

# National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



WPR23LA201

## **EXAMINATION SUMMARY**

August 31, 2023

## **A. ACCIDENT INFORMATION**

Location: Tucson, AZ  
Date: May 24, 2023  
Time: 0940mst  
Airplane: Cessna 177B

## **B. EXAMINATION SUMMARY**

|                   |                                                                      |
|-------------------|----------------------------------------------------------------------|
| FAA IIC           | Pete Kelley<br>Federal Aviation Administration<br>Scottsdale, AZ     |
| Party Member      | Jennifer Barclay<br>Textron Aviation<br>Wichita, KS                  |
| Lycoming Engine   | Mark Platt<br>Lycoming Engines<br>Williamsport, PA                   |
| FAA Airworthiness | Garrett Horne<br>Federal Aviation Administration<br>Scottsdale, AZ   |
| FAA Airworthiness | James Wood<br>Federal Aviation Administration<br>Scottsdale, AZ      |
| FAA Airworthiness | Stephen Woolley<br>Federal Aviation Administration<br>Scottsdale, AZ |

## **C. SUMMARY**

BLUF: The airframe and engine examination revealed that the fuel flow transducer restricted fuel flow to the carburetor. The remainder of the fuel system examination revealed no anomalies; as well, the electrical, induction and exhaust system were unremarkable.

## **D. DETAILS OF THE EXAMINATION**

### **1.0 Accident Site**

Latitude: 32.100071

Longitude: -110.91651

City/State/Time: Tucson/AZ/0940mst

The aircraft impacted the ground in a left-wing and nose-low attitude. Following the initial impact, the airplane crossed over a dirt access road and came to rest facing opposite the direction of flight. The outboard right wing exhibited leading edge damage. The outboard left wing separated at the aileron/flap junction. The empennage was separated from the fuselage aft of the baggage compartment. The cabin roof remained attached to the right wing and the inboard left wing. The instrument panel, engine, and nose strut were observed as one unit.

### **2.0 Airframe Examination**

#### **2.1 Fuselage**

Impact damage was sustained to the upper and lower fuselage. The overhead fuselage separated from the left and right, upper door posts. The left aft section of the fuselage exhibited concave impact signatures, and the empennage was somewhat folded over to the left side of the fuselage, which resembled a scorpion tail folding over the body.

#### **2.2 Empennage**

The empennage remained intact, with the horizontal and elevator resting on the ground. The vertical stabilizer and rudder remained attached and intact. The stabilator, stabilator trim and rudder cables were continuous from the tail to the cockpit area where separations consistent with cuts made by a razor-sharp tool used by recovery personnel. The stabilator cables were attached to the cockpit bellcrank. The rudder cables were attached to the torque tubes in the cockpit. The stabilator trim tab chain was not attached to the sprocket. The rudder trim chain was attached to the indicator sprocket but not the actuator sprocket.

#### **2.3 Wings**

The aileron cables were continuous from the control yoke to approximately the forward door posts which had been removed from the aircraft. Both cables exhibited separations consistent with tension overload. The right aileron direct cable was continuous from the bellcrank to the cabin. The aileron balance

cable was continuous from the right bellcrank to the separated portion of the left wing. Both cables remained attached to the left bellcrank and exhibited separations consistent with tension overload. An approximately 8' section of the left aileron direct cable was not observed. The stabilator trim actuator measured 1.2" which equates to 5° tab Up. The flaps were retracted.

## **2.4 Landing Gear**

The fixed landing gear system sustained impact damage. While the left and right main landing gear strut, wheel, and tires, remained attached to the lower fuselage, the nose strut was forced aft during the impact sequence. The nose wheel was separated at the base of the strut.

## **2.5 Cockpit**

The ignition key was in the Both, position. The throttle control handle was not in the full throttle position and bent downward, exposing about ½" of the throttle handle stem. The propeller controller handle was in the maximum position and the mixture was in the full rich position. The carburetor heat handle position was in the Off position. The master battery switch, alternator switch and beacon switch were pulled out of the panel and their orientation could not be determined. A portion of the panel was broken leaving one light switch unidentifiable.

