

National Transportation Safety Board

Office of Research and Engineering

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CEN22LA130

AUTOMATIC DEPENDENT SURVEILLANCE- BROADCAST (ADS-B) STUDY

Airplane Performance Study

By

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A. ACCIDENT

Location: Aspen, Colorado
Date: February 21, 2022
Time: 11:33 mountain daylight time (MDT)
18:33 UTC
Aircraft: RAYTHEON AIRCRAFT COMPANY HAWKER 800XP

B. SUMMARY

On February 21, 2022, at 1133 mountain daylight time, a Raytheon Aircraft Company Hawker 800XP airplane, N99AP, was substantially damaged when it was involved in an accident near Aspen, Colorado. The two pilots and four passengers were not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 business flight.

C. PERFORMANCE STUDY

1.0 Airplane

The Hawker 800XP is a mid-size twinjet corporate airplane able to fly nine passengers. It has a maximum take-off weight of 27,400 lbs, a maximum speed of 456 kts, and a range of 2,400 NM.



Figure 1. Accident airplane, N99AP.

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. For this accident, only 15 ADS-B points were available.

The airplane was equipped with a cockpit voice recorder (CVR) which recorded the take-off roll.

3.0 Weather

Weather was recorded at Aspen-Pitkin County Airport (KASE), the site of the accident. The temperature was reported as 34°F (1°C), the dew point was 16°F (-9°C), and the barometric setting was 29.61 inHg. Few clouds were reported at 3,600 ft above ground level (AGL) and a broken cloud layer at 6,000 ft AGL. Visibility was ten statute miles.

Winds were reported every five minutes by an automated system and are shown in Table 1 for times before and after the accident. Winds were reported between 10 and 18 kts from 160° to 180° with gusts up to 25 kts.

Table 1. Winds from automated weather station at KASE.

Time	Wind direction	Wind magnitude (kts)	Gusting (kts)
11:05	170	16	
11:10	160	14	
11:15	160	13	
11:20	180	18	
11:25	160	10	15
11:30	180	17	24
11:33 - accident			
11:35	160	10	16
11:40			17
11:45	150	11	
11:50	150	15	
11:53	160	16	25

4.0 Flight Path

The airplane was attempting to take off from runway 33 at KASE. Runway 33 is 8,006 ft of paved surface on a heading of 340° true. Field elevation is 7,837.9 ft.

The airplane was limited to a maximum tailwind of 10 kts at take-off [1] and the crew reported that Air Traffic Control reported the winds as 10 kts from 180° (a 9.3 kts tailwind on the runway heading). As discussed in the Weather section, the automated weather system at the airport was recording higher winds and gusts.

Figure 2 shows a map of the take-off roll and Figure 3 shows the groundspeeds calculated from the position data. ADS-B coverage of the take-off roll did not start until 11:32:53, when the airplane was already at a groundspeed of 135 kts. The beginning point of the take-off roll is therefore unknown. The airplane accelerated to 165 kts by 11:33:01.6 when it was about 3,300 ft from the end of the runway. It then decelerated but left the paved surface at a groundspeed of 120 kts.

