

HISTORY OF FLIGHT

On August 2, 2016, about 2122 mountain standard time, a Piper PA-34-200T Seneca II airplane, N82806, was destroyed when it impacted trees and terrain shortly after takeoff from Flagstaff Pulliam Airport (FLG), Flagstaff, Arizona. The airline transport pilot received fatal injuries. The personal flight was being conducted as a medical delivery mission for the volunteer organization Flights for Life (FFL) under the provisions of Title 14 *Code of Federal Regulations* Part 91. Night visual meteorological conditions prevailed at FLG at the time of the accident, and no flight plan was filed for the cross-country flight that was destined for Falcon Field (FFZ), Mesa, Arizona.

The pilot owned the airplane and based it at FFZ. Commercial flight tracking data indicated that the airplane departed FFZ about 0945 and landed at Show Low Regional Airport (SOW), Show Low, Arizona, about 1030. The airplane then departed SOW about 1055, arriving at FLG about 1140. According to the line service technician at FLG who met the airplane at the time of its arrival, it was "pouring" rain. The technician, who was an employee of Wiseman Aviation, a FLG fixed base operation (FBO), reported that the pilot did not want any fuel, and that the pilot unloaded some of his personal items about 30 minutes after landing, once the rain had stopped. The pilot then spent the day in the FBO, generally working on his computer, while awaiting a United Blood Service (UBS) delivery that was expected about 2100.

About 1900, the pilot and technician relocated the airplane closer to the terminal, and the pilot began "cleaning" and/or rearranging some contents in the airplane to make room for the expected cargo. The technician later asked the pilot again if he needed fuel, and he declined. He and the FBO owner reported that it was a "dark night" and that it was cloudy, but not raining, when they left the airport, which was before the accident airplane departed.

The UBS employee who delivered the cargo reported that the total load was four "large" boxes and two "small" boxes. She stated that full large boxes weigh about 30 pounds (lbs) each; small boxes weigh about 10 lbs each; and two of the large boxes were not full. The pilot loaded all the boxes via the aft left-side cargo door(s). He placed the large boxes on the floor of the aft cabin and the two small boxes on top of them. The UBS employee reported that the pilot then closed the door(s) and that he did not restrain the boxes with a net or by any other means.

The FLG air traffic control tower was closed by the time the pilot was ready for engine start and departure. While the airplane was still on the ground, the pilot contacted Phoenix approach control by radio, and requested visual flight rules (VFR) flight following services for a flight to FFZ. The controller provided altimeter and transponder information, and shortly thereafter, the airplane departed.

At 2119:44, the pilot radioed Phoenix approach that he was "off [runway] two one" and climbing to 11,500 feet. At 2120:17 the controller advised the pilot of "radar contact one mile south" of FLG and instructed him to maintain VFR. At 2120:21 the pilot radioed his acknowledgement; this was the last radio transmission from the flight. At 2122:57, the controller advised the pilot that radar contact had been lost and instructed him to report leaving 9,000 feet. There was no response from the pilot to that instruction, nor were there any distress calls or other abnormal

communications from the pilot. The controller attempted multiple times to contact the flight, and also had Albuquerque ARTCC (ZAB) attempt contact. There was no response by the flight to either facility.

The first ground-based tracking radar return was acquired at 2119:49. At that time, the airplane was located approximately midfield, with a transponder-indicated altitude of 7,300 feet. The radar location and heading data were consistent with a departure from runway 21. The radar track indicated that the airplane initially maintained the approximate runway heading. The track then turned right about 30°, and then nearly 90° left, to a southerly track. The track then made a near-180° right turn to the north before radar contact was lost. The last radar return was received about 2122:19 and showed the airplane descending through an altitude of 7,400 ft.

