



Continental Motors

ENGINE EXAMINATION REPORT

ENGINE MODEL	TSIO-520-NcNB via RAM STC
ENGINE SERIAL NUMBER	509505-H
AIRCRAFT MAKE & MODEL	Cessna 340
AIRCRAFT SERIAL NUMBER	340-0214
AIRCRAFT REGISTRATION	N247AT
FILE NUMBER	17-361

NAME	SIGNATURE	DATE
Nicole L. Charnon		01/17/2018

ENGINE EXAMINATION REPORT**FILE NUMBER:**

17-361

ENGINE S/N:

509505-H

PAGE 2 of 41**GENERAL INFORMATION**

EXAMINATION		ACCIDENT DATA	
DATE	01/09-10/2018	NTSB ACCIDENT #	CEN18FA061
FACILITY	Florida Air Recovery LLC	NTSB INVESTIGATOR	Joshua Lindberg
ADDRESS	455 Tresca Road Jacksonville, FL 32225	FAA INVESTIGATOR	Michael Corrigan
		ACCIDENT DATE	12/24/2017
		ACCIDENT LOCATION	Bartow, Florida

ENGINE INFORMATION

ENGINE POSITION	Left Engine
TOTAL TIME	Unknown
TIME SOH	Unknown
TYPE & TIME SLI	Unknown [Last Annual Inspection took place 01/02/2017 at a Hobbs time of 1,582.9 hours]
BUILD DATE	11/17/1989
IN SERVICE DATE	Unknown

Significant logbook information:

Maintenance records were obtained by the FAA and copies were provided to the investigative team. According to those records, the left engine was overhauled and converted by RAM Aircraft on April 20, 2004 at an engine total time of 3,800 hours. On August 8, 2011 at a Hobbs time of 1,439 hours, two cylinders were replaced due to low compression. On November 17, 2014 at a Hobbs time of 1,543 hours, the engine underwent an annual inspection in which the oil was drained and serviced, and the oil filter was replaced. The engine then underwent annual inspections on December 20, 2015 at 1,558.4 hours and January 2, 2017 at 1,582.9 hours. In both of the last two annual inspection endorsements, the oil filter was listed as having been inspected and replaced. However, the oil filter for the left engine had a date of 11/6/14 written on the side with a time of 1,543 hours. A maintenance entry dated February 1, 2017 at a Hobbs time of 1,582.9 hours indicated that the turbocharger was removed due to bearing failure and an overhauled unit was installed. The last maintenance activity recorded for the left engine was dated November 22, 2017 at a Hobbs time of 1,607.5 hours, and indicated that the starter adapter was removed, overhauled, and reinstalled.

Report Summary:

Search Code(s):

15-12-68

No pre-accident anomalies were noted with the engine, or engine-related systems that would have precluded the its ability to produce full, rated power.

Disposition of engine following exam:

None of the engine or engine-related system components were retained by the NTSB for further examination. The wreckage will be stored at Florida Air Recovery until final release by the NTSB.

ENGINE EXAMINATION REPORT**FILE NUMBER:**

17-361

ENGINE S/N:

509505-H

PAGE 3 of 41**INSPECTION WITNESSES**

NAME	Nicole L. Charnon	NAME	Joshua Lindberg
ADDRESS	Washington, DC	ADDRESS	Dallas, Texas
ORGANIZATION	Continental Motors	ORGANIZATION	NTSB – Central Region
PHONE	[REDACTED]	PHONE	[REDACTED]
NAME	Andrew Hall	NAME	Rick Roper
ADDRESS	Wichita, Kansas	ADDRESS	Waco, Texas
ORGANIZATION	Textron Aviation	ORGANIZATION	RAM Aircraft, L.P.
PHONE	[REDACTED]	PHONE	[REDACTED]

