

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



WPR21FA223

INVESTIGATION MATERIALS SUPPLEMENT

ACCIDENT

Location: Porterville, California
Date: 06/07/2021
Time: 1420 Pacific standard time
Airplane: Vans RV-6A

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HISTORY OF FLIGHT

On June 07, 2021, about 1420, a Vans RV-6A experimental airplane, N94PJ, was substantially damaged when it was involved in an accident in Porterville, California. The pilot was fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* (CFR) Part 91 personal flight.

The pilot departed from his home airport in Fresno, California about 1320 and landed at Porterville shortly thereafter.

Numerous witnesses at the airport observed the pilot refuel and takeoff. They stated that the pilot refueled the airplane with about 17.5 gallons at the self-serve fuel tanks located mid-field. A witness observed the pilot, positioned in the right seat, start the airplane after refueling. The start-up was abnormal and sounded as though it was a “hot start” with the airplane rpm’s immediately accelerating to a near maximum setting. The airplane then continued to the departure end of runway 04 and proceeded to takeoff. The airplane began to climb and the engine was making “popping” sounds while continuing left of centerline. The nose pitched down and the engine momentarily sounded normal as the airplane then climbed to about 300 ft above ground level (agl). The “popping sounds” continued and some witnesses observed that the engine then experienced a loss of power (see Figure 1 below).

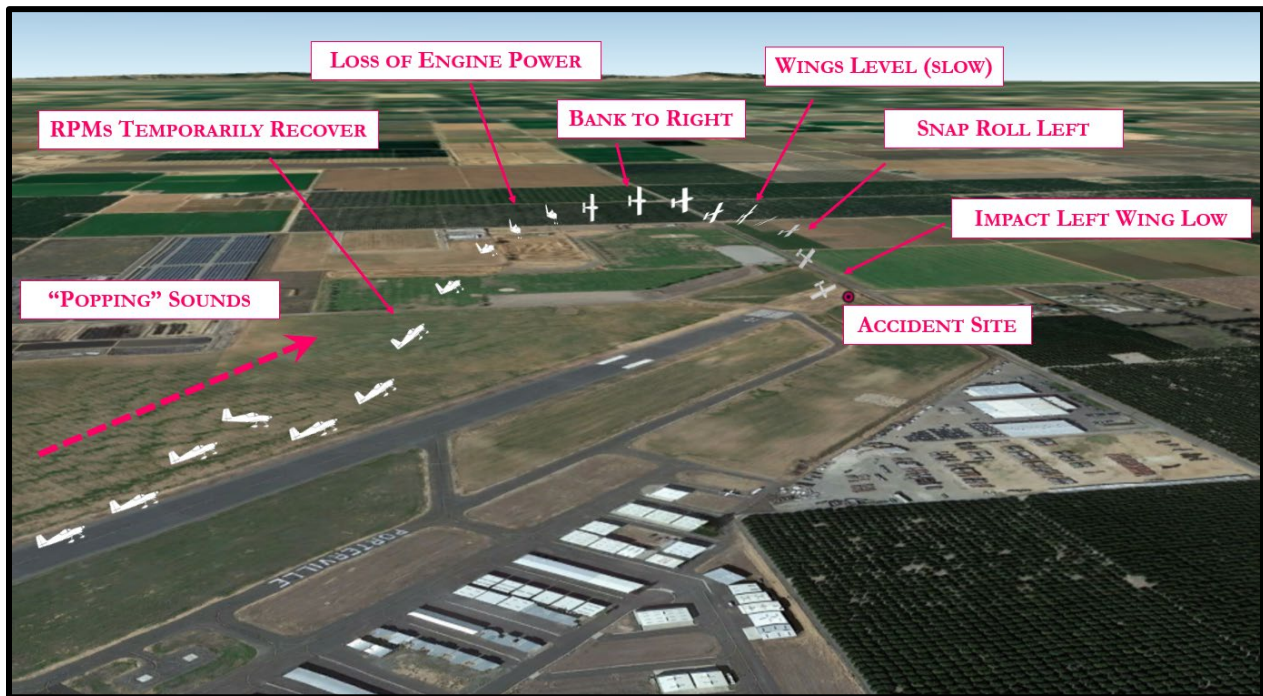


Figure 1: Visual of Witness Reports

Video footage was obtained from a fixed security camera at the airport. A review of the footage revealed that the airplane made a hard right bank, with the wings near perpendicular to the ground, consistent with the pilot attempting to return to the airport. The witnesses further stated that the airplane then momentarily maneuvered to a wings-level attitude and then rolled left, akin to a snap roll. The airplane then rapidly descended in a left-wing low attitude nearly perpendicular to the terrain and immediately erupted into flames.

The accident site was located about 250 ft from the approach end of runway 12 on flat terrain composed of hard, dry dirt and short vegetation. The wreckage was found distributed over an approximate 40-foot distance with the nose pointed on a median magnetic bearing of about 350°. The fuselage and inboard sections of the wings had been consumed by fire. The first identified piece of debris was fragments of red lens, consistent with the tip of the left wing contacting the ground at the beginning of the accident sequence. From the lens fragments was pieces of propeller blades and pieces of the skin.

WRECKAGE AND IMPACT

The accident site was located about 250 feet from the beginning of runway 12 at the following coordinates: 36.036104, -119.070189. The wreckage was found distributed over about 100-feet on a median magnetic bearing of about 040°. The nose was pointed on a median magnetic bearing of about 350°. The fuselage and inboard sections of the wings had been consumed by fire. The first identified piece of debris was fragments of red lens, consistent with the tip of the left wing contacting the ground at the beginning of the accident sequence. From the lens fragments was pieces of propeller blades and pieces of the skin.

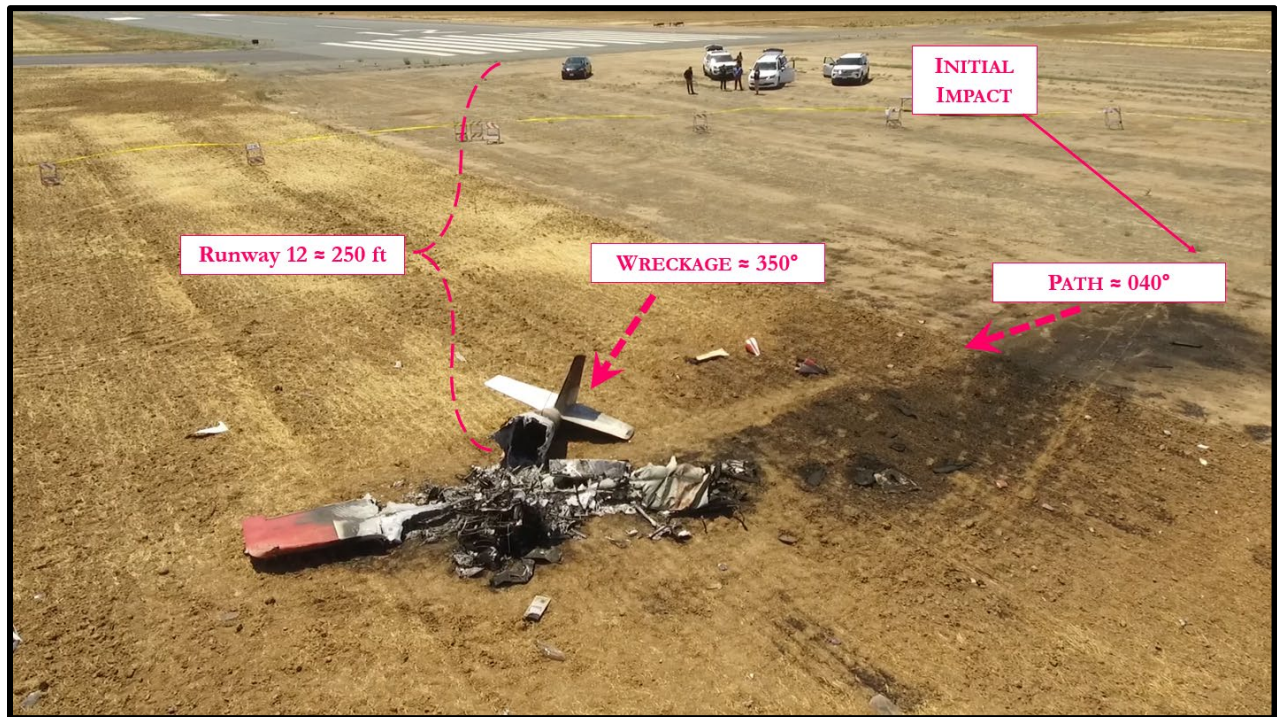


Figure 2: Debris Field (in reference to the runway)

