



NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety

Airframe and Engine Examination

WPR21LA224

November 16, 2022 / April 5, 2023

I <u>concur</u> that the contents within the following “Field Notes”, accurately reflects the information gathered during the examination.		
NAME	SIGNATURE	DATE
Michael Hicks National Transportation Safety Board Federal Way, Washington		
Matt Brewster Yuba Sutter Aviation Inc. Olivehurst, California		

A. ACCIDENT

Location: Washington, California

Date: 02 June 2021

Aircraft: 1965 Cessna, 172G, N3871L (S/N: 17254040)

Engine: Continental O-300-D5D (S/N: 33806D-5-D)

Type Certificate: 3A12

MAA Plate No.: 328358

NTSB Investigator-in-Charge: Michael Hicks

B. SUMMARY

The recovered airplane was examined in Pleasant Grove, California, by the National Transportation Safety Board Investigator-in-charge on November 16 & 17, 2022. The airframe sustained substantial damage to both wings after a loss of engine power and forced landing. A review of the airframe and engine maintenance logbooks indicated that the last Annual Inspection was completed six months before the accident on December 6, 2020. At the time of the annual inspection, the engine had amassed a total time of 4,027 hours, and 1,896 hours since major overhaul. The engine tachometer indicated 2,277 hours during the last annual inspection and indicated 2,288.8 at the time of accident. The engine manufacturer recommended overhaul interval is 1,800 hours or 12 years.

Magneto to engine timing was Left: 33° before top dead center (BTDC) and Right: 32° BTDC. The engine manufacture specification for magneto to engine timing was Left: 28° BTDC and Right: 26° BTDC. About 6 qts of engine oil were extracted from the oil sump. The No. 2 cylinder exhibited low compression and a lighted borescope was used to assess the internal components of each cylinder. The circumference of the No. 2 piston face was degraded, and the outer compression ring had seized to the ring lands and was unmovable.

A subsequent engine examination was conducted April 2, 2023. All cylinders were removed from the crankcase for further examination. Removal of cylinders No. 1 and No. 4 revealed no anomalies. Removal of the No. 2 cylinder revealed that the top compression ring was seized to the piston ring land, with flat spots observed on the top ring. Removal of the No. 3 cylinder revealed that the top compression ring was broken into two pieces, and the exhaust valve was stuck in the valve guide. Removal of the No. 5 cylinder revealed excessive key-holing of the intake valve within its guide. Removal of the No. 6 cylinder revealed that the top compression ring was broken into four pieces.



Figure 1: Images of accident airplane prior to examination



Figure 2: Images of accident airplane prior to examination

C. DETAILS OF THE INVESTIGATION

1.0 Airframe Examination

Examination of the airframe revealed that both wings, the horizontal and vertical stabilizers, the elevator, and rudder were removed by the recovery company to transport the airplane to a secure facility. The upper and lower engine cowling and left entry door sustained impact damage. The nose landing gear and the left main landing gear were separated from the fuselage resulting from impact damage.

Instrument Panel / Cockpit Documentation:

- Throttle: Idle
- Mixture: Rich
- Primer: In and unlocked
- Carburetor Heat: Off
- Cabin Air/Heat: Off
- Pitot Heat: Off
- Magnetos L/R: Off
- Master: Off
- Nav, Landing, Beacon Lights: Off
- Circuit Brakers: In
- Standby Compass: Present and unremarkable
- Fuel Drain Handle: In and closed
- Flap Position Indicator: Undetermined; Gauge needle indicator not present

- Aileron Position Indicator: Present and unremarkable
- Transponder: 4225
- Altimeter: Present and unremarkable; Altimeter setting: 2990
- Left Fuel Gauge: Present and unremarkable
- Right Fuel Gauge: Present and unremarkable
- Oil Pressure: No visible damage, indicated 0 psi
- Oil Temp: No visible damage, indicated less than 0°
- Ammeter: Not Installed
- CHT: Not Installed
- EGT: Not Installed
- Turn Coordinator: Present and unremarkable and indicated 0°
- Vertical Speed Indicator: Present and unremarkable
- Airspeed Indicator: Present and unremarkable
- Heading: Present and unremarkable
- Attitude Indicator: Present and unremarkable
- Manifold Pressure: Remained attached to instrument panel, glass broken, 48 inches indicated
- PM 3000 ICS: Present and unremarkable
- VOR: Present and unremarkable
- TK-MX300 Nav/Comms Radio: Present and unremarkable
- Hobbs: 1,793.7 Hours
- Engine Tachometer: Present and unremarkable; 2,288.8 Hours
- Suction: Present and unremarkable; 0.2 inches mercury
- Fuel Selector: Both
- Elevator Trim Wheel: ¼ inch nose down from takeoff position