EXTERNAL ENGINE CONDITION

The engine was separated from the airframe and was labeled as the left engine based on the data plate and the aircraft maintenance records. The crankshaft was fractured at the nose oil seal and the propeller flange remained attached to the propeller hub. The crankshaft fracture surface displayed tearing, shear lips, and discoloration features consistent with overload. The alternator was separated from the engine and the alternator face gear, bevel gear, and propeller governor drive gear were visible through the alternator mounting pad. No pre-accident anomalies were noted with the gears. The engine sustained impact and thermal damage.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 4 of 41



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 5 of 41



ENGINE COMPONENT EXAMINATION

EXHAUST SYSTEM

Condition: The exhaust system sustained impact-related deformation and separation damage. There were no pre-accident anomalies noted with the v-band clamps, bolted couplings, or slip joints. The waste gate actuator linkage did not display and pre-accident anomalies. Sand and dirt was impacted in the right side exhaust slip joint and the aft exhaust risers were displaced forward.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 6 of 41



INDUCTION SYSTEM

Condition:

The induction system was impact and thermally damaged. The turbocharger intake was unobstructed. The intercooler was separated from the engine nacelle (it should be noted that the intercooler for both the left and right engines were separated and it was not clear as to which one belonged to which engine. Regardless, they displayed similar impact-related damage with no pre-accident anomalies noted). No pre-accident anomalies were noted with the system.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 7 of 41



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 8 of 41

IGNITION SYSTEM

LEFT MAGNETO

Manufacturer: Slick

P/N: 6320

S/N: 05061649

Condition: The magneto was separated from the mounting pad but remained attached to the engine via the ignition harness. The magneto drive shaft was manually rotated and it produced a spark from each lead in firing order when an audible snap of the impulse coupling was heard (the left ignition harness cap was removed for the testing due to damage sustained in the accident sequence, and the right magneto's ignition harness cap was utilized for testing).



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 9 of 41

RIGHT MAGNETO

Manufacturer: Slick

P/N: 6320

S/N: 05021342

Condition:

The magneto was separated from the mounting pad but remained attached to the engine via the ignition harness. The magneto drive shaft was manually rotated and it produced a spark from each lead in firing order when an audible snap of the impulse coupling was heard.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 10 of 41

IGNITION HARNESS

Manufacturer: Slick (Unison)

S/N: LH 2783, RH 2784

Condition:

The ignition harnesses remained attached to the magnetos and all terminals remained attached to their respective sparkplugs, but many of the leads sustained pulling and thermal damage. The leads were cut from the right magneto harness cap, which was used during the functional testing of both magnetos. No pre-accident anomalies were noted with either harness/cap.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 11 of 41

SPARK PLUGS

Manufacturer: Tempest

P/N: URHB32E

Condition:

All of the sparkplugs remained secured to their respective cylinders with no pre-accident anomalies noted. The top sparkplugs were removed from the cylinders. All displayed a normal worn appearance with no signs of lead or carbon fouling. The bottom sparkplugs were examined via a lighted borescope with no pre-accident anomalies noted with the electrodes.



1T



1B



3T



3B

ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 12 of 41



5T



5B



2T



2B



4T



4B

ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 13 of 41



6T



6B

ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 14 of 41

FUEL SYSTEM

FUEL PUMP

Manufacturer: Continental
Motors (overhauled)

P/N: 646210-11

S/N: H719901BR

Condition:

The engine-driven fuel pump was separated from the backside of the engine and the mounting flange and drive coupling were fractured and displaced to one side with the metal was smeared in the same direction. The aneroid bellows and upper deck reference line, vapor return fitting, and fuel inlet line were separated from the pump. The return line from the fuel pressure regulator to the fuel pump remained in place. Removal of the line resulted in residual fuel pouring from the pressure regulator. The pump was disassembled and the pump vanes were intact with no pre-accident anomalies noted with the observed internal components.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 15 of 41



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 16 of 41

THROTTLE BODY METERING UNIT

Manufacturer: Continental
Motors (overhauled)

P/N: 632916-11

S/N: J177948A

Condition:

The throttle body/fuel metering unit remained attached to the left engine nacelle and was thermally damaged and fractured. The mixture and throttle control cables remained attached to their respective control levers, both of which sustained deformation damage. The throttle valve was found in the full open position. The interconnect link between the throttle and the turbo wastegate pressure controller was separated. The mixture control shaft was bent. All of the fittings were fractured on the fuel metering unit. The inlet fuel screen was removed and no obstructions were noted.



