



NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Washington, DC

Beech 58 N501CE Performance Study

December 12, 2019

D.A. Crider

A. ACCIDENT: CEN19FA124

Accident Type: Loss of Control in Flight
Location: Kerrville, TX
Date: April 22, 2019
Time: Approximately 8:51 CDT

B. GROUP IDENTIFICATION:

No group was formed for this activity

C. ACCIDENT SUMMARY

On April 22, 2019, at 0851 central daylight time, a Beech 58 airplane, N501CE, impacted terrain during approach to Kerrville Municipal Airport (ERV), Kerrville, Texas. The pilot and five passengers were fatally injured, and the airplane was substantially damaged. The airplane was registered to and operated by the pilot under the provisions of Title 14 *Code of Federal Regulations* Part 91 as a business flight. Day instrument meteorological conditions prevailed for the flight, which departed on an instrument flight rules flight plan from West Houston Airport (IWS), West Houston, Texas, at 0730.

D. DETAILS OF INVESTIGATION

Introduction

The accident aircraft's flight path on approach to Kerrville airport is shown together with the accident site in figure 1.

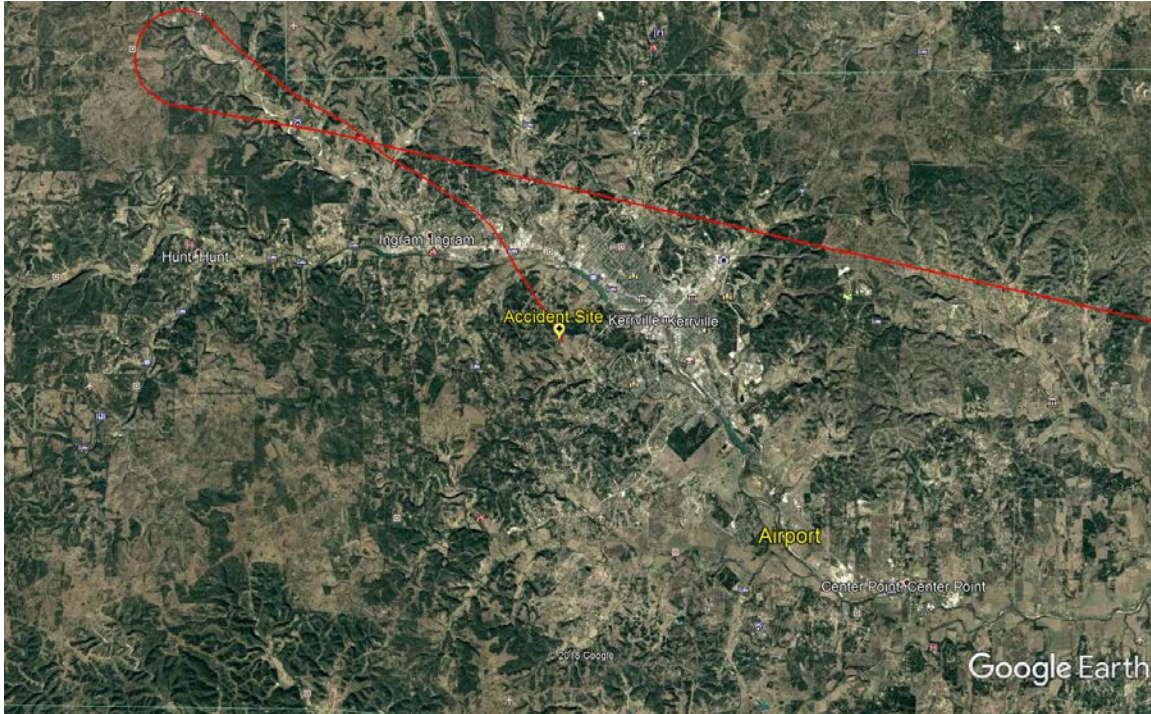


Figure 1 Aircraft flight path

Available Data

Automatic Dependent Surveillance Broadcast (ADS-B) and JPI engine data was available for the investigation. Groundspeed was derived from the ADS-B latitude and longitude recorded time history. As can be seen in figure 2, recorded ADS-B ground speed was smoother than the speed derived from the latitude and longitude time history and was thus used for airspeed computation.

