Aviation Investigation Final Report

Location:	Burlington, North Carolina	**Accident Number:**	ERA13FA115
Date & Time:	January 16, 2013, 05:56 Local	**Registration:**	N68PK
Aircraft:	Pilatus PC-12/45	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Executive/Corporate		

Analysis

The pilot departed in night instrument flight rules (IFR) conditions on a medical specimen transport flight. During the climb, an air traffic controller told the pilot that the transponder code he had selected (2501) was incorrect and instructed him to reset the transponder to a different code (2531). Shortly thereafter, the airplane reached a maximum altitude of about 3,300 ft and then entered a descending right turn. The airplane's enhanced ground proximity warning system recorded a descent rate of 11,245 ft per minute, which triggered two "sink rate, pull up" warnings. The airplane subsequently climbed from an altitude of about 1,400 ft to about 2,000 ft before it entered another turning descent and impacted the ground about 5 miles northeast of the departure airport. The airplane was fragmented and strewn along a debris path that measured about 800-ft long and 300-ft wide.

Postaccident examination of the airplane did not reveal any preimpact mechanical malfunctions that would have precluded the pilot from controlling the airplane. The engine did not display any evidence of preimpact anomalies that would have precluded normal operation. An open resistor was found in the flight computer that controlled the autopilot. It could not be determined if the open resistor condition existed during the flight or occurred during the impact. If the resistor was in an open condition at the time of autopilot engagement, the autopilot would appear to engage with a mode annunciation indicating engagement, but the pitch and roll servos would not engage. The before taxiing checklist included checks of the autopilot system to verify autopilot function before takeoff. It could not be determined if the pilot performed the autopilot check before the accident flight or if the autopilot was engaged at the time of the accident.

The circumstances of the accident are consistent with the known effects of spatial disorientation. Dark night IFR conditions prevailed, and the track of the airplane suggests a loss of attitude awareness. Although the pilot was experienced in night instrument conditions, it is possible that an attempt to reset the transponder served as an operational distraction that contributed to a breakdown in his instrument scan. Similarly, if the autopilot's resistor was in an open condition and the autopilot had been engaged,

the pilot's failure to detect an autopilot malfunction in a timely manner could have contributed to spatial disorientation and the resultant loss of control.

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 due to spatial disorientation during the initial climb after takeoff in night instrument flight rules conditions.

Findings

Personnel issues	Spatial disorientation - Pilot
Personnel issues	Aircraft control - Pilot
Aircraft	(general) - Not attained/maintained
Environmental issues	Dark - Effect on personnel
Environmental issues	Clouds - Effect on personnel
Aircraft	Autopilot system - Not specified

Factual Information

History of Flight

Initial climb	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)
Post-impact	Fire/smoke (post-impact)

HISTORY OF FLIGHT

On January 16, 2013, about 0556 eastern standard time, a Pilatus PC-12/45, N68PK, operated by LabCorp, Inc., as Skylab 53 (SKQ53), was substantially damaged when it impacted terrain shortly after takeoff from Burlington-Alamance Regional Airport (BUY), Burlington, North Carolina. The airline transport pilot was fatally injured. Instrument meteorological conditions prevailed and an instrument flight rules (IFR) flight plan had been filed for the flight destined for the Morristown Municipal Airport (MMU), Morristown, New Jersey. The corporate flight was transporting medical specimens and was conducted under the provisions of 14 Code of Federal Regulations Part 91.

Review of Federal Aviation Administration (FAA) air traffic control (ATC) audio data revealed that at 0541, the pilot contacted Greensboro (GSO) clearance delivery, while on the ground at BUY, and requested an IFR clearance to MMU. The pilot was advised that there was no flight plan stored in the ATC system. His original flight plan had a proposed departure time of 0315 and the flight plan was only good for 2 hours. The pilot subsequently requested to file an IFR flight plan and provided the routing details.

At 0550, GSO ATC provided an IFR clearance to SKQ53 from BUY to MMU, which included an initial altitude of 3,000 feet. ATC subsequently provided a transponder code of 2531, an altimeter setting of 30.01, an initial vector of a left turn to 360 degrees after takeoff, and a clearance void time of 0600, at 0551:30. The pilot acknowledged, read back the assigned transponder code as 2501, and stated that he would be airborne in about 30 seconds.

At 0554, the pilot advised GSO ATC that he was "climbing through thirty." The pilot was asked to "ident" and responded that he was turning to a heading of 360 degrees at 3,000 feet. The pilot was then directed to reset his transponder to code 2531, which he acknowledged with "531."

