



# Aviation Investigation Final Report

|                                |                                      |                         |             |
|--------------------------------|--------------------------------------|-------------------------|-------------|
| <b>Location:</b>               | Atlanta, Georgia                     | <b>Accident Number:</b> | ERA13LA252  |
| <b>Date &amp; Time:</b>        | May 23, 2013, 14:56 Local            | <b>Registration:</b>    | N8225T      |
| <b>Aircraft:</b>               | Beech A36                            | <b>Aircraft Damage:</b> | Substantial |
| <b>Defining Event:</b>         | Aerodynamic stall/spin               | <b>Injuries:</b>        | 5 None      |
| <b>Flight Conducted Under:</b> | Part 91: General aviation - Personal |                         |             |

## Analysis

The pilot reported that, before the flight, he checked the weather and obtained a full weather briefing from flight service. After he boarded the passengers and loaded the luggage into the airplane, the pilot conducted a preflight inspection and noted that everything was "good." During taxi, he asked the air traffic controller if he could take off from runway 3R because it was the longest runway. He then conducted an engine run-up and noted that everything was normal. While holding short of the runway, the pilot heard another pilot ask the controller for a wind check, and the controller replied that the wind was from 300 degrees. Because that would result in a direct crosswind for runway 3R, the pilot asked if runway 34 was available, and the controller replied that it was closed. While waiting for departure, the pilot noted that the windsock seemed to be indicating a slight quartering tailwind. During the takeoff, he applied left aileron because of the crosswind. As he rotated the airplane, "something didn't feel right." The stall warning horn then started "chirping," and the airplane turned into the wind and did not take off with "its usual vigor." He leveled off to stop the stall horn and stated that the engine didn't sound right. He decided to abort the takeoff when the airplane was about 30 ft above ground level (agl). He reduced power and tried to glide the airplane to land. However, shortly thereafter, the stall warning horn "blared," and the airplane entered an aerodynamic stall and impacted the runway. Examination of the wreckage and recorded engine monitor data revealed no evidence of failures or malfunctions.

One of the passengers recorded the takeoff and accident sequence on his cell phone. The video showed that, after the pilot rotated the airplane for takeoff, the stall warning horn sounded; the airplane was in a nose-high attitude and had reached an altitude of between 50 and 100 feet agl when the pilot reduced the power. The video then showed the airplane descending until the sound of impact was heard. During the takeoff, the engine sounded constant and normal.

The reported wind about the time of the accident was 290 degrees at 13 knots gusting to 18 knots. According to the Aircraft Flight Manual/Pilot's Operating Handbook (AFM/POH), these conditions would have resulted in a crosswind component that, during portions of the takeoff and initial climb, would have exceeded the airplane's maximum demonstrated crosswind of 17 knots and would have

resulted in a 2- to 4-knot tailwind component. Further, two pilots reported low-level windshear at the airport about the time of the accident. No convective echoes existed in the local area about the time of the accident; therefore, a microburst event did not occur at the airport at the time of the accident. High-density altitude conditions existed around the time of the accident, which would also have degraded the airplane's performance and increased the distance needed for the takeoff roll. The pilot should have accounted for the crosswind, the tailwind, and the high-density altitude conditions in his preflight planning, but he did not do so.

A review of the pilot's weight and balance calculations revealed that he underestimated the occupant and baggage weights in his calculations and used an inaccurate airplane empty weight. Recalculations using accurate weights revealed that the airplane was operating at least 100 pounds over the published maximum takeoff weight at the time of the accident and that the center of gravity (CG) was farther aft than the pilot had calculated. The AFM/POH performance charts only provide data for operating up to the airplane's maximum takeoff weight; it cautions that if loaded above the maximum takeoff weight, the takeoff distance will be longer, the stall speed will be higher, and the climb rate will be lower than that shown in the performance charts.

