



ENGINE EXAMINATION REPORT

ENGINE MODEL	TSIO-360-FB
ENGINE SERIAL NUMBER	299992-R
AIRCRAFT MAKE & MODEL	Piper PA-28-201T
AIRCRAFT SERIAL NUMBER	28-7921088
AIRCRAFT REGISTRATION	N2890T
FILE NUMBER	19-095

NAME	SIGNATURE	DATE
Kurt Gibson		11/19/2019

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GENERAL INFORMATION

EXAMINATION		ACCIDENT DATA	
DATE	10/24/2019	NTSB ACCIDENT #	CEN19LA317
FACILITY	Florida Air Recovery	NTSB INVESTIGATOR	Dan Baker
ADDRESS	3109 Airman's Dr Fort Pierce, FL 34946	FAA INVESTIGATOR	Conner McCauley
		ACCIDENT DATE	09/11/2019
		ACCIDENT LOCATION	Boca Raton, Florida

ENGINE INFORMATION

ENGINE POSITION	Front (single engine)
TOTAL TIME	928.52
TIME SOH	N/A (NOTE: Logbook incorrectly states that the new engine was an overhauled engine)
TYPE & TIME SLI	1.26 since the last annual inspection
BUILD DATE	09/08/2006
IN SERVICE DATE	10/03/2006

Significant logbook information:

The last annual inspection was performed on 09/02/2019 at a tachometer time of 4058. On 11/02/2018 at a tachometer time of 4015.6, a mechanic wrote the following in the logbook "Compressed air blow cleaned lines from electric fuel pump on up. Checked and cleaned fuel divider." On 01/11/2016 an overhauled fuel manifold valve and a fuel pump were installed. On 12/22/2014 the engine was disassembled and inspected due to a propeller strike.

Report Summary:

Search Code(s):

20-07-06

The throttle and metering assembly contained a small amount of debris within the assembly. There were no further anomalies observed with the engine that would have prevented normal operation or production of rated horsepower. The engine had an STC installed for an automatic wastegate by Merlyn Products Inc. The automatic wastegate and the throttle and metering assembly were retained by the NTSB for further examination

Disposition of engine following exam:

The engine remained at Florida Air Recovery in Fort Pierce, Florida.

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INSPECTION WITNESSES

NAME	Kurt Gibson	NAME	Damian Galbraith
ADDRESS	Mobile, Alabama	ADDRESS	Vero Beach, Florida
ORGANIZATION	Continental Motors	ORGANIZATION	Piper Aircraft, Inc.
PHONE		PHONE	
NAME	Juan Garcia	NAME	
ADDRESS	Miramar, Florida	ADDRESS	
ORGANIZATION	FAA	ORGANIZATION	
PHONE		PHONE	
NAME		NAME	
ADDRESS		ADDRESS	
ORGANIZATION		ORGANIZATION	
PHONE		PHONE	

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PAGE 4 of 31**EXTERNAL INSPECTION OF ENGINE**

The engine was separated from the airframe at the time of the examination. The engine displayed impact damage signatures with most of the damage occurring to the bottom of the engine; the engine also displayed corrosion consistent with fire suppression activity. The crankcase remained intact and there were no holes in the crankcase that would indicate a catastrophic internal engine failure. The propeller flange remained attached to the rest of the crankshaft and there were no signs of cracks in the propeller shaft. All six cylinders remained attached to their cylinder bays and displayed minor impact damage as well as some corrosion consistent with fire suppression activity. The two-blade, constant speed propeller remained attached to the propeller flange and displayed impact damage signatures.

Both magnetos remained attached to their installation points and displayed corrosion consistent with fire suppression activity. The ignition harness displayed impact damage signatures and several of the ignition leads were torn and severed. The spark plugs remained installed in their cylinders and were undamaged.

The fuel pump remained attached to its installation point and displayed impact damage signatures as well as some corrosion. The throttle and metering assembly and the fuel manifold valve remained attached to their installation points and were undamaged. There were no signs of fuel leaks observed around the fuel components.

The exhaust system displayed impact damage signatures in the forms of bending and crushing. There were no signs of exhaust leaks observed. The induction system displayed impact damage signatures to some of the induction tubes. There were no signs of induction leaks observed.

The turbocharger remained attached to the engine and displayed minor impact damage as well as some corrosion consistent with fire suppression activity. It was observed that the fixed wastegate had been removed and an STC was used to install a Merlyn Products, Inc. automatic wastegate.

