

National Transportation Safety Board

Office of Research and Engineering

Washington, D.C. 20594

Performance Study

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A. ACCIDENT

Location:	State College, Pennsylvania
Date:	June 16, 2016
Time:	0828 EDT
Airplane:	Piper PA-31-325 Navajo, N3591P
NTSB Number:	ERA16FA215

B. GROUP

No vehicle performance group was formed.

C. SUMMARY

On June 16, 2016, at 0828 eastern daylight time (EDT), a Piper PA-31-325 Navajo, N3591P, was destroyed following collision with terrain while on approach to University Park Airport (UNV), State College, Pennsylvania. The airplane departed Washington County Airport (AFJ), Washington, Pennsylvania, about 0740 EDT. Instrument meteorological conditions (IMC) prevailed, and an instrument flight rules (IFR) flight plan was filed at 0629 EDT for the on-demand air taxi flight, which was conducted under the provisions of 14 Code of Federal Regulations Part 135.

In the flight plan, the airplane's estimated time of departure was 0730 EDT, with a requested altitude of 7,000 ft during cruise phase. The estimated time en route was 44 minutes, and the estimated fuel endurance was 3.5 hours. The alternate airport requested on the flight plan was Reading Regional Airport (RDG), which was 103 miles away from UNV.

The airplane disappeared from radar while trying to intercept the Instrument Landing System (ILS) glide path to runway 24. The last radar return was received from the airplane at 12:27:23 UTC (UTC = EDT + 4 hours), 2.36 nautical miles from the threshold of runway 24, at an altitude of 2,500 ft MSL (1,309 ft above the airport elevation and 1,300 ft above the wreckage elevation).

D. PERFORMANCE STUDY

The radar data used in the study was obtained from the Air Route Surveillance Radar (ARSR-3) located between Clearfield, Pennsylvania and Dubois, Pennsylvania. The radar is situated 35.3 nautical miles from the wreckage. Radar returns for the accident airplane (corresponding to a transponder code of 6060) were received approximately once every 12 seconds. Part of the flight is shown in Figure 1.



Figure 1. Airplane flight path from Washington County Airport, Pennsylvania to University Park Airport in State College, Pennsylvania.

The airplane's approach into University Park Airport is shown in Figure 2 2 and Figure 3. The airplane's wreckage was situated 0.94 nautical miles from the threshold of runway 24 and 2.36 nautical miles from the final radar return, at an elevation of 1,200 ft.

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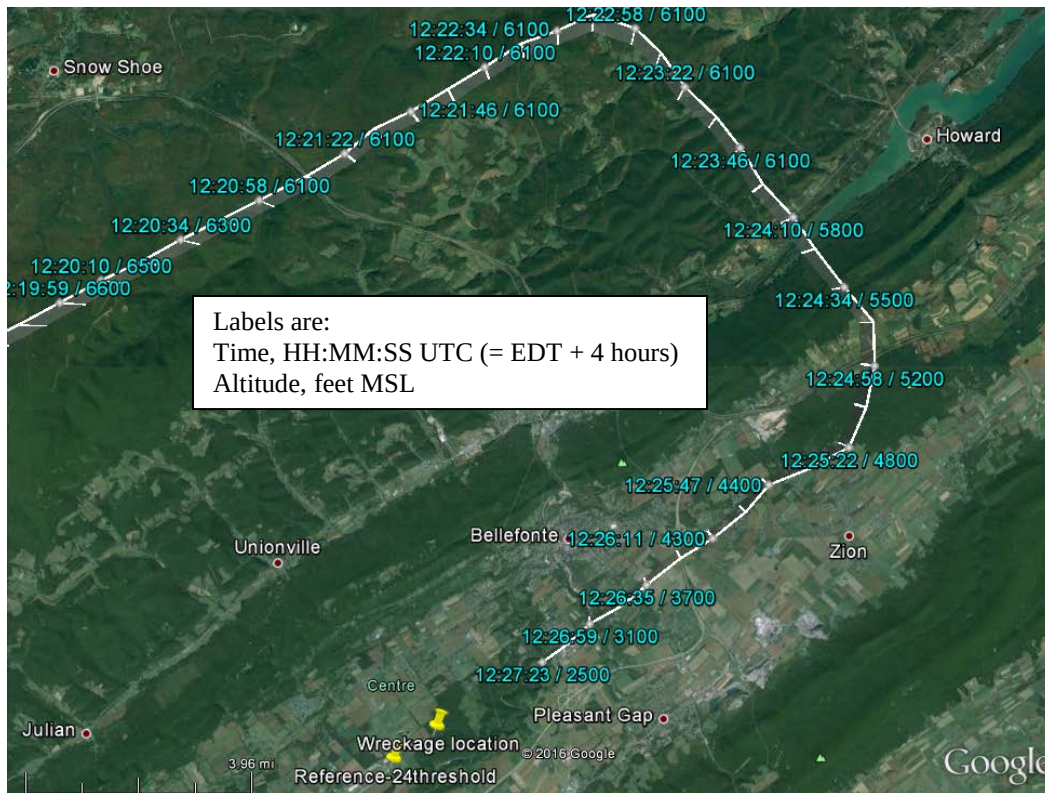


Figure 2. Airplane flight path into University Park Airport (UNV) in State College, Pennsylvania.