The radar returns indicated that, for about the first 60 seconds of the flight, the airplane climbed at a rate of about 1,000 feet per minute (fpm). This climb rate was consistent with the airplane's normal, two-engine climb rate. The climb rate then decreased to and remained about 400 fpm the next 60 seconds. By the end of that period, the airplane reached a maximum transponder-indicated altitude of 8,400 ft. It then descended about 3,000 fpm during the next 20 seconds, when the radar data ended at an altitude similar to the terrain elevation. The final segment of the radar track and the position of the last radar data target were consistent with the observed orientation and location of the debris field.

The impact site was located adjacent to a road, about 2.6 miles southwest of FLG. The airplane was highly fragmented, and earwitnesses reported that the engines were operating at high power just prior to impact. Ground scar and propeller signatures were consistent with both engines operating at impact. Initial post-recovery evaluation of the wreckage did not reveal any mechanical anomalies, including fire, that would have precluded continued normal operation.

PERSONNEL INFORMATION

The 76-year-old pilot held multiple certificates and ratings, including an airline transport pilot certificate with an airplane multiengine land rating. He held an FAA second-class medical certificate dated March 1, 2016, with the limitation that he must have glasses available for near vision. On his application for the medical certificate, the pilot reported a total flight experience of 11,858 hours, including 77 hours in the previous 6 months.

According to the pilot's son, who was a pilot for a major US airline, the pilot flew 4 to 5 FFL missions per month, and about 200 hours per year. The son reported that the pilot usually hand-flew the airplane to cruise altitude before engaging the autopilot and would hand-fly the descents as well. The son reported that, in addition to the autopilot's wing leveling/navigation functions, the pilot also used the autopilot altitude hold function. Finally, the son stated that the airplane "was a very stable platform." To the son's knowledge, the pilot only operated VFR, in part because FFL "did not allow [instrument flight rules] IFR." The pilot's instrument and night currency were unable to be determined.

AIRCRAFT INFORMATION

According to FAA records, the airplane was manufactured in 1980 and was equipped with two Continental Motors TSIO-360-series engines. The engines rotated in opposite directions; when viewed from behind, the left propeller rotated clockwise, and the right propeller rotated counterclockwise.

The pilot purchased the airplane in March 2015. Maintenance records indicated that the most recent annual inspection was completed in May 2016, when the airframe had a total time (TT) in service of about 7,453 hours. The left engine had a TT of about 3,993 hours, with about 342 hours since overhaul. The right engine had a TT of about 353 hours since new.

According to the pilot's son, the airplane was equipped with a KFC 200 two-axis autopilot and a flight director, and both "worked very well." All annunciators worked normally, and the horizontal situation indicator had recently been overhauled. The son reported that the pilot was "a stickler" for ensuring that all mechanical items were in proper working condition, and that he "was not aware of [any] vacuum [gyro instrument air] issues."

Review of the maintenance records for the 16 months preceding the accident did not reveal any uncorrected maintenance deficiencies, or any entries that warranted additional investigation. Review of the weight and balance records and the loading data indicated that the airplane was within its weight and balance envelope for the accident flight.

METEOROLOGICAL INFORMATION

Flagstaff Information

The 2057 FLG automated weather observation included calm winds, visibility 10 miles, scattered clouds at 10,000 ft above ground level (agl), temperature 15°C, dew point 14°C, and an altimeter setting of 30.35 inches of mercury. The 2157 observation included winds from 240° at 3 knots (kts), visibility 10 miles, a broken cloud layer at 11,000 ft, with unchanged temperature, dew point, and altimeter setting.

The National Weather Service (NWS) surface analysis chart station model for Flagstaff for 2000 indicated a light westerly wind about 5 kts, clear skies, temperature 16°C, and dew point 12°C.

The NWS national composite radar image at 2125 for the Flagstaff area depicted only very light intensity echoes associated with a dissipating area of echoes. Data from the NWS Flagstaff Weather Surveillance Radar-1988, Doppler (WSR-88D), which was located 41 miles southeast of the accident site, indicated the absence of any significant weather echoes.

Geostationary Operational Environmental Satellite number 15 (GOES-15) data indicated that a broken to overcast layer of altocumulus to altostratus type clouds extended over the Flagstaff area and the accident site. The measured cloud top temperatures corresponded to cloud tops near 29,000 ft above mean sea level (msl) in that region.