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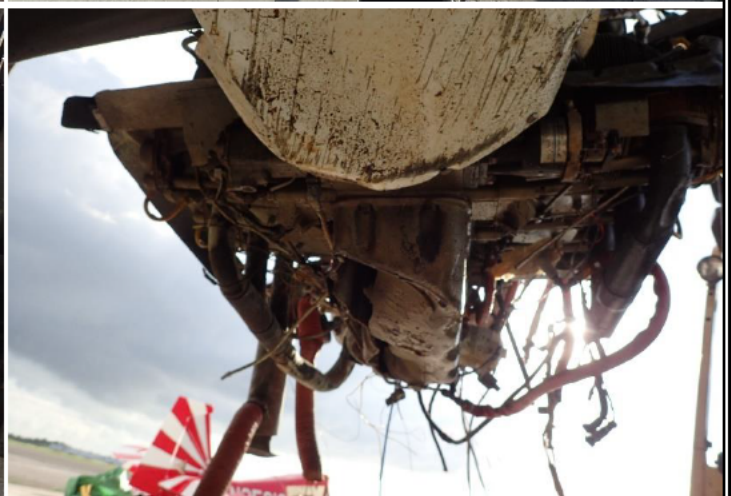
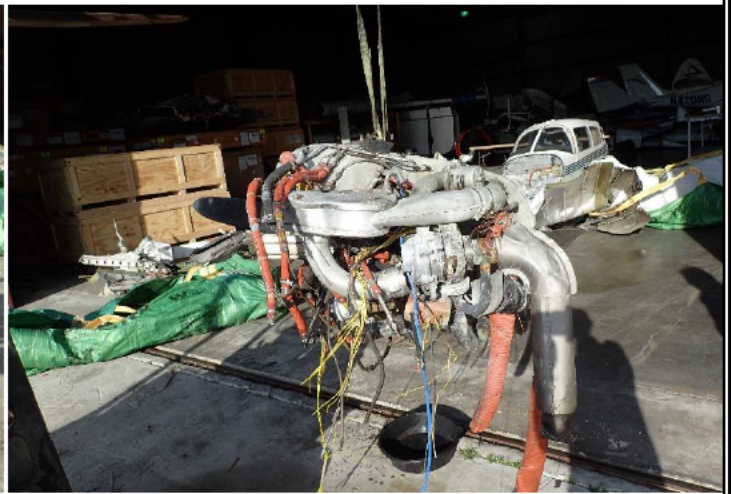
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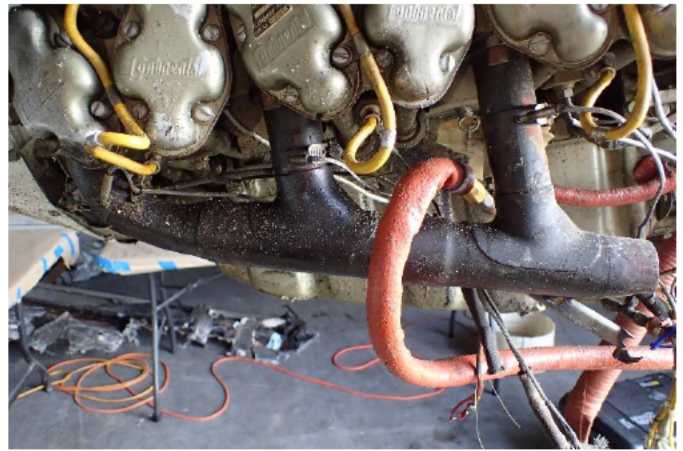
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ENGINE TEARDOWN AND COMPONENT EXAMINATION

EXHAUST SYSTEM

Condition:

The exhaust system remained attached to the engine and displayed impact damage signatures as well as significant corrosion consistent with exposure to fire suppressant chemicals. The V-band clamp remained secured to the turbocharger and there were no exhaust leaks noted around the exhaust tubes and risers. It was noted that the exhaust had been modified to remove the fixed wastegate and to install an automatic wastegate via an STC by Merlyn Products, Inc.



INDUCTION SYSTEM

Condition:

The induction system displayed impact damage signatures to some of the induction tubes as well as the airbox. There were no signs of induction leaks and the inlet air filter was clear of obstructions.



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IGNITION SYSTEM

LEFT MAGNETO

Manufacturer: CMI

P/N: BL-500556-3

S/N: D12JA053R

Condition:

The magneto remained attached to its installation point and displayed corrosion consistent with exposure to fire suppressant chemicals. The magneto impulse coupling was noted to operate during crankshaft rotation and the magneto was capable of producing a spark on all six posts, in the correct firing order, and was in sync with the right magneto.

RIGHT
MAGNETO

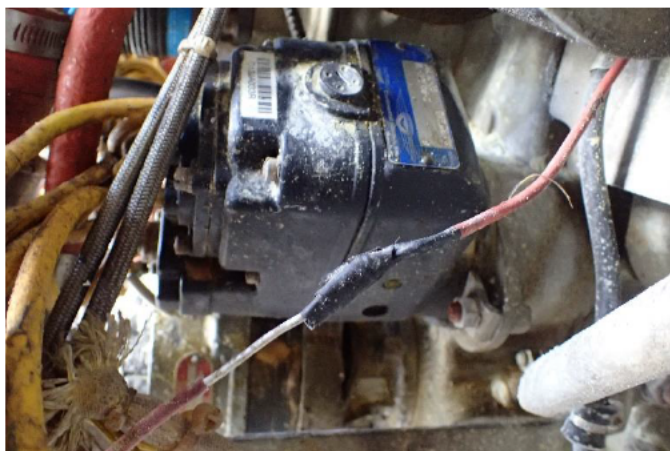
Manufacturer: CMI

P/N: BL-500556-3

S/N: D13JA033R

Condition:

The magneto remained attached to its installation point and displayed corrosion consistent with exposure to fire suppressant chemicals. The magneto impulse coupling was noted to operate during crankshaft rotation and the magneto was capable of producing a spark on all six posts, in the correct firing order, and was in sync with the left magneto.



