

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA22LA191

AUTOMATIC DEPENDENT SURVEILLANCE- BROADCAST (ADS-B) STUDY

Aircraft Performance Study

By

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A. ACCIDENT

Location: Grantsville, Maryland
Date: April 16, 2022
Time: 1952 Eastern daylight time (EDT)
2352 UTC
Airplane: Piper PA-32-260, N3618W

B. SUMMARY

On April 16, 2022, about 1952 Eastern daylight time, a Piper PA-32-260, N3618W, was substantially damaged when it was involved in an accident near Grantsville, Maryland. The commercial pilot and two passengers received minor injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

C. PERFORMANCE STUDY

1.0 Aircraft

The accident airplane was a PA-32-260, also known as a Cherokee Six. It was a single-engine, six seat, light airplane. Figure 1 shows the airplane.



Figure 1. Accident airplane, N3618W.

2.0 Available Data

This performance study is based on Automatic Dependent Surveillance-Broadcast (ADS-B) data provided by the Federal Aviation Administration (FAA). 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 accuracy of approximately 20 meters (65 ft) in both the horizontal and vertical dimensions.

3.0 Weather

Weather was recorded for 2035 at Garrett County Airport (2G4) in Oakland, Maryland, 14 nautical miles (NM) southwest of the wreckage location. The temperature was 43°F (6°C), the dew point was 43°F (6°C), and the barometric setting was 29.92 inHg. Conditions were reported as overcast with a ceiling height of 500 ft above ground level (AGL). Winds were 8 kts, gusting to 18 kts from 290°. Additionally, the Meteorological Factual Report [1] discussed the possibility of icing in the area.

4.0 Flight Path

The airplane took off from Wabash Municipal Airport (KIWH) in Wabash, Indiana at 17:46 EDT (16:46 local time) (Figure 2). The airplane climbed to 8,500 ft above mean sea level (msl) by 18:05 and remained straight and level until 19:15 when it climbed to 10,500 ft msl.

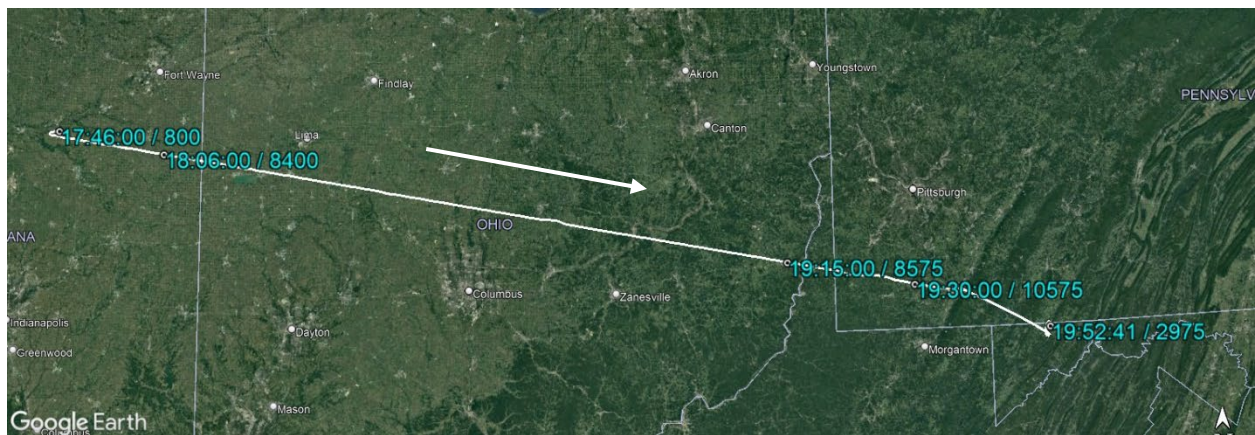


Figure 2. ADS-B flight path with select times (EDT) and altitudes (msl) annotated.

A simplified aerodynamic model of the airplane was created using lift and drag relationships from similar PA-32 variants. The aerodynamic model, combined with the meteorological information and flight path data, can be used to estimate the airplane's attitude, lift, and drag. Figure 3 shows the airplane's altitude and speeds for the flight. Calibrated airspeed is only shown for the end of flight as it is dependent on more local winds¹. Also shown are estimates for the airplane's pitch and angle of attack and drag and lift coefficients. These calculations are based on estimated lift and drag curves and should not be seen in terms of absolute numbers, but rather reflecting trends in the flight.

