



Continental Motors

ENGINE EXAMINATION REPORT

ENGINE MODEL	IO-520-M1B
ENGINE SERIAL NUMBER	1002309
AIRCRAFT MAKE & MODEL	Cessna 310R
AIRCRAFT SERIAL NUMBER	310R0506
AIRCRAFT REGISTRATION	N87297
FILE NUMBER	16-697

NAME	SIGNATURE	DATE
Nicole L. Charnon		07/10/2017

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Transportation & Recovery**ADDRESS** Chino Airport
Hangar 47
Chino, California 91710**ACCIDENT DATA****NTSB ACCIDENT #** WPR17FA136**NTSB INVESTIGATOR** Andrew Swick**FAA INVESTIGATOR** Sean Houlihan**ACCIDENT DATE** 06/30/2017**ACCIDENT LOCATION** Santa Ana, California**ENGINE INFORMATION****ENGINE POSITION** Left Engine**TOTAL TIME** 748.4 hours**TIME SOH** N/A**TYPE & TIME SLI** 73.7 hours since annual inspection**BUILD DATE** 05/19/2010**IN SERVICE DATE** 08/17/2010**Significant logbook information:**

Review of the build and maintenance records revealed that the engine was built on May 19, 2010. It was installed on the accident airplane on August 17, 2010 at a Hobbs time of 742.1 hours. The engine underwent a series of oil changes and annual inspections, the last of which took place on December 21, 2016 at a Hobbs time of 1,416.8 hours. During the last annual inspection, the magnetos were removed, overhauled, and reinstalled for the 500-hour inspection. At the time of the examination, the Hobbs meter registered 1,490.5 hours (748.4 hours since installation).

Report Summary:

Search Code(s):

15-12-68

The engine sustained thermal damage that destroyed the flexible fuel lines and ignition leads. The thermal damage was extensive enough to prevent functional testing of the fuel system components. However, examination of the fuel system components revealed no pre-accident anomalies. The ignition system revealed no pre-accident anomalies, though the magnetos were sent for functional testing. Examination of the core engine components revealed no signs of operational distress with crankshaft and camshaft continuity being confirmed at each cylinder through a thumb compression tests. Borescope examination of the cylinders revealed no pre-accident anomalies with the cylinder barrels, pistons, valves and valve seats.

Disposition of engine following exam:

The magnetos were sent to Continental Motors where they were tested/examined in more detail under the supervision of a NTSB investigator (see Appendix A of this report for the findings from that examination). The engine data monitor (JPI 760) was sent to an NTSB investigator for data download. The propeller will be examined by the manufacturer under the supervision of the NTSB or FAA at a later date.

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NAME	Nicole L. Charnon	NAME	Andrew Swick
ADDRESS	Washington, DC	ADDRESS	Phoenix, AZ
ORGANIZATION	Continental Motors	ORGANIZATION	NTSB – Western Region
PHONE	[REDACTED]	PHONE	[REDACTED]
NAME	Kenneth Collie	NAME	Sean Houlihan
ADDRESS	Riverside, CA	ADDRESS	Riverside, CA
ORGANIZATION	FAA – Riverside FSDO	ORGANIZATION	FAA – Riverside FSDO
PHONE	[REDACTED]	PHONE	[REDACTED]
NAME	Andrew Hall	NAME	
ADDRESS	Wichita, KS	ADDRESS	
ORGANIZATION	Textron Aviation	ORGANIZATION	
PHONE	[REDACTED]	PHONE	

EXTERNAL ENGINE CONDITION

The engine was separated from the nacelle and was hanging from a hoist. The three-bladed variable pitch propeller remained attached to the crankshaft and the spinner was crushed aft around the hub. All three blade tips were curled toward low pitch and one blade was bent forward about mid-span.

The engine was soot covered and the cooling baffle, fuel lines, and ignition leads were thermally damaged. All engine mounts were fractured and according to the aircraft recovery personnel, the fuel lines were the only items securing the engine to the airframe.