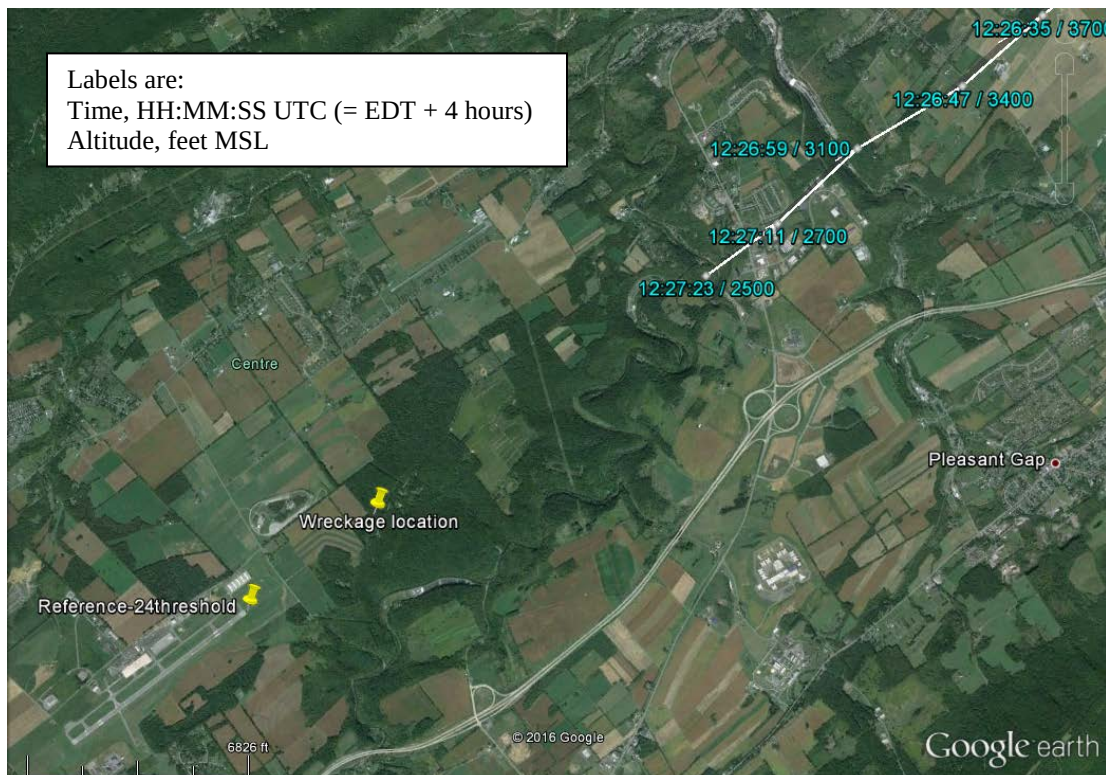


Figure 3. Airplane final approach, position of wreckage and threshold of runway 24.

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Meteorology Information

The Automated Weather Observation System (AWOS) at UNV reported at 0853 EDT calm winds, one-mile visibility in mist, overcast at 300 ft above ground level, temperature 63 °F (17 °C), and an altimeter setting of 29.80 inHg. The AWOS has a listed elevation of 1,231 ft.

The accident occurred at 0828 EDT. No data was saved from the AWOS at UNV from 0555 to 0850 EDT because of data storage issues, but the AWOS information was available during this time.

The winds aloft forecast for 7,000 ft was for winds from the west-northwest with a speed of nine knots. Winds less than eight knots were expected below 7,000 ft with above freezing temperatures, and winds at UNV airport were negligible.

The airplane's cruising altitude was 7,000 ft.

The following model was adopted for the winds and temperatures based on the NTSB meteorology report:

Altitude MSL (ft)	Direction (°)	Magnitude (kts)	T (°C)
1000	0	0	19
2000	0	0	18
3000	280	4	17
4000	280	3	18
5000	340	9	17
6000	340	6	16
7000	310	9	14

Table 1. Model of winds and temperatures.

Airplane Altitude, Ground Track, and Speed

The true airspeed, equivalent airspeed, and groundspeed for the cruise and descent portions of the flight were calculated using the recorded radar data and forecast winds aloft and are shown in Figure 4. The airplane averaged a true airspeed of about 175 kts throughout the cruise portion of the flight. The weight of the airplane was calculated to be 5,281 lbs at takeoff, based on the empty weight of the plane (4,099 lbs), the associated weight for 3.5 hours of fuel (682.5 lbs), and the weight of two passengers and their luggage (500 lbs). The weight of the airplane was estimated to be 5,135 lbs at the time of the crash, based on the previous approximations and the estimated fuel burn during the flight (48 minutes of flight).

