

National Transportation Safety Board

Office of Research and Engineering

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AIRCRAFT PERFORMANCE

Specialist's Study

November 8, 2024

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A ACCIDENT

Location: Little Rock, Arkansas
Date: February 22, 2023
Time: 11:56 central standard time
17:56 UTC
Airplane: Beech B200, N55PC

B AIRCRAFT PERFORMANCE SPECIALIST

Specialist Carl Schultheisz
National Transportation Safety Board
Washington, DC

C SUMMARY

On February 22, 2023, about 11:56 central standard time (CST), a Beech 200 airplane, N55PC, was destroyed when it was involved in an accident near the Bill and Hillary Clinton International Airport (LIT), Little Rock, Arkansas. The commercial pilot and 4 passengers sustained fatal injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 business flight.

Times are reported in CST unless otherwise indicated. UTC = CST plus 6 hours.

D BACKGROUND INFORMATION

1.0 Airplane

The accident airplane was a Beechcraft B200, a low-wing, twin-turboprop design with a T-tail that can carry 2 crew and 6 passengers. The airplane was equipped with two Pratt & Whitney Canada PT6A-42 engines, each rated for 850 shaft horsepower. The airplane was manufactured in 1983, and N55PC was registered to CTEH Leasing, LLC, of Little Rock, Arkansas.

The investigator in charge reported that the airplane weight at takeoff was 12,208 lb. The Pilot's Operating Handbook (POH) [1] shows the maximum takeoff weight for the airplane is 12,500 lb.

Post-accident examination of the airplane found evidence that the engines were rotating at impact. The flap setting could not be determined. Fuel samples were tested, and no issues were identified.

2.0 Airport

The airplane departed from runway 18 at LIT. Runway 18 is 6224 ft long and 150 ft wide, aligned at 182° true, at an elevation of 258.9 ft. The magnetic variation at LIT is 0.00°.

3.0 Data

Automatic Dependent Surveillance – Broadcast (ADS-B) data was provided by the Federal Aviation Administration (FAA). ADS-B broadcasts an aircraft's Global Navigation Satellite System (GNSS) position and other data to ground stations, where it is recorded approximately once per second. The GNSS position data is expected to have an uncertainty of approximately 20 m (65 ft) in horizontal and vertical dimensions. The ADS-B data includes time, latitude, longitude, GNSS altitude to the nearest 25 ft, pressure altitude to the nearest 100 ft, avionics-reported rate of change of pressure altitude, and avionics-reported north and east velocities, which can be combined to calculate groundspeed.

The ADS-B latitude and longitude were converted to distances north and east of the runway 18 threshold using the WGS84 ellipsoid model of the earth. The GNSS altitude was corrected to the altitude above mean sea level (msl) by adding 90 ft. The GNSS altitude is the height above the WGS84 ellipsoid model of the earth, which is 90 ft above the geoid at LIT.

A smooth flight track was created by integrating the avionics-reported north and east velocities. The constants of integration were chosen to minimize the differences between the integrated quantities and the north and east positions calculated from the latitude and longitude. A smooth pressure altitude trace was similarly created by integrating the avionics-reported rate of change of pressure altitude, and then minimizing the difference between the integrated quantity and the recorded pressure altitude. A smooth msl altitude trace was also created by integrating the avionics-reported rate of change of pressure altitude, and then minimizing the difference between the integrated quantity and the msl altitude from the corrected GNSS altitude.

The FAA ADS-B data coverage does not extend to the surface of runway 18 at LIT; the first data point is at an altitude of 496 ft msl, which is 237 ft above ground level (agl). The FAA ADS-B coverage also did not extend to the end of the flight; the

last ADS-B data point occurred at an altitude of 552 ft msl. The elevation at the crash site was about 325 ft.

The FAA also provided ADS-B data for two prior takeoffs by N55PC from runway 18 at LIT for comparison purposes. The first takeoff occurred on February 15, 2023, about 10:05 CST, and the second takeoff occurred on February 19, 2023, about 14:45 CST.

4.0 Video information

Surveillance video from the ramp adjacent to runway 18 showed the airplane from shortly after it lifted off until it descended behind trees, followed by fire and smoke. The camera is identified as "LIT FBO Ramp," and the video was time stamped with the day, date and CST time to the nearest second. A still image from the video is shown in Figure 1.

A second video from a camera mounted on a vehicle travelling westbound in the right lane of Interstate 440 showed the airplane as it passed over the Interstate. The video is labeled "Garmin," and the video was time stamped with the date and CST time to the nearest second. A still image from the video is shown in Figure 2.

Surveillance video from the industrial plant adjacent to the crash site showed the airplane impacting the ground. This video did not include a label or a time stamp.

5.0 Weather

A Meteorology factual report with three attachments is available in the docket for this accident [2]. As the airplane was departing, the wind that had been out of the south was shifting to be out of the southwest or west, in conjunction with a line of heavy rain that was arriving from the west.

At 11:53, an aviation routine weather report (METAR) from the Automated Surface Observing Station (ASOS) at LIT reported wind from 210° at 19 knots with gusts to 27 knots, visibility 10 statute miles or greater, ceiling broken at 4,800 ft agl, overcast clouds at 6,000 ft agl, temperature of 24 °C and dew point temperature of 14 °C, altimeter setting of 29.62 inches of mercury; Remarks: automated station with a precipitation discriminator, peak wind of 36 knots from 220° at 11:21, sea level pressure of 1002.8 hectopascals (hPa), temperature of 23.9 °C and dew point temperature of 14.4 °C, 6-hour maximum temperature of 25.0 °C, 6-hour minimum temperature of 20.6 °C, pressure decreased 1.7 hPa over previous 3 hours.

At 12:02, a special METAR (SPECI) reported wind from 300° at 22 knots with gusts to 40 knots, visibility of 2 statute miles, light rain, scattered clouds at 3,600 ft

agl, ceiling overcast at 4,700 ft agl, temperature of 19 °C and dew point temperature of 13 °C, altimeter setting of 29.68 inches of mercury; Remarks: automated station with a precipitation discriminator, peak wind of 40 knots from 300° at 11:59, wind shift at 11:48, rain began at 12:00, pressure rising rapidly, trace amount of liquid equivalent precipitation since 11:53, temperature of 18.9 °C and dew point temperature of 12.8 °C.

The Meteorology factual report also included one-minute ASOS reports from LIT indicating the wind direction, wind speed, gust direction and gust speed. A subset of the one-minute ASOS data is excerpted in Table 1 below. As discussed in more detail below, the flight occurred between 11:55 and 11:57.

Table 1. One-minute ASOS data excerpted from the Meteorology factual report.				
Time	Wind direction	Wind speed (kt)	Gust direction	Gust speed (kt)
11:54	219°	19	212°	29
11:55	227°	17	245°	18
11:56	241°	17	253°	26
11:57	255°	21	258°	28
11:58	279°	26	298°	39

A High-Resolution Rapid Refresh (HRRR) model sounding for 12:00 was downloaded from the National Oceanic and Atmospheric Administration¹. The HRRR sounding provides a model of the pressure, temperature, dew point, wind speed and wind direction as functions of altitude. After consultation with the NTSB meteorologist, the HRRR sounding pressure and temperature variation was considered appropriate, and the wind experienced by the airplane during the flight was assumed to be 20 kt to 30 kt, from a direction between 210° and 260°.

HRRR soundings were also downloaded to model winds aloft for the prior flights on February 15, 2023, and on February 19, 2023, which were used for comparison with the accident flight.

E DETAILS OF THE INVESTIGATION

1.0 Accident Flight

The preliminary report for this investigation stated that at 11:54:47, the pilot requested takeoff clearance from runway 18 on tower frequency. At 11:54:55, air traffic control cleared the pilot for takeoff. At 11:55:06, the pilot acknowledged the takeoff clearance. There were no other transmissions from the pilot.

