



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety

Western Pacific Region

April 5, 2021

Engine Examination Summary

WPR20LA191

ACCIDENT:

Location: Hayden, ID
Date: June 23, 2020
Aircraft: Enstrom 280FX., Registration Number: N280MM, Serial #: 2099
NTSB IIC: Albert Nixon

EXAMINATION PARTICIPANTS:

Albert Nixon
Senior Aviation Accident Investigator
National Transportation Safety Board
Federal Way, WA

Mark Platt
Air Safety Investigator
Lycoming Engines
Williamsport, PA

EXECUTIVE SUMMARY

The engine examination was accomplished at the facilities of Air Transport in Phoenix, Arizona, on April 5, 2021. The examination revealed that the No. 3 cylinder's bottom spark plug was missing a portion of its center electrode and the No. 4 cylinder's bottom spark plug was missing its center electrode. Additionally, the No. 2 cylinder exhibited a sandblasted appearance consistent with detonation and the No. 4 cylinder exhibited signatures and damage consistent with detonation on the cylinder head and piston. No other additional anomalies that would preclude normal operation were observed during the examination of the engine.

ENGINE

Examination of the Lycoming HIO-360-F1AD engine revealed that it was thermally damaged, exposed to fire suppression, and had corrosion. External examination of the engine revealed no evidence of preimpact catastrophic mechanical malfunction.

The No. 1 cylinder's rocker cover was damaged and had separated from the engine. The Nos. 2, 3, and 4 cylinder's rocker covers were removed. Examination of the valve train within the rocker box area revealed no mechanical malfunction or anomalies. The top and bottom spark plugs were removed and examined. The examination revealed that the top sparks plugs displayed normal wear signatures. The No. 1 cylinder's top sparkplug was coated with rust. Examination of the bottom spark plugs revealed that the No. 3 cylinder's bottom spark plug was absent a portion of the center electrode and the No. 4 cylinder's bottom sparkplug electrode was not present. Utilizing the spark plug openings, a borescope examination of the combustion chambers and cylinder walls revealed no evidence of foreign object ingestion.

Manual rotation of the engine was unable to be accomplished due to thermal damage sustained. Holes were drilled in the crankcase to facilitate internal examination with a borescope. The borescope examination of the crankshaft, connecting rods, and cam lobes revealed that the

crankshaft was intact, the crankshaft and attached connecting rods were free of heat distress, and the cam lobes were undamaged.

The fuel injection servo was attached and was thermally damaged. The fuel servo was disassembled and examined. Examination revealed that the internal diaphragm was thermally damaged, but the fuel metering stem and ball remained intact. The fuel flow divider remained secure and was disassembled. All the fuel injection nozzles were removed and examined. The Nos. 1 and 2 cylinder's nozzles were partially obstructed at their discharge end consistent with external contamination that was caused by the displacement of the induction tubes of each respective cylinder.

The fuel pump remained attached at its mounting pad and was thermally damaged. The fuel pump was removed, and the drive splines, internal rotor, vanes, and turbocharger oil scavenge pump were intact.

The single drive dual magneto was not attached to its mounting pad and not available for examination. The ignition harness sustained thermal damage.

The starter and alternator remained attached to their respective mounting pad and sustained thermal damage.

The oil suction screen was found secured and examination revealed it was clear of contaminants. The oil filter was thermally damaged. It was removed and examination of the filter element revealed that it sustained thermal damage but was clear of any visible contamination.

The accessory case was removed, and the accessory gears were examined with no anomalies noted. The oil pump drive was manually rotated.

The cylinders were removed and examined. Examination revealed that the Nos. 1 and 3 cylinder's combustion chambers exhibited signatures consistent with sustaining thermal damage and being exposed to firefighting suppression. The No.1 cylinder's piston rings were intact but were frozen from corrosion within their respective ring lands. The No. 3 cylinder's piston rings were intact and moved within their respective ring lands and no anomalies were noted. The No. 2 cylinder's head was observed to be absent of any carbon build-up and exhibited a sand blasted appearance consistent with detonation. The piston rings remained intact and moved within their respective ring lands. The No. 4 cylinder exhibited severe signatures of detonation to the cylinder head and piston. The piston was noted to have melted along its edge which compromised the ring lands and rings. Additionally, the piston skirt material was smeared.



Figure 1: No. 2 cylinder piston head as viewed from the top.



Figure 2: No. 4 cylinder piston head as viewed from the top side.



Figure 3: No. 4 cylinder piston head as viewed from the side.



Figure 4: The bottom spark plugs electrodes.

The turbocharger system components remained secured at their respective mountings. The turbocharger had sustained thermal damage. The turbine and compressor blades exhibited no evidence of foreign object ingestion. Each exhaust system clamps were secured. The butterfly valve at the exhaust bypass valve (wastegate) was intact. No oil residue was observed in the exhaust gas path.

Submitted by
Albert Nixon