National Transportation Safety Board

Office of Research and Engineering
Washington, D.C. 20594

Performance Study

Specialist Report
Marie Moler

A. ACCIDENT

Location:	Clay, Alabama
Date:	February 14, 2014
Time:	2221 CST
Airplane:	Cessna 210L, Registration N732EJ
NTSB Number:	ERA14FA120

B. GROUP

No vehicle performance group was formed.

C. SUMMARY

On February 14, 2014, about 2221 Central Standard Time (CST), a Cessna 210L, N732EJ, crashed in a heavily wooded area near Clay, Alabama. The commercial pilot and one passenger were fatally injured. The airplane was destroyed. The airplane was registered to and operated by Southern Seaplane, Inc., under the provisions of 14 Code of Federal Regulations (CFR) Part 135 as a non-scheduled, domestic, cargo flight. Instrument meteorological conditions prevailed in the area at the time and an instrument flight rules (IFR) clearance had been obtained by the pilot from air traffic control. The flight originated from Jackson-Medgar Wiley Evars International Airport (KJAN), Jackson, Mississippi, about 2106 CST, and was destined for Birmingham-Shuttlesworth International Airport (KBHM), Birmingham, Alabama.

D. RADAR STUDY

This study describes the accident airplane's ground track, altitude, speed, and estimated attitude.

Radar data used in this study are from the BHM ASR-9 (airport surveillance radar) en route to KBHM and sampled at a frequency of every 4.5 seconds. The radar is approximately 12 nautical miles (NM) from the aircraft's final location. These radar have approximately a 60 NM range and an inherent uncertainty of ±2 Azimuth Change Pulses (ACP) = ± (2 ACP) x (360º/4096 ACP) = ±0.176° in azimuth, ±50 ft in altitude, and ±1/16 NM in range.

Times in the study are reported in CST.

Weather Observation

The weather conditions reported at KBHM at 2231 CST (10 minutes after the last radar return) were winds from 300° at 14 kts, 10 miles prevailing visibility with a broken cloud layer at 1,500 ft above ground level (agl) and overcast at 3,300 ft agl. The altimeter was 29.81 inHg. The accident site was 12 NM from KBHM. Upper air winds and temperatures were reported and used for this analysis.

Radar Analysis

The BHM radar picked the aircraft up west of Tuscaloosa, Alabama at 2154. The radar path and final wreckage location are shown in Figure 1.

Figure 1. Aircraft radar path in green with some times and altitudes marked. KBHM is in the lower left corner.

The aircraft was on a north-easterly course when the pilot requested IFR clearance for runway 24. At approximately 2218 the pilot was instructed to turn onto a heading of 090°, which he did as shown in Figure 2. At 2219:18 the pilot was instructed to turn onto a heading of 150°. The aircraft began to turn right, but stayed on a course of approximately 105° for about 30 seconds. The aircraft was not on a course of 150° until nearly 2220:30, at which point the controller instructed the aircraft to turn right onto 210°, maintain 2,800 ft, and cleared it for the ILS Runway 24 approach. However, the aircraft instead began to turn left with a last course along 54° and an altitude of 2,400 ft.

