



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

AIRFRAME AND ENGINE EXAMINATION

WPR19FA080

Accident Date: February 5, 2019
Exam Date: February 8, 2019

This document contains 44 embedded images

Photos courtesy NTSB, Lycoming Engines, and Textron Aviation

A. ACCIDENT

Location: Desert Hot Springs, California
Date: February 5, 2019
Aircraft: Cessna 172M, N20556, Serial # 1726139
NTSB IIC: Michael Huhn

B. EXAMINATION PARTICIPANTS:

Michael Huhn
Air Safety Investigator
National Transportation Safety Board
Federal Way, WA

Mark Platt
Air Safety Investigator
Lycoming Engines
Williamsport, PA

Henry Soderlund
Air Safety Investigator
Textron Aviation
Wichita, Kansas

C. SUMMARY

The wreckage was removed from the mountainside and transported to the Air Transport facility in Phoenix on February 7, 2019. Detailed examination of the airframe and engine was conducted by the NTSB and parties on February 8, 2019 at Air Transport. No evidence of preimpact mechanical malfunction, or any pre-or post-impact fire was noted during the examination.

D. AIRFRAME EXAMINATION

1.0 General

- On-scene information and overall damage patterns were consistent with the airplane impacting a very steep (approx. 70° + from the horizontal) terrain in an upright, approximately wings- and pitch- level attitude
- All primary components were located at the impact site

2.0 Fuselage

- The cockpit/cabin area was severely disrupted due to crushing and tearing
- The engine was pushed aft into the cabin
- The cabin floor, starting at the firewall, was crushed aft to the main gear attach points.

3.0 Wings

- The outboard 3 ft of the left wing leading edge was crushed diagonally aft
 - The outboard end was crushed aft to the trailing edge
- The leading edges of both the left and right wings were crushed straight aft to approximately the mid-chord of each wing
- Both fuel caps remained securely fastened in their respective filler necks

4.0 Flight Controls

- All flight controls were present and attached to their respective aerodynamic surfaces
- Control cable continuity was established for the ailerons, elevators, pitch trim, and rudder
- The pitch trim actuator was found in a position corresponding to tab 5° TEU
- The flaps were fully retracted
 - The flap actuator was found in the flaps retracted position
 - The flap position indicator registered 40° (full down)

5.0 Controls & Instruments

- The positions of the electrical switches and circuit breakers were not observed/documented (due to damage)
- The key remained in the ignition switch and its orientation appeared consistent with being in the 'Both' position
- The tachometer registered 6967.2 hours, and the needle pointed to about 1,600 rpm
- The needles on the altimeter, airspeed indicator, and vertical speed indicator were absent
- The altimeter Kollsman window was set to 29.82
- The front plate of the heading indicator was absent
- The airplane and ball on the turn coordinator were absent
- The vacuum regulator filter was observed installed on the vacuum system regulator
- The main vacuum filter was not observed in the wreckage
- The B-nut attached to the "VAC" port on the attitude indicator was found to be hand tight
- The attitude indicator was "laid over" to the right (corresponding to significant left wing down attitude)
- The attitude indicator and heading indicator instruments were disassembled
- The attitude indicator gyro rotor was found offset inside the rotor housing
 - The rotor was free to rotate, but exhibited no rotational scoring
- The heading indicator gyro rotor was free to rotate, and exhibited rotational scoring
- The fuel selector handle and shaft were separated from the fuel selector valve.
 - The fuel selector valve was removed, and its setting (to the right tank) was determined by blowing air through the ports.
 - The selector position was also confirmed by lining up the fractured shaft with the valve
- The fuel strainer bowl was fractured but the full assembly remained attached to the firewall
 - The strainer screen and bowl were clear of debris
- The ELT was an ACK Technologies model E-01, serial number 033768

