National Transportation Safety Board
Aviation Accident Final Report

Location:	Redwood City, California	**Accident Number:**	WPR10FA448
Date & Time:	September 2, 2010, 11:51 Local	**Registration:**	N832B
Aircraft:	Beech 65	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	3 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

Shortly after takeoff for a repositioning flight for the airplane's upcoming annual inspection, numerous witnesses, including the two air traffic controllers, reported observing the airplane climbing out normally until it was about 1/2 mile beyond the runway. The witnesses stated that the airplane then underwent a short series of attitude excursions, rolled right, and descended steeply into a lagoon.

All radio communications between the airplane and the air traffic controllers were normal. Ground-based radar tracking data indicated that the airplane's climb to about 500 feet was normal and that it was airborne for about 40 seconds. Postaccident examination of the airframe, systems, and engines did not reveal any mechanical failures that would have precluded continued normal operation. Damage to both engines' propeller blades suggested low or moderate power at the time of impact; however, the right propeller blades exhibited less damage than the left. The propeller damage, witness-observed airplane dynamics, and the airplane's trajectory were consistent with a loss of power in the right engine and a subsequent loss of control due to airspeed decay below the minimum control speed (referred to as VMC). Although required by the Federal Aviation Administration (FAA)-approved Airplane Flight Manual, no evidence of a cockpit placard to designate the single engine operating speeds, including VMC, was found in the wreckage. The underlying reason for the loss of power in the right engine could not be determined.

The airplane's certification basis (Civil Air Regulation [CAR] 3) did not require either a red radial line denoting VMC or a blue radial line denoting the single engine climb speed (VYSE) on the airspeed indicators; no such markings were observed on the airspeed indicators in the wreckage. Those markings were only mandated for airplanes certificated under Federal Aviation Regulation Part 23, which became effective about 3 years after the accident airplane was manufactured. Neither the Federal Aviation Administration (FAA) nor the airplane

manufacturer mandated or recommended such VMC or VYSE markings on the airspeed indicators of the accident airplane make and model. In addition, a cursory search did not reveal any such retroactive guidance for any twin-engine airplane models certificated under CAR 3. Follow-up communication from the FAA Small Airplane Directorate stated that the FAA has "not discussed this as a possible retroactive action... Our take from the accident studies is that because of the accident record with light/reciprocating engine twins, the insurance industry has restricted them to a select group of pilot/owners..."

Toxicology testing revealed evidence consistent with previous use of marijuana by the pilot; however, it was not possible to determine when that usage occurred or whether the pilot might have been impaired by its use during the accident flight.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A loss of power in the right engine for undetermined reasons and the pilot's subsequent failure to maintain adequate airspeed, which resulted in a loss of control. Contributing to the loss of control was the regulatory certification basis of the airplane that does not require airspeed indicator markings that are critical to maintaining airplane control with one engine inoperative.

Findings

Aircraft	(general) - Malfunction
Personnel issues	Aircraft control - Pilot
Aircraft	Airspeed - Not attained/maintained
Aircraft	Engine out control - Incorrect use/operation
Aircraft	Instrument panel - Related operating info
Personnel issues	Illicit drug - Pilot
Organizational issues	(general) - FAA/Regulator

Factual Information

HISTORY OF FLIGHT

On September 2, 2010, about 1151 Pacific daylight time, a Beechcraft Model 65 Queen Air, serial number LC-112, and registered as N832B, was substantially damaged when it impacted a salt-water lagoon shortly after takeoff from runway 30 at San Carlos Airport (SQL), San Carlos, California. The certificated airline transport pilot, the pilot-rated airplane owner, and the passenger received fatal injuries. The flight was operated under the provisions of Title 14 Code of Federal Regulations (CFR) Part 91. Visual meteorological conditions prevailed, and no flight plan was filed for the personal flight, which was destined for South County Airport of Santa Clara County (E16), San Martin, California.

According to the local controller in the SQL air traffic control tower (ATCT) who was handling the flight, the pilot requested, and was approved, for the "Bay Meadows" departure. The departure consisted of a climb on runway heading to a point about 3 miles beyond the end of the runway, followed by a left turn, while remaining clear of the overlying Class B airspace for San Francisco International Airport (SFO). The controller reported that the airplane appeared to climb normally, and when it was about 1/2 mile beyond the runway, the controller observed the airplane make a "slight right rudder turn" and then correct back. About 3 to 4 seconds later, the local and ground controllers observed the airplane roll and turn to the right, and descend steeply out of sight. Many other witnesses reported a sequence of events similar to that observed by the controllers, but a few reported that the pitch excursion began before the roll excursion. All agreed that the airplane banked sharply to the right, followed closely by the nose pointing towards the ground. None reported a spin, and an ex-airline pilot was certain that the airplane did not spin.