At 0555, ATC advised the pilot that his transponder indicated a code of 2501 at an altitude of 2,000 feet. The pilot did not respond and ATC made numerous attempts to contact SKQ53 without success. The airplane was not radar identified by ATC.

The airplane was subsequently found fragmented in an athletic field that was located about 5 miles northeast of BUY.

PERSONNEL INFORMATION

According to FAA and company records, the pilot, age 57, held an airline transport pilot and flight instructor certificates, with ratings for airplane single-engine land, airplane multiengine land, and instrument airplane. The pilot's most recent FAA second-class medical certificate was issued on November 19, 2012.

According to the pilot's most recent logbook entry, as of January 11, 2013, he had accumulated about 6,370 hours of total flight experience, which included about 315 hours in the same make and model as the accident airplane. He had also logged about 600 hours of flight experience in actual instrument meteorological conditions, and about 3,245 hours as night flight experience. In addition, he had accumulated about 45 hours in the same make and model as the accident airplane during the 90 days preceding the accident, which included about 25, and 20 hours logged in night and actual meteorological conditions; respectively.

According to the company chief pilot, the accident pilot had been flying the PC12 approximately 4 days per week since September 2012. His current schedule called for morning flights with "show times" at 0330. On the day prior to the accident, the pilot flew from BUY to Charleston, West Virginia (CRW). He took a nap at CRW before flying to Columbus, Ohio (OSU), and returned to BUY about 0940. His duty time ended at 1015, on January 15, 2013.

According to company records, in November 2012, the chief pilot arranged for an evaluation flight for the accident pilot in a Pilatus PC12. The chief pilot asked the instructor pilot conducting the evaluation flight to not allow the accident pilot to use the autopilot and preferred that the flight be conducted without flight director programming.

Following the evaluation flight, the flight instructor noted that the accident pilot seemed to get behind the airplane because of lack of trim usage. This was usually masked when using the autopilot, which would input the correct trim for the airplane and was magnified when only using, or not using at all, the flight director. The instructor pilot made some suggestions to the accident pilot that included engine power settings and trim verification, which markedly improved his handling of the airplane. The instructor pilot added that the last two-thirds of the evaluation flight were satisfactory to FAA standards for an instrument rating and commercial pilot single-engine land privileges.

AIRCRAFT INFORMATION

According to FAA records, the low wing, T-tail, retractable-gear airplane, serial number 265, was issued an airworthiness certificate on July 6, 1999. It was constructed primarily of aluminum and powered by a Pratt & Whitney Canada PT6A-67B, turboprop engine, with a takeoff power rating of 1,200 shaft horsepower that was equipped with a Hartzell four-bladed hydraulically actuated, constant-speed propeller assembly.

According to the airplane flight manual, the flight control system utilized push-pull rods and carbon steel cables and were equipped with electric trim systems. Each wing contained a single piece fowler-type flap that was electrically actuated. The airplane was also equipped with a stick shaker-pusher system to improve handling in the low speed flight regime by preventing the airplane from inadvertently entering a stall condition.

According to maintenance records, the airplane's most recent inspection was a "300-hour mini inspection" that was performed on January 14, 2013, at a total airframe time of 4,637 hours. A crack on

the underside of the left flap was repaired on January 15, 2013. At the time of the accident, the airplane had been operated for about 4,650 total hours.

METEOROLOGICAL INFORMATION

The 0554 recorded weather observation at BUY included wind from 040 degrees at 4 knots, visibility 10 statute miles, broken cloud celling at 700 feet, overcast at 1,700 feet, temperature 4 degrees Celsius (C), dew point 3 degrees C; and an altimeter setting of 30.02 inches of mercury.

The 0700 Greensboro-High Point, North Carolina upper air sounding depicted a frontal inversion extending immediately about the surface to 3,533 feet agl. While the surface temperature was 4 degrees C, the freezing level was identified at 11,553 feet. No icing was indicated on the sounding due to the frontal inversion.

AERODROME INFORMATION

Burlington-Alamance Regional Airport was a non-tower-controlled airport with a common traffic advisory. It was equipped with single runway designated as runway 06/24. Runway 06/24 was constructed of asphalt, 6,405-feet-long, and 100-feet-wide. The field elevation for the airport was 616 feet above mean sea level (msl).

FLIGHT RECORDERS

The airplane was not equipped, nor was it required to be equipped with a cockpit voice recorder or flight data recorder.