ENGINE EXAMINATION REPORT

FILE NUMBER:	17-361	ENGINE S/N:	509505-H	PAGE 17 of 41
--------------	--------	-------------	----------	---------------

FUEL MANIFOLD VALVE

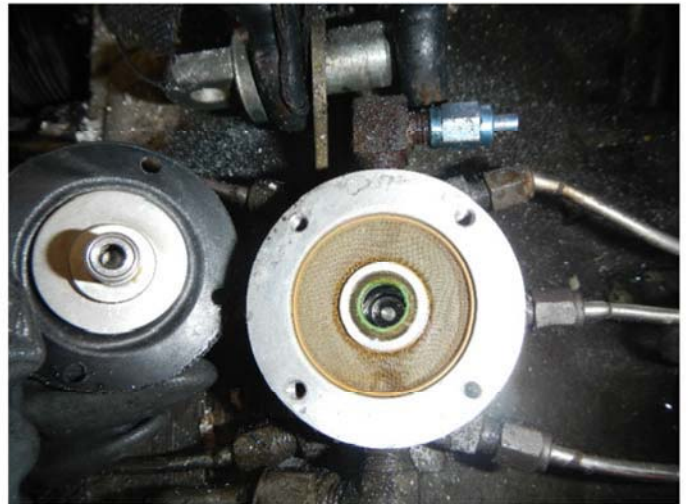
Manufacturer: Continental Motors (overhauled)

P/N: 643326-4A8

S/N: F297929C

Condition:

The fuel manifold valve remained secured to the topside of the engine and the fuel lines remained attached to the housing. The fuel manifold valve cap was removed and the screen was free from obstructions. Residual fuel was observed in the housing.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

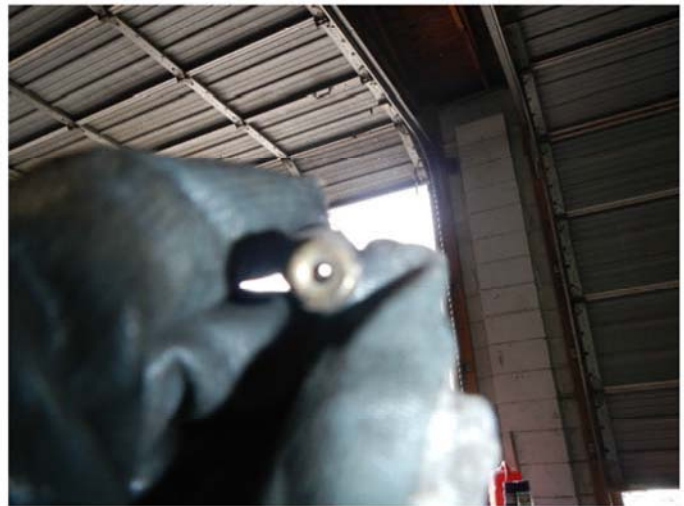
509505-H

PAGE 18 of 41

FUEL NOZZLES AND LINES

Condition:

The fuel lines remained secured to their nozzles and the upper deck reference line remained secured to the nozzles. Removal of the nozzles revealed they were clear and unobstructed.