¹ [READY Archived Meteorology \(noaa.gov\)](https://www.noaa.gov/ready/Archived_Meteorology)

The video from the ramp adjacent to the runway first showed the airplane at 11:55:58, after it had lifted off from runway 18. The airplane entered the field of view from the left and was estimated to be 2495 ft from the threshold and 20 ft above the runway. At 11:56:03, the landing gear began to retract, and they were fully retracted by 11:56:05. The position of the flaps could not be determined from the video. The first ADS-B point was recorded at 11:56:13 with the airplane 5005 ft from the threshold and 237 ft above the runway. The average groundspeed of the airplane between the time it was first visible and the time of the first ADS-B point was therefore about 99 kt, and the average rate of climb was about 870 ft per minute. The airplane was visible in the video from the vehicle on Interstate 440 between 11:56:22 and 11:56:33; the position of the flaps could not be determined. The last ADS-B point was recorded at 11:56:45. At 11:56:48, the video from the ramp shows the airplane rolling left and descending quickly behind trees, with fire and smoke visible at 11:56:54. The plume of smoke rises up and to the left in the video (to the east and/or north). There is a gap in the video from the ramp between 11:57:04 and 11:57:45, after which raindrops are visible in the video, but the smoke plume is also still visible. There is another gap from 11:58:20 to 11:59:05, after which heavier rain is visible and the smoke plume is obscured.

Figure 3 shows a profile view of the flight path on a Google Earth background. Figure 4 shows an overhead view of the flight path on a Google Earth background.

The surveillance video from the industrial plant adjacent to the crash site shows the airplane impacting trees and the ground, followed by a fire. Heavy rain can be observed in the video beginning about 1 minute after the ground impact.

Neither the video from the ramp nor the video from the vehicle on Interstate 440 indicated any obvious problem with airplane. The flap position could not be determined in either video.

The POH provides takeoff distance charts for flaps up and flaps approach; there is no chart for flaps down. For a temperature of 24 °C, a pressure altitude of 500 ft, and headwind of 8 kt or greater, both charts would indicate ground rolls of less than 2000 ft. The video evidence shows the airplane above the runway at 2495 ft from the threshold, so the takeoff appears to be consistent with normal performance. For a flaps up takeoff, the POH specifies rotation at 95 kt and an initial climb speed of 120 kt to clear a 50 ft obstacle; at flaps approach, the POH specifies rotation at 94 kt and an initial climb speed of 106 kt to clear a 50 ft obstacle. For a 2000 ft ground roll, total takeoff distance above a 50 ft obstacle is 3400 ft for flaps up and 2800 ft for flaps approach.

For an airplane weighing 12,208 lb, the POH shows the power-idle, wings-level stall speeds are 101 kt calibrated airspeed for flaps up, 89 kt calibrated airspeed for flaps approach and 79 kt calibrated airspeed for flaps down.

The pressure altitude and msl altitude for the flight are shown in Figure 5, along with event times from the video. The airplane reached its peak altitude about 11:56:25.

The ground track angle for the flight is shown in Figure 6.

Figure 7 shows the groundspeed and true airspeeds for the flight, assuming different combinations of wind speeds and directions. Winds of 20 kt and 30 kt, and wind directions from 210° and 260° are considered. The true airspeed is the magnitude of the vector difference between the groundspeed velocity and the wind velocity. Winds from 210° would have been closer to a direct headwind, and therefore correspond to a higher true airspeed. The groundspeed was generally decreasing throughout the flight, but there was a slight increase at 11:56:43 near the end of the data. The airplane turns slightly to the right near the end of flight, which results in changes in the computed true airspeed that depend on the wind speed and direction assumed.

Figure 8 shows the calibrated airspeeds for the different assumed wind conditions, along with the power-idle, wings-level stall speeds from the POH. The calibrated airspeeds are about 3 kt less than the true airspeeds in Figure 7. The calibrated airspeed remains above the flaps-up stall speed only for the case assuming a wind of 30 kt from 210°. The cases assuming winds from 260° have calibrated airspeeds below the flaps-up stall speed for nearly the entire time of recorded data, and for the case assuming a wind of 20 kt from 260°, the calibrated airspeed also drops below the flaps-approach stall speed for about 10 s.

Figure 9 shows the potential energy, the kinetic energy calculated from the inertial speed (groundspeed coupled with rate of climb), and total energy during the flight. The data indicate that the total energy began to decrease about 11:56:20, which was 5 s before the peak altitude was reached. The slight increase in groundspeed at 11:56:43 was offset by the decrease in altitude at the same time, with the total energy continually decreasing.

A simplified mathematical model of the airplane was used to calculate the thrust and the power (thrust multiplied by true airspeed) required by the airplane during the flight. The lift coefficient is assumed to be a linear function of angle of attack, and there is no provision to identify or model stall behavior. The drag coefficient is a function of lift coefficient and flap setting. The flaps-up calculated thrust required for each assumed wind condition is shown in Figure 10, and the flaps-up calculated horsepower is shown in Figure 11. Both the thrust and horsepower

show a sharp decrease at 11:56:20, consistent with the decrease in total energy shown in Figure 9. Each engine is rated at 850 shaft horsepower, for a total of 1700 horsepower; the actual power delivered to the airframe will be less than that total because the engines and propellers are not 100 % efficient. In this case, the maximum value calculated was only about 900 horsepower, and after 11:56:20, the value was less than 400 horsepower.

2.0 Comparison with prior flights

FAA ADS-B data for two prior takeoffs by N55PC from runway 18 at LIT was used to compare the airplane performance during the accident flight with the performance in prior takeoffs. The first takeoff occurred on February 15, 2023, about 10:05 CST, and the second takeoff occurred on February 19, 2023, about 14:45 CST. HRRR soundings were downloaded to determine the winds aloft and atmospheric conditions for those takeoffs.

Altitudes for the three flights are compared in Figure 12, with time shifted to the first ADS-B data point for each set of data. The ADS-B data did not extend to the runway surface for any of the flights. Only the first 100 s of data is shown. In the earlier takeoffs, the airplane climbed at about 2000 ft per minute.

Figure 13 compares the groundspeeds and Figure 14 compares the calibrated airspeeds. The speeds demonstrated in the earlier flights are substantially higher than in the accident flight.

Figures 15 and 16 compare the thrust calculated from the mathematical model of the airplane. The weight of the airplane during the earlier flights is unknown, so two cases were examined, one with the airplane at the maximum takeoff weight of 12,500 lb and one with the airplane at 9,000 lb, which is the lowest weight shown in the take-off distance or stall speed charts in the POH. Figure 15 compares the thrust calculated for the takeoff on February 15, 2023, with the thrust calculated for the accident flight (previously shown in Figure 10). Figure 16 compares the takeoff on February 19, 2023, with the accident flight. During the prior flights, the airplane was developing 2500 lb to 3500 lb of thrust, while during the accident flight it was developing only 1000 lb of thrust or less after the first 10 s of data.

Figures 17 and 18 compare the horsepower calculated from the mathematical model of the airplane. The weight of the airplane during the earlier flights is again taken as either 12,500 lb or 9,000 lb. Figure 17 compares the horsepower for the takeoff on February 15, 2023, with the horsepower for the accident flight (shown in Figure 11). Figure 18 compares the takeoff on February 19, 2023, with the accident flight. The horsepower calculated for the prior flights is consistent with what would be expected from the two 850 shaft horsepower engines, while the accident flight

was developing less than 400 horsepower after the first 10 s of data. Figures 17 and 18 also indicate that increasing the weight of the airplane from 9,000 lb to 12,500 lb requires an increase of 300 – 400 horsepower. If the airplane during the accident flight had been heavier than the 12,208 lb reported, the calculated horsepower required would increase, but it is unlikely that an error in weight could explain the extremely low horsepower computed for the accident flight.

3.0 Effect of flaps

The mathematical model of the airplane was also used to estimate the effect of flap position on the calculated thrust and horsepower required. The POH provides takeoff distance charts for flaps up and flaps approach. The normal operations section of the POH specifies that the gear are to be raised once a positive climb is established, and flaps are to be retracted once the airspeed reaches 121 kt. As shown in Figure 8, the calibrated airspeed might not have exceeded 121 kt, depending on the wind speed and direction assumed. Figure 19 indicates the effect of flap position on the thrust required, and Figure 20 indicates the effect of flap position on horsepower. Figures 19 and 20 both show results for wind assumed to be 30 kt from 210°, which required the highest thrust and horsepower for the flaps-down case. Full flaps result in a substantial increase in drag, requiring greater thrust and horsepower for the airplane to fly through the recorded data. However, the required thrust and horsepower are still much less than those plotted in Figures 15 – 18 for the prior flights.

