Aviation Investigation Final Report

Location:	Marietta, Ohio	**Accident Number:**	ERA23FA024
Date & Time:	October 18, 2022, 07:09 Local	**Registration:**	N515GK
Aircraft:	Beech E-90	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

Shortly after departure to pick up a passenger at their destination airport about 75 nm away, the pilots climbed and turned onto a track of about 115° before leveling off about 11,000 ft mean sea level (msl), where the airplane remained for a majority of the flight. Pilot and controller communications during the flight were routine and there were no irregularities reported. As the airplane descended into the destination airport area, the airplane passed through areas of light to heavy icing where there was a 20 to 80% probability of encountering supercooled large droplets (SLD) during their initial descent and approach. While level at 4,000 ft msl, the flight remained in icing conditions, and then was cleared for the instrument approach to the runway. The flight emerged from the overcast layer as it crossed the final approach fix at 2,800 ft msl; the flight continued its descent and was cleared to land. The controller informed the flight that there was a vehicle on the runway but it would be cleared shortly, which was acknowledged; this was the final communication from the flight crew.

Multiple eyewitnesses and security camera footage revealed that the airplane, while flying straight and level, suddenly began a steep, spinning, nearly vertical descent until it impacted a commercial business parking lot; the airplane subsequently collided with several unoccupied vehicles and caught fire.

The airplane was certified for flight in known icing conditions and was equipped with pneumatic deice boots on each of the wings and tail surfaces. The pneumatic anti-icing system was consumed by the postimpact fire; the control switches were impact and thermally damaged and a reliable determination of their preimpact operation could not be made. Further examination of the airframe and engines revealed no indications of any preimpact mechanical anomalies that would have precluded normal engine operation or performance.

During the approach it is likely that the airframe had been exposed to and had built-up ice on the control surfaces. It could not be determined if the pilots used the pneumatic anti-icing system, or if the system was inoperative, based on available evidence. Review of the weather conditions and the airplane's calculated performance based on ADS-B data, given the speeds at which the airplane was flying, and the lack of any discernable deviations that might have been expected due to an extreme amount of ice accumulating on the airframe, it is also likely that the deice system, if operating at the time of the icing encounter, should have been able to sufficiently remove the ice from the surfaces. Although it is also uncertain when the pilots extended the landing gear and flaps, it is likely that the before-landing checklist would be conducted between the final approach fix and when the flight was on its 3-mile final approach to land. Given this information, the available evidence suggests that the sudden loss of control from a stable and established final approach was likely due to the accumulation of ice on the tailplane. It is likely that once the pilots changed the airplane's configuration by extending the landing gear and flaps, the sudden aerodynamic shift resulted in the tailplane immediately entering an aerodynamic stall that maneuvered the airplane into an attitude from which there was no possibility to recover given the height above the ground.

Postaccident toxicological testing detected the presence of delta-8 THC. Delta-8 THC has a potential to alter perception and cause impairment, but only the non-psychoactive metabolite carboxy-delta-8-THC was present in the pilot's liver and lung tissue. Thus, it is unlikely that the pilot's delta-8-THC use contributed to the accident.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

Structural icing on the tailplane that resulted in a tailplane stall and subsequent loss of control.

Findings

Environmental issues	Freezing rain/sleet - Effect on equipment
Aircraft	Directional control - Attain/maintain not possible

Factual Information

History of Flight

Approach-IFR final approach	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On October 18, 2022, at 0709 eastern daylight time, a Beech E-90, N515GK, was substantially damaged when it was involved in an accident in Marietta, Ohio. The two commercial pilots were fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 135 positioning flight.

The flight originated at the John Glenn Columbus International Airport (CMH), Columbus, Ohio, about 0640 and was enroute to Mid-Ohio Valley Regional Airport (PKB), Parkersburg, West Virginia. Automatic dependent surveillance - broadcast (ADS-B) data revealed that after takeoff from CMH the airplane climbed and turned on a ground track of 115°, and then leveled off at 11,000 ft mean sea level (msl), where it remained for most of the enroute portion of the 75-nautical-mile (nm) flight.

