Continental Motors

ENGINE EXAMINATION REPORT

ENGINE MODEL	TSIO-520-NB
ENGINE SERIAL NUMBER	519303
AIRCRAFT MAKE & MODEL	Cessna 414A
AIRCRAFT SERIAL NUMBER	414A0495
AIRCRAFT REGISTRATION	N789UP
FILE NUMBER	14-488

NAME	SIGNATURE	DATE
Phillip Grice	[redacted]	09/01/2015
Nicole Charnon	[redacted]	09/01/2015

GENERAL INFORMATION

EXAMINATION		ACCIDENT DATA	
DATE	09/01/2015	**NTSB ACCIDENT #**	CEN15FA190
FACILITY	Continental Motors	**NTSB INVESTIGATOR**	Todd Fox
ADDRESS	[redacted] Mobile, AL 36615	**FAA INVESTIGATOR**	Stanley Swank II
		ACCIDENT DATE	04/07/2015
		ACCIDENT LOCATION	Bloomington, IL

ENGINE INFORMATION

ENGINE POSITION	Right Engine
TOTAL TIME	5,592.9 hours at time of accident*
TIME SOH	1,684.3 hours at time of accident*
TYPE & TIME SLI	Last Annual Inspection 10/01/2014, 43.3 hours prior to accident*
BUILD DATE	08/31/1979
IN SERVICE DATE	Unknown

Report Summary: Search Code(s): 15-12-68

There were no pre-impact anomalies observed with the engine or engine-related components that would have affected the engine's ability to produce full, rated power.

Disposition of engine following exam:

The NTSB investigator-in-charge released the engine and its turbocharger components to be returned to the facility where the remaining wreckage is being stored.

Significant logbook information:

*According to the NTSB investigator-in-charge (IIC) the Hobbs meter was not legible at the accident site. However, the NTSB IIC indicated that at the time of the accident, the Hobbs meter should have read 2111.6 hours (this time was calculated using the maintenance entry from the point of Hobbs meter replacement, plus the Hobbs times listed in the maintenance entries since the Hobbs meter replacement, the flight log observed at the accident site, as well as the two legs of the accident flight).

The engine was built on August 31, 1979. Review of the engine maintenance records revealed that the engine underwent a RAM Aircraft Corporation conversion/overhaul at an engine total time of 2,855.1 hours on July 10, 1996, and was installed in the accident airplane's right nacelle on July 20, 1996.

On September 24, 1998, a new Hobbs meter was installed on the accident airplane after the engine accumulated 624.3 hours since the RAM overhaul.

On June 13, 2000, at a Hobbs time of 411.7 hours and 1,036 hours since the RAM overhaul, the engine underwent another overhaul where it received a replacement crankcase and cylinders from Superior. The maintenance entry for that overhaul indicated that the engine total time was 3,908.6 hours, but the calculated time based on the recorded Hobbs meter times indicated that the engine total time should have been 3891.1 hours.

On September 1, 2010, at a Hobbs time of 1,882.7 hours (1,471 hours since the last overhaul and an engine total time of 4,326.1 hours), the engine was "disassembled and cleaned" and a number of core engine components were replaced. The reason for disassembly was not indicated in the maintenance entry.

Since the last overhaul, the engine underwent routine maintenance, oil changes, and annual inspections. The last annual inspection took place on October 1, 2014, at a Hobbs meter time of 2,068.3 hours (1,656.6 hours since the last overhaul and 185.6 hours since its last engine disassembly/repair).

INSPECTION WITNESSES

NAME	Phillip Grice	**NAME**	Matthew Phillips
ADDRESS	Mobile, AL	**ADDRESS**	Mobile, AL
ORGANIZATION	Continental Motors	**ORGANIZATION**	Continental Motors
PHONE	[redacted]	**PHONE**	[redacted]
NAME	Greg Eastburn	**NAME**	Nicole L. Charnon
ADDRESS	Mobile, AL	**ADDRESS**	Washington, DC
ORGANIZATION	Continental Motors	**ORGANIZATION**	Continental Motors
PHONE	[redacted]	**PHONE**	[redacted]
NAME	Todd Fox	**NAME**	David Slaybaugh
ADDRESS	Chicago, IL	**ADDRESS**	Springfield, IL
ORGANIZATION	NTSB – Central Region	**ORGANIZATION**	FAA – Springfield FSDO
PHONE	[redacted]	**PHONE**	[redacted]
NAME	Les Doud	**NAME**	Rick Roper
ADDRESS	Piqua, OH	**ADDRESS**	Waco, TX
ORGANIZATION	Hartzell Propellers, Inc.	**ORGANIZATION**	RAM Aircraft
PHONE	[redacted]	**PHONE**	[redacted]
NAME	Ernie Hall	**NAME**	
ADDRESS	Wichita, KS	**ADDRESS**	
ORGANIZATION	Textron Aviation	**ORGANIZATION**	
PHONE	[redacted]	**PHONE**	

