Aviation Investigation Final Report

Location:	Pulaski, Tennessee	**Accident Number:**	ERA24FA058
Date & Time:	December 7, 2023, 11:03 Local	**Registration:**	N5891J
Aircraft:	Beech 35-C33	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

After departure on a 430-nautical mile (nm) cross-country flight, initial controller-pilot communications and headings were unremarkable. However, as the airplane climbed through 6,500 ft mean sea level (msl) and became established enroute, a performance study of ADS-B data showed that the airplane's altitude and airspeed began to vary as the airplane repeatedly descended and climbed with fluctuating airspeeds. These oscillations became increasingly more severe over about 25 minutes, with altitude deviations up to 1,500 ft and significant fluctuations in airspeed.

An air traffic controller advised the pilot that the airplane was left of course; although the pilot acknowledged the controller, the deviations continued to worsen and the pilot stopped responding to radio calls. Faint emergency transmissions were later received from the pilot and passenger as the airplane continued to descend. During the final portion of the flight, the airplane exceeded a descent rate of 10,000 ft per minute with a groundspeed of about 228 knots before terrain impact. The increasing altitude and heading deviations, loss of communication, and rapid uncontrolled descent were consistent with a loss of airplane control.

Flight instructors who had flown with the pilot before the accident indicated that she routinely demonstrated poor manual aircraft handling and struggled with cockpit automation, including autopilot and trim use. The pilot's training history showed that she had demonstrated difficulty maintaining situational awareness, suggesting the high-performance airplane she had purchased about 1.5 years before the accident was beyond her level of pilot proficiency, something explicitly noted by one of the instructors who had flown with her.

Postaccident examination of the airplane wreckage did not reveal evidence of any anomalies or mechanical irregularities that would have precluded normal operation, though the degree of fragmentation and fire damage precluded a complete evaluation of the airplane's flight controls and autopilot system.

Given the airplane's heading was stable during the initial portion of the flight, it is likely that the pilot had been using the autopilot. Based on the pilot's reported misunderstanding of that system, including, but not limited to the autopilot's pitch inputs and the requirement for manual pitch trim application, it is possible that the pilot inadvertently mis-trimmed the airplane, which resulted in oscillations that were exacerbated by the pilot's application of force on the control yoke. These kinds of pilot-induced oscillations can occur when manual yoke or pitch trim inputs are in conflict with the autopilot's pitch control inputs, leading to delayed, or out-of-sync, corrections, rather than a smooth, constant altitude hold. The airplane's vertical profile as evidenced by the ADS-B data, was consistent with these kinds of pilot-induced oscillations. As the oscillations became stronger, the pilot may have ultimately been unable to control the airplane's pitch, even with the autopilot disengaged, resulting in the loss of airplane control.

Toxicology results indicated that the pilot had used a combination of medications that may be used to treat conditions such as anxiety and depression, which may have performance-impairing effects. However, no details about any associated underlying conditions were available from reviewed records. Additionally, the medications trazodone, alprazolam, and buspirone may cause psychomotor and cognitive impairment such as slowed reaction time, diminished situational awareness, and sedation. However, due to the extent of the pilot's injuries, measurement of drug levels was limited to tissue specimens only, preventing reliable comparison to antemortem reference ranges in blood. Overall, the pilot may have been experiencing impairing effects of medication use or an associated underlying condition at the time of the accident, and such effects may have diminished her ability to render effective control inputs. However, available medical and circumstantial evidence was insufficient to establish whether such effects contributed to the accident, particularly given the pilot's demonstrated baseline proficiency in the high-performance airplane.

Probable Cause and Findings

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

The pilot's failure to maintain airplane control, which resulted in pilot-induced oscillations and a subsequent loss of control and impact with terrain.

Findings

Personnel issues	Aircraft control - Pilot
Aircraft	Pitch control - Not attained/maintained

Factual Information

History of Flight

Enroute-cruise	Loss of control in flight (Defining event)
Enroute-descent	Collision with terr/obj (non-CFIT)

On December 7, 2023, at 1103 central standard time, a Beech 35-C33 airplane, N5891J, was destroyed when it was involved in an accident near Pulaski, Tennessee. The private pilot and passenger sustained fatal injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The flight originated from Knoxville Downtown Island Airport (DKX), Knoxville, Tennessee, about 0948 and was enroute to Saline County Regional Airport (SUZ), Benton, Arkansas, which was about 430 nm away. Air traffic control communications and ADS-B data provided by the FAA revealed that after takeoff from DKX, the airplane climbed and turned to a ground track of 255°, then leveled off for about 12 minutes at 2,500 ft mean sea level (msl), before climbing to 6,500 ft msl. Controller and pilot communications during the departure and up to the initial enroute portion of the flight were normal.