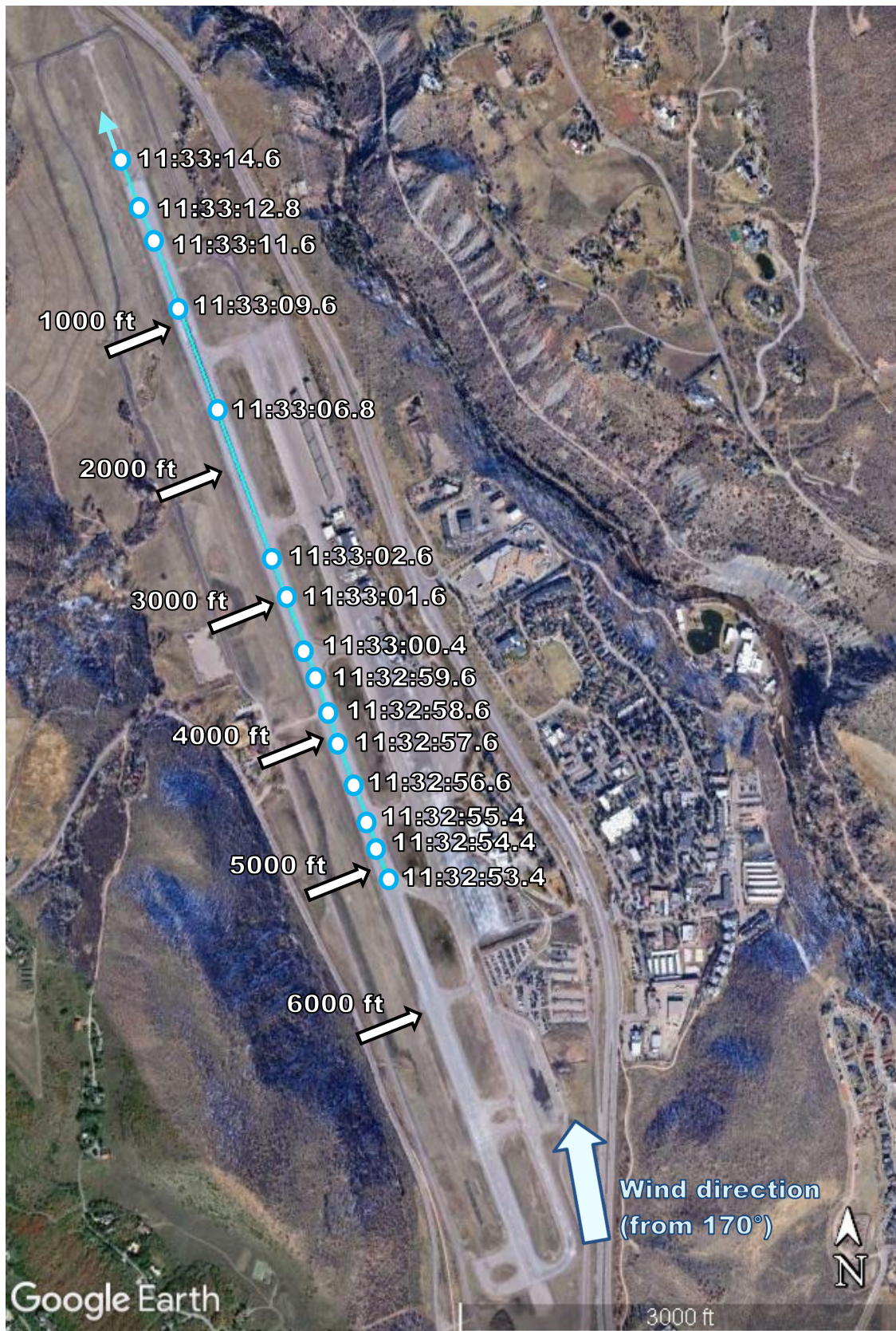


Figure 2. Aircraft take-off roll with selected times and distance to end of runway annotated.