Pilots are expected to perform airplane performance calculations and determine takeoff distances using accurate weight and balance information and taking into account other important factors, such as wind and pressure conditions, that can affect climb performance and takeoff distance. However, the accident pilot did not properly calculate the airplane's weight and balance during his preflight calculations, and he overloaded the airplane at an aft CG, which would have degraded the airplane's performance. Further, he did not account for the high-density altitude or wind conditions at the airport at the time of the accident, which would have further degraded the airplane's performance. Therefore, it is likely that the airplane was not able to achieve a positive climb rate and that its nose was pitched up due to the combined effects of these conditions, which led it to exceed its critical angle-of-attack and subsequently stall.

## **Probable Cause and Findings**

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

The pilot's inadequate preflight planning, which resulted in the airplane being loaded in excess of its maximum gross weight at an aft center of gravity for a takeoff with a quartering tailwind and high-density altitude conditions, all of which degraded the airplane's climb performance and led to the airplane exceeding its critical angle-of-attack and experiencing an aerodynamic stall.

## Findings

|                             |   |
|-----------------------------|---|
| <b>Personnel issues</b>     | Use of manual - Pilot                             |
| <b>Personnel issues</b>     | Weight/balance calculations - Pilot               |
| <b>Personnel issues</b>     | Performance calculations - Pilot                  |
| <b>Personnel issues</b>     | Decision making/judgment - Pilot                  |
| <b>Aircraft</b>             | CG/weight distribution - Incorrect use/operation  |
| <b>Aircraft</b>             | Climb rate - Not attained/maintained              |
| <b>Personnel issues</b>     | Aircraft control - Pilot                          |
| <b>Aircraft</b>             | Maximum weight - Capability exceeded              |
| <b>Aircraft</b>             | Airspeed - Not attained/maintained                |
| <b>Aircraft</b>             | Angle of attack - Not attained/maintained         |
| <b>Aircraft</b>             | Maximum crosswind component - Capability exceeded |
| <b>Environmental issues</b> | High density altitude - Effect on equipment       |
| <b>Environmental issues</b> | Crosswind - Effect on equipment                   |

## Factual Information

### History of Flight

|                             |   |
|-----------------------------|---|
| <b>Prior to flight</b>      | Aircraft loading event                  |
| <b>Initial climb</b>        | Aerodynamic stall/spin (Defining event) |
| <b>Initial climb</b>        | Loss of control in flight               |
| <b>Uncontrolled descent</b> | Collision with terr/obj (non-CFIT)      |

On May 23, 2013, about 1456 eastern daylight time a Beech A36, N8225T, operated by Bonanza 5 Incorporated, was substantially damaged when it entered an aerodynamic stall and impacted terrain shortly after takeoff at DeKalb-Peachtree Airport (PDK), Atlanta, Georgia. The private pilot and four passengers were not injured. Visual meteorological conditions prevailed, and an IFR flight plan had been filed for the personal flight destined for Venice Municipal Airport (VNC), Venice, Florida, which was conducted under Title 14 Code of Federal Regulations Part 91.

According to the pilot, the purpose of the flight was to fly to VNC for fuel and then continue on to their final destination, Key West International Airport (EYW), Key West, Florida. In anticipation of having a "full load" of passengers and baggage, two days before the trip the pilot had fueled the airplane up to the "slots", which equated to 70 gallons of usable fuel onboard. On the day of the flight, he checked the weather and obtained a full weather briefing from flight service before leaving for the airport.

When he and his passengers arrived at the airport, they loaded their possessions into the airplane and the pilot conducted a preflight inspection of the airplane. Everything was "good" and they pulled the plane out of the hangar, put their cars in the hangar, and got in the airplane. He then started the engine and started to taxi. One of the passengers however, had left his iPad in the hangar, so he taxied back to the hangar, shut down, and the passenger retrieved it.

When the passenger returned, the pilot started the airplane again and taxied out to the end of the row of hangars, obtained the field conditions from the airport terminal information service, received his IFR clearance to VNC, then his clearance to taxi, and set the altimeter setting in the Kollsman window. He was cleared to taxi to runway 3L but, asked for runway 3R as he preferred to use runway 3R which was the longest runway at PDK. He then taxied to the run up area for runway 3L and completed the run up. Again, everything was normal.