The airplane's headings remained relatively stable throughout most of the flight; however, shortly before leveling off at 6,500 ft msl, the airplane's groundspeed dropped to 80 kts before accelerating to 130 kts once reaching altitude. The airplane maintained 6,500 ft and a groundspeed just below 130 kts for about 10 minutes. After 1020, the airplane began a series of descents to 6,000 ft, along with an associated increase in groundspeed, before climbing back to 6,500 ft while slowing; it was about this time when the controller handed off the pilot to the Memphis air route traffic control center (ARTCC), who provided services during the final portion of the accident flight. The controller issued the nearest altimeter setting and questioned the pilot's altitude, which the pilot acknowledged and confirmed.

An aircraft performance study was conducted with ADS-B data, and the Beechcraft Debonair 35-C33 and Bonanza E33 F33 Pilot's Operating Handbook and FAA Approved Airplane Flight Manual. The study indicated that, at 1033, the altitude and speed fluctuations became more pronounced and that the airplane no longer maintained a steady altitude for any significant amount of time. Weather conditions from the time of the accident indicated that the calibrated airspeed was about 5 kts lower than the groundspeed (figure 1). The airplane gained airspeed while descending and slowed while climbing. Airspeed fluctuated between 100 and 160 kts while repeatedly gaining and losing 1,000 to 1,500 ft of altitude.

The rate of climb varied between -1,200 ft/min during the descents to near 500 ft/min during the climbs. Smaller variations in altitude during the climbs and descents were also observed.

