



U.S. Department
of Transportation
**Federal Aviation
Administration**

Aviation Safety

Bradley Flight Standards District Office
1699 King Street, Suite 210
Enfield, CT 06082

Date: 19 October 2022

To: Lynn Spencer, Air Safety Investigator, NTSB

From: William Midwood, EA-FSDO-63, Mark Duchesneau, EA-FSDO-63

Accident: NTSB ID ERA22LA369

Subject: After Action Brief, Teardown and Inspection Observation for CESSNA N4751F

Overview: On Friday, October 14, 2022 the following group met at AMF North, 64 Lock House Road, Westfield, Mass 01085, for the purpose of examining the airframe and engine from CESSNA 172N, Registration Number N4751F.

Group Members: Mr. Henry J. Soderlund, Chief Air Safety Investigator, Textron Aviation

Mr. Ryan Enders, Supervisor of Air Safety, Lycoming Engines

Mr. William Midwood, FAA ASI, EA-FSDO-63

Mr. Mark Duchesneau, FAA ASI, EA-FSDO-63

Event Brief: Team agreed to split into two groups since the Engine and the Airframe were to be inspected. Mr. Midwood would team with Mr. Soderlund on the airframe and Mr. Enders and Mr. Duchesneau would team on the engine.

AIRFRAME

General - The Airframe for Cessna C-172N, N4751F was located in the same maintenance bay as the engine. This observation was made to try and determine the state of the aircraft fuel system as it related to the aircraft engine. It should be noted that the aircraft had been in outdoor storage and exposed to the elements since the accident date of August 11, 2022. Both the L & R wings, both L & R horizontal stabilizers, and the engine had been removed at the accident for transportation. The vertical stabilizer was attached to the empennage. The fuselage was sitting on the nose landing gear strut and the right main landing gear strut. The left strut was not attached and was not present.

Observations - The fuel line screens (forward and aft) of both L & R wings were removed and verified to be clean with no observable debris. The fuel caps from the L & R wings were removed. The seals on the fuel caps were intact and showed no signs of deterioration or cracking. There were no signs of blue streaking or discoloration of any kind around the caps in-situ that would signify a siphoning of fuel from the tanks during flight. Both L & R fuel tanks were observed through a borescope. There was no evidence of debris or corrosion in either fuel tank. Because of the timeframe between this observation and the date of the crash, determining the fuel status at the time of the crash was not possible.

The cockpit mixture handle was in the "FULL RICH" position. The engine primer handle was retarded slightly and the friction lock WAS NOT locked.

The cockpit fuel selector handle was set to "BOTH". The fuel selector valve was set to "BOTH". Air was blown through the fuel lines routed within the door post to verify their operation. The fuel was captured from the fuel strainer / gascolater. The fuel was clear, with very small amounts of water, and no visible debris. It should be noted that the fuel lines had been exposed to the elements while in storage since the accident date. The gascolater was still installed and safety wired. The strainer was removed and had light corrosion in the bowl.

ENGINE

General - Lycoming engine S/N L-64008-76T, Model 0-320-H2AD. The engine was hoisted to chest level by mobile crane utilizing chains mimicking the orientation of the engine when installed on the aircraft by the facility support personnel. This engine has a fixed propeller that was removed prior to this inspection.

Observations:

Engine Fuel System – Inspected the Fuel Control Cable. Cable was previously cut approx. 2 feet from mount on carburetor (CARB). Technician concluded the fuel setting to be at FULL RICH based upon position, cable movement, cable cut traces, and mechanism orientation. Inspected the Throttle Cable. Cable was previously cut approx. 2 feet away from mount on CARB, the remaining cable installation moved freely. No observations noted. Next removed the engine main fuel line inlet screen. Accessing the inlet screen requires separation of main fuel line from the inlet fitting on the CARB. No debris was found in screen. Removed the CARB from the engine and moved to a bench. A small leak between CARB and intake was noticed due to traces of fuel on intake matting surfaces. The CARB body assembly was separated from the bowl assembly, visually inspected, with no findings observed.

Electrical System – Cut electrical leads from Magneto (MAG) to spark plugs close to MAG housing for access to MAG mount bolts. The MAG was moved to a bench for inspection. The R MAG (as installed orientation) had considerable damage. The L MAG had loose components and cause of looseness not determined. Removed MAG cap to expose inner working of MAG. The points and other items were secure in the housing. It appeared that there may be an issue with the points on the MAG which may warrant further evaluation. No movement of the MAG points

were observed when the MAG drive shaft was manually rotated. An attempt was made to time the MAG utilizing a buzz box/timing light. The R MAG had heavy damage and was unable to time, the L MAG appeared to have limited damage and an attempt was made to time but timing failed. The engine was rotated several times to establish Top Dead Center (TDC) when performing this check. To rotate the engine, the technician applied a spinning force with a hand tool to the engine crankshaft output flange. After the check, removed MAG from engine and observed the case cover/cap of MAG was loose. Further inspection revealed the (4) each fasteners holding the MAG cover/CAP were found to be loose.

