

National Transportation Safety Board

Office of Research and Engineering

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WPR23FA208

AUTOMATIC DEPENDENT SURVEILLANCE- BROADCAST (ADS-B) STUDY

Aircraft Performance Study

By

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A. ACCIDENT

Location: Tupelo, Mississippi
Date: June 3, 2023
Time: 08:11 central daylight time (CDT)
Airplane: Piper PA-31-325, N4077W

B. SUMMARY

On June 3, 2023, about 0811 central daylight time, a Piper PA-31-325, N4077W, was destroyed when it was involved in an accident near the Tupelo Regional Airport (TUP), Tupelo, Mississippi. The pilot and pilot rated passenger were fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

C. PERFORMANCE STUDY

1.0 Aircraft

The airplane was a Piper PA-31 Navajo, a twin-engine utility aircraft built by Piper Aircraft. The airplane has a maximum speed of 227 kts, a cruise speed of 207 kts, and a service ceiling of 26,300 ft.



Figure 1. Piper PA-31-325, N4077W

2.0 Available Data

This performance study is based on Automatic Dependent Surveillance-Broadcast (ADS-B) data collected by Flightradar24 ground receivers. ADS-B broadcasts an airplane's Global Positioning System (GPS) position and other data to the ground where it is recorded. The GPS position has an expected uncertainty of approximately 20 meters (65 ft) in both the horizontal and vertical dimensions. Altitude was reported from Flightradar24 as mean sea level (MSL).

ADS-B location data recorded by the Federal Aviation Administration (FAA) is typically recorded approximately once a second if a ground station receives the airplane signal, but FAA ADS-B data was not available for this accident. This study uses 14 ADS-B locations recorded by Flightradar24 for the airplane from 08:10:20 to 08:11:15. The time between data points varied between one and nine seconds.

3.0 Weather

Weather was recorded for 07:53 at TUP. The temperature was reported as 73°F (23°C), the dew point was 66°F (19°C), and the barometric setting was 29.87 inHg. Winds were 4 kts from 20°. Skies were clear and visibility was ten statute miles.

4.0 Flight Path

The elevation of the runway at TUP is listed as 346 ft MSL. The airplane took off from runway 36. The airplane's takeoff roll began at 08:10:20 and the airplane lifted off between 08:10:35 and 08:10:44. A total of 10 ADS-B positions were recorded for the flight. Airplane speeds are calculated using the airplane's position data and the weather information. However, due to the irregular sampling of the airplane's position, there was increased uncertainty in the speed calculations.

Figure 2 shows the airplane's takeoff roll and flight with altitude in MSL. Figure 3 shows the altitude as height above ground and calculated groundspeed, calibrated airspeed, and true airspeed. The atmospheric conditions at the time of the accident meant that the calibrated airspeed was within one to two kts of the true airspeed. The airplane began a right turn about 08:10:53 as it climbed through 600 ft MSL, 250 ft above ground level (AGL). Its speed was 100 kts and slowing. The Sound Spectrum Study [1] determined that at least one engine was functioning normally throughout the flight. The wreckage exam found the flaps to be at 15°.



Figure 2. ADS-B flight path with times and altitudes in MSL noted.

