



ERA13LA382

Middle Grove, New York

August 27, 2013

Revo, Incorporated Lake Model 250

N522WB

NTSB ENGINE EXAMINATION NOTES

26 Embedded Photographs

September 16 - 17, 2013

PARTICIPANTS IN THE EXAMINATION

Shawn Etcher
Air Safety Investigator
National Transportation Safety Board
Ashburn, VA

HISTORY OF FLIGHT

On August 27, 2013, about 1520 eastern daylight time, a Revo, Incorporated Lake Model 250, N522WB, registered to Terell Enterprises LLC, operated by a private individual, was landed hard during a forced landing in a field near Middle Grove, New York. Visual meteorological conditions prevailed at the time and no flight plan was filed for the 14 Code of Federal Regulations (CFR) Part 91 personal flight from Saratoga County Airport (5B2), Saratoga

Springs, New York, to a body of water called Blue Mountain Lake, located in Indian Lake, New York. The airplane sustained substantial damage and the private pilot, the sole occupant sustained minor injuries. The flight originated about 3 minutes earlier from 5B2.

ENGINE INFORMATION

Engine Manufacturer: Lycoming Engines

Engine Model Number: IO-540-C4B5

Engine Serial Number: L-23517-48A

INITIAL EXAMINATION AS RECEIVED

The engine was received attached to the vertical pylon. Examination of the engine revealed an engine crankcase breach in the vicinity of Cylinder No. 6. Further examination of the engine revealed that all three propeller blades exhibited curling at the tip. Oil was present on the engine as well as evidence of oil along the inside of the cowling. The engine cowling, propeller hub, and vertical pylon were removed for further examination of the engine.



Photo 1: Right Side of Engine as Received



Photo 2: Left Side of Engine as Received



Photo 3: Rear of Engine with Propeller Hub



Photo 4: Front of Engine as Received

DETAILED EXAMINATION

Engine Examination

The engine was examined and the cylinder head covers were removed from all six (6) cylinders and all twelve (12) spark plugs were removed. Minimal damage was noted on the crank case excluding the breach. The oil filler cap was found secured and in place, it was removed and no oil was present on the stick. Prior to removal of the propeller hub the engine was attempted to be rotated by hand; however, resistance was noted and rotation was not achieved. All components on the rear accessory pad, which in this installation was the forward section of the engine as this engine had a rear mounted propeller assembly. The engine was mounted on a vertical engine tripod stand and Cylinder Nos 1, 2, 3, and 4 were removed; however, examination of Cylinder Nos. 5 and 6 revealed extensive damage to mounting surface of the associated cylinder and the engine case which precluded removal. The nuts associated with the through bolts and cylinder studs were painted in the same color as the engine case and no evidence was found indicating that any of the cylinders had been removed since assembly. Cylinder No. 6 connecting rod remained connected to the piston by the piston pin; however, the connecting rod was separated from the crankpin journal. The connecting rod cap was not attached to the connecting rod. The connecting rod was deformed at the yoke. The shank and threaded portion of one connecting rod bolt remained trapped in the deformed portion of the connecting rod, and the head portion of the bolt was separated. The head portion of the bolt was bent, fractured, and tapered. Approximately the last 3 to 4 threads of the bolt visually appeared undamaged, while numerous threads toward the shank portion of the bolt were damaged; the associated nut was not present on the bolt. The inside of the case in the vicinity of Cylinder Nos. 5 and 6 had extensive scoring and gouge marks indicative of rotation and failure of the connecting rod. All other cylinders appeared normal;

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however, rotation was not able to be achieved due to internal damage noted through the breached hole in the engine case. The oil pan was removed and contained about 4 ounces of black oil and metal fragments. The fragments were recovered, examined, and appeared to consist of part of the engine case, part of the piston, main bearing, and the nut that was absent from the connecting rod attach bolt; however no other bolt was definitively identified. Cylinder No. 6 was cut between the cylinder barrel and cylinder head to facilitate the removal of the piston. Examination of the other cylinder connecting rods and main bearings were unremarkable and oil was present on all surfaces.