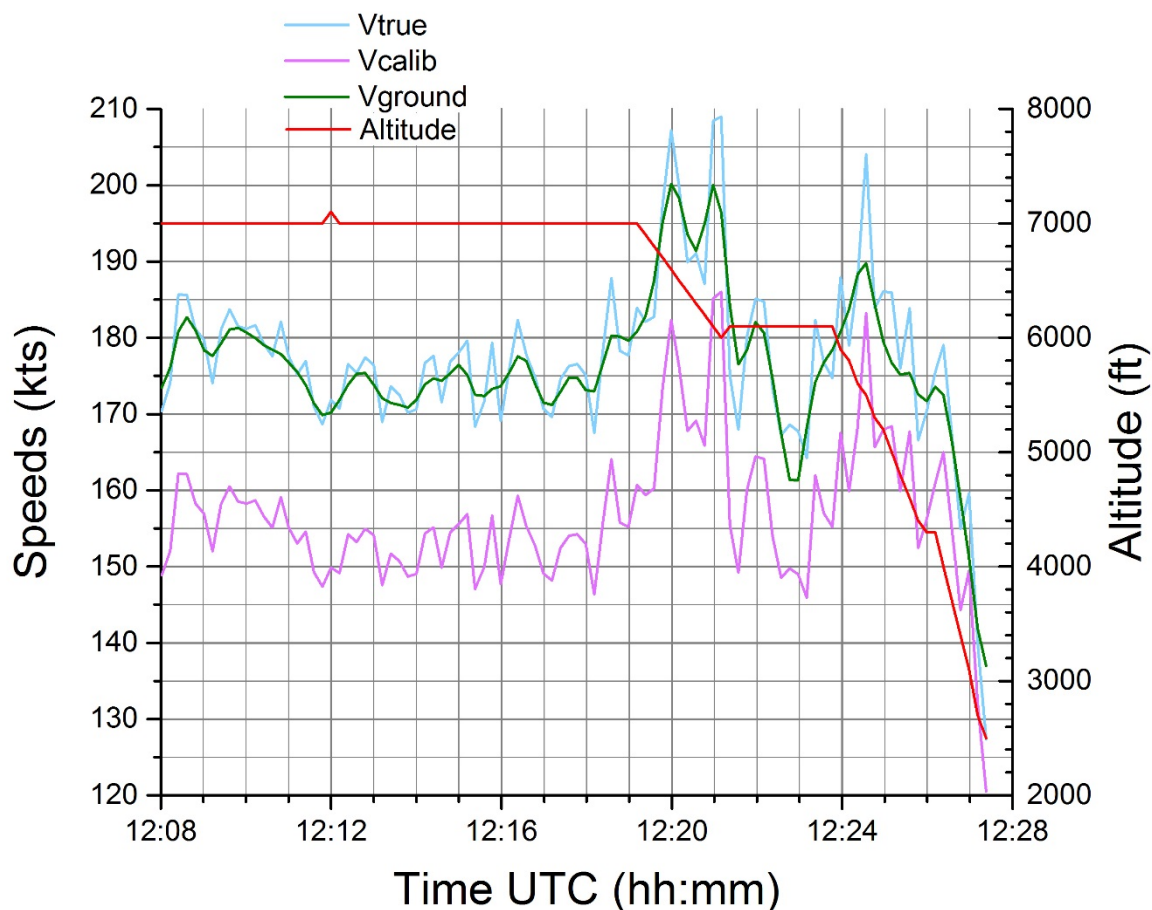


Figure 4. Altitude, true airspeed, smoothed groundspeed, and calibrated airspeed for the last 20 minutes of flight.

In this plot, the ground speed (green line) has been smoothed. The non-smoothed groundspeed is almost identical to the true airspeed due to the winds' direction and magnitude.

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The airplane's last minute of flight is not shown in this report due to a loss in the radar signal. The end of the recorded data is consistent with the airplane slowing on final approach to runway 24. Figure 5 shows the speed of the airplane during the last four minutes of recording. The final approach speed of the airplane would be expected to be 91 kts based on the procedures specified in the Pilot's Operating Handbook (POH) [1].

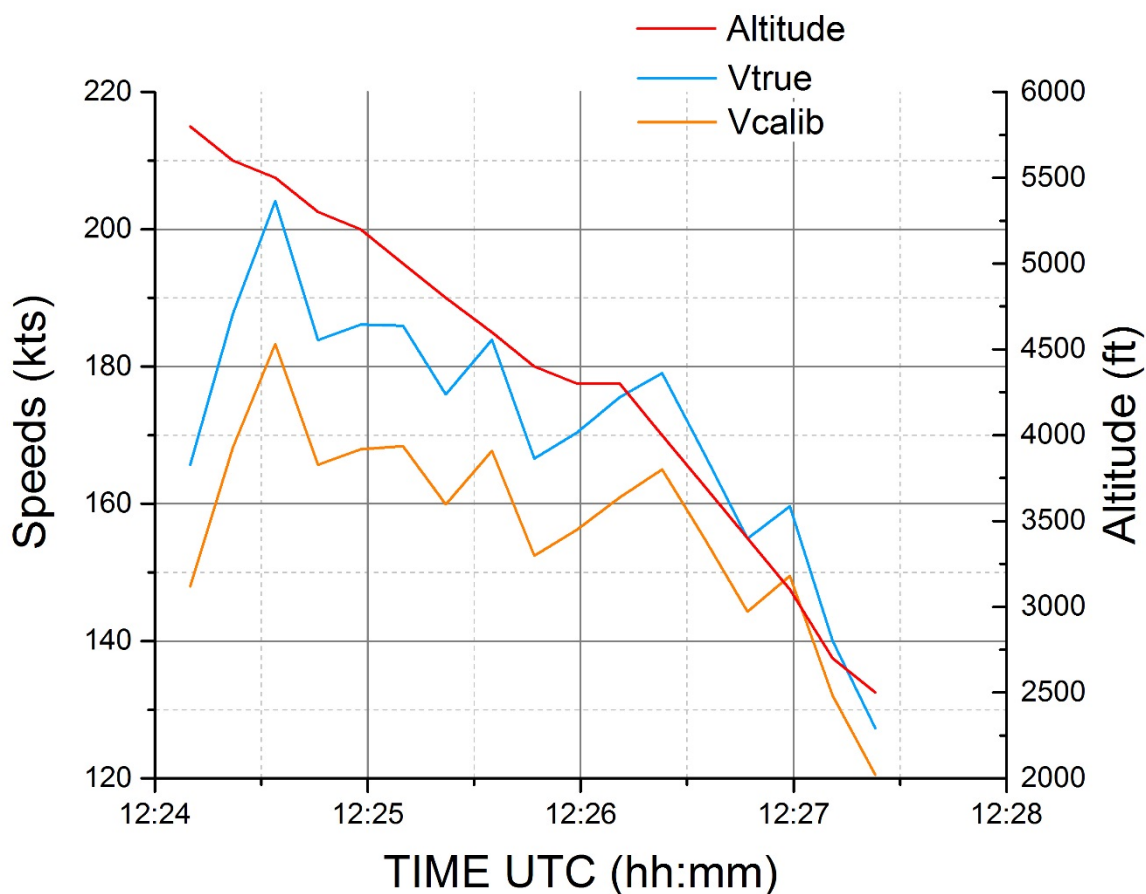


Figure 5. Altitude, true airspeed, and calibrated airspeed for the last 4 minutes of flight.

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Figure 6 shows the calculated angles of the plane versus time for the last 20 minutes of flight.