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IGNITION HARNESS

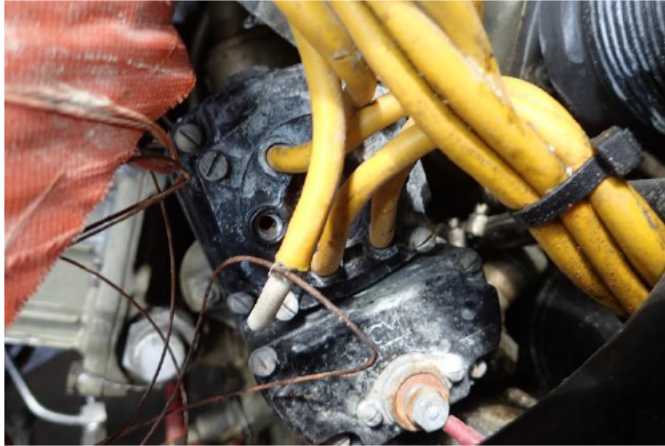
Manufacturer: Not observed

P/N: Not observed

S/N: Not observed

Condition:

The ignition harness remained attached to the engine and displayed impact damage signatures; three of the ignition leads had pulled out from the magneto caps. It was observed that during magneto impulse coupling operation all of the intact ignition leads were capable of conducting a spark from the magneto to the ignition lead end; the 3 ignition leads that had pulled out displayed normal operating signatures.



SPARK PLUGS

Manufacturer: Unisom and Champion

P/N: Unisom: URHM38E Champion: RHM38E

Condition:

The spark plugs remained installed in their cylinders and were undamaged. The top spark plugs were removed for examination and the bottom spark plug electrodes were examined using a lighted borescope. The electrodes displayed normal operating and all of the spark plugs were in a normal worn-out condition.



#1 Top Spark Plug



#1 Bottom Spark Plug

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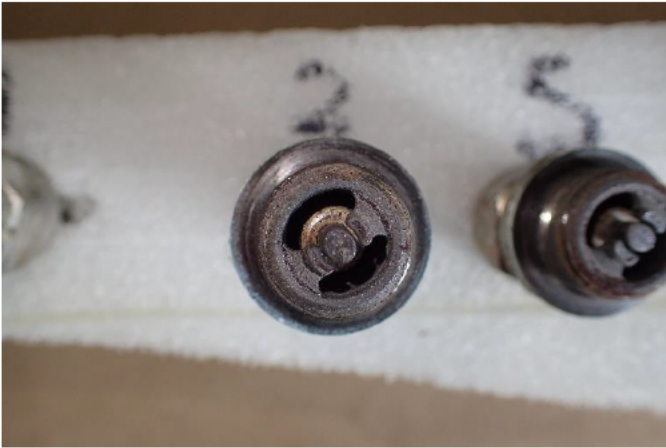
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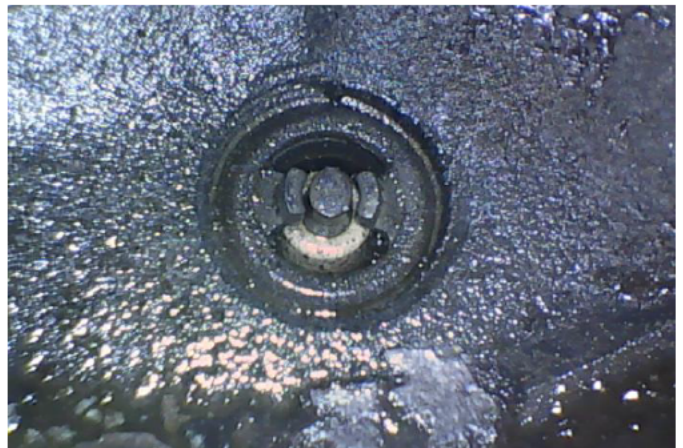
#3 Top Spark Plug



#3 Bottom Spark Plug



#5 Top Spark Plug



#5 Bottom Spark Plug



#2 Top Spark Plug



#2 Bottom Spark Plug

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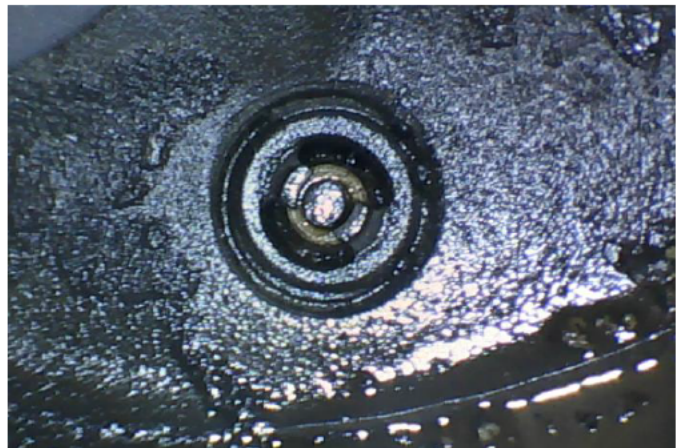
#4 Top Spark Plug



#4 Bottom Spark Plug



#6 Top Spark Plug



#6 Bottom Spark Plug

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FUEL SYSTEM

FUEL PUMP

Manufacturer: CMI (overhauled
by Kelly Aerospace)

P/N: 649368-2

S/N: H179204BR

Condition:

The fuel pump remained attached to its installation point and displayed impact damage signatures to several of the AN fittings. The fuel pump was removed and it was observed that the drive coupling remained intact. The fuel pump was disassembled and the internal components were examined. The housing was noted to contain some oil consistent with oil leaking past the seal; the oil drain vent was noted to be unobstructed. The rest of the internal components displayed normal operating signatures.