He was then cleared to cross 3L and hold short of 3R while waiting for release from air traffic control. There was a King Air behind him and he was asked to move over to let him by, which he did. Around this time, someone asked for a wind check and the tower replied that the wind was from 300 degrees (a direct cross wind). He then asked if Runway 34 was available and was told it was closed because of an air show. Then while they were waiting, or when they were cleared to depart, he looked at the wind sock and it seemed to be indicating a slight quartering tailwind.

He performed a static takeoff, and double checked that all instruments were normal and in the green

before releasing the brakes. At 50 knots indicated airspeed he cross-checked the instruments and everything was normal. He would normally try and rotate around 80-84 Knots and leave the landing gear down as long as there was runway remaining. He could not recall exactly what speed he rotated at, but it was "probably around 80 knots". Because of the cross wind, he applied left aileron during the takeoff. As he rotated, something didn't feel right. The stall warning horn started "chirping", the plane then turned into the wind, and did not takeoff with "its usual vigor". He leveled off to stop the stall horn and it still didn't feel right. The engine also didn't sound right. He believed that something was wrong and that he should abort the takeoff. He was not sure of his exact altitude at this point, but guessed that he was probably 30 feet above ground level. The engine, or prop, still didn't sound right. He still had runway remaining ahead of him and the landing gear was still down, so he radioed that he was "putting it back down". He decided to land on the runway and not risk an over run, so he reduced power and tried to glide it in. Shortly thereafter, the stall warning horn "blared", the airplane entered an aerodynamic stall and impacted the runway.

### Pilot Information

|                                  |   |  |                   |
|----------------------------------|---|--|-------------------|
| <b>Certificate:</b>              | Private   | <b>Age:</b>                              | 53                |
| <b>Airplane Rating(s):</b>       | Single-engine land; Multi-engine land   | <b>Seat Occupied:</b>                    | Left              |
| <b>Other Aircraft Rating(s):</b> | None  | <b>Restraint Used:</b>                   | 3-point           |
| <b>Instrument Rating(s):</b>     | Airplane  | <b>Second Pilot Present:</b>             | No                |
| <b>Instructor Rating(s):</b>     | None  | <b>Toxicology Performed:</b>             | No                |
| <b>Medical Certification:</b>    | Class 3 Without waivers/limitations   | <b>Last FAA Medical Exam:</b>            | August 28, 2012   |
| <b>Occupational Pilot:</b>       | Yes   | <b>Last Flight Review or Equivalent:</b> | December 20, 2012 |
| <b>Flight Time:</b>              | 613 hours (Total, all aircraft), 306 hours (Total, this make and model), 547 hours (Pilot In Command, all aircraft), 9 hours (Last 90 days, all aircraft), 3 hours (Last 30 days, all aircraft) |  |                   |

According to Federal Aviation Administration (FAA) and pilot records, the pilot held a private pilot certificate with ratings for airplane single-engine land, multi-engine land, and instrument airplane. His most recent application for a FAA third-class medical certificate was dated October 28, 2012. The pilot reported that he had accrued 613 total hours of flight experience, of which 306 hours were in the accident airplane make and model.