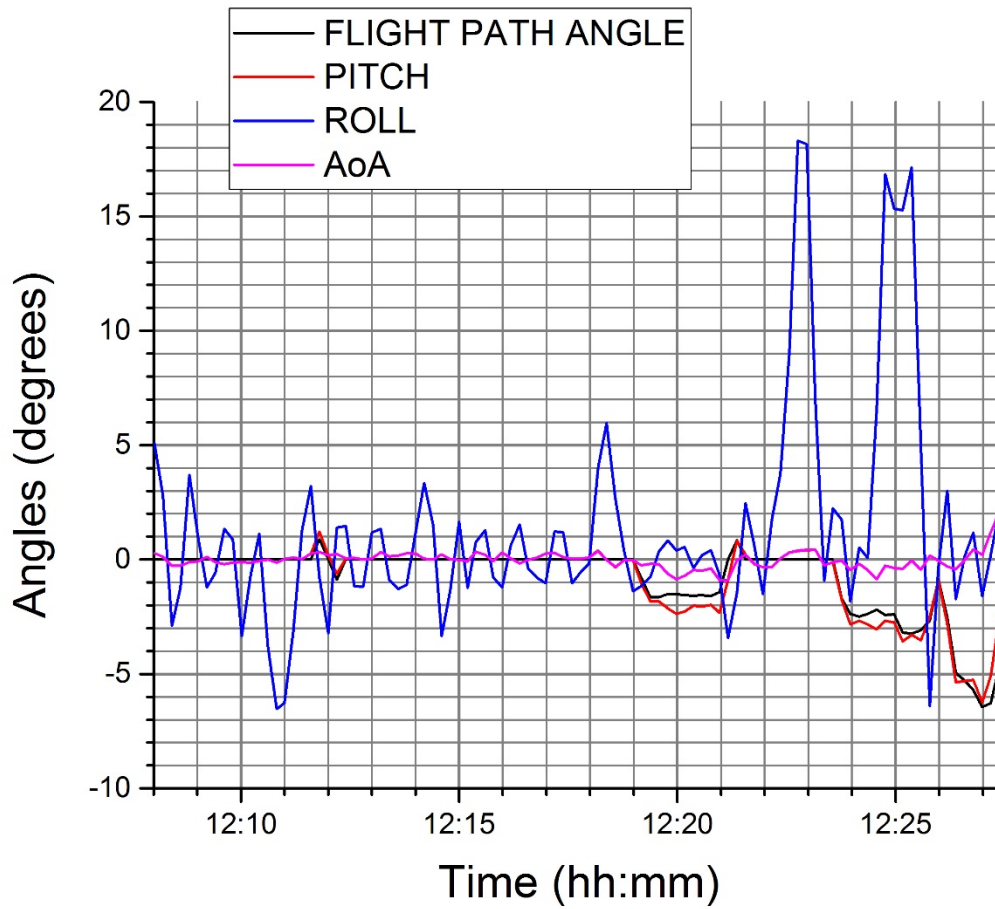


Figure 6. Angles versus time for the last 20 minutes of flight.

This figure shows the descent from cruise, and the last two turns to get onto the final. This is consistent with the airplane intercepting the ILS 24 approach.

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Stall speeds for the approach were determined using the landing configuration of the airplane as observed at the wreckage site (landing gear down, flaps 15°, 5,135 lbs at the estimated time of the crash) and are shown in Figure 7. The red line shows the stall speed of 65 KIAS for a bank angle of 0°. The blue line shows a stall speed of 67 KIAS for a bank angle of 20°, which is the maximum bank angle calculated from the data available.

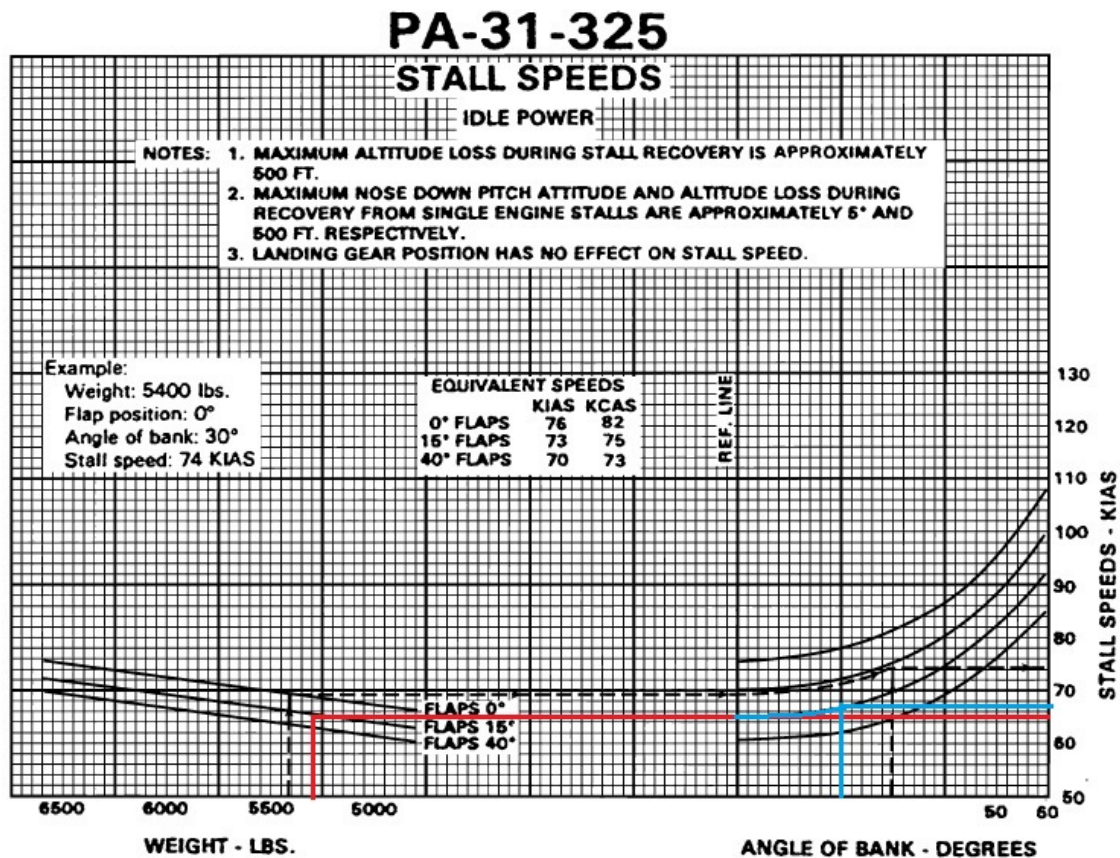


Figure 7. Stall speeds versus aircraft gross weight and bank angle from Pilot's Operating Handbook (POH) [1].