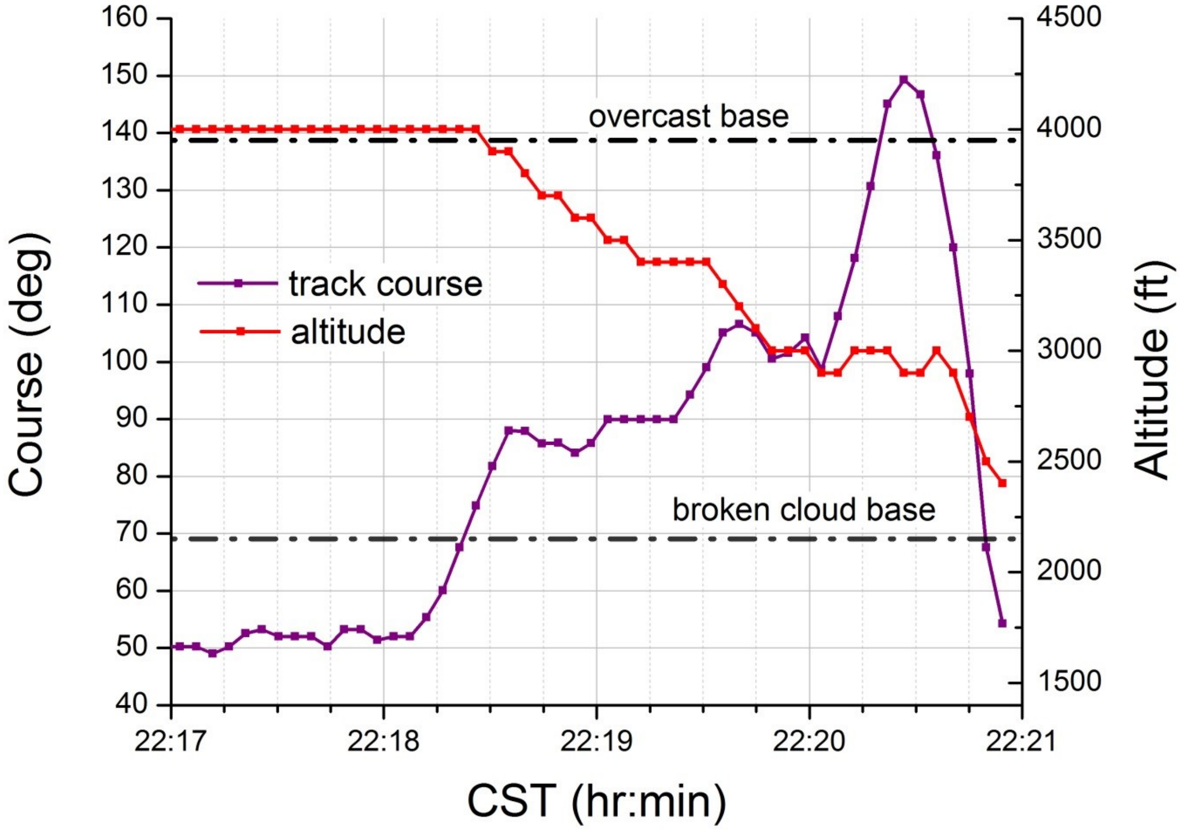

Figure 2. Aircraft course and altitude.

A basic aerodynamic model for the Cessna 210 was constructed and using the model, the weather data, and the radar data, the aircraft's airspeed and ground speed were calculated. The aircraft's groundspeed, true airspeed, and altitude for the last four minutes of flight are shown in Figure 3. The aircraft's airspeed increased from about 140 kts to 170 kts during its descent from 4,000 ft to 2,400 ft.

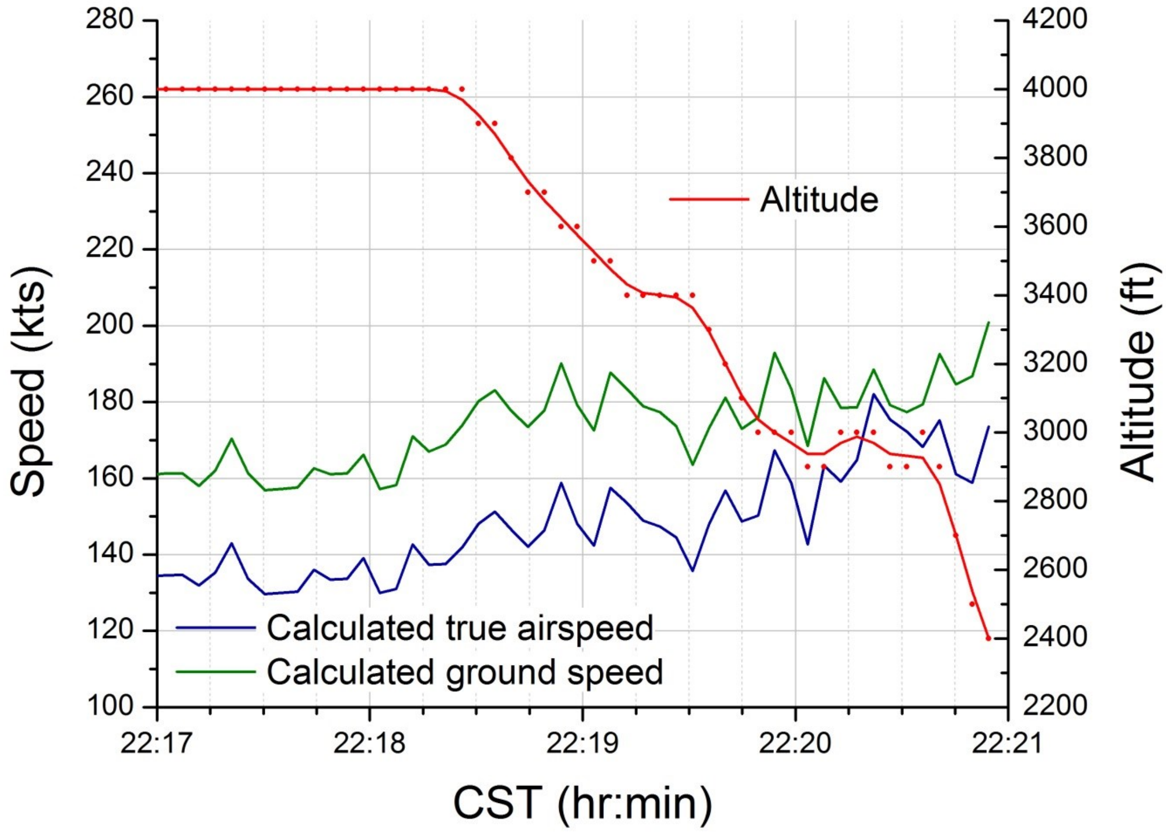

Figure 3. Aircraft calculated true airspeed and groundspeed and altitude.