## **2.6 Survivability**

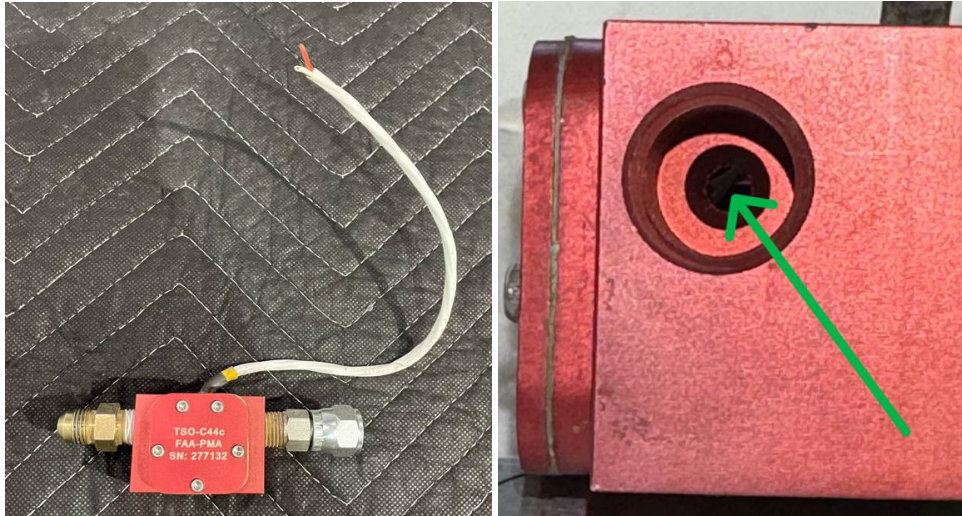
The pilot seat was equipped with a 3-point harness. The harness appeared to be used by the pilot, as the condition of the nylon harness was cut, presumably by first responders, and the material separation signatures did not indicate tensile overload. The pilot's seat rail sustained impact damage and was not intact. The back of the seat remained intact, as well as the base and feet of the seat.

The airspeed indicator displayed 0 knots airspeed, the turn coordinator was level, and the attitude indicator displayed >20° down and a 10° right turn. The turn coordinator ball indicated Right, and the heading indicator showed 195°. The altimeter indicated 8,800', and the altimeter indicated 29.96 InHg.

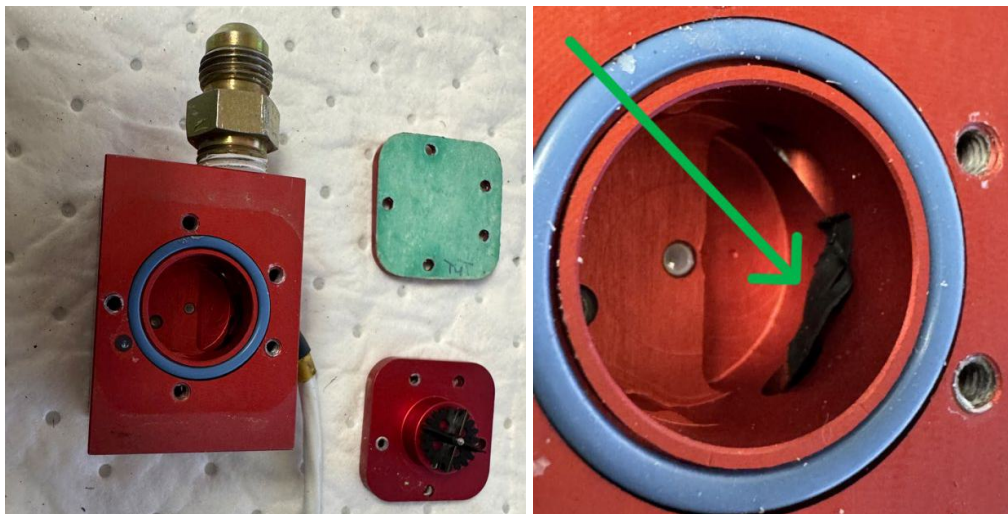
## **2.7 Fuel/Fuel System**

Fuel system continuity was observed from the wing tanks to the auxiliary feeder tank, through to the fuel selector. From the fuel selector to the gascolater, continuity was observed, and a small amount of fuel drained from the fuel strainer which tested negative for water entrainment using Sar-Gel water water/phase separation indicating paste. Compressed air was used to verify