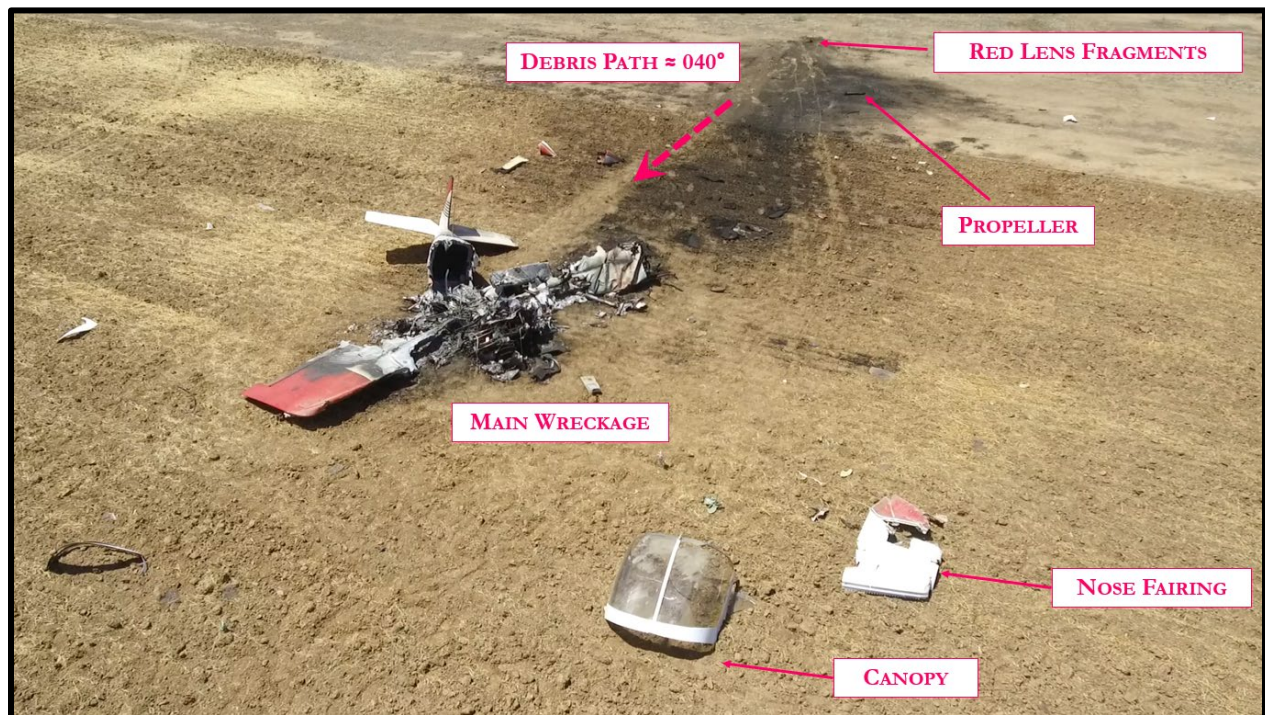


Figure 3: Debris Field

The furthest wreckage was the emergency locator transmitter (ELT), the canopy and the upper cowling, all of which remained unburned. There was no evidence that the ELT activated; the switch was in the "OFF" position.

The canopy and upper nose cowling were forward of the main wreckage. They were clean from oil and soot.

AIRFRAME

The fuselage had come to rest upright and was partially consumed by fire with only the outboard right wing and tail not thermally damaged. After collection and examination of the flight control system components, control continuity was established from the flight controls in the cockpit to the breaks in the system which displayed evidence of tensile overload and from the breaks in the system to the flight control surfaces.

The right wing was attached at the fuselage; the aileron and flap remained attached to the wing. The left-wing spar was fractured at the fuselage, the left flap connecting rod was fractured, and the left aileron was separated from the wing. The left wingtip was separated from the airplane and located at the first observed ground scar. The rudder and vertical stabilizer were attached. Both the left and right elevators displayed crinkling from the outboard portions inward. Flight control continuity was established from the ailerons, elevator, and rudder surfaces to the cockpit controls. The cockpit was heavily damaged and folded open; the canopy was separated and lay over the right horizontal stabilizer.

The cockpit was consumed by fire and the gauges and switches were unreliable. The keys were found loose in the wreckage.

FUEL SYSTEM

The fuel system consisted of two aluminum tanks contained in the inboard leading edge section of the wings in addition to two fiberglass tanks located in each wing tip. The system was designed for fuel to be taken from each tank through a screen located in the tank outlet fitting and into the fuel selector valve located under the floor panel under the middle seats. The fuel selector valve was controlled by a selector lever located above the floor panel.

From the selector valve, fuel was routed to an Airflow Performance (p/n 3090050) electric fuel pump. On the electric pump there were two valves, one was the pressure relief valve (blue valve) and the other was a bypass-check valve (gold color). When the electric pump is off the check valve allows free flow to the engine pump. When the electric pump is energized the check valve closes which keeps electric pump flow from short circuiting. With the electric pump on, the pressure is built up until the opening pressure of the relief valve is met (25-35 PSI) which supplies the fuel injection system with the required fuel pressure to operate. The excess flow that the electric pump generates is returned back to the inlet of the electric pump.

Fuel was then fed to a transducer and then through the firewall. From the firewall, the fuel was routed to a Tempest mechanical fuel pump, AF-15473 (s/n F003164) and continued to the Precision EX-5VA2 fuel servo. From the servo the fuel was routed to the spider located on top of the engine, which divided the fuel into the four cylinders.