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THROTTLE BODY
METERING UNIT

Manufacturer: TCM

P/N: 640563-15A5

S/N: A06HA013R

Condition:

The throttle and metering assembly remained attached to its installation point and was undamaged. The throttle control rod end remained secure to the throttle control arm and the control arm was secured to the shaft. The throttle and metering assembly was disassembled and the internal components were visually examined; it was observed that there was some small particle debris within the fuel metering assembly and the screw for the mixture adjustment was corroded. The debris and the throttle and metering assembly were retained by the NTSB for further examination and testing.



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FUEL MANIFOLD VALVE

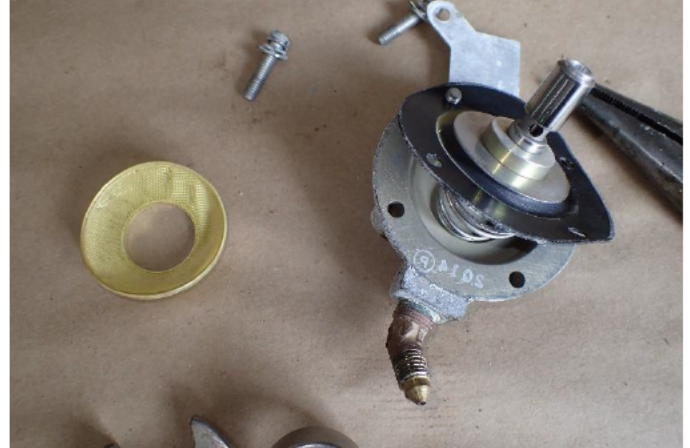
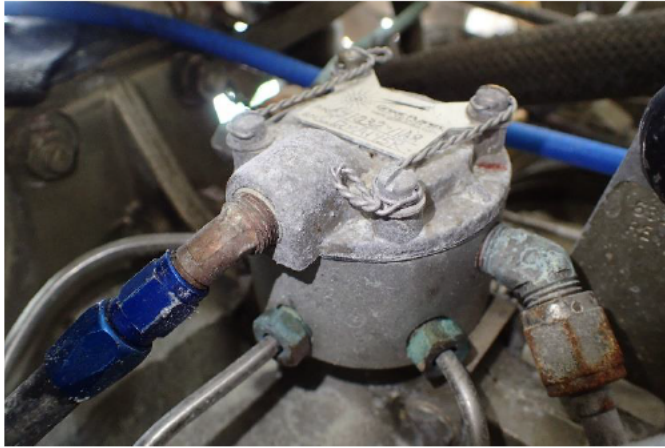
Manufacturer: CMI
(overhauled by Great
Planes)

P/N: 641032-11A8

S/N: C12FA145R

Condition:

The fuel manifold valve remained attached to its installation point and was undamaged. The valve was disassembled, and the internal components were visually examined; there was a small amount of debris noted on the unfiltered side of the manifold valve. The rest of the components displayed normal operating signatures and the screen was clear of debris.



FUEL NOZZLES AND LINES

Manufacturer: GAMI

Position

#1

#3

#5

#2

#4

#6

Size

GA126

GM136

GF151

GA126

GM136

GF151

Condition:

The nozzles remained installed in their cylinders and displayed corrosion consistent with exposure to fire suppressant chemicals. The nozzles were removed and checked for obstructions. It was observed that the #1 nozzle was visually obstructed; air was blown into the inlet side of the nozzle and the debris was able to be easily blown out. The rest of the nozzles were unobstructed.

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#1 Nozzle (after air was blown through the inlet)



#3 Nozzle



#5 Nozzle



#2 Nozzle



#4 Nozzle



#6 Nozzle

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LUBRICATION SYSTEM

OIL SUMP

Condition:

The oil sump remained attached to its installation point and displayed impact damage signatures; the oil sump was breached and the quick drain had broken free. There were no anomalies observed with the oil sump.

OIL PICK-UP
TUBE & SCREEN

Condition:

Due to the type of inspection performed the oil pick-up tube and screen were not observed.

OIL PUMP

Condition:

The operation of the oil pump was verified by rotating the crankshaft and observing oil being pumped out of the oil filter adapter. The oil pump operated normally.

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OIL FILTER

Manufacturer: Champion

P/N: CH48108-1

Condition:

The oil filter remained attached to the oil filter adapter and displayed impact damage signatures. The oil filter was removed, and the filter housing was cut open. There was no metallic material noted within the filter pleats.



