Revisions to original narrative

HISTORY OF FLIGHT

On August 2, 2018, about 1705 Pacific daylight time, a Mooney M20J, N56039, was substantially damaged when it impacted terrain during an approach to Lopez Island Airport (S31), Lopez Island, Washington. The flight instructor and private pilot receiving instruction were fatally injured. The airplane was registered to and operated by the pilot as a Title 14 *Code of Federal Regulations* (*CFR*) Part 91 personal flight. Visual meteorological conditions prevailed and no flight plan was filed for the flight, which departed Friday Harbor Airport (FHR), Friday Harbor, Washington at an unknown time.

According to the instructor's wife, her husband was scheduled to perform a flight review with the accident pilot at 1400, but the flight was delayed until 1500 for unknown reasons.

A witness reported that he was departing in an airplane from an airport about 3 nautical miles (nm) west of the accident airplane at the time of the accident. During the witness' initial climb, he heard another pilot announce over the radio that he was on an extended left base for "runway 14" at S31, and stated that the voice sounded unsure or distracted. The witness then made a left turn to an easterly course, where he observed an airplane about 300 ft above ground level and about 0.5 nm north of S31 that appeared to be initiating a turn from the base to final leg of the traffic pattern for runway 16 at S31. The airplane's left turn progressed into a 45° bank that continued to increase until the airplane entered a nose-down dive. He saw the airplane complete one revolution on its roll axis before it disappeared from his line of sight.

Audio of the accident was captured by a surveillance camera at a nearby residence. The video camera faced the accident site but did not capture the impact, as the airplane was obscured by trees. The airplane's engine could be heard about 30 seconds into the approximate 1-minute long audio sample; the sound was smooth and continuous. After several seconds, the engine sound was consistent with an engine advancing to a high power setting. Almost instantaneously, the airplane was heard impacting trees, and several trees in the distance could be seen moving in the video.

PERSONNEL INFORMATION

The pilot receiving instruction did not hold a current flight review at the time of the accident.

The flight instructor, age 68, held a flight instructor certificate with a rating for airplane single-engine. His most recent second-class medical certificate was issued on May 30, 2018, with the restriction "must have available glasses for near vision." His total flight time was constructed using his flight logbook, which was current as of January 2018, and the tachometer records for his personal airplanes; these records indicated that the flight instructor had about 1,462 total hours of flight experience at the time of the accident, 74 of which were in the previous 90 days. His logbook records from June 2017 to the time of the accident showed that the pilot was practiced in Piper Aircraft and a Waco. The logbook did not show any experience in the accident airplane make and model.

FAA records indicated that the instructor had previously failed two check rides. His first failure was recorded in September 2012 during an examination for his flight instructor certificate. According to an FAA inspector, the failure was the result of exceeding aircraft limitations and other basic airmanship deficiencies. He retested for his flight instructor certificate 2 weeks later and was found satisfactory.

The instructor subsequently applied for a 14 *CFR* Part 135 Air Taxi initial check ride to fly for a local commercial operator in the San Juan Islands. Records indicated that he passed the oral portion of the examination but failed the route check and flight portion of the annual check "substantially." According to the FAA, the failures were remarkable both in the volume of unsatisfactory items and that they were failures in basic airmanship, including aircraft control, uncoordinated flight, and inadequate airmanship in traffic patterns. The records indicated that the pilot did not retest.

METEOROLOGICAL INFORMATION

The 1653 recorded weather observation at FHR, located about 4 nm from the accident site, included wind from 220° at 6 knots, 8 statute miles visibility, broken clouds at 4,300 ft above ground level (agl), overcast clouds at 5,000 ft agl, temperature 16°C, dew point 11°C, and an altimeter setting of 30.04 inches of mercury.

AIRPORT INFORMATION

S31 was located at an elevation of 208 ft mean sea level, and comprised one asphalt runway in a 16/34 configuration. The runway was 2,905 ft long and 61 ft wide; the FAA airport chart supplement depicted a right traffic pattern for runway 16 and a standard left traffic pattern for runway 34.

WRECKAGE AND IMPACT INFORMATION

The airplane came to rest in wooded area about 400 ft from the western shore of Lopez Island and about one half nm northeast of S31. An initial impact point (IIP) was identified by an airframe fragment in the canopy of a tall tree. A tree scar that measured about 5 ft was observed about halfway up a 100-foot tall tree. The main wreckage, which comprised the empennage, left wing, right wing root, fuselage, and engine, was located a few feet forward of the scarred tree oriented on a magnetic heading of 180°, and marked the end of the debris path. The debris path was oriented on a heading of 126° magnetic and the distance between the IIP and the main wreckage was about 60 ft. The right wing separated at the wing root and was found in the debris path a few feet to the right of the main wreckage, also near the scarred tree. The inboard top skin of the right wing displayed brown and yellow transfer signatures consistent with tree contact. Both propeller blades remained attached to the propeller hub, which remained attached to the engine. Refer to Figure 1 for an illustration of the debris path.

Figure 1: Wreckage Diagram

Airplane Examination

The airplane was recovered to a secure facility for further examination. Rudder, elevator, and aileron control continuity was established from the cockpit to each respective control surface through overload separations.

The elevator trim system was continuous from the trim motor jackscrew through the trim servo to the trim tab. The elevator trim jackscrew beneath the forward cockpit measured 1.5 inches and displayed 20 threads, consistent with full nose-up trim.

Both wing fuel tanks were breached and did not contain any fuel. The fuel selector valve was attached to the lower forward fuselage. The valve was unobstructed and found in the left tank detent. Movement of the fuel selector handle was restricted, and further disassembly revealed that the selector handle stem had fractured internally. The fuel strainer showed trace amounts of debris at the low hex nut but was otherwise unrestricted. The fuel from the strainer was tested using a water-finding paste, which did not reveal any evidence of water contamination.