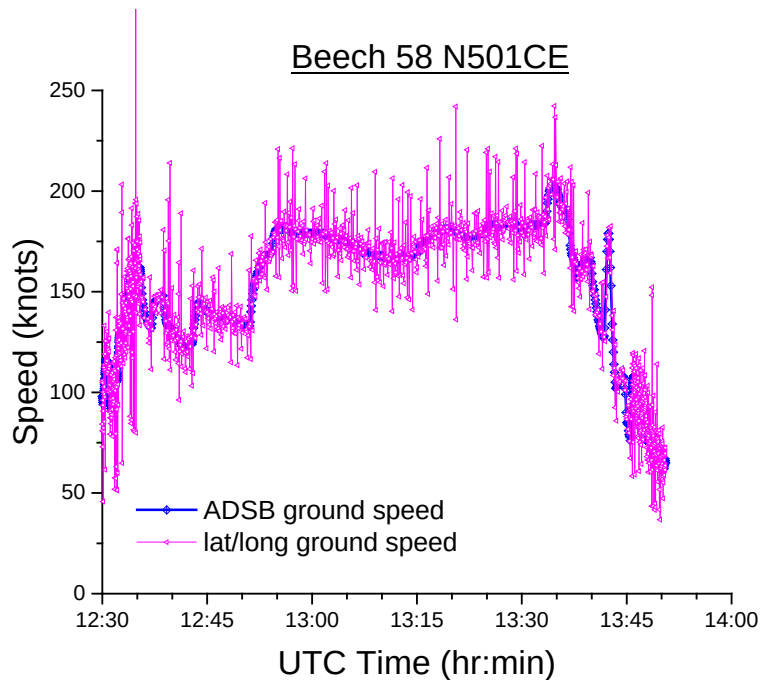


Figure 2 Ground speed comparison

Airspeeds were calculated with a program that calculates airspeeds from an input file of altitude, course and groundspeed as well as data from a local weather observation and a file of winds aloft. The weather observation data from Kerrville TX was:

Barometric pressure: 30.04 in Hg
 Temperature: 18 deg C (64.4 deg F)
 Observation elevation: 1617 ft

Data for the wind input file shown below consist of surface winds from the Kerrville weather observation and winds aloft data from San Antonio.

Altitude (ft.)	Direction (deg.)	Speed (knots)	Vertical Wind
0.0	170	11	0
1617.0	170	11	0
3000.0	170	32	0
6000.0	190	24	0
9000.0	190	0	0

The derived true airspeed and calibrated airspeed are plotted with ADS-B ground speed and altitude in figure 3 for the entire flight and figure 4 for the end of the flight. Engine parameters recorded on the JPI indicated that engine 2 failed to increase power as engine 1 did about 5 minutes before the end of the data. This time is also indicated on figure 4.

The 84 knot indicated airspeed (83 KCAS) published V_{mca} (air minimum control airspeed with an engine out) is also shown on figure 4. It assumes that the prop on the failed engine is windmilling¹. Stall speed was 81 KCAS with flaps up and 72 KCAS with flaps down at the accident weight.

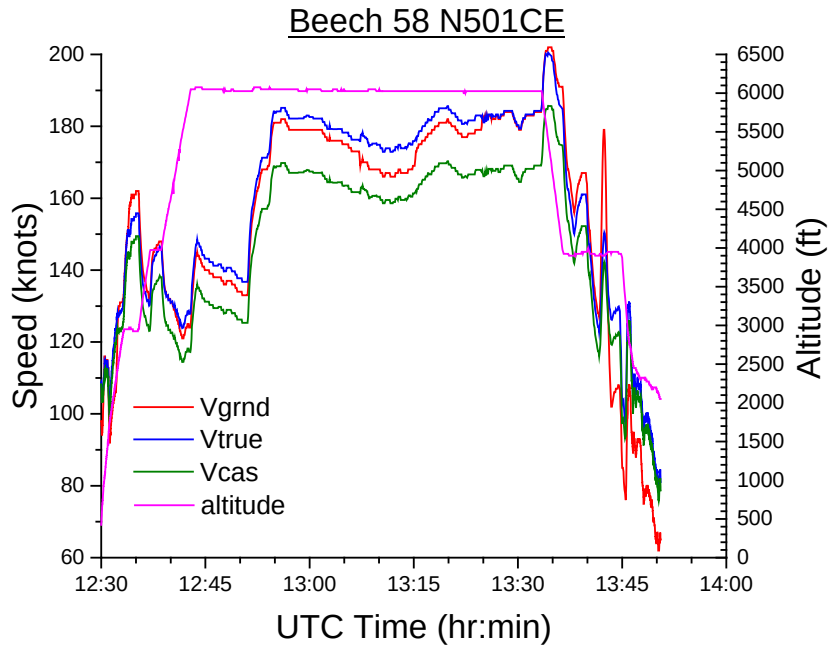


Figure 3 Airspeeds and Altitudes

¹ It further assumes a 5 deg bank towards the operative engine, landing gear retracted, flaps set to takeoff, and the most rearward center of gravity.