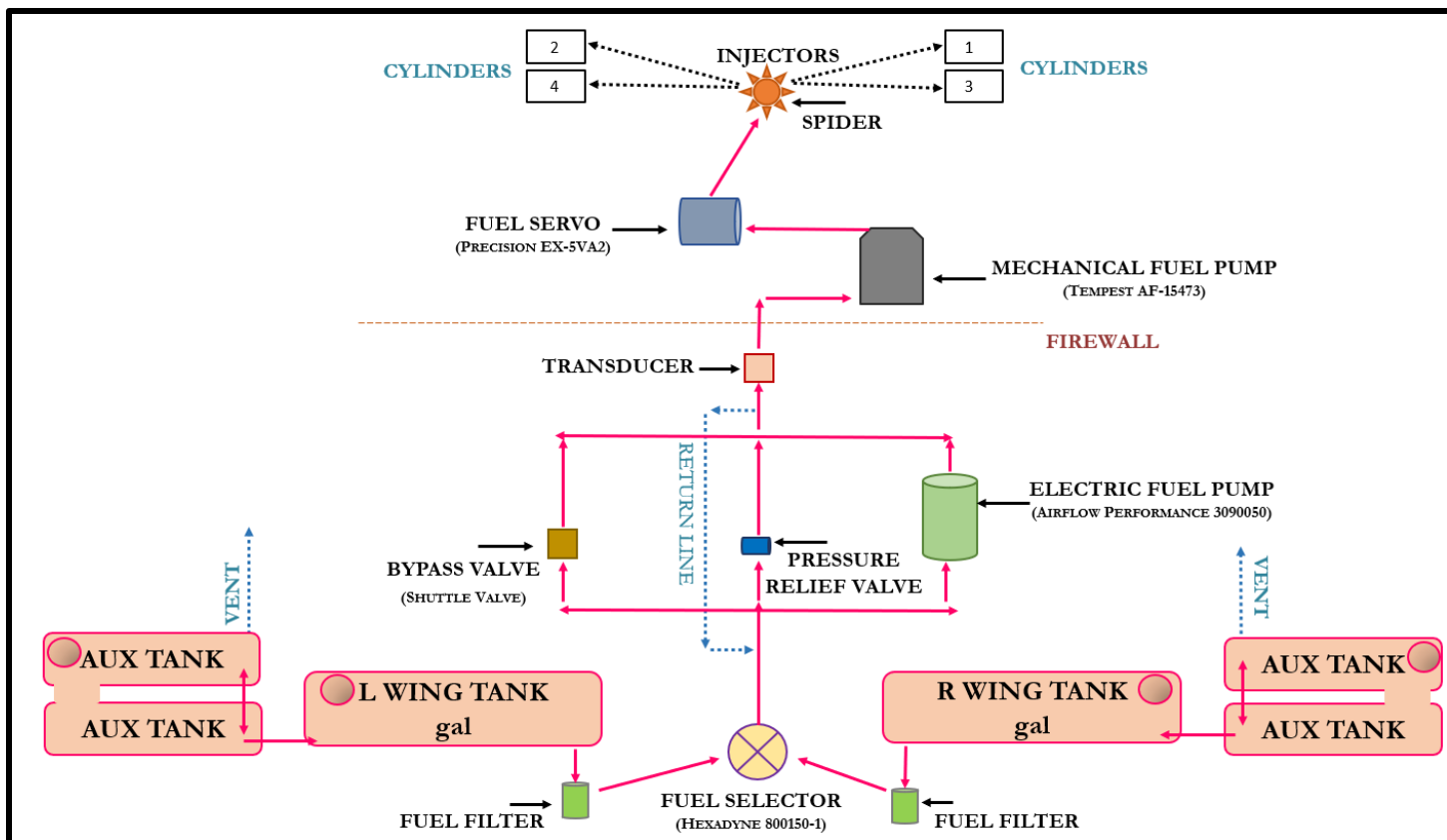


Figure 4: Graphic Depiction of the Fuel System

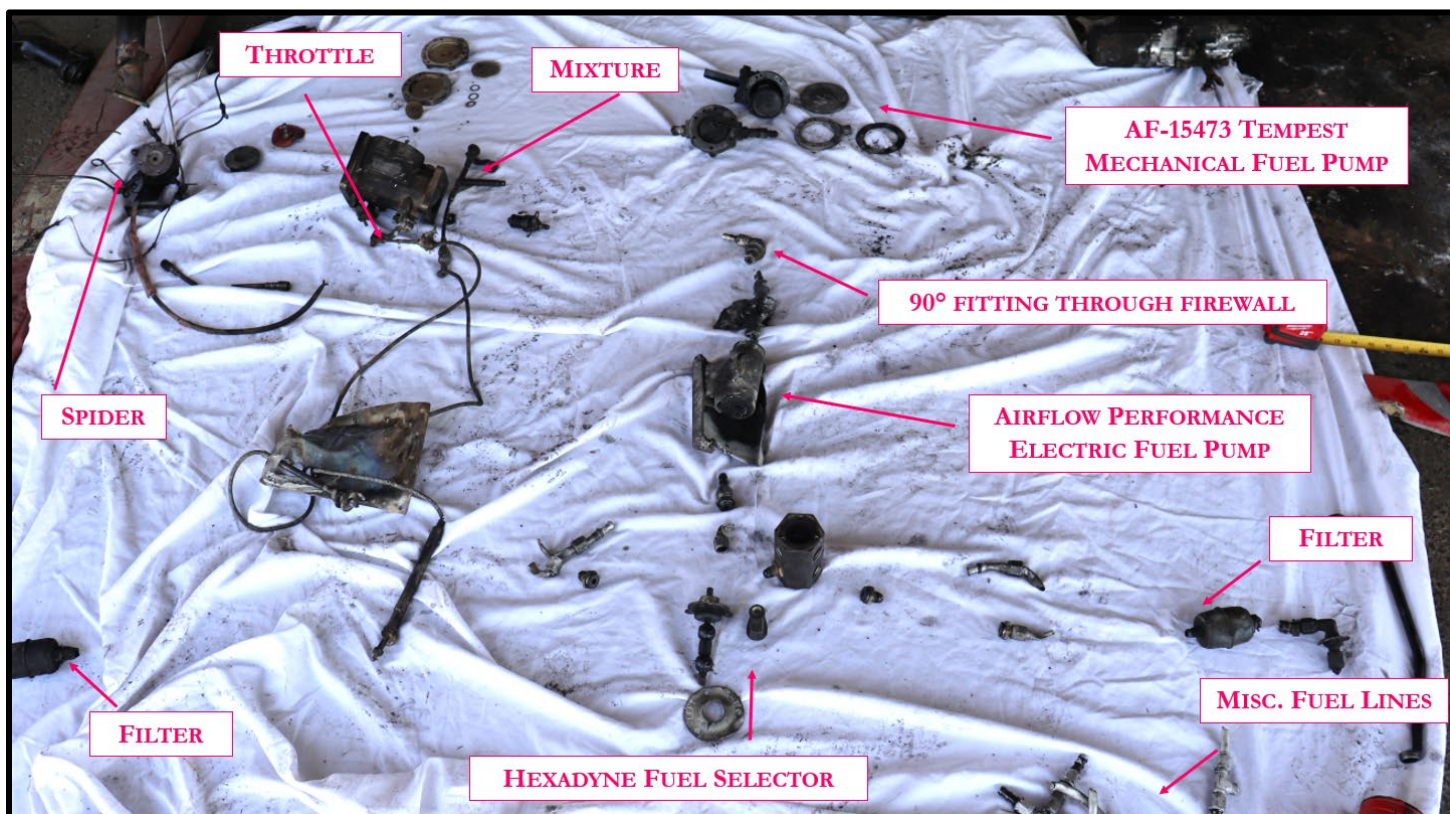
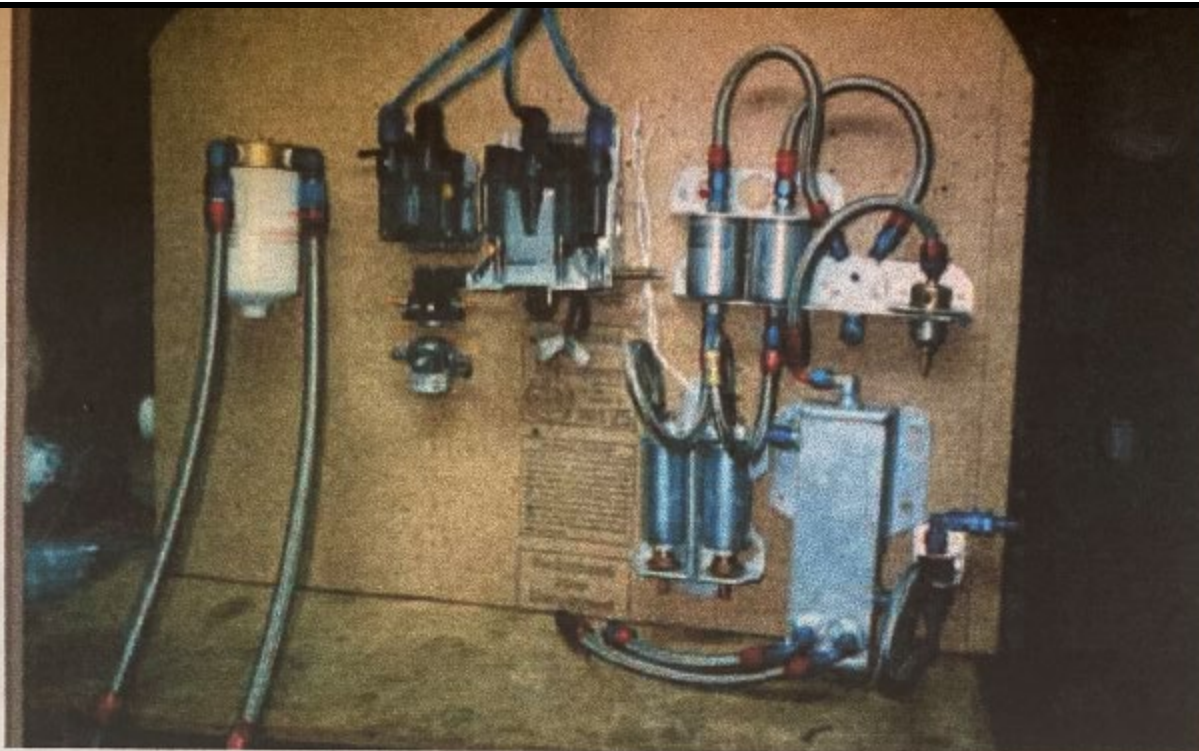


Figure 5: Fuel System

The following information was in the original paperwork for the airplane build, but it is unknown what the pilot had done or if he modified the fuel system further.