Air traffic control (ATC) communication information revealed that the flight crew was in communication with the Indianapolis Air Route Traffic Control Center during the enroute portion the flight and that all communications with the controllers were normal with no indication of any irregularities.

After departing the cruise portion of the flight, in preparation for the approach into PKB, the airplane descended at a rate of about 1,200 ft per minute at a calculated airspeed of 122 knots. As the airplane approached PKB, the controllers cleared the flight to descend and maintain 4,000 ft msl.

About 0706, the pilot contacted PKB requesting the RNAV approach to runway 21 and was instructed to report upon reaching MIDCO, the Final Approach Fix (FAF) for that instrument approach. MIDCO was 5.9 nm from the runway threshold and had a minimum crossing altitude of 2,800 ft msl. The pilots were subsequently cleared for the RNAV RWY 21 approach. The airplane leveled off at 2,800 ft msl and increased speed to 150 knots and turned on a long final approach to join the RNAV RWY 21 instrument approach procedure. Shortly after, the pilots were instructed to contact the PKB control tower. Subsequent communication exchanges with the controllers were normal.

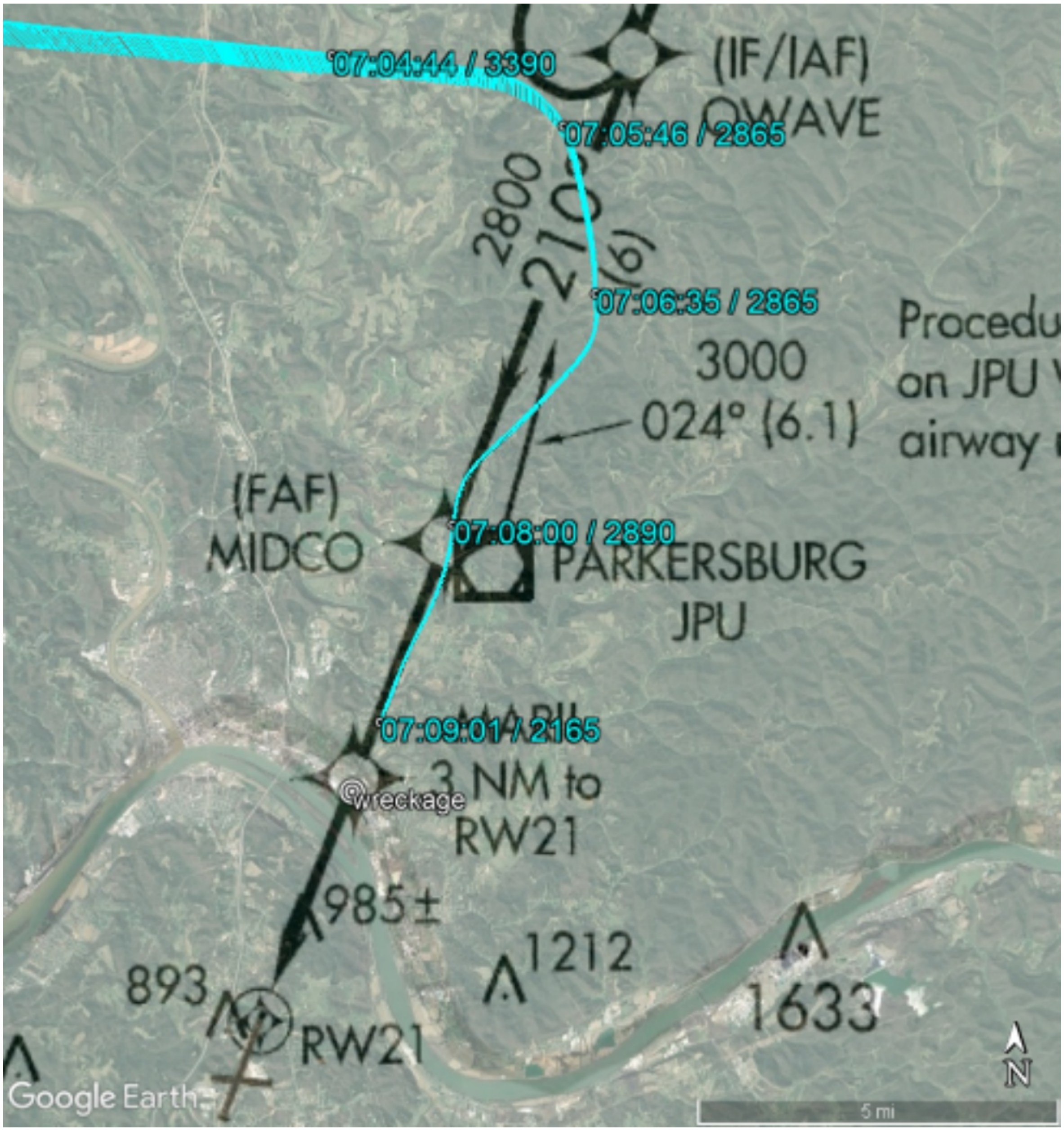

Figure 1 - Airplane flight path with selected times and altitudes annotated. A portion of the RNAV (GPS) RWY 21 instrument approach procedure has been superimposed onto aerial imagery.

About 0709, as the airplane was on a 3-mile final approach, the controller notified the pilots that there was a vehicle on the runway checking for wildlife and that it would be cleared shortly; this was acknowledged by the pilots. About 1 minute later, the airplane was observed emerging from the overcast cloud layer while it simultaneously crossed MIDCO, after which the pilots were cleared to land on runway 21. It was traveling about 170 knots and aligned with the runway heading. The speed decreased to 126 knots in preparation for approach and landing. (The airplane's published approach speed was about 90 knots and the stall speed was about

65 knots with full flaps [88 knots with no flaps at maximum gross weight]). There were no additional communications received from the flight crew.

Multiple eyewitnesses located on the airport and area surrounding the accident site reported that the airplane, while flying straight and level, suddenly began a steep descent and spun near vertically to the ground. Security camera footage from multiple camera angles showed the airplane's descent through impact, which was consistent with the eyewitness's accounts (see figure 2).

Figure 2 - Three sequential still images from the security camera video showing the airplane's near vertical descent to impact. Note landing light and position light.