## Aircraft and Owner/Operator Information

|                                      |                                |                                       |                 |
|--------------------------------------|--------------------------------|---------------------------------------|-----------------|
| <b>Aircraft Make:</b>                | Beech                          | <b>Registration:</b>                  | N8225T          |
| <b>Model/Series:</b>                 | A36                            | <b>Aircraft Category:</b>             | Airplane        |
| <b>Year of Manufacture:</b>          | 1993                           | <b>Amateur Built:</b>                 |                 |
| <b>Airworthiness Certificate:</b>    | Normal                         | <b>Serial Number:</b>                 | E-2801          |
| <b>Landing Gear Type:</b>            | Retractable - Tricycle         | <b>Seats:</b>                         | 6               |
| <b>Date/Type of Last Inspection:</b> | March 4, 2013 Annual           | <b>Certified Max Gross Wt.:</b>       | 3600 lbs        |
| <b>Time Since Last Inspection:</b>   | 55 Hrs                         | <b>Engines:</b>                       | 1 Reciprocating |
| <b>Airframe Total Time:</b>          | 3763 Hrs as of last inspection | <b>Engine Manufacturer:</b>           | CONT MOTOR      |
| <b>ELT:</b>                          | Installed, not activated       | <b>Engine Model/Series:</b>           | IO-550-B        |
| <b>Registered Owner:</b>             | BONANZA FIVE INC               | <b>Rated Power:</b>                   | 300 Horsepower  |
| <b>Operator:</b>                     | BONANZA FIVE INC               | <b>Operating Certificate(s) Held:</b> | None            |

According to FAA and airplane maintenance records, the airplane was manufactured in 2006. The airplane's most recent annual inspection was completed on March 14, 2013. At the time of the accident the airplane had accrued 3,763 total hours of operation.

## Meteorological Information and Flight Plan

|   |                                  |   |                  |
|---|----------------------------------|---|------------------|
| <b>Conditions at Accident Site:</b>     | Visual (VMC)                     | <b>Condition of Light:</b>                  | Day              |
| <b>Observation Facility, Elevation:</b> | PDK, 1003 ft msl                 | <b>Distance from Accident Site:</b>         | 0 Nautical Miles |
| <b>Observation Time:</b>                | 14:56 Local                      | <b>Direction from Accident Site:</b>        |                  |
| <b>Lowest Cloud Condition:</b>          | Few / 5000 ft AGL                | <b>Visibility:</b>                          | 10 miles         |
| <b>Lowest Ceiling:</b>                  | None                             | <b>Visibility (RVR):</b>                    |                  |
| <b>Wind Speed/Gusts:</b>                | 13 knots / 18 knots              | <b>Turbulence Type Forecast/Actual:</b>     | / None           |
| <b>Wind Direction:</b>                  | 290°                             | <b>Turbulence Severity Forecast/Actual:</b> | / N/A            |
| <b>Altimeter Setting:</b>               | 29.97 inches Hg                  | <b>Temperature/Dew Point:</b>               | 28°C / 16°C      |
| <b>Precipitation and Obscuration:</b>   | No Obscuration; No Precipitation |   |                  |
| <b>Departure Point:</b>                 | Atlanta, GA (PDK )               | <b>Type of Flight Plan Filed:</b>           | IFR              |
| <b>Destination:</b>                     | Venice, FL (VNC )                | <b>Type of Clearance:</b>                   | IFR              |
| <b>Departure Time:</b>                  | 14:56 Local                      | <b>Type of Airspace:</b>                    | Class C          |

The following meteorological information was derived from multiple sources:

### Recorded Weather

The recorded weather at PDK, at 1456, included: winds from 290 degrees at 13 knots gusting to 18

knots, 10 miles visibility, few clouds at 5,000 feet, scattered clouds at 6,500 feet, temperature 28 degrees C, dew point 16 degrees C, and an altimeter setting of 29.98 inches of mercury.

### Density Altitude

Calculations using the recorded temperature, station pressure, and dew point, for PDK indicated, that the density altitude for the airport was, approximately 2,899 feet above sea level around the time of the accident.

### Synoptic Conditions

The National Weather Service (NWS) Surface Analysis chart for 1400 edt, depicted a cold front extending across eastern Kentucky, Tennessee, into northern Alabama, Mississippi, into Louisiana moving southeastward. The chart depicted a relative weak pressure gradient across the area with wind from the west-northwest at about 10 knots across northern Georgia.

The NWS NEXRAD Mosaic of WSR-88D radars across the southeast indicated no significant meteorological echoes in the Atlanta vicinity at 1450 edt.