Photo 5: Cylinders No. 1, 3, and 5



Photo 6: Cylinders No. 2, 4, and 6

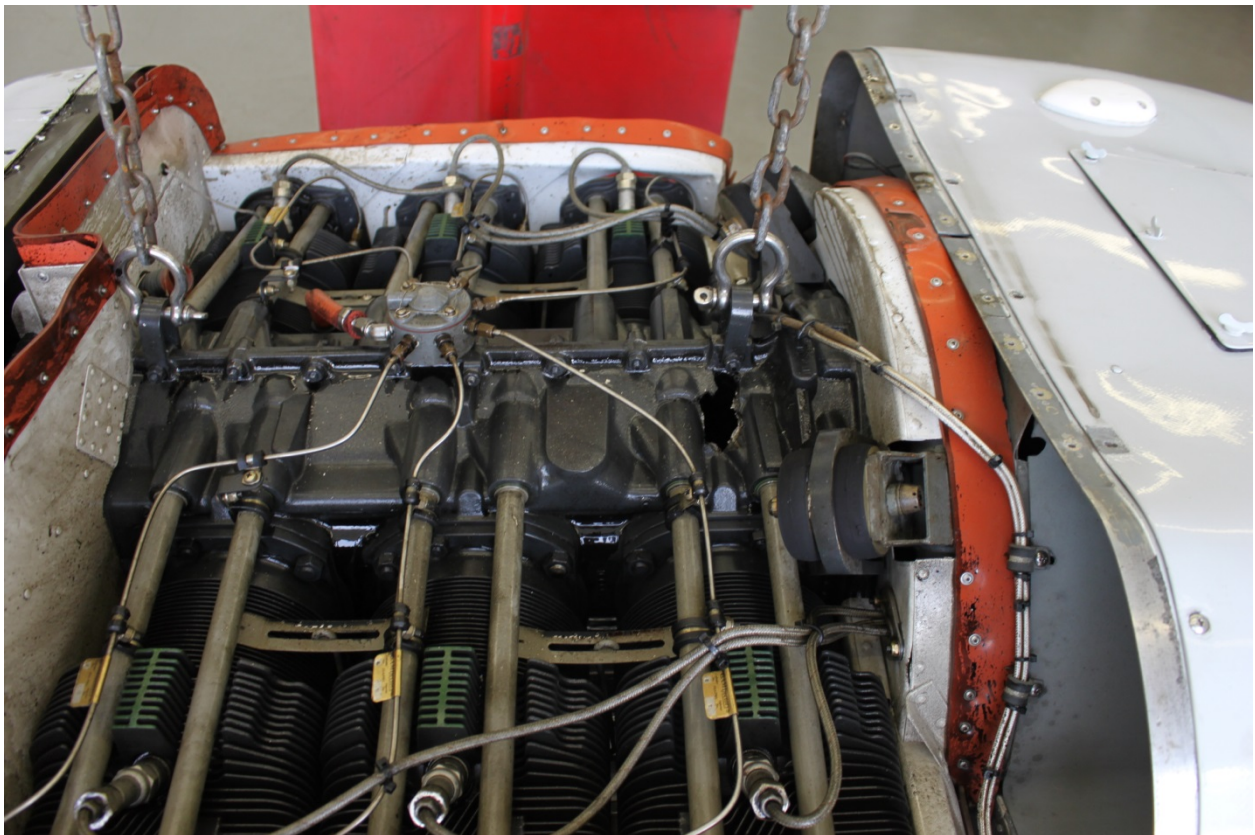


Photo 7: Top of Engine with Breach in Case in the Vicinity of Cylinder No. 6



Photo 8: Engine Data Tag on Oil Pan

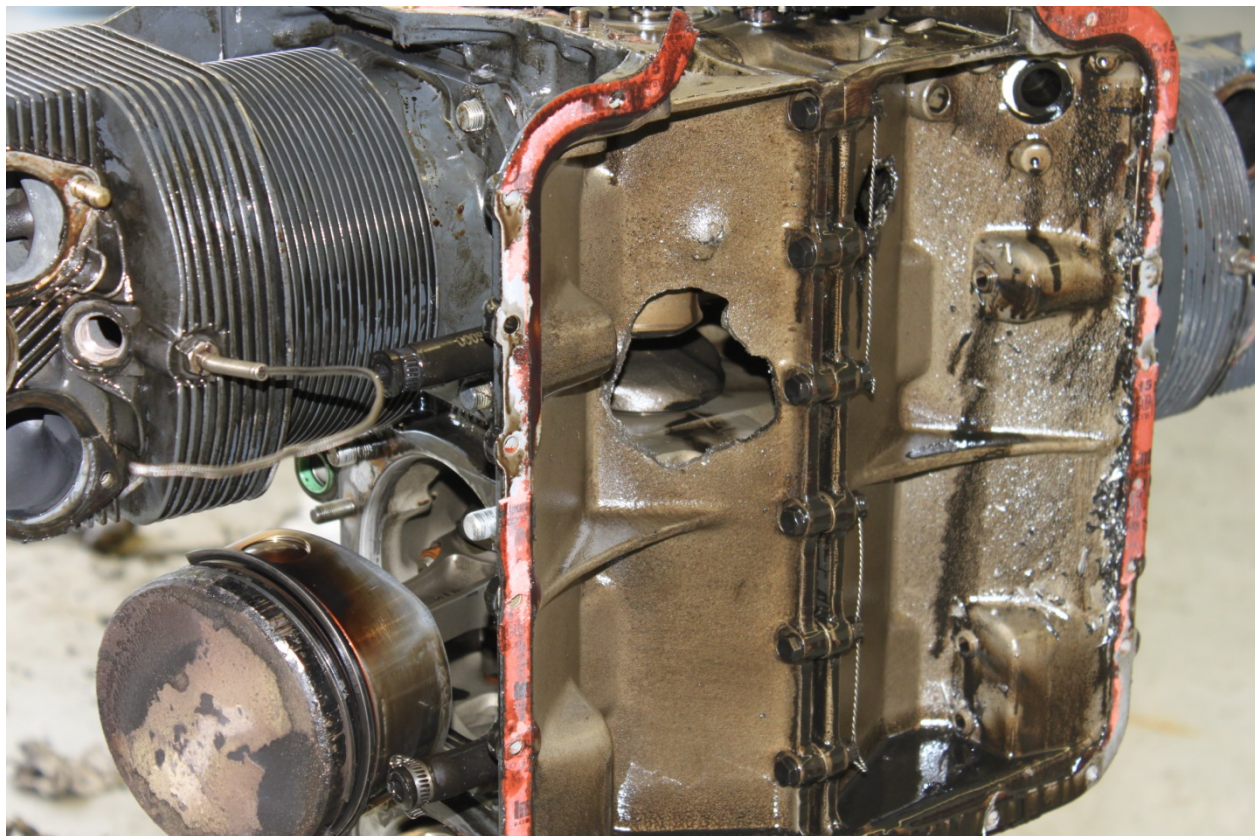