1. Firewall mockup for determining placement of fuel, ignition, and oil subsystem components.

Fuel system components:

Lower right - Fuel filter
 Lower right - Fuel header tank (aluminum rectangular box)
 Left of Header tank - two high pressure fuel pumps
 Over Fuel pumps - two fuel filters
 Over Header tank - Fuel distribution "Y" to rejoin fuel flow and pressure regulator

Ignition system components

Center right - Trail ignition module
 Center left - Lead ignition module
 (note: ended up mounting Lead module above Trail module on aircraft firewall)

Starter/master relays (note: ended up mounting both relays inside cockpit)

Figure 6: Excerpt from Builder's Manual

Several pictures taken prior to the accident revealed that there was rubber lined fuel hoses. Additives in the fuel will deteriorate and erode the rubber liner, creating either a cavitation void for an air leak or a fuel leak; either could cause a starvation or a momentary fuel starvation.

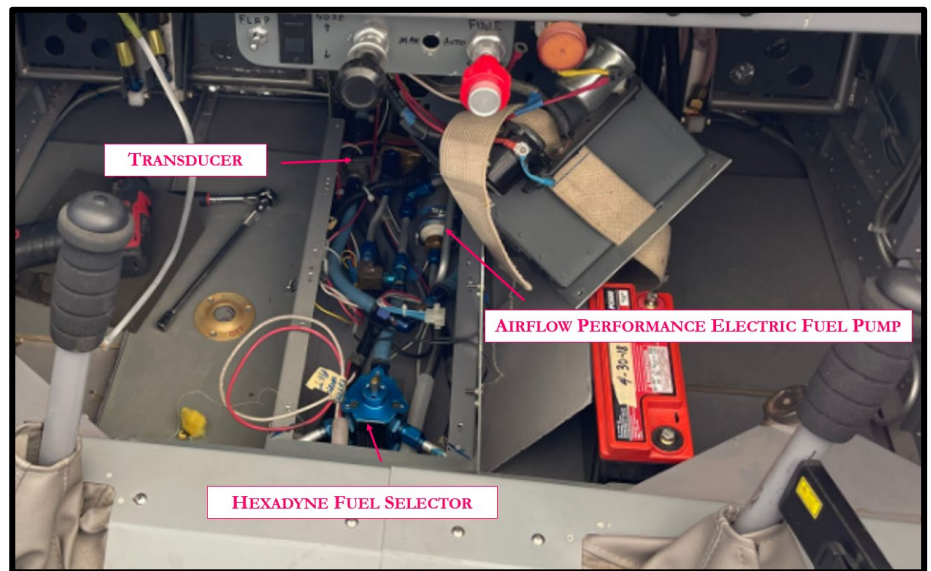


Figure 7: Pictures of the Airplane Prior to the Accident

QUANTITY

The fuel receipt from the last known fueling was the day of the accident at 1341. The invoice showed the pilot added 17.53 gallons of 100LL AvGas.

EXAMINATION

The fuel caps on both main tanks and auxiliary tanks were found secured in their respective receptacles.

The fuel selector handle was attached body and found in the “OFF” position. The selector position plate was affixed to the structure and bent over on the handle. There was a divot in the plate metal consistent with the selector handle being in the “OFF” position at the time of impact. The fuel lines remained installed on the fuel selector, but were melted off at about 1-2 inches outboard of the selector. When routing air through the outlet,

investigators could establish that the air escaped from the intended tank position selected, with a tactile detent at each position. The internals of the assembly were thermally consumed.

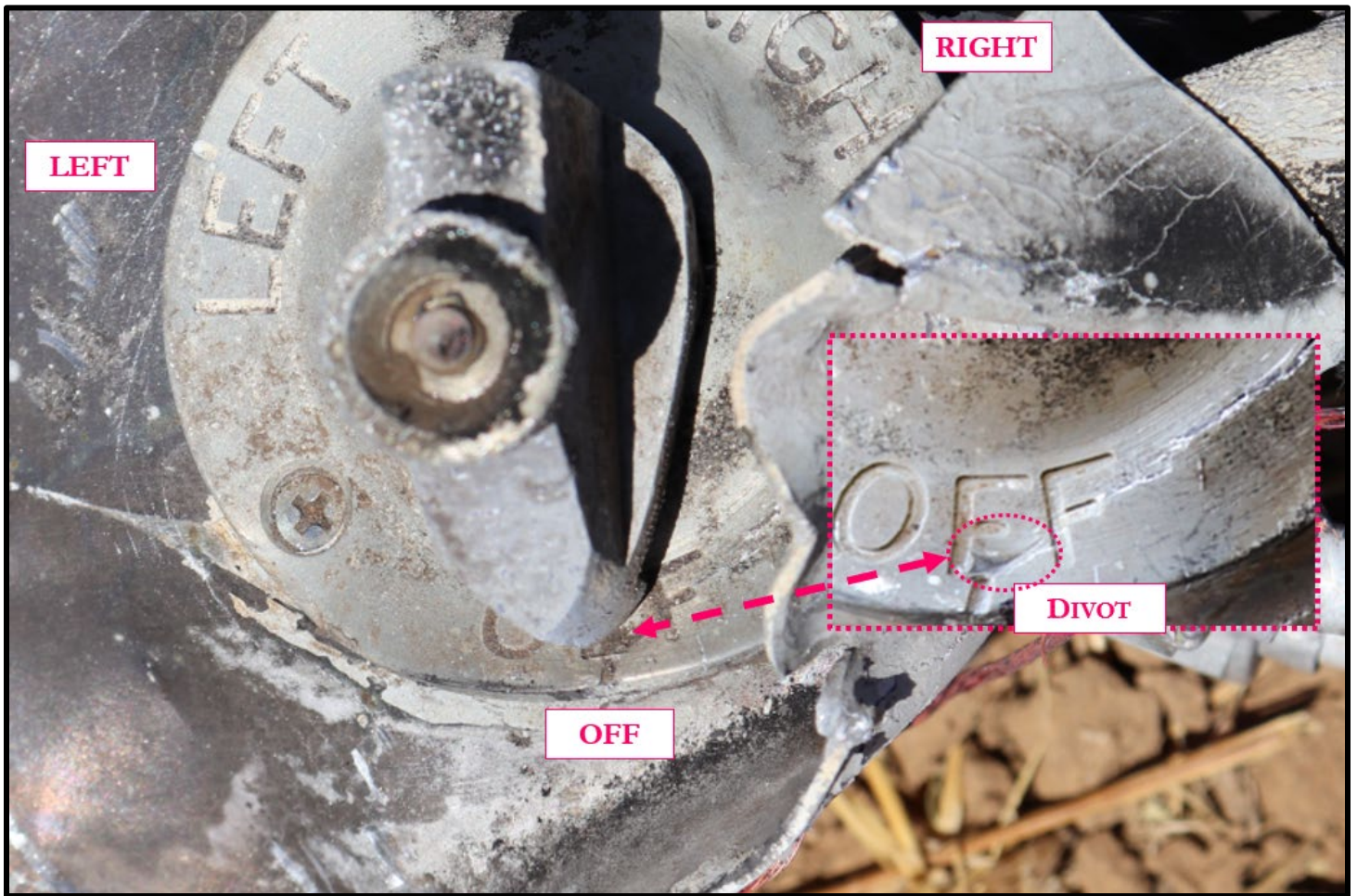


Figure 8: Fuel Selector

There was a white residue in the inside of the lines which was likely a result of one of the following reasons:

- 1)The residue is the oxidation of a non-ferrous component within the steel line. Exposure to heat or a combination of exposure to heat and then to moisture through air or water can result in this type of oxidation.
- 2)Gasoline additive are not all organic and may not necessarily evaporate or burn away.
- 3)Or a combination of all of these things.