Pilot Information

Certificate:	Commercial; Flight instructor; Remote	**Age:**	49,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Unmanned (sUAS)	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane single-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	March 9, 2022
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	1940 hours (Total, all aircraft), 15 hours (Total, this make and model), 1910 hours (Pilot In Command, all aircraft)		

Co-pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	45,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Unmanned (sUAS)	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane single-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	February 22, 2022
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	2500 hours (Total, all aircraft), 250 hours (Total, this make and model), 1400 hours (Pilot In Command, all aircraft), 56 hours (Last 90 days, all aircraft), 23 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N515GK
Model/Series:	E-90	**Aircraft Category:**	Airplane
Year of Manufacture:	1974	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	LW-108
Landing Gear Type:	Retractable - Tricycle	**Seats:**	8
Date/Type of Last Inspection:	September 20, 2022 100 hour	**Certified Max Gross Wt.:**	10500 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo prop
Airframe Total Time:	9521 Hrs as of last inspection	**Engine Manufacturer:**	Pratt & Whitney Canada
ELT:	Installed, not activated	**Engine Model/Series:**	PT6A-28
Registered Owner:	AVINTEL MANAGEMENT LLC	**Rated Power:**	680 Horsepower
Operator:	AVINTEL MANAGEMENT LLC	**Operating Certificate(s) Held:**	None

The airplane was a high-performance, conventional-tail, pressurized, twin-engine turbo-propeller airplane and was designed and equipped for flight in instrument meteorological conditions, day or night, and into known or forecast icing conditions. The surface deice system would remove ice accumulation from the leading edges of the wings and stabilizers through the use of pneumatic boots. Ice would be removed by alternately inflating and deflating the deice boots. Pressure-regulated bleed air from the engines supplied pressure to inflate the boots. A venturi ejector, operated by bleed air, created a vacuum to deflate the boots and hold them down while not in use. To assure operation of the system in the event of failure of one engine, a check valve was incorporated in the bleed air line from each engine to prevent loss of pressure through the compressor of the inoperative engine. Inflation and deflation phases were controlled by a distributor valve. A three-position switch in the ICE PROTECTION group on the pilot's subpanel, placarded SURFACE DEICE - SINGLE - OFF MANUAL, controlled the deicing operation.