Photo 9: Two (2) Breaches in Bottom of Engine case as Viewed after Removal of Oil Pan

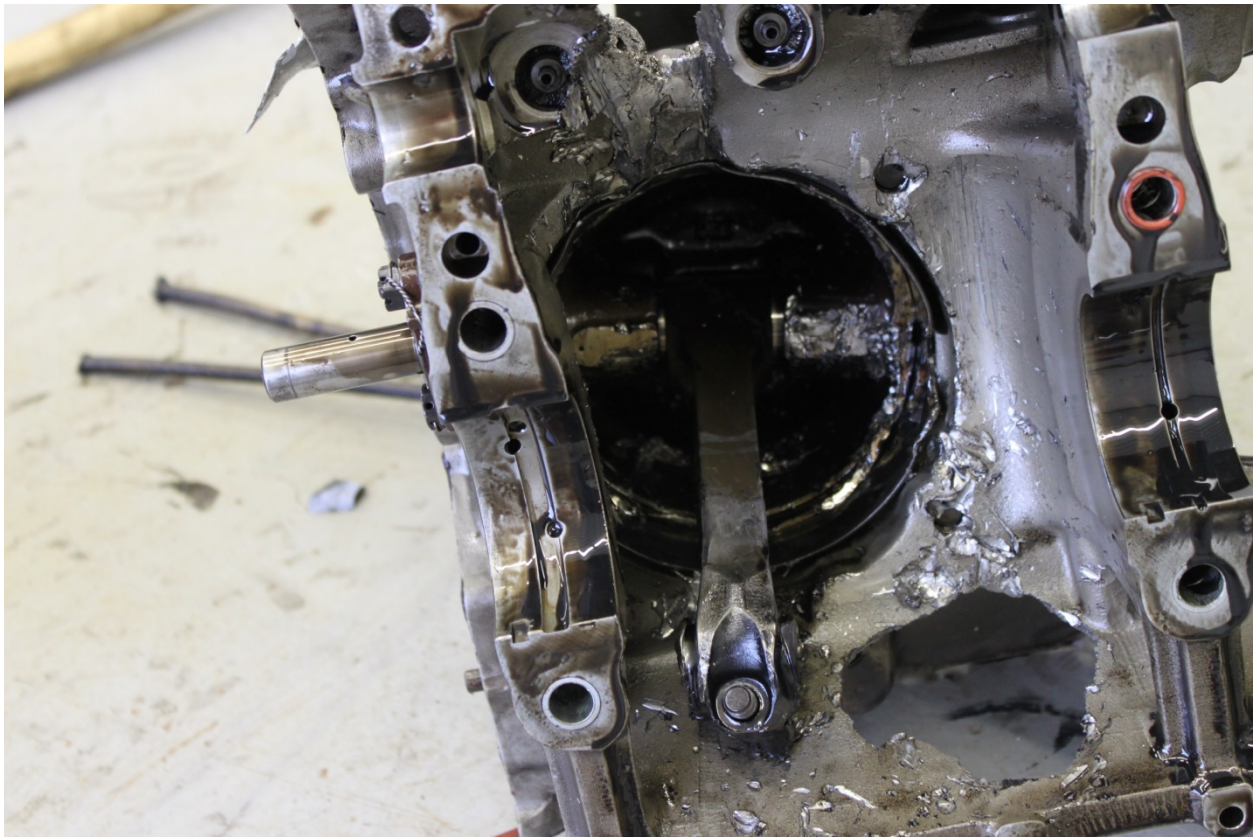


Photo 10: Cylinder No. 6 after Engine Case was Split



Photo 11: Cylinder No. 6 Arm with Bolt attached and Nut found in the Bottom of the Oil Pan