- o The ELT was armed but had not activated
 - o The battery due date was 12/31/24
 - o The ELT had separated from its mounting holddown, but remained attached to its antenna
 - o The ELT battery case was fractured, and the holddown clamp was found in the released position
- A Flight school document found in the airplane indicated that the tachometer registered 6966 (sic) hrs when the airplane was released to the pilot

E. AIRFRAME PHOTOGRAPHS



Figure 1 - Wreckage Layout



Figure 2 - Cockpit Flight Controls



Figure 3 - Cockpit / Cabin



Figure 4 - Cockpit Avionics & Wiring



Figure 5 - Left Wing



Figure 6 - Right Wing



Figure 7 - Tachometer



Figure 8 - Altimeter Face



Figure 9 - Left-Side Instrument Panel Section



Figure 10 - Rotors From Attitude and Directional Gyros



Figure 11 - Instrument Panel Section



Figure 12 - Ignition Switch



Figure 13 - ELT Mounting Bracket



Figure 14 - ELT



Figure 15 - Fuel Selector Valve

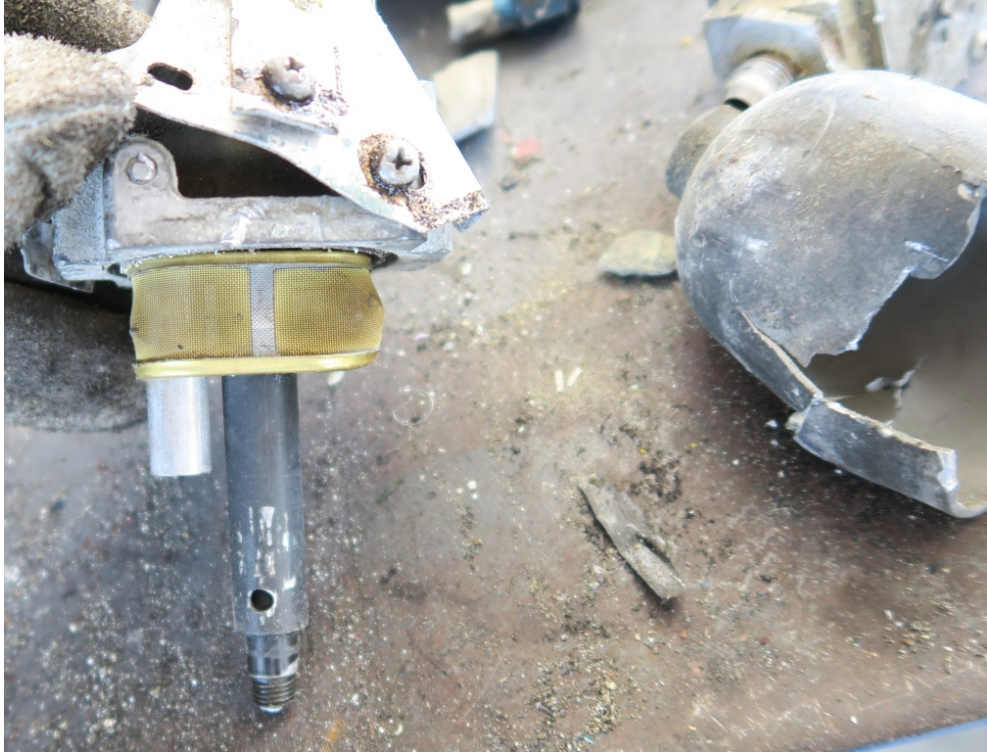


Figure 16 - Fuel Strainer



Figure 17 - Fuel Strainer Bowl

Air filter element
SB 95-03 FLAP ATTACHMENT

New Squawks

Times Hobbs Out: 3349.7

Clock Times Tach Out: 6966

Departure: ____ : ____

100LL Fuel Pump Start: ____

Oil Type: W100+

Fuel On Board: Unknown as of 02/03/19 13:00

Seat Holders: >> none <<

Student & Instructor Signature: _____

Flying Academy ▣ 14569 SW 127th ST, Miami FL, 33186 ▣ 1903 C Aviation

HEADSET
IPAD

Figure 18 - Airplane Dispatch Release Sheet

F. ENGINE EXAMINATION

1.0 General

- The powerplant was a Lycoming O-320 E2D series engine; four cylinder; air cooled, direct drive, horizontally opposed, normally aspirated (carburetor), rated at 150hp @ 2700rpm.
- Serial # L-44359-27A
- Most recent overhaul 9/13/18 (264.8 hours since overhaul)
- Most recent annual 11/2/18
- The engine was received at AT detached from the airframe at the engine mount
- The engine had sustained significant impact damage
- The exhaust system and portions of the induction system had been fracture-separated from the engine
- The propeller, magnetos, starter, and alternator had also been fracture-separated from their respective mountings
- Visual examination of the engine revealed no evidence of pre-impact catastrophic mechanical malfunction or fire.

2.0 Engine Internal & Drive Train

- The top spark plugs were removed
- The vacuum pump was removed, and crankshaft rotation was attempted by hand through the drive pad utilizing a drive tool.
 - Rotation of the crankshaft was precluded due to impact damage to the engine case and crankshaft at the nose of the engine.