The switch was spring-loaded to return to the OFF position from SINGLE or MANUAL. When the SINGLE position was selected, the distributor valve would inflate all of the airframe boots, both wings and tail. After an inflation period of approximately 7 seconds, an electronic timer switched the distributor to deflate the boots. After these boots have inflated and deflated, the cycle was complete. When the switch was held in the MANUAL position, all the boots would inflate simultaneously and remain inflated until the switch was released. The switch returned to the OFF position when released. After the cycle, the boots would remain in the vacuum hold-down condition until again actuated by the switch.

According to the airplane’s Airplane Flight Manual (AFM) landing checklist:

1. Cabin Sign - ON
2. Propeller Synchrophaser - OFF
3. Autofeather Switch - ARM
4. Flaps - AS REQUIRED
5. Landing Gear - DOWN
6. Landing and Taxi Lights - AS REQUIRED
7. Pressurization - CHECK
8. Propeller Levers - HIGH RPM AFTER TOUCHDOWN
9. Power Levers - BETA RANGE AS REQUIRED AFTER TOUCHDOWN

Figure 3 - Excerpt from AFM showing the landing checklist items.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	PKB,615 ft msl	**Distance from Accident Site:**	3 Nautical Miles
Observation Time:	06:53 Local	**Direction from Accident Site:**	222°
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:	Overcast / 1400 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	3 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	260°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.8 inches Hg	**Temperature/Dew Point:**	3°C / 1°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Columbus, OH (CMH)	**Type of Flight Plan Filed:**	IFR
Destination:	Parkersburg, WV (PKB)	**Type of Clearance:**	IFR
Departure Time:	06:20 Local	**Type of Airspace:**	Class D

Weather information at the time of the accident indicated that there were pilot reports throughout the area for trace to moderate icing conditions and AIRMETs for moderate icing. Weather satellite data showed supercooled liquid water clouds from 1,300 ft above ground level (agl) to about 8,000 ft agl.

Mid-Ohio Valley Regional Airport (PKB), Parkersburg, West Virginia, had the closest official weather station to the accident site and was the intended destination airport. PKB had an Automated Surface Observing System (ASOS) and reports that were augmented by ATC. The PKB ASOS was located 4 miles south-southwest of the accident site at an elevation of 808 ft and issued the following observations surrounding the period of the accident. The PKB reported weather at 0653 included wind from 260° at 3 knots, visibility 10 miles or greater, overcast ceiling at 1,400 ft agl, temperature of 3° C, dew point temperature 1°C, and an altimeter setting of 29.80 inches of mercury. The sea level pressure was 1009.4 hPa, temperature 3.3°C, and dew point temperature 0.6°C.

The reported weather at PKB at 0750 included wind from 260° at 6 knots, visibility 10 miles or greater, overcast ceiling at 1,300 ft agl, temperature of 3°C, dew point temperature 1°C, and an altimeter setting of 29.81 inches of mercury.

The NWS Current Icing Product (CIP) and Forecast Icing Product (FIP) were intended to supplement other icing advisories such as AIRMETs and SIGMETs. The CIP icing probabilities and severity and 1-hour forecast was valid at 0700 and showed that at 3,000, 4,000, and 5,000 ft, there was a 60 to 85% probability of icing at 3,000 to 5,000 ft surrounding the accident area (see figure 4). Furthermore, the icing intensity near the accident site ranged from “light” to “heavy,” with a 20 to 80% probability of Supercooled Large Droplets (SLD). For additional weather information see the meteorology factual report in the public docket for this investigation.