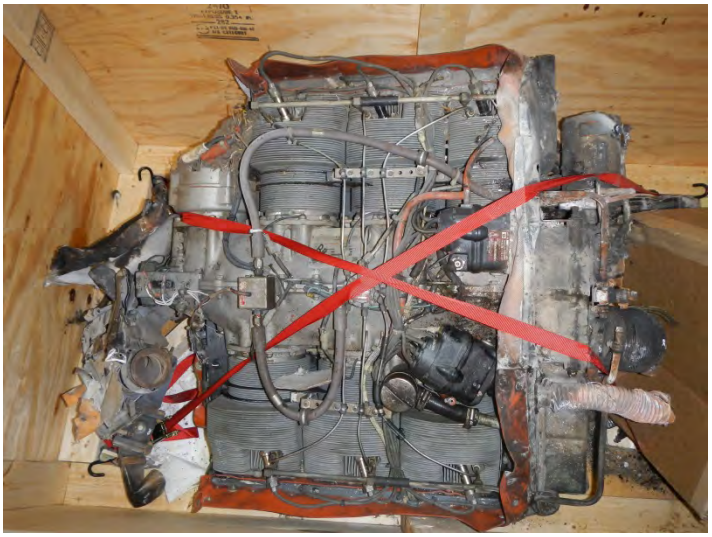
EXTERNAL INSPECTION OF ENGINE

The engine was shipped to Continental Motors in a wooden crate with a number of components, such as the turbocharger/wastegate, turbo controller, throttle body/fuel metering unit, engine-driven fuel pump and fuel pump coupling, removed from the engine and boxed separately within the crate. The propeller flange was separated from the crankshaft at the crankcase and was included with the boxed components. The portion of crankshaft that remained with the separated propeller flange displayed a bend in one direction with circumferential cracks noted on the tension side of the bend. The fracture surface associated with the tension side of the bend displayed a 45-degree lip. The fracture surface on the compression side of the bend was irregular and jagged in shape.

The left magneto was separated from its mounting pad and it was lying on the top of the engine still connected to the ignition leads. Its mounting flange was fractured and portions of the flange remained secured under the attaching hardware. The right magneto remained secured to its mounting flange. The ignition harnesses remained attached to their respective magnetos. The top sparkplugs were removed from the engine during the on-scene portion of the investigation.

The bottom side of the engine nacelle was crushed upward around the oil sump and remained with the engine. The intercooler remained attached to the engine/nacelle and was displaced upward into the backside of the engine. The oil sump was crushed from the bottom side up as were the exhaust manifolds and front side exhaust risers. The exhaust manifolds on both sides were flattened. The intake manifolds also sustained impact, puncture, and deformation damage on the bottom sides. The induction balance tube was flattened. The #2 and #4 pushrod shrouds were deformed upward.

The backside of the engine and its related components sustained thermal damage.




TELEDYNE
CONTINENTAL MOTORS
Aircraft Products Division
MODEL TSIO-520-NB
100-100LL GRADE MIN.
518305
UNDER ONE OR MORE OF THE FOLLOWING U.S. PATENTS
RPM 2700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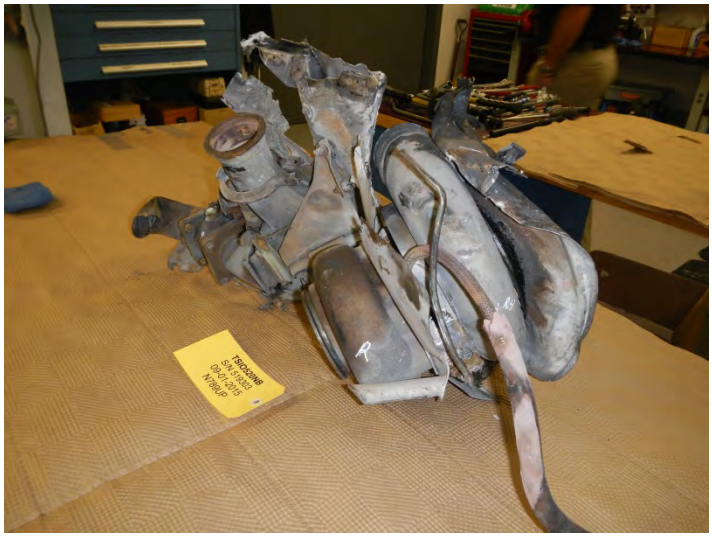
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INTERNAL INSPECTION OF ENGINE