- The rocker covers were removed; The complete valve train within the rocker box areas appeared to be free of any pre-impact mechanical malfunction
- The combustion chamber of each cylinder was examined through the spark plug holes utilizing a lighted borescope.
- The combustion chambers and bottom spark plug electrodes (#2B was destroyed) remained mechanically undamaged, and there was no evidence of foreign object ingestion.
- The valves were intact and undamaged.
- There was no evidence of valve to piston face contact observed.
- The gas path and combustion signatures observed at the spark plugs, combustion chambers and exhaust system components displayed coloration consistent with normal operation
- To facilitate further internal examination, holes were drilled through the top of the engine case material in-line with the rotational plane of each connecting rod.
- A lighted borescope was inserted to visualize the connecting rod, crankshaft and cam lobes at the respective cylinder positions
- The crankshaft and attached connecting rods were free of heat distress.
- The camshaft was intact and each of the cam lobes exhibited its characteristic elliptical shape
- There was no evidence of lubrication deprivation
- There were no signatures or conditions observed consistent with any pre-impact catastrophic mechanical malfunction

3.0 Lubrication System

- The oil filter mounting pad casting was fracture-separated from the engine due to overload.
- The oil filter was crushed and remained attached to the mounting pad.
 - It was not removed from the pad for examination.
- The oil suction screen was found secure and uncontaminated by any pre-impact debris.
- There was no evidence observed of any pre-impact lubrication system contamination found during the examination.

4.0 Accessories & Accessory Case

- The accessory case was removed.
- The accessory gears including the crankshaft gear, bolt, and dowel were intact and remained undamaged by any pre-impact malfunction.
- The camshaft gear was manually rotated using a drive tool and normal "lift action" and mechanical continuity was observed at each rocker assembly.
- The rear-mounted vacuum pump remained attached to the mounting pad.

- o One of the 4 holddown nuts was absent; there was no evidence that the nut had been removed by impact
 - o The remaining 3 nuts were secure
 - o RAPCO model RAP215CC, sn A67068
- The pump was removed, examined and photographed.
 - o The drive shaft was intact.
 - o The rotor was fractured into multiple pieces
 - o One vane was fractured.