The throttle body/fuel metering unit was separated from the wye plenum and remained attached to the nacelle via the throttle and mixture control cables. The fuel pump remained attached to the backside of the engine and all of the fuel lines remained attached to their respective fittings; however, the inlet fitting was fractured at the housing. The fuel manifold valve and fuel injector nozzles remained attached to the engine and their respective cylinders.

The magnetos remained attached to the topside of the engine with the burnt remains of the ignition harness in place between the magnetos and sparkplugs.

No external anomalies were noted with the engine or the engine-related systems.

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ENGINE COMPONENT EXAMINATION

EXHAUST SYSTEM

Condition: The exhaust risers remained attached to the cylinders and the mufflers were cut away from the manifolds by the aircraft recovery personnel. No pre-accident anomalies were noted with the exhaust system components.



INDUCTION SYSTEM

Condition: The intake air box was burned and impact damaged. The throttle body was separated from the wye plenum, which was thermally destroyed. The intake tubes and risers were thermally damaged.



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IGNITION SYSTEM

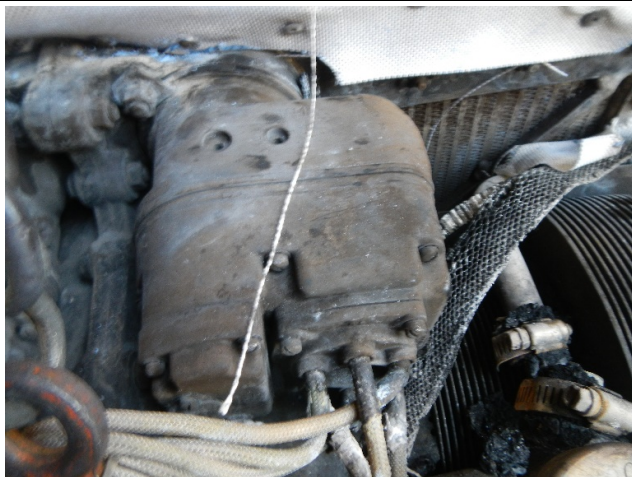
LEFT MAGNETO

Manufacturer: Continental
Motors

P/N: Not Legible

S/N: Not Legible

Condition: The magneto remained secured to the topside of the engine and manual manipulation of the housing did not result in any slipping or rotation of the magneto on its mounting pad. It was soot covered and the vent plug was partially melted. The ignition harness remained in place on the magneto. The vent cover was removed from the housing and the distributor gear was intact and rotated during crankshaft rotation, with no pre-accident anomalies noted. The magneto was removed from the engine and its drive shaft was manually rotated with no binding noted. The magneto was retained for further testing.



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RIGHT MAGNETO

Manufacturer: Continental
Motors

P/N: Not Legible

S/N: Not Legible

Condition:

The magneto remained secured to the topside of the engine and manual manipulation of the housing did not result in any slipping or rotation of the magneto on its mounting pad. It was soot covered and the vent plug was partially melted. The ignition harness remained in place on the magneto. The vent cover was removed from the housing and the distributor gear was intact and rotated during crankshaft rotation, with no pre-accident anomalies noted. The magneto was removed from the engine and its drive shaft was manually rotated with no binding noted. The magneto was retained for further testing (see Appendix A of this report for more details).