The electric fuel pump remained mounted within the cabin floor that had burned and was folded in on itself.

The mechanical fuel pump was attached to the accessory gear case. The fuel lines were burned on both the inlet and outlet. Disassembly revealed that the diaphragm was completely consumed.

Investigators established continuity from the throttle and mixture controls from the controls in the cockpit to the arms on the fuel servo; the stop bushing was thermally consumed. The idle screw adjustment was not saftied. The butterfly valve was found in the closed position and the heat marks were consistent with it being in that position during heat exposure. Disassembly of the servo revealed that the diaphragm was burned.

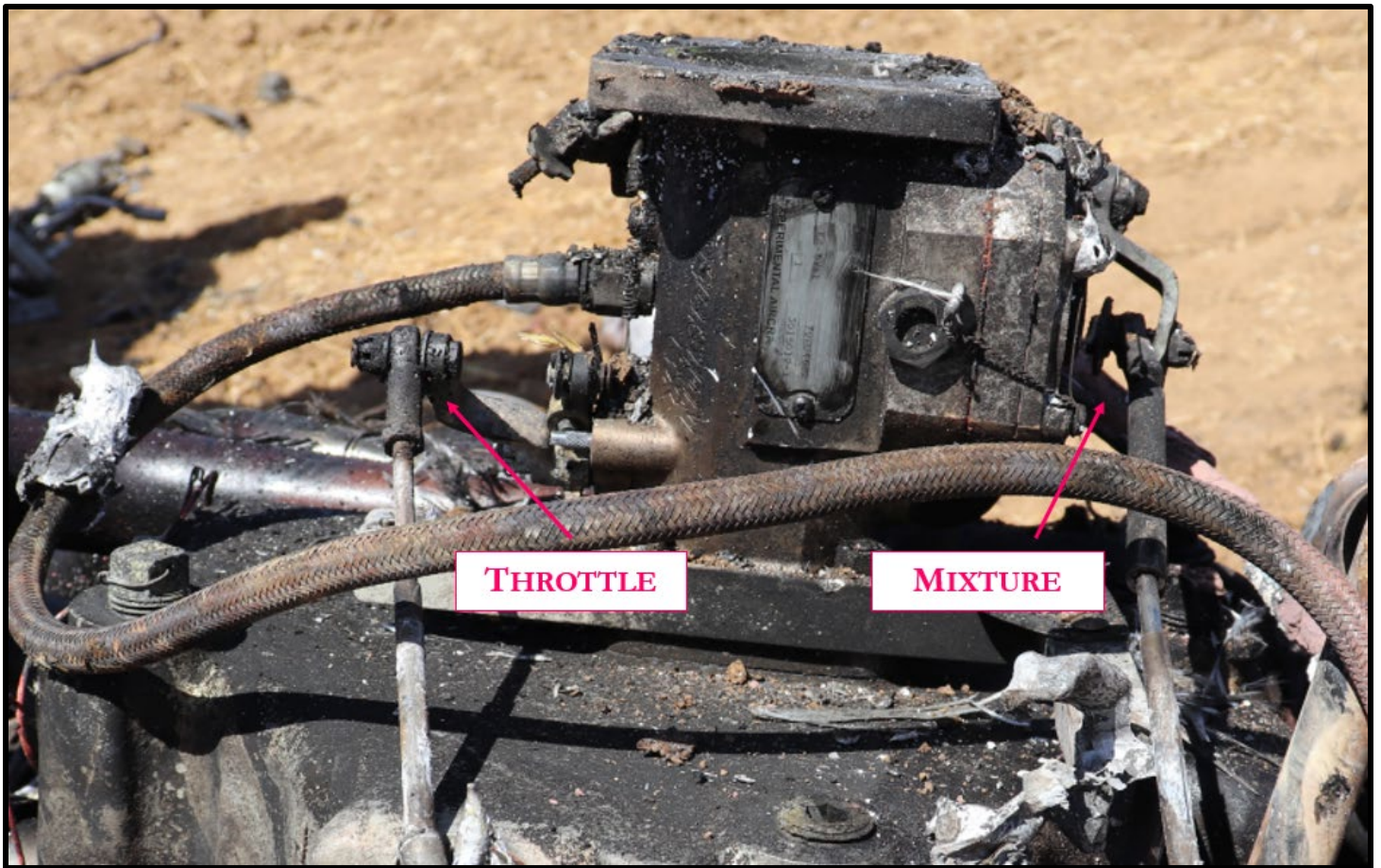


Figure 9: Fuel Servo

The fuel line from the fuel servo to the spider was melted with the fire sleeve partially burned off. The line was completely blocked from the material melting inside. The spider did not contain obvious fuel and several drops of moisture found were positive for water; the post-accident fire was extinguished with water and a chemical suppressant. Disassembly revealed that the diaphragm was torn and burned consistent with a post-impact damage.

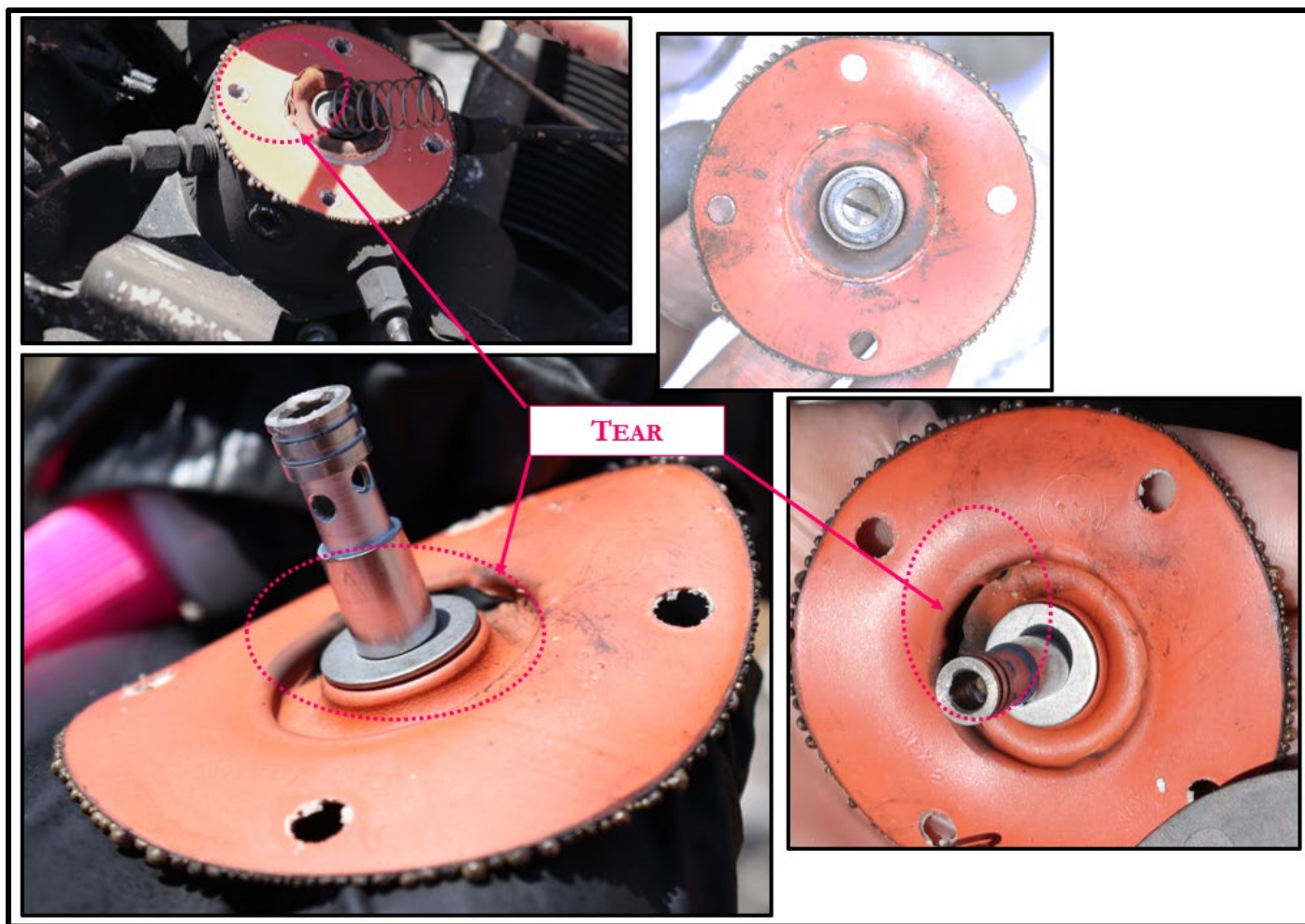


Figure 10: Fuel Manifold (Spider)

The injector lines were clear of debris but has sustained thermal exposure. Several of the injector nozzles had trace amounts of debris inside, but was easily removed with tapping them on a hard surface.

