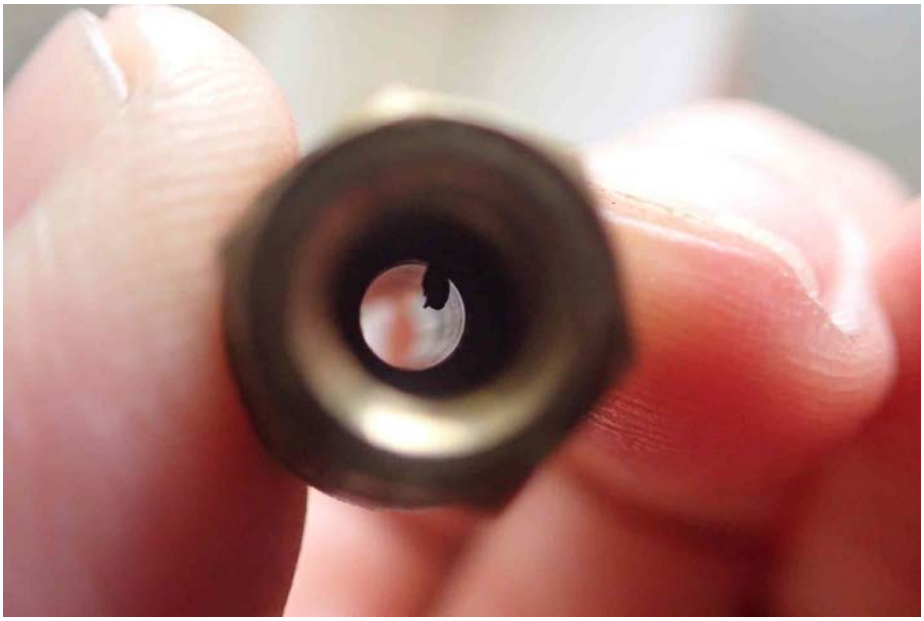

Photo 10 - Left (Cylinders 2/4) Carburetor Mixing Tube Bore

Photo 11 – Coolant Overflow Line

Photo 12 – Fuel Line Chaffing

Photo 13 – Cylinder 3 Rocker Cover

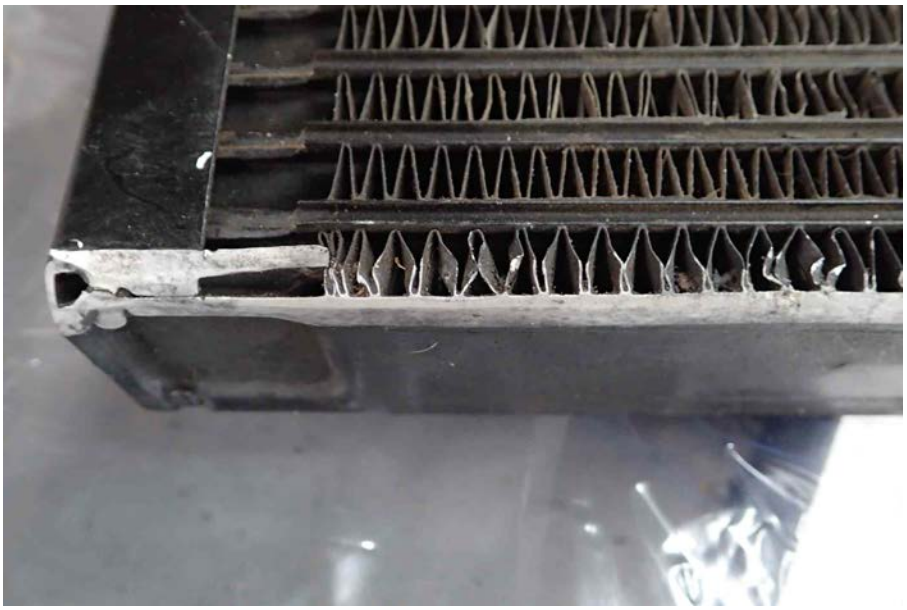

Photo 14 – Oil Cooler

Photo 15 – Brass Burr

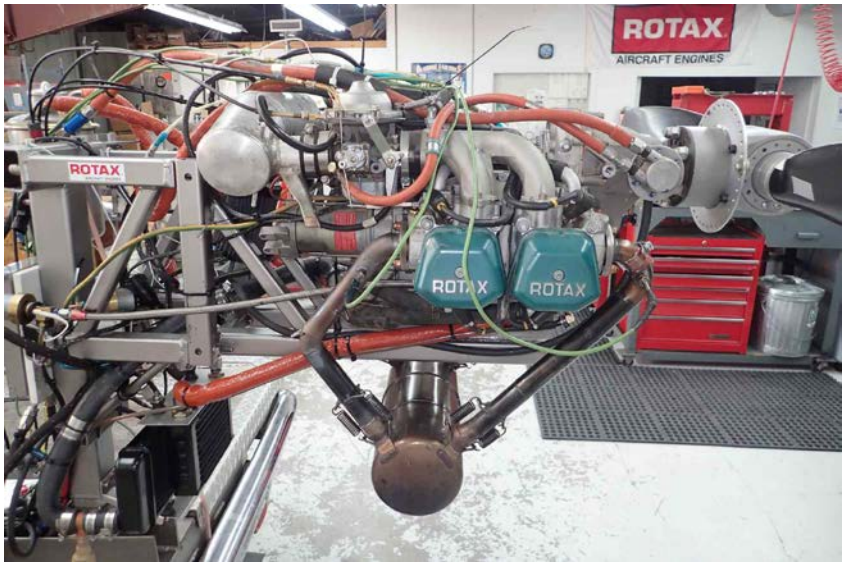

Photo 16 – Engine on Test Stand

Photo 17 –Left (Cylinders 2/4) Carburetor Fixation Screw Head

Photo 18 – Fuel Line Chaffing

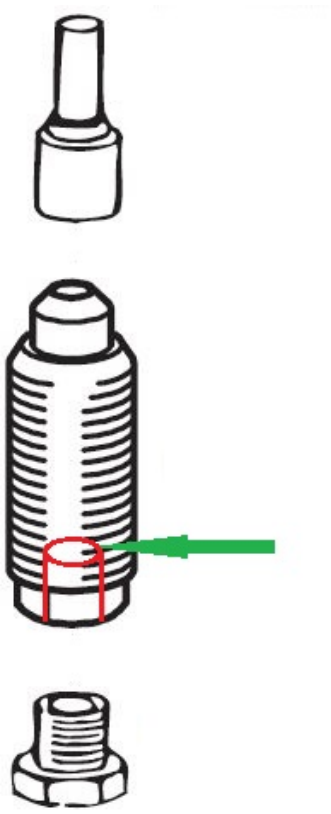

Figure 1 – Left (Cylinders 2/4) Carburetor Mixing Tube Bore Showing Burr Location

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Procedures Manual

TEST RUN

8.2.2 Test Run

WO # WPR16LA115

BREAK – IN PROCEDURE AS PER SEC 16.4	TCU log "on" 914 only	RPM					
		5 min - 3000	5 min - 4000	5 min - 5000	5 min - 3500	5 min - 4500	5 min - 5500
	NA	NA	NA	NA	NA	NA	NA

Performance check sec 16.5	Time	RPM	OIL				Manifold Pressure (In. Hg)	FUEL		CHT		EGT			
			Press (Psi)	Temp (°F)	Vac (In. Hg)	Case Pressure (Psi)		Press (PSI)	Consum (G/h)	Cyl 2 (°F)	Cyl 3 (°F)	Cyl1 (°F)	Cyl 2 (°F)	Cyl 3 (°F)	Cyl 4 (°F)