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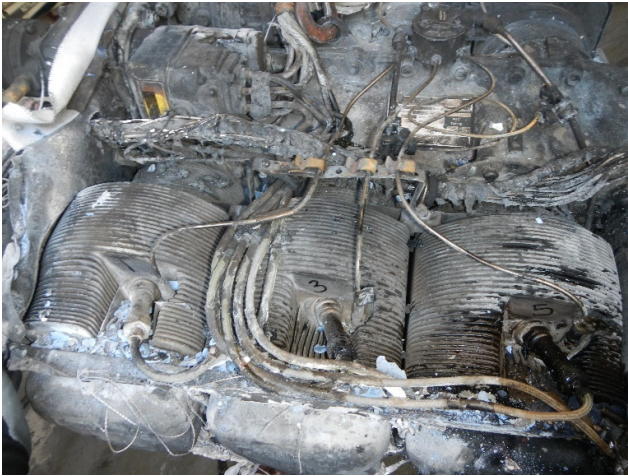
IGNITION HARNESS

Manufacturer: Continental
Motors

P/N: Not Legible

S/N: Not Legible

Condition: The ignition harness remained attached to both magnetos and each lead remained attached to their respective ignition harness. The leads were thermally damaged beyond functional testing. No pre-accident anomalies were noted with the ignition harness.



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SPARK PLUGS

Manufacturer: Tempest

P/N: URHB32E

Condition: The sparkplugs remained secured to their respective cylinder and each ignition terminal remained attached to its sparkplug. The top sparkplugs were removed from the cylinders and each displayed a normal worn condition with no evidence of carbon or lead fouling. The bottom sparkplugs were examined/photographed via lighted borescope.



1T



1B



2T



2B

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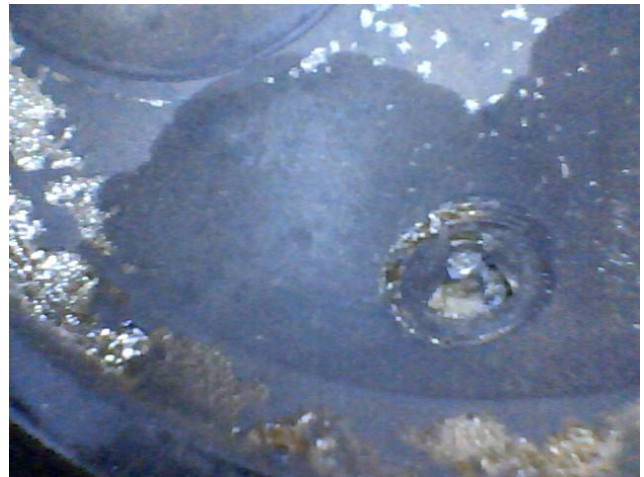
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3T



3B



4T



4B



5T



5B

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6T



6B

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FUEL SYSTEM

FUEL PUMP

Manufacturer: Continental
Motors

P/N: 646212-27A1

S/N: B10DA198R

Condition: The engine-driven fuel pump remained secured to the backside of the engine and all of the fuel lines remained secured to their respective fittings, though the fuel inlet fitting was fractured. The pump was removed and the drive coupling was intact. The pump could not be functionally tested due to the thermal damage, but disassembly revealed that the pump vanes were intact and no pre-accident anomalies were observed with the pump's internal components.



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THROTTLE BODY METERING UNIT

Manufacturer: Continental
Motors

P/N: R-657018A2

S/N: A10DA045R

Condition: The throttle body/fuel metering unit was separated from the wye plenum and remained secured to the engine nacelle via the throttle and mixture control cables. The fuel lines leading to and from the fuel metering unit remained secured to their respective fittings, though the lines were cut by recovery personnel. The mixture control lever was bent however, manual manipulation of the mixture and throttle control levers resulted in a coinciding movement in their control cams. The fuel inlet screen was removed and no obstructions were observed.



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FUEL MANIFOLD VALVE

Manufacturer: Continental Motors

P/N: 641032-21A2

S/N: C10?A007R

Condition: The fuel manifold valve remained secured to the topside of the engine and all lines to and from the manifold valve remained secured in place. The manifold valve was thermally damaged and re-solidified resin from the diaphragm was beaded up around the housing and the cap. The cap was removed and the diaphragm was intact and the plunger was in place. The screen was clear and there was a small amount of burnt debris noted behind the screen.