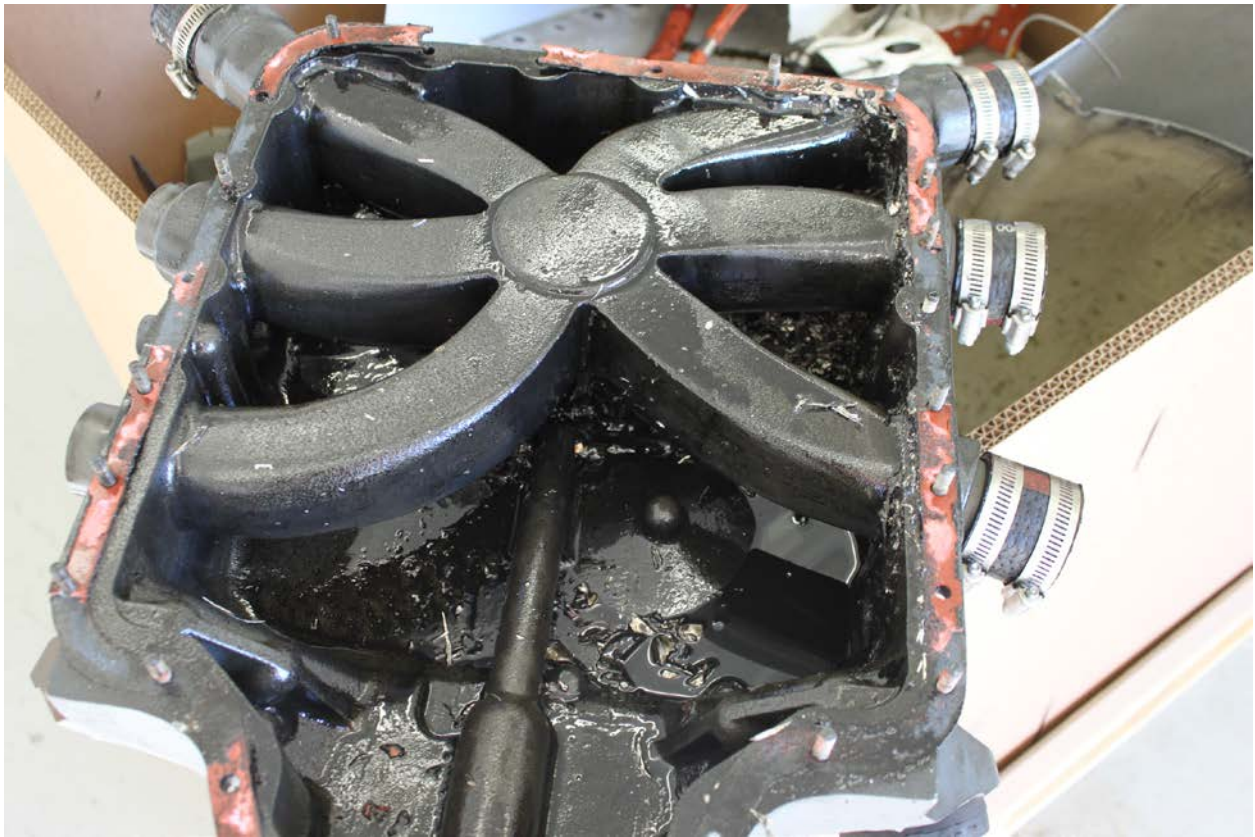


Photo 12: Oil Sump with Debris

Camshaft

The camshaft was removed and exhibited torsional overload stress fracture near one of the camshaft lobes near the camshaft rear main journal, which would have been in the area of Cylinder No. 6.



Photo 13: Camshaft After Removal from Engine Case



Photo 14: Fracture Surface of the Camshaft

Crankshaft

The crankshaft remained attached to Cylinder No. 5 after removal of the even numbered cylinders crankcase half as Cylinder No. 5 was damaged to the extent that removal of that cylinder would have required cutting of potential future examination needs. The crankshaft section associated with Cylinder Nos. 1, 2, 3, and 4 appeared unremarkable and intact; however, the section of the crankshaft associated with Cylinder Nos. 5 and 6 exhibited scoring and gouging along the circumference of the shaft. Visual continuity could be confirmed from the propeller flange, through the crankcase, to the accessory pad.