F CONCLUSION

As the airplane was departing from runway 18 at LIT, the wind that had been out of the south was shifting to be out of the southwest or west, in conjunction with a line of heavy rain that was arriving from the west. Performance calculations were based on different combinations of wind speeds of 20 kt and 30 kt, and wind directions of 210° and 260°.

Video indicated that the airplane took off within the first 2500 ft of the runway, consistent with the performance specified in the POH. At the first ADS-B data point at 11:56:13, the airplane was 237 ft above the runway and 5005 ft from the threshold. The ADS-B data lasted 32 seconds, and the groundspeed was decreasing for the entire time. The altitude peaked at 386 ft above the runway at 11:56:25, and it decreased thereafter.

At 11:56:48, about 3 s after the ADS-B data ended, video showed the airplane rolling left and descending behind trees, followed by fire and smoke. The airplane crashed before heavy rain began.

The total energy (kinetic plus potential) peaked at 11:56:20, and the thrust and horsepower calculated for the airplane showed a sharp decrease at that time. Assuming the flaps were up, the thrust calculated during the last 25 s of ADS-B data from the accident flight was about 30 % of the thrust calculated for two prior takeoffs. Assuming flaps up, the horsepower calculated during the last 25 s of ADS-B data from the accident flight was about 20 % of the horsepower calculated for the two prior takeoffs. The horsepower calculated for the prior takeoffs was consistent with what would be expected from the two 850 shaft horsepower engines on the airplane.

Even with the added drag corresponding to the flaps fully deployed, the thrust calculated during the last 25 s of ADS-B data from the accident flight was only about 80 % of the thrust calculated for two prior takeoffs. Similarly, with flaps fully down, the horsepower calculated during the last 25 s of ADS-B data from the accident flight was only about 56 % of the horsepower calculated for the two prior takeoffs.

If the flaps were up during the flight, a lower wind speed and/or wind from the west (260°) would have led to calibrated airspeeds below the flaps-up, wings-level, power-idle stall speed of the airplane. The left roll captured by the video at the end of the flight was consistent with a post-stall wing drop.

Submitted by:

Carl R. Schultheisz
Chief, Vehicle Performance Division

REFERENCES

1. Beechcraft Super King Air B200 & B200C Pilot's Operating Handbook and FAA Approved Flight Manual, Raytheon Aircraft Company, 2004.
2. Meteorology Specialist's Factual Report, with three attachments, National Transportation Safety Board, 2023.



Figure 1. Still image from the surveillance video from the ramp adjacent to runway 18, with the camera identified as LIT FBO Ramp. The accident airplane is visible at the top center of the image, and the time stamp is 11:56:02 CST.



Figure 2. Still image from the video taken by a camera mounted on a moving highway vehicle as the accident airplane passed over Interstate 440. The video is labeled Garmin, and the video time stamp is 11:56:32.



Figure 3. Profile view of the accident flight path. Annotations indicate the time, altitude msl and groundspeed. North is to the left.



Figure 4. Overhead view of the accident flight path. Annotations indicate the time, altitude msl and groundspeed. North is at the top.

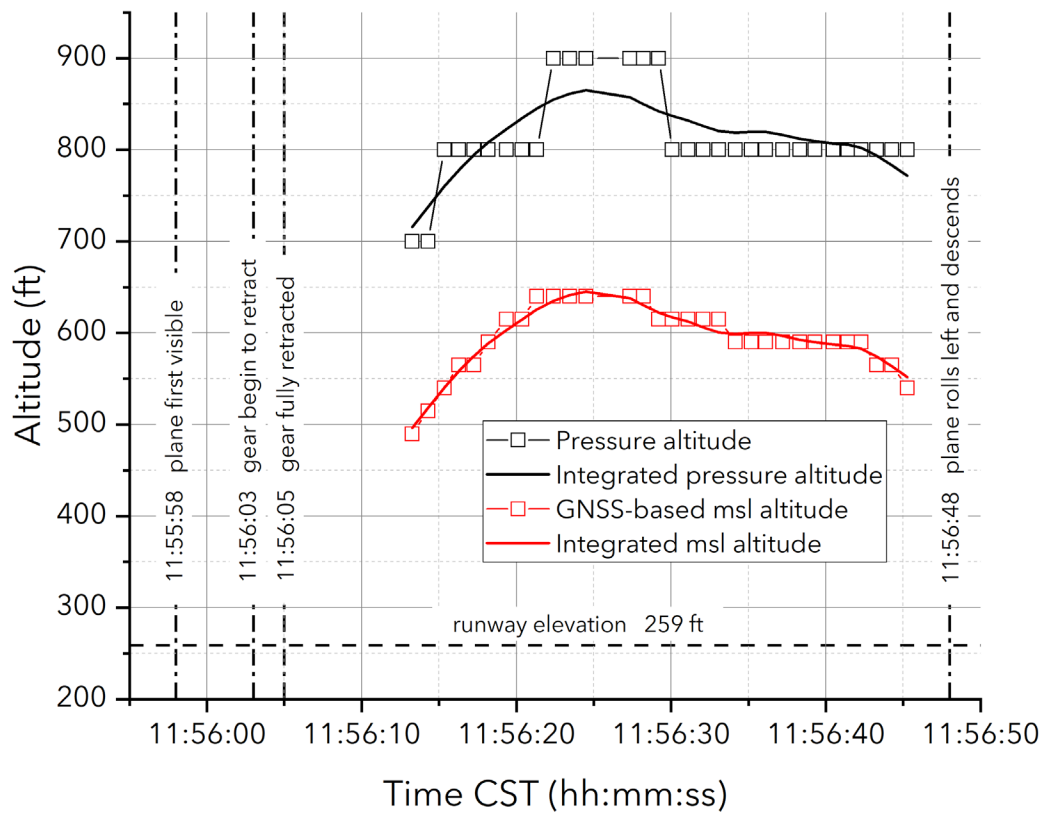


Figure 5. ADS-B pressure altitude and GNSS altitude converted to msl, along with altitude traces calculated by integrating the avionics-reported rate of change of pressure altitude. Events identified in the surveillance video from the camera adjacent to the ramp are indicated, along with the runway elevation.

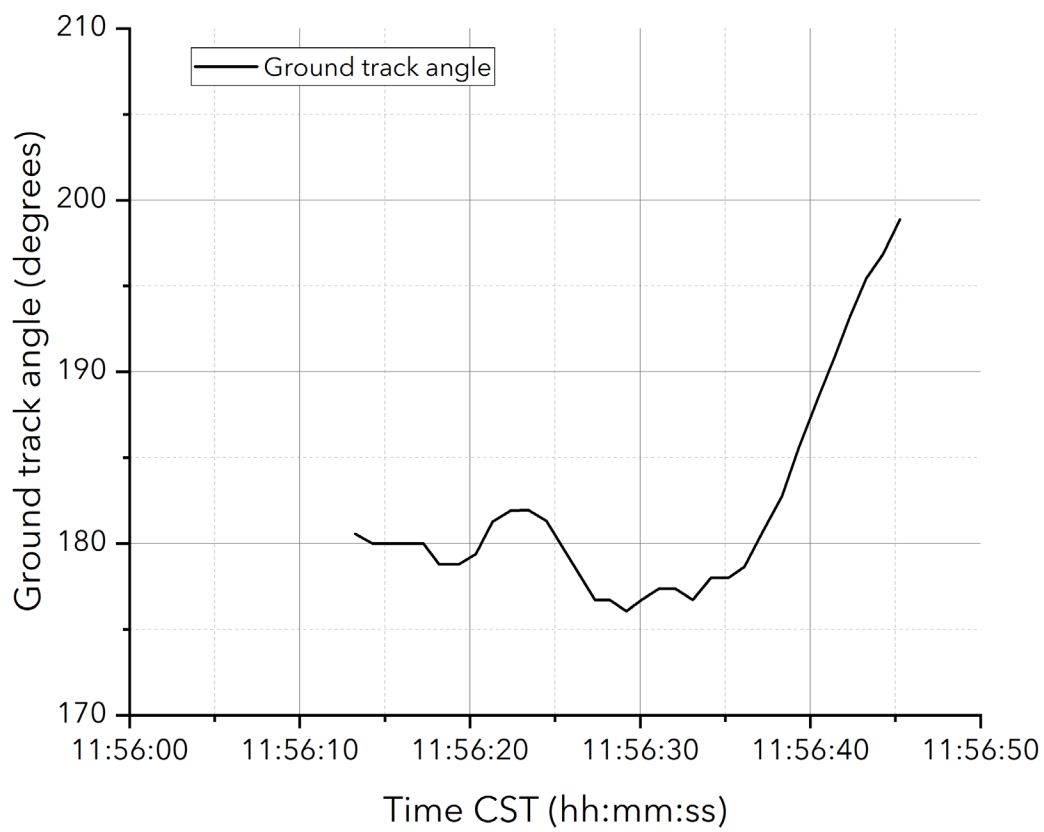


Figure 6. Ground track angle for the accident flight.