3.0 Fuel System Examination

Pressurized air was applied to the fuel inlet lines of the left, and the right wing fuel tank fittings and continuity was obtained to the fuel selector valve. The fuel selector valve was observed in the BOTH position, and cycled through the Left, Right, and Both positions using compressed air, with no obstructions observed. Continuity was confirmed from the fuel selector to the airframe fuel strainer. The fuel line from the fuel selector valve to the strainer tee was not damaged, and fuel was extracted using the fuel drain handle in the cabin. The internal components of the fuel strainer remained intact, and the fuel strainer yoke assembly remained safety wired to the strainer bracket. The fuel strainer was unremarkable, and the screen assembly was free of debris. The fuel strainer spring, gasket and yoke assembly remained intact.

The fuel line from the fuel strainer to the carburetor fuel inlet remained attached and secure. The mixture control linkage was unremarkable and operated without impedance from each stop when manipulated using the mixture control handle in the cabin. The fuel primer lines remained attached and unremarkable. The throttle control linkage was unremarkable and moved from each stop without impedance from each stop when manipulated using the throttle control handle in the cabin. The carburetor heat linkage was unremarkable and moved without impedance from each stop when manipulated using the carburetor heat handle in the cabin.

Marvel Schebler
Part No. 633029
Model No. MA-3SPA

Serial No. MSC10101



Figure 3: Image of disassembled carburetor bowl

The carburetor remained attached to the engine oil sump and the induction box remained attached to the carburetor. The fuel inlet line was attached and secure at the carburetor inlet fitting and the fuel strainer fitting. The carburetor was removed and examined externally which revealed no impact damage. The carburetor was disassembled, and the float bowl was free of contaminants. The fuel inlet line was introduced to compressed air and the floats operated without impedence. The blue in color, composite floats were unremarkable and remained buoyant when removed from the carburetor and submerged. The needle valve was removed, and the stainless-steel tip was clean and moved freely. No fuel stains were observed around the throttle plate valve O-rings. The accelerator pump housing and assembly were unremarkable and free of contaminants. The mixture metering valve was present and unremarkable.

4.0 Ignition System Examination

Kelly Aerospace

Left M-2930

Serial Number: 94040136/J-01169

Model Number: 6364

Lag: 35

Rotation: Left

Rev: G

Kelly Aerospace

Right M-2931

Serial number: 07090926/J-01170

Model Number: 6364

Lag: 35

Rotation: Left

Rev: G

The left and right magneto remained secure in their respective housing. The magneto p-leads for the left and right magneto were secure and intact. The left and right magneto distributor housing appeared intact and free of damage. The ignition harness for the left and right magneto did not reveal any visual indications of preexisting or impact damage from the distributor to each respective spark plug. The top spark plugs were removed from each of their respective cylinders and labeled. With the ignition switch in the 'Both' position and the master switch in the on position, the propeller was rotated through by hand. When rotated through, each ignition lead produced a spark in the correct firing order (1, 6, 3, 2, 5, 4). When rotated the crankshaft was rotated, impulse coupling engagement could be heard.



Figure 4: Image of top spark plugs



Figure 5: Image of bottom spark plugs

5.0 Induction & Exhaust System Examination

The carburetor was securely affixed to the carburetor air intake housing assembly, which was intact and unremarkable. Per the accident site photos, the air intake filter contained debris consistent with vegetation from the accident site, and no structural impact damage and no additional obstructions observed. The ducting attached to the left exhaust stack and the hose attached to the air intake housing were intact and secure. The hose from the air intake housing to the cabin heat valve

assembly was intact at both fittings and secure. The carburetor heat linkage was intact and unremarkable, with movement from stop to stop. The carburetor heat valve opened and closed without impedance and was free of debris. The air intake mixture control linkage and cable were intact, and movement was observed from stop to stop. The left and right intake manifolds were intact, connected to the oil sump, and secured to their respective elbows and cylinders.

