National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594

WPR22FA055

INVESTIGATIVE SUPPLEMENT

ACCIDENT

Location: Medford, Oregon
Date: 12.05.2021
Time: 1652 Pacific standard time
Airplane: Piper PA-31-350 Navajo Chieftain

INVESTIGATIVE SUPPLEMENT

IIC Zoë Keliher
National Transportation Safety Board
Portland, Oregon

PARTY MEMBERS

Kathryn Whitaker
Piper Aircraft, Inc.
Vero Beach, Florida

Les Doud
Hartzell Propeller, Inc.
Piqua, Ohio

Mark Platt
Lycoming Engines
Williamsport, Pennsylvania

History of Flight

On December 05, 2021, at 1652, a Piper PA-31-350 Navajo Chieftain airplane, N64BR, was substantially damaged when it was involved in an accident in Medford, Oregon. The pilot and passenger were fatally injured. The airplane was operated as a Title 14 Code of Federal Regulations (CFR) Part 91 personal flight.

The pilot and passenger made a flight on November 24, from the airplane's home airport in Fallon, Nevada to Medford. After landing, the pilot noticed the airplane was leaking a large amount of fuel from the right wing-root. The pilot arranged to make the necessary repairs with a fixed based operator (FBO) at the airport and drove a rental car back home to Nevada. On December 4, a mechanic at the FBO notified the pilot that the maintenance to the airplane was completed. The pilot responded that he would plan to get the airport about 1430 the following day (on the day of the accident). The pilot and passenger drove to Medford arriving about 1600.

Figure 1: Flight Plan

The timeline is as follows:

Date	Time	Occurrence	Source
11/24/2021		Landed	Flight Aware
11/24/2021	1300	Rented Car	Hertz
12/2/2021	1200	Swapped out Rental Cars	Hertz
12/3/2021	1500	Jet Center ordered hose	Boeing/Aviall
12/4/2021	1518	Maintenance signed off as complete	Jet Center
12/4/2021	1540	Airplane refueled	Millionaire
12/5/2021	1600	Returned Rental Car	Hetz
12/5/2021	1642	First 911 call	Medford Police Call

Figure 2: Timeline

The radio communication times could not be confirmed. The pilot received an instrument flight rules (IFR) clearance and was issued the BRUTE7 departure procedure with the LANKS transition. During the exchange of the clearance instructions, the pilot requested the controller read back the departure procedure and transition phonetically. The pilot's family and a business associate stated this was very normal for the pilot and he would often have people clarify names and instructions. The published BRUTE SEVEN Standard Instrument Departure (SID) with a takeoff from runway 14 consisted of a "climbing right turn direct MEF [Medford] NDB [nondirectional beacon]," and continue to the BRUTE intersection on a bearing of 066°.

After receiving the clearance, the controller informed the pilot the overcast layer base was at 200 ft above ground level (agl) the tops of the layer was at 2,500 ft. After the airplane departed the pilot made a radio communication to the controller asking "will you be calling my turn for the BRUTE7?" The controller replied that he would not be calling his turn and that the pilot should fly the departure as published making a climbing right turn to overfly the approach end of runway 14 before proceeding to the BRUTE intersection (see Figure 1 below). The pilot acknowledged the communication, which was his last transmission. Several seconds later, the controller stated that he was receiving a low-altitude alert that the airplane's altitude was showing 1,700 ft. He made several attempts to reach the pilot with no response.

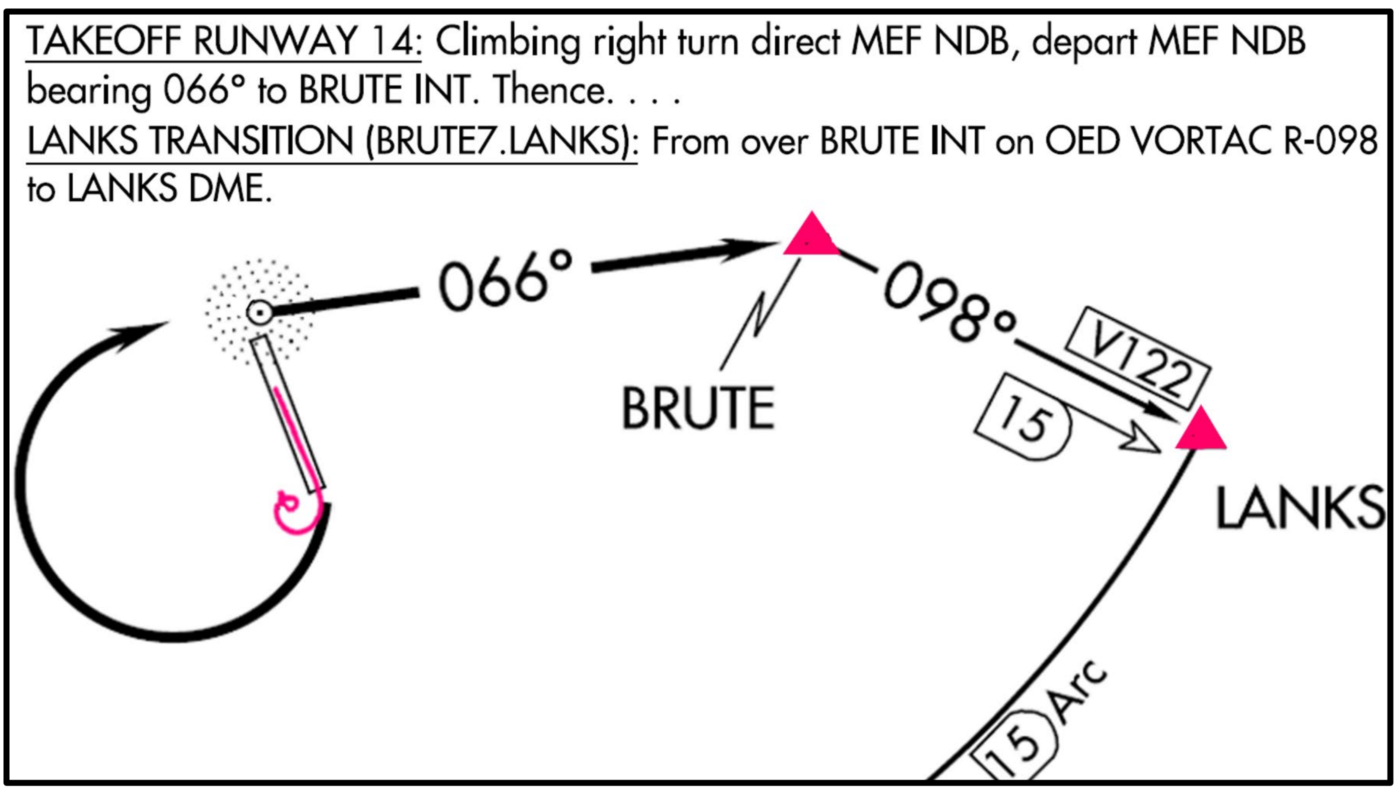

Figure 3: The Airplane's Flight Track Overlayed a Visual Depiction of The BRUTE7 Departure

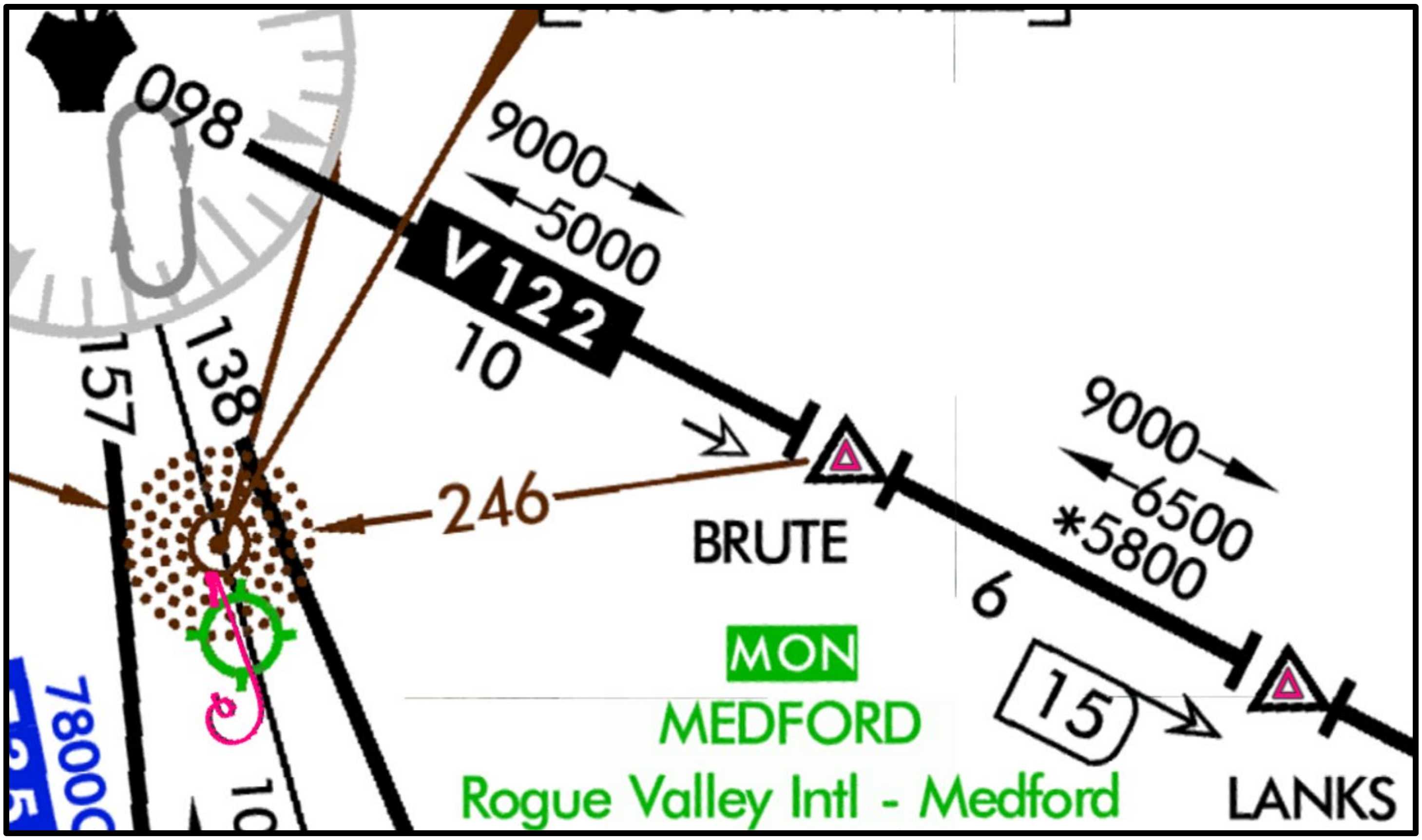

Figure 4: The Airplane's Flight Track Overlayed the Departure

The radar and automatic dependent surveillance-broadcast (ADS-B) information disclosed that the airplane arrived in the run-up area for runway 14 about 1643 and then continued onto the runway about 6 minutes thereafter. The airplane departed about 1649:30 and after crossing over the south end of the runway, it climbed to about 1,550 ft mean sea level, equivalent to 200 ft agl (see Figure 2 below). The airplane then began a gradual right turn and climbed to 1,950 ft maintaining an airspeed between 120-130 kts. As the airplane turn continued to the north the altitude momentarily decreased to 1,650 ft (about 350 ft agl) with the airspeed increasing to 160 kts. Thereafter, the airplane then increased the bank angle and made a 360-degree turn initially climbing to 2,050 ft. At the completion of the turn, the airplane descended to 1,350 ft, consistent with it maneuvering below the cloud layer. The airspeed increased to about 160 kts and several seconds later, the airplane climbed to 2,250 ft with the derived airspeed showing below 15 kts. Six seconds later was the last radar return, located about 990 ft north-northwest of the accident site.