FUEL SYSTEM COMPONENTS

According to the NTSB IIC, the engine-driven fuel pump was partially separated from the backside of the engine at the accident site. The NTSB IIC rotated the crankshaft prior to the complete removal of the engine-driven fuel pump. The drive coupling was found fractured. Close examination of the drive coupling revealed that the fracture surface was irregular in shape with bending observed adjacent to the fracture surfaces. Soot was also noted on the fracture surface. Examination of the fracture surface by a Continental Motors metallurgist revealed that the fracture was a result of overload.

The engine-driven fuel pump's fuel inlet fitting was fractured. The aneroid housing was fractured, displaced, and thermally damaged. Re-solidified molten metal was adhering to the safety wire. The pump was exposed the thermal stresses significant enough to char the diaphragm. Disassembly of the fuel pump revealed that the pump vanes were intact and no pre-accident anomalies were noted with the internal components.

The throttle body/fuel metering unit was thermally damaged and the mixture and throttle levers were bent. The throttle valve was near idle position. The inlet and return fittings were fractured. The fuel metering unit was removed from the throttle body and the fuel inlet screen was removed. Some debris consistent with soot and dirt was observed in the inlet area; however, the screen was clear and free from any obstructions. The metering unit sustained deformation damage that prevented the mixture shaft/cam from being removed. Besides the thermal damage and debris, no pre-accident anomalies were noted with the observed components.

The fuel injection nozzles were removed from the cylinders and none were obstructed. The nozzles were reattached to their respective lines and the fuel manifold valve and nozzles were taken to the production test stand for a flow test. The unit did not meet the production test standards as it flowed slightly lower than new standards throughout all test ranges; however, it did function properly throughout the test.


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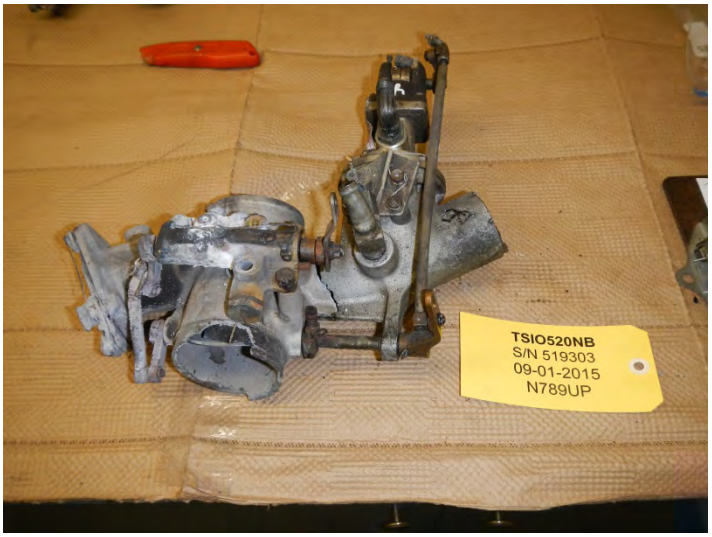
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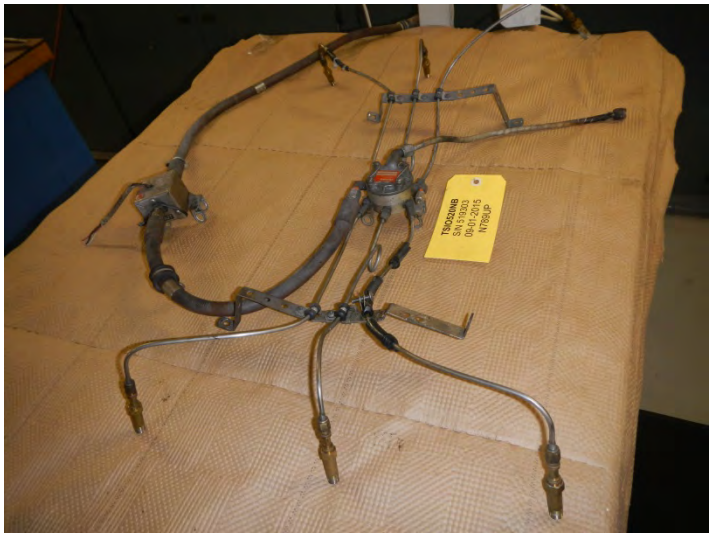