5.0 Ignition System

- The left magneto sustained impact damage, and was fracture-separated from its mounting pad.
 - o The fracture surface signatures on the magneto-mounting flange were consistent with overload forces.
 - o The sections of magneto flange that remained at the mounting pad were securely clamped
- Magneto to engine timing could not be ascertained.
- The impulse coupler drive was found intact and secure.
 - o The drive functioned normally during hand rotation of the drive
- The magneto produced spark at the four leads during hand rotation of the drive.
- The right magneto had sustained impact damage, and was fracture-separated from the mounting pad.
 - o The fracture surface signatures at the magneto-mounting flange were consistent with overload forces.
 - o The sections of magneto flange that remained at the mounting pad were securely clamped.
- Magneto to engine timing could not be ascertained.
- The drive was found intact and secure.
- The magneto housing and internal components had sustained impact damage which rendered the magneto unsuitable for testing.
- The spark plugs were secure at each position with their respective ignition leads attached.
- The removed spark plugs were examined and photographed.
 - o The spark plug electrodes were mechanically undamaged
 - o According to the Champion Spark Plugs Check-A-Plug chart AV-27, the spark plug electrodes displayed coloration consistent with normal operation.
- The ignition harness was attached at each magneto and respective spark plug
 - o The ignition harness components sustained varying degrees of impact damage
 - o The harness was not tested.

6.0 Fuel System

- The fuel system utilizes gravity fed fuel; there is no engine driven fuel pump.
- The carburetor was fracture-separated from the engine
 - o The portion that remained attached at the mounting pad was secure. The fracture surface signatures were consistent with overload.

- The throttle control rod end was found securely attached at the control arm of the carburetor.
 - The castellated nut and cotter pin remained secure and the serrated interface at the throttle arm remained securely mated.
- The mixture arm had been pulled from the carburetor due to overload.
- Both the throttle and mixture controls had been moved beyond the normal operating range during the accident.
 - Reliable setting positions at the time of impact could not be determined due to damage
- The section of the carburetor that housed the throttle valve was fracture separated from the carburetor body due to impact.
 - The float assembly and needle valve were destroyed.
- The foam filter element remained securely attached to the airbox bracket.
 - The filter element remained intact and exhibited no evidence of pre-impact obstruction to airflow.

7.0 Exhaust System

- There was no oil residue observed in the exhaust system gas path
- There was significant ductile bending of the exhaust system components.
- A review of the maintenance records indicates the subject muffler and heat shroud were replaced with new components at the time of engine overhaul and installation
 - Entry dated 10/15/2018 @ Tach 6702.7