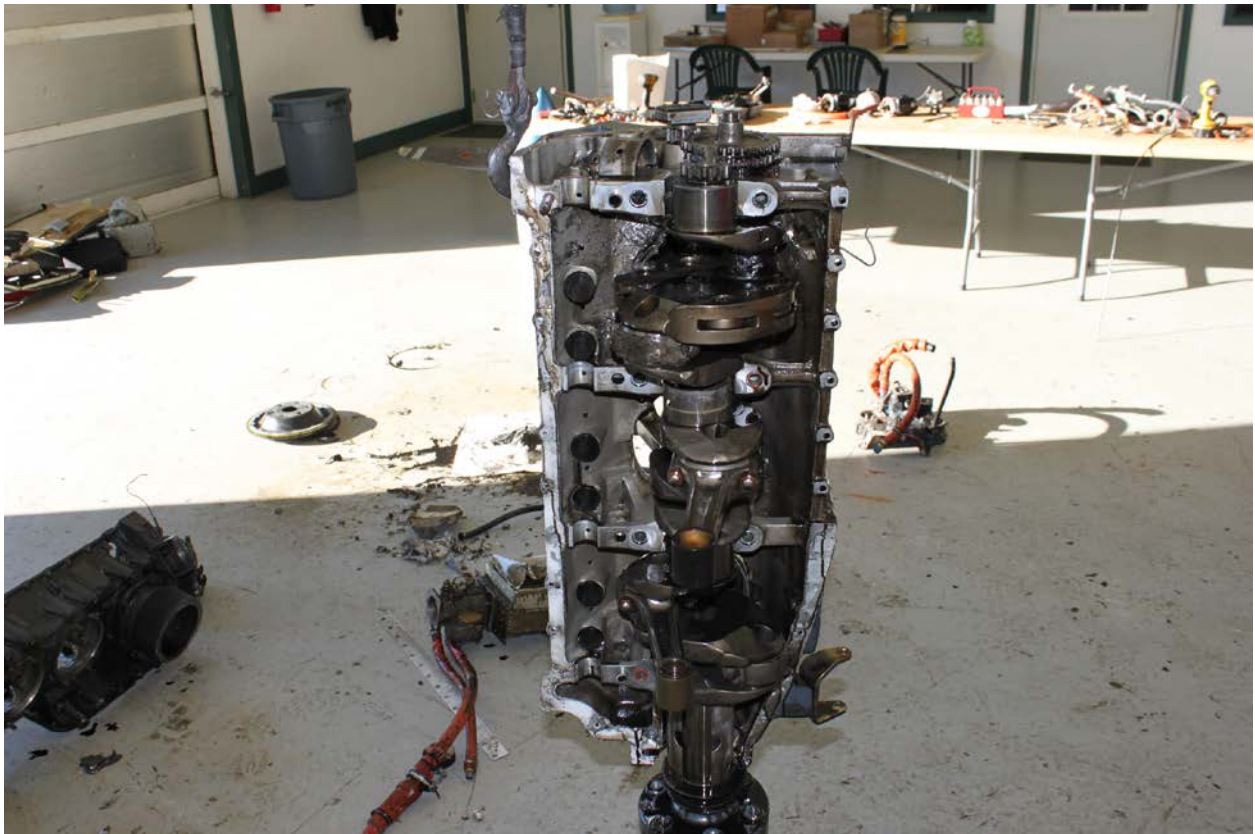


Photo 15: Crankshaft with the Odd numbered Cylinder Case Half Attached

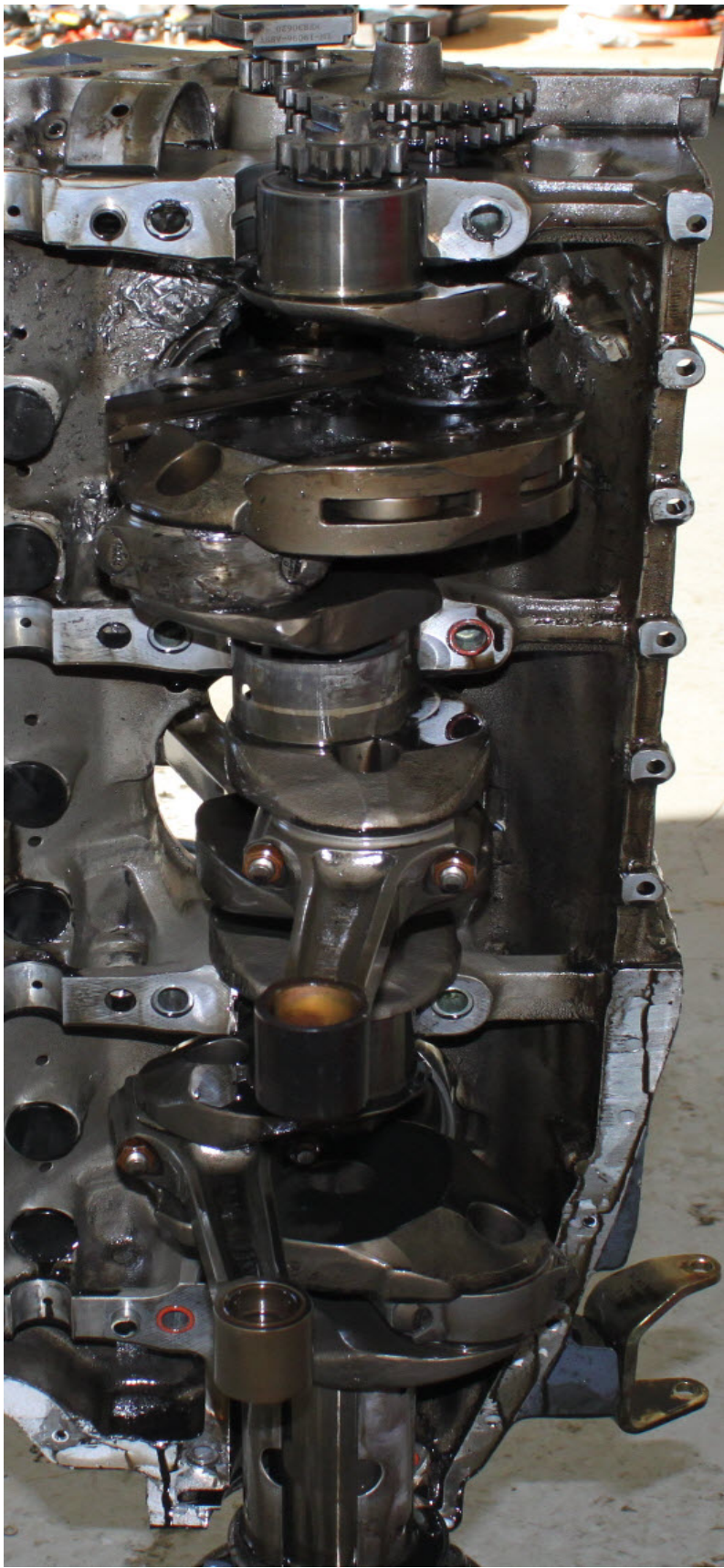


Photo 16: Expanded View of Picture Above

Spark Plugs

The spark plugs were removed and placed in a spark plug tray. The 6 top spark plugs and 6 bottom spark plugs were manufactured by Champion and were an REM40E. The plugs appeared to be oil coated and some especially those on the odd cylinder numbers side and installed on the bottom side of the cylinder, had oil present. According to the recovery personnel the engine was stored on its side pending the examination; however, it could not be definitively recalled as to which side of the engine was the lowest side. The even numbered cylinder's sparkplugs were dark in color and had normal wear when examined.



Photo 17: Champion Spark Plugs after Removal

Vacuum Pump

The vacuum pump was manufactured by RAPCO and had a part number of RAP215CCv , Serial Number A46095. The vacuum pump remained attached and when rotated smoothly by hand produced a suction. The vacuum pump was not disassembled and exhibited no damage.