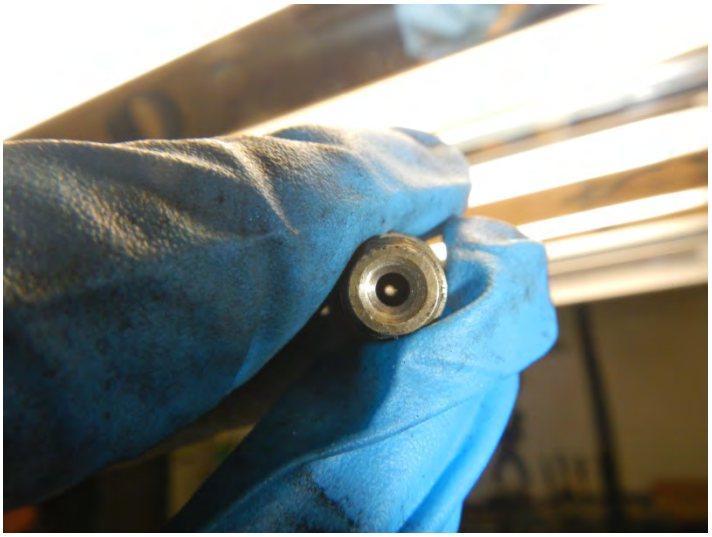

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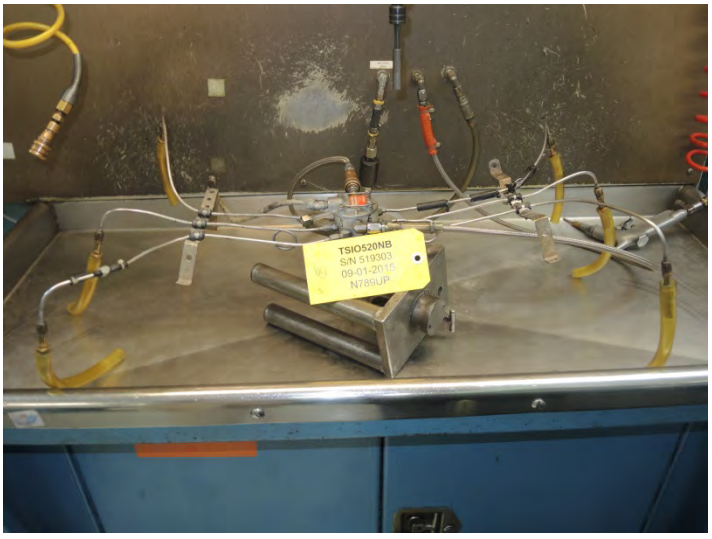
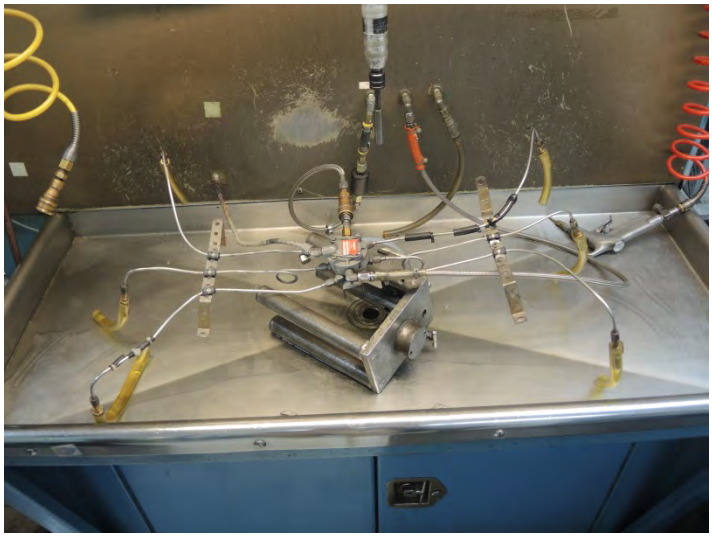
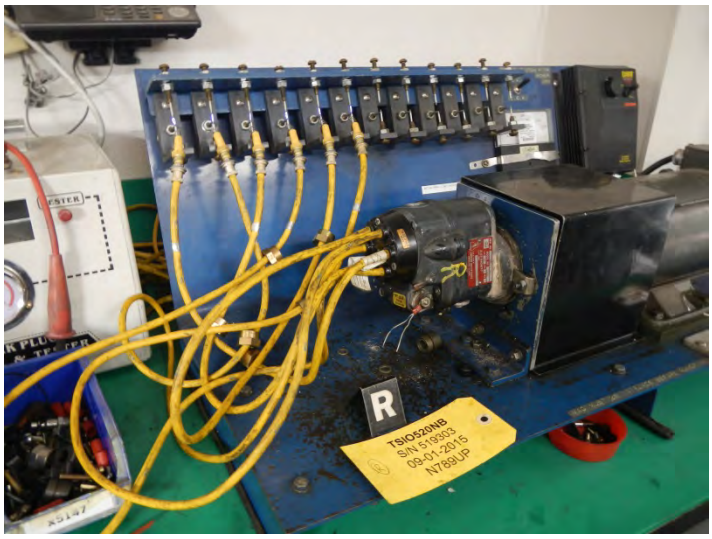