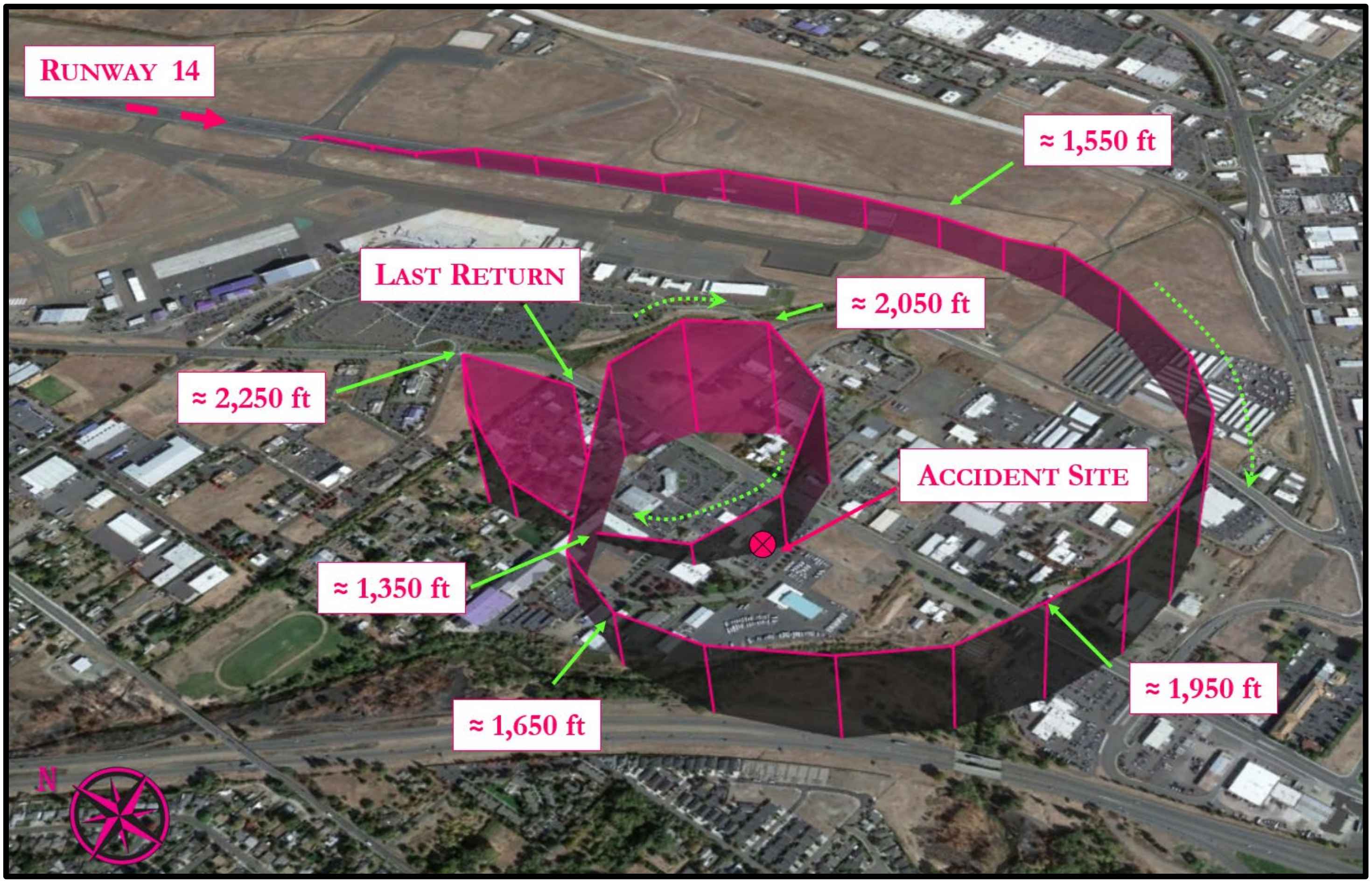

Figure 5: The Airplane's ADS-B Flight Track

Video footage was obtained from several fixed security cameras on buildings around the accident site. A review of the footage revealed that the airplane descended below the cloud layer and then climbed back up. About 16 seconds thereafter, the airplane is seen descending in a near vertical attitude (see Figure 3 below). The airplane's position and strobe light appeared to be illuminated throughout the video. The preliminary review of the recorded audio from the camera footage revealed that there were sound components at frequencies that correspond to the normal operating speed range of the airplane engines.

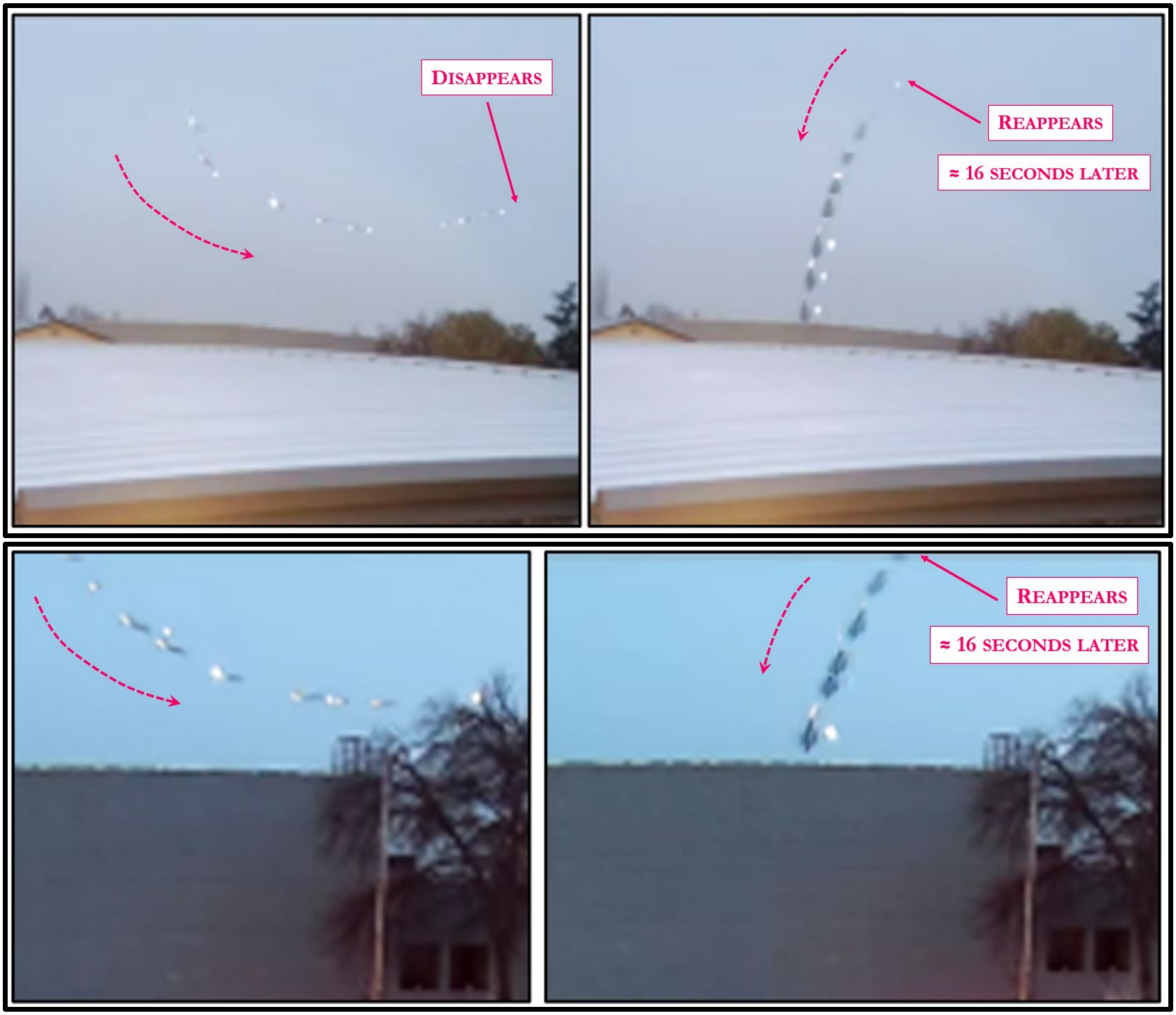

Figure 6: Excerpts of Security Camera Footage

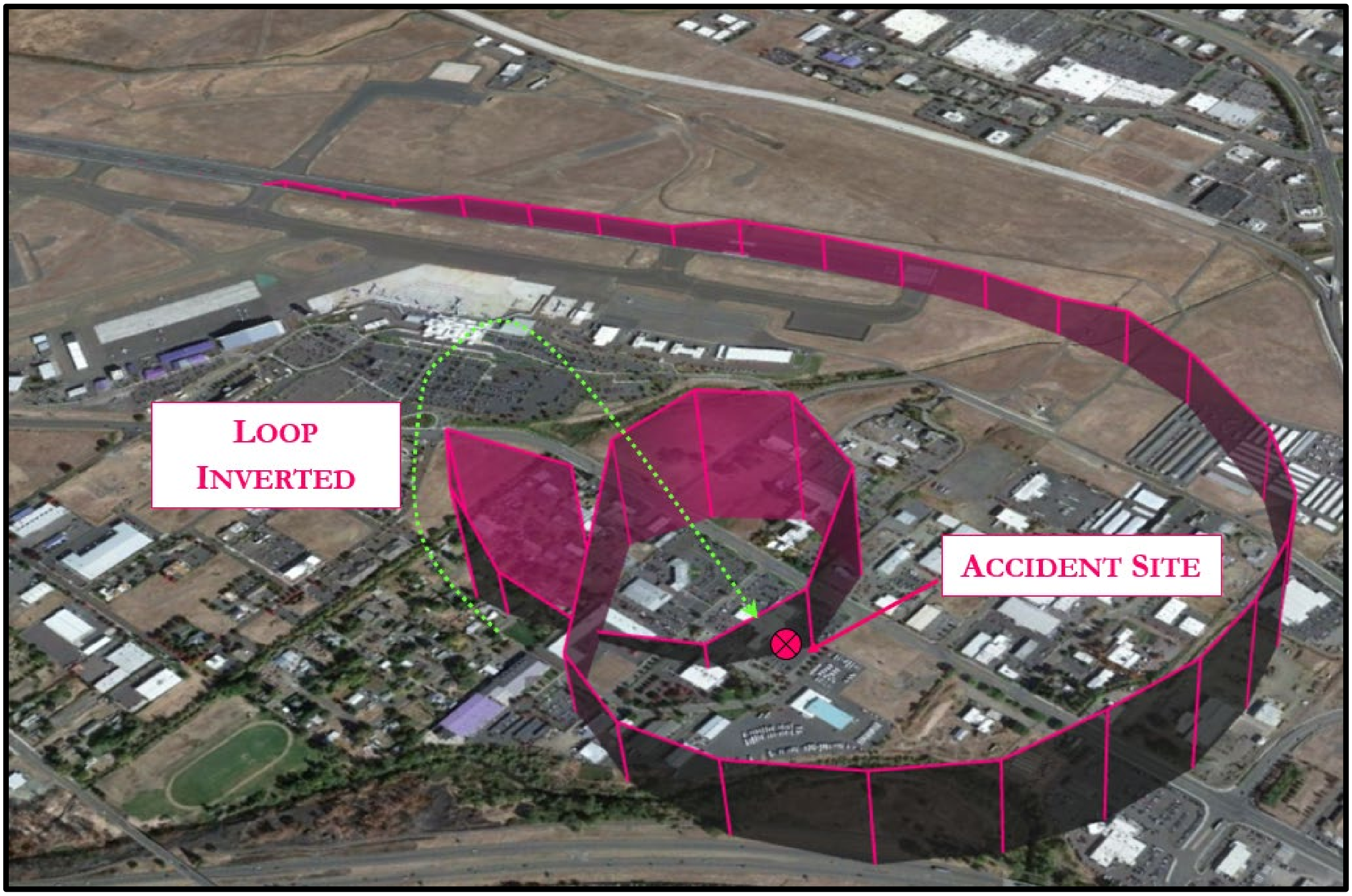

Figure 7: Flight Path with Annotations

RECORDED INFORMATION

The Safety Board Performance Division reviewed the audio from recorded videos. A performance engineer stated that the engine speeds were estimated retrospectively through spectral analysis of sound recorded by a camera on a nearby commercial building. This analysis revealed that the estimated engine speed remained consistent within the range of 2,500±100 rpm throughout the time before the accident consistent with normal operation. From the sound analysis alone, it was not possible to ascertain whether the recorded sound originated from both engines operating at the same speed or from a single engine.

According to Hartzell, the spectrogram showed evidence of a 4-blade prop operating near the 2575 engine rating and what appeared to be the engine exhaust (3/rev). There was no evidence of a propeller windmilling. The last two bright vertical bands (broad spectrum noise) are consistent with the impact and then the explosion.

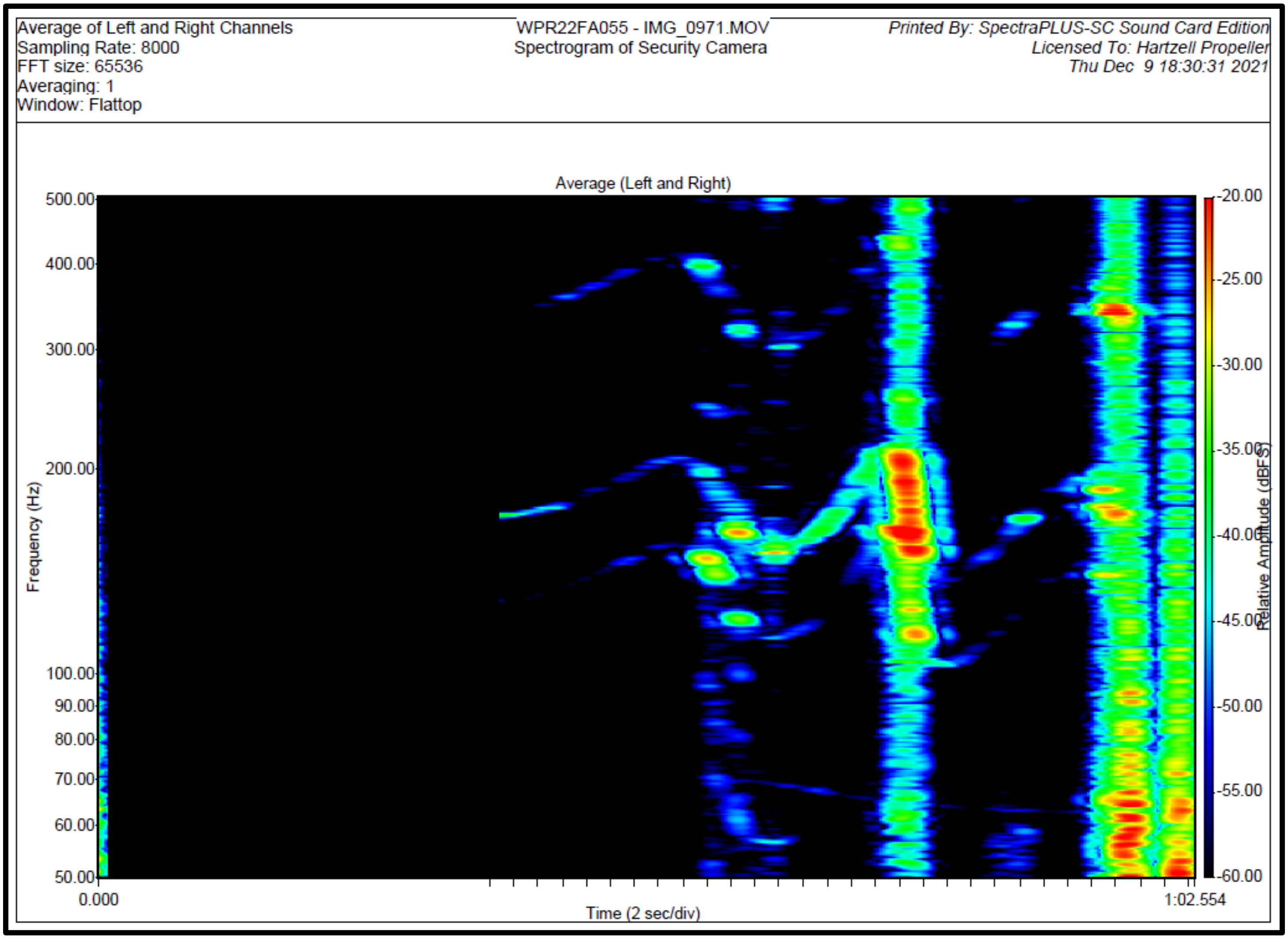

Figure 8: Hartzell Spectrogram Graph

The geometric altitude increases from 1450 feet to 2500 feet between time 105.2 seconds and time 114.4 seconds. This is average climb rate of (2500-1450)/(114.4-105.2)=114 feet/second = 6840 feet/minute.