	0 Min Start of Performance check	(FULL THROTTLE min 5770)	65	210	-8	7.9	28	4.4	NA	247	260	1352	1364	1257	1405
	5 min End of performance check	(FULL THROTTLE min 5770)	67	214	-8	8	28	4.4	NA	246	255	1357	1366	1258	1402
	2 min	**5500**	58	150	-5	4	26.7	4.4	NA	212	215	1301	1328	1334	1496
	2 min	**5000**	62	183	-6	5	27	4.4	NA	223	229	1285	1256	1274	1393
	2 min	**4500**	53	157	-4	4	25	4.4	NA	208	215	1183	1114	1291	1473
	2 min	**4000**	50	144	-3	2.2	20.5	3.2	NA	184	190	1202	1244	1210	1400
	2 min	**3500**	50	141	-3	1.8	20	5.1	NA	185	191	1166	1117	1165	1205

Mag Drop @ 4000 RPM (max drop 300, max diff 115)	Circuit A	Circuit B	Voltage @4000 RPM (@ 150W)	13.6	Alt warn Light (ON or OFF)	NA	Ambient Temperature (min 0° max 30°C)	19.44
	3870	3830	Voltage @ 4000 RPM (@ 0W)	NA	Atmospheric Pressure (in. Hg)	30.17		

Operators signature

I attest the above engine meets the performance specifications and parameters of the Overhaul Manual Sec 16.5.		Date:	SEPTEMBER 28 2016

Rev 7 Mar 3, 2015

Figure 2 – Engine Test Run Results

Submitted by: Eliott Simpson