### Pilot Reports

There were 2 pilot reports of low-level wind shear reported at 1420 and 1840 EDT from aircraft landing at KPDK, and reported wind shear of plus or minus 10 to 15 knots within the lowest 200 feet agl of runway 3R.

### Sounding

The Atlanta-Peachtree City 0800 sounding depicted a frontal inversion immediately above the surface to about 1360 feet. The sounding had a relative humidity greater than 80 percent from the surface to 8,000 feet. The wind profile indicated a surface wind from the west or 285 degrees at 4 knots with wind veering to the northwest immediately above the inversion to 5,000 feet and then backing to the west with height. A low level wind maximum was identified at 2,000 feet with the wind from 320 degrees at 23 knots. As a result a low-level turbulence potential existed within the lowest 1,000 feet of the surface. The mean 0 to 6 kilometer or 18,000 feet wind from 278 degrees at 22 knots.

### Satellite

The Geostationary Orbiting Environmental Satellite (GOES-14) visible image at 1445 depicted scattered fair weather cumulus clouds surrounding the area. No cumulonimbus or cumulus congestus type clouds were identified in the vicinity that could have produced any microburst type activity, and no outflow boundaries were identified for any significant shifts in wind direction

### Radar

The NWS Atlanta WSR-88D radar depicted no meteorological echoes in the vicinity during the period, only ground cluster associated with the surface based temperature inversion and false echoes.

## Airport Information

|                             |                              |                                  |          |
|-----------------------------|------------------------------|----------------------------------|----------|
| <b>Airport:</b>             | DeKalb-Peachtree Airport PDK | <b>Runway Surface Type:</b>      | Concrete |
| <b>Airport Elevation:</b>   | 1003 ft msl                  | <b>Runway Surface Condition:</b> | Dry      |
| <b>Runway Used:</b>         | 03R                          | <b>IFR Approach:</b>             | None     |
| <b>Runway Length/Width:</b> | 6001 ft / 100 ft             | <b>VFR Approach/Landing:</b>     | None     |

DeKalb-Peachtree Airport was located approximately 8 miles northeast of the city of Atlanta, Georgia.

According to the Airport Facility Directory, PDK had four runways oriented in a 3R/21L, 16/34, 3L/21R, and 9/27 configuration. Runway 3R was concrete, grooved, and in good condition. The total length of the runway was 6,001 feet, and its width was 100 feet.

It was equipped with nonprecision runway markings, in good condition, high intensity runway edge lights, and runway end identifier lights.

## Wreckage and Impact Information

|                            |        |                             |                           |
|----------------------------|--------|-----------------------------|---------------------------|
| <b>Crew Injuries:</b>      | 1 None | <b>Aircraft Damage:</b>     | Substantial               |
| <b>Passenger Injuries:</b> | 4 None | <b>Aircraft Fire:</b>       | None                      |
| <b>Ground Injuries:</b>    | N/A    | <b>Aircraft Explosion:</b>  | None                      |
| <b>Total Injuries:</b>     | 5 None | <b>Latitude, Longitude:</b> | 33.871944,-84.301109(est) |

Examination of the airplane by a Federal Aviation Administration inspector revealed no evidence of any preimpact failure or malfunction of the airplane that would have precluded normal operation. Further examination revealed that, the airplane had incurred substantial damage to the wings and fuselage.

## Flight recorders

The airplane was not equipped with a cockpit voice recorder (CVR) or a flight data recorder (FDR), nor was it required to be equipped with a CVR or FDR under the CFRs. The airplane was however, equipped with an engine monitoring system that had recording capability, and one of the passengers had a cell phone that was capable of recording video which was operating during the takeoff and initial accident sequence.

Engine Monitor



The J.P. Instruments (JPI) EDM-700 was a panel mounted instrument enabling the operator to monitor and record up to 24 parameters related to engine operations. Depending on the installation, engine parameters monitored could include: exhaust gas temperature (EGT), cylinder head temperature (CHT), oil pressure and temperature, manifold pressure, outside air temperature, turbine inlet temperature (TIT), engine revolutions per minute, compressor discharge temperature, fuel flow, carburetor temperature, and battery voltage. The unit could also calculate, in real-time, horsepower, fuel used, shock cooling rate and EGT differentials between the highest and lowest cylinder temperatures. The calculations were also based on the aircraft installation.