IGNITION SYSTEM

The left magneto was separated from its mounting pad but remained attached to its ignition leads. The magneto's mounting flange was fractured and deformed and was the drive gear boss. The right magneto remained in place and secured to the mount flange. The ignition harness sustained damage in the accident that separated a few leads. The terminal ends remained attached to their respective sparkplugs and the sparkplugs remained secured to their cylinders. The ignition harnesses were removed and the magnetos were placed on a test bench with replacement ignition harnesses. The right magneto produced a blue spark across a 7mm gap during all RPM ranges. The left magneto drive shaft would not rotate. Disassembly of the left magneto revealed that the drive gear shaft was displaced within the housing. No pre-accident anomalies were noted with either magneto.

The top sparkplugs were removed during the on-scene portion of the investigation. All of the sparkplugs were removed and they all displayed little-to-no wear. They were all covered with normal combustion deposits, and the #2 and #4 bottom sparkplugs displayed solidified material on the electrodes and insulator, but there was no sign of fouling.

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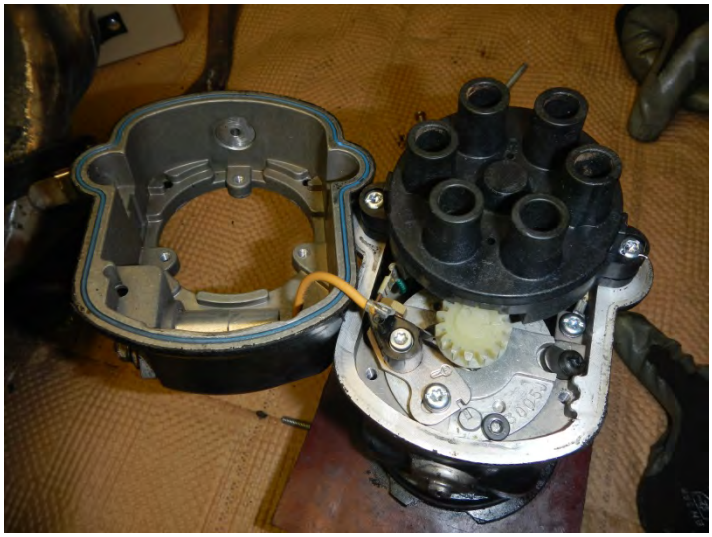