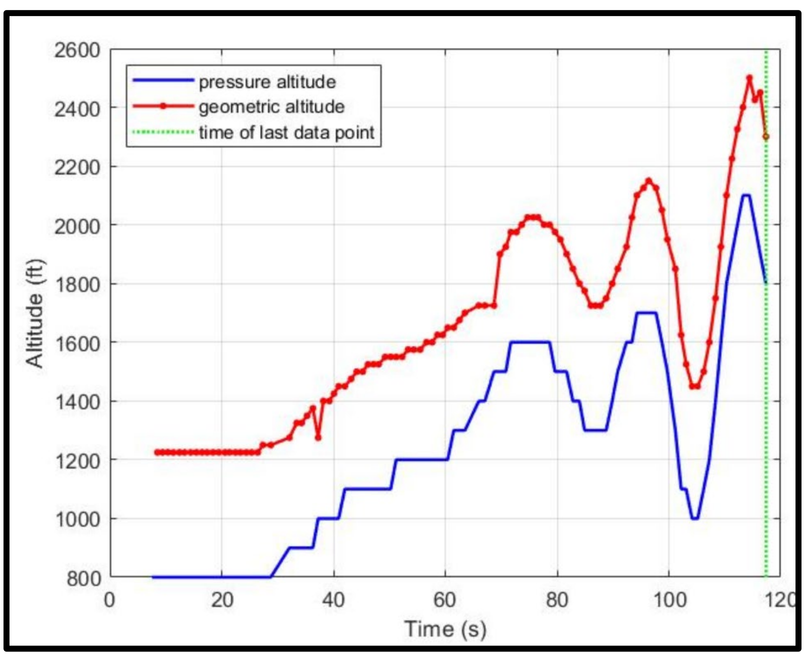

Figure 9: Altitude Chart

AIRPLANE INFORMATION

The Piper PA-31-350 Navajo (Panther conversion), airplane was manufactured in 1977 and was powered by two Lycoming TIO-540-J2B series engines driving two, four-bladed Q-Tip propellers. The airplane was equipped with a Garmin GNS 530W (installed July 2021) and an autopilot. The subscription was current.

NavData.Coverage.Garmin.GNS 400 WAAS Series.GNS 500 WAAS Series.Americas: 10-NOV-21 through 09-NOV-22 Tail Number: N64BR

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Fuel System Design and Fuel Pumps

The fuel system consisted of fuel cell, engine-driven and emergency fuel pumps, fuel boost pumps, control valves, fuel filters, fuel pressure and fuel flow gauges, fuel drains and non-icing fuel tank vents. Fuel could be stored in four flexible fuel cells, two in each wing. The outboard cells hold 40 gallons each and the inboard cells hold 56 gallons each, giving a total of 192 gallons, of which 182 gallons were usable.

Fuel is routed from the wing fuel cells to the selector valve, the fuel filter, the fuel boost pump, the emergency fuel pump, the firewall shutoff, the engine driven fuel pump, and then to the fuel injectors. The engine driven fuel pump and its associated fuel line are located in the engine compartment forward of the turbocharger.

According to the Piper Aircraft Company, each engine is equipped with an engine driven fuel pump, an emergency fuel pump, and a fuel boost pump. The engine driven fuel pumps run continuously, and they are not controllable by the pilot. The emergency fuel pumps are installed for emergency use in case the engine driven pumps fail. The emergency fuel pumps are also used for takeoff and landing and, when necessary, to prime the engines. Control switches for the emergency fuel pumps are located in the cockpit's overhead switch panel.

The fuel boost pumps operate continuously and are provided to maintain fuel under pressure to the other fuel pumps. There are no fuel boost pump control switches. Each fuel boost pump is controlled by a separate circuit breaker, located in the circuit breaker control panel. The fuel boost pumps are activated when the master switch is turned on, and they continue to operate until the master switch is turned off or the fuel boost pump circuit breakers are pulled to the off position.

A note in the Pilot's Operating Manual (POM) Description - Airplane and Systems chapter, in part, stated: "The crossfeed system was not to be used for normal operation. When the crossfeed valve was on, be certain fuel selector valve on tank not in use was off. Do not use crossfeed to compensate for an inoperative emergency fuel pump."

Regarding in-flight fires, the POH states, in part, that the pilot should move the firewall shutoff valve of the affected engine to the off position. Then, they should close the throttle, feather the propeller, place the mixture control in the idle cutoff position, close the engine's cowl flaps to reduce drag, and secure the engine. To secure the engine, the pilot should turn off the magneto switches, the emergency fuel pump switch, and the fuel selector. The pilot should also pull out the fuel boost pump circuit breaker. The landing gear should be extended when landing is assured.

According to the PA-31-350 Pilot Operating Handbook: "TURN OFF ANTI-COLLISION LIGHTS WHEN TAXIING IN VICINITY OF OTHER AIRCRAFT OR DURING FLIGHT THROUGH CLOUD, FOG OR HAZE. STANDARD POSITION LIGHTS TO BE TURNED ON FOR ALL NIGHT OPERATIONS."
And. "Anti-collision lights should not be operating when flying through cloud, fog or haze, since the reflected light can produce spatial disorientation. Strobe lights should not be used in close proximity to the ground such as during taxiing, takeoff or landing."

WRECKAGE AND IMPACT

The accident site was located in a car dealership parking area 2,180 ft west-southwest from the departure end of runway 32. In character, the impact area was flat asphalt surrounded by numerous automobiles and adjacent to large garage door bays [the unoccupied Service Center]. The wreckage was found distributed on the dealership roof and throughout the parked automobiles, with the nose coming to rest on a heading of north. Approximately 13 automobiles were damaged and 11 were destroyed.

Figure 10: Accident Site in Relation to the Runway

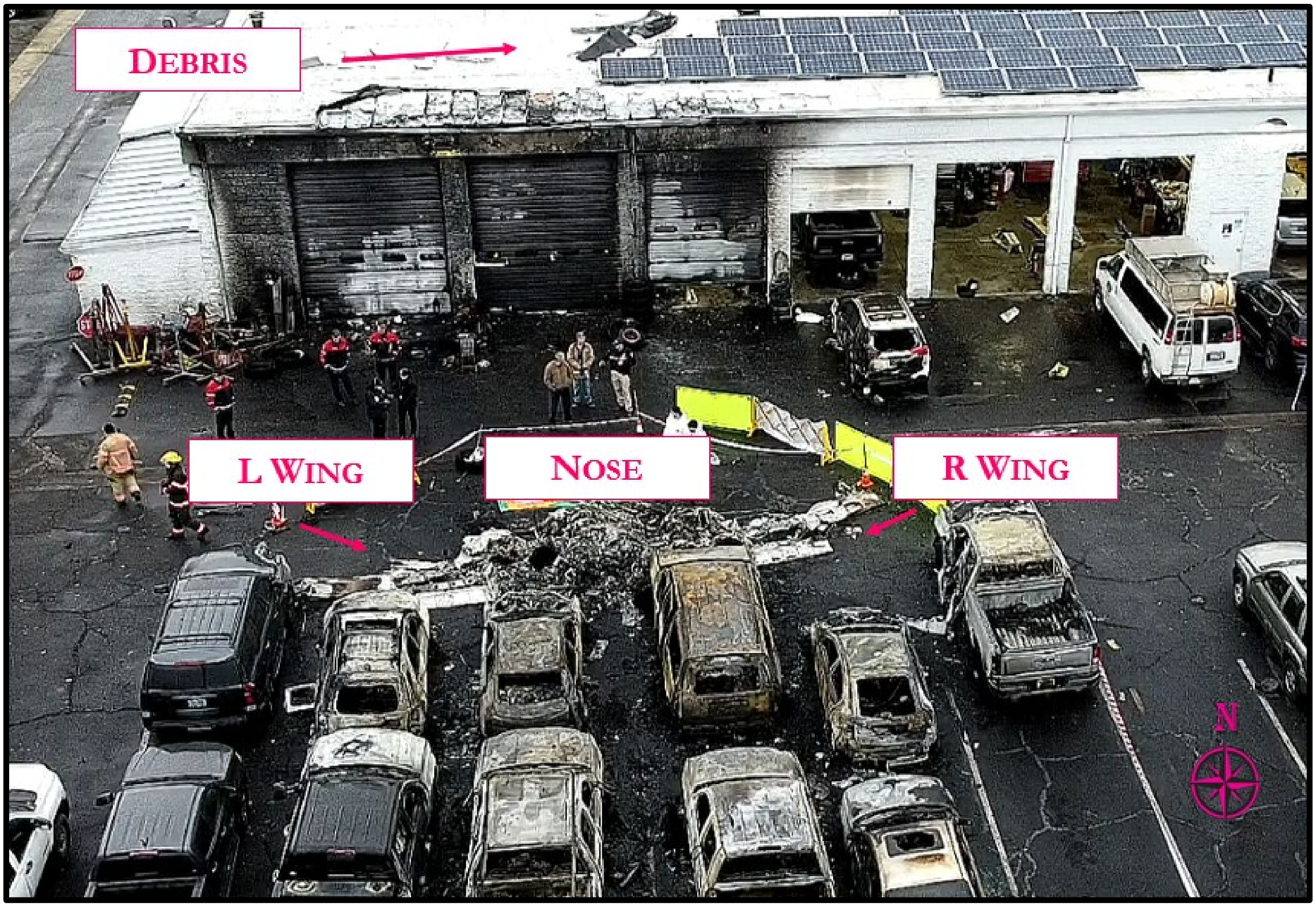


Figure 11: Accident Site

Figure 12: Ariel View of Accident Site (showing fuselage)

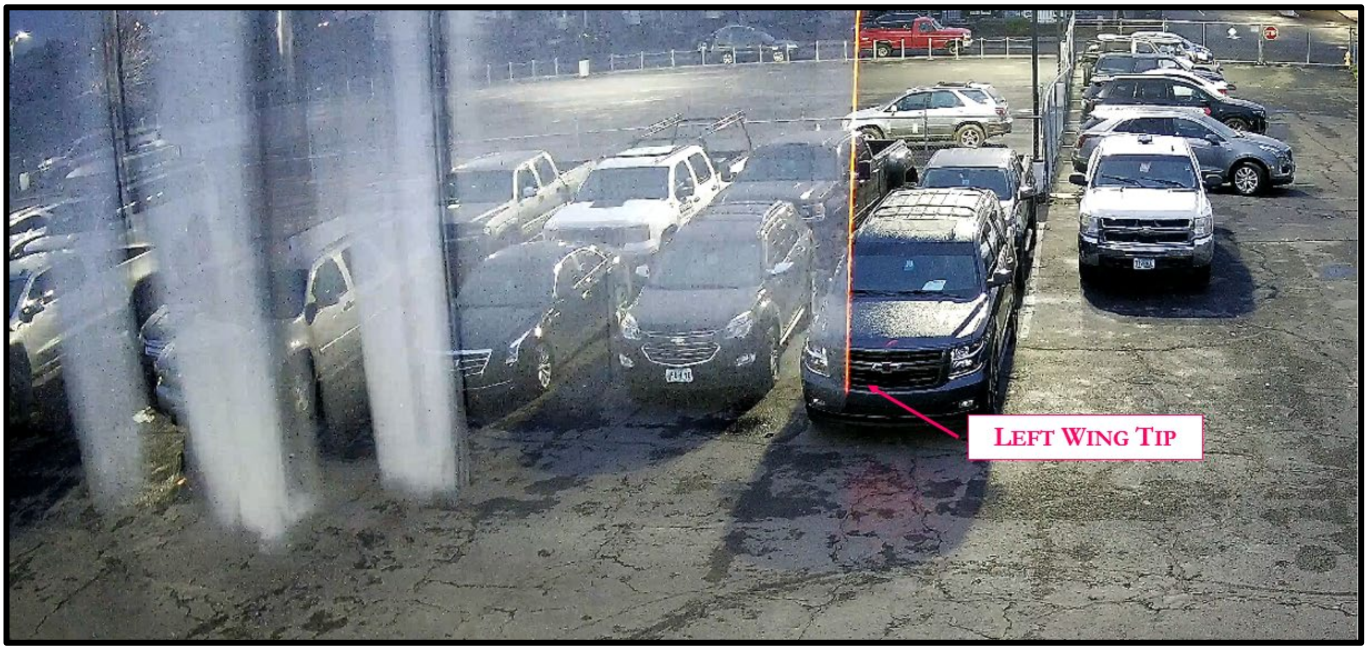


Figure 13: Video Image Showing the moment Before Impact

Figure 14: Video Image Showing the Moment After Impact

AIRFRAME

FUSELAGE

The fuselage sustained aft crush damage and was partially consumed by the post-impact fire. The nose section sustained the most fragmentation with the nose landing-gear displaced aft, aligning with the main wing-spar. The instrument panel had sustained major thermal damage with the instruments and radios separated; there was limited meaningful information that could be derived from the gauges due to the damage. The landing gear lever remained attached within the instrument panel and was positioned midway through its range.