ENGINE EXAMINATION REPORT

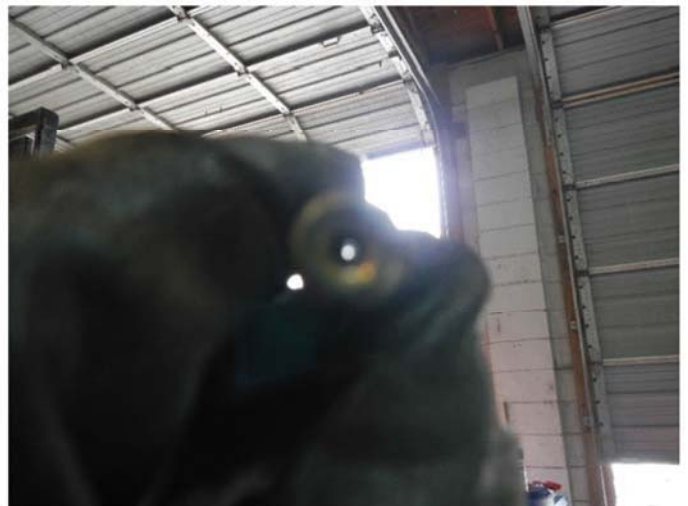
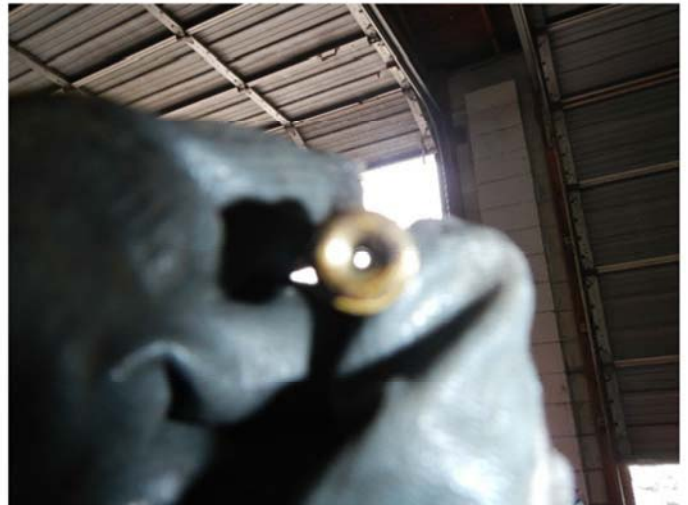
FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 19 of 41



ENGINE EXAMINATION REPORT

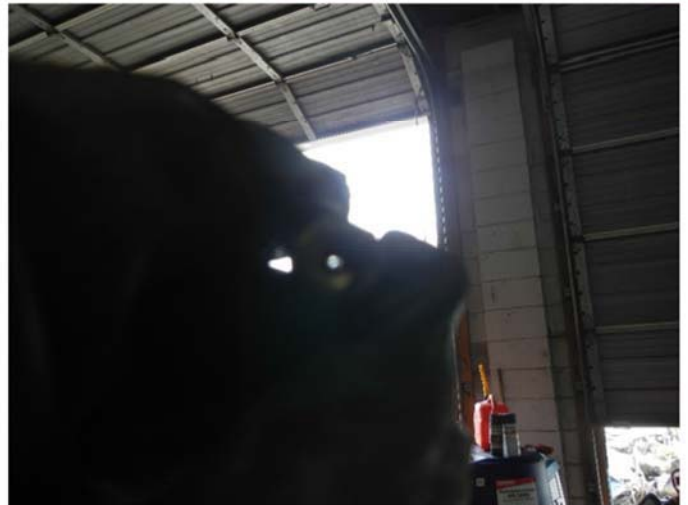
FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 20 of 41



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 21 of 41

LUBRICATION SYSTEM

OIL SUMP

Condition: The oil sump remained attached to the bottom side of the engine, but it was displaced upward and camshaft gear teeth were protruding from punctures.