OIL COOLER

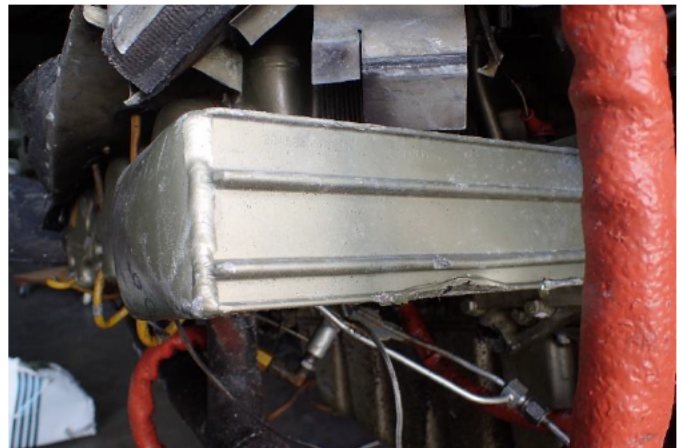
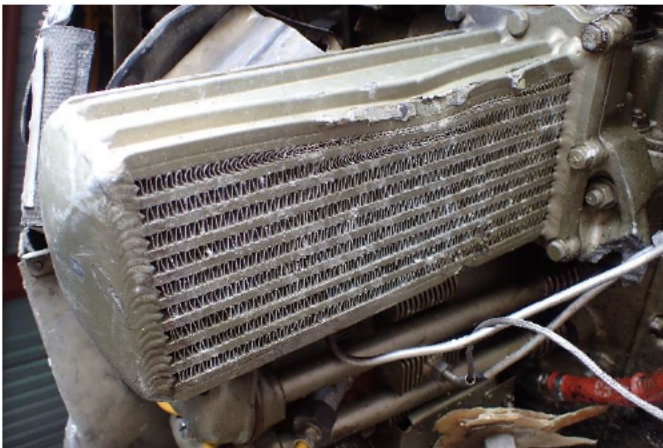
Manufacturer: Not observed

P/N: 20458A 10795

S/N: C-11358

Condition:

The oil cooler remained attached to its installation point and displayed impact damage signatures. There were no oil leaks or other anomalies observed with the oil cooler.



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CYLINDERS

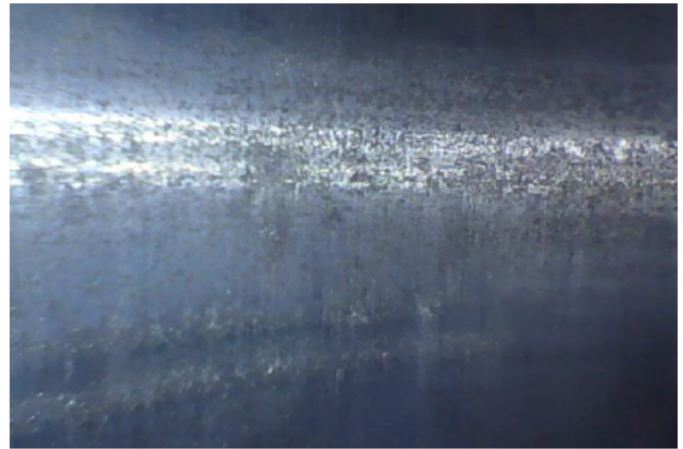
CYLINDERS

Condition:

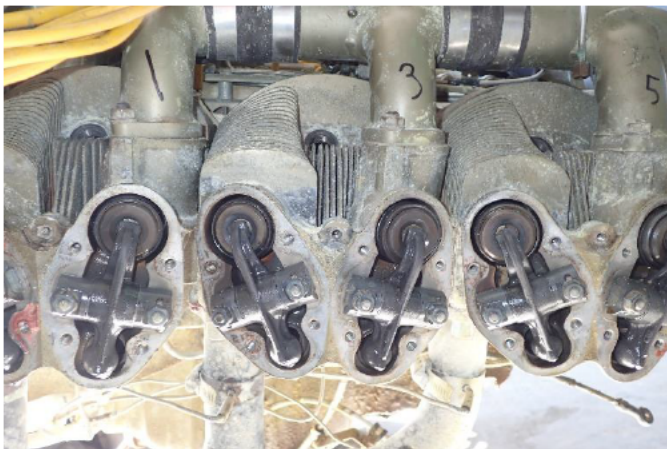
The cylinders displayed varying amounts of impact damage and displayed corrosion consistent with exposure to fire suppressant chemicals. The cylinders were inspected using a lighted borescope; the cylinder bores displayed surface corrosion as well as normal operating signatures. The valve heads and piston faces displayed normal operating and combustion signatures. During crankshaft rotation all of the cylinders displayed good thumb compression and suction and all of the overhead components (springs, valves, and rocker arms) operated normally. The overhead components displayed normal operating and lubrication signatures.