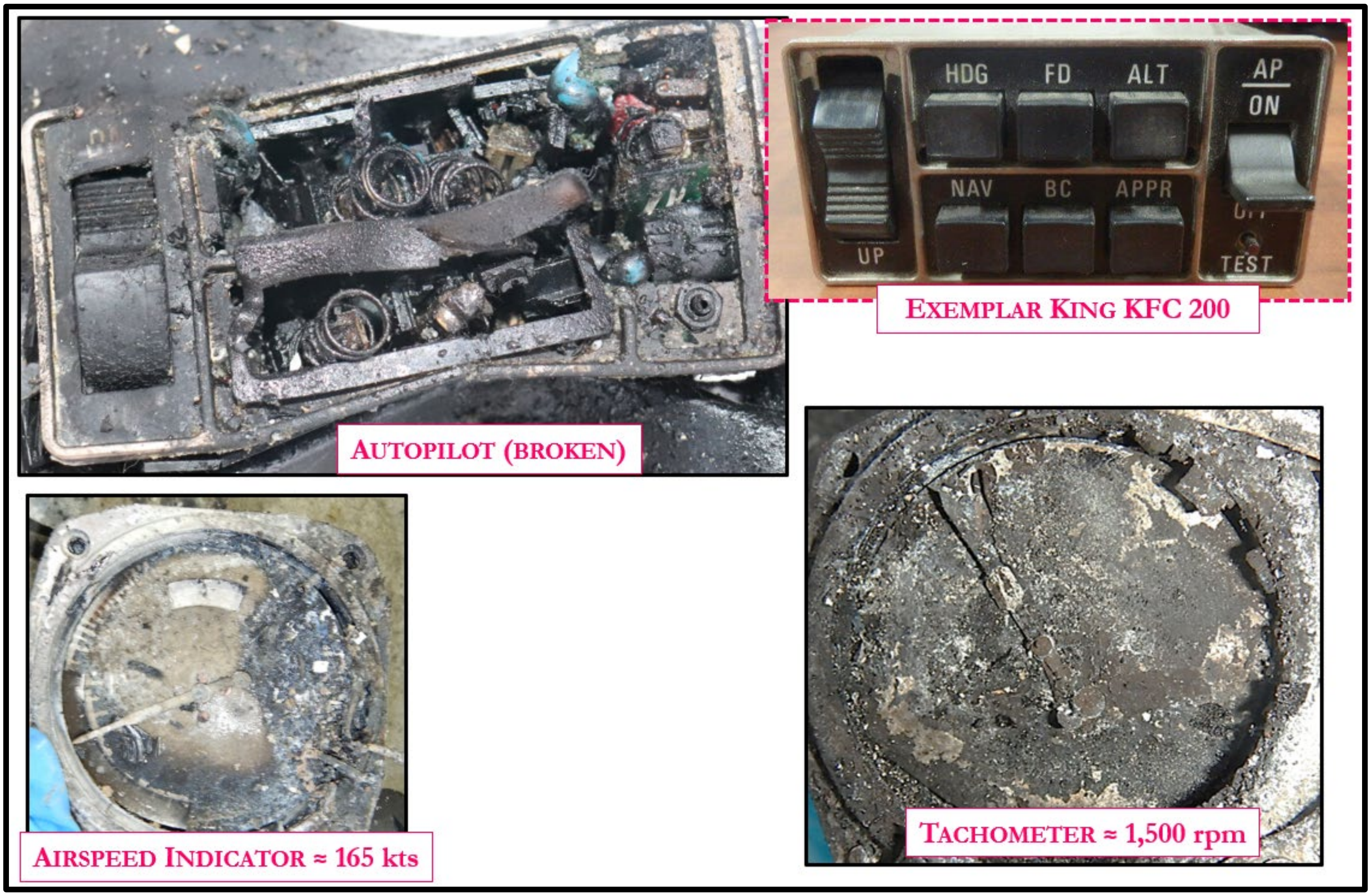


Figure 15: Instruments That Were Recognizable

The elevator control torque tube was detached from the surrounding structure and sustained crush damage. The elevator control cables were located within the remains of the forward cabin and could be traced to to the aft cabin. The yokes broke away from the yoke shafts and suffered impact damage. The aileron control chain was fragmented, but the aileron control cables remained connected to remnants of the chain, tracing back to the main wing spar carry-through. The rudder pedal bar fragmented and shifted from its standard position, with one rudder cable observed attached to a fragment of the pedal bar.

The seats sustained damage from both impact and thermal effects. During recovery, the forward seats were removed from the cabin floor, making it impossible to determine their exact positions on the seat tracks. The lap belts and shoulder harnesses for the forward left and forward right seats had been attached to structures and were severed for the purpose of the occupants' recovery.

The right wing remained connected to the fuselage through the main wing spar. Its leading edge had been crushed aft, and the wing skins were thermally damaged. Despite deformation and thermal damage, the aileron stayed attached to the wing. Additionally, the flap remained affixed to the wing and appeared to be in the retracted position, displaying both thermal and impact damage. The flap jackscrew could not be located. The landing gear was found within the wheel well and exhibited thermal damage.

The right aileron control cable remained connected to the aileron bellcrank and was traceable to the fuselage. The balance cable had separated from the bellcrank (consistent with impact) but was traced back to the fuselage. The aileron trim screw, which was also thermally damaged, extended approximately 0.5 inches or about 2 threads out of the barrel, indicating a neutral trim position.

The left wing had remained connected to the fuselage through the main wing spar. The leading edge had suffered aft crushing, and the wing skins were thermally damaged. Despite deformation and thermal damage, the aileron remained attached to the wing, and the control cable could be traced back to the fuselage. The balance cable had separated from the bellcrank due to impact but was traceable to the fuselage. The bellcrank itself had also experienced thermal damage, although the stops were undamaged. The left flap remained affixed to the wing and appeared to be in the retracted position; it had sustained thermal and impact damage; the flap jackscrew was not found. The landing gear was located within the wheel well and had sustained thermal damage.

The fuel caps were found secure in the wings. In the wing root area of the right wing, the fuel system components had sustained damage from both impact and thermal effects. The fuel selector valve was found positioned to the outboard tank, and the firewall shutoff valve was identified to be in the open position. Within the wing root area of the left wing, the fuel system components had suffered damage from both impact and thermal effects. The fuel selector valve was discovered near the outboard tank, the firewall shutoff valve was found in the closed position, and the crossfeed valve was open. The fuel selector in the cockpit was thermally damaged.

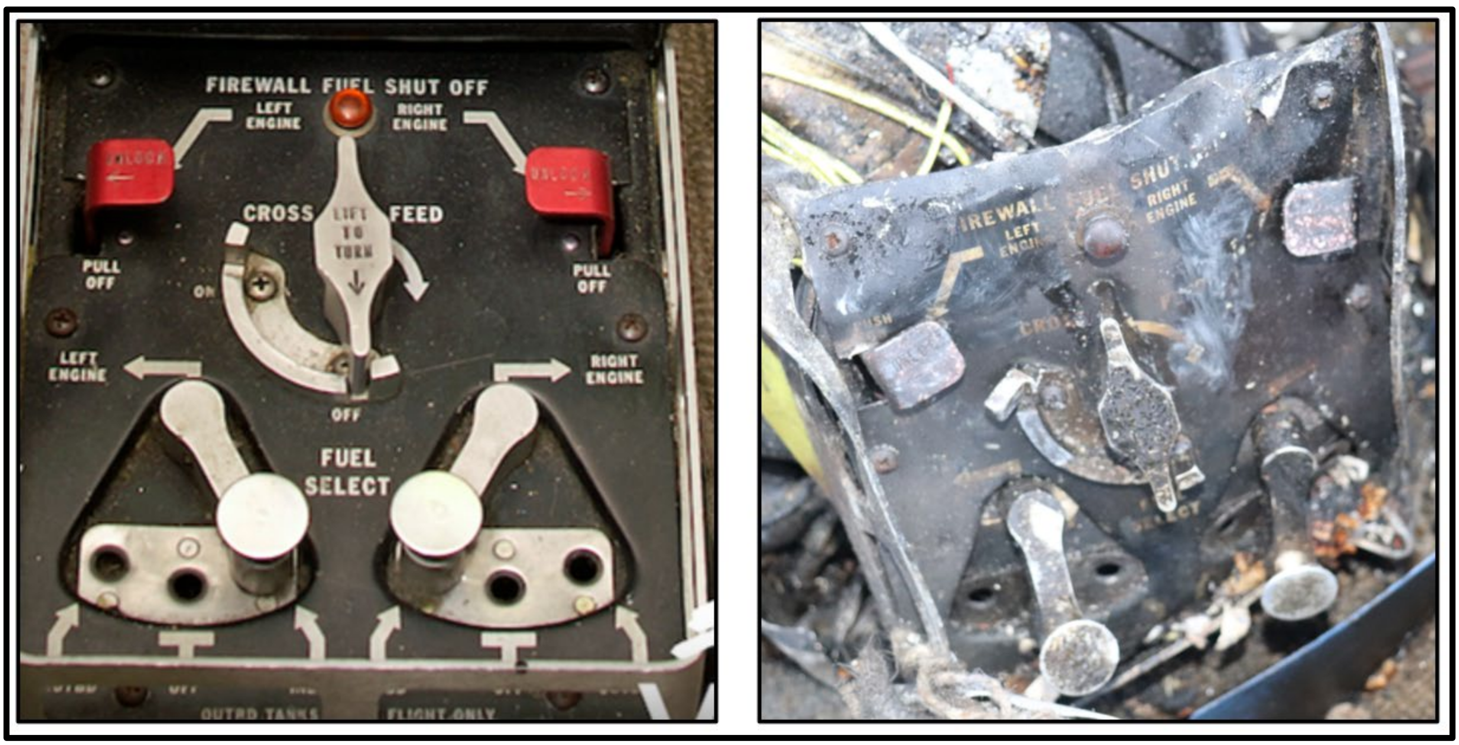


Figure 16: Fuel Selector (left side exemplar and right side as found at accident site)

The empennage had been consumed by fire. The remains of the stabilizers had come to rest over the cabin and had been set beside the wreckage during the recovery of the occupants. The elevators were partially consumed by fire. The elevator trim screw had extended about 1.25 inches, which equated to 9 threads, from the forward end of the barrel, indicating aircraft nose-up trim. The comingled remains of the vertical stabilizer and rudder exhibited fire damage. The rudder cables remained connected to the rudder control horn. The rudder trim barrel was not found with the rudder.

Engines

Left Engine and Propeller Blades

The left engine came to rest in a crater in the asphalt. The forward crankcase and oil sump had been fragmented and the engine had sustained thermal damage. The nacelle and engine mount tubes were bent over the engine and the firewall was crushed forward against the engine accessories. A substance consistent with engine oil was found distributed throughout the engine and impact crater.

The fuel servo had been separated from the engine from impact forces and was fragmented. Both magnetos had sustained impact damage and were separated from their mounting pads. The vacuum pump had been impact damaged and was separated from the accessory case. The turbocharger wastegate was found open with debris inside; there was no signs of rubbing on the turbine wheel.

The propeller governor was separated from the crankcase; its respective control cable remained attached. The left propeller was found in the left-engine's impact crater. The propeller hub had been shattered, and all four "Q-tip" propeller blades were detached. All four blades exhibited chordwise scoring, leading edge chips, and were twisted and bent.

Figure 17: Left Propeller Blades

RIGHT ENGINE AND PROPELLER BLADES

The right engine sustained impact and thermal damage and was located in a crater in the asphalt. As a result of the impact, the front of the engine was shattered, with one cylinder separated and the crankcase fragmented; the crankshaft fractured. The engine sustained thermal damage, and the oil sump was shattered. The nacelle and engine mount tubes were displaced over the engine with the firewall was crushed forward against the engine accessories. The accessory section was fragmented, and the accessories were impact separated. A substance consistent with engine oil was distributed throughout the engine and impact crater.