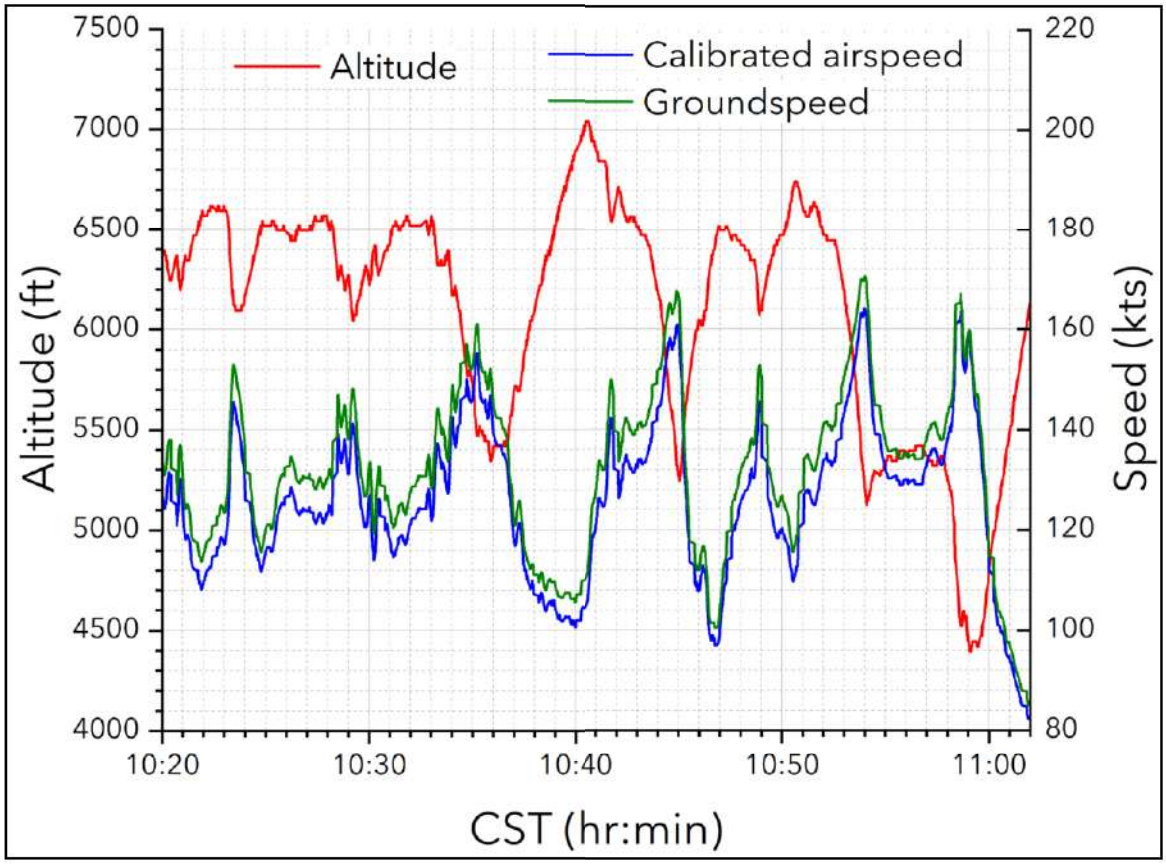

Figure 1. Airplane altitude, calculated airspeed, and groundspeed for the final 40 minutes of flight.

About 1036, the airplane entered a descent that was arrested about 5,300 ft at an airspeed of 133 kts, after which it climbed to its highest altitude of about 7,000 ft msl before descending again. The controller informed the pilot that she was "well left of course" and the pilot acknowledged and responded that she was correcting. However, the correction was small, and flight track data indicate that she remained significantly left of course.

After 1059 the airplane slowed from 160 kts to 140 kts while remaining level about 4,500 ft before beginning a climb to above 6,000 ft. During the climb, the airplane continued to slow. The controller twice attempted to contact the pilot in order to advise that she needed to contact the Memphis center control, but no response was received.

About 1103, there was a faint communication received from the pilot stating the "…this is Debonair, [unintelligible…] Emergency." The transmission coincided with the airplane turning left, with a corresponding descent rate of about 2,000 ft/min and the airspeed increasing to over 170 kts (see figure 2). About 60 seconds later, a faint male voice transmitted, "[unintelligible], oh…. help us." The controller's subsequent attempts to contact the pilot were

unanswered, and there was no further communication from either the pilot or passenger. During this time, the airplane was in a rapid descent before radar contact was lost in the vicinity of the accident site. During the last several seconds of the flight, the airplane was on a ground track of 262° descending at an airspeed of 230 kts, and the descent rate was over 10,000 ft per minute.