G. ENGINE PHOTOGRAPHS



Figure 19 - Engine Data Plate



Figure 20 - Engine Top



Figure 21 - Engine Aft

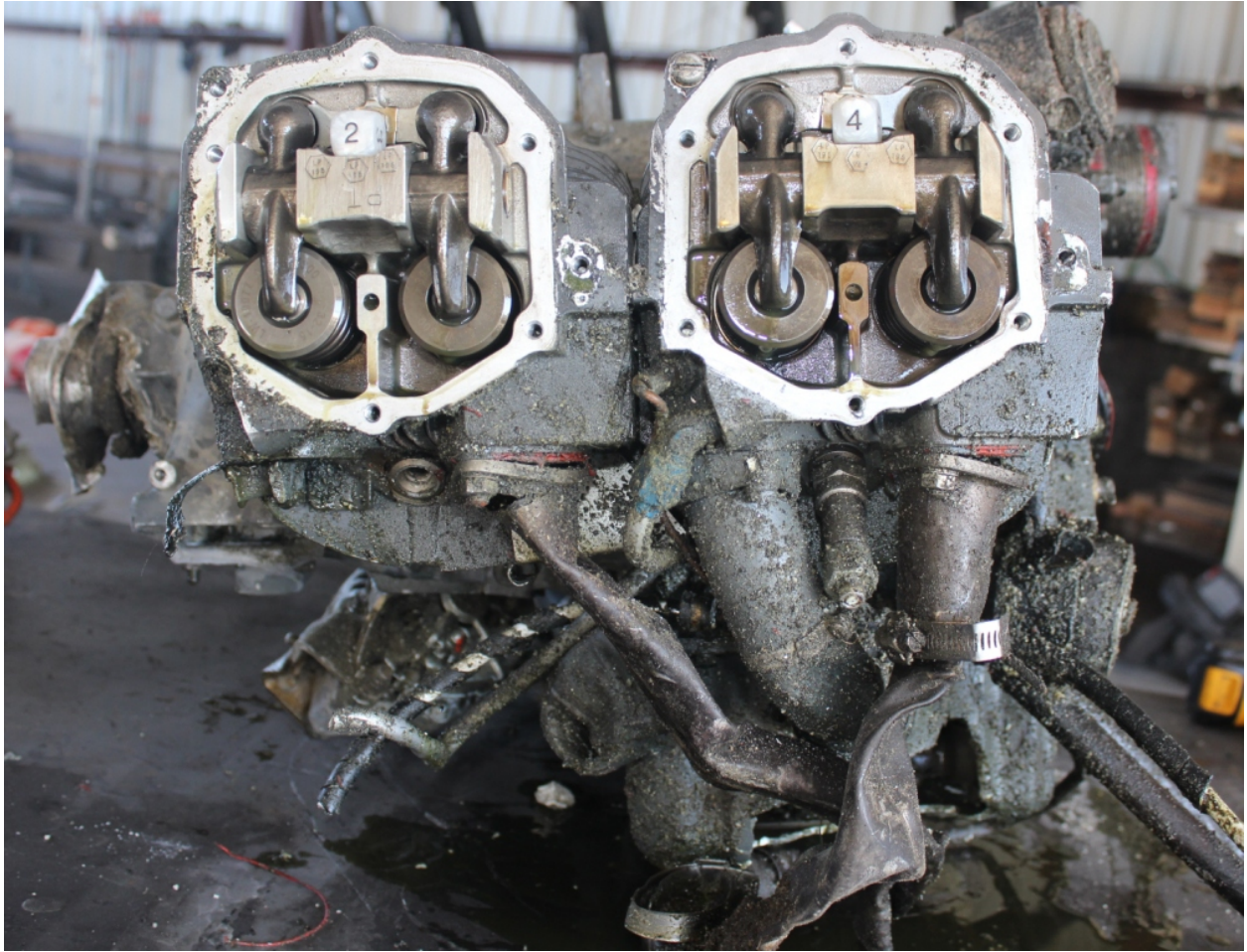


Figure 22 - Left Cylinder Bank