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The airplane's last recorded calibrated airspeed was 120 kts. This speed is higher than the stall speeds predicted by the POH, even with a high bank angle.

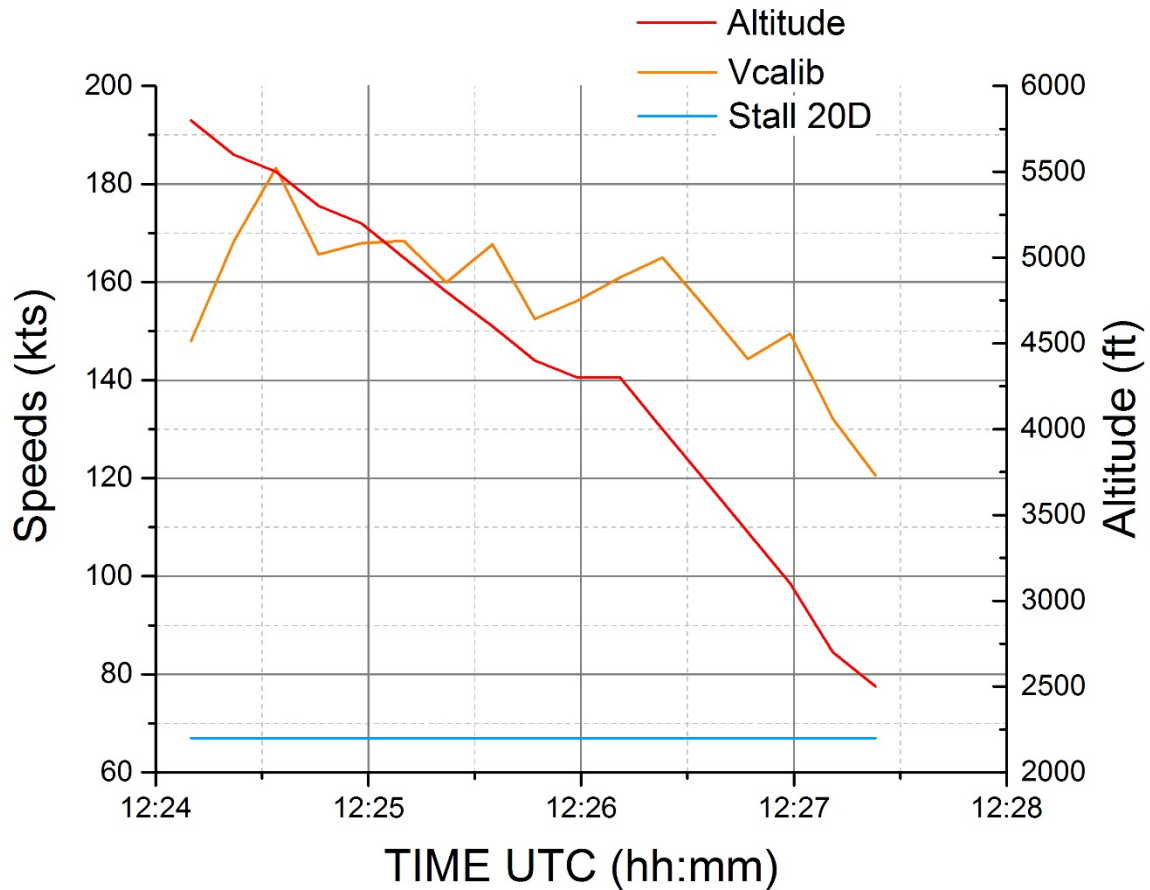


Figure 8. Altitude and calibrated airspeed for the last 4 minutes of flight, compared to the stall speed for a bank angle of 20°.

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Figure 9 shows the airplane's rate of climb and altitude versus time for the last 20 minutes of flight.