OIL PICKUP TUBE & SCREEN

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

OIL PUMP

Condition: The oil pump and scavenge pumps remained intact, but the cap for both were impact damaged. The oil pump and scavenge pump caps were removed. Residual oil was observed on the gears and in the gear housing. Short shavings of metal were observed on the oil pump's gear teeth and coinciding gouges were noted on the housing walls, consistent with rotation at impact. No pre-accident anomalies were noted.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 22 of 41



ENGINE EXAMINATION REPORT

FILE NUMBER:	17-361	ENGINE S/N:	509505-H	PAGE 23 of 41
--------------	--------	-------------	----------	---------------

OIL FILTER

Manufacturer: Tempest

P/N: AA48108-2

Condition: The oil filter remained attached to the adapter, but the adapter was fractured and separated from the engine. The oil filter was deformed and punctured. The following information was hand-written on the side associated with the date and tach time, respectively: 11/6/14 1543.



OIL COOLER

Manufacturer: Not Recorded

P/N: Not Recorded

S/N: Not Recorded

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



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 24 of 41

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. The exception is for cylinder #2 and #3 which have additional photographs described in the narrative.

CYLINDER #1

Condition:

The cylinder remained attached to the crankcase with no external signs of operational distress. The rocker cover was removed and the valve springs displayed signs of corrosion. Residual oil was observed in the rocker cover. The cylinder was inspected and documented utilizing a lighted borescope. The piston, valves, and valve seats were unremarkable.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

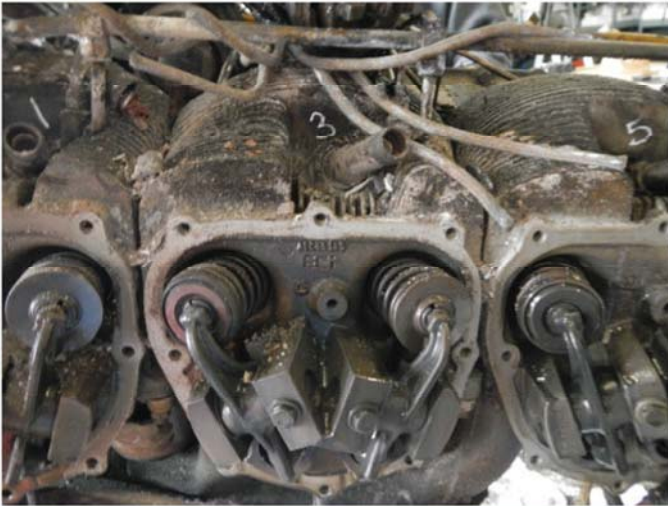
ENGINE S/N:

509505-H

PAGE 25 of 41

CYLINDER #3

Condition: The cylinder remained attached to the crankcase with no external signs of operational distress. The rocker cover was removed and the valve springs displayed signs of corrosion. Residual oil was observed in the rocker cover. The cylinder was inspected and documented utilizing a lighted borescope. The #3 exhaust valve displayed two areas of green discoloration consistent with a pre-existing exhaust gas leak (the last three photos in this section consist of different views of the exhaust valve). Otherwise, the piston, valves, and valve seats were unremarkable.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 26 of 41



CYLINDER #5

Condition:

The cylinder remained attached to the crankcase with no external signs of operational distress. The rocker cover was removed and the valve springs displayed signs of corrosion. Residual oil was observed in the rocker cover. The cylinder was inspected and documented utilizing a lighted borescope. The piston, valves, and valve seats were unremarkable.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 27 of 41



CYLINDER #2

Condition:

The cylinder remained attached to the crankcase with no external signs of operational distress. The rocker cover was removed and the valve springs displayed signs of corrosion. The #2 intake inner valve spring was fractured. Residual oil was observed in the rocker cover. The cylinder was inspected and documented utilizing a lighted borescope. The piston, valves, and valve seats were unremarkable. The 2nd, 3rd and 4th photographs below are closer views of the intake valve springs.