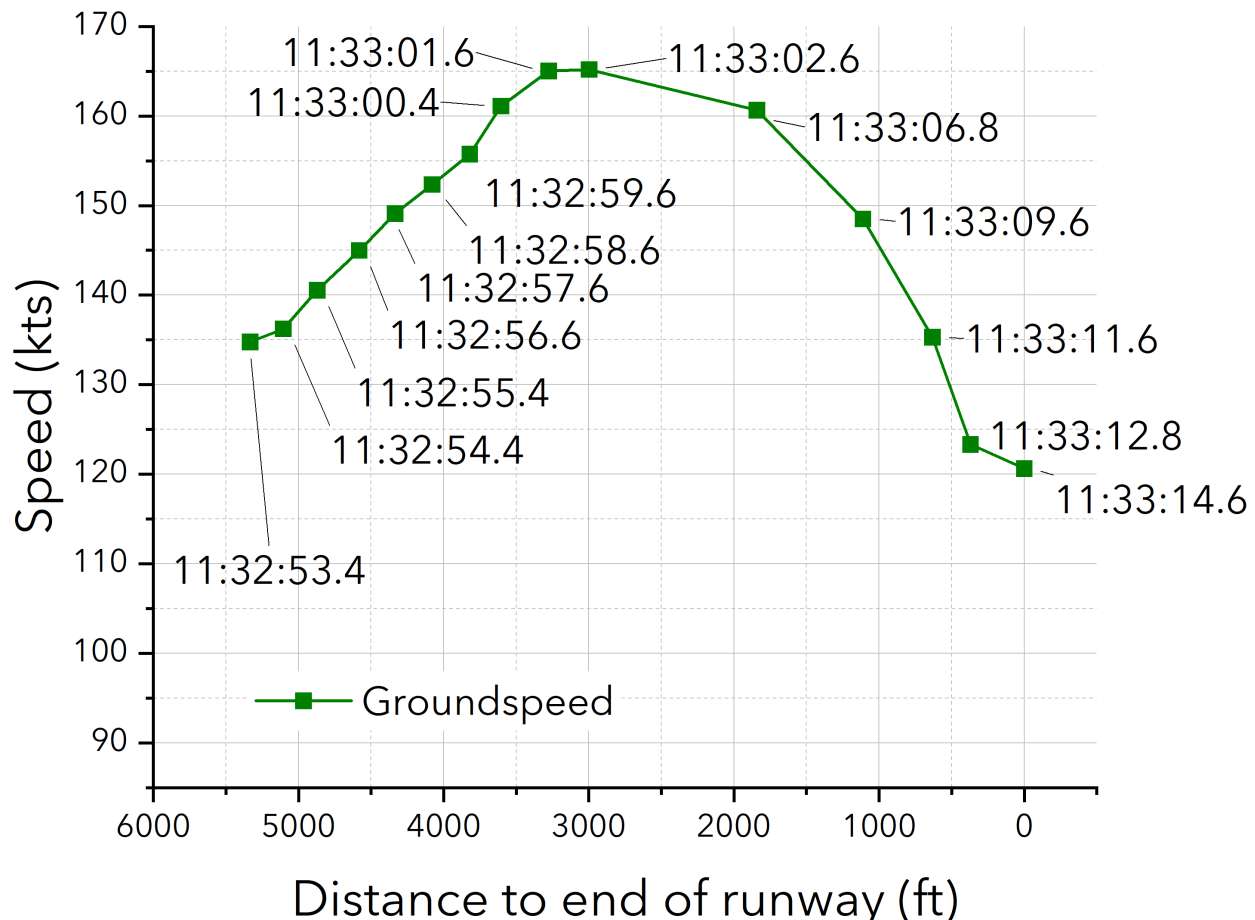


Figure 3. Calculated groundspeed versus distance to end of runway. Times are noted at each point.

The crew, using a weight of 23,916 lbs and flaps 15°, calculated the airplane's V_1 ¹ and V_R ² airspeeds to be 111 kts and 121 kts [2]. An airplane's airspeed indicator reports indicated airspeed (IAS), which is a function of the pitot-static system and reflective of the dynamic pressure of the air. Calibrated airspeed (CAS) is IAS corrected for instrument and position error and can also be calculated using groundspeed, atmospheric conditions, and winds. CAS and IAS are usually within a knot or two of each other. True airspeed (TAS) is the airplane's groundspeed minus the wind and is how fast the airplane is moving through the airmass. CAS and TAS are the same at sea level under International Standard Atmosphere conditions (15°C, 29.91 inHg, 0% humidity), but CAS drops as altitude increases and air density decreases. Therefore, at a high-altitude airport like Aspen a 10 kts tailwind will result in a CAS that can be more than 10 kts lower than the TAS and nearly 20 kts lower than the groundspeed.

The crew called out when the airplane passed V_1 (11:32:55) and V_R (11:32:59) and then when the take-off was aborted (11:33:10). While the airplane did not have a

¹ V_1 is the takeoff decision speed beyond which takeoff should no longer be aborted.

² V_R is rotation speed. At this speed the airplane is pitched up and will leave the ground.

data recorder, these call outs can be assumed to reflect the indicated airspeed at two points during the takeoff roll. The crew reported that the airplane did not rotate after V_R . Figure 4 shows the groundspeed and three calculated calibrated airspeeds based on three wind conditions. The 111 kts V_1 speed was in line with what calibrated airspeed would be for a 17 kts wind from 180° , which was the automated wind report for 11:30 (Table 1). The V_R callout falls between the CAS for 17 kts and 24 kts (the gusting condition), suggesting a possibility that the wind increased between the V_1 and V_R callouts.