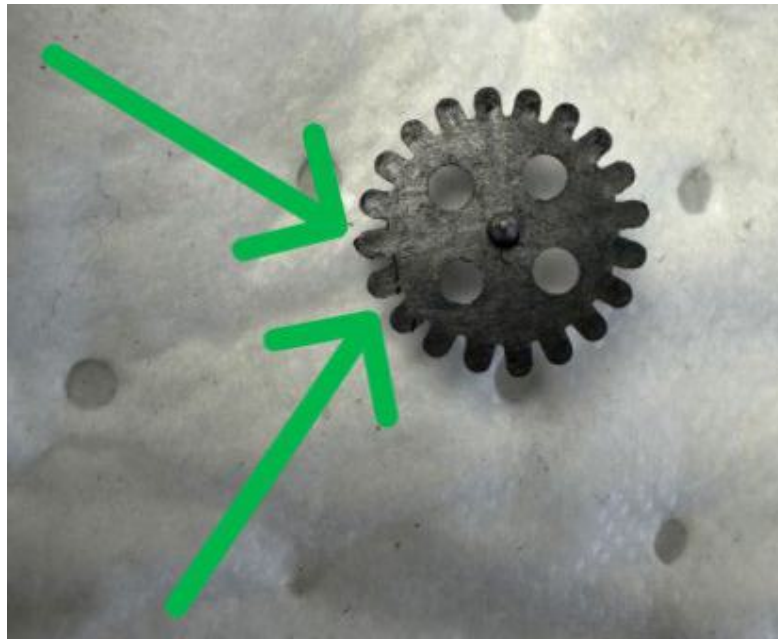
that there were no obstructions in the fuel system from each tank to the engine drive fuel pump inlet line. A small amount of dirt was found in the fuel strainer bowl. The fuel flow transducer exhibited a fuel flow restriction that limited the quantity of fuel delivered to the carburetor. The transducer was removed and retained for further examination. The carburetor was removed, disassembled and unremarkable. Fuel intake lines remained attached to each respective cylinder. No anomalies were observed with the carburetor, induction, or exhaust systems.



**Figure 1:** Fuel Flow Transducer after removal from airplane, before disassembly



**Figure 2:** Disassembled transducer showing restricted orifice



**Figure 3:** Transducer rotor deformation and witness markings

Fuel system continuity was observed from the wing tanks through to the fuel flow transducer. With the application of air pressure into the transducer, the volumetric outflow was inhibited. The lines to and from the transducer were unrestricted and free of debris.

Further examination of the fuel flow transducer was conducted to identify the fuel flow restriction. The Electronics International Inc. FT-60 transducer was disassembled and revealed that the rotor was unremarkable, however, inside the transducer there was a 5/8" length x 1/4" width polymer material strip inside of the fuel entry port bore.



**Figure 4:** Polymer material restriction size

Fuel Flow Transducer  
Electronics International Inc.  
Model: FT-60 (Red Cube)

Manufacturer Specifications:

K-Factor: 68,000 Pulses/Gal (installation configurations can affect the K-Factor)  
(use 680 when programing the K- Factor in the FP-5(L).

Pressure Drop (with 6.0 Lbs/Gal fuel), (blocked or unblocked rotor):

0.5PSI @ 28 Gal/Hr

2.0PSI @ 56 Gal/Hr

To Calculate Pressure Drop:  $P = \frac{(\text{Flow})^2 \times W_f}{9573}$

P = Pressure Drop in PSI

Flow = Fuel Flow in Gal/Hr.

Wf = Weight of Fuel in Lbs/Gal

Non-Flow Restricting Design (a blocked  
rotor does not restrict flow) Fuel Flow  
Range: 0.6 to 70+ Gal/Hr.

Fuel Flow Over Range (with no damage to  
transducer): Unlimited Linearity: +/- 1%  
over an engine's normal operating range.

Repeatability: +/- 1/4%

Burst Pressure:  
4,000 psi minimum

Maximum Operating  
Pressure:  
250 psi

Temperature Range:  
-65°C to 125°C

Weight: 5.26 Oz.

Life Expectancy: 10,000 Hrs. Min.

FAA TSO-C44c, STC'd and PMA'd

## **2.8 Other Systems**

Exhaust fittings attached at No. 1 and No. 3 cylinders, but No. 2 and No. 4 separated at the cylinder fittings. Intake fitting on No. 1 cylinder intake pipe, separated at the case fitting, with restriction noted to elbow of the intake pipe. Exhaust pipes sustained impact damage on the No. 2 and No. 4 cylinders. The muffler sustained gross impact damage and was examined. An external light source was introduced to the muffler exhaust gas entry and exit ports to determine restrictions or blockages, of which none were observed.

## **3.0 Engine Examination**

Per aircraft maintenance records, the engine was overhauled by Aircraft Engine Specialist and installed on the airframe by Aero Experts Inc. May 22, 2023. The total time of the engine was 3,667.4 hrs., the tachometer indicated 5,668.2 hrs. and the Hobbs meter indicated 2,302.0 hrs.

During the engine examination, the engine, firewall and instrument panel was separated from the airframe to transport the airplane to the facility. Visual examination of the engine revealed no evidence of pre-impact catastrophic mechanical malfunction or fire. The engine remained attached to the mounts, albeit the right-side mount sustained impact damage. Rocker covers were all securely affixed to their respective cylinders, push pull rods were intact and operational per movement observed when the engine was rotated through. All spark plugs remained attached to the case and the harness remained intact. Each of the accessories remained securely affixed to the case. The exhaust fittings attached at the cylinder No. 1 and No. 3, were separated at the No. 2 and No. 4 cylinder fittings.