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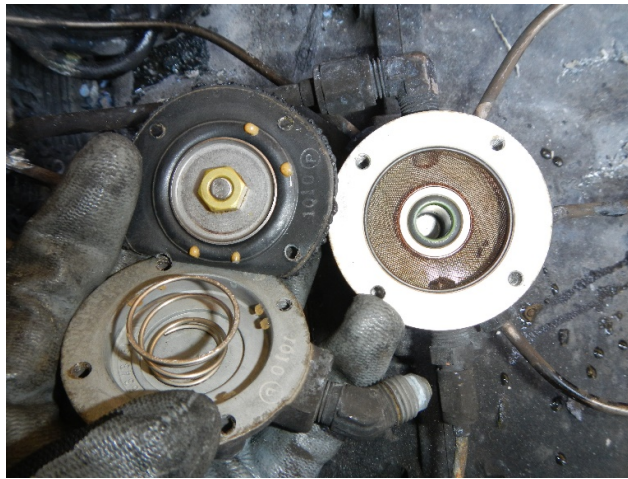
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FUEL NOZZLES AND LINES

Manufacturer: GAMI

Condition: The fuel injector nozzles remained secured to their respective cylinders and the fuel injection lines remained intact. The nozzles were removed and there were no obstructions or blockages noted in any of the nozzles.



1



3

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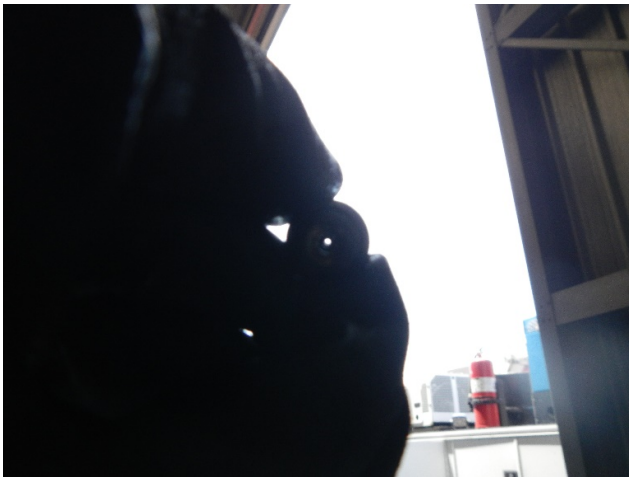
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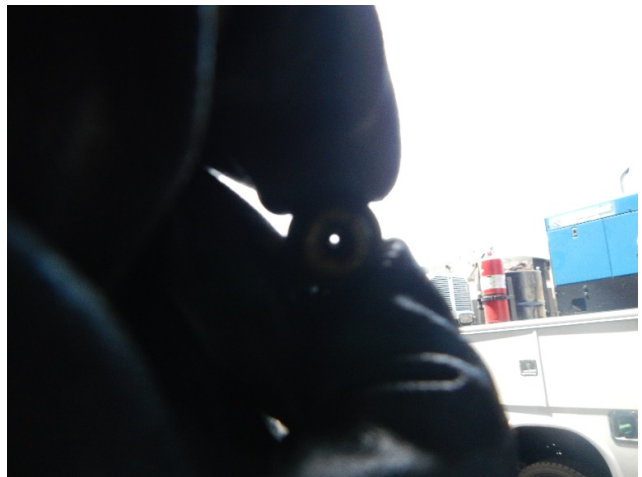
5



2



4



6

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LUBRICATION SYSTEM

OIL SUMP

Condition: The oil sump remained secured to the bottom side of the engine and sustained slight deformation damage. The oil drain plug remained in place with no pre-accident anomalies noted.



OIL PICKUP TUBE & SCREEN

Condition: The oil pickup tube and screen were not observed.