WRECKAGE AND IMPACT INFORMATION

The elevation at the accident site was 531 feet msl and the majority of the wreckage was located strewn in a field. All major portions of the airplane, including all flight control surfaces and associated counterweights were located at the accident site. A debris path that was about 800 feet long, and 300 feet wide, was observed on a magnetic heading about 140 degrees. The right wing pitot tube was located about 10 feet from the initial impact point. Various sizes of wing spar segments were located in an impact crater. The crater was located on a berm, extended about 50 feet, and varied in depth to about 3 feet. The propeller hub, two propeller blades and the front reduction gear box were located in the crater. The third propeller blade was located about 200 feet along the debris path. The spinner was located in the vicinity of the third propeller blade. The fourth propeller blade and the propeller overspeed governor were located about 400 feet along the path. All four propeller blades exhibited S-bending damage.

The cabin area, just aft of frame 24 and forward of the aft pressure bulkhead, was located about 300 feet along the debris path. The right aileron and about one-third of the right flap were located with the cabin and with the nose landing gear. The empennage was located in the vicinity of the cabin. The horizontal and vertical stabilizers were impact damaged. The horizontal stabilizer came to rest inverted. The vertical stabilizer was fractured and came to rest on the horizontal stabilizer. The left wing was located on the right side of the debris path, about 350 feet from the initial impact point. Signatures on the bottom on the left wing, similar to fence impressions were noted. The cockpit was located about 350 feet from the initial impact point. Both cockpit seats and the throttle quadrant were located in the vicinity of the cockpit.

Flight control continuity was confirmed for the aileron, elevator, and rudder. Mechanical trim control continuity was confirmed for the horizontal stabilizer, aileron, and rudder trim systems. Measurement of the horizontal stabilizer trim actuator corresponded with a trim setting consistent in the takeoff range. Measurement of the aileron trim actuator corresponded with a neutral trim setting. The rudder trim actuator measured 1.125 inches, which was near the full right trim position of 1.18 inches. Examination of the inboard and outboard flap actuators corresponded to the retracted flap position. All 3 landing gear were in the up position.

The engine was located within the debris path. In the vicinity of the engine, there was evidence of a small postcrash fire. There was no soot staining or thermal damage observed on the wreckage that would have been consistent with an in-flight fire.

The engine sustained impact damage and was partially dissembled at the accident site. Rotational scoring was confirmed at both the compressor and power turbines, and mechanical continuity was confirmed from the compressor to the accessory gearbox. The engine displayed compressive deformation to the exhaust duct and the gas generator case. The compression was more pronounced on the front and bottom sections of the case and duct. The front and rear reduction gearboxes were separated at their respective mating flanges. The power turbine shaft was fractured consistent with torsional overload. The rear reduction gearbox and the power turbine shaft housing were separated from the engine. Rotational signatures on the compressor turbine, the 1st stage power turbine, and the 2nd stage power turbine from contact with their adjacent components were consistent with the engine producing power at the time of impact. Subsequent testing and examination of the fuel control unit and the fuel pump did not reveal any preimpact anomalies that would have prevented normal operation. The engine did not display any indications of any pre-impact anomalies that would have precluded normal engine operation.

MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy was performed on the pilot by the North Carolina Department of Health and Human Services, Office of the Chief Medical Examiner, Raleigh, North Carolina. Review of the autopsy report revealed that the cause of death was identified as "Massive blunt force trauma due to plane crash."

The FAA Civil Aerospace Medical Institute toxicology report was negative for all drugs in the screening profile. In addition, the report stated that no ethanol was detected in muscle or liver. A carbon monoxide test was not performed.

TESTS AND RESEARCH

Autopilot Flight Computer

The airplane was equipped with a KFC-325 autopilot system. Several components of the autopilot system were forwarded to their manufacturer, Honeywell, Olathe, Kansas, for examination under the supervision of an FAA inspector.

Examination of the KCP-220 flight computer revealed no physical damage to the circuit cards. A return to service test was conducted for the applicable airframe, which required replacement of the personality modules. The unit powered up and passed the self-test; however, the "AP CLU" lamp indicated there was no drive voltage to the Autopilot Roll and Pitch Servo clutches. Subsequent troubleshooting

revealed that the R-259 resistor, which did not contain any obvious signs of physical damage, was open. The resistor was manufactured by Ohmite. It could not be determined if the open condition existed during the flight or was the result of impact forces. It could also not be determined if the autopilot was engaged at the time of the accident.