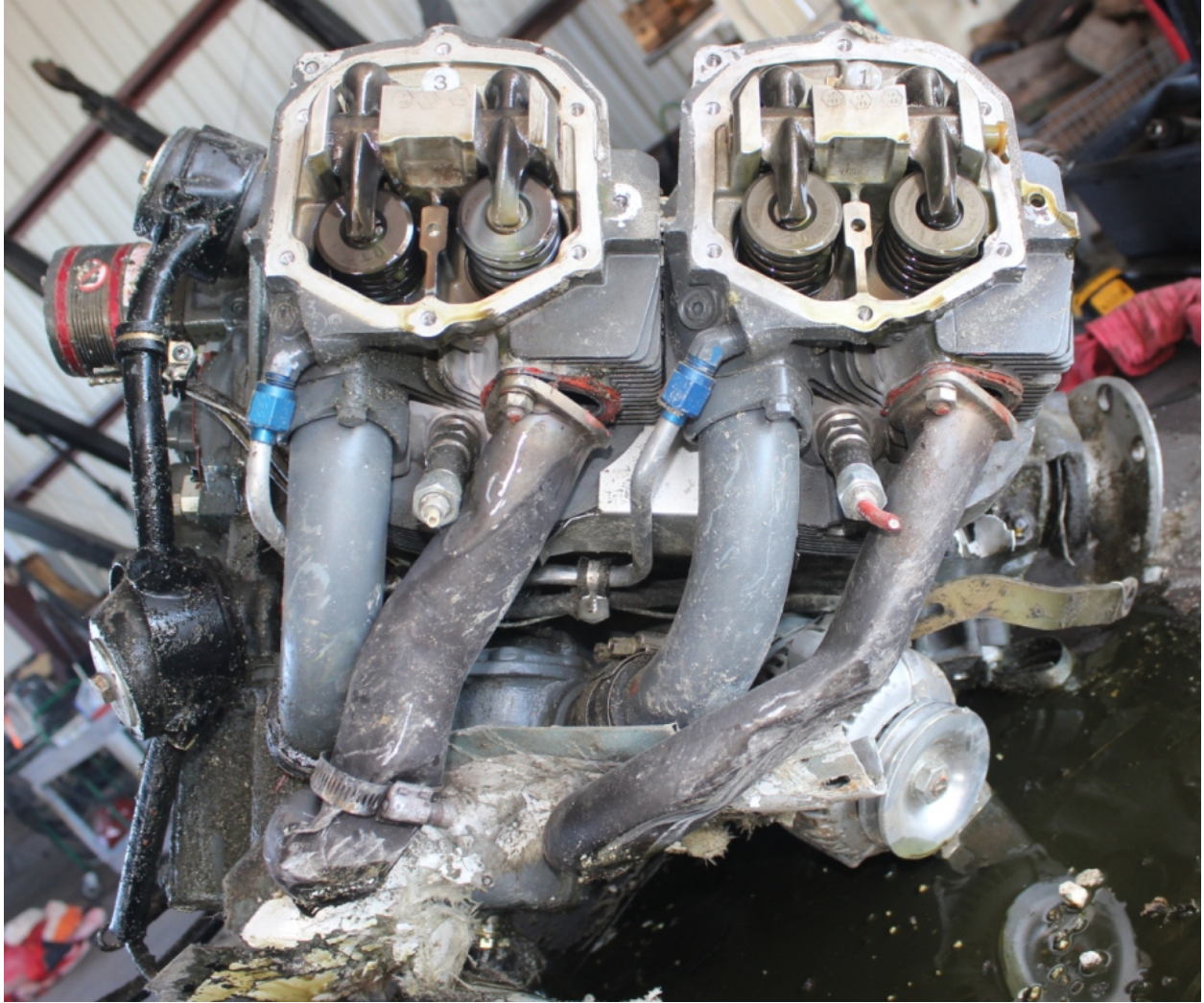


Figure 23 - Right Cylinder Bank



Figure 24 - Right Side and Underside

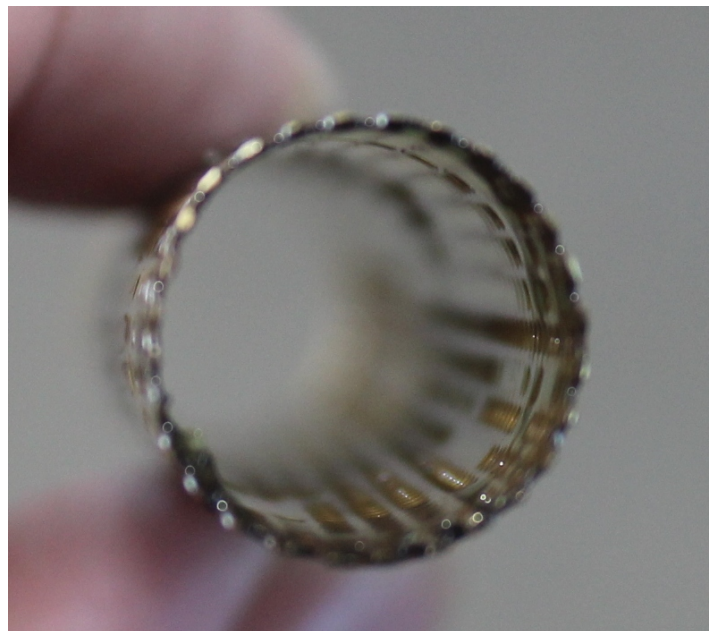