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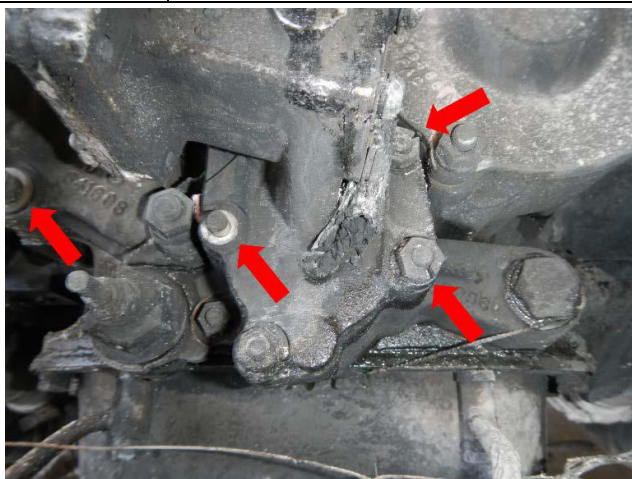
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OIL PUMP

Condition:

The oil pump remained attached to backside of the engine and some of the housing nuts were split and missing (see red arrows in 1st photo below). There was no evidence of a pre-accident oil leak on the engine nacelle or wing and it is presumed that the cracked hardware was due to post-crash thermal exposure. Disassembly of the oil pump revealed residual oil in the housing and circumferential scores on the pump walls indicating hard particle passage at some point in the engine's history. The gears were intact with no signs of operational distress noted. The oil pressure relief valve and valve seat did not display any sign of abnormal seating.



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Manufacturer: Not Legible

P/N: Not Legible

Condition:

The oil filter remained in place on the oil filter adapter and the safety-wire was intact. The oil filter was thermally damaged and no pre-accident anomalies were noted.

**OIL COOLER**

Manufacturer: Niagara

P/N: 654572

S/N: B10-8562-64

Condition:

The oil cooler remained attached to the engine with no pre-accident anomalies noted.



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CYLINDERS

NOTE: The photographs that follow each cylinder condition description represent the cylinder overhead components, the piston, the intake valve, and the exhaust valve in that order unless otherwise specified.

CYLINDER #1

Condition: The cylinder remained attached to the engine and the original torque putty appeared to be intact on the attaching hardware (the serial number matched that on the build record). The cylinder was soot covered with no other signs of pre-accident anomalies. The rocker cover was removed and no pre-accident anomalies were observed with the rockers or valve springs. A borescope inspection of the cylinder's internal components did not reveal any pre-accident anomalies with the barrel, piston, valves or valve seats. A thumb compression test resulted in compression and confirmed connecting rod, piston, and rocker arm movement.



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CYLINDER #3

Condition: The cylinder remained attached to the engine and the original torque putty appeared to be intact on the attaching hardware (the serial number matched that on the build record). The cylinder was soot covered with no other signs of pre-accident anomalies. The rocker cover was removed and no pre-accident anomalies were observed with the rockers or valve springs. A borescope inspection of the cylinder's internal components did not reveal any pre-accident anomalies with the barrel, piston, valves or valve seats. A thumb compression test resulted in compression and confirmed connecting rod, piston, and rocker arm movement.



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CYLINDER #5

Condition: The cylinder remained attached to the engine and the original torque putty appeared to be intact on the attaching hardware (the serial number matched that on the build record). The cylinder was soot covered with no other signs of pre-accident anomalies. The rocker cover was removed and no pre-accident anomalies were observed with the rockers or valve springs. A borescope inspection of the cylinder's internal components did not reveal any pre-accident anomalies with the barrel, piston, valves or valve seats. A thumb compression test resulted in compression and confirmed connecting rod, piston, and rocker arm movement.