According to Honeywell, during autopilot operation, a drive voltage is applied to the "AP Clutch Engage" solenoid when the autopilot is activated. This drive voltage enables the roll and pitch servos by engaging the clutches. If the autopilot is not engaged, the open R-259 resistor would have no effect on the flight control system. If the resistor is in an open condition at the time of autopilot engagement, the autopilot will appear to engage with a mode annunciation indicating engagement, but the pitch and roll servos will not engage. If the R-259 resistor becomes open while the autopilot is engaged, the pitch and roll servos will disengage and an aural warning would sound. The unit passed all return to service tests after the R-259 resistor was replaced.

According to Honeywell, any failure of the R-259 resistor would not affect a pilot's ability to manually control the airplane. In addition, the before taxiing checklist of the airplane flight manual (AFM) included checks of the autopilot system to verify autopilot function prior to takeoff, and section 4.20.1 Autopilot Operation Summary, included a warning which stated, in part: "The pilot in command must continuously monitor the autopilot when it is engaged, and be prepared to disconnect the autopilot and take immediate corrective action – including manual control of the airplane and/or performance of emergency procedures – if autopilot operation is not as expected or if airplane control is not maintained…."

During March 2015, Honeywell issued service bulletin KCP 220-22-A0017, which included an inspection and replacement of the R-259 resistor on certain KCP-220 Flight Computers, if the resistor was manufactured by Ohmite or if the manufacturer could not be determined.

Central Advisory and Warning System

The airplane's Central Advisory and Warning System display unit was examined for filament analysis by the NTSB Materials Laboratory, Washington, DC. The "INERT SEP" (Inertial Separator), "PROBES DEICE", "FLAPS" and "WSHLD HEAT" were found to have hot coil filament stretching on one or both bulb filaments. With regards to the "FLAPS" caution, while it was noted that all 4 flap actuators were in a position consistent with the retracted position, a Pilatus representative noted that if the flap computer detected a flap malfunction which was not resettable, the flaps would not have been available for landing and appropriate procedures were provided for such a condition in the airplane flight manual.

Flap Control and Warning Unit

The airplane's Flap Control and Warning Unit (FCWU) was initially examined by the NTSB Vehicle Recorders Laboratory, Washington, DC, and subsequently downloaded by its manufacturer, EMCA Electronic Ltd., Horw, Switzerland, under the supervision of an investigator from the Swiss Accident Investigation Board (AIB). The download revealed no error codes stored in the FCWU's non-volatile memory unit.

Elevator and Stick Pusher Assembly

Portions of the elevator and stick pusher assembly consisting of a section of the elevator control cable and the entire length of the bridle cable were examined at the NTSB Materials Laboratory, Washington, DC, and then tested at Pilatus, Stans, Switzerland, under the supervision of an investigator from the Swiss AIB. Bridle cable displacement from its original manufactured position was noted. On the forward cable clamp, the extension of the bridle cable past the end of the clamp was 29mm (29 millimeters), in accordance with the airplane maintenance manual. On the aft clamp, only the bead on the end of the bridle cable extended past the end of the clamp approximately 1mm (1 millimeter). The length of the bridle cable between the forward clamp and turnbuckle was 5 mm (5 millimeters). Examination of the capstan pulley revealed mechanical damage to the periphery of the pulley with no anomalous wear. A tensile load test of the clamp assemblies revealed that both the forward and aft cable clamps resisted slippage on the control cable beyond the expected operational force of 600N (600 newtons); however, the force that resulted in the displacement of the aft clamp from its manufactured position could not be determined. [Additional information can be found in Materials Laboratory Factual Report No. 15-031 located in the public docket.]

ADDITIONAL INFORMATION

Airplane Flight Path

Radar data obtained from FAA revealed a radar target at 0553:36 consistent with the accident airplane about .75 mile from the departure end of runway 6, at 1,800 feet and climbing. The airplane flew on northeasterly heading and reached an altitude of 3,200 feet at 0554:50.

The accident airplane was equipped with a KMH 820 Multi-hazard computer. According to Honeywell, when an enhanced ground proximity warning system (EGPWS) alerting event occurs, an alert history record will be created in non-volatile memory. Each alert record contains a history of EGPWS signals from 20 seconds prior to the event to 10 seconds after the event. The KMH-820 was sent to Honeywell, Redmond, Washington, and successfully downloaded under the supervision of an NTSB investigator.