The left and right exhaust stacks were present and securely affixed to their respective cylinder exhaust ports. Each air ducting was intact, and securely affixed to its respective exhaust stack. Both exhaust stacks were removed and examined. The right exhaust baffling had a one-inch crack next to the outflow port. The left exhaust stack outer shroud was removed and checked for cracks and deformation of the inner shroud, which resulted in unremarkable findings.

6.0 Oil Lubrication System Examination

The oil dip stick was present and when removed, indicated that the engine contained about 6 quarts of oil. The engine oil filler cap was present and securely affixed to the filler port. The sump was intact, secured to the bottom of the engine crank case and operational. The oil sump drain plug was safety wired and secured to the accessory case. The oil sump drain bolt was present, safety wired, and secured to the sump. The oil was drained into a bucket with a wire mesh filter to assess for metal fragments in the oil. The oil temperature sensor was present, and securely affixed to the accessory case. The engine oil screen was attached, secure, and subsequently removed which revealed no anomalies, as the screen was clean, intact, and free of debris. The oil drained from the sump was dark in color.

7.0 Accessory Case & Electrical Examination

The accessory case remained intact, undamaged, and securely affixed to the crankcase. The starter adapter assembly was present, intact, and secured to the upper case. The vacuum pump was intact and securely affixed to the starter adapter. The alternator was present, intact, and securely affixed to the bottom of the case. The engine tachometer reduction adapter was present, intact, and securely affixed to the case. The battery was present, the terminals were secure, and the two voltage regulators were securely affixed to the battery box and to the firewall.

8.0 Engine Examination

All cylinders remained attached and secured to the crankcase. Only the No. 6 cylinder sustained minor impact damage specifically to the cooling fins. Each of the intake and exhaust push rod tubes were intact, and securely affixed to the to the cylinder and crankcase lifter housing cover. All rocker covers remained attached to their respective cylinder and were unremarkable. The engine crankshaft rotated freely by hand using the propeller. Rotational continuity was established throughout the engine and valve train. Thumb compression was obtained on each of the cylinders, but the No. 2 cylinder exhibited low compression. All pistons moved within their respective cylinders, verifying engine and valve train continuity. Each cylinder's rocker box cover was removed, and equal travel of the intake and exhaust valve rocker arm movement was observed in correct firing order when the crankshaft was rotated.



Figure 6: Images of right and left side of engine before examination



Figure 7: Image of accident engine data plate

Each of the six cylinders were removed and disassembled as a result of the low thumb compression on the No. 2 cylinder and the stuck top piston ring.

No. 1 Piston and Cylinder

The piston's top, middle and bottom compression rings were present, unremarkable and the gaps were not lined up together. The oil scraper ring was present and unremarkable and moved without impedance. The ring lands and cylinder walls were unremarkable. The piston face exhibited normal operational signatures. The exhaust and intake valve guides, keepers, springs, retainers, push rods, rocker arms and shaft were unremarkable. The exhaust valve was unremarkable. The intake valve

exhibited thermal discoloration about the stem with lead and carbon deposits at the base. The intake valve head exhibited normal operational signatures.

No. 2 Piston and Cylinder

The piston's top compression ring was seized to the ring land and flat spots were observed on the ring. The middle and bottom compression rings were present, unremarkable and the gaps were not lined up together. The oil scraper ring was present and unremarkable and moved without impedance. The ring lands exhibited heavy scuffing. The cylinder walls were unremarkable. The piston face exhibited normal operational signatures. The exhaust and intake valve guides, keepers, springs, retainers, push rods, rocker arms and shaft were unremarkable. The exhaust valve was unremarkable. The intake valve exhibited discoloration about the stem with lead and carbon deposits at the base.