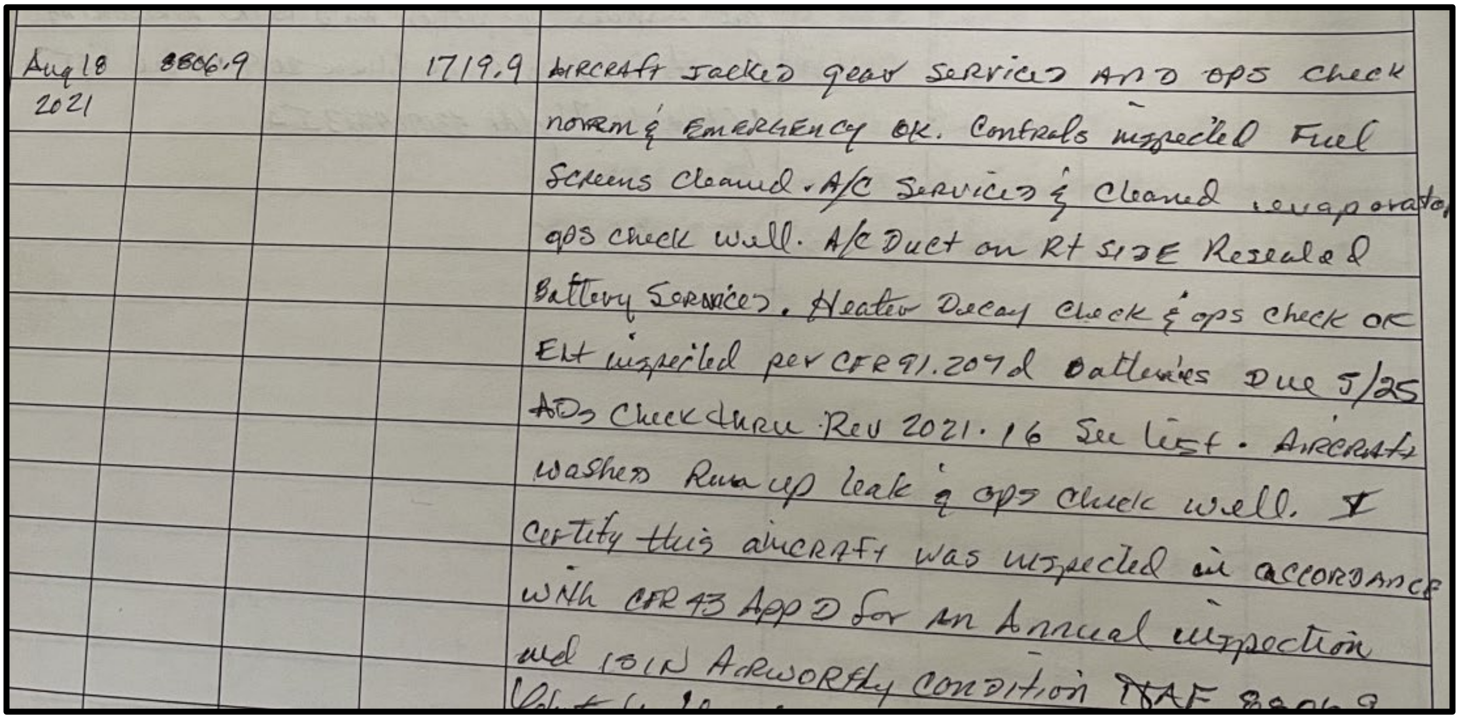
The fuel servo was separated from the engine and was fragmented. Disassembly revealed the bellows was damaged, likely as a result of impact. The propeller governor was separated from the crank case. The single-drive dual magneto was impact from its mounting pad, and the case was broken. The vacuum pump was separated from the mounting pad and was shattered. All separations were consistent with impact. The right turbocharger was split open revealing a damaged compressor wheel; the turbine wheel was burned with several blade tips cracked.

The right propeller sustained damage within the impact crater created by the right engine. The propeller hub was cracked, releasing one of the four "Q-tip" propeller blades. One propeller blade was impact separated at the shank. All four propeller blades sustained bending and twisting, displayed chordwise scraping, tip separation, and leading-edge chipping.

Figure 18: Right Propeller Blades

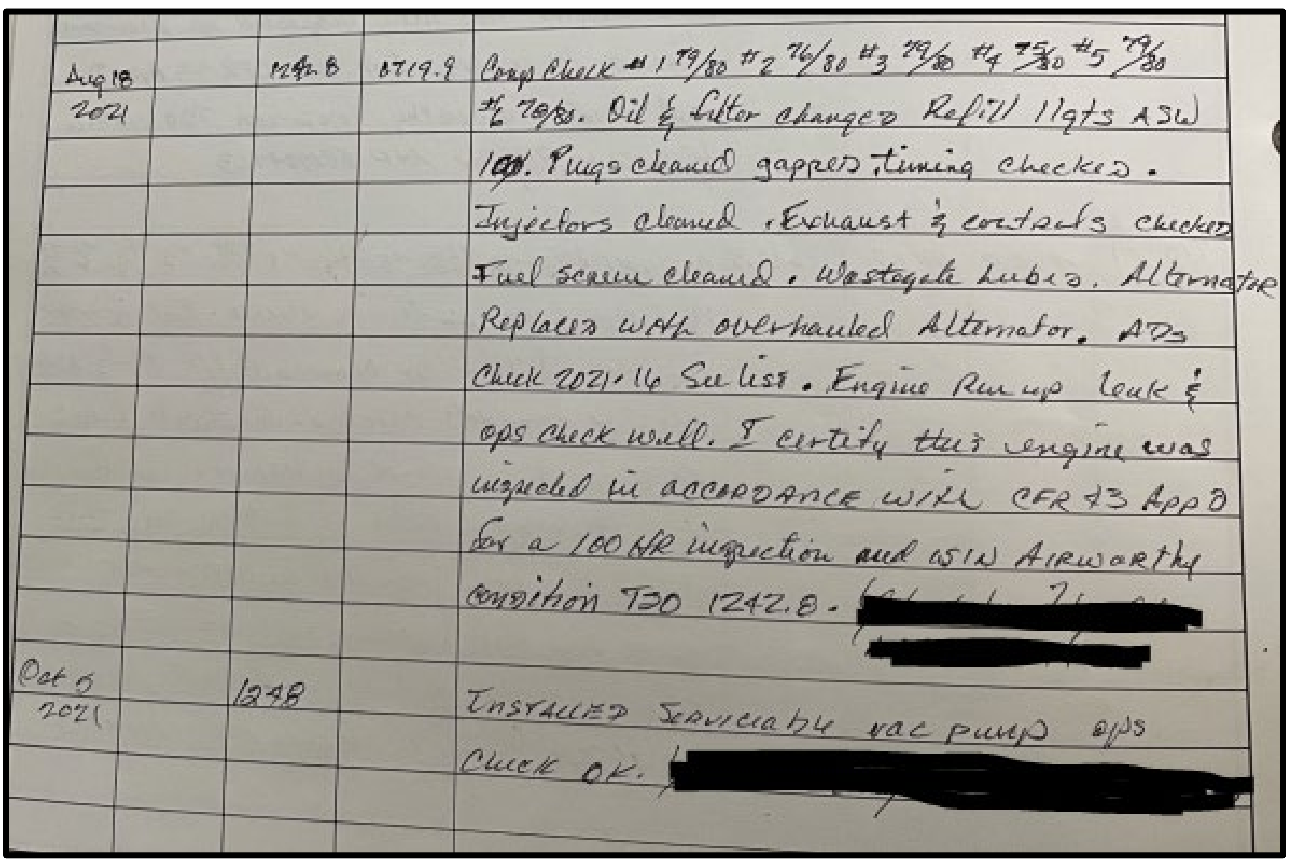
RECORDS

A review of the logbooks revealed that last 100 hour inspection was completed on August 18, 2021 at a tachometer time of 1,719.9 hours The left vacuum pump was replaced in October 2021.



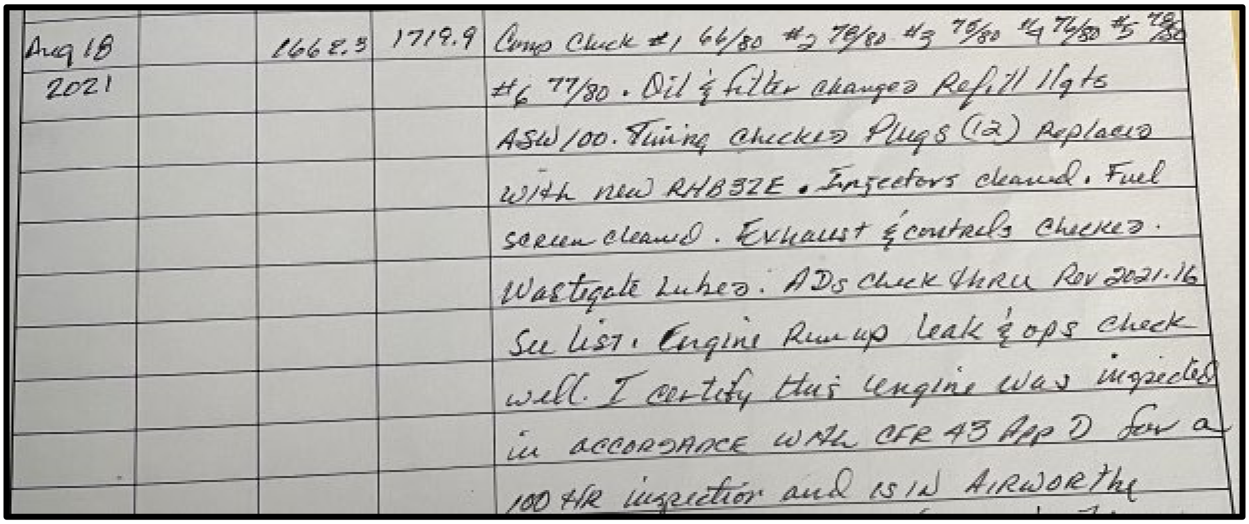
Aug 18 2021	3806.9		1719.9	AIRCRAFT JACKED gear SERVICED AND OPS Check normal & EMERGENCY OK. Controls inspected Fuel Screens Cleaned. A/C SERVICED & Cleaned evaporator ops check well. A/C Duct on Rt SIDE Resealed Battery SERVICED. Heater Decay check & ops check OK ELT inspected per CFR 91.207d batteries Due 5/25 ADs Check thru Rev 2021.16 See list. Aircraft washed Run up leak & ops check well. I certify this aircraft was inspected in ACCORDANCE with CFR 43 App D for an Annual inspection and is IN AIRWORTHY CONDITION TTAF

Figure 19: Last 100-hour Inspection (Airframe Logbook Excerpt)



Aug 18 2021		1242.8	1719.9	Comp Check #1 79/80 #2 76/80 #3 79/80 #4 75/80 #5 79/80 #6 78/80. Oil & filter changed Refill 11qts ASW 100. Plugs cleaned gapped, timing checked. Injectors cleaned, Exhaust & controls checked Fuel screen cleaned. Wastegate lubed. Alternator Replaced with overhauled Alternator. ADs Check 2021.16 See list. Engine Run up leak & ops check well. I certify this engine was inspected in ACCORDANCE with CFR 43 App D for a 100 HR inspection and is IN AIRWORTHY condition TSO 1242.8. [redacted]
Oct 5 2021		1248		INSTALLED Serviceable vac pump ops Check OK. [redacted]

Figure 20 :Last 100-hour Inspection (Left Engine Logbook Excerpt)



Aug 18 2021		1668.3	1719.9	Comp Check #1 66/80 #2 78/80 #3 76/80 #4 76/80 #5 78/80 #6 77/80. Oil & filter changed Refill 11qts ASW/100. Timing checked Plugs (12) Replaced with new RHB32E. Injectors cleaned. Fuel screen cleaned. Exhaust & controls checked. Wastegate lubed. ADs check thru Rev 2021-16 See list. Engine Run up leak & ops check well. I certify this engine was inspected in accordance with CFR 43 App D for a 100 HR inspection and is in Airworthy

Figure 21: Last 100-hour Inspection (Right Engine Logbook Excerpt)

The last examination was recorded as being completed on December 04, 2021 at a tachometer time of 1,754.4 hours. The invoice stated that an auxiliary hose assembly was replaced the day before the accident following a leak.

1) Removed and replaced right wing fuel hose to aux pump with new hose as required in reference to PA-31-350 MM Section 9. Operations and leak check good.

Discrepancy: 3

Problem:
Fuel leak.

Action Taken:
Troubleshot and found flexible fuel supply line in right wing root leaking. Replaced fuel line with new. Leak check good at this time. No further defects noted.

