

NTSB AIRFRAME AND ENGINE EXAMINATION

**NTSB Investigation: ERA21LA309
N36DK, Enstrom 280FX
Lycoming HIO-360-F1AD (S/N L-32665-51A)
Operated by BETA AIR LLC**

DETAILS OF THE EXAMINATION

The wreckage was located in a shipping container at the operator's facility. The NTSB was not present when the wreckage was removed from the accident site. Permission was given to recover the helicopter and store it for this examination. It was examined by the NTSB investigator-in-charge on September 8 and 9, 2021, with representatives from Beta Air LLC, Enstrom Helicopters, and Lycoming Engines participating in the examination.

AIRFRAME

The majority of the airframe displayed significant fire damage and the fiberglass body of the helicopter was nearly entirely destroyed by fire. The seats in the cockpit were destroyed by fire. The rudder pedals remained installed. The magnetos were found selected to both as indicated by the key position. The fuel shutoff valve was found in the OFF (not engaged) position. The mixture lever was found pulled toward the idle-cut-off position. The cockpit instruments displayed fire damage and were not readable. The electronic engine instrument was consumed by fire. The firewall displayed thermal damage and it displayed impact crushing on its lower left¹ side.

The No. 1 and 2 main rotor blades displayed thermal damage, bending, and impact damage witness marks. The No. 3 rotor blade remained relatively straight and had little thermal damage. One tail rotor blade displayed impact damage.

ENGINE

The powerplant was a four-cylinder, air cooled, direct drive, supplemental type certificated turbocharged, helicopter, fuel injected, horizontally opposed engine rated for 190HP @ 3050RPM.

The entire engine displayed significant thermal damage. The top of the engine was sooted black. The greatest thermal damage was located around the No. 3 cylinder, which was the forward left portion of the engine, near the turbocharger location.

The flexible fuel and oil lines all displayed significant thermal damage, and some were destroyed by fire. The metal fuel lines connecting to their respective attach points were found secure.

The engine's cylinders, valves, rods, and spark plugs all had varying degrees of fire damage, however, no evidence of preimpact mechanical malfunctions were observed.

¹ All left and right references in this report refer to airframe left/ right.

The rocker box covers were removed and visually examined. The exhaust rocker bosses of the No. 3 cylinder were broken, however, no pushrod tubes were bent. All cylinders were borescoped and cylinders 1 and 3 showed carbon material flaked off and laying in the bottoms of the cylinders.

The engine crankshaft would not rotate when force was applied to the crankshaft. The accessory housing was removed from the engine and photographed. Cylinders 1 and 3 were removed to establish valve train continuity. Cylinder No. 3 would not pull away from the piston and was removed by removing the connecting rod bolts and connecting rod. Cylinder #1 once removed was photographed and no discrepancies were noted. The piston of cylinder No. 3 was not capable of being removed, likely due to excessive surface corrosion found within the engine.

The connecting rod bearings for No. 3 cylinder appeared normal. With both No. 1 and 3 cylinders removed; valve train continuity was visually established. Engine rotation was attempted again, and the crankshaft did rotate. The crankshaft, camshaft, and tappet bodies displayed surface corrosion.

Fuel System

The fuel injector unit was destroyed during the fire sequence. The throttle and mixture control cable attachments remained. A portion of the injector unit remained attached to the firewall.

The flow divider remained attached to the top of the engine with the fuel injector lines properly secured. The unit was photographed and removed for further examination. The part number and serial number were not legible. The diaphragm was destroyed by fire.

The fuel injector nozzles remained in their respective cylinder heads. The No. 3 cylinder nozzle was loose due to damage to the cylinder head from the thermal forces. The nozzles were unobstructed when removed from the cylinder heads for visual examination.

The fuel pump remained attached to the turbo scavenge pump but was destroyed by the fire.

Spark Plugs, Magnetos, Starter

The dual magneto remained secured to the back of the engine but was destroyed by the fire. It was removed and photographed.

The Tempest spark plugs remained installed in their respective cylinder heads. The spark plugs were removed for further examination. The bottom number 4 plug was not removed due to minor impact damage. The electrode was examined during the cylinder borescope inspection and appeared to be undamaged/normal.

The spark plugs displayed normal coloration when compared to the Champion Aerospace Aviation Check-A-Plug AV-27 chart.

The starter harness was destroyed by fire. The starter data plate was not located. The starter remained attached to the engine. The starter drive was engaged with the starter ring gear.

Oil System

The oil suction screen remained safety wired in place, and it was removed for further examination. The suction screen contained minor carbon. The oil filter remained attached to the engine accessory housing and showed signs of thermal damage to the exterior. The unit was

loose as a likely result of the fire. The filter was cut open and photographed. The element was destroyed by fire, no contamination was noted inside of the remaining filter element. The engine oil dipstick was loosely attached to the engine and the filter tube cap was missing.

The oil coolers were destroyed by the fire sequence. The turbo scavenge pump remained attached to the accessory housing. The unit was damaged by thermal forces.

Liquid oil was only found under the oil pressure relief valve assembly. No other liquid oil was found in the engine.

Turbocharger

The turbo system added by Enstrom helicopters remained mostly attached to the right aft portion of the engine. The outer portion of the turbocharger displayed significant thermal damage. The turbocharger exhaust and inlet clamps remained installed, their safety wire was present, and the clamps remained tight. The turbocharger was partially disassembled, and its core appeared unremarkable.