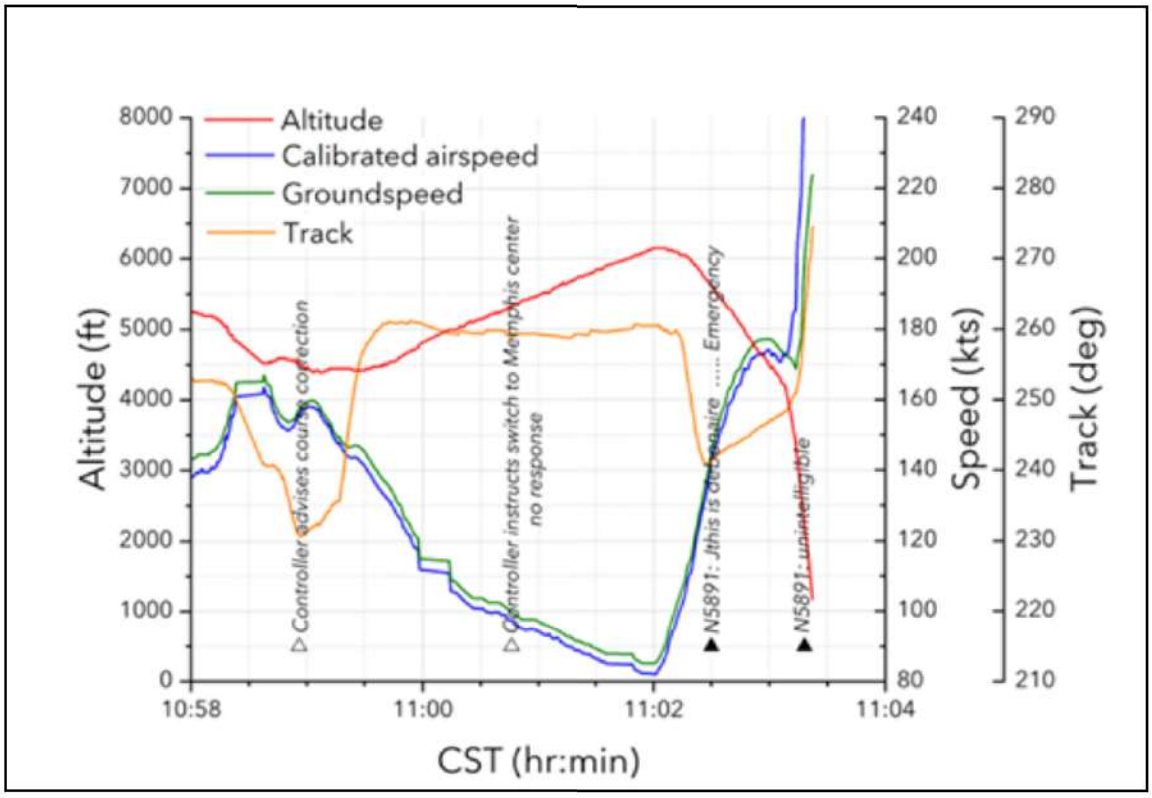

Figure 2. Airplane altitude and track, with calculated airspeed and groundspeed and selected ATC communications, at the end of the flight.

Pilot Information

Certificate:	Private	**Age:**	44,Female
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	January 20, 2023
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 390 hours (Total, all aircraft), 200 hours (Total, this make and model)		

Passenger Information

Certificate:		**Age:**	78,Male
Airplane Rating(s):		**Seat Occupied:**	Right
Other Aircraft Rating(s):		**Restraint Used:**	3-point
Instrument Rating(s):		**Second Pilot Present:**	No
Instructor Rating(s):		**Toxicology Performed:**	
Medical Certification:		**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:			

On October 20, 2021, the pilot passed her Private Pilot Airplane Airmen Knowledge Test. On May 14, 2022, she passed her private pilot (single-engine land) practical test, at which time she had accumulated 193.2 hours total flight time. Of those hours, 182.6 were dual instruction received; nearly all of the hours were accomplished in a Piper PA-28-140 that she had purchased on June 15, 2021. The following year she sold PA-28-140 and subsequently bought the accident airplane on July 13, 2022. The pilot's logbook was found at the accident site but was heavily damaged. The most recent logbook pages that were not damaged revealed the pilot had logged 390.3 hours total time as of August 14, 2023, about 3 months and 3 weeks before the accident flight. None of the pilot's logbook endorsements were contained within the undamaged segment of logbook that was reviewed.

An interview with one of the pilot's former flight instructors was conducted. The instructor stated that she, "leaned on technology too much and did not have solid stick and rudder flying skills." Regarding the systems on the airplane, specifically the trim and autopilot, he stated that she would often confuse the trim direction and would manually adjust the trim in the wrong direction. The instructor stated, "For instance, she could get flustered. If that trim was in the wrong position, if the autopilot was not happy, she would just disconnect it and fly manually." On the autopilot, "She would press the Down or Up button repeatedly. I would just tell her to gently press and hold the button down," she would "repeatedly" push it.

A subsequent interview with the general manager of the pilot's flight school indicated that her training progress was not meeting the necessary proficiency levels. He reported that several weeks before the accident she was given an instrument phase check and that it did not go well on almost all aspects of aircraft control, situational awareness, and risk management. He reported that he advised her that she was behind the Debonair and that he believed she had purchased more aircraft than she was ready for. "She and her father did not disagree when I repeated this assessment."

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N5891J
Model/Series:	35-C33	**Aircraft Category:**	Airplane
Year of Manufacture:	1965	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	CD-919
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	May 11, 2023 Annual	**Certified Max Gross Wt.:**	3050 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	3449 Hrs as of last inspection	**Engine Manufacturer:**	Continental
ELT:	Installed, not activated	**Engine Model/Series:**	IO-470-N
Registered Owner:	On file	**Rated Power:**	260 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The airplane was equipped with a Continental IO-470-N six-cylinder, fuel-injected engine producing 260 horsepower. The airplane featured retractable landing gear and a constant-speed propeller, making it a complex and high-performance airplane. These systems require specific pilot management and add to the aircraft's complexity compared to fixed-landing gear, fixed-pitch propeller trainer airplanes. It was capable of a maximum structural cruising speed of 161 knots and had a never-exceed speed of 195 knots.