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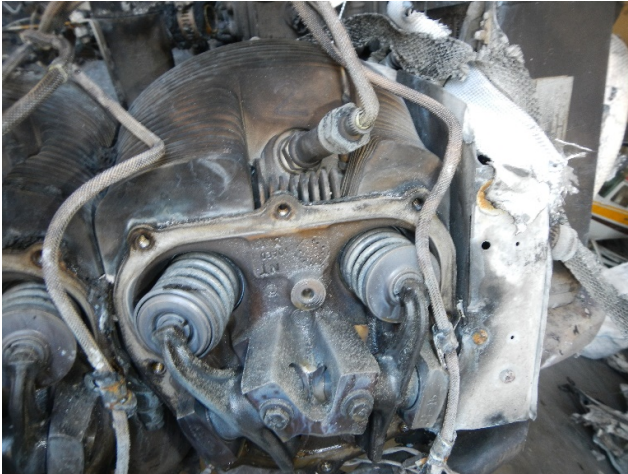
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CYLINDER #2

Condition: The cylinder remained attached to the engine and the original torque putty appeared to be intact on the attaching hardware (the serial number matched that on the build record). The cylinder was soot covered with no other signs of pre-accident anomalies. The rocker cover was removed and no pre-accident anomalies were observed with the rockers or valve springs. A borescope inspection of the cylinder's internal components did not reveal any pre-accident anomalies with the barrel, piston, valves or valve seats. A thumb compression test resulted in compression and confirmed connecting rod, piston, and rocker arm movement.



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CYLINDER #4

Condition: The cylinder remained attached to the engine and the original torque putty appeared to be intact on the attaching hardware (the serial number matched that on the build record). The cylinder was soot covered with no other signs of pre-accident anomalies. The rocker cover was removed and no pre-accident anomalies were observed with the rockers or valve springs. A borescope inspection of the cylinder's internal components did not reveal any pre-accident anomalies with the barrel, piston, valves or valve seats, though the barrel was rust covered in isolated areas. A thumb compression test resulted in compression and confirmed connecting rod, piston, and rocker arm movement.



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CYLINDER #6

Condition: The cylinder remained attached to the engine and the original torque putty appeared to be intact on the attaching hardware (the serial number matched that on the build record). The cylinder was soot covered with no other signs of pre-accident anomalies. The rocker cover was removed and no pre-accident anomalies were observed with the rockers or valve springs. A borescope inspection of the cylinder's internal components did not reveal any pre-accident anomalies with the barrel, piston, valves or valve seats. A thumb compression test resulted in compression and confirmed connecting rod, piston, and rocker arm movement.



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CRANKCASE ASSEMBLY

CRANKCASE

Condition:

The crankcase remained intact with no pre-accident anomalies noted.



CRANKSHAFT ASSEMBLY

CRANKSHAFT

Condition:

Though the crankshaft was not viewed in its entirety, crankshaft continuity was confirmed from the propeller flange aft to the crankshaft gear and out to each connecting rod/piston during a thumb compression test. The crankshaft gear bolts were safety-wired and in place. There was no binding noted during crankshaft rotation.



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Condition: The camshaft was not observed; however, camshaft continuity was confirmed by the movement of all 12 rockers during crankshaft rotation. No pre-accident anomalies were noted.

**ACCESSORY
GEARS**

Condition: The accessory gears rotated during crankshaft rotation, with no pre-accident anomalies noted.



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ACCESSORIES

STARTER

Manufacturer: Not Legible

P/N: Not Legible

S/N: Not Legible

Condition:

The starter motor remained attached to the adapter with no pre-accident anomalies noted.



STARTER ADAPTER

Condition:

The starter adapter remained intact and in place. No anomalies were noted during crankshaft rotation.



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Manufacturer: Not Legible

P/N: Not Legible

S/N: Not Legible

Condition:

The engine-driven alternator remained attached to the front right side of the engine. The alternator sustained thermal damage that partially melted the wires attached to the unit. No external pre-accident anomalies were noted with the unit.

**VACUUM
PUMP**

Manufacturer: Not Recorded

P/N: Not Recorded

S/N: Not Recorded

Condition:

The vacuum pump remained attached to the accessory pad on the backside of the engine and was not examined as part of the investigation.