Charges This Item:					4.22 Hours @ [redacted] $			[redacted]
Part Number	**Description**	**Credit**	**Quantity**	**Units**	**List Price**	**Disc**	**Unit Price**	**Extended**
AE7010000H0180	Hose Assy		1.00	Each	[redacted]		[redacted] $	[redacted]
	Freight		1.00				[redacted] $	[redacted]
							Total For This Discrepancy: $	[redacted]

Figure 22: Excerpt of Maintenance Invoice

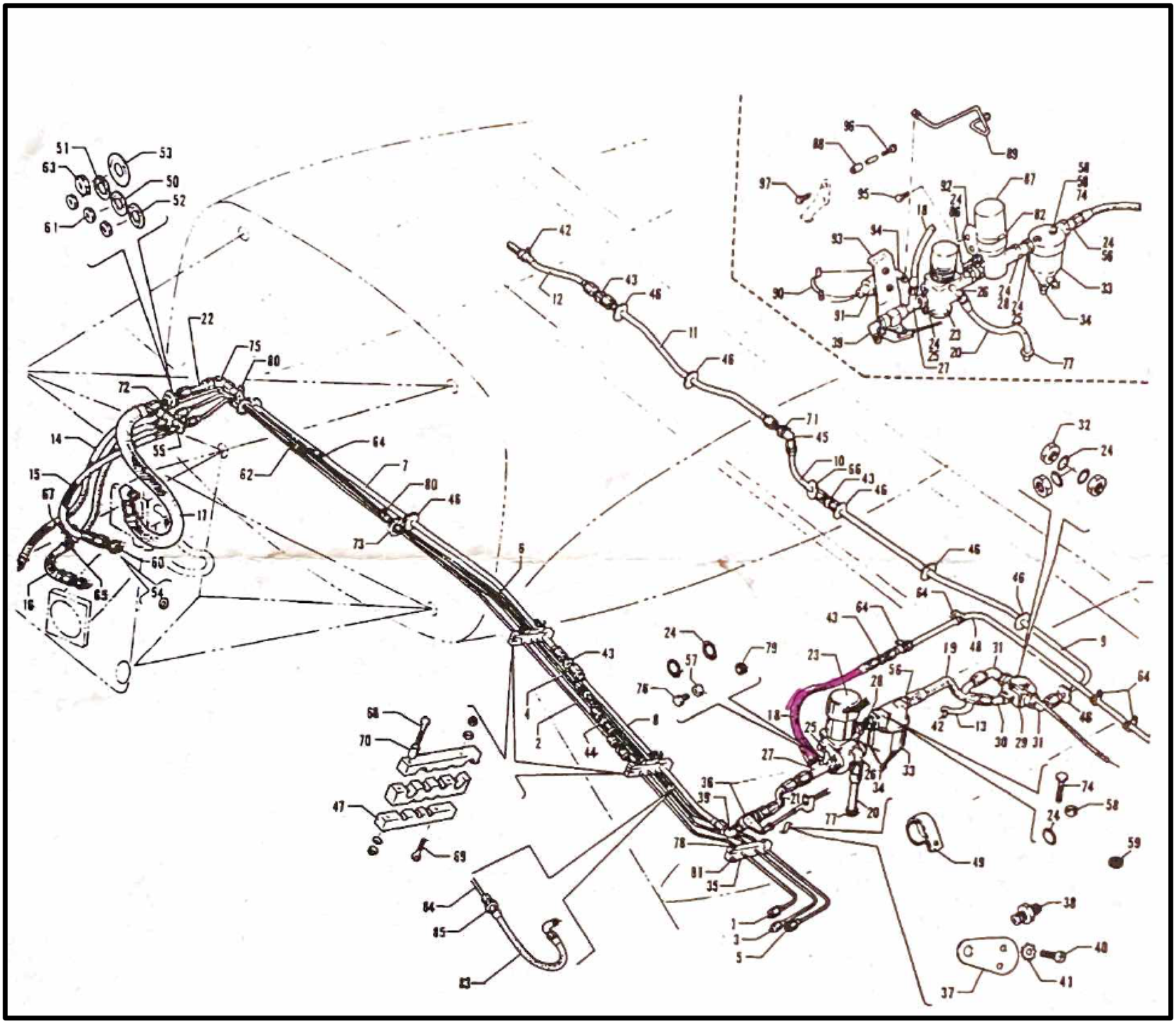


Figure 23: Fuel Line that was Replaced (No. 18 highlighted)

The airplane was refueled on December 04, 2021 at 1540:56.

12/04/2021	12/04/2021	N/A		N64BR
Item Number	**Inv. Item**	**Description**	**Quantity**	
1	Fuel	AVGAS Date: 12/4/2021 3:40:56 PM; Bill of lading#: ; Flight#: ; Operator: Import, TCS; Batch#: 11_211204_111319; Equip.: Avgas Truck 11; Meter1: Truck 11 (End=307083.900 Start=306955.500); Qty.: 128.400	128.400	

Figure 24: Fuel Receipt

PILOT INFORMATION

Pilot: Donald Harbert Sefton1
(COMMERCIAL PILOT ASEL AMEL ASES INSTRUMENT), a 69-year-old male. This pilot reported civil flight experience that included 2,054 total and 41 hours in last six months as of exam dated 8/6/2021. This pilot was 73 inches tall and weighed 199 lbs. at the time of the last exam. This pilot was issued a Second Class Medical Certificate AASI with Interim Issuance with the following limitation: "Must wear corrective lenses. Not valid for any class after 8/31/2022.
Insurance reported: Total Time: 2087 and as of 2019 ME Time: 1,386 Model: 1,375

The pilot had previously owned a PA-31-350 and purchased the accident airplane in 2013. According to his electronic logbooks he had amassed about 1,520 hours in a PA-31-350 of which 273 hours was in actual instrument meteorological conditions. The logbooks indicated that the pilot had departed from Medford in August 2018 and 2019 by way of the JACKSON1 and EAGLE6 departure procedures, respectively. The records started in May 2004 and ended on November 02, 2021. A review of the records revealed a total time of 2,167 hours. The following dates and times were the flights to/from Medford.

Date	Reg #	From	To	Day	Actual	PIC	XC	Total	Comments	Inst App	Type App
8/25/2016	64BR	KFLX	KMFR	1.8	0	1.8	1.8	1.8	ODFG HZN, AHC, LMT, KMFR	0	
8/28/2016	64BR	KMFR	KFLX	1.9	0	1.9	1.9	1.9	ODFG AHC->BACHS->KFLX	0	
8/7/2018	64BR	KFLX	KMFR	1.8	0.3	1.8	1.8	1.8	ODFG, HZN, AME, LKV, OED, Vectors to 14 ILS 1.5 mile visibility	1	ILS 14
8/10/2018	64BR	KMFR	KCVO	1	0.2	1	1	1	ODFG - JACKSON 1 Departure Vectors to EUG to CVO, landing rwy 35	0	
8/20/2019	64BR	KUAO	KMFR	1.4	0.4	1.4	0	1.4	ODFG: EUG->OED->SAMIE->RNAV 32	1	RNAV
8/23/2019	64BR	KMFR	KFLX	1.9	0	1.9	1.9	1.9	ODFG: EAGLE 6 DEPARTURE ->LMT->AHC THEN REDIRECT TO KFLX	0	

Figure 25: Excerpt of Electronic Logbooks

In early November 2021 the pilot went to recurrent SIMCOM training. The training consisted of 4 flight hours; 2 hours of simulated IMC; 2 The training is in Florida in a Navajo simulator and covers:
Simulator training modules will consist of Aircraft Orientation, Normal, Abnormal and Emergency Procedures. This training provides instruction to develop the skills necessary to maneuver the aircraft with and without the automatic flight control systems. Selected abnormal and emergency procedures are introduced and practiced. The pilot will become proficient in the use of checklists, precision approaches, non-precision approaches and full integration of avionics systems

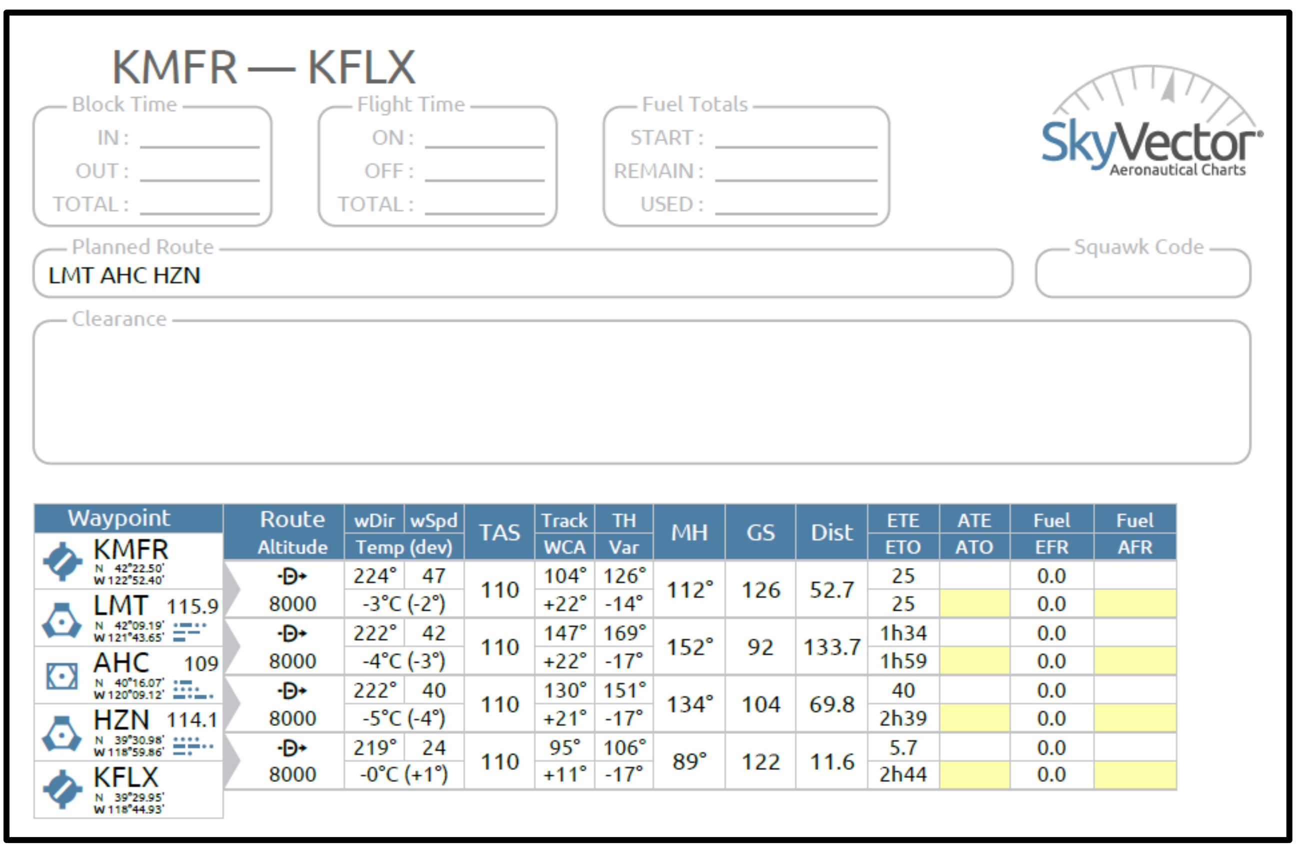
The pilot owned a 2004 Decathlon and both airplanes are based at Fallon, NV (FLX).

In the wreckage there were numerous paper charts, including the current departure procedures.

[1] https://www.linkedin.com/in/don-sefton-957416a/ (according to insurance occupation is "programmer"

Figure 26: Paper Aeronautical Maps and Charts Found in the Wreckage

The pilot made a flight plan at an unknown time that was presumably the flight course for the accident flight:



KMFR — KFLX

Block Time
IN :
OUT :
TOTAL :

Flight Time
ON :
OFF :
TOTAL :

Fuel Totals
START :
REMAIN :
USED :

SkyVector Aeronautical Charts

Planned Route
LMT AHC HZN

Squawk Code

Clearance

Waypoint	Route / Altitude	wDir / Temp (dev)	wSpd	TAS	Track / WCA	TH / Var	MH	GS	Dist	ETE / ETO	ATE / ATO	Fuel EFR	Fuel AFR
KMFR N 42°22.50' W 122°52.40'													
	-D- / 8000	224° / -3°C (-2°)	47	110	104° / +22°	126° / -14°	112°	126	52.7	25 / 25		0.0 / 0.0	
LMT 115.9 N 42°09.19' W 121°43.65'													
	-D- / 8000	222° / -4°C (-3°)	42	110	147° / +22°	169° / -17°	152°	92	133.7	1h34 / 1h59		0.0 / 0.0	
AHC 109 N 40°16.07' W 120°09.12'													
	-D- / 8000	222° / -5°C (-4°)	40	110	130° / +21°	151° / -17°	134°	104	69.8	40 / 2h39		0.0 / 0.0	
HZN 114.1 N 39°30.98' W 118°59.86'													
	-D- / 8000	219° / -0°C (+1°)	24	110	95° / +11°	106° / -17°	89°	122	11.6	5.7 / 2h44		0.0 / 0.0	
KFLX N 39°29.95' W 118°44.93'													

Figure 27: Electronic Flight Plan

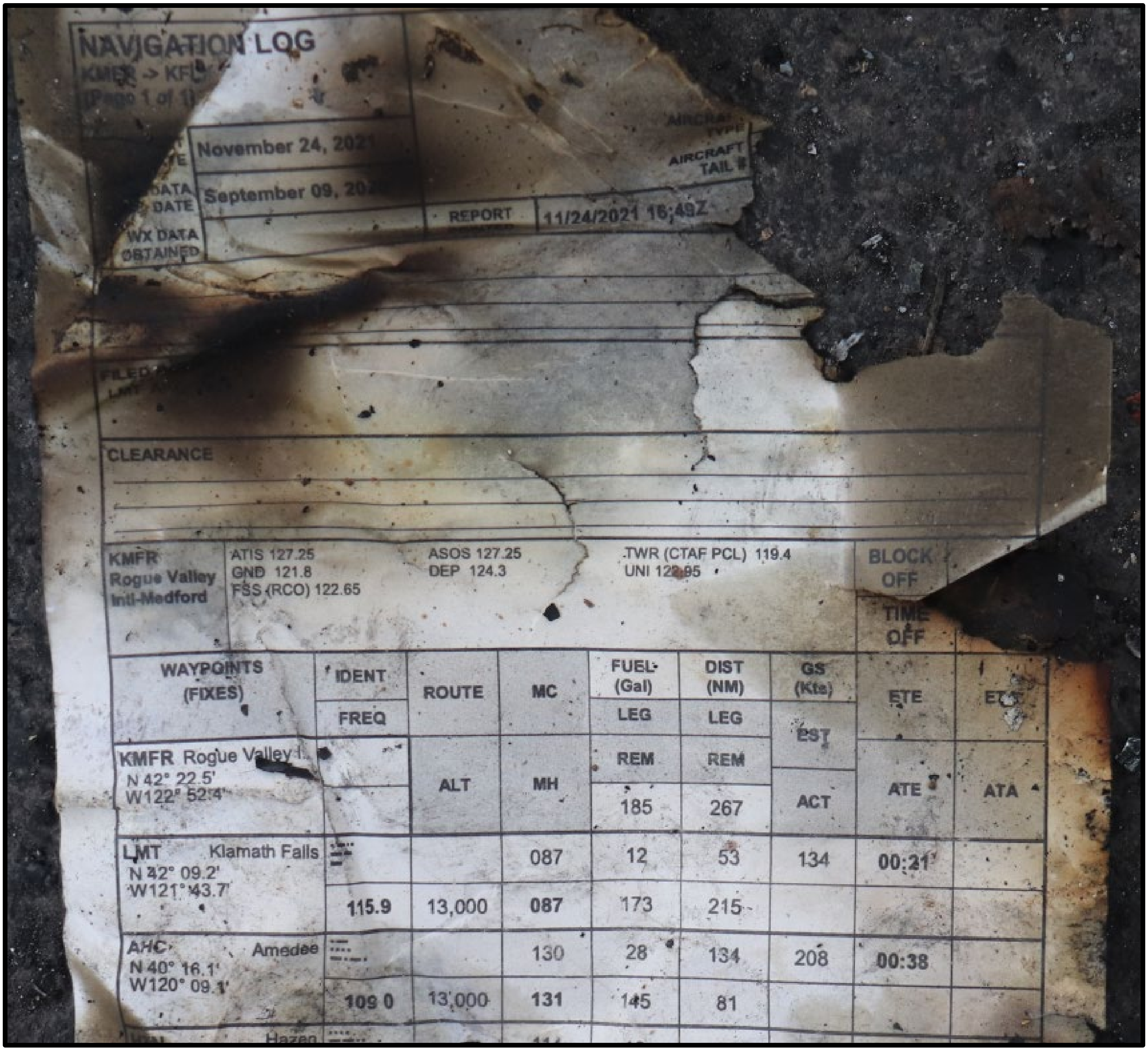


Figure 28: Flight Plan in the Wreckage

Weather Information

Video footage revealed that the airplane disappeared into a cloud layer and then reappeared immediately prior to the accident.