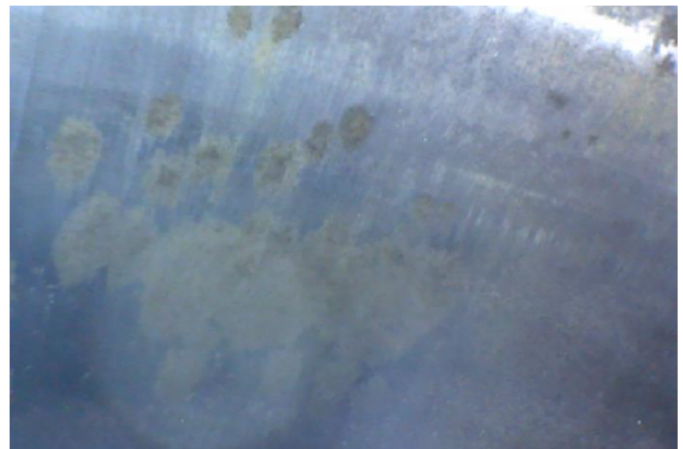
#1 Cylinder Overhead



#1 Cylinder Bore



#3 Cylinder Overhead



#3 Cylinder Bore

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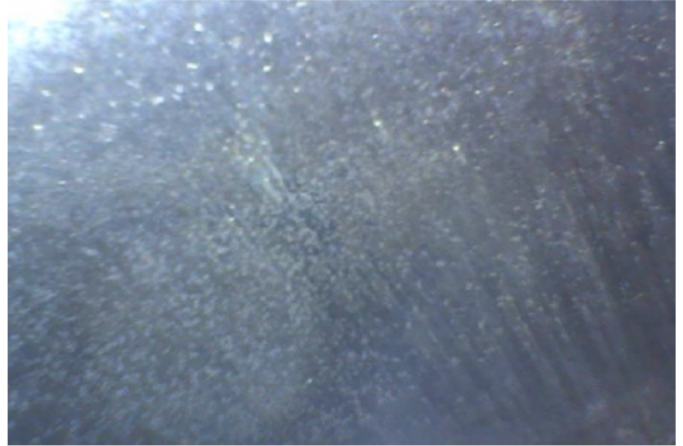
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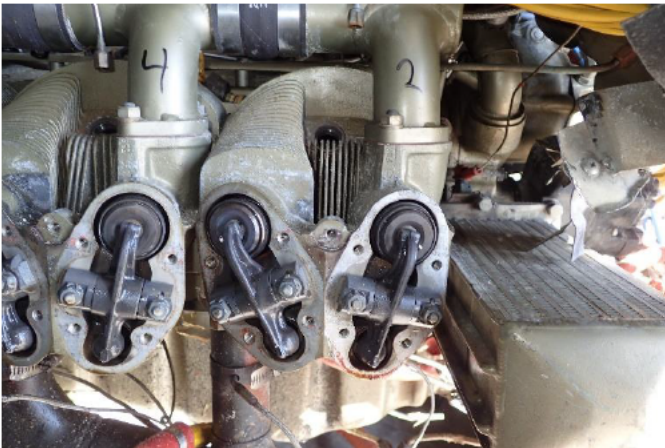
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#5 Cylinder Overhead



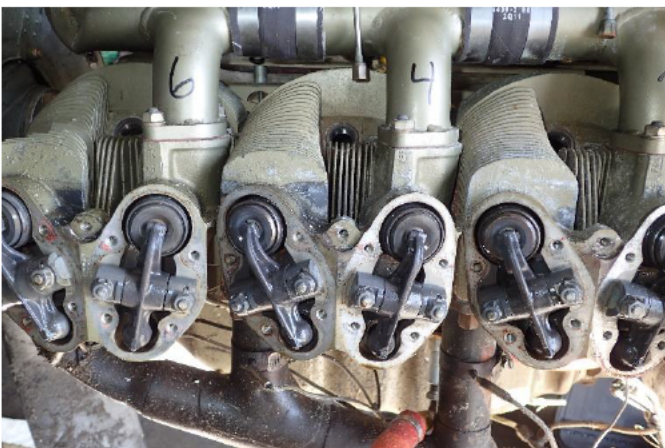
#5 Cylinder Bore



#2 Cylinder Overhead



#2 Cylinder Bore



#4 Cylinder Overhead



#4 Cylinder Bore

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#6 Cylinder Overhead



#6 Cylinder Bore

VALVES AND GUIDES

Condition:

The valve heads were inspected using a lighted borescope. The valve heads displayed normal operating and combustion signatures. During crankshaft rotation all of the valves operated normally.



#1 Exhaust Valve



#1 Intake Valve

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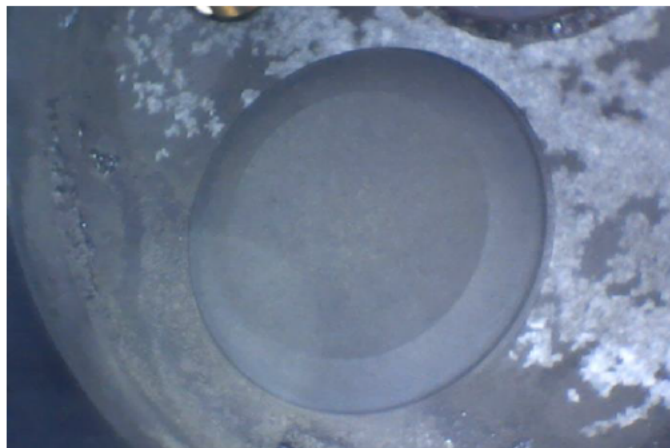
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#3 Exhaust Valve