The terminal area forecast (TAF) for FLG, which has a coverage area radius of 5 statute miles, called for light and variable winds at 5 kts or less, visibility better than 6 miles, scattered clouds

at 6,000 ft agl, broken ceiling at 10,000 ft agl, with a temporary period (between 1700 and 2000) of light rain showers and a broken ceiling at 7,000 ft agl.

The area forecast for northern Arizona for the period of the accident was for a broken ceiling between 12,000 and 14,000 ft msl, cloud layers to 25,000 ft msl, with widely scattered light rain showers and thunderstorms.

Solar and Lunar Illumination Information

Local sunset occurred at 1928, and civil twilight ended at ~~1917~~56. The moon rose at 0527 and set at 1922; the phase of the moon was new (unilluminated disk).

Enroute and Destination Weather Information

The 12-hour surface prognostic chart valid for 0500 on August 3, 2016, depicted a high-pressure system over northern Arizona with a thermal low-pressure system over southeastern California and a trough extending southward. A large area of scattered thunderstorms and rain showers was depicted over almost all of Arizona.

No TAFs are issued for the destination airport, FFZ. The closest airport to FFZ that issues TAFs was Phoenix-Mesa Gateway Airport (IWA), located about 10 miles south of FFZ. The IWA forecast, valid from 1900 August 2 to 1700 August 3 was as follows:

- Wind 350° at 18 kts with gusts to 30 kts, visibility 6 statute miles, thunderstorms in the vicinity, scattered clouds at 6,000 ft agl, scattered cumulonimbus at 10,000 ft agl, and broken ceiling at 12,000 ft agl
- Temporary (from 1900 to 2100): wind variable direction at 20 kts with gusts to 40 kts, visibility 3 statute miles, thunderstorms and rain, broken cumulonimbus ceiling at 8,000 ft agl, overcast at 12,000 ft agl
- From 2200 on: wind 120°, visibility 6 statute miles, showers in the vicinity, scattered clouds at 10,000 ft agl, and broken ceiling at 20,000 ft agl

The 2125 NWS national composite radar image depicted a band of light to moderate echoes extending from eastern Arizona southwestward through the Phoenix area. The GOES-15 satellite image depicted a large area of cumulonimbus clouds over the Phoenix and Mesa areas, with the anvil extending northward to the Sedona area.

AIRPORT INFORMATION

FLG was situated at an elevation of 7,014 ft msl, about 3 miles south of the city in semi-rural, mountainous terrain. The surrounding terrain for several miles to the east, south, and west was sparsely populated, with little ground lighting.

FLG was equipped with a single paved runway, designated 3/21, which measured 8,800 ft by 150 ft. The runway was lighted. The airport was equipped with an air traffic control tower, but the tower had closed for the night at 2100.

WRECKAGE AND IMPACT INFORMATION

The accident site was located on Coconino National Forest property on the east side of Arizona Hwy 89A, about 2.6 nautical miles (nm), on a true bearing of 236°, from the FLG runway 3 threshold. The elevation of the accident site was about 6,950 ft msl. The wreckage trajectory/debris field was oriented on a true heading of 042°. The debris field site terrain was level, with moderately spaced trees (primarily pines, about 60 to 100 ft tall) and generally sparse undergrowth. A residential neighborhood, with widely-spaced homes and an integral golf course, was situated about 1/3 of a mile east of the accident site.

The wreckage was highly fragmented. The debris field measured about 60 ft by 600 ft. The airplane cut/broke the tops off eight trees; these tree locations, and their remaining heights, were catalogued. Some of the fractured tree trunks were 12 to 15 inches in diameter at their separation points. Some tree limbs, up to about 4 inches in diameter, displayed clean angular cuts at their ends, consistent with being severed by a rotating propeller.