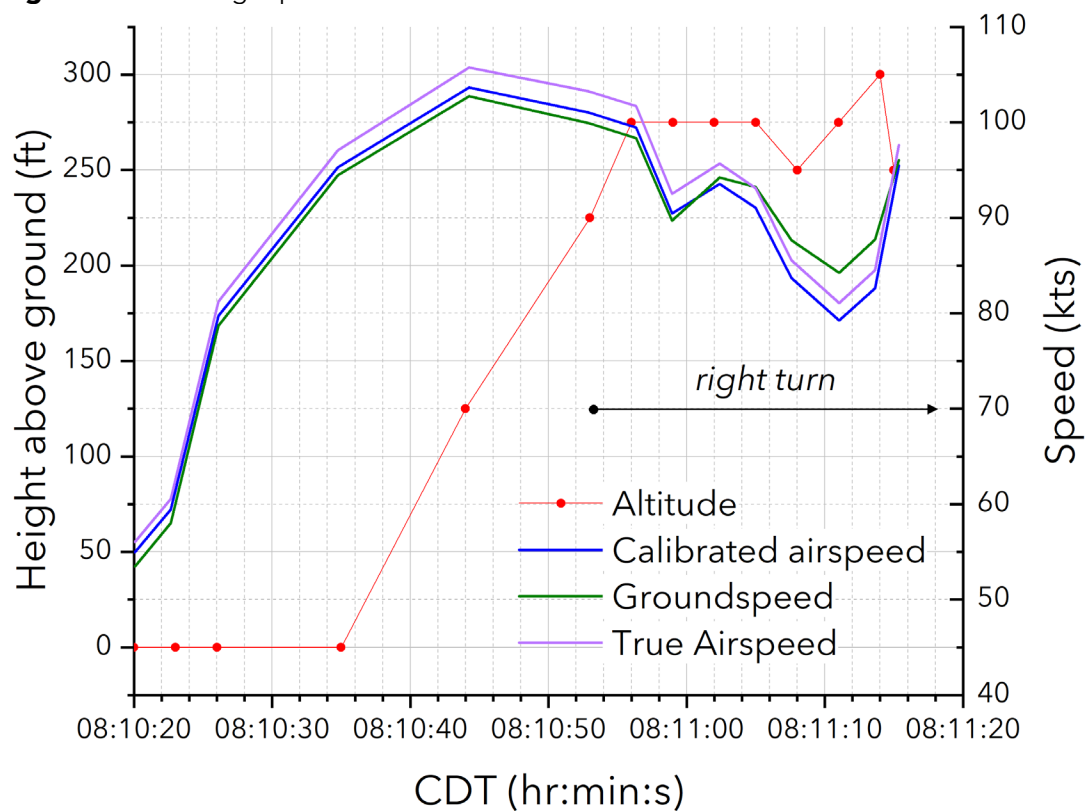


Figure 3. Height above ground with calculated calibrated airspeed and groundspeed.

As the airplane turned right, its speed slowed to below 90 kts calibrated airspeed. The airplane's listed calibrated stall speeds for flaps 15°, gear extended, 6,500 lbs is 66 kts and for 4,750 lbs it is 56 kts [2]. However, during a turn, the stall speed will rise with square root of the load factor, N , according to

$$V_{banked\ stall} = V_{wings\ level\ stall} \sqrt{N}$$

The load factor on the airplane can be estimated using the airplane's true airspeed, shown here as V_T , and the radius of the turn, r , according to

$$N = \frac{1}{\cos(\varphi)} = \frac{1}{\cos\left(\operatorname{atan}\left(\frac{V_T^2}{rg}\right)\right)}$$

where φ is the bank angle and g the acceleration due to gravity. The final right turn tightened from an 830 ft radius turn at 93 kts true airspeed at 08:11:05 to a 560 ft radius turn at 81 kts true airspeed at 08:11:11 (Figure 4). Table 1 shows the resulting banked stall speeds for each part of the turn. As the turn tightened the flaps 15, heavy stall speed increased to be within 2 kts of the calculated true airspeed.

Table 1. Calculation of banked stall speed when 66 kts is wings level stall speed.