No radio transmissions regarding the event were received from the airplane. Ground-based radar tracking data indicated that the airplane reached a maximum altitude of 500 feet, and that the airplane was airborne for about 40 seconds. Witnesses who saw the impact all reported that the airplane descended at a steep angle, in a nose-down attitude. The airplane struck the water in the shallow lagoon, and sank within a few minutes. First responders recovered the passenger shortly after the accident. The airplane was recovered from the lagoon about 30 hours after the accident.

PERSONNEL INFORMATION

Front Left Seat Occupant

According to FAA records, the individual in the front left seat held an airline transport pilot certificate, as well as flight and ground instructor certificates. He was 72 years old, and his most recent FAA second-class medical certificate was issued in April 2010. At the time of that application, he reported 18,000 total hours of civilian flight experience. A "Pilot History Form" for that individual, which contained hand-written entries and his signature, was recovered

from the wreckage. That form was dated September 2009, and was part of an airplane insurance application/information package for the accident airplane and the registered owner. The form listed the individual's occupation as "aviator," and the date of his most recent flight review as January, 2008. He reported his total hours "Flying Hours as Pilot-in-Command" as "18k+," including "6k+" in the accident airplane make and model, and 150 hours in the 90 days prior to that application.

According to persons who either knew him or the airplane owner, the front left seat occupant was an aviation acquaintance of the owner. The owner's son stated that to his knowledge, that individual was the only person who flew the accident airplane in recent years.

This individual was in the left front seat when the airplane was recovered from the lagoon. The San Mateo County Coroner's Office autopsy report stated "multiple blunt injuries" as the cause of death. The Coroner's report on forensic toxicology examinations on specimens stated "No common acidic, neutral or basic drugs detected" and "No blood Ethyl Alcohol detected." The report stated that blood carboxyhemoglobin saturation was less than 3 percent. A subsequent separate communication from the Coroner's Office explicitly stated that "our normal toxicology screen does not test for THC." THC is the abbreviation for tetrahydrocannabinol.

The FAA Civil Aeromedical Institute (CAMI) also conducted forensic toxicology examinations on specimens from the individual in the front left seat. The carboxyhemoglobin test, which used a cutoff saturation limit of 10 percent, indicated that no carbon monoxide was detected in the blood. Tetrahydrocannabinol was detected in the lung, liver and chest cavity blood samples, and tetrahydrocannabinol carboxylic acid was detected in the lung, liver, chest cavity blood, and urine samples.

The son of the individual stated that he did not have any direct knowledge of his father's use of marijuana.

Front Right Seat Occupant

The individual in the front right seat was the registered owner of the airplane. He was 91 years old. According to FAA records, he held a commercial pilot certificate, with airplane single engine and multi-engine land ratings. On his April 2004 application for an FAA medical certificate, which was denied, he reported 12,004 total hours of civilian flight experience. No records of any subsequent FAA medical applications were discovered, and he did not hold a valid FAA medical certificate at the time of the accident. The San Mateo County Coroner's Office autopsy report stated "multiple blunt injuries" as the cause of death. The Coroner's report on forensic toxicology examinations on specimens stated "No common acidic, neutral or basic drugs detected" and "No blood Ethyl Alcohol detected." The report stated that blood carboxyhemoglobin saturation was less than 3 percent.

The FAA CAMI also conducted forensic toxicology examinations on specimens from the individual in the front right seat. The carboxyhemoglobin test, which used a cutoff saturation limit of 10 percent, indicated that no carbon monoxide was detected in the blood sample. Ethanol was detected in the brain and blood samples, methanol was detected in the muscle and

blood samples, and N-Propanol was detected in the brain sample. Amlodipine, which is used alone or in combination with other medications to treat high blood pressure and chest pain (angina), was detected in the liver and blood samples.

Passenger

The female passenger was 47 years old, and did not hold any pilot certificates. She was recovered from the lagoon shortly after the accident, and the investigation was unable to determine where she was seated for the flight. The San Mateo County Coroner's Office autopsy report stated "multiple blunt injuries" as the cause of death. The Coroner's report on forensic toxicology examinations on specimens stated "No common acidic, neutral or basic drugs detected" and "No blood Ethyl Alcohol detected." The report stated that blood carboxyhemoglobin saturation was less than 3 percent. According to one of her sons, she was in a personal relationship with the front left seat occupant, and that she did not use marijuana.