Air filter located forward of the No. 2 cylinder was affixed to the baffling and connected via ducting to the carburetor air induction box attached to the carburetor. The muffler was removed, and a flashlight was shined through each orifice, emitting light through the entire can, which indicated that there were no restrictions or internal blockage.

Intake fitting on the No. 1 intake pipe, separated at the case fitting, with restriction noted to elbow of the intake pipe. Exhaust pipes sustained impact damage on the cylinder No. 2 and No. 4 side. Muffler sustained impact

damage. Muffler removed and a light was shined through each orifice and light emitted through the entire can.

The vacuum pump, which was secured to the case, was removed. The engine was rotated via the vacuum pump drive gear, to establish valve train continuity, which was observed on each cylinder with no anomalies. Equal travel of the rocker arms was observed on each cylinder, with no binding or restriction. The top spark plugs were removed, and thumb compression was obtained on all cylinder in the correct firing order (1,3,2,4). The spark plugs were normal in appearance and appeared to be recently replaced, as observed by a lack of carbon deposits and light wear.

Right magneto removed from accessory case first, and the harness was removed from the magneto. The left magneto was removed, and the impulse coupling arm would not hold contact. The magnetos remained securely clamped at their respective mounting pads. The ignition harness was secure at each magneto. Magneto to engine timing could not be ascertained, due to the destruction of the flywheel; however, both magnetos timing was within 1 degree of each other. The right magneto produced spark at the end of the respective spark plug lead, during hand rotation of the drive. The drives of each magneto remained intact and undamaged. The impulse coupler of the left magneto was not functioning during hand rotation of the drive. The pawl was not engaging the pin. There was no apparent damage to the drive. There was no evidence of pre-impact mechanical malfunctions observed during the examination of the engine. All engine compartment fuel lines were secure at their respective fuel system components.

Carburetor removed and mixture control cable was separated and appeared to be pulled through the mixture control arm bolt bore, while curling signature were observed to the control cable.

The throttle cable control bracket did not exhibit signs of chaffing or rubbing on bracket where it's attached via bolt plate. When the cabin throttle control lever was manipulated out in the cockpit, the throttle control cable contacted the idle stop, and when pushed forward, failed to contact the full throttle stop. Throttle control was continuous and secure. The serrated interface at the throttle arm remained intact and properly mated. The throttle bracket was secure. There was a noticeable amount of flexing about the throttle cable plate, however, functionality and operation appeared unimpeded.

The carburetor remained affixed to the oil sump and removed and disassembled and the fuel filter exhibited normal signatures, clean in appearance, with no anomalies. The carburetor bowl remained free of visible contaminants. The float assembly was secure on its mounting and did not

retain fluid. The mixture metering valve (main jet) was free of obstructions to flow. There were no obstructions to air flow observed within the carburetor and induction system. The foam air filter element remained intact and unobstructed.

The engine driven fuel pump remained securely attached at the mounting pad. The fuel lines remained secure at their respective fittings. The fuel pump was removed and examined. The diaphragm remained intact and pliable. There were no visible contaminants observed within the fuel pump.

#### 4.0 Propeller Examination

Prop governor sustained impact damage indicated by witness marks impressed into the fire wall. The propeller governor was fractured at the mounting base. The propeller separated from the engine case at the propeller flange. The spinner exhibited impact damage in the form crushing signatures about the lower left side of the spinner. Both propeller blades exhibited rotational scoring and "S" bending, indicating that power was applied with the airplane impacted terrain.

#### 5.0 Logbook Entries

| <u>AERO EXPERTS, INC.</u>                                                                                                                                                                                                                                                                                                                                                                                          |                                     | 2000 E. Airport Dr.<br>Tucson, AZ 85756 |                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------|-------------------------------|
| <u>PROPELLER MAINTENANCE ENTRY</u>                                                                                                                                                                                                                                                                                                                                                                                 |                                     |                                         |                               |
| <u>Manufacture:</u> McCauley                                                                                                                                                                                                                                                                                                                                                                                       | <u>Model:</u> B2D34C211-B/G-82PCA-6 | <u>Serial Number:</u> 080536            | <u>Reg. Number:</u> N34713    |
| <u>Tach Time:</u> 5668.2                                                                                                                                                                                                                                                                                                                                                                                           | <u>TTSN:</u> 1366.2                 | <u>TSMOH:</u> 392.7                     | <u>Maintenance Performed:</u> |
| Performed annual inspection IAW inspection check list and Cessna 177 service manual. Dressed prop. All AD's has been complied up to this date. Prop was removed for engine overhaul and reinstalled after engine installation. I certify that this propeller has been inspected IAW an annual inspection and determined to be in airworthy condition. This prop is approved for return to service. ----- End ----- |                                     |                                         |                               |
| <u>Print Name:</u> Ki Yun Yoon                                                                                                                                                                                                                                                                                                                                                                                     | <u>Signature:</u>                   | <u>Cert#:</u> [REDACTED]                | 22-2023                       |