¹ Reported winds of 8 kts from 290° were used for the calculations, which are likely not accurate for the higher altitude portion of the flight as ground measurements are not reflective of winds aloft.

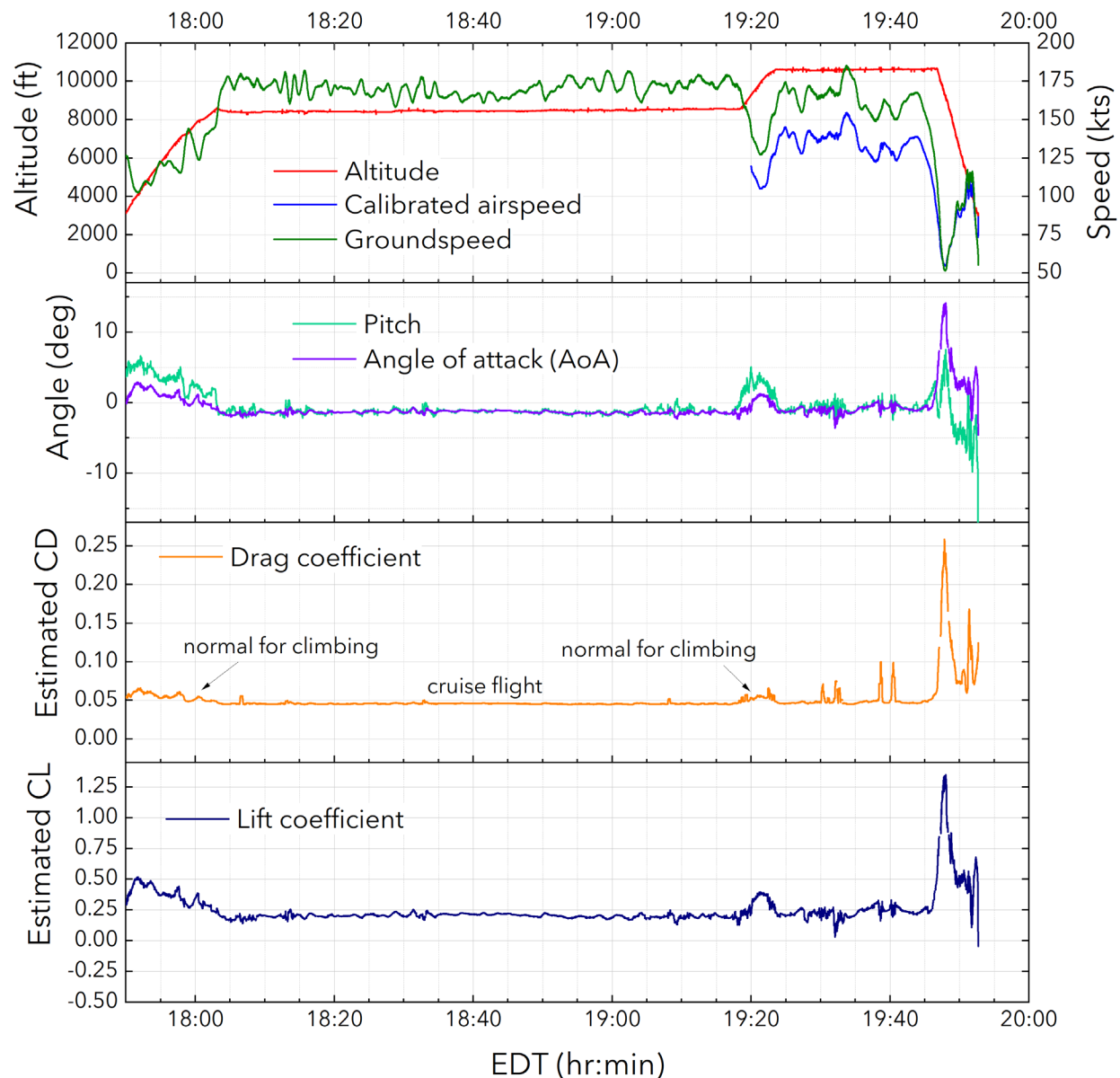


Figure 3. Flight altitude (msl), calculated groundspeed and calibrated airspeed, pitch and angle of attack, drag coefficient, and lift coefficient.