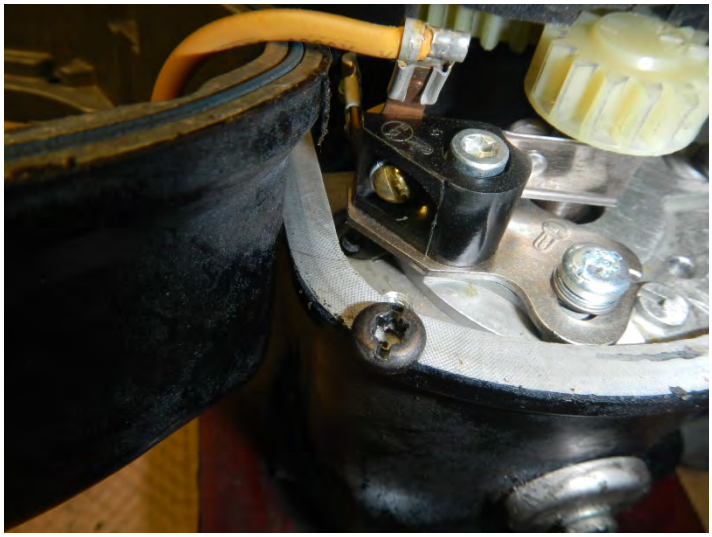


SPARK PLUGS


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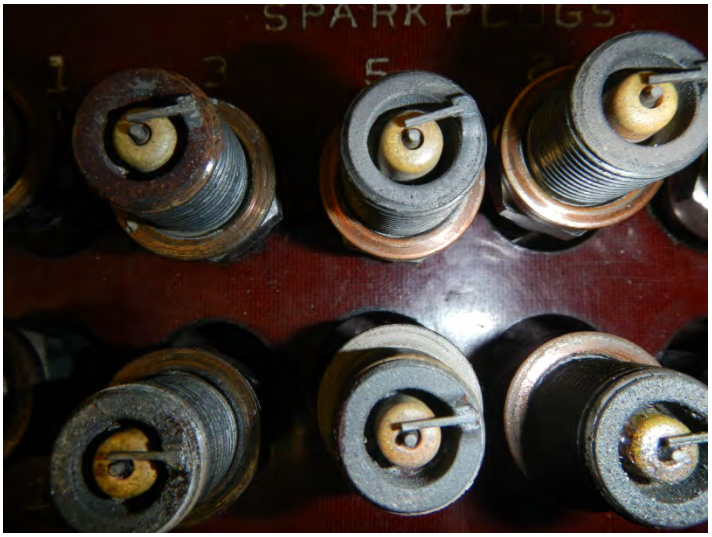
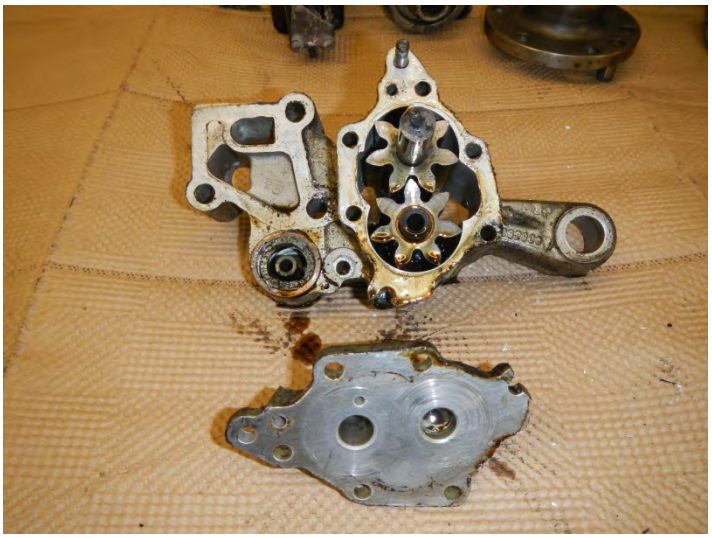

SPARK PLUGS


SPARK PLUGS

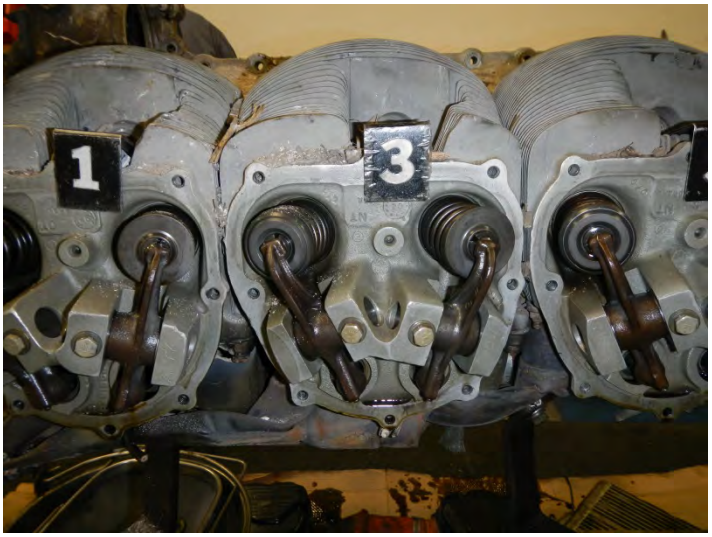
LUBRICATION SYSTEM

The oil sump was crushed from the bottom side up and was punctured. Removal of the oil sump revealed sludge and residual oil. The oil pickup screen and tube were displaced upward. The screen was not obstructed and there were no signs of blockage. The oil pump was removed and the gears and drive shaft were intact. The oil pump walls displayed circumferential scoring consistent with hard particle passage. The oil filter was cut open and metallic debris was noted within the filter element. All of the engine components appeared to be well lubricated and there was no sign of lubrication distress.