The largest wreckage elements included the mid-forward fuselage, the right-wing root and aft nacelle section, and a section that included the left firewall, engine mount, wing spar section, and left main landing gear (LMLG) assembly. These three elements comprised the main wreckage. The engines had separated from the airplane, and the propellers had separated from the engines. Each propeller hub retained all three blades, and all three blades in each hub were significantly damaged. This damage was consistent with both engines developing power at impact. A few flight and engine instruments were identified in the wreckage. Damage to the flight gyroscopic instruments precluded determination of their functionality, or whether they were operating during the flight or impact.

Several hundred pages of maintenance records and other airplane documentation were scattered throughout the debris field. Some pages were loose, and some were partially- or wholly-contained in notebooks. Multiple computers and other portable electronic devices were present at the accident site. Some were intact and in flight/travel bags, and some were extensively damaged and/or not contained in any cases.

The debris field was mapped. Left-side airplane/engine components were generally located towards the left side of the debris field, and right-side airplane/engine components were generally located towards the right side of the debris field; overall, this was consistent with the airplane not being inverted at impact. Refer to the separate "Debris Field" document in the NTSB public docket for this accident for detailed information.

The wreckage was recovered and transported to a secure facility. A two-dimensional layout of some of the wreckage was conducted, and all flight control surfaces were accounted for. The flap setting at impact could not be determined. Damage precluded determination of flight control system continuity, or the condition or airworthiness of the pre-accident airplane.

All major airframe, engine, and propeller components were accounted for, and their damage patterns were consistent with all components being present and intact at the time of impact. No

evidence of any pre-impact mechanical deficiencies or failures of the airframe, engines, or propellers was observed. No evidence consistent with in-flight or post-impact fire was observed.

Refer to the NTSB public docket for this accident for additional details.

MEDICAL AND PATHOLOGICAL INFORMATION

On his FAA medical certificate applications, the pilot reported using amlodipine and valsartan to treat hypertension, and levothyroxine for hypothyroidism, and aspirin. None of these medications are considered impairing.

The Coconino County (Arizona) Office of the Medical Examiner, Arizona, performed an autopsy of the pilot and determined that the cause of death was "multiple injuries due to aircraft accident." Examination of the body for natural disease was significantly limited by the severity of the pilot's injuries; neither the brain nor heart were available for examination. The autopsy report did not contain any findings (either positive or negative) on the pre-impact health of the pilot.

The FAA's Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, performed toxicology testing and identified metoprolol in muscle and lung tissue. Metoprolol is a prescription blood pressure medication often marketed with the names Lopressor and Toprol.

Metoprolol is used alone or in combination with other medications to treat high blood pressure. It also is used to prevent angina (chest pain), and to improve survival after a heart attack. Metoprolol also is used in combination with other medications to treat heart failure. Metoprolol is in a class of medications called beta blockers. Metoprolol is also sometimes used to prevent migraine headaches and to treat irregular heartbeat and movement disorders caused by medications for mental illness. It is not generally considered impairing.

In addition, ethanol was identified in muscle tissue, but was not detected in kidney tissue. When ethanol is ingested, it is rapidly distributed throughout the body's tissue and fluids fairly uniformly. Ethanol may also be produced in the body after death by microbial activity. In such post-mortem cases, the amount of ethanol identified in different tissues may vary widely.

ADDITIONAL INFORMATION

Flights for Life Information

According to its website, FFL is a non-profit organization dedicated to providing free air transportation to transport blood for UBS. FFL works in cooperation with hospitals, blood banks, health-care agencies, and private individuals, and flies scheduled and on-demand missions, primarily within Arizona. The pilot was a well-known, long serving, and active member of FFL. The pilot became a member in 2006. He spent 4 years as the FFL Mission Safety Officer and then became the FFL President. At the time of the accident, the pilot had been the president for 3 years.

The January 2016 edition of the FFL Member Handbook, which was current at the time of the accident, specified the particular conditions, requirements, limitations, and recommendations for the FFL pilots and the conduct of the mission flights. The pilot's status as the FFL President did not relieve him from complying with any of the guidance in the FFL Member Handbook. Comparison of the Member Handbook guidance with the known circumstances of the accident flight revealed several instances of non-compliance.