ENGINE

The Superior XP-IO360-B1CC2, serial number 36F071211, was installed on the airplane in 2013 by the original builder.¹ The ignition system consisted of one Slick magneto and one Light Plasma III ignition. The engine was outfitted with Vetterman exhaust.



Figure 11: Data Plate on Engine

¹ The airplane was originally equipped with a Chevrolet 4.3 Liter V6 engine (s/n 10066011)

An external examination of the engine revealed that the crankcase had fractures in numerous areas around the casing. The predominant crack was between the Nos 1 and 3 cylinders and continued over the backbone of the case to the top forward bolt attaching the No. 2 cylinder; another crack has between the Nos. 2 and 4 cylinders. There was no oil visible seeping around the engine, nor was the evidence of oil on the windscreen. Investigators were able to rotate the engine by exerting force on the remaining propeller blades.

Investigators removed the cylinders which revealed no evidence of foreign object ingestion or detonation. All valves were intact and the internal cylinder domes and piston crowns exhibited similar combustion deposits with the No. 2 and No. 4 exhaust appearing to be more reddish in color, consistent with hot operation. The valves and guides were examined and no evidence of material transfer was visually apparent.

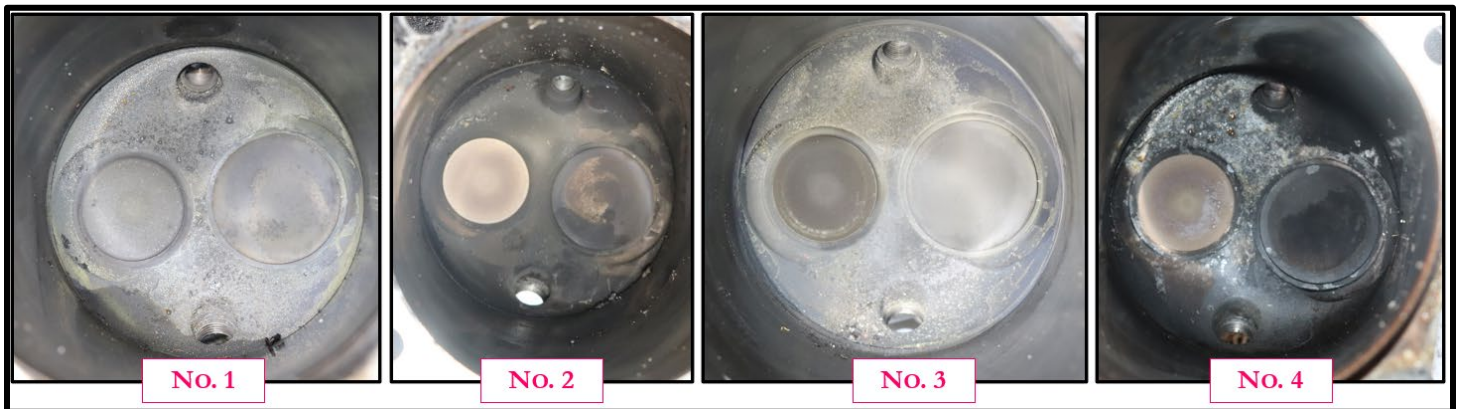


Figure 12: Cylinders and Valve Faces

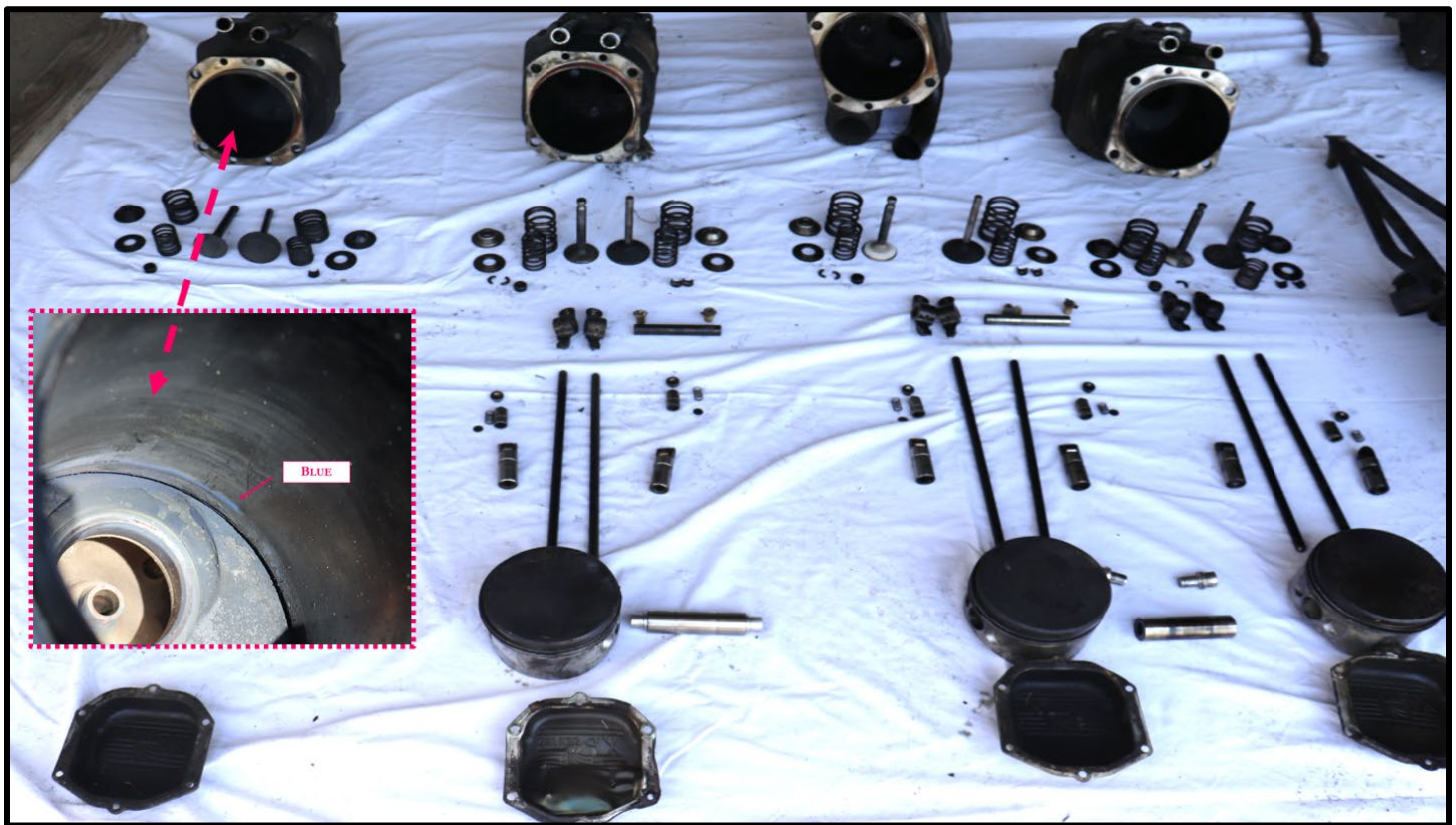


Figure 13: Engine Internal Components

The crankshaft, idler gear, and camshaft gears were all aligned with their respective marks aligning. The oil pump was disassembled revealing intact gears; the pump rotated freely.

The thermal exposure appeared to be more extensive on the Nos. 1 and 3 cylinders. The bearings were free of wear and no fretting was observed. The crankshaft was intact and the connecting rods remained secured with a dark coloration consistent with thermal damage.