As would be expected, during the airplane's two climbs pitch and angle of attack increased as did the airplane's lift and drag. All parameters were mostly level during the cruise portion of flight. However, during the level flight above 10,000 ft, some unexplained increases in drag can be seen in addition to some significant increases in drag during the airplane's final descent.

The pilot reported that he increased engine power and turned pitot heat on, but the airplane was "underperforming and unable to climb over the clouds." He reported that while in the clouds, airspeed decreased and the autopilot was increasing pitch to

maintain altitude. The pilot disconnected the autopilot, decreased the pitch attitude, but found it difficult to maintain pitch control.

Figure 4 shows flight parameters from the final nine minutes of flight. Figure 5 shows the flight path for the final six minutes of flight. From 19:45, pitch was increasing as the airspeed dropped, which was consistent with the pilot's report that the autopilot was increasing pitch to maintain altitude, and by 19:46, lift and angle of attack were increasing. Just after 19:46:30, pitch was decreased, likely corresponding to the pilot's report that he disconnected the autopilot and decreased the pitch attitude. The airplane began to descend 15 seconds later and there was a marked increase in drag.

At 19:47 the airplane began a turn to the right, leaving the straight track it had been on for the prior ten minutes of flight. Pitch again increased, but the descent continued while lift and drag increased. Drag at this point in the flight was four times higher than at any point in the flight. The airplane's calculated airspeed slowed to near 54 kts. At 19:48, angle of attack, pitch, lift, and drag all dropped. This loss of lift was consistent with an aerodynamic stall. The airplane's angle of attack and lift had been increasing continuously as the airplane descended and slowed. The calculated 54 kts of calibrated airspeed at the time was below the listed power off, gross weight, wings level, no flaps stall speed of 57 kts [2].

The nose was lowered and the airplane gained airspeed while continuing to descend. Lift and drag decreased, but not to pre-19:46 values. After 19:49 the airplane was on a mostly northerly track.

At 19:51, drag again quickly increased but without an increase in lift. The airplane began a turn to the right. At 19:51:30, lift dropped sharply without having increased during the increase in drag. This sudden loss of lift occurred at a much lower lift coefficient and angle of attack than the previous event at 19:48 and at a speed well above the listed stall speeds.

The airplane recovered briefly before drag again began to increase. The airplane was still descending and slowing. ADS-B data ended as the airplane descended below 150 ft above the terrain². The wreckage was 2,500 ft farther into a valley, indicating that the airplane continued to be aloft for a few more seconds before impacting the ground.

² Elevation in the mountainous area varied between 2,300 and 2,800 ft msl.