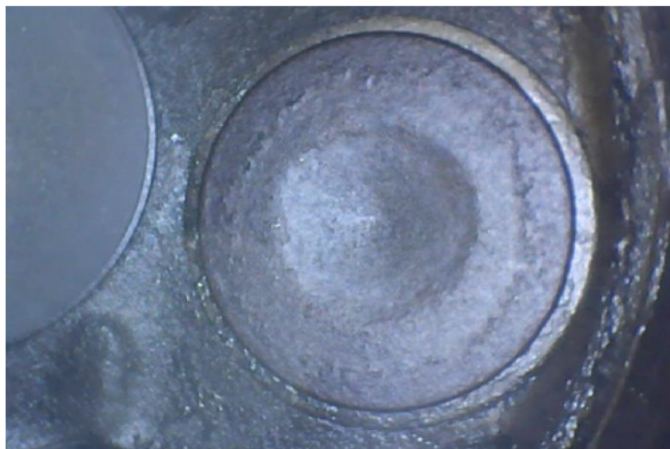
#3 Intake Valve



#5 Exhaust Valve



#5 Intake Valve



#2 Exhaust Valve



#2 Intake Valve

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#4 Exhaust Valve



#4 Intake Valve



#6 Exhaust Valve



#6 Intake Valve

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ROCKER ARMS AND SHAFTS

Condition:

The rocker arms remained attached to their installation points and were undamaged. The rocker arms displayed normal operating and lubrication signatures and the rocker arms operated normally during crankshaft rotation.



PISTONS

Piston P/N: Inaccessible

Condition:

The piston faces were inspected using a lighted borescope. The piston faces displayed normal operating and combustion signatures. During crankshaft rotation all six pistons operated normally.



#1 Piston



#3 Piston

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#5 Piston



#2 Piston



#4 Piston



#6 Piston

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CRANKCASE ASSEMBLY

CRANKCASE	Casting Number:	1-3-5: Not observed	2-4-6: Not observed	S/N: S06GA008
Condition:	The crankcase remained intact and displayed discoloration consistent with exposure to fire suppressant chemicals. There were no holes in the case that would indicate a catastrophic internal engine failure.			



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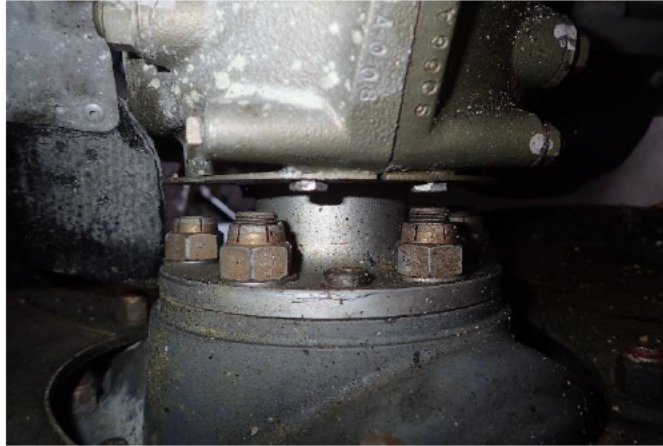
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CRANKSHAFT ASSEMBLY

CRANKSHAFT	Forging Number: Inaccessible	S/N: N06FA027	Heat code: Inaccessible
Condition:	The propeller flange remained attached to the rest of the crankshaft and there was no visible damage to the crankshaft. The crankshaft was rotated by hand and continuity was established between the crankshaft, camshaft, connecting rods and associated components. There were no anomalies observed.		



CONNECTING RODS	P/N: Inaccessible	Forging or Serial Number: Inaccessible
Condition:	The operation of the connecting rods was verified by rotating the crankshaft and observing piston movement. The connecting rods operated normally	

CAMSHAFT

CAMSHAFT	P/N: Inaccessible	S/N: Inaccessible
Condition:	The operation of the camshaft was verified by rotating the crankshaft and observing rocker arm movement. The camshaft operated normally.	
ACCESSORY GEARS		
Condition:	The operation of the magneto drive gears was verified by rotating the crankshaft and observing magneto impulse coupling operation. The magneto drive gears operated normally.	

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ACCESSORIES

STARTER

Manufacturer: TCM

P/N: 655565F12V

S/N: ?596?230

Condition:

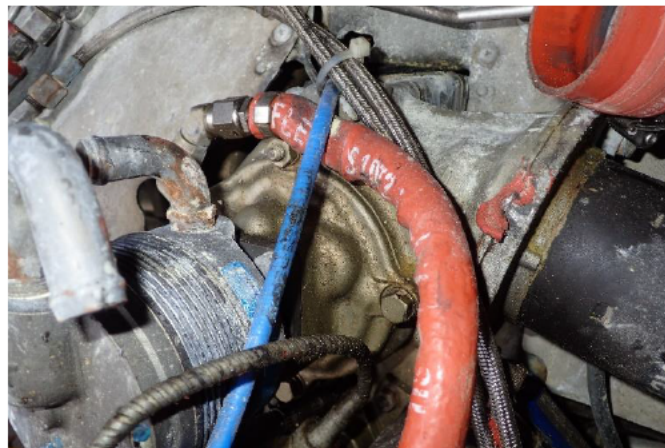
The starter remained attached to the starter adapter and displayed corrosion consistent with exposure to fire suppressant chemicals.

STARTER
ADAPTER

P/N: Not observed

Condition:

The starter adapter remained attached to its installation point and was undamaged.