Induction/Exhaust – Identified an induction tube to cylinder head fuel leak for cylinders # 1 and # 4. Identified a fuel leak at the induction tube rubber boot for the # 2 cylinder.

Valve and Power Train - Performed a “thumb” compression test of each cylinder and found strong pressure at each cylinder. Removed all four (4) valve covers from the engine, rotated the engine applying a spinning force with a hand tool to the engine crankshaft output flange. The technician then observed movement of valve-train (rocker arms & push rods) of each cylinder. Good movement was observed for each cylinder. Inspected the engine crankshaft output flange and propeller mounting surfaces with no findings observed.

Lubrication - Disassembled the removed engine oil filter, which required use of a special tool to cut the oil filter mount boss and face from the filter assembly. This exposed the paper filter element which was removed from the filter casing. The paper element was then stretched out fully and inspected for debris. No debris was observed.

Pneumatic System - Removed the Air Pump assembly from the engine. The pump was moved to a bench and completely disassembled. No findings were observed.

Engine Accessories:

The following Accessories were observed as being removed from engine S/N L-64008-76T by Mr. Ryan Enders.

Marvel Schebler Carburetor
Model – MA-4SPA
S/N – MS091W07
P/N – 10-5217
Manufacturer P/N LW-15986-70

Dry Air Pump
S/N – A78P77
P/N – RAP215CC

Magneto (MAG) Dual Configuration Single Drive
Model – 10-382555-14
S/N 8204258
P/N – D4RN-2021

Submitted.

William Midwood, Principle Maintenance Inspector
Mark Duchesneau, Aviation Safety Inspector
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N4751F Cessna 172 Harmony, NY

Post-Crash Engine Evaluation

M/N O-320-H2AD

S/N L-6408-76T

Piston Engine 100-Hour Inspection

Visual Documentation:

- *Overall Engine Damage (cylinder damage, crankcase damage, pre-impact fire, etc.)* **There was no pre or post impact fire or cylinder damage. There was a hole in the sump from the outside in that was impact damage. Could have been from the nose gear being torn off from tree impact.**
- *Engine Mount(s) Condition* **The engine mount was broken from impact damage.**
- *Engine Accessories (what is separated, what is still attached, and are they 100% secure to their mount?)* **The alternator was damaged from impact. The starter was engaged from the pilot trying to start it inflight after it quit. The magneto case cap was broken from impact damage with the oil filter drip guide. No other accessories were noted as damaged.**
- *Verify all fuel/oil lines are secure* **All lines were connected as best that could be verified.**
- *Verify Throttle/Mixture/Carb heat/Propeller Governor control positions on the engine and obtain continuity to the cockpit controls (if able)* **The mixture, throttle and carb heat cables were connected but could not be moved due to impact damage. The mixture was set to full rich and the throttle was full open but the control area in the cockpit was compressed forward from impact.**
- *Verify engine oil level (if the engine/oil supply tank is level)* **There was oil on the dip stick but the quantity could not be verified due to the angle of the engine at the crash site. When the engine was removed for inspection and leveled, oil came out of the hole in the sump. Again we were unable to determine quantity.**

Remove Items Prior to Rotating Crankshaft:

- *Disconnect all spark plug wire ignition leads (top and bottom)* **All leads were removed**
- *Remove and label all top spark plugs (label what cylinder they came from!)* **The top spark plugs were removed and label. We did not have the right tools to remove the lower spark plugs.**
- *Inspect spark plug electrode for mechanical damage. Damaged electrodes could be an indicator of foreign object ingestion or internal mechanical malfunction of the engine.* **There was no damage found to the four spark plugs removed. There was no evidence that any of the plugs were fouled.**
- *Remove the engine-driven fuel pump (Continental fuel injected engines) to document the drive coupling prior to crankshaft movement.* **No fuel pump installed on this engine.**
- *Remove the vacuum pump (if equipped) and document the drive coupling prior to crankshaft movement.* **The vacuum pump was not removed, the drive appeared to be intact.**
- *Remove propeller if needed to facilitate crankshaft rotation (Lycoming's are timed using the starter ring gear, so be mindful of this if you want to obtain engine to magneto timing. Mark flywheel/crankshaft flange orientation with sharpie for reference)* **The propeller was removed and it was noted that the propeller mounting bolts were bent from impact damage. The position was marked.**
- *Disconnect the magneto primary "P" ignition leads* **The P leads had been cut during the engine removal. The condenser for the right magneto had impact damage and was broken out of the cap. There was a dual magneto that was installed.**
- *Remove all cylinder rocker box covers* **Did not remove covers.**