CYLINDERS

No pre-accident anomalies were noted with any of the cylinders or their associated components.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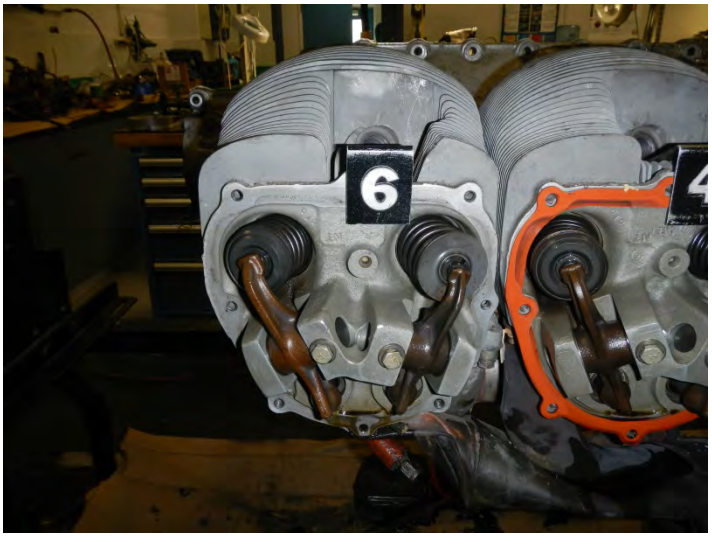
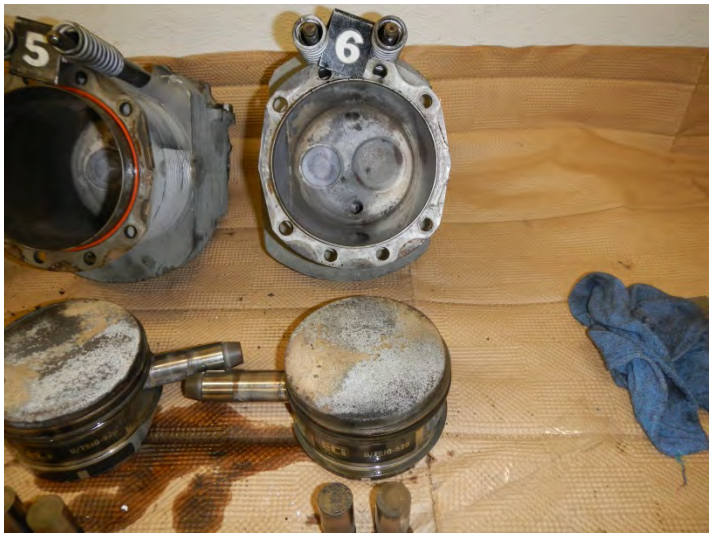
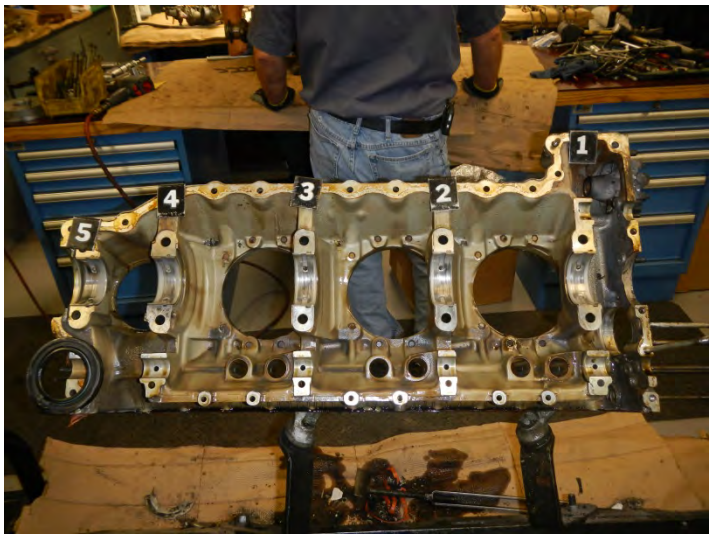




CRANKCASE

The crankcase halves remained secured to each other and no pre-accident anomalies were noted with either crankcase half. Disassembly of the crankcase revealed that the main bearings were in place and there was no sign of bearing movement. The bearing saddles and saddle mating surfaces did not reveal any sign of fretting or gouging.