Automated 5-minute observations were generated by an Automated Surface Observation System (ASOS) at the Medford Airport. The 5-minute observation generated at 1650 included wind calm; visibility of 3 statute miles; mist; an overcast cloud layer at 200 feet. It recorded the temperature at 39 degrees Fahrenheit; dew point 39 degrees Fahrenheit and an altimeter setting of 30.39 inHg. High-Resolution Rapid Refresh (HRRR) model sounding for near the accident site at 1700, cloud tops for the cloud layer nearest the surface around MFR was about 2,200 to 2,500 feet above mean sea level.

12/05/21 16:40:31 5-MIN KMFR 060040Z 00000KT 2SM BR OVC002 04/04 A3039 900 |
| 100 -100 000/00 RMK AO2 T00390039 |
|12/05/21 16:45:31 5-MIN KMFR 060045Z 00000KT 3SM BR OVC002 04/04 A3039 910 |
| 100 -100 000/00 RMK AO2 T00390039 |
|12/05/21 16:50:31 5-MIN KMFR 060050Z 00000KT 3SM BR OVC002 04/04 A3039 910 |
| 100 -100 000/00 RMK AO2 SLP298 T00390039 |
|12/05/21 16:55:31 5-MIN KMFR 060055Z 00000KT 3SM BR OVC002 04/04 A3039 910 |
| 100 -100 000/00 RMK AO2 T00390039 |
|12/05/21 17:00:31 5-MIN KMFR 060100Z 00000KT 3SM BR OVC002 04/04 A3039 910 |
| 100 -100 000/00 RMK AO2 T00390039 |

Figure 29: Weather Information

On the day of the accident, the time of sunset was 1639:18 and twilight was at 1710:32.

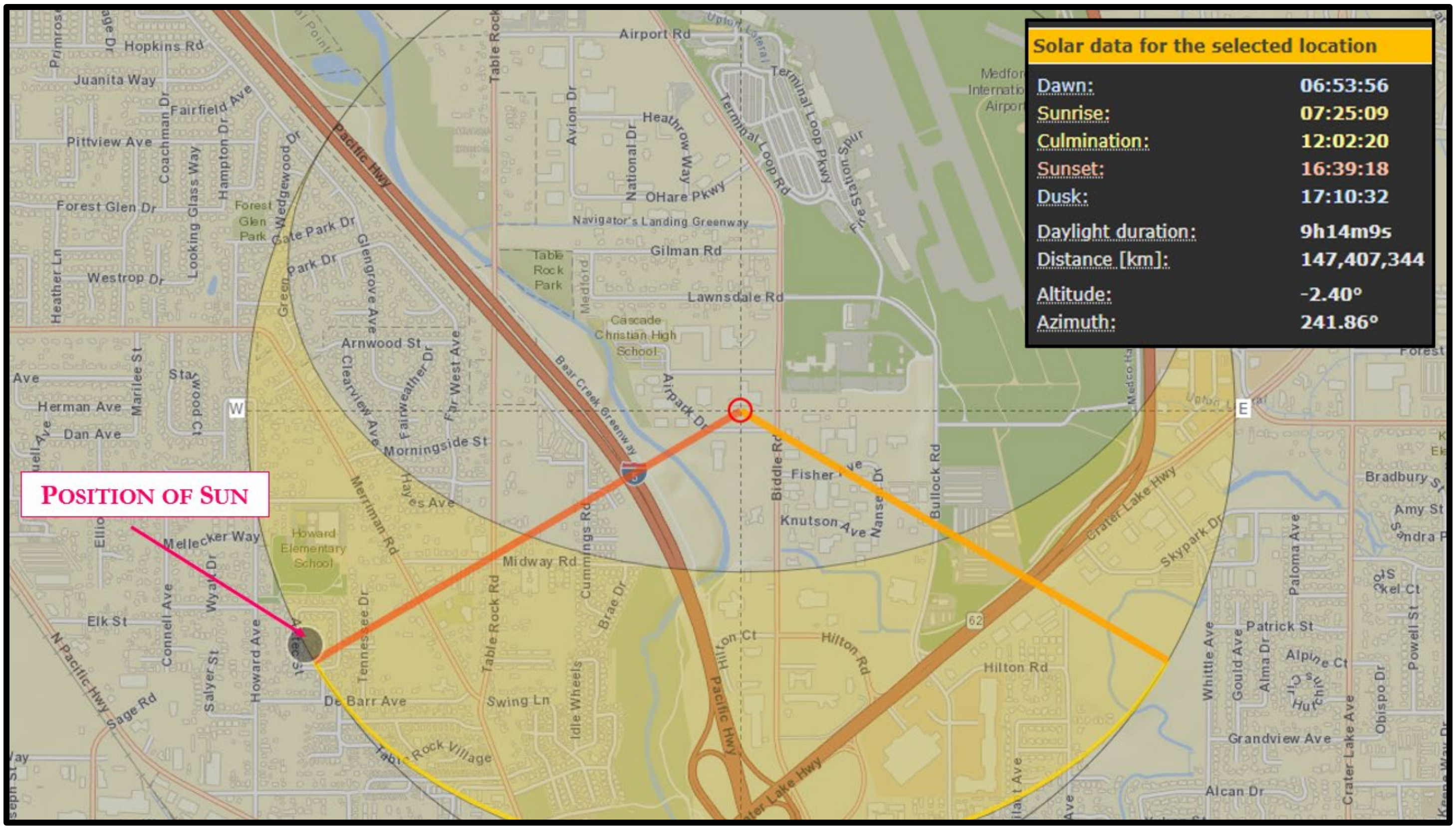


Figure 30: Sun Information (provided by suncalc.ord)

AERODROME INFORMATION

The Federal Aviation Administration (FAA) is conducting an aeronautical study of a proposal to decommission the Medford Nondirectional Beacon (MEF) near Medford, OR.

MEF is being considered for decommissioning because of increasing costs and difficulties repairing and maintaining the equipment. MEF supports the Rogue Valley International—Medford Airport (KMFR) BRUTE SEVEN and GNATS SEVEN instrument departure procedures. These procedures will be amended, and it is possible that Area Navigation (RNAV) Global Positioning System (GPS) procedures will be developed as mitigation.

Departure Comparison

Investigators compiled a comparison of ADS-B data from two airplanes that departed before the accident airplane (at 1507 and 1556) and two that departed after (1734 and 1813). A comparison of flight tracks from the three airplanes that departed runway 14 revealed that all began the right turn after the accident flight.

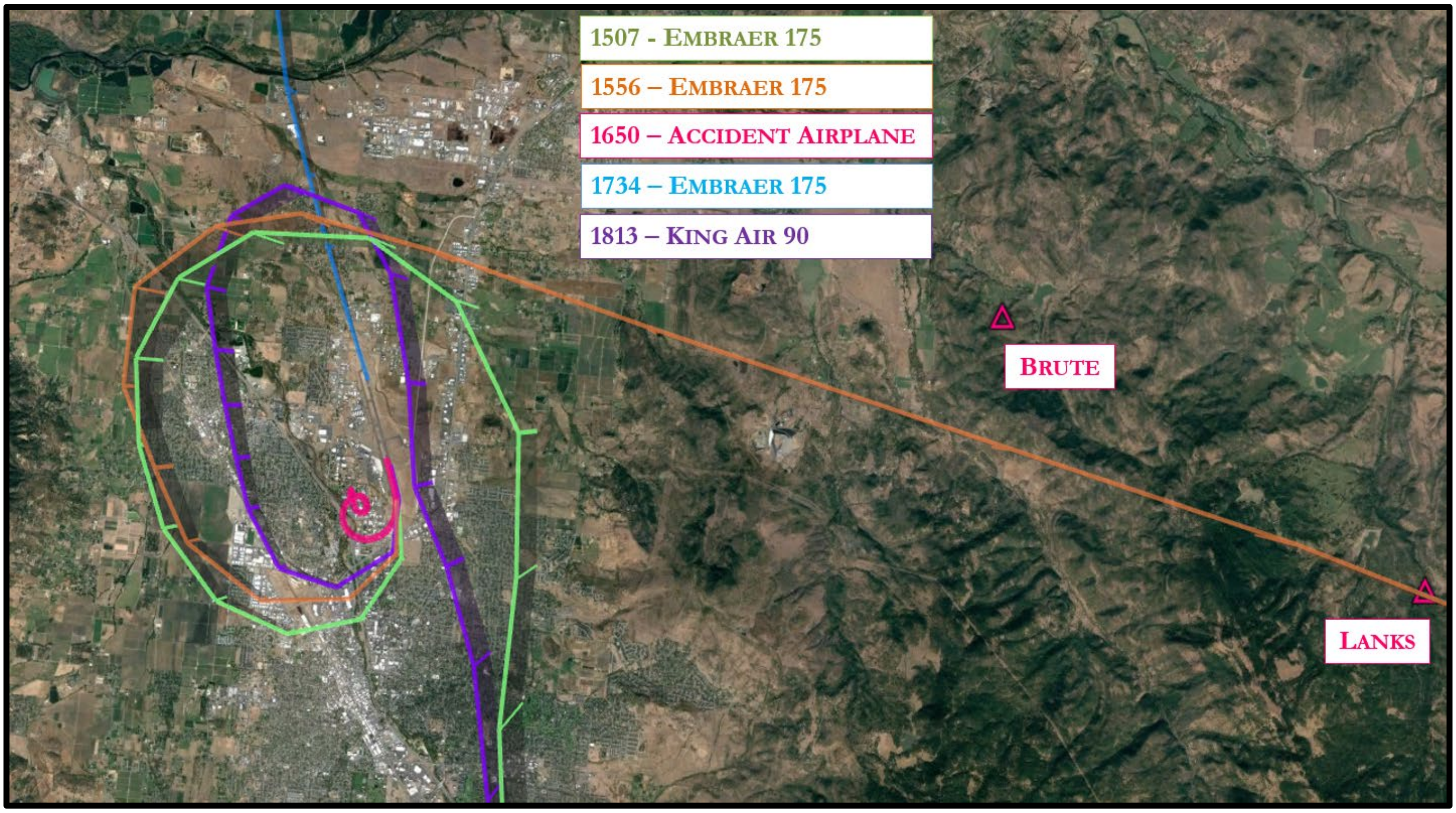


Figure 31: Comparison of Flight Tracks from Departures Before and After the Accident Flight