The trajectory analysis of the data using the basic aerodynamic model estimated the necessary bank angle for the aircraft to fly through the radar points at the calculated speeds. Figure 4 shows an estimated required bank angle of 45° left wing down during the final turn captured by the radar.

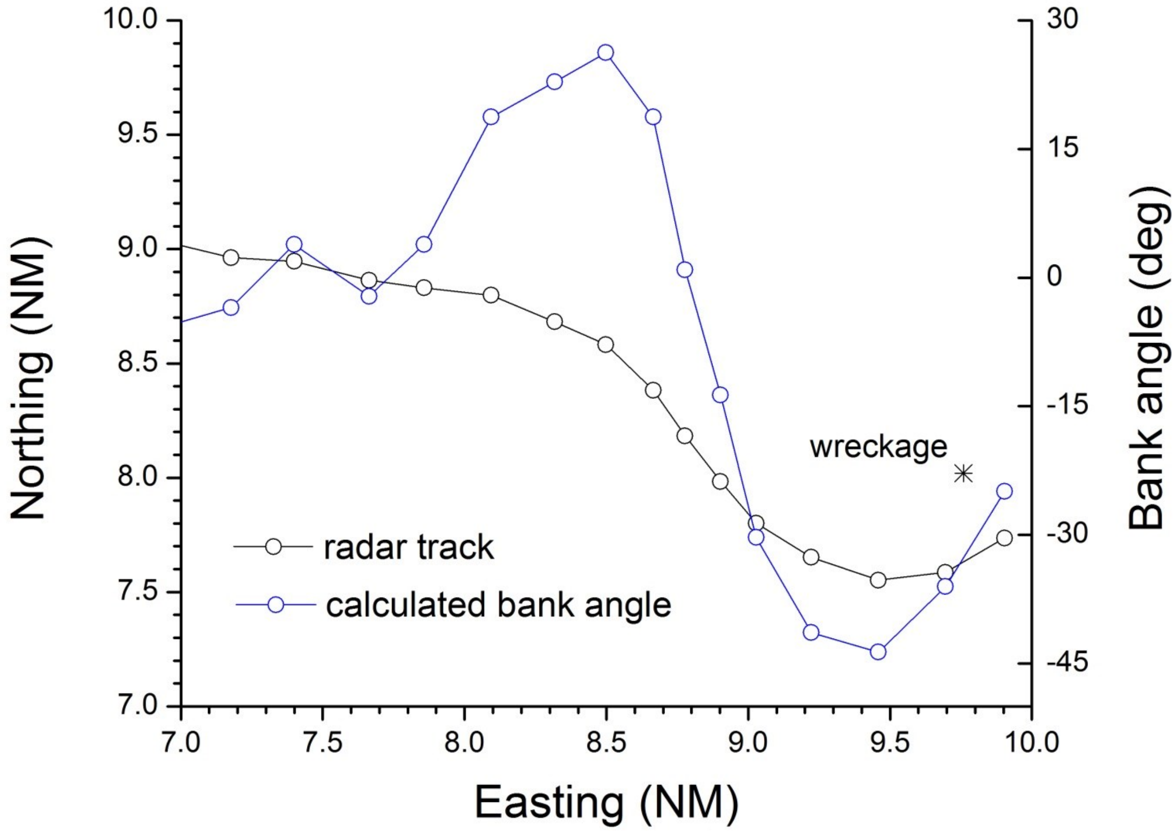

Figure 4. Radar track and calculated bank angle with wreckage location.

The rate of turn for the left hand turn was calculated using the points shown in Figure 5. Assuming the aircraft is in a constant radius level turn, the rate of turn from the 136° course to the final 54° course would be 4.4°/s. From the 119° course to the 54° course the rate would be 4.7°/s. A standard rate turn is 3°/s.