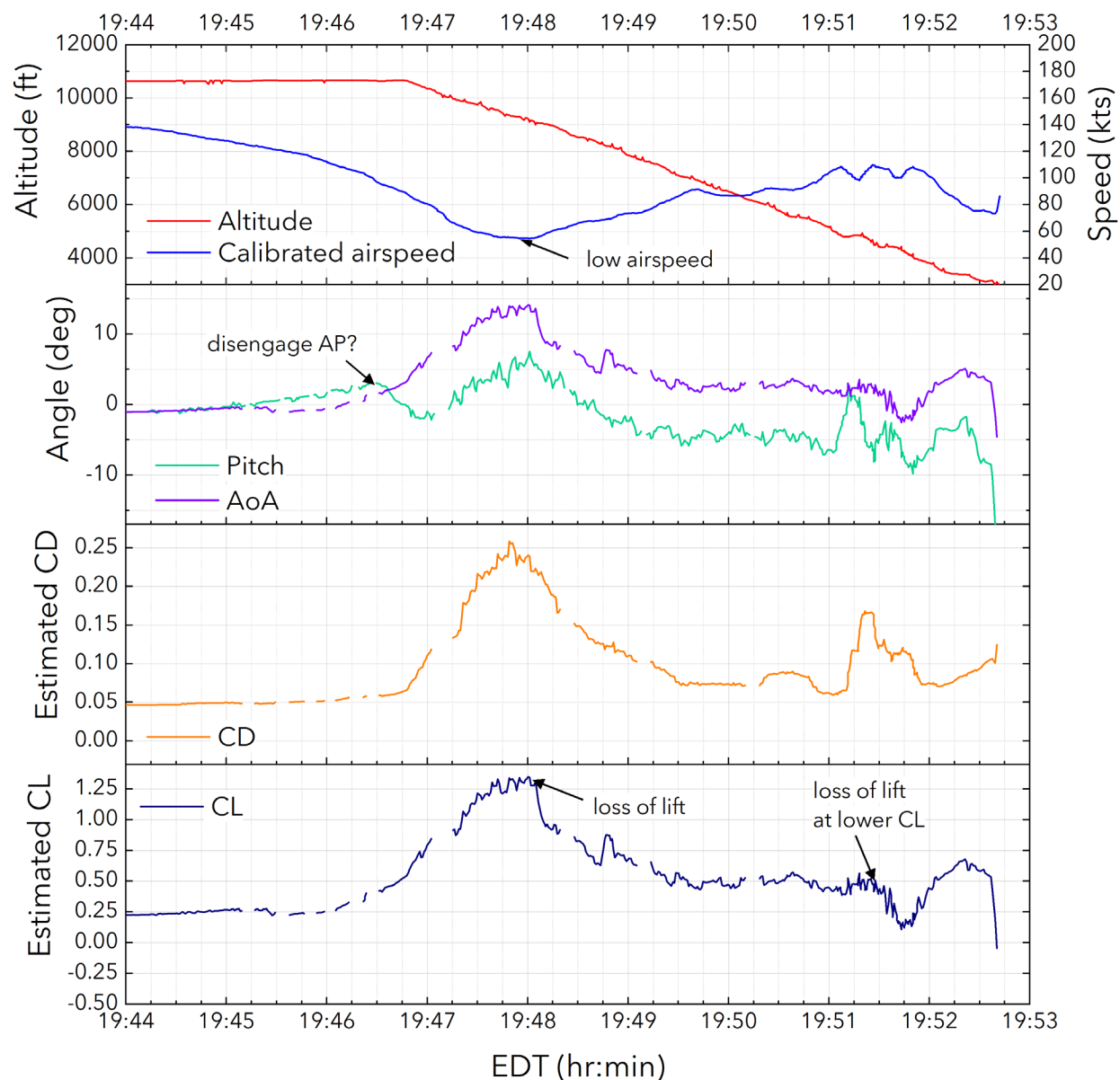


Figure 4. Last ten minutes of flight altitude (msl), calibrated airspeed, pitch and angle of attack, drag coefficient, and lift coefficient.