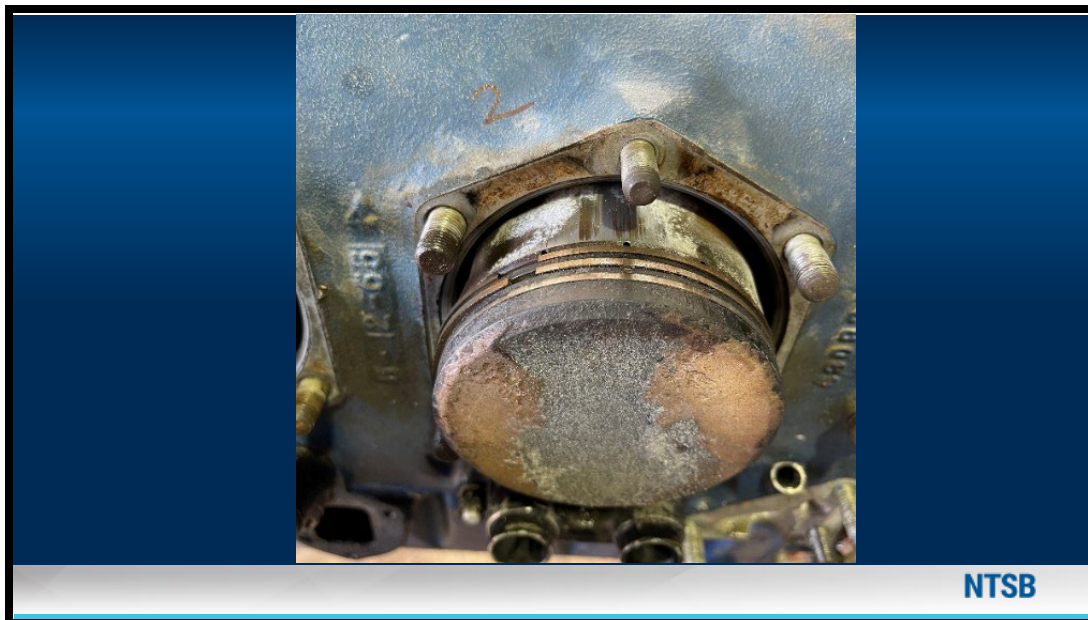


Figure 8: Image of No. 2 piston with seized top compression ring and flat spots

No. 3 Piston and Cylinder

The piston's top compression ring remained its respective land but was broken into two pieces. The middle and bottom compression rings were present in their respective land and the gaps were not lined up together. The oil scraper ring was present and unremarkable and moved without impedance. The piston face exhibited normal operational signatures. The intake valve guides, keepers, springs, retainers, push rods, rocker arms and shaft were unremarkable. The exhaust valve was stuck in the guide. The intake valve exhibited thermal discoloration about the stem with lead and carbon deposits at the base.



Figure 9: Images of No. 3 piston with missing top compression ring No. 3 cylinder stuck exhaust valve

No. 4 Piston and Cylinder

The piston's top, middle and bottom compression rings were present in their respective land and the gaps were not lined up together. The oil scraper ring was present and unremarkable and moved without impedance. The cylinder walls were unremarkable. The piston face exhibited normal operational signatures. The exhaust and intake valve guides, keepers, springs, retainers, push rods, rocker arms and shaft were unremarkable. The exhaust valve was unremarkable. The intake valve exhibited thermal discoloration about the stem with lead and carbon deposits at the base.

No. 5 Piston and Cylinder

The piston's top, middle and bottom compression rings were present in their respective land and the gaps were not lined up together. The oil scraper ring was present and unremarkable and moved without impedance. The cylinder walls were unremarkable. The piston skirt was unremarkable. The piston face exhibited normal operational signatures. The exhaust and intake valve guides, keepers, springs, retainers, push rods, rocker arms and shaft were unremarkable. The exhaust valve was unremarkable. The intake valve exhibited thermal discoloration about the stem with lead and carbon deposits at the base. Additionally, the intake valve exhibited excessive key-holing, and the valve face exhibited normal operational signatures.

No. 6 Piston and Cylinder

The piston's top compression ring remained in its respective land but was broken into four pieces. The middle and bottom compression rings were present in their respective land and the gaps were not lined up together. The oil scraper ring was present and unremarkable and moved without impedance. The piston skirt exhibited thermal signatures. The cylinder walls were unremarkable. The piston face exhibited normal operational signatures. The exhaust and intake valve guides, keepers, springs, retainers, push rods, rocker arms and shaft were unremarkable. The exhaust valve was unremarkable. The intake valve exhibited thermal discoloration about the stem with lead and carbon deposits at the base.



Figure 10: Image of No. 6 piston with missing top compression ring


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Matt Brewster Yuba Sutter Aviation Inc. Olivehurst, California		4-28-23

Figure 1: Signed airframe and engine examination

NOTHING FOLLOWS