The unit contained non-volatile memory for data storage of the parameters recorded and calculated. The rate at which the data was stored was selectable by the operator from 2 to 500 seconds per sample. The memory could store up to 20 hours of data at a 6 second sample rate. The data could then be downloaded by the operator using J.P. Instruments software.

The unit was in good condition and data was extracted normally. The unit contained recorded data over 13 power cycles, recorded at a sample rate of once every 6 seconds. The recorded data spanned dates of April 27, 2013 through the accident flight on May 23, 2013, as recorded by the unit internal clock. The parameters recorded were EGT, CHT, voltage, and fuel flow. Additionally, the calculated shock cooling rate and maximum difference between EGT sensors was also recorded. No other parameters were recorded by the unit.

When the unit was powered on, it displayed 71 gallons of fuel remaining and 2 gallons of fuel used. The EDM-700 recorded time of the first data sample based on the unit's internal clock. This clock was set and updated by the operator. Examination of the recorded data, and comparison with the reported accident time, indicated the EDM-700 internal clock was set to Coordinated Universal Time (UTC), but was 10 minutes ahead of actual UTC. As such, 10 minutes was subtracted from all EDM-700 recorded times to correct for the error.

Review of the data revealed that, fuel flow began to increase above 5 gallons per hour (gph) at approximately 14:47:08 achieving a value of about 26 gph by 14:47:20. Coincident with the fuel flow increase, the EGT and CHTs also increased. At about 14:47:44, the fuel flow began to decrease from 26 gph, reaching 5 gph by 14:47:56 and then 0 gph by the end of the recording at 14:48:08. Throughout the recording, CHT-5 was the coolest recorded cylinder.

#### Cell Phone

The video file that was retrieved from the cell phone was in an MP4 format of 1920 X 1080 resolution at 29.97 frames per second with a 48000Hz audio track. The video was recorded with the cell phone oriented in a vertical position, causing the file to be cropped and two black bars added to either side of the video to maintain a 16:9 aspect ratio.

The video was shot by a rearward facing passenger, on the right side of the airplane. The video captured the view out of the right rear passenger window looking toward the airplane's right horizontal stabilizer. As the video progressed, a portion of the airplane's cabin was captured including a view of the baggage storage area and another passenger sitting in the rearmost, forward facing seat, on the left side of the

cabin. An additional passenger was also seen briefly as the camera panned during the recording. The video was 36 seconds and 19 frames in length (36.43 seconds).

Time in the video is expressed as video elapsed time, which is the time from the beginning of the recording. Times are expressed as SSFF, where SS represents seconds and FF frames of video elapsed time. Additionally, the video elapsed time in seconds has been added in parentheses immediately following the convention noted above.

The video began with a view out of the right rear window during the takeoff roll, with the airplane accelerating on the ground. The recorded engine noise on the audio track sounded constant and healthy, which concurred with the data that was downloaded from the engine monitor. At 1018 (10.6 sec.) as the airplane continued its takeoff roll, the camera began to pan toward the interior of the airplane. As the camera panned right, at 1408 (14.26 sec.), the reference to the horizon was lost. As the camera panned inside the airplane a view of the baggage area was shown and a young adult male was seen reading in the left rear forward facing seat. The baggage area was noted to have an amount of luggage (restrained by a cargo net) great enough to fill the cabin to the ceiling. Additional baggage could also be seen piled up on the floor in front of the cargo net area. The camera continued to pan right, and at 1418 (14.6 sec.), the horizon became visible again, outside of the left rear passenger window. At approximately 1515 (15.5 sec.) an airplane pitch change in the positive (up) direction was observed and the airplane rotated for takeoff. Almost immediately after rotation however, at 1602 (16.06 sec.), the stall warning horn was heard to annunciate. The airplane continued in a nose up attitude as the camera panned camera right, at 1701 (17.03 sec.), the left side, rearward facing, adult passenger, was captured. At this instant the stall warning alarm was intermittent at a high rate.