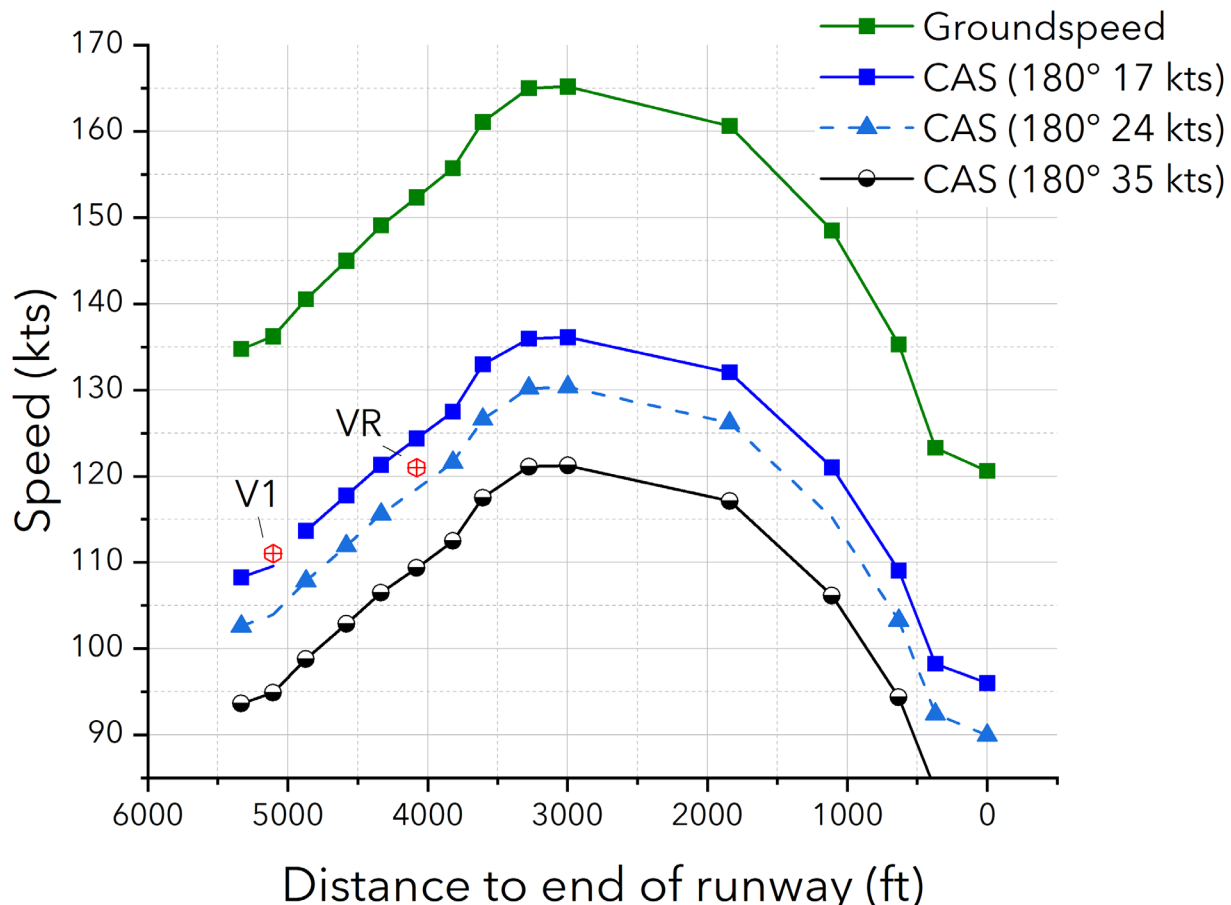


Figure 4. Calculated calibrated airspeeds for three different wind conditions.

At V_R , the airplane should have developed sufficient lift for the elevator deflection to raise the airplane's nose and begin lifting off. However, the pilots reported that the airplane did not rotate. The pilot-in-command's statement was:

At rotation speed I pulled back on the Yoke and there was no slightest indication of nose wheel coming off the ground or airplane becoming airborne. Moreover, the Yoke did not have any air resistance or any pressure on it as we experience normally in Hawkers (the weight and pressure on the Yoke felt the same as though as the airplane was stationary on ground).

The wreckage examination found no abnormalities in the control surfaces. This would imply that when the pilot pulled back on the yoke, there was an insufficient airload on the elevators to induce rotation. Figure 4 also shows the calculated CAS for 35 kts winds from 180°. Winds of this magnitude or greater would keep the airplane's airspeed just below rotation speed such that the airplane would be unable to rotate or lift-off. The necessary winds would therefore had to have been significantly more than those ATC reported to the pilots and actively gusting higher as the airplane went down the runway.

The airplane reached a maximum groundspeed of 165 kts at 11:33:02, three seconds after the V_R callout (Figure 5). Between 11:33:02 and 11:33:06 the airplane decelerated to 160 kts. The CVR recorded the crew announcing that the take-off was aborted at 11:33:10 when the groundspeed was 148 kts and the airplane was about 1,000 ft from the end of the runway. Security video showed braking smoke towards the end of the runway. At the final ADS-B point at the end of the paved surface, the airplane had decelerated to a groundspeed of 121 kts.