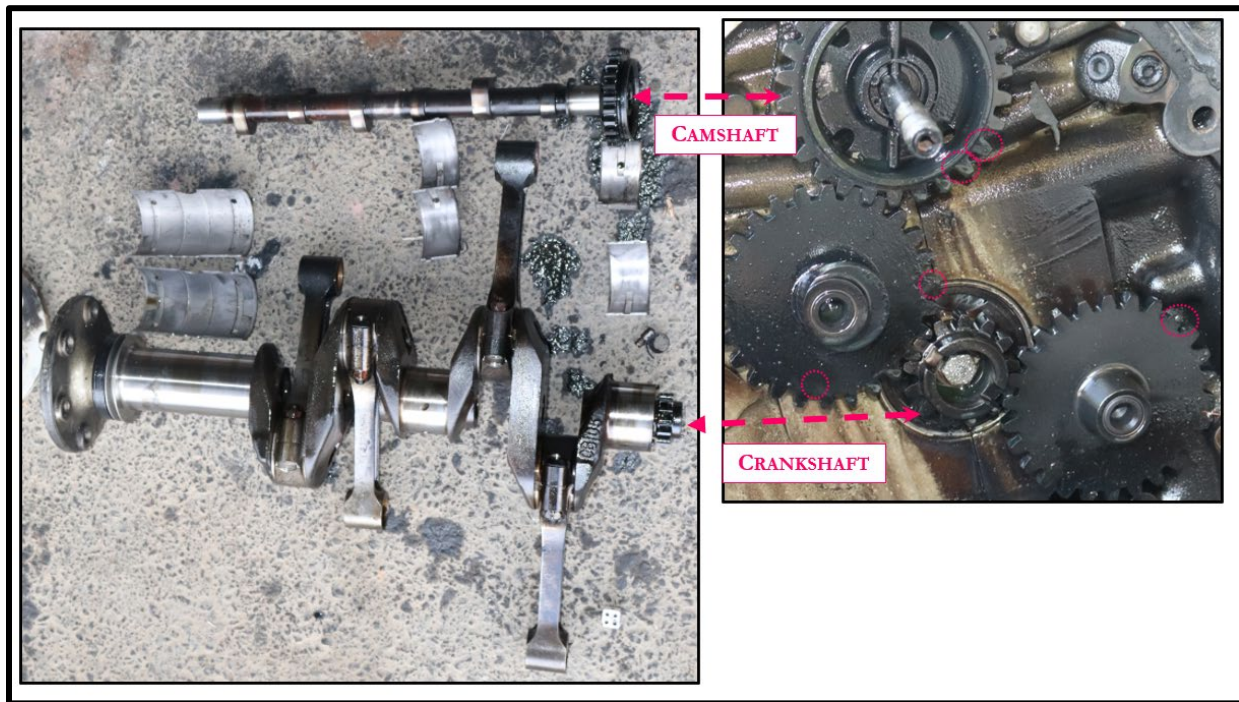


Figure 14: Crankshaft and Camshaft

The oil sump contained oil and no evidence of metal was found. The exhaust tubing attached to the oil sump contained white deposits inside, consistent with a normal to lean fuel/air mixture.

The airplane was equipped with a dual ignition system. A Light Plasma III electronic module provided ignition to the upper spark plugs and a Slick magneto was used for the lower spark plugs. The electronic modules found were partially burned and could not be tested. Disassembly of the magneto revealed the internal mechanisms were thermally destroyed. The park plugs were removed revealing a No. 4 plug had a cracked ceramic core.

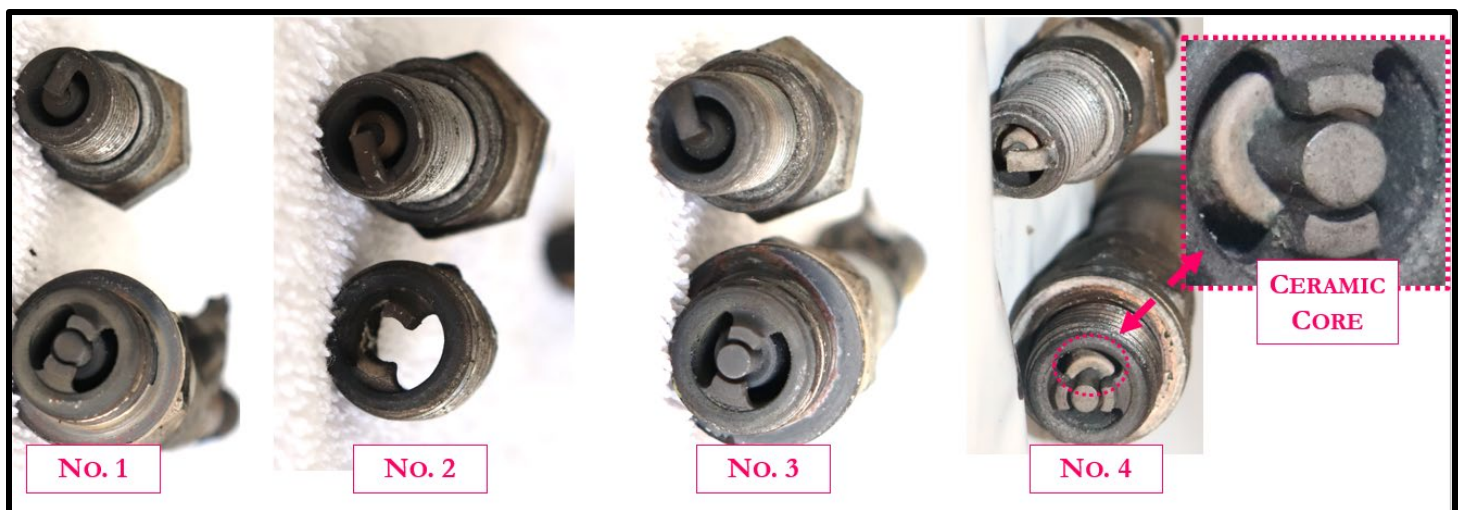


Figure 15: Spark Plugs

PROPELLER

The Catto two-bladed propeller was a 70in diameter and 78in pitch. One of the wood/composite blades was not attached to the hub; the other blade partially remained in the hub.

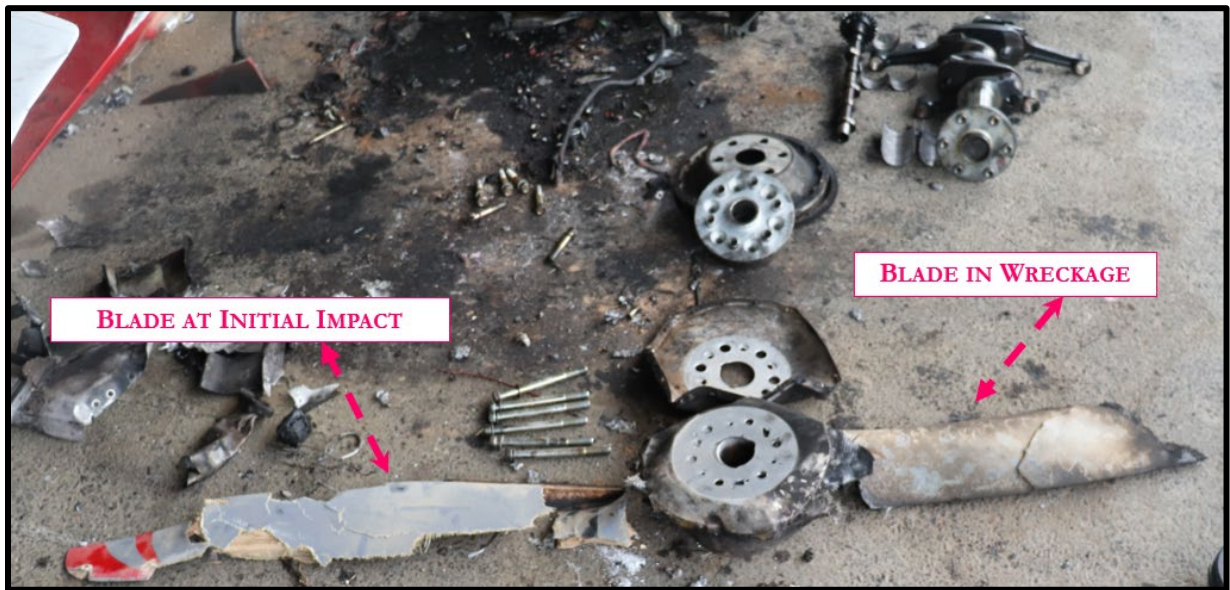


Figure 16: Propeller

RECORDS

The accident aircraft was a tricycle landing gear equipped, two seat, low wing airplane. The pilot purchased the airplane on May 19, 2021.