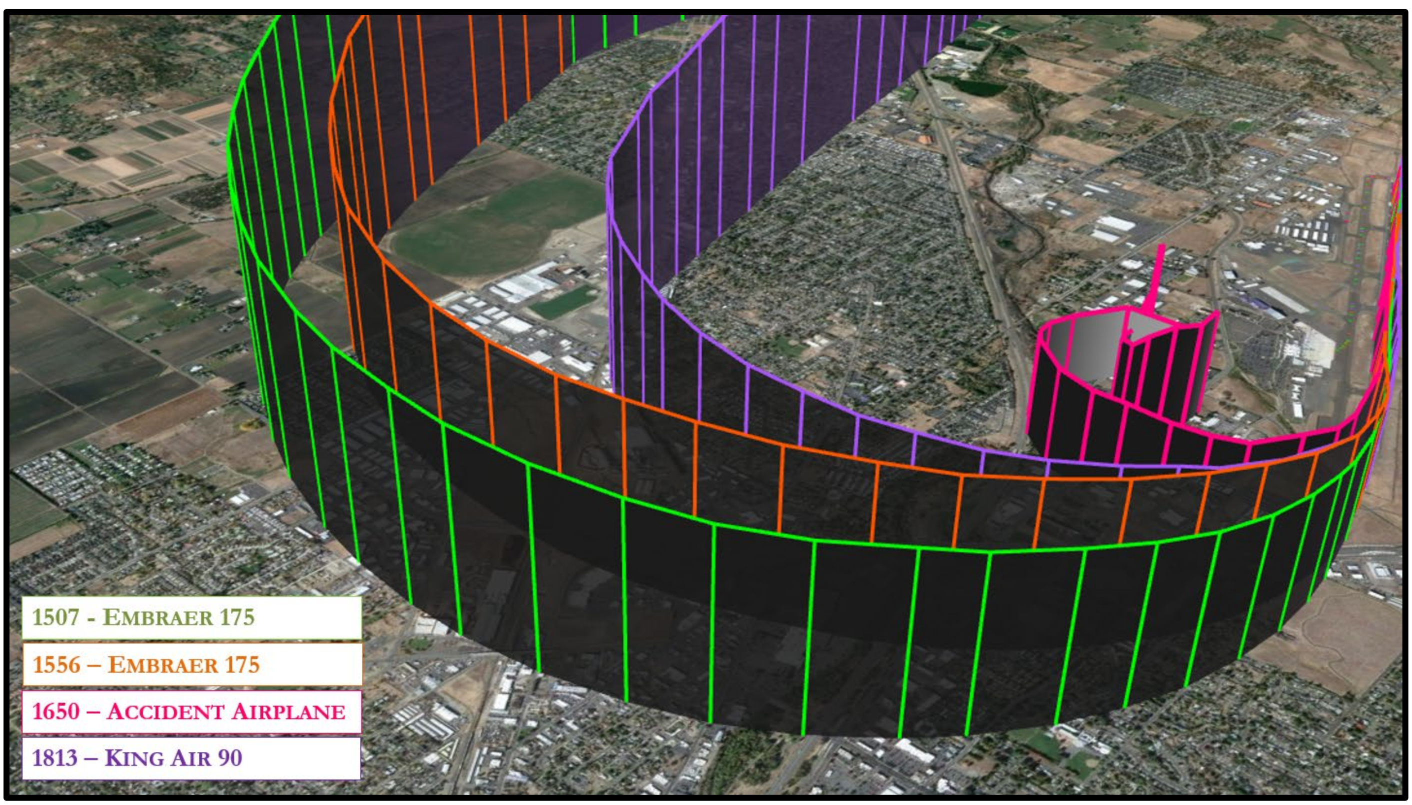


Figure 32: Comparison of Flight Tracks from Departures Before and After the Accident Flight

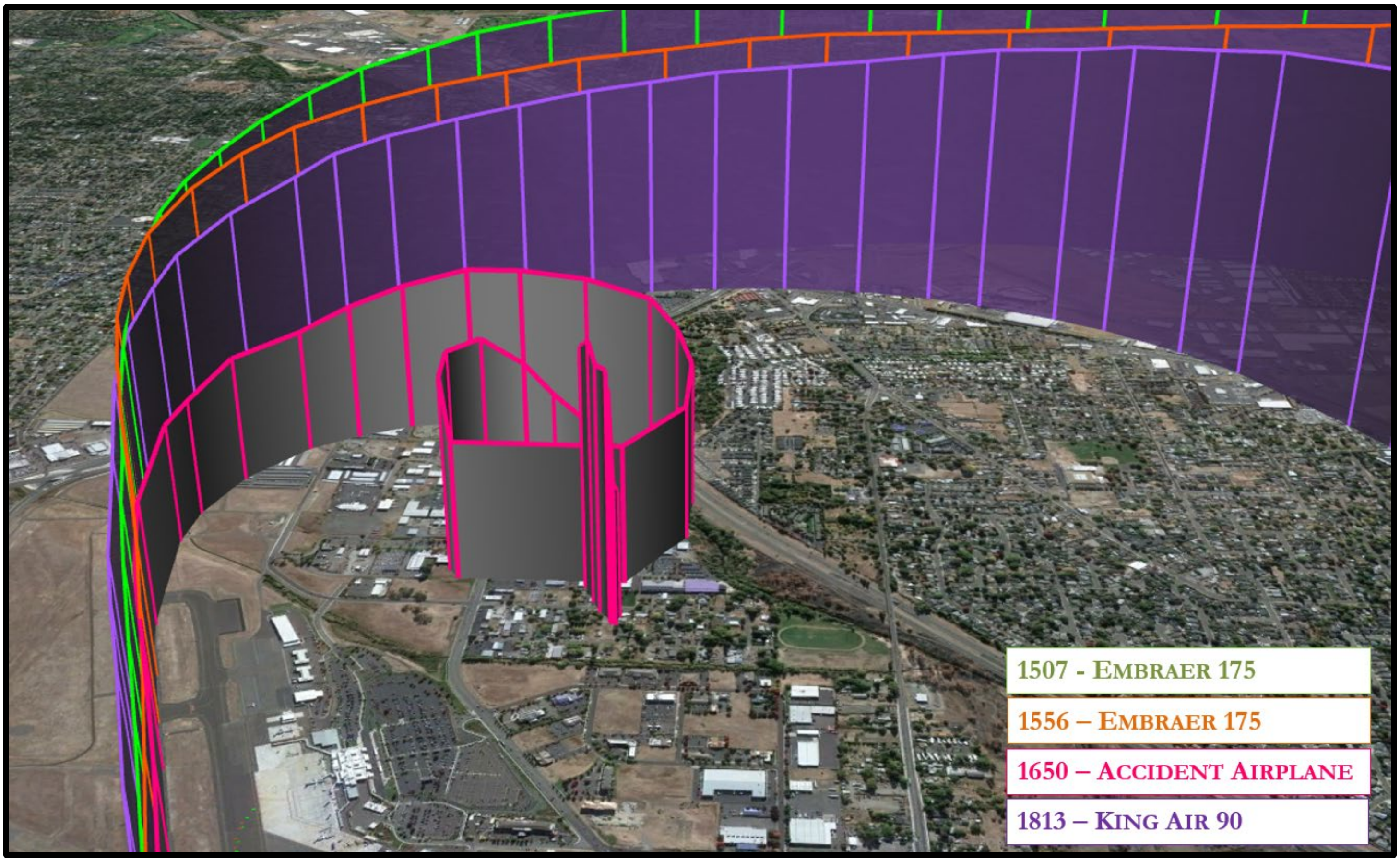


Figure 33: Comparison of Flight Tracks From Departures Before and After the Accident Flight

SkyWest 3372: Embraer 175 departed at 1507 destined for Los Angeles, California2 (green)
SkyWest 3507: Embraer 175 departed at 1556 destined for Salt Lake City Utah3 (orange)
Accident Flight
SkyWest 3937: Embraer 175 departed at 1735 destined for Seattle, Washington4 (blue)
N51DN: Beech KingAir 90 departed at 1813 destined for Lincoln, California5 (purple)

N51DN began the right turn at 2;000 ft msl

COMMUNICATIONS

N64BR established communication with the controller, stated they had ATIS Information U, and requested their IFR clearance. The controller issued the IFR clearance to N64BR to the Fallon (FLX) Airport via the BRUTE7 Departure Procedure LANKS Transition, then as filed, to which N64BR read back the clearance and advised ready for taxi. The controller instructed N64BR to taxi to Runway 14 via Taxiway A, to which N64BR advised they would also be conducting a run-up. The controller broadcast a tops report at 2,500 feet with bases at minimums. N64BR advised ready for departure, to which the controller subsequently cleared them for takeoff on Runway 14 via the BRUTE7 Departure Procedure. The BRUTE7 Departure Procedure requires aircraft

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[2] https://flightaware.com/live/flight/SKW3372/history/20211205/2300Z/KMFR/KLAX
https://globe.adsbexchange.com/?icao=a11ad4&lat=42.359&lon=-122.873&zoom=11.4&showTrace=2021-12-05&leg=8&trackLabels
[3] https://flightaware.com/live/flight/SKW3507/history/20211205/2125Z/KMFR/KSLC
https://globe.adsbexchange.com/?icao=a7fa2d&lat=42.367&lon=-122.868&zoom=13.3&showTrace=2021-12-06&leg=1&trackLabels
[4] https://flightaware.com/live/flight/SKW3937/history/20211206/0126Z/KMFR/KSEA
[5] https://flightaware.com/live/flight/N51DN/history/20211206/0145Z/KMFR/KLHM

departing Runway 14 to turn right northeast bound direct to the MFR NDB. N64BR departed Runway 14 and asked the controller if they would receive an instruction to begin a right turn, to which the controller stated to N64BR that they should fly the departure procedure as published. The controller provided detailed instructions to N64BR on flying the departure procedure. N64BR began a tight climbing right turn to 2,000 feet, and then descended to 1,700 feet, to which the MSAW alarmed. The controller immediately issued a Safety Alert and the local altimeter, with no response. N64BR continued a tight climbing right turn to 2,100 feet, descended to 1,500 feet, and climbed to 2,500 feet after completing two 360-degree turns. Both radar and radio communications were lost. Subsequently, the controller coordinated with Cascade Approach and asked if N64BR established communication with them, to which they replied in the negative.

ADDITIONAL INFORMATION

STANDARD INSTRUMENT DEPARTURES (SIDS)

A SID is an ATC-requested and developed departure route, typically used in busy terminal areas. It is designed at the request Of ATC in order to increase capacity of terminal airspace, effectively control the flow of traffic with minimal communication, and reduce environmental impact through noise abatement procedures.
While obstacle protection is always considered in SID routing, the primary goal is to reduce ATC/pilot workload while providing seamless transitions to the en route Structure. ATC clearance must be received prior to flying a SID. SIDS also provide additional benefits to both the airspace capacity and the airspace users by reducing radio congestion, allowing more efficient airspace use, and simplifying departure clearances. All Of the benefits combine to provide effective efficient terminal operations, thereby increasing the overall capacity of the NAS.

If you cannot comply with a SID, if you do not possess the charted SID procedure, or if you simply do not Wish to use SIDS, include the statement "NO SIDS" in the remarks section of your flight plan. Doing so notifies ATC that they cannot issue you a clearance containing a SID, but instead Will clear you via your filed route to the extent possible, or via a Preferential Departure Route (PDR). It should be noted that SID usage not only decreases clearance delivery time, but also greatly simplifies your departure, easing you into the IFR structure at a desirable location and decreases your flight management load. While you are not required to depart using a SID, it may be more difficult to receive an "as filed" clearance when departing busy airports that frequently use SID routing.

SIDS are always charted graphically and are located in the TPP after the last approach chart for an airport. The SID may be one or two pages in length, depending on the size of the graphic and the amount of space required for the departure description. Each chart depicts the departure route, navigational fixes, transition routes, and required altitudes.

The SID is designed to allow the pilot to provide his or her own navigation with minimal radio communication. This type of procedure usually contains an initial set of departure instructions followed by one or more transition routes. A SID may include an initial segment requiring radar vectors to help the flight join the procedure, but the majority of the navigation remains the pilot’s responsibility.

A radar SID usually requires ATC to provide radar vectors from just after takeoff (ROC is based on a climb to 400 feet above the DER elevation before making the initial turn) until reaching the assigned route or a fix depicted on the SID chart. Radar SIDs do not include departure routes or transition routes because independent pilot navigation is not involved. The procedure sets forth an initial set of departure instructions that typically include an initial heading and altitude. ATC must have radar contact with the aircraft to be able to provide vectors. ATC expects you to immediately comply with radar vectors, and they expect you to notify them if you are unable to fulfill their request. ATC also expects you to make contact immediately if an instruction causes you to compromise safety due to obstructions or traffic.

ATC can assign SIDs or radar vectors as necessary for traffic management and convenience. To fly a SID, you must receive approval to do so in a clearance. In order to accept a clearance that includes a SID, you must have the charted 1-29 SID procedure in your possession at the time of departure. It is your responsibility as pilot in command to accept or reject the issuance of a SID by ATC.

You must accept or reject the clearance based on:

- The ability to comply with the required performance.
- The ability to navigate to the degree of accuracy required for the procedure.
- Possession of the charted SID procedure.
- Personal understanding of the SID in its entirety.

BRUTE 7 DEPARTURE ON GARMIN 530

Garmin does not chart the textual obstacle departure procedure (ODP) turns. On the GNS 530w the BRUTE 7 departure selection provides a line directly from the airport to the NDB; it did not go into Omni-bearing Selector (OBS) Mode or suspend mode. Meaning, after departing to the south the pilot would either place the unit into OBS mode or reset to DIRECT and then fly that track.

According to the Garmin 500 series user manual:

- Map Page: The Map Page displays your present position (using an airplane symbol) relative to nearby airports, VORs, NDBs, intersections, user waypoints and airspace boundaries — and your route displayed as a solid line.

- The Nearest NDB Page displays the identifier, symbol, bearing, distance and frequency to the 25 nearest NDBs (within 200 NM of your present position).

Figure 34: Example of Display on GNS 530W

Figure 35: Example of Display on GNS 530W [ignore magenta line and distance]

Figure 36: Example of Display on GNS 530W [ignore magenta line and distance]

Figure 37: Example of Display on GNS 530W [ignore magenta line and distance]

The aircraft was fitted with a King KFC200 flight control system, incorporating an automatic pilot and a flight director. The autopilot could be operated in a heading and/or attitude mode, as well as in an altitude hold mode. It had the capability of interfacing with the GPS in the navigation mode. In the attitude mode, the autopilot maintained an attitude selected by the pilot via a switch on the autopilot control panel. The autopilot could be used to establish the aircraft in a climb or descent by operating the vertical trim switch UP or DOWN. Out-of-trim forces, generated when the autopilot commanded elevator movement, were transferred via cable operated torque switches to a servo motor on the pitch trim cable drum. Any control forces were automatically trimmed out so that the aircraft was in trim following autopilot disengagement. If the elevator pitch trim motor malfunctioned, out-of-trim forces would be contained by the pitch trim servo until the autopilot was disconnected, or the limit of the servo was reached. In either case, the resultant out-of-trim forces could cause the aircraft to pitch up or down abruptly.