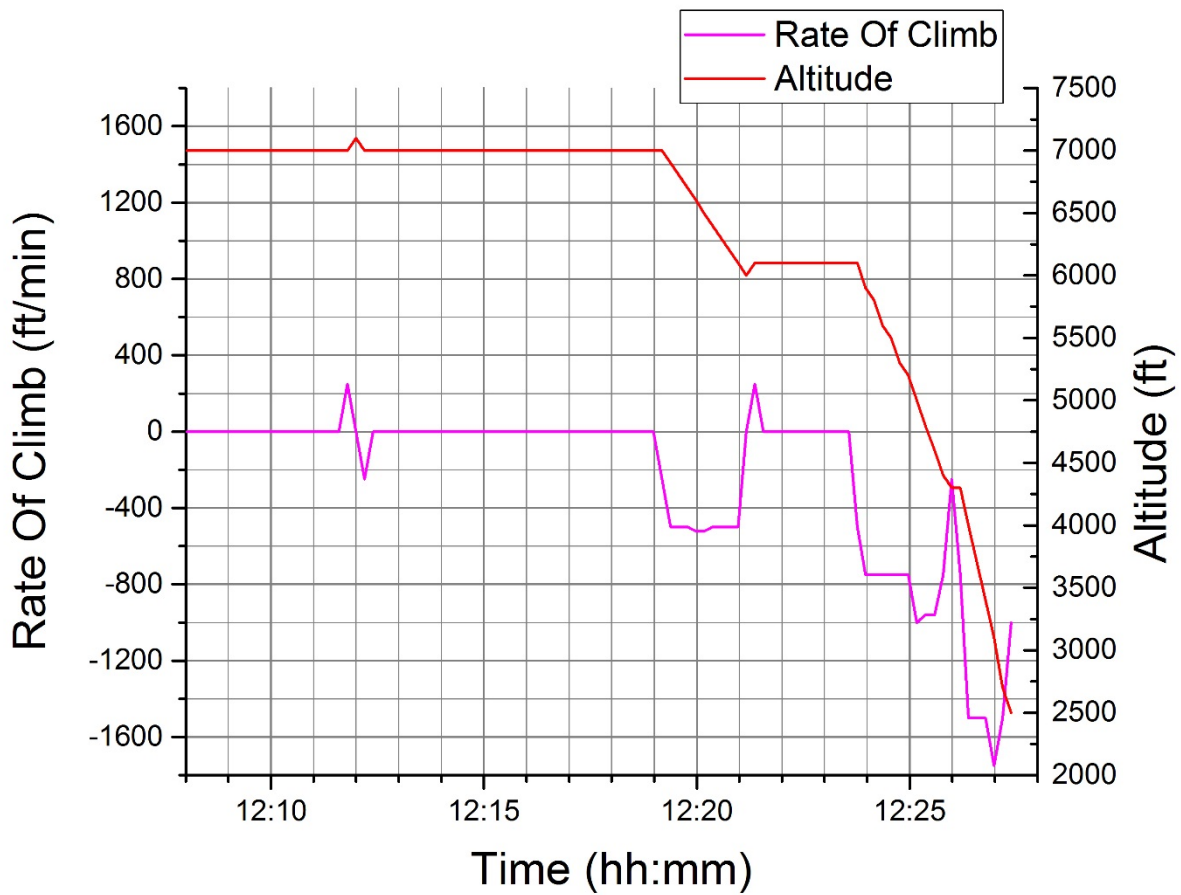


Figure 9. Rate of climb and altitude versus time for the last 20 minutes of flight.

This figure shows the end of the cruise phase, and the descent to final approach.

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Figure 10 shows the rate of climb of the aircraft from 12:24 to 12:28 UTC.

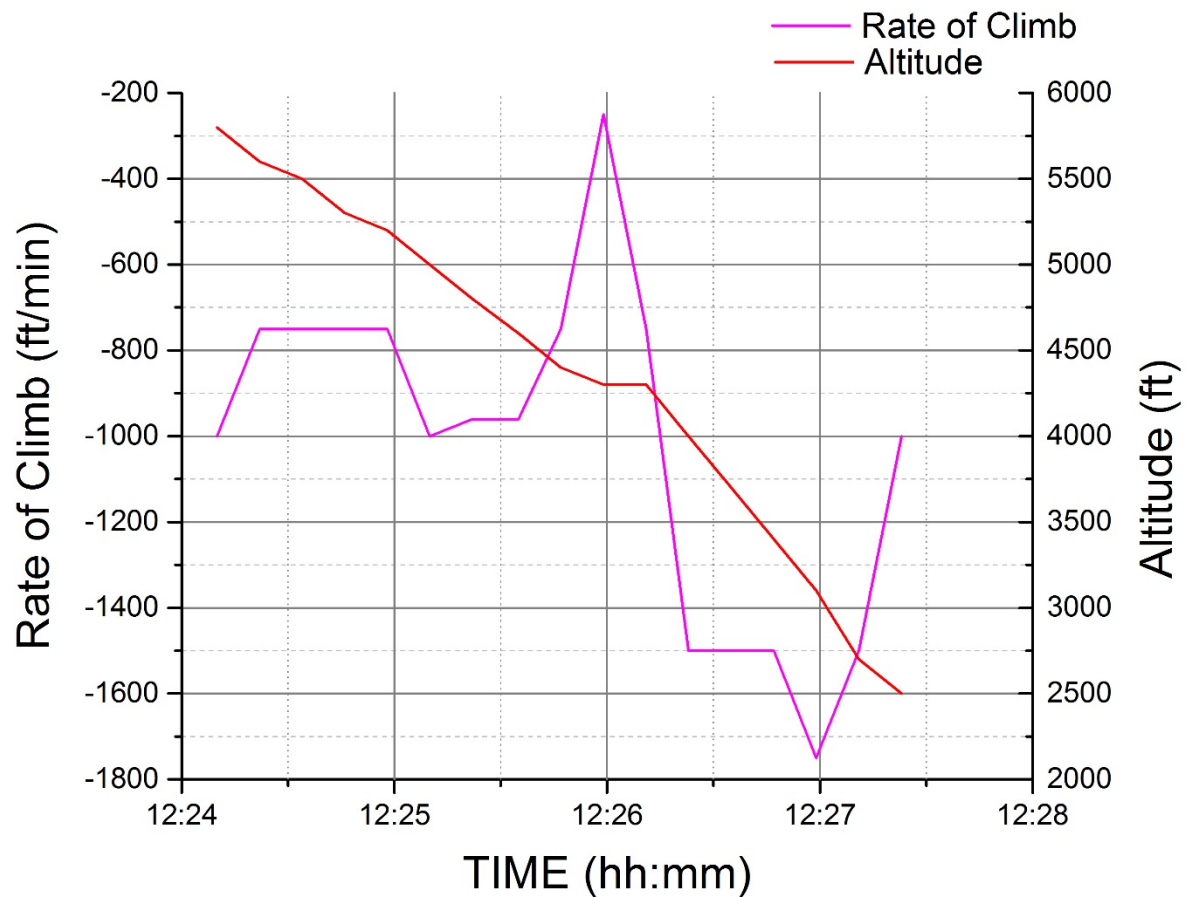


Figure 10. Rate of climb and altitude versus time for the last 4 minutes of flight.

The last 20 seconds of flight are consistent with the airplane pitching up, which is confirmed by the increase of the angle of attack, flight path angle and pitch in the last 20 seconds of flight (Figure 6).

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At 0824 EDT, the ATC cleared the airplane for the ILS 24 approach. Figure 11 shows the ILS approach plate to runway 24 at UNV airport.