Elevator Trim System Examination

The elevator trim servo, electric trim switch, and lower trim gear box assembly (with trim jackscrew) were examined at the manufacturer's facility with oversight from Federal Aviation Administration inspectors.

The wiring cable to the elevator trim servo had been cut during removal and could not be functionally tested. Examination of the wiring revealed no anomalies. One of the wires broke free during continuity testing, but was soldered to the switch post and had partially detached prior to breaking while it was being moved for testing. Although the switch exhibited long-term wear, it displayed no evidence of preimpact anomalies that would have precluded normal operation.

The lower trim gear box assembly was placed in a vice to measure the torque required to back the traveling block away from the stop nut. During the test setup, the jackscrew rotated freely, backing the traveling block from the stop nut. Further rotation of the jackscrew showed that the screw was bent inside the gear box housing consistent with impact damage.

Engine Examination

Mechanical continuity was established throughout the engine, valve train, and accessory section as the crankshaft was manually rotated at the propeller. Thumb compression and suction were obtained for all four cylinders. A borescope examination revealed that the cylinder combustion chambers remained mechanically undamaged, and there was no evidence of foreign object ingestion or detonation. The ignition system was functionally tested while the crankshaft was manually rotated, but did not exhibit any anomalous indications. An examination of the top and bottom spark plugs revealed signatures consistent with normal wear. The fuel tanks were breached from the impact, but the fuel system did not exhibit any anomalies.

The two-blade, variable-pitch propeller was separated from the propeller hub. One propeller blade displayed a forward bend about midspan along with tip curling and chordwise scratches on the blade face and nicks and gouges on the leading edge. The other propeller blade was bent slightly aft and exhibited tip curling, chordwise scratches on the blade face, and nicks and gouges on the leading edge.

Fuel Boost Pump Examination

A functional examination of the airframe fuel boost pump was performed at the manufacturer's facility with oversight from the FAA. The pump did not operate correctly when the acceptance test procedure voltage was applied. A teardown of the unit revealed that the failure was the result of a locked armature caused by the poor condition of the motor's drive end bearing. The manufacturer reported that the condition of the bearing would have likely manifested over several months or years and was not the result of impact damage.

According to the aircraft manufacturer, the engine should run normally utilizing only the engine-driven fuel pump during takeoffs, landings, and cruise flight. The electric boost pump is primarily used for priming during engine start, during an inflight restart following an engine failure, and to supply fuel in the event of an engine-driven fuel pump failure.

MEDICAL AND PATHOLOGICAL INFORMATION

The San Juan County Coroner's Office performed an autopsy of the pilot and flight instructor. Both the pilot's the flight instructor's cause of death was listed as "multiple blunt force trauma." A local toxicology test showed that the pilot had a chest cavity blood/alcohol level of 0.~~035~~ 013 g/100 mL, and the autopsy report showed that he had 80% atherosclerotic disease in his right coronary artery. The report did not indicate the presence of any drugs of abuse and no significant natural disease was identified.

Toxicology testing was performed on specimens of the pilot and flight instructor by the FAA Forensic Sciences Laboratory. Samples from the flight instructor were negative for carbon monoxide, ethanol, and all tested-for drugs.

Samples from the pilot detected 28 mg/dL ethanol in the blood (cavity). Additionally, testing detected Atenolol, Triamterene, and Famotidine in the blood (cavity) and urine. It is likely that some or all of the identified ethanol was from sources other than ingestion.

Atenolol is a beta blocker commonly used in the treatment of hypertension. Triamterene is a potassium-sparing diuretic used in combination with other drugs for the treatment of hypertension (high blood pressure) and edema, but is not generally considered impairing. Famotidine (INN) is a histamine H2-receptor antagonist that inhibits stomach acid production, it is commonly marketed under the trade names Pepcidine and Pepcid. Atenolol and Famotidine are generally not considered to be impairing.

ADDITIONAL INFORMATION

Cross-Control Stalls

According to the FAA Airplane Flying Handbook (FAA-H-8083-3B),

The aerodynamic effects of the uncoordinated, cross-control stall can surprise the unwary pilot because it can occur with very little warning and can be deadly if it occurs close to the ground. The nose may pitch down, the bank angle may suddenly change and the airplane may continue to roll to an inverted position, which is usually the beginning of a spin. It is therefore essential for the pilot to follow stall recovery by reducing the AOA [angle of attack] until the stall warning has been eliminated, then roll wings level using ailerons, and coordinate with rudder inputs before the airplane enters a spiral or spin.

A cross-control stall occurs when the critical AOA is exceeded with aileron pressure applied in one direction and rudder pressure in the opposite direction, causing uncoordinated flight. A skidding cross-control stall is most likely to occur in the traffic pattern during a poorly planned and executed base-to-final approach turn in which the airplane overshoots the runway centerline and the pilot attempts to correct back to centerline by increasing bank angle, increasing elevator back pressure, and applying rudder in the direction of the turn (i.e. inside or bottom rudder pressure) to bring the nose around further to align it with the runway. The difference in lift between the inside and outside wing will increase, resulting in an unwanted increase in bank angle. At the same time, the nose of the airplane slices downward through the horizon. The natural reaction to this may be for the pilot to pull back on the elevator control, increasing the AOA toward critical. Should a stall be encountered with these inputs, the airplane may rapidly enter a spin. The safest action for an "overshoot" is to perform a go-around. At the relatively low

altitude of a base-to-final approach turn, a pilot should be reluctant to use angles of bank beyond 30 degrees to correct back to runway centerline.