Figure 25 - Oil Screen



Figure 26 - Aft Engine Face

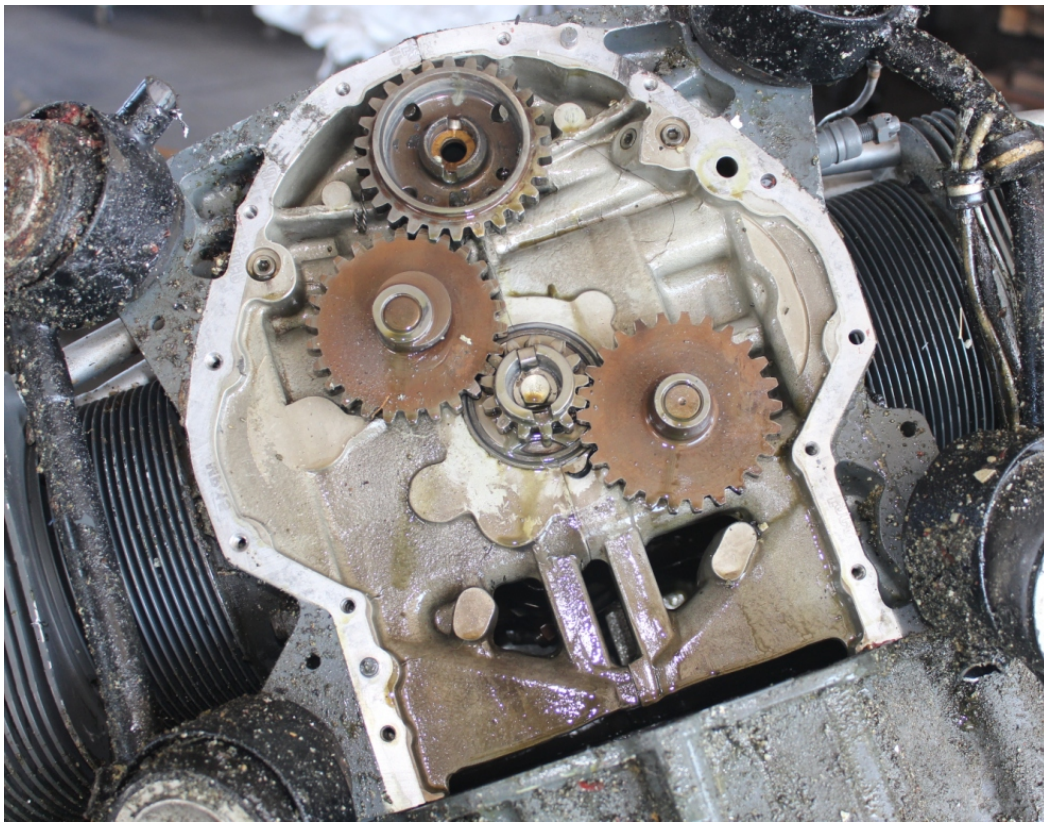


Figure 27 - Accessory Case Drive Gears



Figure 28 - Vacuum Pump (in situ)