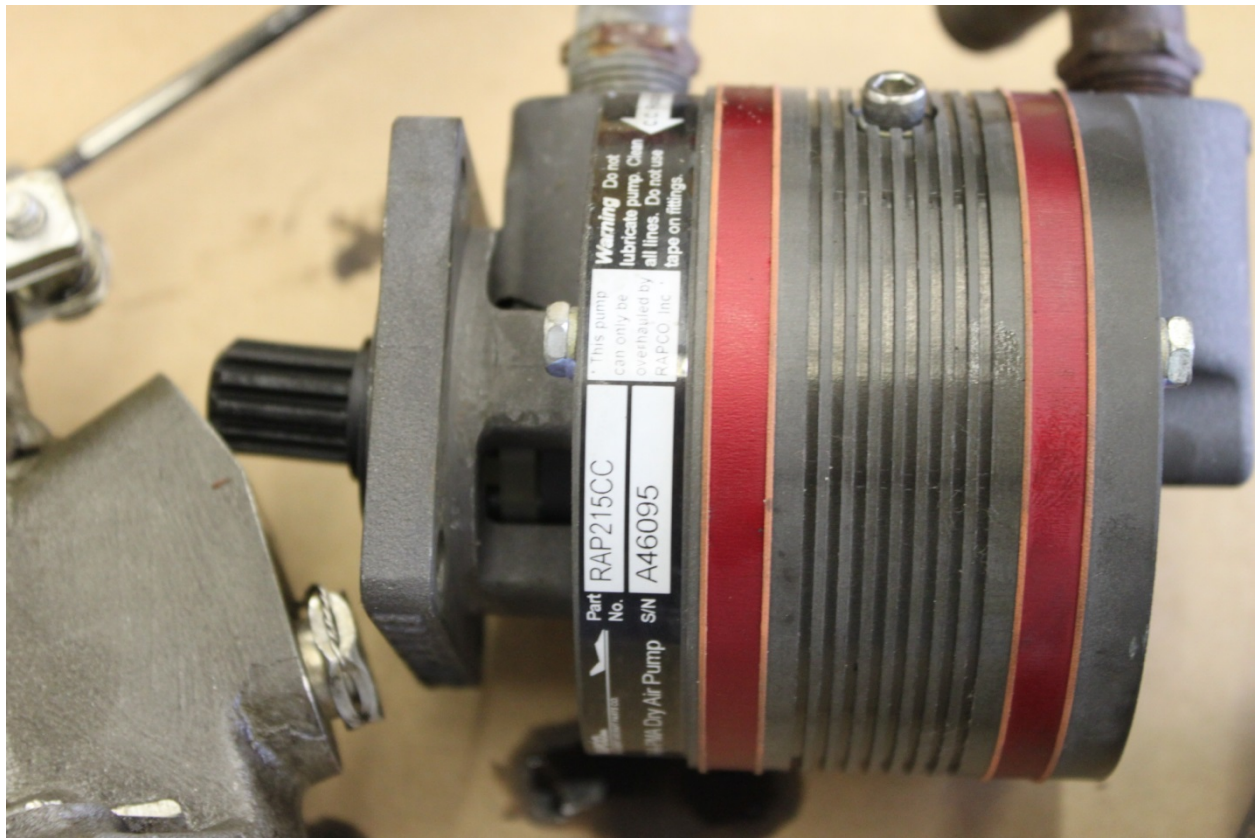


Photo 18: Vacuum Pump after Removal

Magnetos

The magnetos had a remanufactured label affixed to them and were labeled LH and RH. The magneto labeled LH was a Slick Magneto; Model Number 6393, and a Serial Number 11031405. When the LH magneto's coupling was rotated by hand spark was generated from the associated towers and it rotated smoothly with no noticeable binding. The magneto labeled RH was a Slick Magneto; Model Number 6350, and a Serial Number 11090906. When the RH magneto's coupling was rotated by hand spark was produced on all towers with no noticeable binding.



Photo 19: Left Magneto after Removal



Photo 20: Right Magneto after Removal

Propeller Governor

It was a Woodward Propeller Governor; Part number 210932 and a Serial No. 2168154. The unit was rotated by hand and operated smoothly.



Photo 21: Woodward Propeller Governor after Removal

Fuel Manifold

The fuel manifold was manufactured by Bendix, Part number 75283, Serial Number 25242232. The unit remained attached to the top of the engine case and all injectors remained attached their respective cylinders. No noticeable damage was noted to the fuel cylinder and when disassembled the gasket remained attached and also exhibited no damage. A liquid was observed similar in smell and color to 100LL aviation fuel, dripping from the injector labeled as cylinder 1.