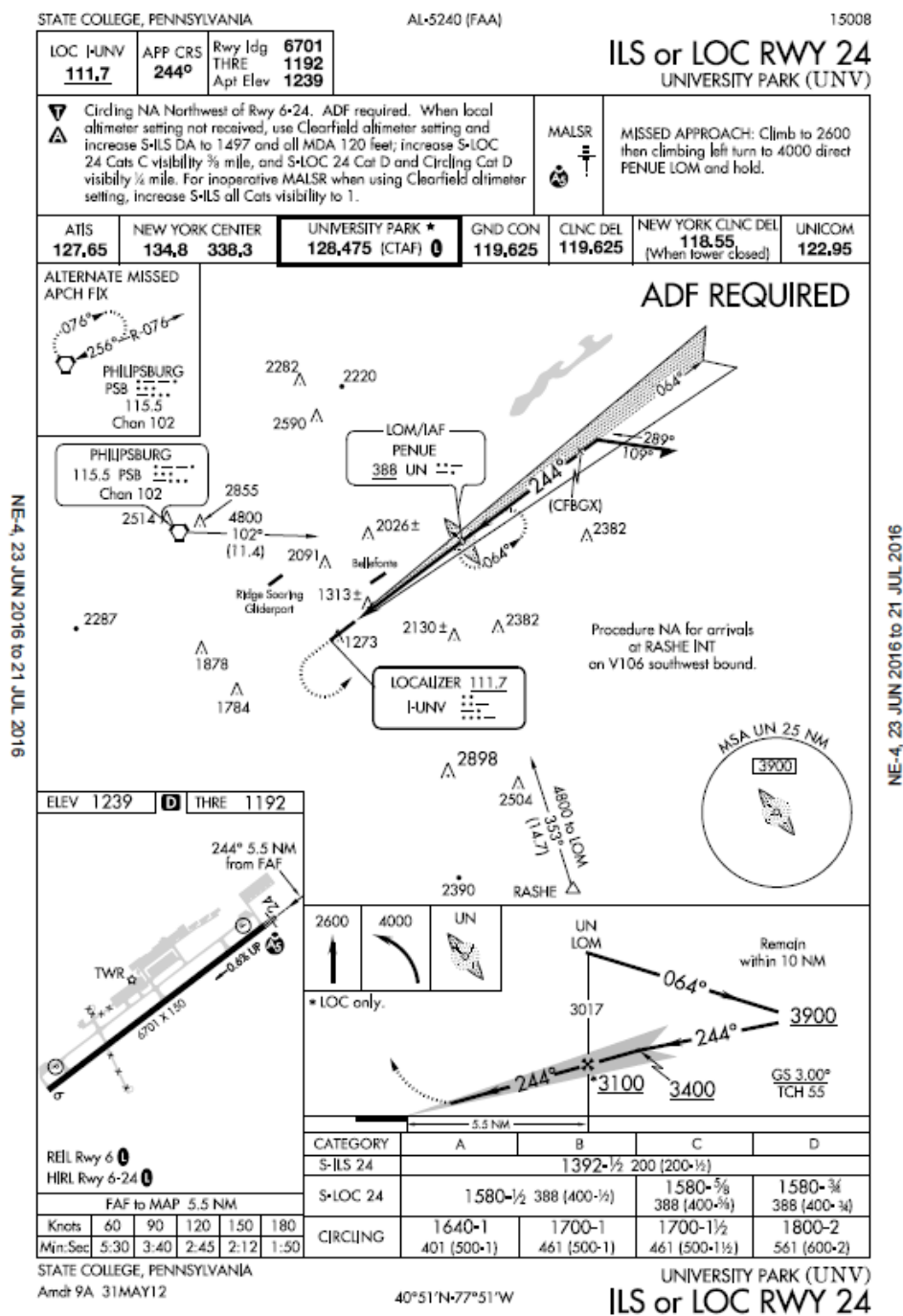


Figure 11. ILS approach plate to runway 24 at UNV airport.

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Figure 12 and Figure 13 show the airplane position compared to the ILS approach to runway 24.

Figure 12 shows the airplane's path compared to what an ILS approach should be (red line, heading 244°).