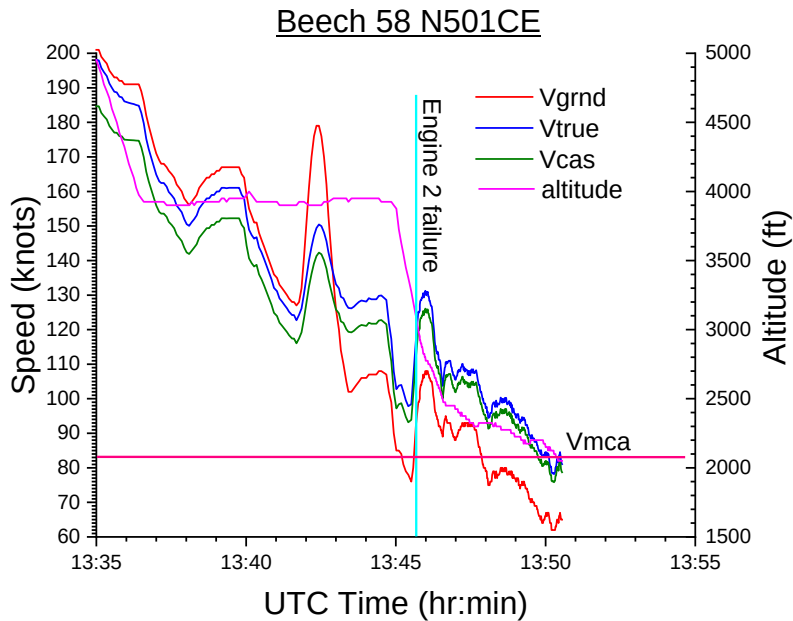


Figure 4 Airspeeds and Altitudes last 15 minutes

The aircraft was cleared for an approach to runway 12 at Kerrville. This approach called for beginning a descent from 4000 ft., 12.3 miles from the runway, to arrive at 3300 ft., 5.3 nautical miles from the runway. The aircraft's flight profile is shown together with airspeed in figure 5.

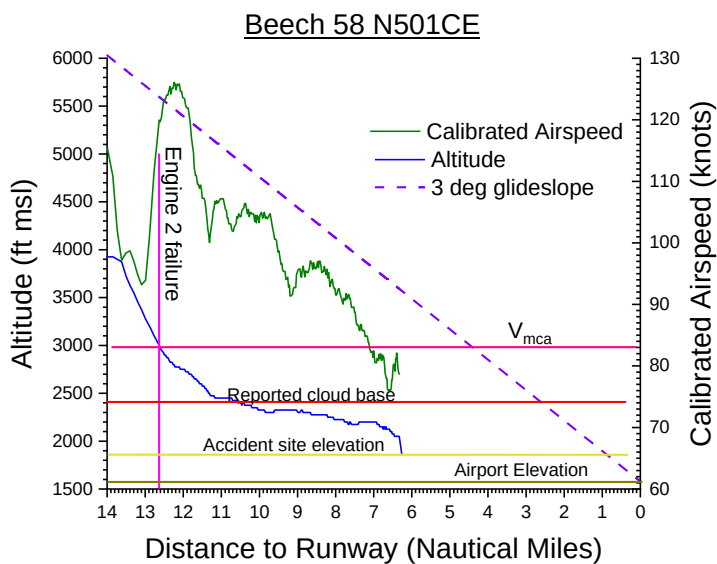


Figure 5 Approach flight profile

The engine out procedure for the model 58 calls for landing gear and flaps up, throttle on the inoperative engine closed, propeller on the inoperative engine feathered and the speed at engine failure maintained but not to exceed 100 knots. Wreckage examination showed that the flaps were at 15 degrees and the propeller was not feathered.

Between penetration of the reported cloud base and the aircraft reaching an airspeed below V_{mca} , the aircraft was descending at an average rate of 92 fpm corresponding to an average gradient of 59.3 ft/N. Mile (-0.56 deg flight path angle). A gradient of 79 ft/N. Mile (-0.74 deg flight path angle) would touch down at the PAPI² on the runway.

² A set of lights beside the runway that provides glide slope guidance.

“What if” Calculations

The parameter Thrust – Drag (T-D) for the accident flight for the period the aircraft was descending with an average flight path angle of -0.56 deg can be calculated from the following equation.