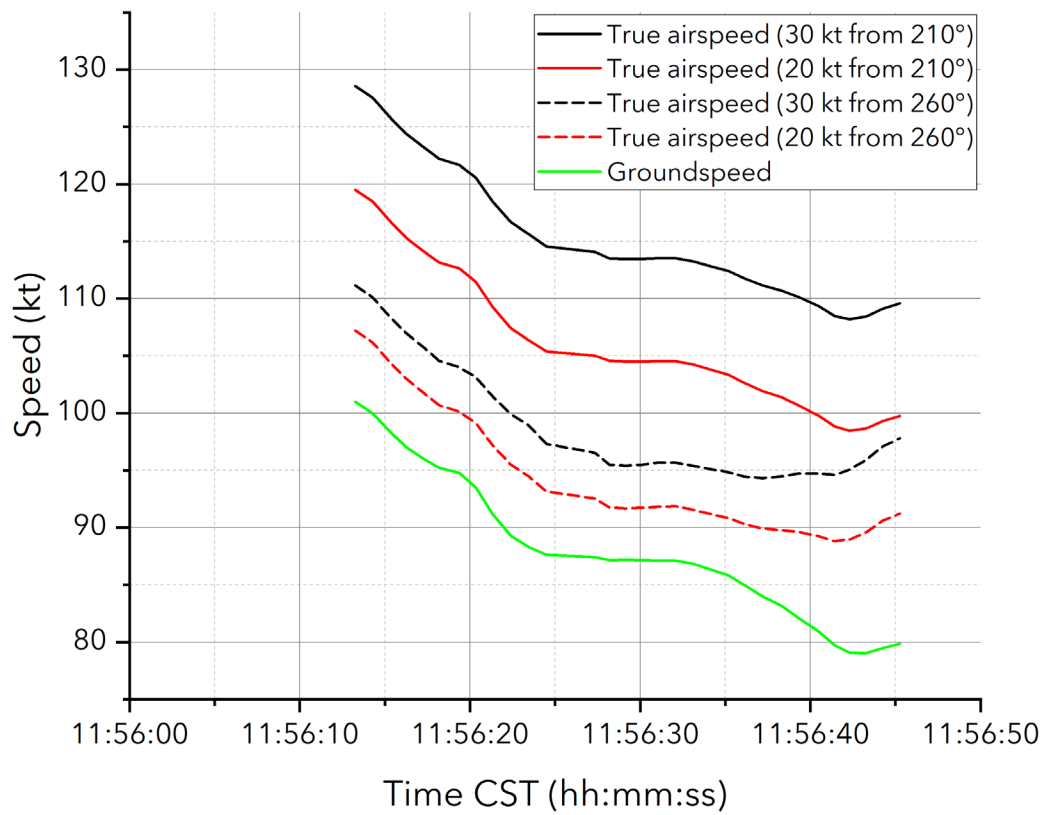


Figure 7. Groundspeed and true airspeeds based on the winds aloft assumed.

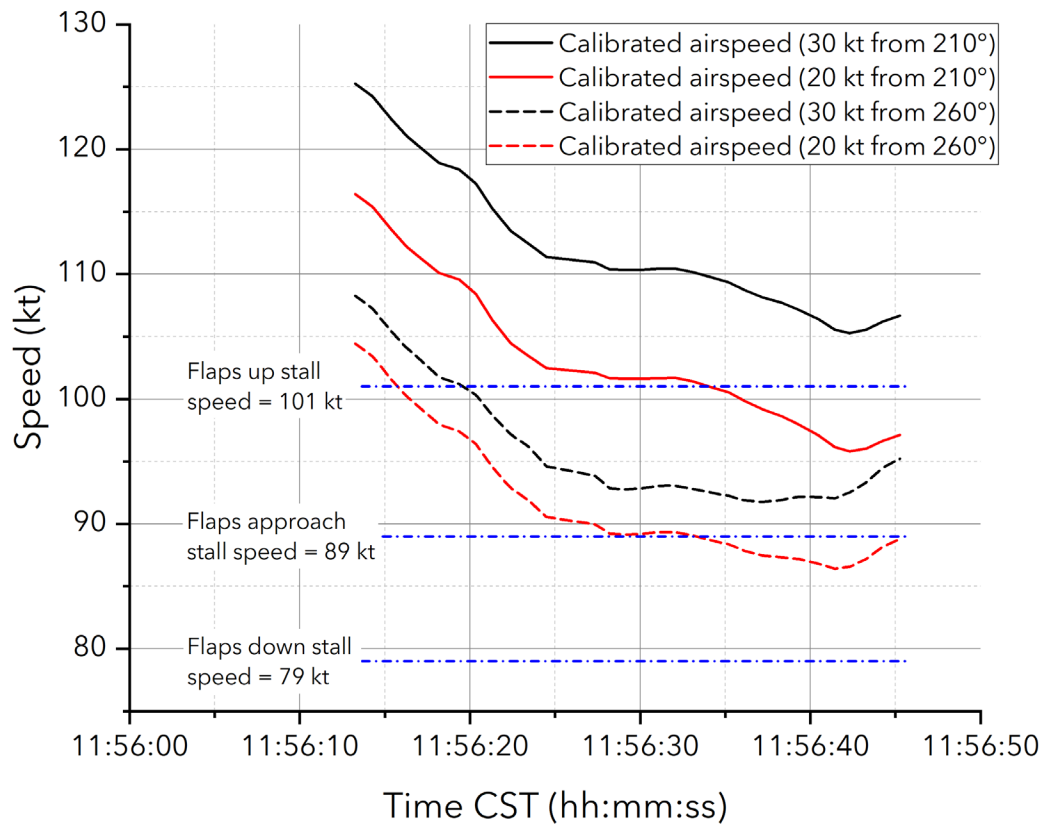


Figure 8. Calibrated airspeeds for the different winds assumed, along with stall speeds from the POH.