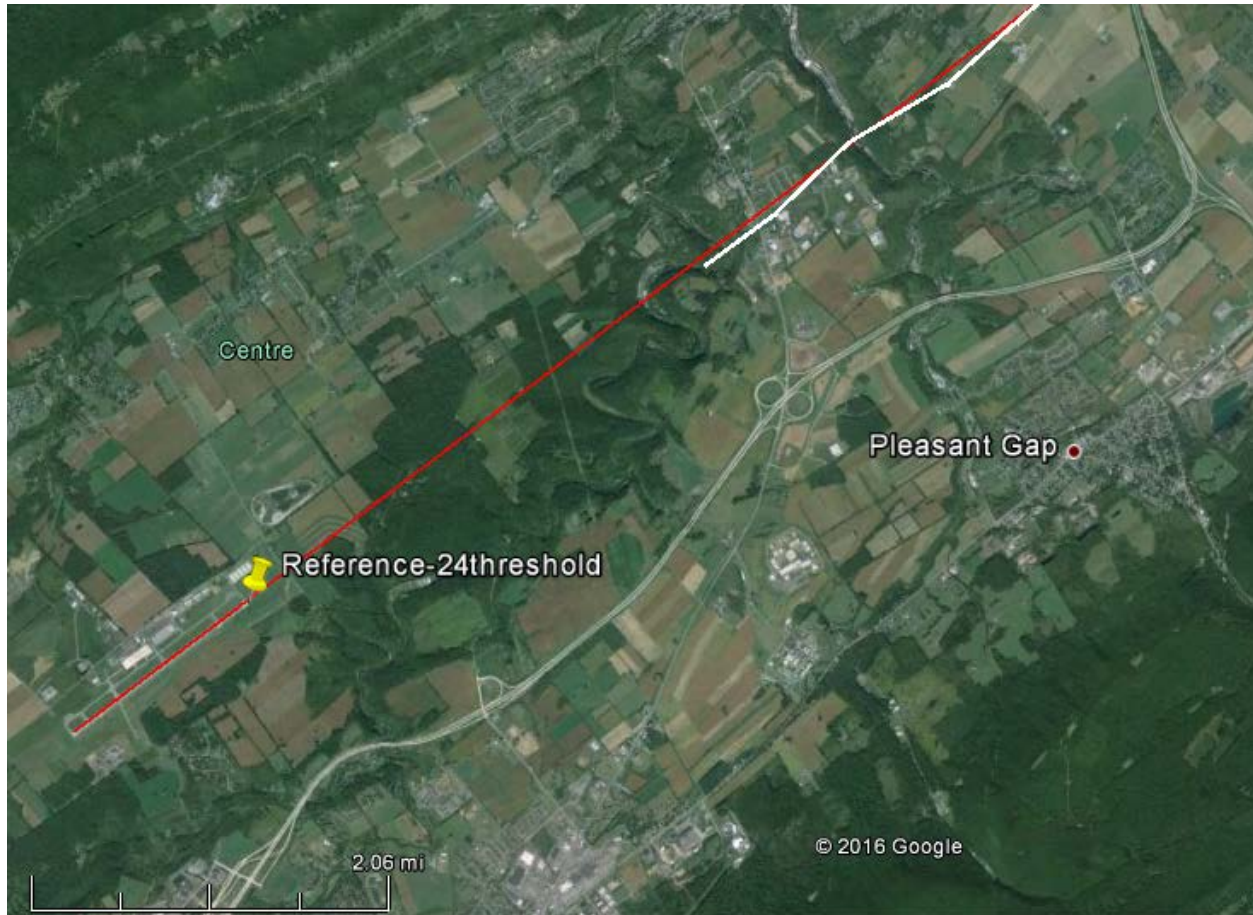


Figure 12. Theoretical heading for an ILS approach and real path for the final approach

This plot is consistent with the airplane's track being stabilized. However, to be stabilized on the ILS approach, the airplane also would have had to follow a particular glide slope.

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Figure 13 shows the airplane's altitude versus distance to runway, where 0 NM would be the threshold of runway 24. The wreckage is situated at 0.94 nautical miles from the threshold of runway 24.

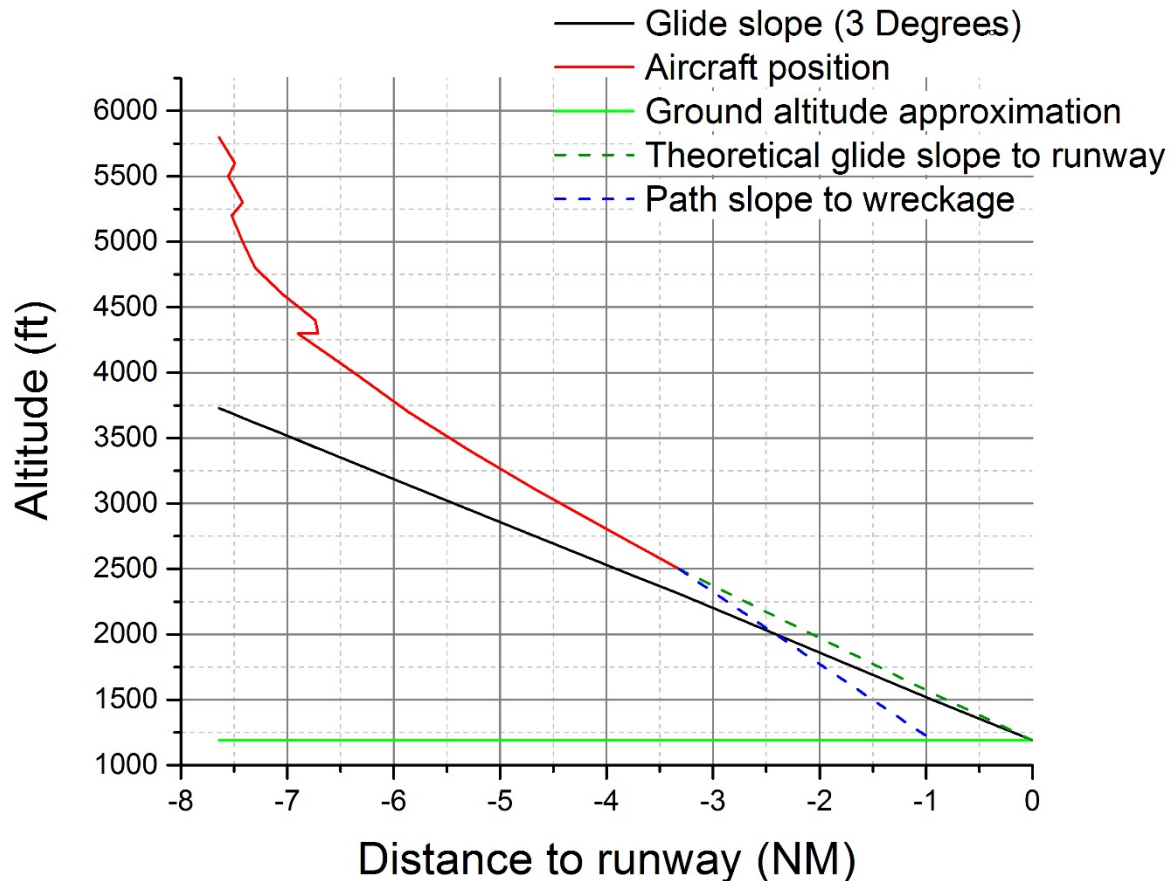


Figure 13. Altitude and slopes versus distance to Runway

Figure 9, Figure 10 and Figure 13 are consistent with the airplane being high on glide slope. The glide slope angle for runway 24 is 3° (5.24%). To reach the threshold from its last recorded position, the airplane would have had to follow a 3.74° (6.53%) glide slope (green line). From its last recorded position to the location of the wreckage, the airplane would have had to follow a 5.23° (9.14%) path slope (blue line).

E. CONCLUSIONS

Based on the available radar data, the airplane slowed its speed to 120 kts on final to runway 24. The airplane was high above the glide slope, but was reducing speed and increasing the descent rate, which are actions consistent with achieving the correct glide slope. The last radar return showed the airplane at 2500 ft, 1,300 ft. above and 2.36 nautical miles from the wreckage location, apparently still in controlled flight.

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F. REFERENCES

1. Pilot's Operating Handbook, NAVAJO C/R, PA-31-325, September 17th, 1979.