$$(T-D) - W \sin(\gamma) = M A$$

Where

$$W = 5300 \text{ lbs}$$

$$\gamma = -0.56 \text{ deg (flight path angle)}$$

$$M = 164.6 \text{ slugs}$$

$$A = -0.33 \text{ ft/sec}^2 \text{ (average acceleration with } \gamma = -0.56 \text{ deg)}$$

$$(T-D) - 5300 \sin(-0.56) = 164.6 * -0.33$$

$$(T-D) = -106 \text{ lb}$$

The drag reduction required to maintain 100 KCAS (169ft/sec) at approximately 13:48 rather than continue to decelerate can be calculated from:

$$(T-D) - W \sin(\gamma) + \frac{1}{2} \rho V^2 S \Delta C_D = 0.0$$

Where:

$$\rho = 0.002378 \text{ slug/ft}^3$$

$$S = 199.2 \text{ ft}^2$$

$$\Delta C_D = -(-106 - 5300 \sin(-0.56)) / (\frac{1}{2} \rho (169)^2 199.2)$$

$$\Delta C_D = 0.008$$

A Textron Aviation flight operations pilot who regularly performs single engine drag demonstrations reported that a gear up, propeller feathered and flaps 15 deg (approach) configuration, produced a 150 fpm decrease in climb rate relative to the same configuration with flaps retracted. A gear and flaps up propeller not feathered configuration produced a 400 fpm decrease in climb rate relative to the same configuration with the propeller feathered. These demonstrations were done at the G58 101 knot best single engine rate of climb speed³. The pilot estimated a weight between 5100lb and 5400lb for these demos. This corresponds to⁴:

For 15 deg flaps:

$$5100 \text{ lb} \Rightarrow \Delta C_D = 0.0109$$

$$5400 \text{ lb} \Rightarrow \Delta C_D = 0.0115$$

For a non-feathered prop:

$$5100 \text{ lb} \Rightarrow \Delta C_D = 0.029$$

$$5400 \text{ lb} \Rightarrow \Delta C_D = 0.0307$$

Accordingly, the drag reduction from feathering the prop exceeded the 0.008 drag coefficient reduction required to maintain speed and glide path. Had the pilot feathered the prop he could have maintained the flight path angle to make the runway without slowing down.

The glideslope required to maintain 100 knots without retracting flaps or feathering the prop can be calculated from the following equation.

$$R/C = (T-D)V/Wt$$

Where:

$$(T-D) = -106 \text{ lb (see above)}$$

$$V = 100 \text{ KCAS (169 ft/sec)}$$

$$Wt = 5300 \text{ lbs}$$

$$R/C = -3.38 \text{ ft/sec (-203 ft/min)}$$

Ground speed at this point was about 87 knots with an altitude of 2300 ft. The altitude of the runway is 1573 ft which at 203 ft/min descent would be reached in about 3.6 minutes. Had the pilot maintained 100 knots without retracting flaps or feathering the prop, the aircraft would travel 5.2 N miles well short of the runway but would have the possibility of a controlled touchdown.

³ Best single engine rate of climb speed for the accident airplane was 100 knots.

⁴ See Appendix A

Conclusions

While on approach with the right engine out, near the reported cloud base the pilot reduced the aircraft rate of descent to establish a glideslope to reach the runway for landing. From this point, the aircraft decelerated with the speed going below V_{mca} just prior to departure from controlled flight. Had the pilot feathered the prop of the inoperative engine the drag reduction would have been sufficient to maintain the glideslope to the runway assuming that the remaining engine maintained thrust.

Appendix A

Drag Increment Calculations

A Textron Aviation flight operations pilot who regularly performs single engine drag demonstrations reported that a gear up, propeller feathered and flaps 15 deg (approach) configuration, produced a 150 fpm decrease in climb rate relative to the same configuration with flaps retracted. A gear and flaps up propeller not feathered configuration produced a 400 fpm decrease in climb rate relative to the same configuration with the propeller feathered. These demonstrations were done at the G58 101 knot best single engine rate of climb speed. The pilot estimated a weight between 5100lb and 5400lb for these demos.

The corresponding drag increments can be calculated from the rate of climb equation.

$$\Delta R/C = \Delta DV/Wt$$

$$\Delta R/C = (1/2 \rho V^2 S \Delta C_D) V / Wt$$

$$\Delta C_D = \Delta R/C Wt / (1/2 \rho V^3 S)$$

Where:

$$\Delta R/C = 150 \text{ ft/min} = 2.5 \text{ ft/sec for 15 deg flap}$$

$$\Delta R/C = 400 \text{ ft/min} = 6.67 \text{ ft/sec for non-feathered prop}$$

$$\rho = 0.002378 \text{ slug/ft}^3$$

$$S = 199.2 \text{ ft}^2$$

$$V = 101 \text{ Kts} = 170.5 \text{ ft/sec}$$

$$Wt = 5100 \text{ lb to } 5400 \text{ lb}$$

For 15 deg flaps:

$$5100 \text{ lb} \Rightarrow \Delta C_D = 0.0109$$

$$5400 \text{ lb} \Rightarrow \Delta C_D = 0.0115$$

For non-feathered prop:

$$5100 \text{ lb} \Rightarrow \Delta C_D = 0.029$$

$$5400 \text{ lb} \Rightarrow \Delta C_D = 0.0307$$