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Manufacturer: Unknown

P/N: Not Observed

S/N: Not Observed

Condition:

The propeller governor remained secured to the front left side of the engine and the control cable remained attached to the control lever. The propeller synchrophaser switch was in the off position in the cockpit. The burnt remains of the propeller synchrophaser mechanism remained attached to the propeller governor.

**PROPELLER**

Manufacturer: McCauley

P/N: 3AF32C504

S/N: 960084

Condition:

The propeller remained attached to the engine crankshaft and all three propeller blades remained attached to the hub, though one was loose in the hub. The propeller piston was crushed aft and deformed. The internal spring was visible. All three blade tips were curled toward low pitch and one blade was bent forward. The propeller will be sent to the manufacturer for a more detailed examination under NTSB or FAA supervision.



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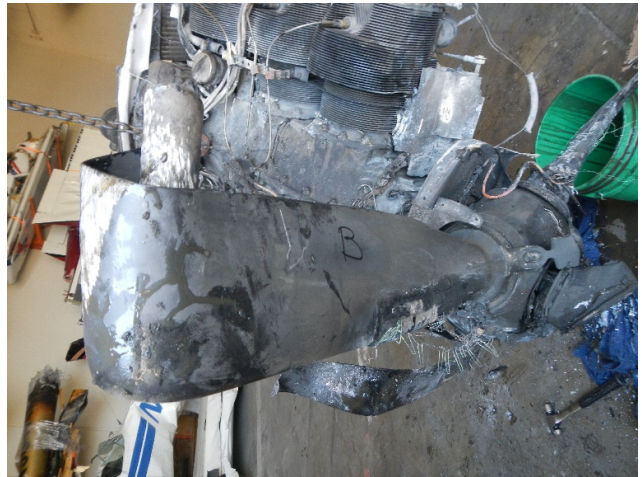
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Appendix A

Magneto Examination/Testing



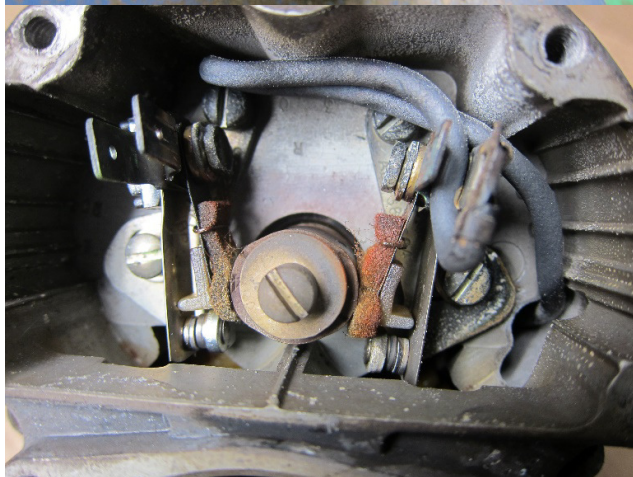
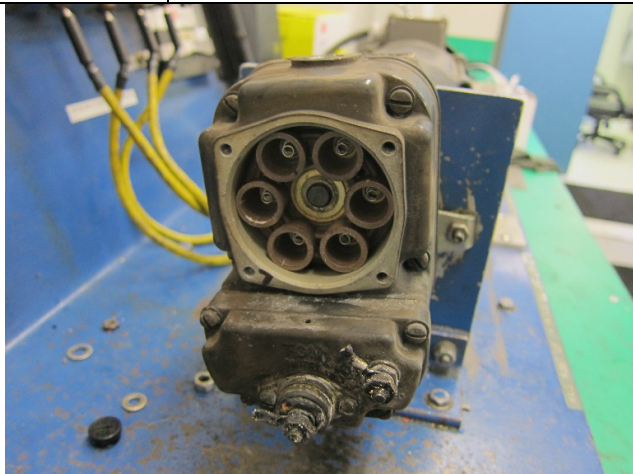
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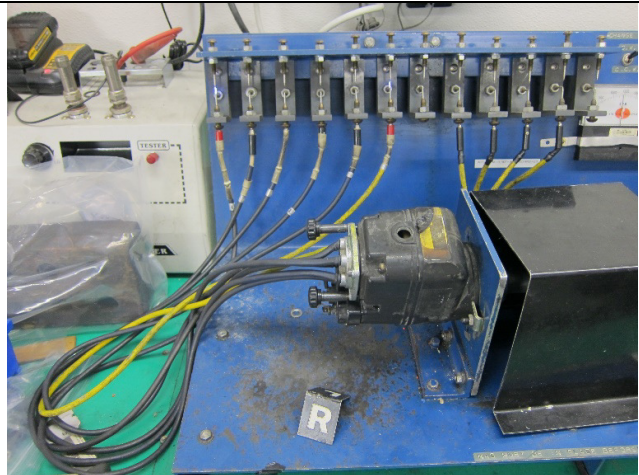
N/R = Not Reported / N/A = Not Applicable