Partially burned maintenance logbooks were found. The first entry in the engine logbook indicated that engine was installed with an Airflow Performance injection, 1 Slick Magneto, 1 Light Plasma III ignition, a Sky-Tec starter, a Vetterman exhaust and a Catto propeller. The next entry indicated that at an engine time of 43 hours, the following work was done:

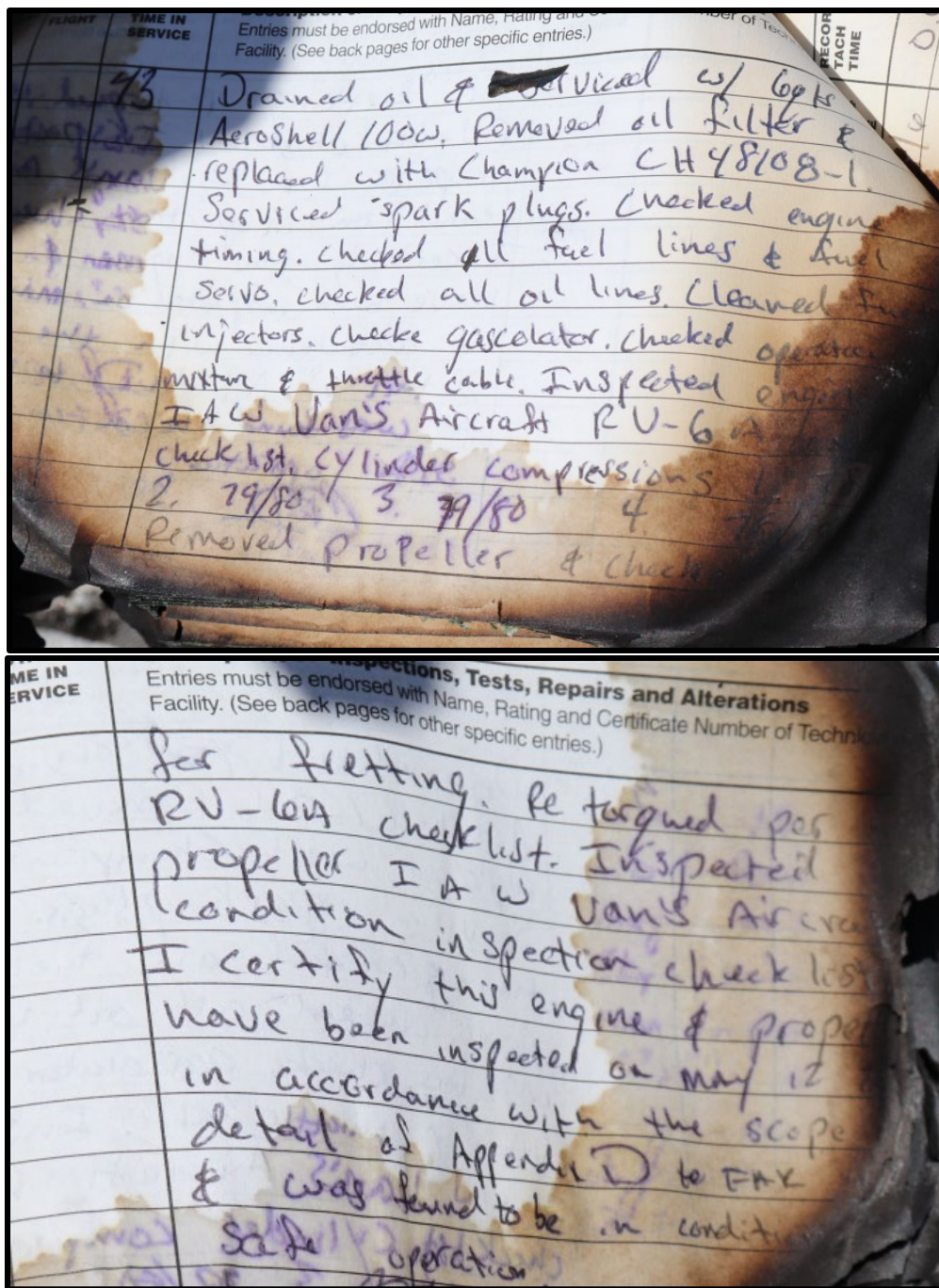


Figure 17: Excerpts of Logbooks

The last fueling record indicated before the accident the pilot added 17.53 gallons:

CUSTOMER INVOICE

INVOICE LISTED BY SITE ID

From Date: 6/7/2021
Time: 12:00:00PM

To Date: 6/7/2021
Time: 1:45:59PM

Page 1 of 1
Print Date: 6/8/2021 Time: 6:08:21AM

Transactions for SITE ID: 0001 Porterville Airport

Transactions for User -

Date	Time	TC	Site	Vehicle ID	Tran #	Odometer	Hose	Grade	Product	Unit Cost	Quantity	Total
6/7/2021	1:41:00PM	99	0001			0	1	1			17.53	

Figure 18: Last Fueling Record

There were partially burned pilot records also located in the wreckage but did not have the accident airplane's registration number. The pilot was a Lieutenant Colonel in the 144th squadron from the Air Force. He flew F-16 jets and it is unknown how much total experience he had in piston engine airplanes.

DATE				AIRCRAFT		DEPARTURE/ARRIVAL	
DATE	TYPE	TAIL NO	FROM	TO			
8/27/15	C172	8402	LMT-A32	LMT			
9/1/15	C172	8402	LMT	LMT			
9/14/15	C172	8402	LMT	LMT			
9/14/15	C172	8402	LMT	LMT			
9/16/15	C172	8402	LMT	LMT			
9/18/17	AC-119	57190	V6T	V6T			
9/19/17	AC-119	57190	V6T	V6T			
9/19/17	DE-95	57190	V6T	V6T			
1/16/21	C182	57190	PVF	E79			
1/18/21	C182	57190	E79	C79			
1/31/21	C182	57190	C79	O32			
1/31/21	C182	57190	O32	C79			
2/2/21	C182	57190	E79	KMAE			
2/4/21	C182	57190	KMAE	C79			
2/15/21	C182	57190	C79	C79			

Figure 19: Remnants of Pilot Logbooks

ADDITIONAL INFORMATION

According to the Lycoming Flyer:

Detonation is the sudden and violent combustion of a portion of the unburned fuel ahead of the flame front. It occurs part-way through the burning cycle when the remaining unburned fuel suddenly reaches its critical temperature and ignites spontaneously. There is severe heat and pressure shock within the combustion chamber that will cause spark plugs to have broken or cracked insulator tips along with damage to the electrodes and lower insulator seal. Engine parts such as the piston, cylinder head and connecting rod may suffer serious

damage. When detonation has occurred, the cylinder must be examined with a borescope and may require replacement. Corrective action is imperative.

It further states “DON’T — reuse any plug with cracked porcelain... It will cause serious preignition.”

According to a spark plug manufacturer, Tempest:

Preignition is caused when the combustion charge is ignited prior to the normal, timed spark. This may be caused by a hot spot due to an overheated spark plug. Serious damage to the engine may result. Indicators include a rapid rise in the cylinder head temperature or engine roughness. If preignition is suspected, remove all spark plugs and inspect for damage (excessive wear, electrode crack or insulator nose irregularities).

Detonation is an explosion of the unburned combustion charge prior to the normal flame front. This condition may damage the spark plug electrodes or crack the insulator nose. Indications include a mildly rough engine, coupled with a knocking sound. If detonation is suspected, remove and inspect the spark plugs and follow the engine manufacturer’s recommendations for correction procedures.