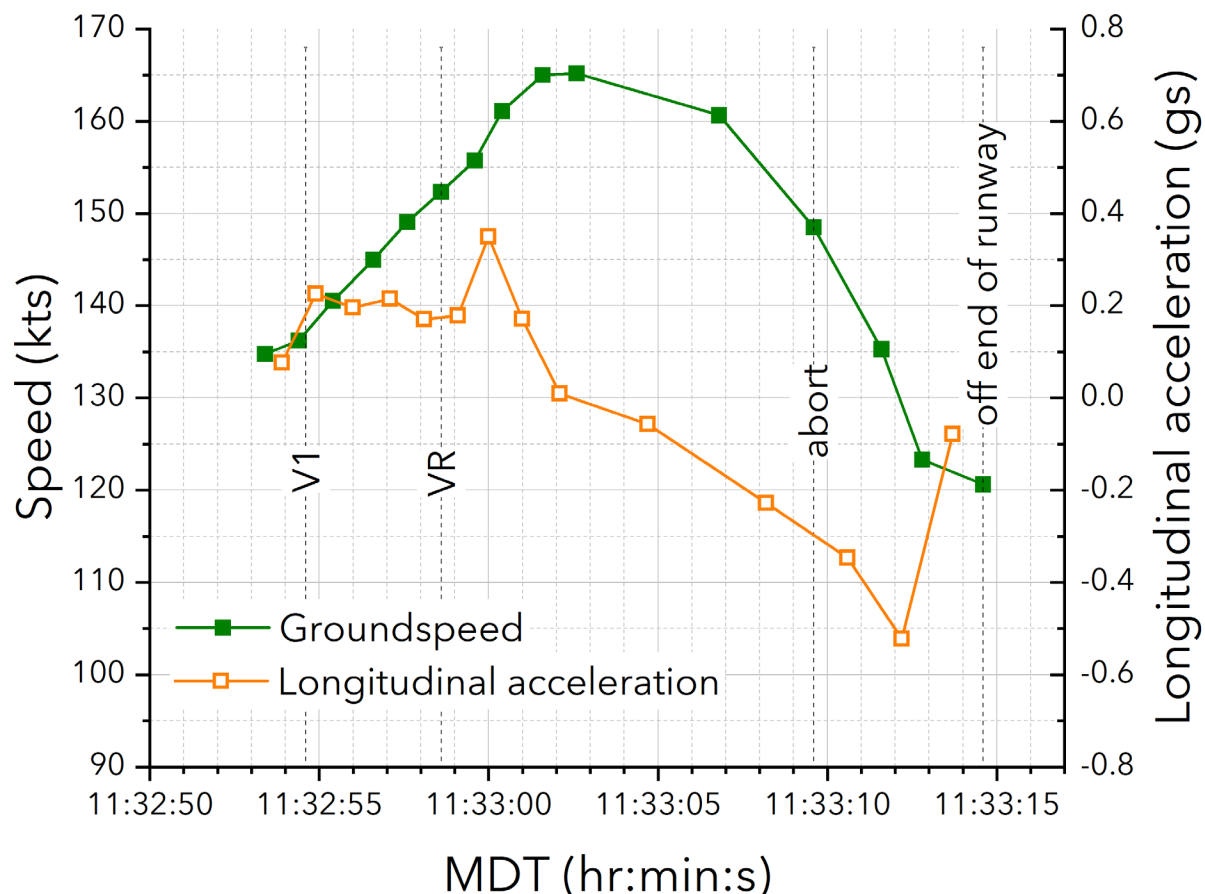


Figure 5. Calculated groundspeed and longitudinal acceleration versus time.

D. SUMMARY

The airplane's groundspeed was calculated from ADS-B data and airspeeds for three different wind conditions were calculated. Based on V_1 and V_R callouts on the CVR versus the airplane's groundspeed, the wind down the runway was greater than what was reported by ATC, above the airplane's tailwind takeoff limitation, and increasing. The crew reported the airplane did not respond when the yoke was pulled back. If the winds continued to increase significantly, it is possible that the airspeed was insufficient to rotate, despite a maximum groundspeed of 165 kts.

The airplane's groundspeed continued to increase for three seconds after the V_R callout. Eleven seconds after the V_R callout, the crew called to abort the takeoff. The airplane decelerated to 121 kts of groundspeed when it left the paved runway surface.

E. REFERENCES

1. Hawker 850XP Airplane Flight Manual. Hawker Beechcraft. 2007.
2. Crew interviews, CEN22LA130, National Transportation Safety Board, 2022.