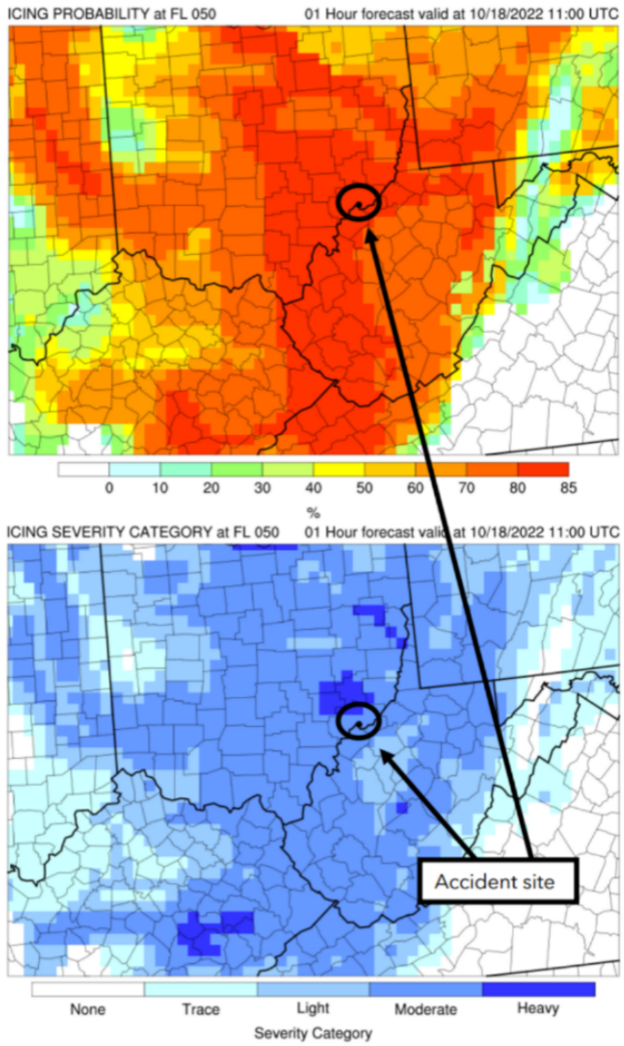

Figure 4 - Icing probability and severity charts with accident location annotated.

A search of archived information indicated that the accident pilot(s) did not request weather information from Leidos Flight Service. The accident pilot(s) did use their ForeFlight account to gather and receive a weather briefing through ForeFlight about 2008 on October 17. The ForeFlight weather briefing from 2008 on October 17 contained all the standard weather forecast information valid then through the proposed departure and flight time, starting at 0630 on October 18. While the text AIRMETs (Sierra and Zulu) were highlighted for the accident flight route, the G-AIRMETs were not forecast for the region after 0500 due to it being beyond the G-AIRMET forecast issuance timeframe. No weather imagery was viewed in the ForeFlight application before the flight.

Airport Information

Airport:	MID-OHIO VALLEY RGNL PKB	**Runway Surface Type:**	Asphalt
Airport Elevation:	858 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	21	**IFR Approach:**	RNAV
Runway Length/Width:	7240 ft / 150 ft	**VFR Approach/Landing:**	

Wreckage and Impact Information

Crew Injuries:	2 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	39.400997,-81.410431

The airplane impacted an automobile dealership parking lot at an elevation of 614 ft msl about 3 miles northeast of the approach end of runway 21 at PKB. The airplane struck several vehicles before coming to rest on level pavement. The wreckage path was compact and oriented on a heading of 305° magnetic. All major components of the airplane were accounted for at the accident site. The cockpit and forward portions of the fuselage were crushed aft.

A significant postimpact fire ensued consuming a majority of the fuselage and the cockpit area. The fuselage above the floorboards was totally consumed by fire. The instrument panel and all associated instrumentation, gauges, and switches were severely impact and thermally damaged. The left and right flaps, which were significantly damaged by impact and postimpact fire, remained attached to their respective mounts; the actuators indicated a flap position of 15°.

Partial flight control continuity from the cockpit to the ailerons, elevator, and rudder was established through cables, bell cranks, and push/pull rods. All breaks in the cables consisted of a “broom straw” appearance indicative of overload and push/pull rod damage was consistent with overload and thermal damage.