Internal Continuity:

- Examine all cylinders with a borescope (if able). **Look for...** **Did not have access to borescope equipment.**
- Rotate the crankshaft in the direction of normal rotation by hand using the propeller or a hand tool attached to an accessory drive pad. If you are unable to rotate the crankshaft successfully, remove all engine accessories that are attached to the engine and try again. If you are still unable to rotate the crankshaft, it is possible you will need to remove cylinders and the accessory case to examine the issue further. Ultimately this could result in you completely disassembling the engine. Be mindful of preserving any potential internal fracture surfaces. Continued attempts to rotate the crankshaft may obliterate or alter evidence. **It was noted that the engine would not rotate due to the starter being engaged. There may have been internal damage to the starter that prevented it from rotating. When the propeller was removed, along with the starter ring, the engine rotated freely. There was a slight dragging indication while rotating but the crankshaft seemed to be slightly bent from the crash impact.**
- While rotating the crankshaft, verify all pistons are moving within the cylinders and each of the accessory gears are moving. **The mounted accessories rotated, both the vacuum pump and magneto, freely. The magneto impulse coupling operated correctly.**
- While rotating the crankshaft, observe the rocker arm movement on all cylinders for the intake and exhaust (should be equal movement up and down). Any asymmetrical movement could be an indicator of worn camshaft lobes requiring further examination. **Covers were not removed.**
- Obtain "THUMB" compression and suction on all cylinders by placing thumb lightly over the top sparkplug hole and rotating the crankshaft through by hand. Make sure your thumb is over the spark plug holes lightly and not sticking inside them. This could result in an injury! **Thumb compression was obtained from all four cylinders.**
- If you do not obtain thumb compression on a cylinder, you may need to stake the valve. Following visual inspection of the valve springs, rocker arms, etc., you'll need to use a dead blow hammer (large rubber hammer) and hit the portion of the rocker arm that is connected to the valve stem/springs. The reason for this is usually carbon and/or debris can get between the valve and the valve seat during the accident sequence, which would prevent it from closing all of the way. **N/A**
- While rotating the engine crankshaft, verify spark on all ignition harness leads if magnetos are impulse coupler equipped. If there is damage to the leads, cut the harness at the damaged area, and obtain spark to that point. If no spark is produced, further examination of the magneto may be necessary. Depending on the magneto or ignition system, removal and further testing may be needed. **Could not verify spark from any leads. There was damage to the magneto distributor cap that effected the right magneto but not spark could be obtained from either side of this dual magneto.**
- If both magnetos remained attached to their mounts, verify engine to magneto timing if able. **Unable to verify magneto timing.**

Induction / Exhaust System:

- Document the air intake tubes/ air filter-screen for overall condition, damage, blockages, and leaks. **The intake filter was destroyed at impact, could not verify condition. It was noted that fuel staining was present on the #4 intake pipe which could be coming from the cylinder primer.**
- Document the exhaust system for overall condition, damage, ductile bending. Also be sure to inspect the exhaust gas path for possible oil film, soot. Attempt to inspect internal exhaust baffles to see if they are in place (they can separate and restrict air flow, thus reducing engine performance). **The muffler and tail pipe were damaged from impact. The other exhaust exhaust pipes looked normal.**
- If equipped with a turbocharger, inspect the associated tubes/clamps to and from the waste gate to the turbo charger to the exhaust for security. **N/A**
- Verify rotation of the turbocharger. **N/A**
- Inspect turbocharger impellers (compressor/turbine) for damage. **N/A**
- Inspect the waste gate to document the condition and position of the valve and that all linkages are intact. **N/A**

Accessories:

Ignition System / Magnetos: Did not remove magneto, dual mag, due to not having the ability to bench test on site. Could not get any spark from ignition leads onsite. Impulse coupling equipped.

- If you are unable to obtain spark on the ignition leads, remove the magnetos and ignition harness once magneto to engine timing has been determined, if able.
- Examine the magneto drive shaft and associated gears for security/damage/wear.
- Rotate the magneto drive shaft in direction of normal operation, and if equipped, note how the impulse coupling works. If the magneto is not equipped with an impulse coupling, you may need to use a hand drill to rotate the drive shaft. If the magnetos do not produce spark, examine them further by removing the harness cap and partially disassembling the magneto to verify the internal component condition.
 - Note: You can also use a paperclip inserted into the magneto cap posts to get spark from the paperclip to the cap housing or utilize 2 screwdrivers to do so. Also, most of the time, a local maintenance shop will have a magneto test bench and will test magnetos for less than \$50. You'll probably need to see a shop to test magnetos with shower of spark, retard breakers, etc.
- Document the ignition harness. Check for impact or any preexisting damage.
- Document all of the spark plugs (top and bottom). This includes coloration within the electrode area, electrode wear and gap. Inspect for mechanical damage at the electrode.
- For those engine equipped with an electronic ignition system, typically the timing/ref sensor is located on the forward part of the engine at the crankshaft. It varies per system. In order to test this, you'll most likely need to remove the entire system after documenting the installation and send it to the manufacturer.