The takeoff time recorded in the status log was about 2 minutes prior to the beginning of recorded flight data, which began about 0554:46. At that time, the airplane was at an altitude about 3,200 feet, a ground speed about 208 knots, and a heading about 030 degrees. The airplane was in a right turn and reached a maximum recorded altitude of about 3,326 feet about 10 seconds later, before entering a descending right turn. About 0555:05, a descent rate of 11,245 feet per minute was recorded which was followed by a "sink rate" and "pull up" warning. Shortly thereafter, the GPS signal was lost. A second "pull up" warning was recorded about 0555:13, at an altitude of about 1,400 feet. Shortly thereafter, the recorded altitude indicated a climb to about 2,000 feet, which was the last recorded altitude on the KMH-820.

Radar data indicated that the airplane was at altitude of 2,000 feet, and a heading of about 065 degrees at 0555:46. Approximately 4 seconds later, the airplane was at an altitude of 1,900 feet, and a heading of about 140 degrees, which was followed by the last recorded radar target at 0555:55, at an altitude of 1,400 feet and a heading of about 100 degrees.

Spatial Disorientation

According to the FAA Instrument Flying Handbook (FAA-H-8083-15A), flying in instrument meteorological conditions can result in sensations that are misleading to the body's sensory system. FAA-H-8083-15A further stated:

"…Orientation is the awareness of the position of the aircraft and of oneself in relation to a specific reference point. Disorientation is the lack of orientation, and spatial disorientation specifically refers to the lack of orientation with regard to position in space and to other objects.

Orientation is maintained through the body's sensory organs in the three areas: visual, vestibular, and postural. The eyes maintain visual orientation. The motion sensing system in the inner ear maintains vestibular orientation. The nerves in the skin, joins, and muscles of the body maintain postural orientation. When healthy human beings are in their natural environment, these three systems work well. When the human body is subjected to the forces of flight, these senses can provide misleading information. It is this misleading information that causes pilots to become disoriented…."

Pilot Information

Certificate:	Airline transport; Flight instructor	**Age:**	57,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	November 19, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	July 15, 2012
Flight Time:	6369 hours (Total, all aircraft), 315 hours (Total, this make and model), 6234 hours (Pilot In Command, all aircraft), 166 hours (Last 90 days, all aircraft), 42 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Pilatus	**Registration:**	N68PK
Model/Series:	PC-12/45	**Aircraft Category:**	Airplane
Year of Manufacture:	1999	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	265
Landing Gear Type:	Retractable - Tricycle	**Seats:**	2
Date/Type of Last Inspection:	January 14, 2013 AAIP	**Certified Max Gross Wt.:**	9921 lbs
Time Since Last Inspection:	12 Hrs	**Engines:**	1 Turbo prop
Airframe Total Time:	4637 Hrs as of last inspection	**Engine Manufacturer:**	P&W CANADA
ELT:	C126 installed, not activated	**Engine Model/Series:**	PT6A-67B
Registered Owner:	REGIONS EQUIPMENT FINANCE CORP	**Rated Power:**	1200 Horsepower
Operator:	LABORATORY CORPORATION OF AMERICA HOLDINGS	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	BUY,616 ft msl	**Distance from Accident Site:**	5 Nautical Miles
Observation Time:	05:54 Local	**Direction from Accident Site:**	215°
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:	Broken / 700 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots / None	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	40°	**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	30.02 inches Hg	**Temperature/Dew Point:**	4°C / 3°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Burlington, NC (BUY)	**Type of Flight Plan Filed:**	IFR
Destination:	MORRISTOWN, NJ (MMU)	**Type of Clearance:**	IFR
Departure Time:	05:53 Local	**Type of Airspace:**	

Airport Information

Airport:	Burlington-Alamance Regional BUY	**Runway Surface Type:**	Asphalt
Airport Elevation:	616 ft msl	**Runway Surface Condition:**	Unknown
Runway Used:	06	**IFR Approach:**	None
Runway Length/Width:	6405 ft / 100 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	36.113609,-79.420555(est)

Administrative Information

Investigator In Charge (IIC):	Neylon, John
Additional Participating Persons:	Michael Harville; Greensboro FSDO; Greensboro, NC Konrad Oetiker; Pilatus-Switzerland; Stans Bob Renshaw; Pilatus-USA; Denver, CO Jeff Davis; Pratt & Whitney Canada; Bridgeport, WV Michael Foster; Honeywell; Olathe, KS Michael Flueckiger; Swiss AIB; Payerne
Original Publish Date:	January 14, 2016
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=86029