The pneumatic anti-icing system, including bleed lines, pneumatic boots, and their respective operating system on each of their respective wing leading edges and empennage, were consumed by postimpact fire; the switches were impact and thermally damaged. A reliable determination of their preimpact operation could not be made.

Both engines were located in the wreckage in their respective attachment locations and both displayed significant impact and thermal damage. On-scene examination revealed that both engines displayed rotational contact signatures to their internal and external components, which is indicative of power generation at impact. There were no indications of any preimpact mechanical anomalies to any of the engine components that would have precluded normal engine operation.

Both left and right propeller assemblies impact-separated from their respective engine propeller shaft flanges. All 4 blade shanks on each of the 2 assemblies remained attached to their respective hubs. There were no discrepancies noted in the components examined that would prevent or degrade normal operation before impact with terrain; all damage was consistent with high impact forces. Blade damage included chordwise/rotational scoring on both camber and face sides, bending forward/thrust direction, bending opposite rotation, and leading-edge gouging consistent with impact while rotating with power. There was no damage to indicate either propeller was feathered or at low pitch/idle power at the time of impact. Impact signatures indicated the blade angle for both propellers were approximately 30° while rotating with power and generating thrust.

A Garmin GTN 750 was recovered from the wreckage and sent to the NTSB vehicle recorders laboratory for examination. The units exhibited severe impact and fire damage. The unit's internal circuit boards were fire damaged and the extent of the damage precluded normal and advanced recovery procedures. No data pertinent to the accident were recovered.

Medical and Pathological Information

The Montgomery County Coroner's Office performed the autopsy of the pilot. According to the autopsy report, the pilot's cause of death was multiple injuries.

The FAA Forensic Sciences Laboratory performed toxicological testing of postmortem tissue of the pilot. Amlodipine and atorvastatin were detected in liver and muscle tissue. Carboxy-delta-8-THC was detected in liver at 96.9 ng/g and lung tissue at 17.7 ng/g. Amlodipine is a prescription medication commonly used to control high blood pressure. Atorvastatin is a prescription medication used to treat high cholesterol and reduce cardiovascular risk. Both medications are not generally considered impairing.

Carboxy-delta-8-THC is a non-psychoactive metabolite of the psychoactive chemical delta-8-THC (which was not detected here). Delta-8-THC products are often marketed simply as "hemp" or "CBD" products, which consumers may not associate with psychoactive effects.

Delta-8-THC is available in a variety of over-the-counter products for oral consumption, smoking, and inhalation. Delta-8-THC used in consumer products is typically chemically manufactured from cannabidiol (CBD), a chemical in the cannabis plant. Delta-8-THC has psychoactive and intoxicating effects that can impair motor coordination, reaction time, decision making, problem solving, and vigilance. The potency of delta-8-THC varies widely in consumer products. In one recent report, products were tested to assess how much delta-8-THC was contained within them; only 32% of tested products had accurate labeling for the amount of delta-8-THC contained. Delta-8 THC products have not been evaluated or approved by the Food and Drug Administration for safe use in any context.

The Montgomery County Coroner’s Office performed the autopsy of the copilot. According to the autopsy report, the copilot’s cause of death was multiple injuries.

The FAA Forensic Sciences Laboratory performed toxicological testing of postmortem tissue from the copilot. No tested-for substances were detected.

Additional Information

A performance study revealed that the glide performance for the E90 model was not available, but the Beech B200 had a glide performance of 2 nm for every 1,000 ft of altitude. The final descent to the wreckage location was not consistent with a loss of power.

Pilot reports throughout the area stated trace to moderate icing conditions and AIRMETs and upper air soundings reported moderate or greater icing potential (rime, clear, mixed) from 2,600 ft through 9,000.