Carburetor Equipped Engines: Did not remove carburetor onsite. The float bowl plug was removed and fuel was present in the bowl. Did not remove inlet screen onsite. Fuel line was intact and connected at crash site.

- Verify fuel lines to the carburetor are secure.
- Remove carburetor from the engine (if still attached)
- Actuate the throttle arm from stop to stop and verify that the accelerator pump functions (if equipped).
- Verify the mixture arm moves stop to stop (if equipped). Also, it is fairly typical on Stromberg carburetors to either not have a mixture arm or it'll be safety wired full rich.
- Remove the fuel inlet screen and verify it is free of debris.
- Disassemble the carburetor
- Note the condition of the floats, needle valve, needle valve seat, float bowl
- Inspect for visible contaminants and water within float bowl. Utilize water finding paste as needed.
- Check the fuel primer system (lines/plunger) for leaks and general function.
- Verify the fuel pump and fuel lines to and from it are secure (if equipped). Some engines have a low pressure fuel pump to supply fuel to the carburetor. These are usually work with an arm which rides on the camshaft.)

Fuel Injected Engines: N/A

- Verify all fuel lines to the fuel pump, throttle body fuel control unit, fuel flow divider/manifold valve, and fuel injectors are intact and secure.
- Remove the fuel screen from the throttle body fuel control unit (servo) and look for potential debris.
- Verify throttle plate moves when the throttle arm is actuated from stop to stop and that all linkages are intact and secure.
- Verify mixture arm movement from stop to stop.
- When examining an engine with an engine driven fuel pump (Continental's), pay attention to the fuel pump drive coupling. This coupling has a sheer point and if it is not removed prior to rotation of the engine, it could shear when the crankshaft is rotated. This is specifically common with engines that are fire

damaged or water submerged. It's also nice to know if it failed prior to you rotating the engine or not. Lycoming's are a different setup.

- *Remove the fuel nozzles from the cylinders and inspect for blockages.*
- *Remove the fuel flow divider or fuel manifold valve and disassemble as needed. Depending on the system, you could have an internal diaphragm and spring to inspect the condition of. Others may just feature internal cavities for fuel transfer.*
- *Be mindful of any potential water contamination within the fuel system components and lines.*

Miscellaneous Accessories / Systems:

- *Remove propeller governor (if equipped), rotate the drive shaft, actuate the lever, and document the oil screen for debris. A governor overhaul shop can run the propeller governor throughout all ranges of operation on a test bench if needed. **N/A***
- *If equipped, remove oil filter and cut open to examine the internal oil filter element. Note any metallic debris, etc. Also note that Tempest oil filters have a built in magnet to collect metallic debris. **Did not remove oil filter as did not have tools to cut it open for inspection.***
- *If the engine is not equipped with an oil filter, it should have an oil screen located within the system. Remove the screen and inspect for metallic debris. **Did not remove suction screen.***
- *If oil pressure issues have been part of the engines operational history, check the oil pressure relief spring assembly and the vernatherm. The engine manufacturer can assist with providing additional details.*
- *Document the propeller assembly (hub, blades, spinner).*
- *Examine the vacuum pump and disassemble if needed. **Vacuum pump rotated with the crankshaft but did not remove the pump onsite.***

Note: When the propeller was removed it was noted that the mounting bolts were bent and also the propeller mounting flange was bent. These seemed to be bent from impact damage as the propeller suffered impact damage. There was no evidence of propeller rotation was the aircraft struck the trees and came to rest nose down in the dirt.



NTSB MEMORANDUM OF RECORD

Lynn Spencer
Air Safety Investigator
Eastern Region, Office of Aviation Safety (AS-ERA)
National Transportation Safety Board

NTSB Accident Number: ERA22LA369
Subject: Loose magneto cap reference in examination summary
Date: 10/25/2022

Photo IMG_0365.jpg, taken by the FAA on August 15, 2022, before wreckage recovery, showed the magneto cap off with someone holding it. This is relevant to the examination findings that describe the loose cap at the post-recovery examination.



Photo 1 - Magneto with cap removed (Photo Courtesy of FAA)