Between 1800 (18.0 sec.) and 1900 (19.0 sec.), the stall warning alarm briefly ceased, and little change in pitch attitude was noted, which indicated that the airplane was still pitched nose up. At 2006 (20.2 sec.), the stall warning horn was heard again, and it continued to fluctuate in frequency. At 2020 (20.66 sec.), the camera panned back toward the left rear, forward facing, passenger, and the airplane was noted to be in a nose high attitude. At 2300 (23.0 sec.), the horizon was visible again. At this moment, the camera panned back to the left outside of the right rear window, and showed that the airplane was in a nose high attitude. Between 2500 (25.0 sec.) and 2700 (27.0 sec.) a sound similar to a very slight engine surge was noted. At 3001 (30.03 sec.), the airplane appeared to have reached its highest altitude (50 to 100 feet above the runway surface). At the same instant, the engine noise reduced by a significant amount. By 3311 (33.36 sec.), the camera showed the elevator control surface exhibiting a range of motion between neutral and a positive pitch command which continued until the end of the recording. At 3316 (33.53 sec.), the stall warning horn became steady for the remainder of the recording. The airplane was in an obvious descent and at 3505 (35.16 sec.), the elevator could last be seen exhibiting a significant pitch up command. The camera then rapidly changed its field of view, and at 3529 (35.96 sec.) the sound of impact was heard. The recording terminated at 3613 (36.43 sec.).

## Tests and Research

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Weight and Balance

Review of the pilot's weight and balance revealed that he had calculated that the airplane was approximately 5 pounds below its maximum takeoff weight of 3,650 pounds. Further review revealed however that the empty weight listed did not agree with either the empty weight that was in the airplane flight manual / pilot's operating handbook (AFM/POH) or any of the flying club's weight and balance sheets that was supplied to members for the airplane.

Review of flying club documents also revealed that the equipment both onboard and installed on the airplane had changed over the years however, it was discovered that all of the changes were not reflected in the airplane's equipment list in the AFM/POH.

Review of the video recording had revealed that the baggage area had an amount of luggage (restrained by a cargo net) great enough to fill the cabin to the ceiling, and that additional baggage could also be seen piled up on the floor in front of the cargo net area. Review of the pilot's weight and balance however indicated that only 15 pounds of baggage was stowed in the aft luggage area.

There were five occupants onboard the airplane. Comparison of the occupants weights listed on the pilot's weight and balance to the occupant weights provided to the NTSB, indicated the total occupant weight was greater than originally calculated by the pilot.

According to the pilot, he advised that he had 67 gallons of fuel onboard at takeoff. Review of his weight and balance and the fuel indicating system revealed that there was at least 70 gallons (420 pounds) of fuel onboard when the airplane came to rest.

Further review of the pilot's weight and balance and reweighing of the baggage revealed that the airplane at the time of the accident was at least 100 pounds over its maximum takeoff weight, and that the center of gravity of the airplane was further aft than originally calculated by the pilot.

#### Performance Information

Examination of the weather conditions revealed that the winds at the time were approximately 290 degrees at 13 knots gusting to 18 knots. According to the AFM/POH this would have resulted in a crosswind component which during portions of the takeoff and initial climb would have exceeded the manufacturer's demonstrated crosswind of 17 knots and would have resulted in a tailwind component of 2 to 4 knots.

Further review of the AFM/POH also revealed that the performance charts only provided data for operation up to the airplane's maximum takeoff weight. Therefore, though the airplane's performance would have been degraded due to the airplane being loaded above its maximum takeoff weight and aft of the calculated center of gravity originally calculated by the pilot, accurate performance of the airplane could not be determined with the published information available.