ENGINE EXAMINATION REPORT

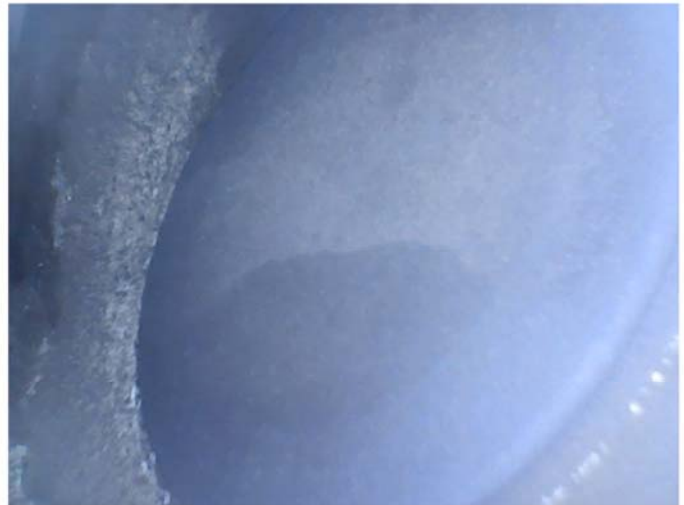
FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 28 of 41



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 29 of 41

CYLINDER #4

Condition: The cylinder remained attached to the crankcase with no external signs of operational distress. The rocker cover was removed and the valve springs displayed signs of corrosion. Residual oil was observed in the rocker cover. The cylinder was inspected and documented utilizing a lighted borescope. The piston, valves, and valve seats were unremarkable.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

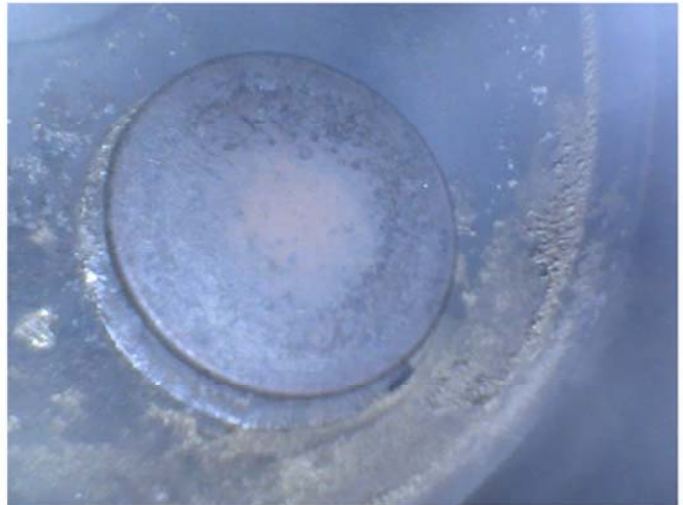
ENGINE S/N:

509505-H

PAGE 30 of 41

CYLINDER #6

Condition: The cylinder remained attached to the crankcase with no external signs of operational distress. The rocker cover was removed and the valve springs displayed signs of corrosion. Residual oil was observed in the rocker cover. The cylinder was inspected and documented utilizing a lighted borescope. The piston, valves, and valve seats were unremarkable.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 31 of 41

CRANKCASE ASSEMBLY

CRANKCASE	Casting Number:	1-3-5: Not Recorded	2-4-6: Not Recorded	S/N: Not Recorded
Condition:	The crankcase remained intact with no external signs of operational distress noted.			



CRANKSHAFT ASSEMBLY

CRANKSHAFT	Forging Number: Unknown	S/N: Unknown	Heat code: Unknown
Condition:	The propeller flange was separated from the crankshaft and the fracture surface displayed tearing, shear lips, and discoloration features consistent with overload. A tool was fitted to the backside of the crankshaft and rotation of the crankshaft was not possible. Impingements on the crankshaft and camshaft were noted at the front of the crankcase and the oil sump respectively. Examination of the crankshaft through the alternator mounting bad showed no pre-accident anomalies with the alternator face gear and oil transfer collar. The crankshaft gear was secured in place.		