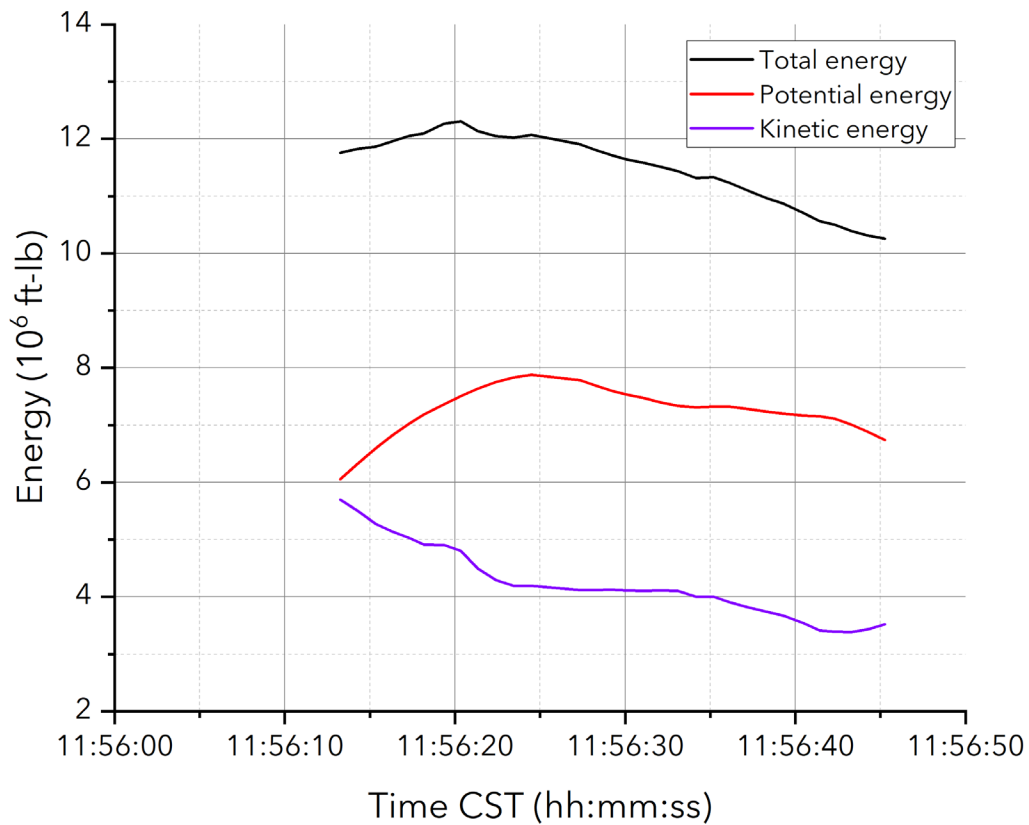


Figure 9. Potential energy, kinetic energy calculated from the inertial speed (groundspeed combined with rate of climb) and total energy (the sum of potential and kinetic energy) for the accident flight.

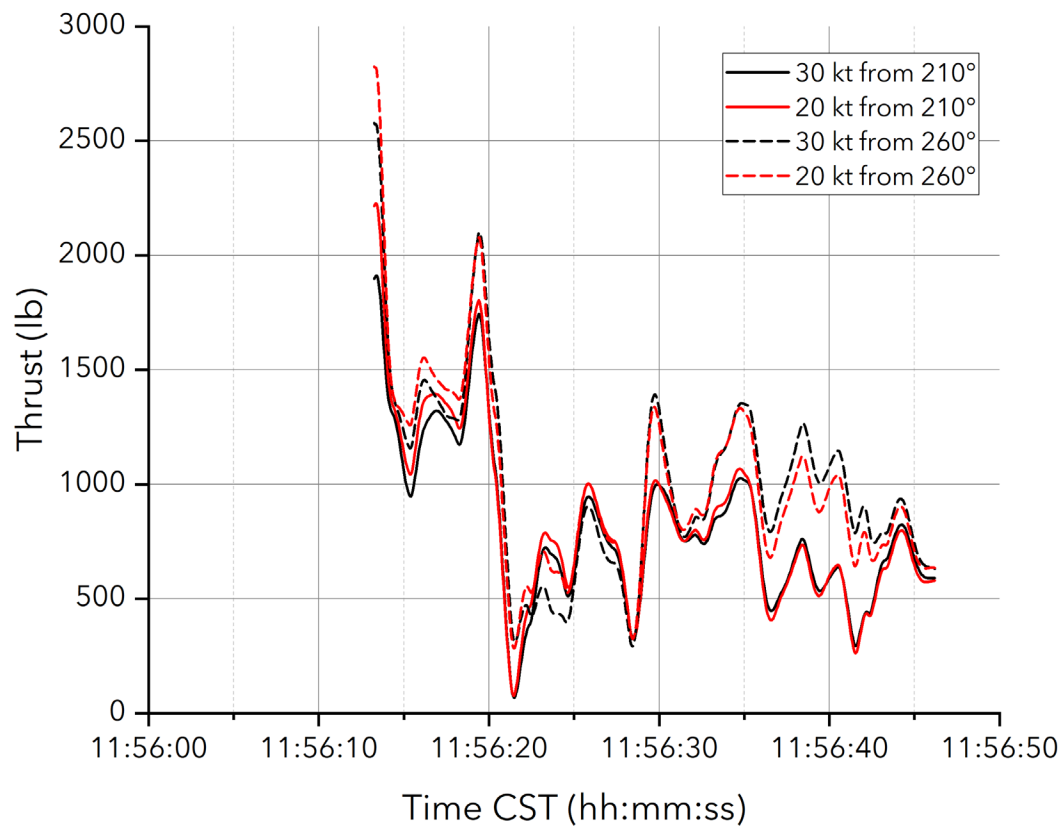


Figure 10. Thrust calculated for the different wind conditions assumed, using a simplified mathematical model of the airplane, with flaps up.

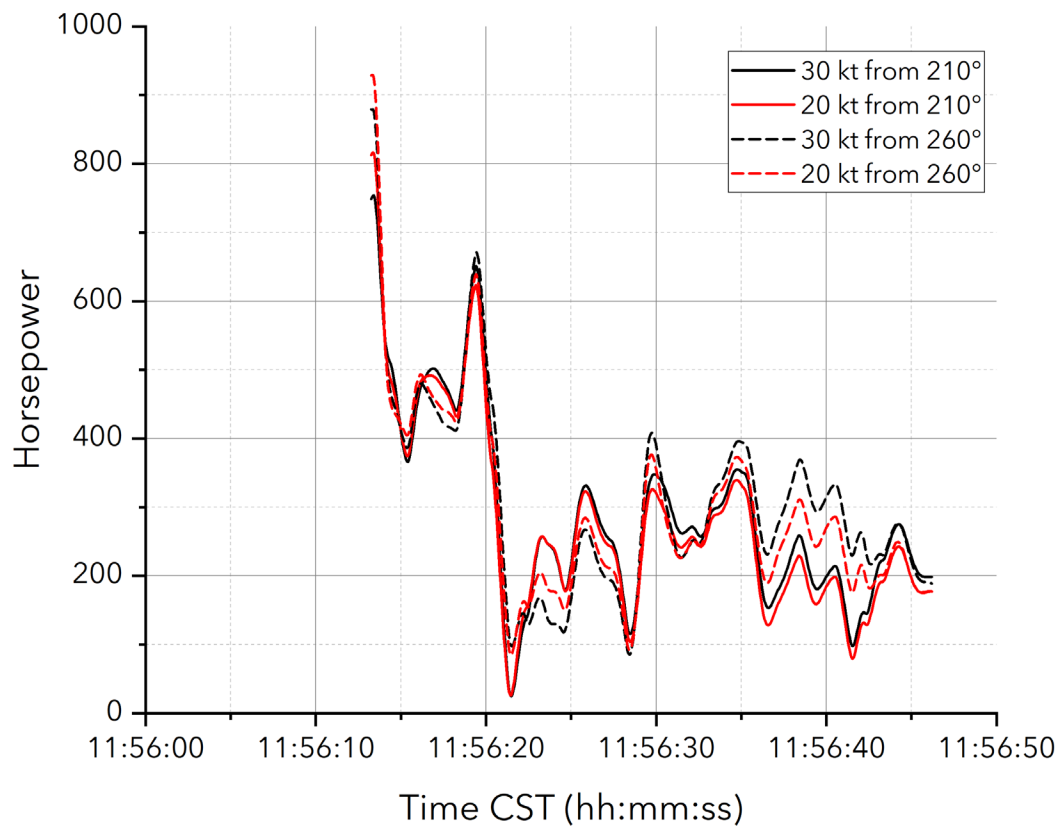


Figure 11. Horsepower calculated for the different wind condition assumed, using a simplified mathematical model of the airplane, with flaps up.