The following two paragraphs, excerpted from the FFL Member Handbook, list the pilot requirements for day and night cargo flights.

Pilot Requirements for Day Cargo Flights.

1. 100 Hours minimum [pilot-in-command] PIC time.
2. 5 Hours minimum time in aircraft make and model to be flown, or 10 Hours minimum if in high performance aircraft.
3. 25 Hours minimum time flying cross-country.
4. Be in an "Active" pilot status.

Pilot Requirements for Night Cargo Flights.

1. Same requirements as for day Cargo flights, except as listed below:
 - a. 300 Hours minimum PIC time, or 200 hours minimum with Instrument Rating.
 - b. 50 Hours minimum time flying cross-country.
 - c. 30 Hours minimum night flight, or 15 hours with an Instrument Rating.

The handbook did not specify any instrument currency requirements for either day or night flights.

The handbook stated, "All FLIGHTS FOR LIFE, INC., flights will be conducted in accordance with Visual Flight Rules (VFR), except [that] Marginal VFR and IFR [instrument flight rules] to VFR on Top flights are permissible, but are restricted to daylight hours only." The forecast and observed weather conditions were consistent with the potential for IFR conditions enroute to FFZ.

The handbook also stated, "It is strongly recommended that flight plans be filed for all flight distances greater than 50 nautical miles." The straight-line distance between FLG and FFZ was about 101 nautical miles (nm), but the pilot did not file a flight plan for the accident flight.

The handbook recommended two pilots for night flights. In contrast, the pilot was the only pilot planned for, or onboard, the airplane. The accident flight was not the first occurrence of such a situation for this pilot; review of FFL flight records as far back as 2008 indicated repeated occurrences of solo night flights.

Gyroscopic Flight Instruments

The airplane manufacturer's Pilot's Operating Handbook (POH) included the following information about the airplane's flight instrumentation. "The directional gyros and attitude indicators are driven by positive air pressure. The pressure system consists of a pressure pump on

each engine, plus plumbing and regulating equipment. Check valves and a pressure air manifold...allow pressure instruments to function during single-engine operation, or in the event of malfunction of one of the pressure pumps....Operation of the gyro pressure system can be monitored via a pressure gauge on the instrument panel, to the left of the copilot's control wheel shaft. The two warning indicators mounted on the gauge serve to alert the pilot should one of the engines be producing less than sufficient pressure to operate the gyro instruments. Additional warning of a possible malfunction in the gyro pressure system is provided by a light in the annunciator panel."

There was no specific POH procedure for failure of an instrument air pressure pump; the only related POH procedures were for a decrease in instrument air pressure below the minimum allowable limit of 4.5 inches of mercury, which would not typically occur with the failure of one pump. The POH guidance stated that, if the pressure decreases below the minimum limit, engine speed should be increased to 2,575 rpm, and the airplane should be descended to an altitude at which a pressure of 4.5 inches of mercury can be maintained.

The investigation did not locate any records of any recent pre-accident problems or anomalies with the flight instruments. Damage to the flight gyroscopic instruments precluded determination of their functionality, or whether they were operating during the flight or impact.

The instrument air pressure pumps were recovered and shipped to the manufacturer (Tempest) for examination. The pump installed on the left engine was model number AA3215CC, and the pump installed on the right engine was model AA442CW-6. The pumps were examined in late June 2017 at the Tempest facility, with FAA oversight. According to the manufacturer's report, the vanes in the left pump were found to be "worn well beyond" their service limits. Powdery residue found inside that pump indicated that the left pump was inoperative at the time of impact. The internal condition of the right pump was consistent with it operating at the time of impact. Impact damage to the air system lines, check valves, and other components precluded determination of the pre-accident functionality of the system.

Detailed information regarding the instrument air system and the pump examinations is contained in the NTSB public docket for this accident.