A simplified aerodynamic model of the airplane was constructed to estimate body attitudes and aerodynamic coefficients during the flight. Absolute values of each parameter were estimated, with the trends reflective of the airplane’s aerodynamic behavior. Lift and drag increased with pitch as the airplane climbed and then leveled during cruise flight. Drag also increased during descents when the airplane maintained or decreased speed. However, drag did not increase substantially enough during the flight to indicate a buildup of ice on the airframe. If icing was present, the calculations made from the ADS-B flight path data were not able to capture its effects. Additionally, icing effects localized to a control surface or similar would not be discernible from just flight path data alone.

The FAA Advisory Circular AC_91-74B, the effect of icing section 3-7 Tailplane icing, stated the following: “a. Downward Lift. Most aircraft have a nose-down pitching moment from the wings because the center of gravity (CG) is ahead of the center of lift. It is the role of the tailplane to counteract this moment by providing downward lift. The result of this configuration is that actions that move the wing away from stall, such as deployment of flaps or increasing speed, may increase the negative AOA [angle of attack] of the tail. With ice on the tailplane, it may stall after deployment of flaps.” This could result in a sudden pitchover.

Section b. states, “Tailplane Stall. Since the tailplane is ordinarily thinner than the wing, it is a more efficient collector of ice. On most aircraft, the tailplane is not visible to the pilot, who therefore cannot observe how well it has been cleared of ice by any deicing system. Thus, it is important that the pilot be alert to the possibility of tailplane stall, particularly after full flap deflection, on airplanes not evaluated for susceptibility. A no-flap landing should be considered to avoid a tailplane stall, consistent with AFM procedures.”

Preventing Similar Accidents

Aircraft Inflight Icing (SA-014)

The Problem

As little as 1/4 inch of leading-edge ice can increase your airplane's stall speed 25 to 40 knots. Sudden departure from controlled flight is possible with only 1/4 inch of leading-edge ice accumulation at normal approach speeds. The danger is that some 1/4-inch accumulations have minimal impact on level-flight characteristics and pilots become overconfident. Further, using the autopilot can hide changes in the handling qualities of the airplane that may be a precursor to premature stall or loss of control. Turn off or limit the use of the autopilot in order to better "feel" changes in the handling qualities of the airplane.

For 60 years, pilots have been taught to wait for a prescribed accumulation of leading-edge ice before activating the deice boots because of the believed threat of ice bridging. However, ice bridging is extremely rare, if it exists at all. In theory, ice bridging could occur if the expanding boot pushes the ice into a frozen shape around the expanded boot, thus rendering the boot ineffective at removing ice. Yet there have been no known cases where ice bridging has caused an incident or accident, but there have been numerous incidents and accidents involving a delayed activation of deice boots.

Early activation of the deice boots limits the effects of leading-edge ice and improves the operating safety margin. Many pneumatic deice boot systems only provide a means to manually cycle the system and have no provision for continuous operation. While icing conditions exist, continue to manually cycle the deice system unless the system has a provision for continuous operation.

What can you do?

- Leading-edge deice boots should be activated as soon as icing is encountered, unless the aircraft flight manual or the pilot’s operating handbook pilots specifically directs not to activate them.
- If the aircraft flight manual or the pilot’s operating handbook specifies to wait for an accumulation of ice before activating the deice boots, maintain extremely careful vigilance of airspeed and any unusual handling qualities.
- While icing conditions exist, continue to manually cycle the deice system unless the system has a provision for continuous operation.
- Turn off or limit the use of the autopilot in order to better “feel” changes in the handling qualities of the airplane.
- Be aware that some aircraft manufacturers maintain that waiting for the accumulation of ice is still the most effective means of shedding ice.

See https://www.ntsb.gov/Advocacy/safety-alerts/Documents/SA-014.pdf for additional resources.

The NTSB presents this information to prevent recurrence of similar accidents. Note that this should not be considered guidance from the regulator, nor does this supersede existing FAA Regulations (FARs).

Administrative Information

Investigator In Charge (IIC):	Mccarter, Lawrence
Additional Participating Persons:	David Schluep; FAA FSDO; Columbus, OH Casey Love; Textron; Whichita, KS Mike Hodge; Pratt & Whitney; Bridgeport, WV Beverly Harvey; TSB Canada; Quebec , OF Les Doud; Hartzell; Picua, OH
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