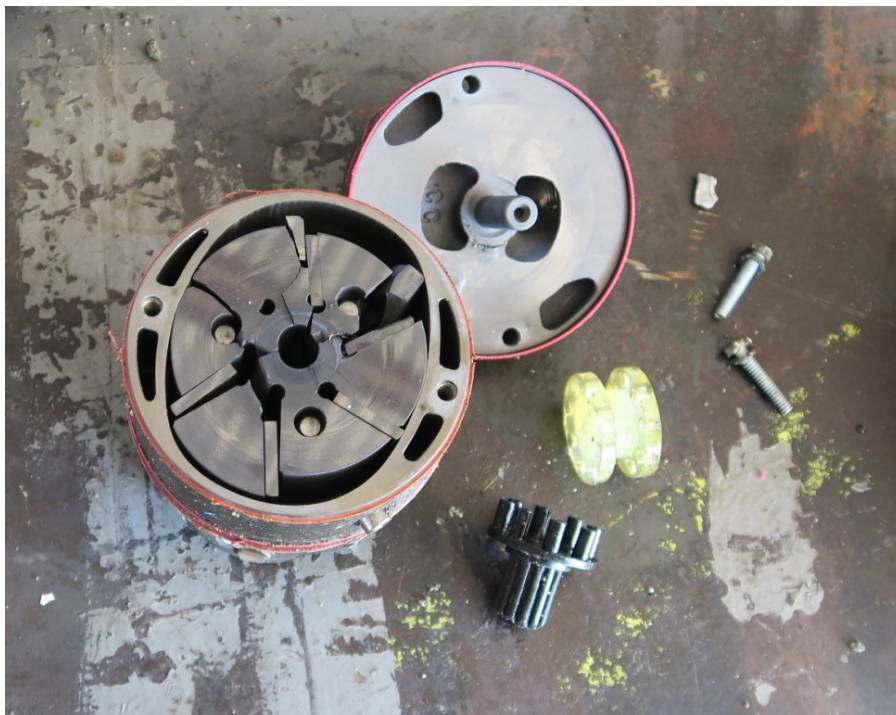


Figure 29 - Vacuum Pump Rotor and Vanes



Figure 30 - Left Magneto



Figure 31 - Left Magneto



Figure 32 - Right Magneto



Figure 33 - Right Magneto



Figure 34 - Right Magneto

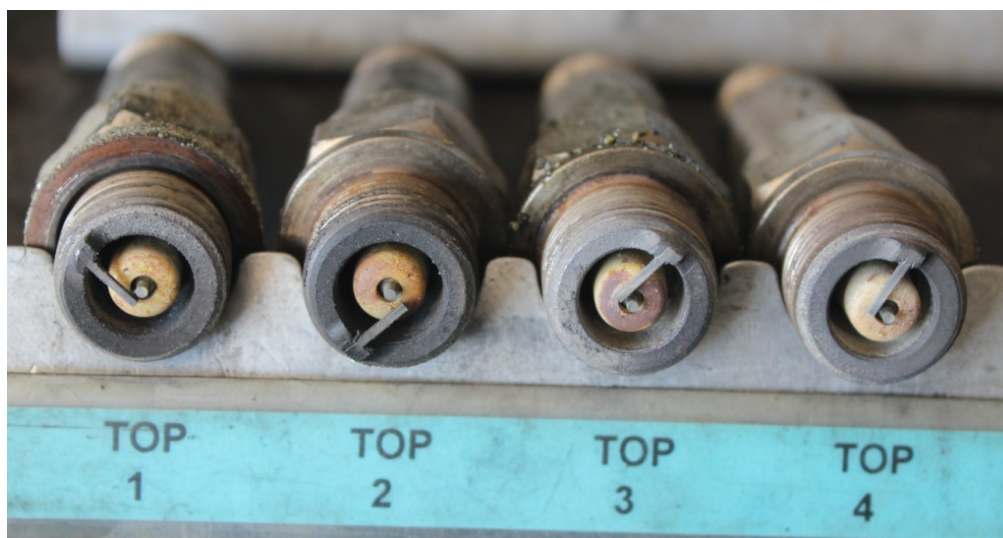


Figure 35 - Top Spark Plug Electrodes



Figure 36 - Separated Throttle Section



Figure 37 - Separated Throttle Section



Figure 38 - Engine Air Filter Assembly

H. PROPELLER EXAMINATION

- The metal two bladed fixed pitch propeller was fracture-separated from the crankshaft flange at the mechanical attachments.
- The fracture surfaces exhibited signatures consistent with overload due to the absorption of rotational energy.
- The propeller blades remained attached to the hub.
- The metal spinner was fracture-separated from the propeller/hub.
- The propeller blades displayed varying degrees of leading edge gouging, torsional twisting, chordwise striations across the cambered surface, and trailing edge “S” bending.
- The signatures were consistent with the absorption of rotational forces applied at the crankshaft at the time of impact.



Figure 39 - Propeller and Related Components



Figure 40 - Propeller



Figure 41 - Blade 'A' Face



Figure 42 - Blade 'A' Back



Figure 43 - Blade 'B' Face



Figure 44 - Blade 'B' Back