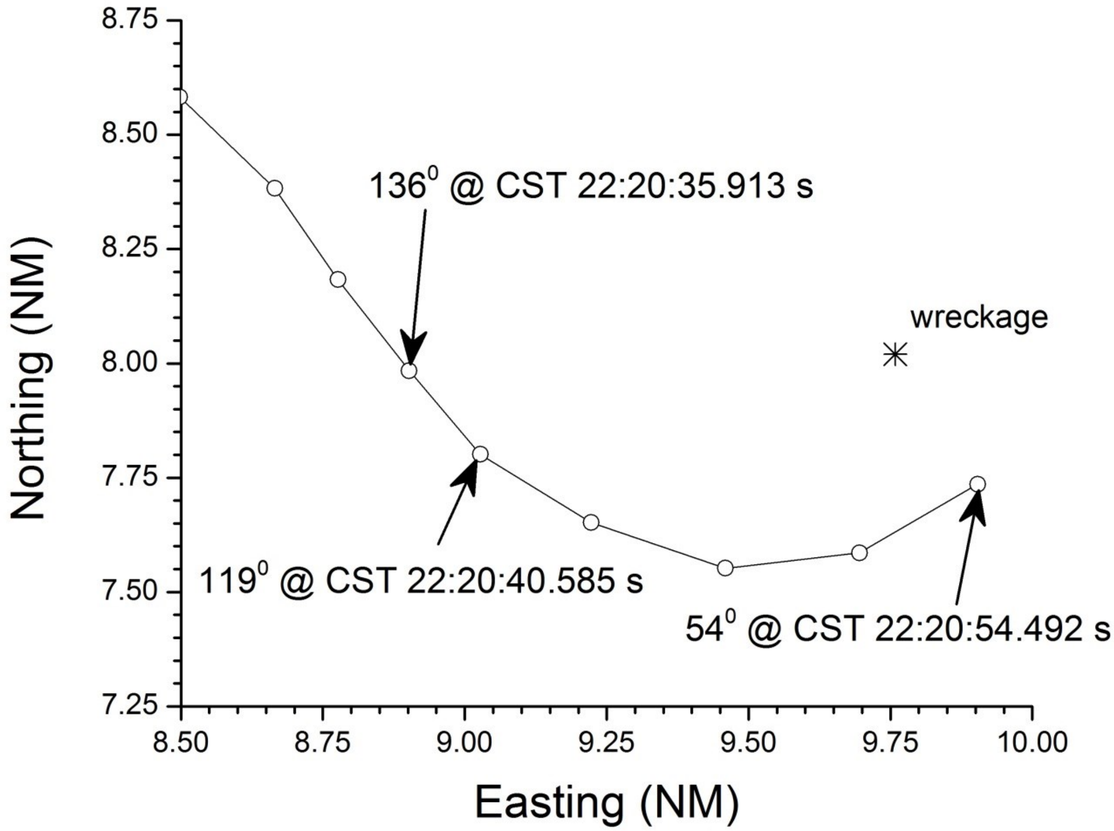

Figure 5. Aircraft's final path and wreckage location with selected course directions.

Path to Wreckage Analysis

The aircraft wreckage energy path lay along a direction of 284° while the track between the last two radar points was oriented at 54°. Figure 6, below, shows these directions through the wreckage location and the last radar point as blue lines. The last radar point and wreckage cannot be connected by a constant radius path matching the course at each point. A simple smoothed path between the two points matching the course at each end is shown in purple. The wreckage was found at a measured elevation of 1,075 ft.

Figure 6. Last radar point and wreckage location. Aircraft final radar track and wreckage orientation shown as blue lines. Smoothed estimated path between last radar and wreckage is shown in purple.

The first portion of the purple path shown in Figure 6 is a curve with a radius of approximately 0.25 NM. The required bank angle to complete a level turn of a given radius is described by the following equation

$$\theta = tan^{-1}\left(\frac{V^2}{gR}\right)$$

Where θ is bank angle, V is speed, g is the gravitation constant, and R the radius of the turn. This equation balances the lift required to keep the aircraft aloft against the centripetal force of the turn. It does not consider aerodynamics or winds or whether the aircraft is able to generate the necessary lift at that attitude and speed. The aircraft's last calculated airspeed was approximately 170 kts. At 170 kts, the aircraft would need to be 60° left wing down to complete the turn. At 100 kts, a 30° left wing down attitude would be necessary.

The rate of turn can be calculated using

$$rate\ of\ turn\ (°/s) = \frac{V}{R \cdot 20 \cdot \pi}$$

For a 0.25 NM level turn at 170 kts the rate of turn would be 10.8°/s. At 100 kts the rate would be 6.4°/s. A standard rate turn, as stated above, is 3°/s. For comparison, to complete a 0.25 NM radius turn at 3°/s, the aircraft's speed would need to be 47 kts, which is below the aircraft's stall speed for any configuration reported in the pilots operating handbook [1 and 2].

E. CONCLUSIONS

The aircraft's flight path, altitude, and calculated speeds do not indicate any unusual performance issues during the portion of the flight recorded by the BHM radar.

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F. REFERENCES

1. Cessna Centurion 1975 Model 210L, Cessna Aircraft Company, Wichita, Kansas. Performance Specifications.
2. Cessna Centurion 1977 Model 210M, Cessna Aircraft Company, Wichita, Kansas. Figure 5-3, Stall Speeds.