It was discovered however, that even though the performance charts were unusable to determine performance if operating above the airplane's maximum takeoff weight, the airplane manufacturer had included guidance in the AFM/POH on not operating above the maximum takeoff weight and maintaining center of gravity, advising that maintaining center of gravity within the approved envelope throughout the planned flight is an important safety consideration.

It further advised that the airplane must be loaded so as not to exceed the weight and center of gravity (CG) limitations, and those airplanes that are loaded above the maximum takeoff or landing weight limitations will have an overall lower level of performance compared to that shown in the Performance section of the AFM/POH.

The AFM/POH also cautioned that If loaded above maximum takeoff weight, takeoff distance and the landing distance would be longer than that shown in the Performance section; the stalling speed would be higher, rate of climb, the cruising speed, and the range of the airplane at any level of fuel will all be lower than shown in the performance section of the AFM/POH.

It further cautioned, if an airplane is loaded so that the CG is forward of the forward limit, it will require additional control movements for maneuvering the airplane with correspondingly higher control forces and that the pilot may have difficulty during takeoff and landing because of elevator control limits, and if an airplane is loaded aft of the aft CG limitation, the pilot would experience a lower level of stability.

Airplane characteristics that indicate a lower stability level are; lower control forces, difficulty in trimming the airplane, lower control forces for maneuvering with attendant danger of structural overload, decayed stall characteristics, and a lower level of lateral-directional damping.

## **Additional Information**

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### Pilot's Handbook of Aeronautical Knowledge

According to the Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25A), the effect of gross weight on takeoff distance is significant and proper consideration of this item must be made in predicting the aircraft's takeoff distance. Increased gross weight can be considered to produce a threefold effect on takeoff performance:

1. Higher lift-off speed.
2. Greater mass to accelerate.
3. Increased retarding force (drag and ground friction).

If the gross weight increases, a greater speed is necessary to produce the greater lift necessary to get the aircraft airborne at the takeoff lift coefficient. As an example of the effect of a change in gross weight, a 21 percent increase in takeoff weight will require a 10 percent increase in lift-off speed to support the greater weight. A change in gross weight will change the net accelerating force and change the mass that is being accelerated. If the aircraft has a relatively high thrust-to-weight ratio, the change in the net accelerating force is slight and the principal effect on acceleration is due to the change in mass.

For example, a 10 percent increase in takeoff gross weight would cause:

- A 5 Percent increase in takeoff velocity.
- At least a 9 percent decrease in rate of acceleration.
- At least a 21 percent increase in takeoff distance.

The effect of wind on takeoff distance is also large, and proper consideration also must be provided when predicting takeoff distance. The effect of a tailwind requires the aircraft to achieve a greater groundspeed to attain the lift-off speed. A tailwind that is 10 percent of the takeoff airspeed will increase the takeoff distance approximately 21 percent.

Density altitude also has specific effects on takeoff performance. An increase in density altitude can produce a twofold effect on takeoff performance:

1. Greater takeoff speed.
2. Decreased thrust and reduced net accelerating force.

The effect of density altitude on powerplant thrust also depends much on the type of powerplant. In the case of an unsupercharged reciprocating engine, an increase in altitude above standard sea level will bring an immediate decrease in power output.

## Administrative Information

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|--|---|
| <b>Investigator In Charge (IIC):</b>     | Gunther, Todd   |
| <b>Additional Participating Persons:</b> | Robert E Williams; FAA/FSDO; Atlanta, GA<br>John Kent; Continental Motors Incorporated; Mobile, AL      |
| <b>Original Publish Date:</b>            | March 26, 2015  |
| <b>Last Revision Date:</b>               |   |
| <b>Investigation Class:</b>              | <a href="#">Class</a>   |
| <b>Note:</b>                             | The NTSB did not travel to the scene of this accident.  |
| <b>Investigation Docket:</b>             | <a href="https://data.ntsb.gov/Docket?ProjectID=86974">https://data.ntsb.gov/Docket?ProjectID=86974</a> |

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