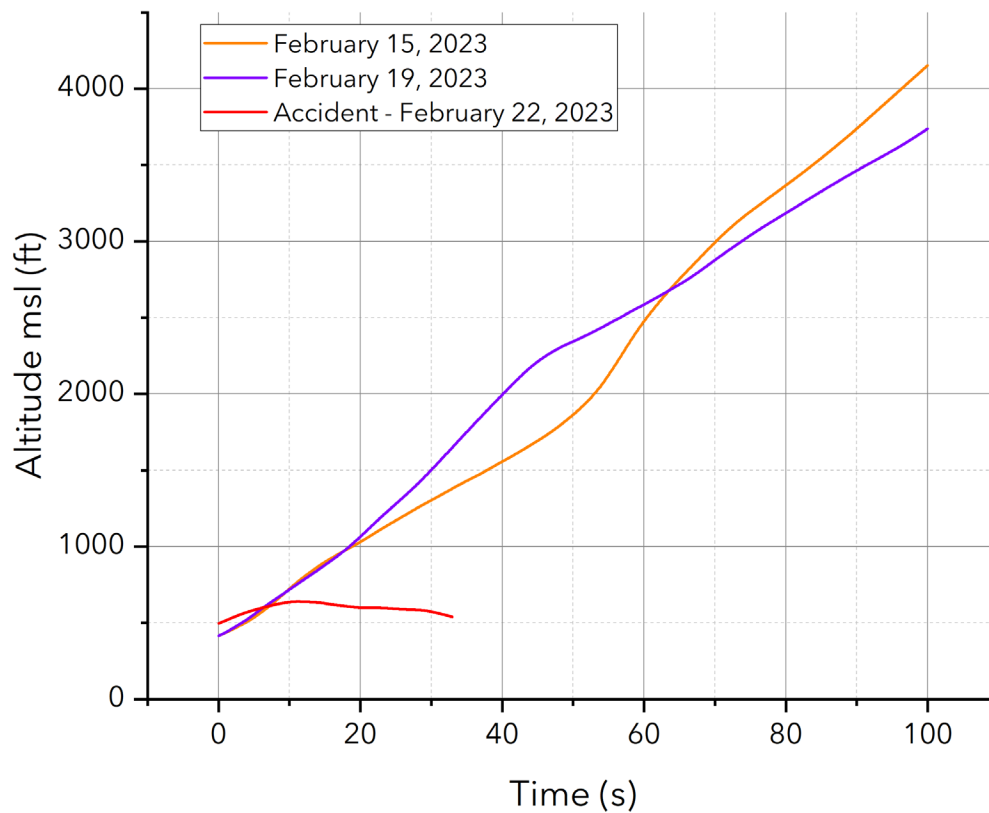


Figure 12. Altitudes for the accident flight and two prior takeoffs. Times are shifted to align the first ADS-B data point for each flight at zero, and the data for the prior flights is limited to the first 100 s.

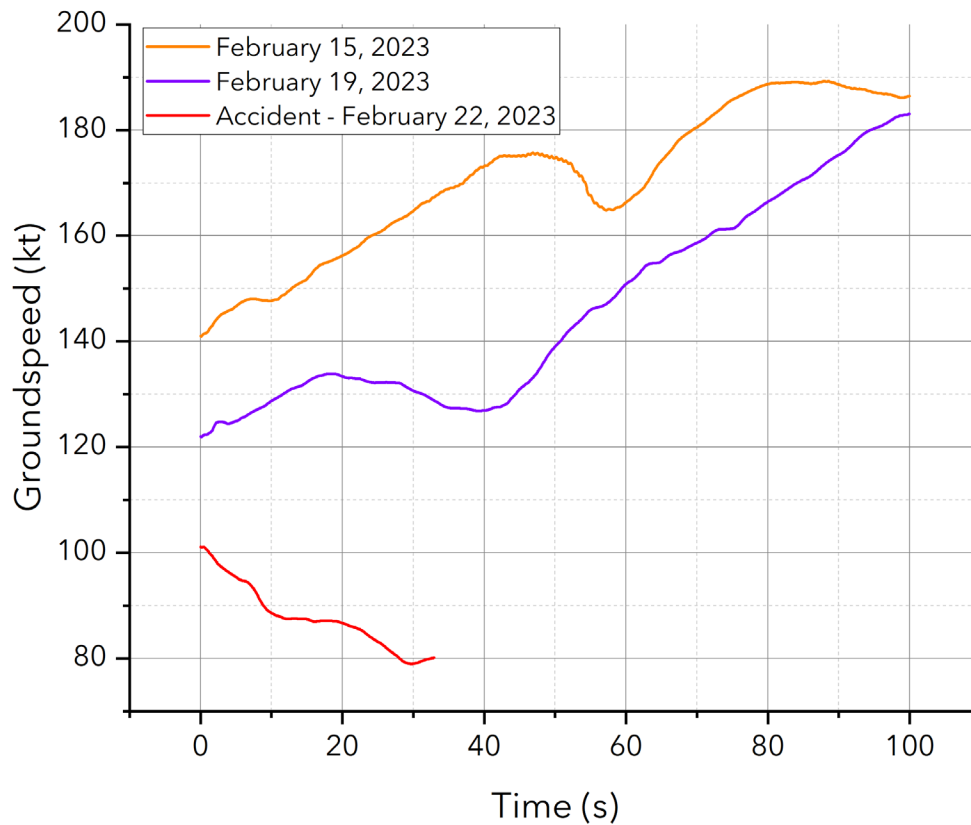


Figure 13. Groundspeeds for the accident flight and two prior takeoffs. Times are shifted to align the first ADS-B data point for each flight at zero, and the data for the prior flights is limited to the first 100 s.

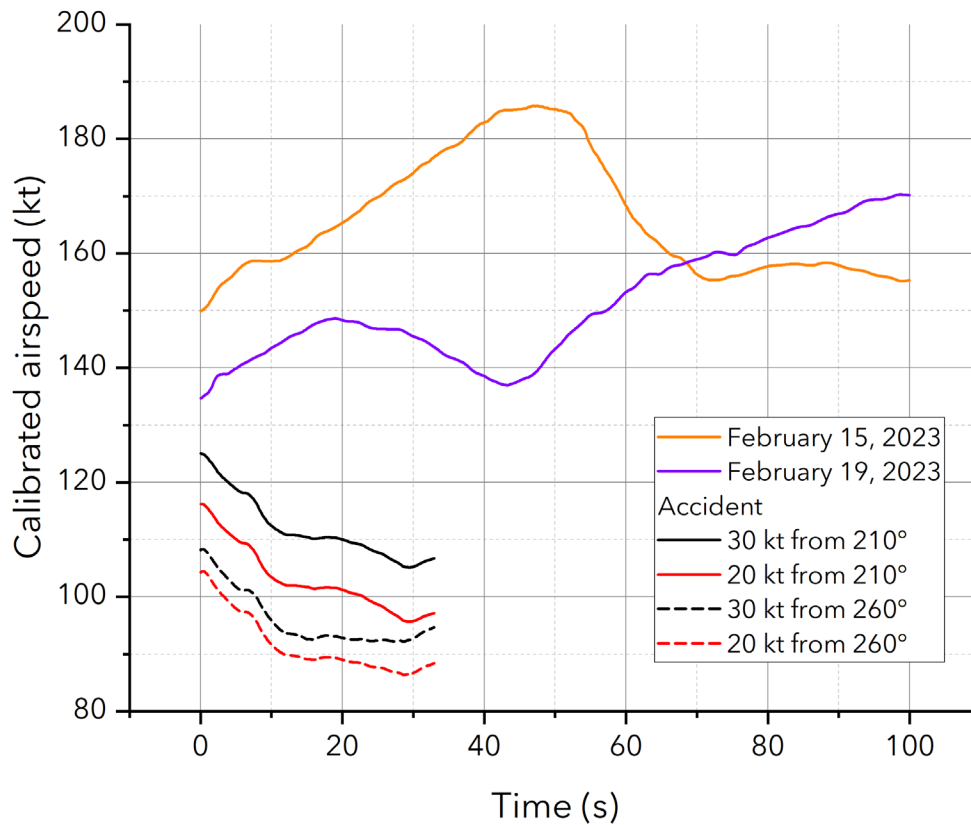


Figure 14. Calibrated airspeeds for the accident flight (for the assumed wind conditions) and two prior takeoffs. Times are shifted to align the first ADS-B data point for each flight at zero, and the data for the prior flights is limited to the first 100 s.