Turn radius, ft	TAS, kts	Bank angle, deg	Load factor, N	Banked stall speed in CAS, kts
830	93	42	1.36	77
560	81	46	1.44	79

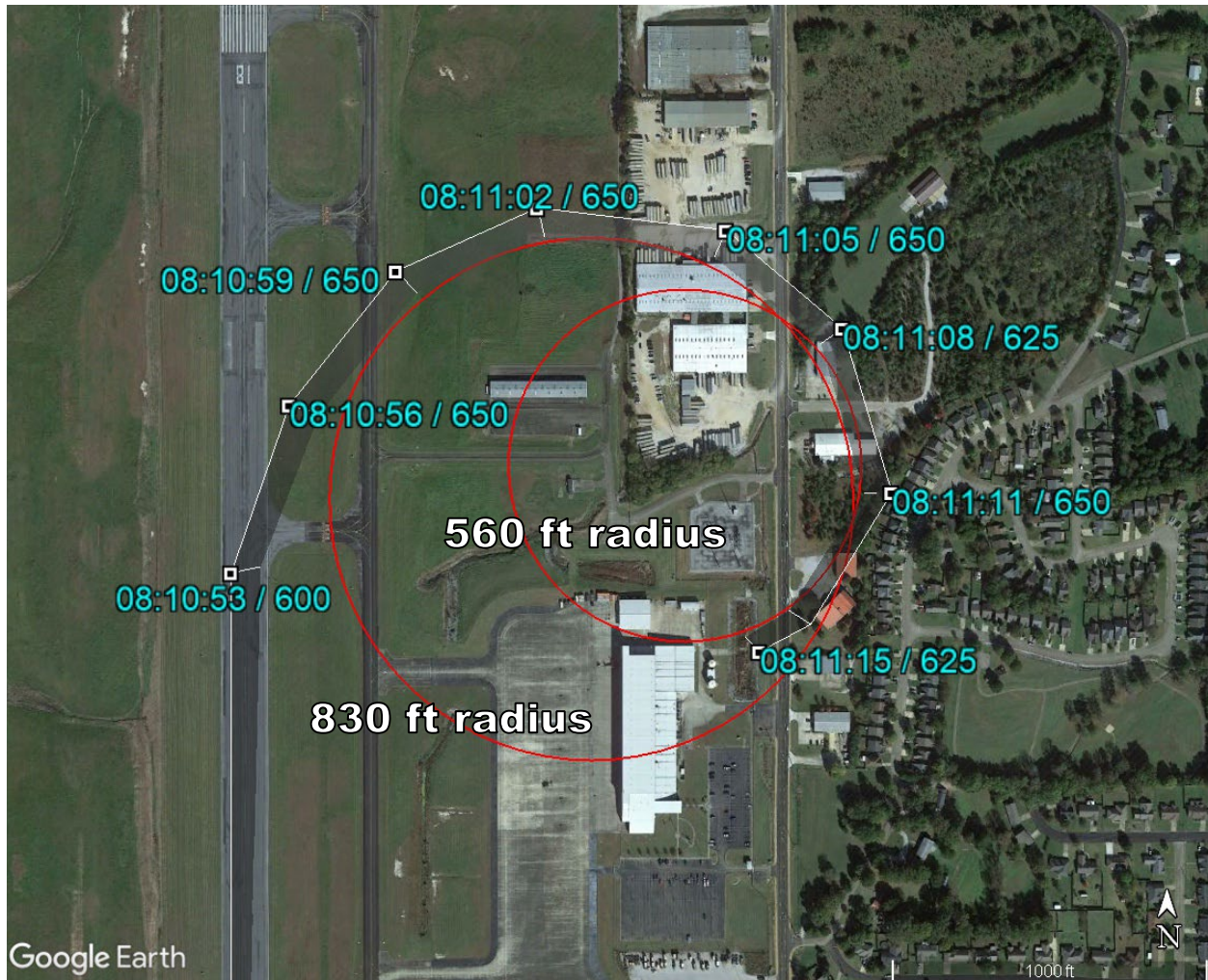


Figure 4. ADS-B flight path and altitude.

D. SUMMARY

The airplane took off between 08:10:35 and 08:10:44. As it climbed through 250 ft AGL it began a tightening right turn. As the turn tightened, the airplane's speed slowed towards its banked stall speed.

E. REFERENCES

1. Sound Spectrum Study, WPR23FA208, National Transportation Safety Board, 2023.
2. The Navajo, Pilot's Operating Manual, Piper Aircraft Corporation, 1970.