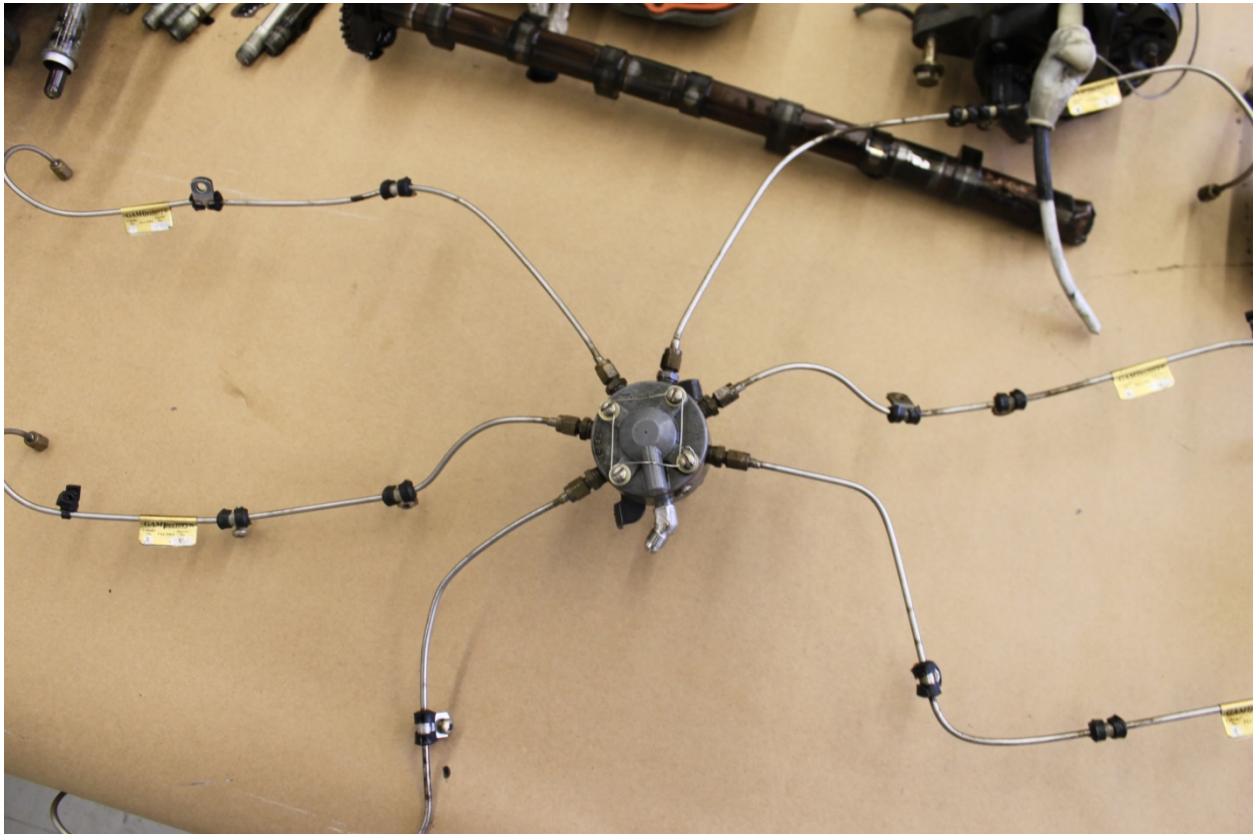


Photo 22: Fuel Manifold after Removal

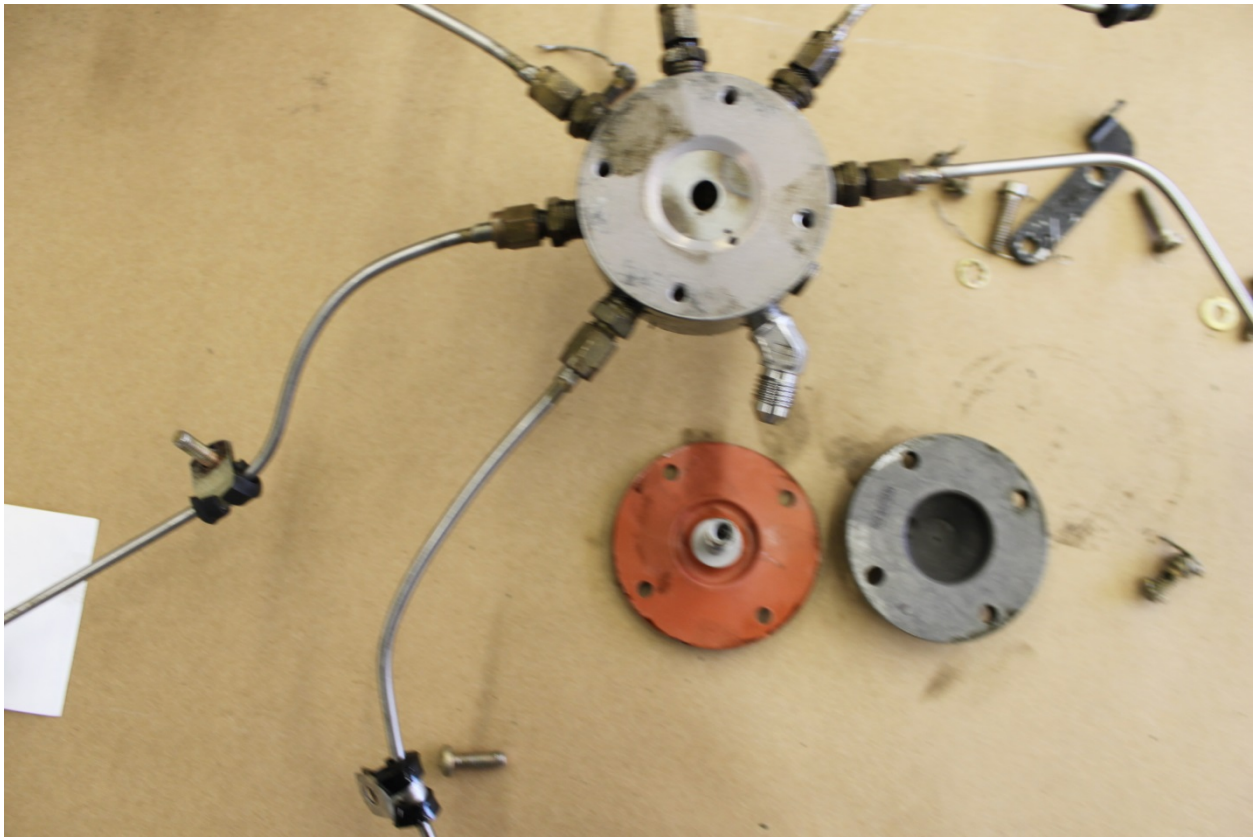


Photo 23: Fuel Manifold after Disassembly

Engine Oil Cooler

The engine oil cooler/heat exchanger was manufactured by Pacific Oil Cooler Service; Part No. 10599R; Serial No. 5783 with a date stamped on the case of "APR 09 2009." The oil cooler remained attached, was free of debris, and was noted as unremarkable. There was no evidence of oil leaking from the oil lines or the associated fittings.



Photo 24: Oil Cooler/Heat Exchanger

Engine Oil Filter

The oil filter remained attached to the accessory pad. The filter had a handwritten date of "6/11/13" written on it with a handwritten "Hobbs" time of "1636." The filter was removed; however, was not cut open as the examination was concerned of adding particulate matter to the filter paper with the improvised tools available. The suction screen was examined and appeared normal and no particulate matter was visible.



Photo 25: Oil Filter after Removal

FUTURE ACTIVITIES

Cylinder No. 6 connecting rod, bolt, nut, and piston head have been retained by the NTSB (reference Evidence Control NO. ERA13LA382 – Exam – 001) and will be sent to the NTSB's material laboratory for further examination. The examination will attempt to determine failure mode of the assembly as well as examine the threads on both the bolt and nut to determine if the proper torque had been applied.



Photo 26: Retained Items (Reference Evidence Control No. ERA13LA382 - Exam - 001