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ALTERNATOR

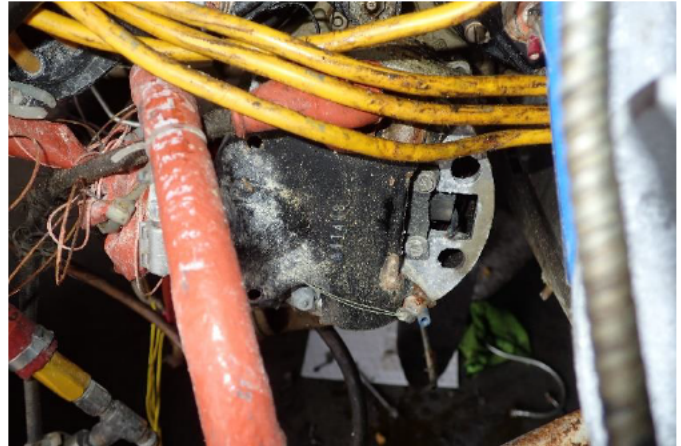
Manufacturer: Kelly Aerospace

P/N: ALX-952??

S/N: ?062834

Condition:

The alternator remained attached to its installation point and displayed impact damage signatures as well as corrosion consistent with exposure to fire suppressant chemicals. There were no anomalies observed.

VACUUM
PUMP

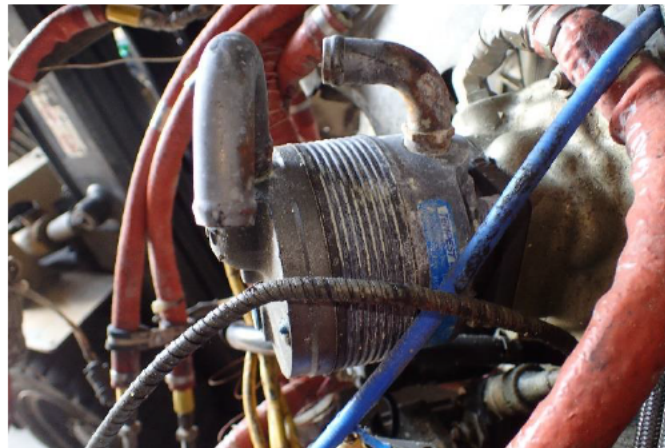
Manufacturer: Tempest

P/N: AA3215CC

S/N: 04U824

Condition:

The vacuum pump remained attached to its installation point and was undamaged.



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TURBO

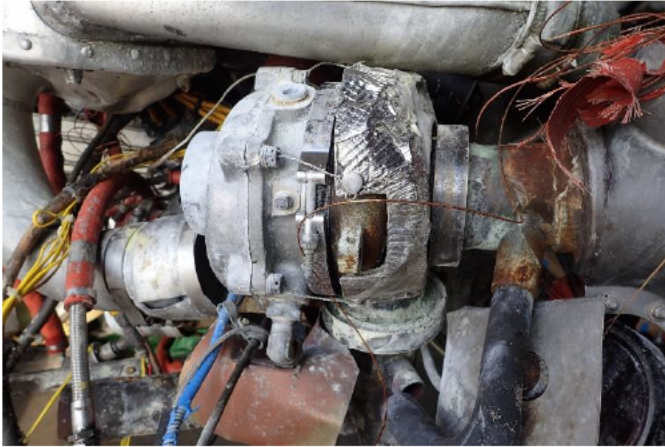
Manufacturer: Hartzell Engine
Technologies

P/N: GF600573-9000

S/N: H-TR0814028

Condition:

The turbocharger remained attached and displayed impact damage as well as corrosion consistent with exposure to fire suppressant chemicals. The turbine and compressor blades displayed normal operating signatures and were capable of rotation.



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WASTEGATE

Manufacturer: Merlyn
Products, Inc.

P/N: Illegible

S/N: 1893090533

Condition:

The fixed wastegate was replaced with an automatic wastegate via an STC by Merlyn Product, Inc. The wastegate remained attached to its installation point and both AN fittings were secure. The wastegate was retained by the NTSB for additional testing.

OVERBOOST
VALVE

Manufacturer: Kelly Aerospace

P/N: 641404-1

S/N: JEN00006

Condition:

The overboost valve remained attached to its installation point and was undamaged. There were no anomalies observed.



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PROPELLER

PROPELLER
GOVERNOR

Manufacturer: Woodward

P/N: G210681

S/N: 1490597Y

Condition:

The propeller governor remained attached to its installation point and was undamaged. The propeller control rod end remained attached to the control arm; it was observed that the propeller control arm spring had detached from its installation point.



PROPELLER

Manufacturer: Hartzell

P/N: Not observed

S/N: Not observed

Condition:

The two-blade, constant speed propeller remained attached to the crankshaft and both propeller blades remained within the propeller hub. Both propeller blades displayed impact damage signatures. One of the propeller blades (blade "A") displayed minor aft bending deformation and minor chordwise scratches at the trailing edge of the blade. The other propeller blade (blade "B") displayed aft bending deformation, minor twisting deformation, and minor chordwise scratches at the leading edge of the blade.



Propeller Blade "A"

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Propeller Blade "B"



Propeller with both propeller blades