**Figure 5:** Propeller Logbook Entry

|                                   |                                |                                         |                               |
|-----------------------------------|--------------------------------|-----------------------------------------|-------------------------------|
| <b>AERO EXPERTS, INC.</b>         |                                | 2000 E. Airport Dr.<br>Tucson, AZ 85756 |                               |
| <b>AIRCRAFT MAINTENANCE ENTRY</b> |                                |                                         |                               |
| <b>Model:</b> Cessna 177B         | <b>Serial Number:</b> 17701951 | <b>Registration Number:</b> N34713      |                               |
| <b>Total AF Time:</b> 5868.2      | <b>Tach Time:</b> 5668.2       | <b>Hobbs:</b> 2302.0                    | <b>Maintenance Performed:</b> |

1. Performed annual inspection IAW inspection check list and Cessna 177 service manual.
2. Replaced ELT with ACK 406MHZ M/N: ACK E-04, S/N: 09234. Next Battery replacement due at **Nov 2027**.  
ELT HEX code: 2DC8A 44284 FFBFF
3. Lubed flight controls and engine controls.
4. Complied AD 2023-02-17 Wing Spar Inspection per AD and Textron SB 57-09 R1. No discrepancy noted.  
Complied AD 2011-10-09 Seat rail, CW by inspection.  
Complied AD 76-07-12 Ignition Switch by ops check. All AD's has been complied up to this date.
5. Removed tachometer, hobbs meter, manifold pressure, CHT, ammeter, fuel pressure, oil pressure, oil temp, and fuel quantity gauges and installed Electronics International Engine monitor CGR-30,S/N: 283838 per installation instructions II 02151301-Rev.E: 5/8/15. Old tach time at **5668.2** and hobbs **2302.0**.
6. Removed engine and sent to Aircraft Engine Specialist for overhaul. Reinstalled same overhauled engine. Ground ran engine for leak and operation per break in procedure provided by Aircraft Engine Specialist.
7. Replaced all fluid carrying flexible hoses.
8. Serviced nose strut and repacked all wheel bearings.
9. Replaced engine baffles with new kit P/N: C177-7374PCBK.

I certify that this aircraft has been inspected with an annual inspection and determined to be in airworthy condition. This aircraft is approved for return to service. ----- End -----

**Print Name:** Ki YunYoon    **Signature:** \_\_\_\_\_    **Cert#:** [REDACTED]    **Date:** 05/22/2023

**Figure 6:** Airframe Logbook Entry

|                                   |                                   |                                         |                      |
|-----------------------------------|-----------------------------------|-----------------------------------------|----------------------|
| <b>AERO EXPERTS, INC.</b>         |                                   | 2000 E. Airport Dr.<br>Tucson, AZ 85756 |                      |
| <b>ENGINE MAINTENANCE ENTRY</b>   |                                   |                                         |                      |
| <b>Model:</b> Lycoming O-360-A1F6 | <b>Serial Number:</b> L-14512-36A | <b>Registration Number:</b> N34713      |                      |
| <b>Engine Total Time:</b> 3667.4  | <b>TSMOH:</b> 0.0                 | <b>Tach Time:</b> 5668.2                | <b>Hobbs:</b> 2302.0 |

1. Performed annual inspection IAW inspection check list and Cessna 177 service manual.
2. Removed engine and sent to Aircraft Engine Specialist for overhaul. Reinstalled same overhauled engine.
3. Replaced all fluid carrying flexible hoses.
4. Ground ran engine for leak and operation per break in procedure provided by Aircraft Engine Specialist.
5. All AD's has been complied with up to this date.

I certify that this engine has been inspected with an annual inspection and determined to be in airworthy condition. This engine is approved for return to service. ----- End -----

**Print Name:** Ki Yun Yoon    **Signature:** \_\_\_\_\_    **Cert #:** [REDACTED]    **Date:** 5/22/2023

**Figure 7:** Engine Logbook Entry

Submitted by:

Michael Hicks  
Air Safety Investigator