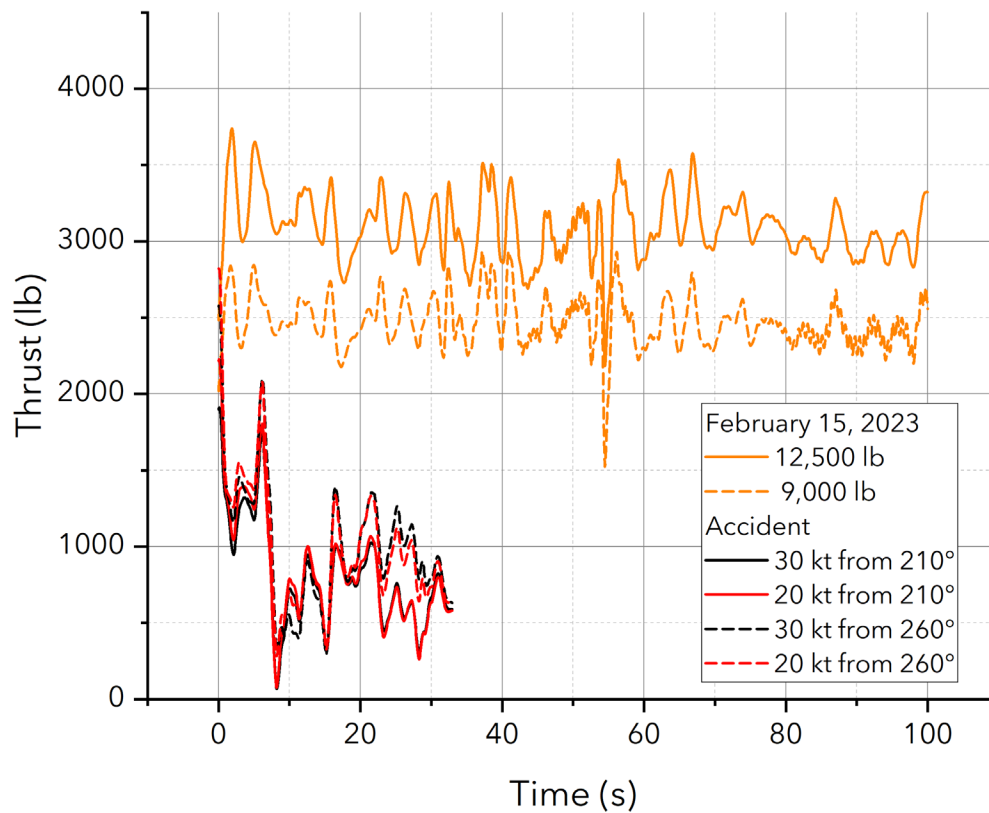


Figure 15. Thrust calculated for the accident flight (for the assumed wind conditions) and the prior flight on February 15, 2023.

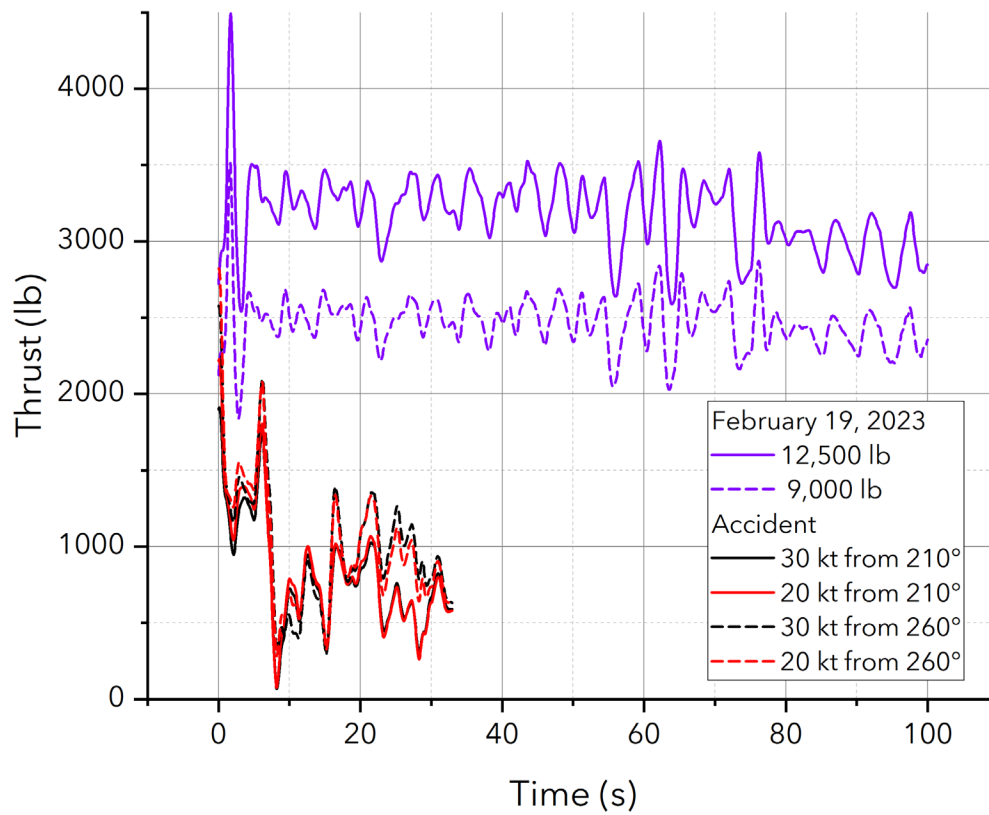


Figure 16. Thrust calculated for the accident flight (for the assumed wind conditions) and the prior flight on February 19, 2023.

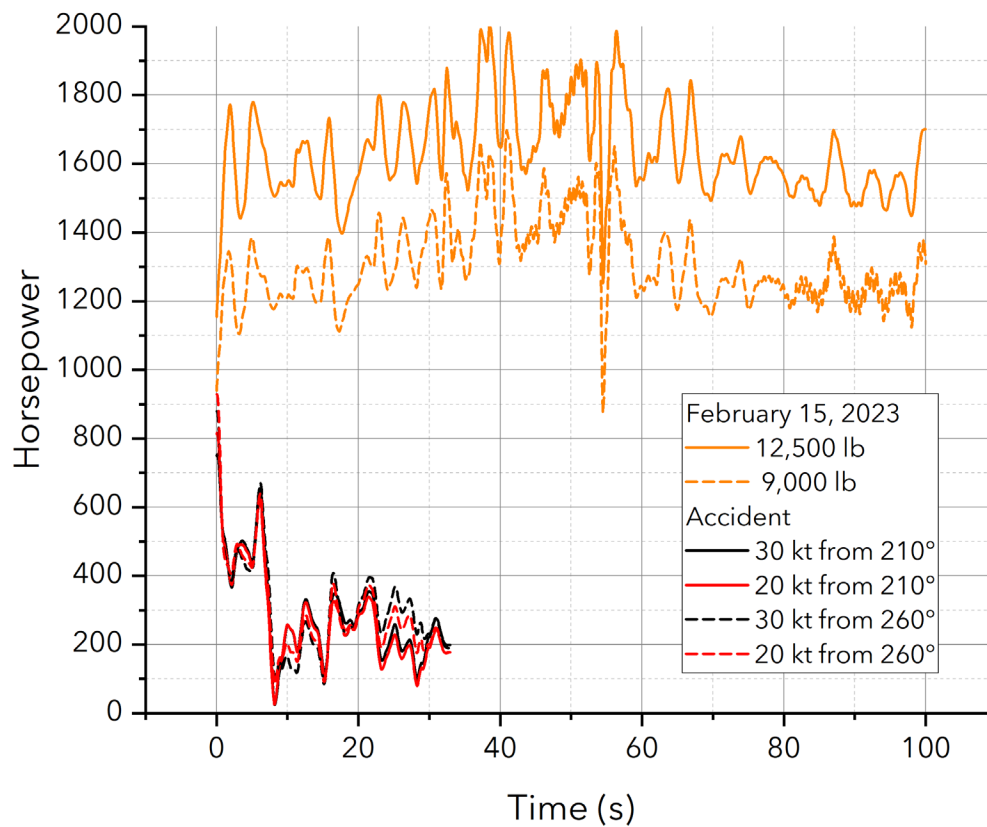


Figure 17. Horsepower calculated for the accident flight (for the assumed wind conditions) and the prior flight on February 15, 2023.