The airplane was equipped with a Century 2000 autopilot. This model was a prompting autopilot, meaning automatic control of the elevator trim (auto trim) was not available on this system. When the autopilot displayed a flashing TRIM UP or TRIM DOWN on the annunciator, the pilot would need to manually move the trim control of the airplane in the direction indicated on the autopilot. When the autopilot determined that the trim condition was satisfied, the trim lamp on the annunciator would extinguish and the pilot could then stop trim action. There were 2 degrees of trim prompting: for a small trim error, the trim prompt will flash approximately once each second. A large trim error will cause the prompt to flash approximately 3 times per second. A large error not corrected for a period of approximately 2 minutes would sound an alert for 5 seconds. The alert would repeat every 2 minutes until the error was corrected.

According to airworthiness records, the pilot's previous airplane, the Piper PA-28-140, had fixed landing gear, a fixed-pitch propeller, and a 160-hp engine installed in accordance with a supplemental type certificate; it was not a high performance or complex airplane. FAA airworthiness records showed that the airplane had been equipped with a Bendix King/Tru Trac autopilot system. Its cruise speed was about 110 kts with a maximum speed of 125 kts.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	LUG,717 ft msl	**Distance from Accident Site:**	16 Nautical Miles
Observation Time:	11:15 Local	**Direction from Accident Site:**	8°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	9 knots / None	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	190°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	30.19 inches Hg	**Temperature/Dew Point:**	12°C / 0°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Knoxville, TN (DKX)	**Type of Flight Plan Filed:**	None
Destination:	Benton, AR (SUZ)	**Type of Clearance:**	VFR flight following
Departure Time:	09:48 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	35.250013,-86.848071

The airplane impacted hilly, wooded terrain at an elevation of 971 ft, with the wreckage path oriented on a heading of about 268° magnetic. The wreckage was highly fragmented, and the debris field extended in a fan-like pattern about 100 yards long. The tops of several trees leading to the main wreckage were cut off at progressively lower heights leading up to the main impact with the terrain. The fuel tanks were breached consistent with impact damage and a post-impact fire spread in the vicinity of the wreckage to the surrounding trees and undergrowth.

A witness in the vicinity of the accident site stated that the airplane flew overhead at a high rate of speed and described that the engine was running when it impacted the ground.

All major components of the airplane were located at the accident site. The engine was partially buried in in a crater that was 5 ft deep by 8 ft wide. The engine was severely damaged by impact forces, and crankshaft continuity and cylinder compression could not be confirmed due to internal impact damage.

The magneto key was broken off in the switch and set to the “Both” position. Both magnetos separated from the engine during the accident sequence, were damaged by impact forces, and could not be functionally tested. The spark plugs were impact damaged but showed minimal wear when compared to the Champion Check-A-Plug chart and did not display any evidence of carbon or lead fouling.

The propeller blades separated from the hub during the impact sequence. One blade was buried in the impact crater while the opposing blade was found 30 feet west of the main wreckage. The buried blade exhibited a significant bend with chordwise scraping and leading-edge gouges. The opposing blade had a slight bend and also exhibited chordwise scraping. The propeller spinner exhibited rotational crushing damage.

The flight control system components from the cockpit to all control surfaces were significantly damaged or destroyed by impact forces and the post-impact fire. Flight control continuity could not be established; however, all observed breaks of the flight control cables displayed features that were indicative of tensile overload. The cables had “broomstraw” appearances consistent with impact-related separation. Measurement of the elevator trim actuator correlated to a 5° deflection of the left trim tab in the trailing edge down direction (the right trim tab position could not be determined due to impact-related damage). The rudder, left horizontal stabilizer, and elevator remained attached to the empennage, and were free to move when manually manipulated. The rudder cables remained attached to the bellcrank at the rudder. The elevator cables remained attached to the fractured bellcrank. One flap actuator was discovered loose in the wreckage but could not be attributed to the right or left side.

The cockpit was destroyed by impact forces and fire, and no flight instrumentation or gauges could be accurately identified or read. The autopilot’s instrument panel faceplate was identified, but no settings of the autopilot could be determined. The autopilot servos were also damaged by impact and fire.

Two video recording devices were discovered in the wreckage. Both units appeared intact with superficial exterior damage and retained their respective micro-SD data cards. The units were retained and delivered to the NTSB Recorders Laboratory for examination and download. Examination and testing revealed that the memory card from one of the devices was destroyed beyond repair, and no data was recoverable. The memory card from the other device did not contain any video recordings, and a forensic examination recovered only deleted files from previous flights and revealed that the camera was likely not recording during the accident.