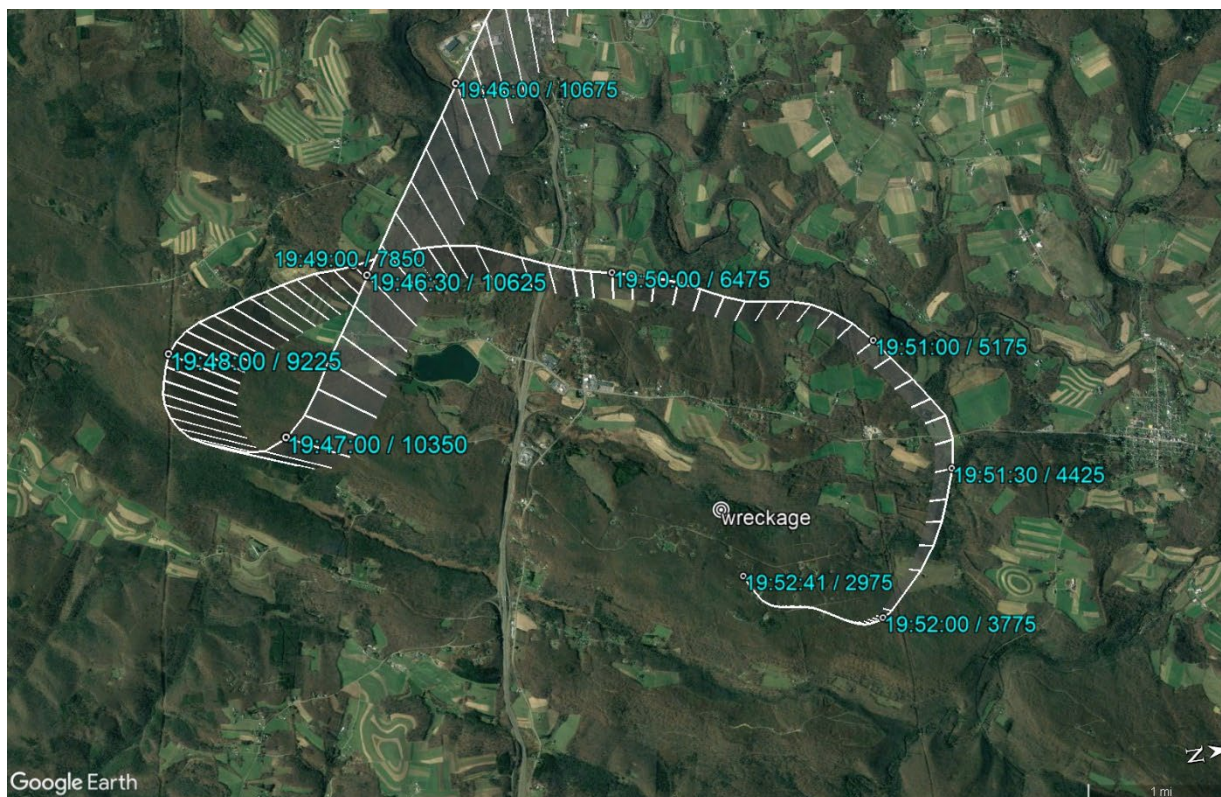


Figure 5. End of flight with selected times (EDT) and altitudes (msl) annotated. North is to the right in the image.

5.0 Icing Discussion

While drag increases with lift, ice accumulation on the wings increases drag and reduces the amount of lift the wing can produce. Ice accumulation on the fuselage of an airplane also increases drag. Additionally, ice accumulation on the propeller blades reduces the amount of thrust that can be produced.

The pilot's reports that the airplane was underperforming, unable to climb, and that autopilot was increasing pitch to maintain altitude was consistent with a buildup of ice on the propeller, reducing thrust, and possibly the airplane body, further increasing drag. After disconnecting the autopilot, the pilot found it difficult to maintain pitch control, consistent with ice accumulation degrading handling.

While a complete lift and drag relationship for the PA-32-260 was not available, the estimated aerodynamic model should accurately reflect the trends in the airplane's lift and drag. The loss of lift event at 19:48 occurred at a high lift coefficient, high angle of attack, and at a calculated calibrated airspeed lower than the reported stall speeds. While ice accumulation on the airplane may have contributed to making it difficult for the pilot to control airspeed and attitude, it did not appear to cause the wing to stall prematurely.

However, the loss of lift at 19:51:30 occurred without an increase in the lift coefficient and a speed above 100 kts. Additionally, there was a marked increase in drag before the loss of lift. This would be consistent with an accumulation of ice on the wing increasing drag and reducing the amount of lift it could produce before stall.

The airplane continued to descend for more than another minute and drag again began to increase before the airplane descended below 150 ft above the terrain and was no longer recorded by ADS-B.

D. SUMMARY

During the airplane's flight above 10,000 ft msl, the pilot reported insufficient power and the autopilot pitching the airplane up in to maintain altitude. After disconnecting the autopilot, the airplane descended and slowed, pitching up until there was a loss of lift near the reported aerodynamic stall speed. Three and a half minutes later, after an increase in drag without an accompanying increase in lift, the airplane experienced a second sudden loss of lift at a much lower lift coefficient and higher airspeed. Drag continued to gradually increase until the flight was no longer recorded by ADS-B. Airplane wreckage was found 2,500 ft beyond the last ADS-B point.

An accumulation of ice on the propellers and subsequent decrease in thrust would be consistent with the airplane's inability to climb and the autopilot pitching the airplane up to maintain altitude. Ice on the airplane would also make it more difficult to control the airplane's attitude. The increase in drag and subsequent loss of lift while at a low lift coefficient at 19:51:30 was consistent with an early-onset aerodynamic stall due to ice accumulation.

E. REFERENCES

1. Meteorological Specialist's Factual Report, ERA22LA191, National Transportation Safety Board. 2022.
2. Pilot's Operating Manual, Cherokee Warrior, Piper, July 14, 1975.