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 32 of 41



CAMSHAFT

CAMSHAFT

S/N: Unknown

Condition:

The camshaft was not observed in its entirety. The bevel gear was observed through the alternator mounting pad and no pre-accident anomalies were noted. The camshaft gear was impinged upon by the deformed oil sump.



ENGINE EXAMINATION REPORT**FILE NUMBER:**

17-361

ENGINE S/N:

509505-H

PAGE 33 of 41**ACCESSORIES****STARTER**

Manufacturer: Unknown

P/N: Unknown

S/N: Unknown

Condition:

The starter was separated from the adapter.

**STARTER
ADAPTER**

Condition:

The starter adapter remained attached to the backside of the engine but it was fractured at the motor flange. The scavenge pump remained in place on the adapter. No pre-accident anomalies were noted.

**ALTERNATOR**

Manufacturer: Prestolite

P/N: ALV-9510

S/N: 7091788 81019

Condition:

The alternator was separated from the engine and the mounting flange was fractured. The alternator drive coupling remained in place and no pre-accident anomalies were noted. The alternator face gear remained intact with no pre-accident anomalies noted.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 34 of 41

VACUUM PUMP

Manufacturer: Unknown

P/N: Unknown

S/N: Unknown

Condition:

The vacuum pump was separated from the backside of the engine and fragments were noted in the wreckage. The vacuum pump drive coupling was identified and it was intact. The pump housing, rotors, and vanes were fractured (the bottom photo represents the two housings identified in the wreckage).



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 35 of 41

TURBO

Manufacturer: RAM

P/N: 2060-1

S/N: YK033273

Condition:

The turbocharger remained with the left nacelle area. The compressor housing was fractured. The intake impeller blades displayed deformation damage and curling opposite the direction of normal rotation. The turbocharger turbine wheel/blades remained intact.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 36 of 41



TURBO CONTROLLER

Manufacturer: RAM

P/N: 4708.36-18

S/N: ED013361

Condition:

The turbo wastegate controller was thermally damaged and separated from the engine.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 37 of 41

WASTEGATE

Manufacturer: Not Recorded

P/N: Not Recorded

S/N: Not Recorded

Condition:

The waste gate actuator linkage remained intact and attached to the wastegate, though deformation and thermal damage were extensive.



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 38 of 41

OVERBOOST VALVE

Manufacturer: Unknown

P/N: Unknown

S/N: Unknown

Condition:

The overboost valve was thermally damaged and separated from the induction system. Remnants of two overboost valves were identified in the wreckage and the photograph below display those components.



ENGINE EXAMINATION REPORT**FILE NUMBER:**

17-361

ENGINE S/N:

509505-H

PAGE 39 of 41**PROPELLER****PROPELLER GOVERNOR**

Manufacturer: Not Recorded

P/N: Not Recorded

S/N: Not Recorded

Condition:

The propeller governor remained attached to the engine and the drive gear was intact with no pre-accident anomalies noted.

**PROPELLER**

Manufacturer: McCauley

P/N: 3AF32C515

S/N: 001768

Condition:

The propeller remained attached to the propeller flange, which was separated from the crankshaft at the engine nose seal. The propeller hub remained intact and the piston housing was compressed aft. All three blades remained attached to the hub, but they were free to rotate, indicative of a pitch change link fractures. The blades were labeled 1, 2, and 3 according to their hub location. Blade 1 was missing its counterweight and was bent aft slightly. The leading edge displayed some light gouging and the cambered side displayed chord-wise scrapes and paint erosion. Blade 2 displayed a small twist toward low pitch, paint erosion on the cambered side and light leading edge gouges. The counterweight remained attached to the blade shank. Blade 3 was missing its counterweight. The blade displayed light chord-wise paint erosion aft of the deice boot, but was otherwise unremarkable.

ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 40 of 41



ENGINE EXAMINATION REPORT

FILE NUMBER:

17-361

ENGINE S/N:

509505-H

PAGE 41 of 41