SUMMARY

There was no evidence that the engine suffered a catastrophic engine failure that would have contributed to a loss of engine power or engine fire. There was no evidence that the exhaust system and its associated clamps at the turbocharger location were a factor in the accident. There was no surviving evidence that allowed for the evaluation of the fuel and oil lines that may have contributed to the reported in-flight fire.

The fire damage was the most severe near the forward left portion of the engine compartment, which was near the location of oil lines, the turbocharger and exhaust, and the oil dipstick.

APPENDIX A: PHOTOGRAPHS



Photo 1: Overview of the engine

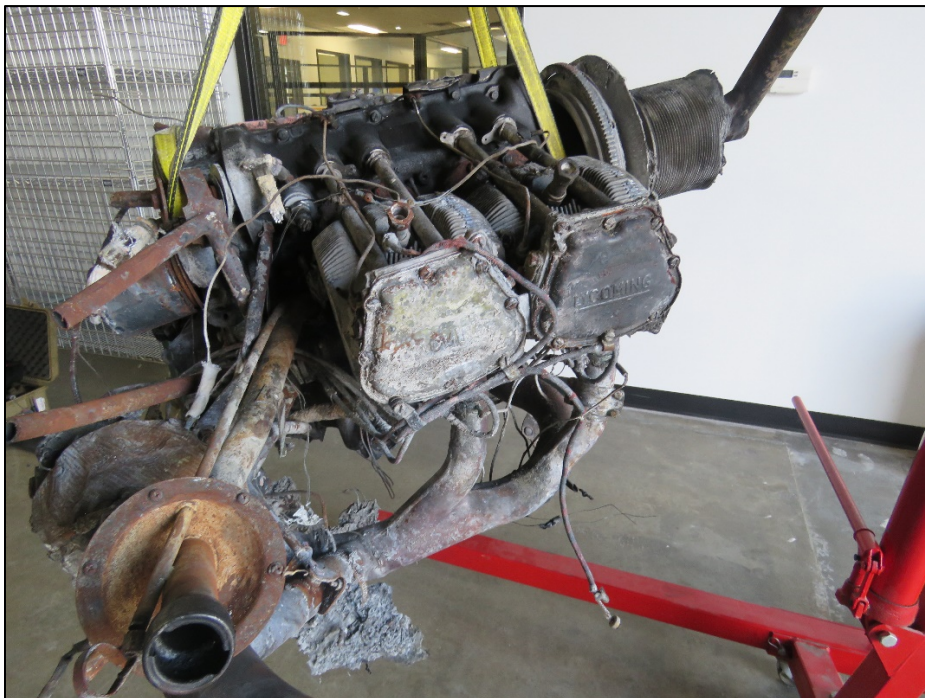


Photo 2: Overview of the turbocharger side of the engine



Photo 3: Overview of the engine cylinders



Photo 4: View of the cylinder valves

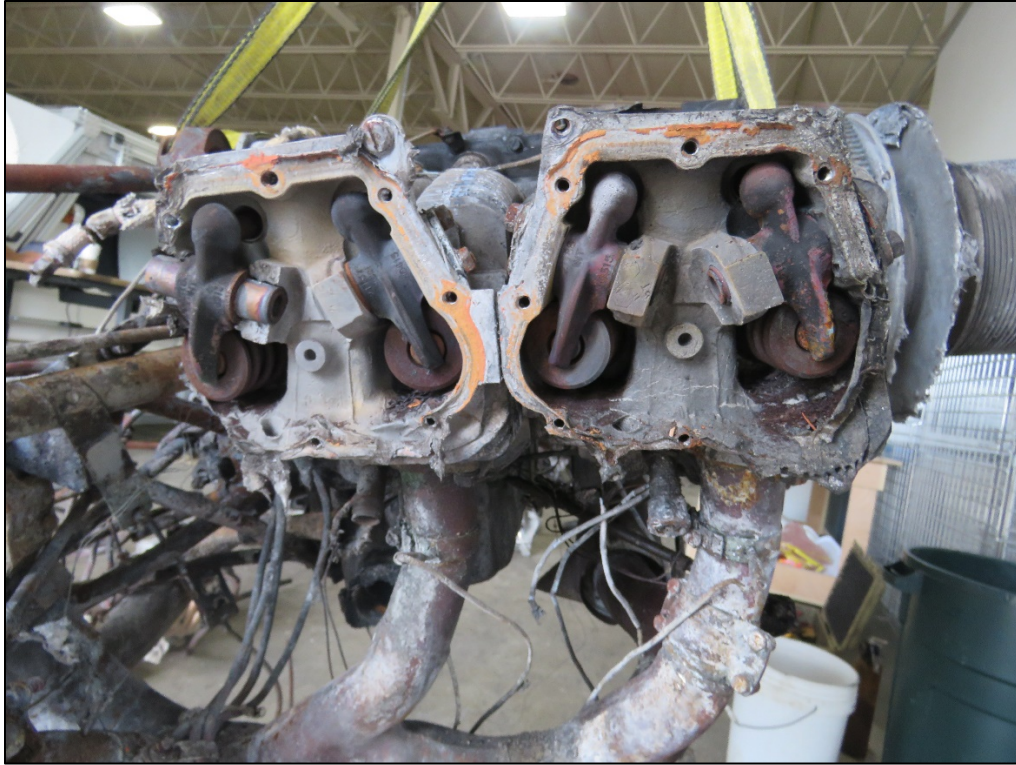


Photo 5: View of the engine cylinders



Photo 6: Accessory section of engine and view of damaged oil and fuel hose lines



Photo 7: View of the turbo charger



Photo 8: View of the turbo charger with fire debris removed from its outer area



Photo 9: View of the exhaust clamps at the turbocharger