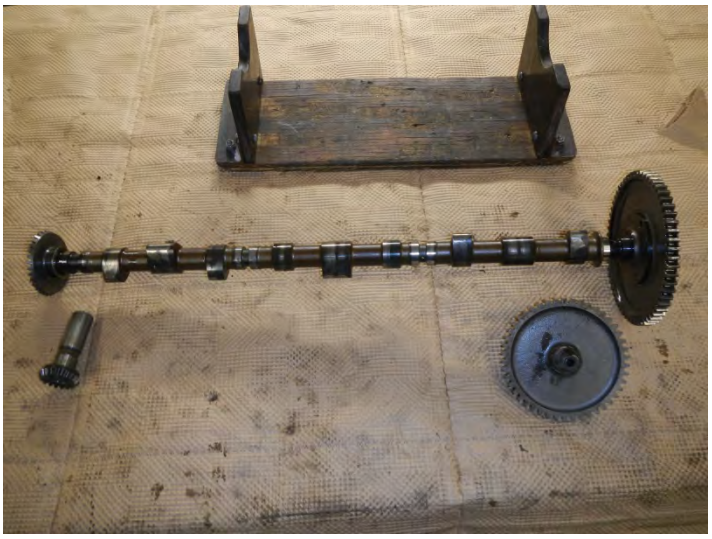


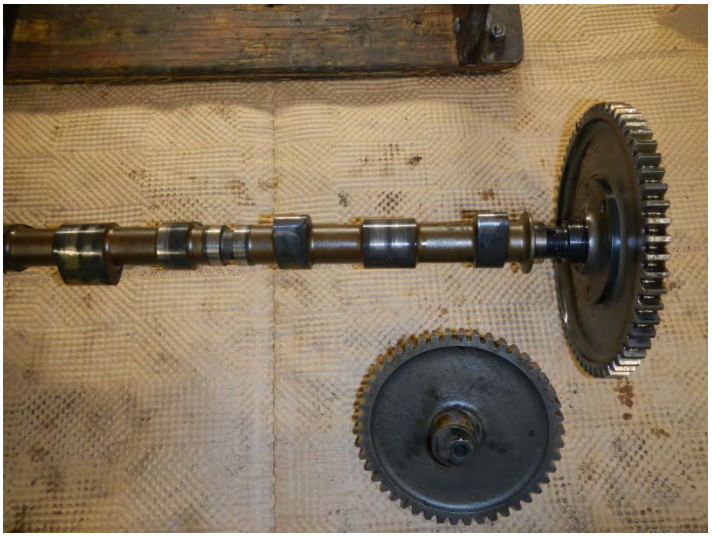
CRANKSHAFT & CONNECTING RODS

The crankshaft was intact with the exception of the fracture noted aft of the propeller flange. There were no pre-accident anomalies noted on any of the crankshaft main journals, connecting rod journals, crankshaft gear, or counterweights.

CAMSHAFT & LIFTERS

Some of the lifters displayed spalling damage. The camshaft lobes did not display any anomalies or signs of excessive wear. The camshaft gear did not display any pre-accident anomalies.





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TURBOCHARGER COMPONENTS

The turbocharger components were visually examined and readied for transport to the Hartzell facility. The overboost valve was not observed and is presumed destroyed. No external pre-accident anomalies were noted with any of the components.


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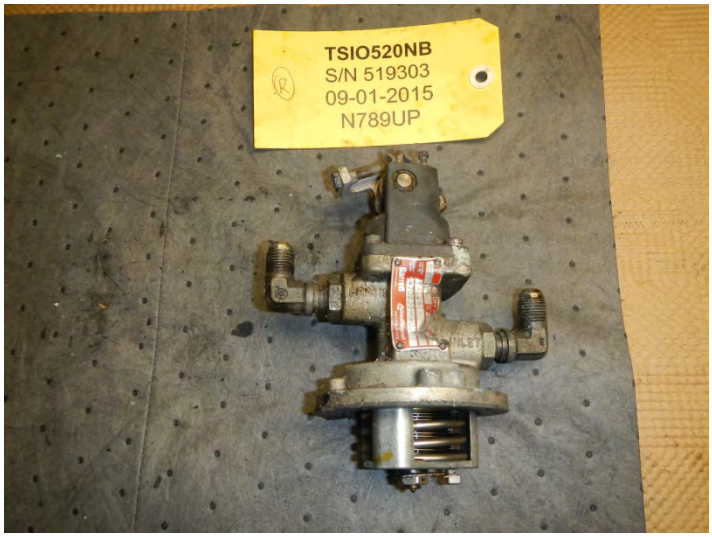
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VACUUM PUMP

The vacuum pump was displaced on its mounting pad and the housing sustained deformation and thermal damage. Disassembly of the vacuum pump revealed that all of the vanes were intact, but the rotor was fractured.

ACCESSORIES

No pre-accident anomalies were noted with the alternator, starter motor and starter adapter, or the propeller governor.


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