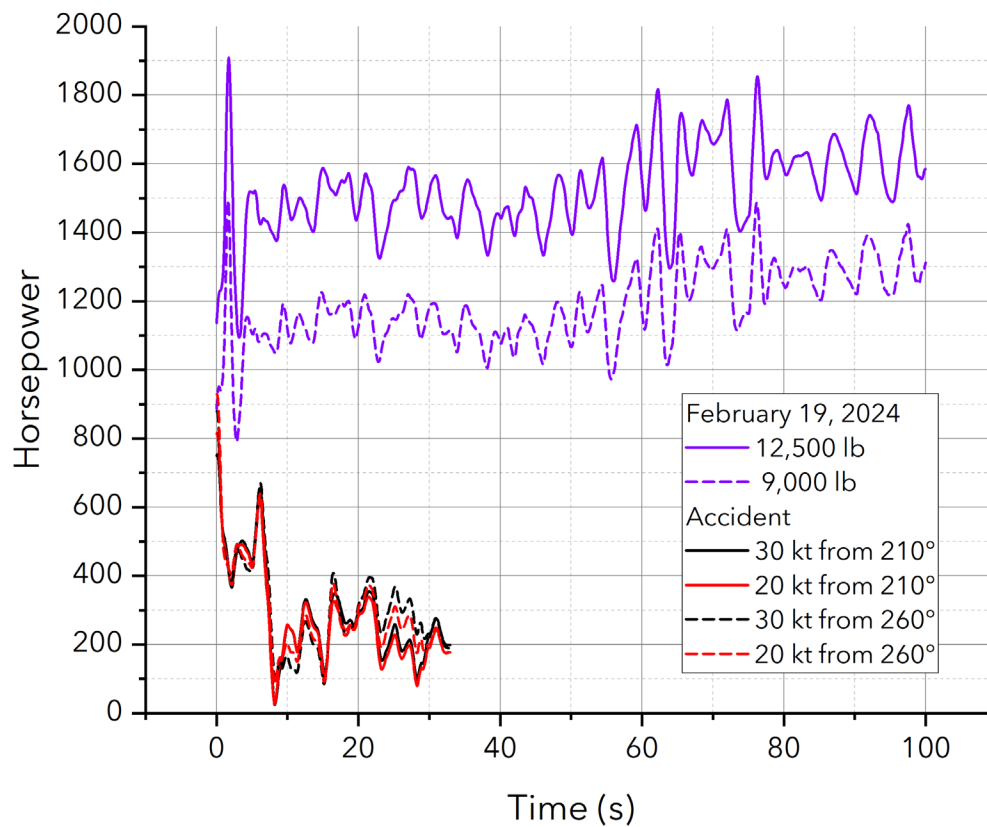


Figure 18. Horsepower calculated for the accident flight (for the assumed wind conditions) and the prior flight on February 19, 2023.

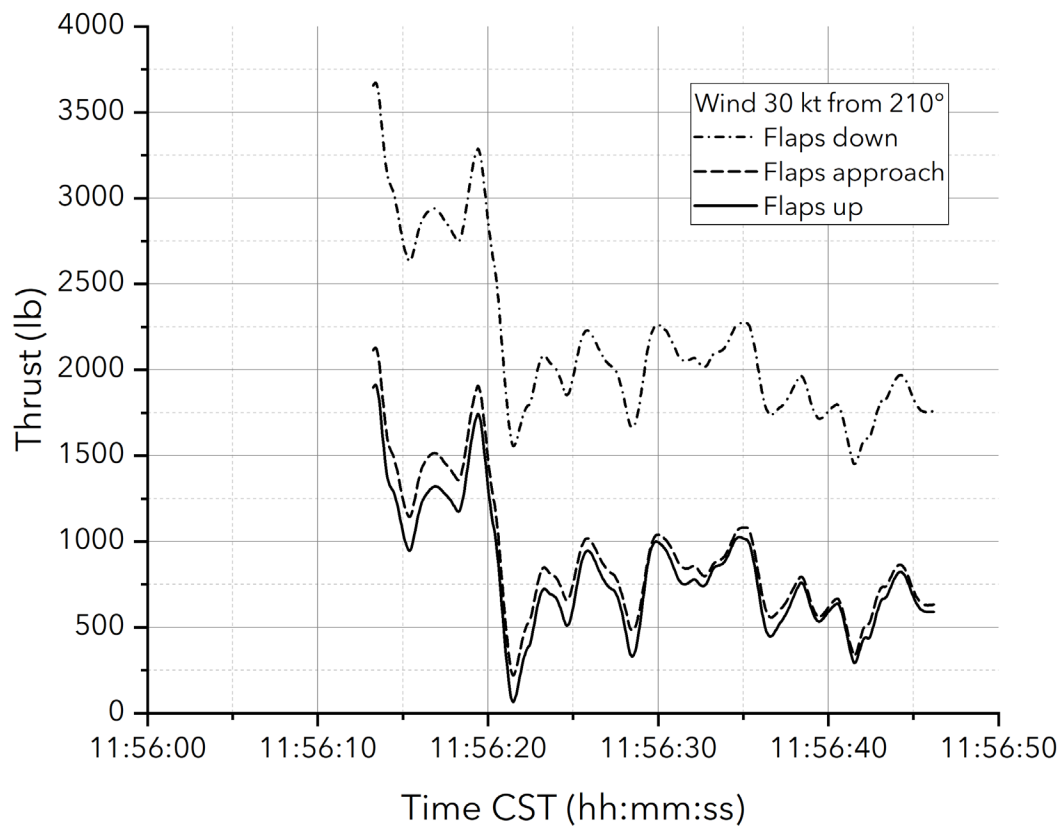


Figure 19. Thrust calculated for the accident flight assuming wind of 30 kt from 210° at different flap settings.

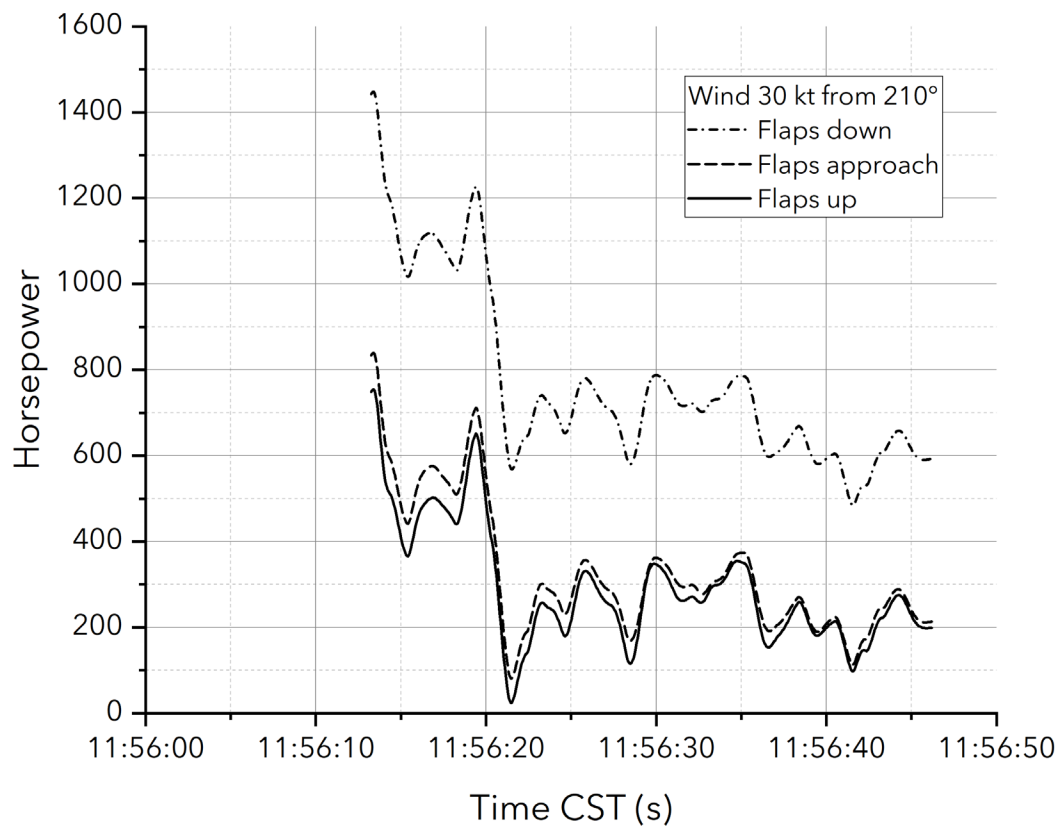


Figure 20. Horsepower calculated for the accident flight assuming wind of 30 kt from 210° at different flap settings.