Medical and Pathological Information

According FAA medical records, the 44-year-old pilot's last aviation medical examination was January 20, 2023. At that time, she reported using the medication fexofenadine (an over-the-counter, non-sedating antihistamine commonly used to treat symptoms of seasonal allergies). She otherwise reported no active medical conditions. The pilot was issued a third-class medical certificate with the limitation that she must wear corrective lenses to meet vision standards at all distances.

The Middle Tennessee Regional Forensic Center performed the pilot's autopsy for the Giles County Medical Examiner. According to the pilot's autopsy report, her cause of death was multiple injuries, and her manner of death was accident. Due to the extent of her injuries, the autopsy was limited for evaluation of natural disease.

At the request of the Middle Tennessee Regional Forensic Center, NMS Labs performed toxicological testing of postmortem liver tissue from the pilot. Alprazolam was detected at 530 ng/g. Alpha-hydroxyalprazolam was detected at 56 ng/g. The FAA Forensic Sciences Laboratory also performed toxicological testing of postmortem specimens from the pilot. Alprazolam was detected in liver tissue at 222 ng/g and was detected in muscle tissue at 81 ng/g. Alpha-hydroxyalprazolam was detected in liver tissue at 57 ng/g and was detected in muscle tissue at 4 ng/g. Trazodone was detected in liver tissue at 286 ng/g and was detected in muscle tissue at 56 ng/g. Buspirone was detected in liver tissue at 55.5 ng/g and was detected in muscle tissue at 3.8 ng/g. Ondansetron, propranolol, fexofenadine, and azacyclonol were detected in both liver and muscle tissue.

Oxymetazoline was detected in liver tissue and was not detected in muscle tissue. Alprazolam (sometimes marketed as Xanax) is a potent prescription benzodiazepine medication used to treat generalized anxiety disorders and panic disorders. It typically carries a warning that use may cause central nervous system depression including increased sedation, reduced concentration, and reduced inhibitions. Alprazolam generally carries a warning that users should avoid engaging in hazardous occupations or activities requiring complete mental alertness such as operating machinery or driving a motor vehicle. Alpha-hydroxyalprazolam is an active metabolite of alprazolam. According to the FAA, alprazolam is a Do Not Issue/Do Not Fly medication.

Trazodone is a prescription antidepressant medication that may be used to treat major depression, insomnia, generalized anxiety disorders, panic disorders and post-traumatic stress disorders. It typically carries a warning that use may slow thinking and impair motor skills, and that users should not drive, operate heavy machinery, or do other dangerous activities until they know how the drug affects them. The FAA considers trazodone a Do Not Issue/Do Not Fly medication.

Buspirone is a prescription medication commonly used to treat anxiety. Use of buspirone may cause dizziness. Buspirone generally carries a warning that users should be cautious

operating a motor vehicle or heavy machinery until they know how the drug will affect them. According to the FAA, buspirone is a Do Not Fly medication.

Ondansetron is a prescription medication commonly used to treat and prevent nausea and vomiting. Multiple studies have found no significant effect of ondansetron on cognitive and psychomotor performance. According to the FAA medical case review for this investigation, ondansetron is disqualifying for FAA medical certification due to side effects including serious heart rhythm irregularities, drowsiness, and dizziness.

Propranolol is a prescription medication commonly used to treat high blood pressure, migraine headaches, and chest pain caused by reduced blood flow to the heart (angina). Propranolol also may be used to treat various forms of anxiety including situational anxiety and post-traumatic stress disorders. Propranolol has minimal effects on cognition and treats the physical symptoms of anxiety such as high blood pressure, increased heart rate, and respiratory rate. Propranolol is not generally considered impairing. Use of propranolol in pilots for anxiety, essential tremors, or migraines requires case-by-case FAA evaluation of the underlying condition and response to treatment.

Azacyclonal is a metabolite of fexofenadine. Oxymetazoline is an over-the-counter nasal spray commonly used to treat nasal congestion from allergies. Fexofenadine and oxymetazoline are not generally considered impairing.

Administrative Information

Investigator In Charge (IIC):	Mccarter, Lawrence
Additional Participating Persons:	Jennifer Baraclay; Textron; Witchita, KS David Lewis; FAA/FSDO; Nashville, TN
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Note:	
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