Date Received:	07/10/2017		Analytical Date:	07/10/2017	
File Number	16-697		NTSB Accident:	WPR17LA136	
Engine Model:	IO-520-M		Engine S/N:	1002309	
Engine:		Component:	☒		
Aircraft Make/Model:	Cessna 310R		Aircraft S/N:	310R0506	Reg. #: N87297
Engine Position:	Single:	Left:	☒	Right:	Front: Rear:
Engine Build Date:	05/19/2010	Date in Service:	Unknown		
Occurrence Date:	06/30/2017		Date Received:	07/10/2017	
Occurrence Location:	Santa Ana, California		Returned By:	NTSB	
Inspection Performed By:	Kurt Gibson		Search Code:	15-12-68	
Summary:	Both of the magnetos displayed thermal damage signatures. The magnetos were placed on a test bench and neither magneto were capable of producing a spark. It was determined both of the capacitors were shorted which was consistent with the thermal damage. After a functional capacitor was installed and the points were cleaned of soot the magnetos were capable of functioning normally.				
Comments:					

LEFT MAGNETO	Manufacturer: CMI	P/N: Illegible	S/N: Illegible
Condition:	The left magneto displayed thermal damage to the magneto. The magneto was placed on a test bench and the magneto was unable to produce a spark. The magneto cap was removed and the points were visually inspected. The points and associated components displayed thermal damage; the cam was unable to open the points which were consistent with thermal damage. The points were cleaned and adjusted to allow for the cam to open the points. The capacitor was tested and it was noted to be shorted to ground which was consistent with the thermal damage to the capacitor. A functional magneto cap with capacitor was installed and the magneto was placed on the test bench. The magneto was capable of producing a spark on all six posts in the correct order at all tested RPM settings. There were no pre-impact anomalies noted that would have prevented normal operation.		



RIGHT MAGNETO	Manufacturer: CMI	P/N: Illegible	S/N: Illegible
Condition:	The magneto displayed thermal damage to the magneto. The magneto was placed on a test bench and the magneto was unable to produce a spark. The magneto cap was removed and the capacitor was tested; the capacitor was noted to be shorted to ground which was consistent with the thermal damage. A functional magneto cap and capacitor was installed on the magneto and the magneto was placed on the test bench. The magneto was capable of producing a spark on all six posts in the correct order at all tested RPM settings. There were no pre-impact anomalies noted that would have prevented normal operation.		



Engine / Component Disposition			
Release for core salvage:		Date:	
Release to Repair Station:		Date:	
Scrap:		Date:	
Return to storage facility:	X	Date:	07/12/2017
Customer Name/Company:	Jack Vandeman		
Address:	South West Aviation Transportation and Recovery Attn: Jack Vandeman 866 Bing Spring Court Corona, California 92880		