AIRCRAFT INFORMATION

History and Background Information

According to FAA records, the airplane was manufactured in 1961, and was equipped with two Lycoming IGSO-480 piston engines. Each engine was equipped with a three-blade fully feathering Hartzell propeller, controlled by a lever in the cockpit. The airplane was equipped with tricycle-configuration retractable landing gear. The airplane was certificated to carry 9 persons, including 2 crewmembers, and had a maximum takeoff weight of 7,700 pounds. Entry and exit was via a cabin door aft of the left wing.

At the time of the accident, the airplane was registered to an individual who had purchased it in August 2008. Airport administrative records indicated that the airplane was hangared at SQL by that owner. The insurance application referenced in the "PERSONNEL INFORMATION, Front Left Seat Occupant" section stated that the airplane had not been flown in the year preceding September 2009.

Takeoff Weight and Balance Information

No weight and balance documentation for the accident flight was discovered. The most recent weight and balance information found for the airplane was dated August 2009. The estimated accident flight takeoff weight was 6,771 pounds, and the center of gravity location was estimated to be 156.27 inches aft of the datum, which was within the allowable envelope. Refer to the accident docket for substantiating information.

Maintenance Records and Maintenance Activity

Maintenance records were recovered in the wreckage and from the lagoon. Those records

indicated that the most recent annual inspection was completed in September 2009. At that time, the airplane had a total time in service (TT) of about 4,722 hours. The left and right engines each had a TT of 1,725 hours, with service times of 260 hours since major overhaul (TSMOH). The left and right propellers each had a TT of about 4,722 hours; the left propeller had a TSMOH of 438 hours, while the right propeller had a TSMOH of 260 hours. At the time of the accident, the airplane hour meter registered slightly over 4726.6 hours, which indicated that the airplane had accumulated 4.2 hours in the year since the most recent annual inspection. No documentation regarding any maintenance subsequent to the most recent annual inspection was recovered.

A son of the rear-seat passenger reported that he had visited the hangar and the airplane with the left-seat occupant a few weeks before the accident. He reported that the left engine was observed to be decowled, and appeared to be in the midst of maintenance activity, although not actively at the time of his visit. No other persons were present or working on the engine at the time of his visit. The son was unable to provide any details regarding the nature or extent of the maintenance. He reported that the left-seat occupant had expressed frustration about the quality and duration of that maintenance. The investigation was unable to discover any further details about the alleged maintenance activity.

Fuel System

The airplane was equipped with a total of four fuel tanks. Each wing contained a 44-gallon capacity main tank, two 23-gallon auxiliary tanks, and one 25-gallon auxiliary tank, for a total airplane usable fuel capacity of 230 gallons. A review of fuel purchases at SQL for the airplane since 2007 revealed only three purchases. These were: December 2008, 157.8 gallons; July 2009, 56.0 gallons, and May 2010, 190.8 gallons.

The auxiliary fuel tanks in each wing were interconnected to one another, but independent of the main fuel tank. The main tank and the rear inboard auxiliary tanks each contained a boost pump which was electrically controlled from the cockpit. The airplane was also equipped with an "Idle Cut-Off (ICO)" switch and an "Enrichment" switch for each engine. The ICO switch controls a solenoid to permit (ICO switch ON) or prevent (ICO switch OFF) fuel pressure at the fuel nozzle, and it is primarily used for engine start and shutdown. In addition, the OM prescribed turning the ICO switch to "OFF" in the event of an engine failure after "it is positively known which engine has failed." The enrichment system was primarily intended for use during high power applications (such as climbs) at high altitudes.

Each of the two fuel selector valves (one per engine) had three positions; OFF, AUX and MAIN. The fuel selector valve controls were mounted in the cockpit, while the valves were mounted on the respective engine firewalls. The valve controls actuated the valves via cables. In addition, an electrically-controlled crossfeed valve could be used to feed either engine from the tanks on the opposite side wing.

The only entries in Section II ("Operating Check List") of the airplane manufacturer's OM "Pre-Starting Procedure" checklist that were related to the fuel system were steps 3, 4 and 7, which appeared as:

"Idle cut-off switches - DOWN"
"Enrichment switches - OFF"
"Fuel tank selectors - MAIN"

The only entries in the OM "Start Procedure" checklists that were related to the fuel system were steps 1, 2 and 6 for each engine, which respectively appeared as:
"Boost pump - on MAIN; check pressure"
"Idle cut-off switch - ON (up)"
"Boost pumps - OFF; check pressure."

The only entry in the OM "Before Take-off Check" that was related to the fuel system was step 3, which appeared as:
"Gas - fuel selector on MAIN. Check auxiliary position. Return to MAIN, actuate boost pumps, check crossfeed."

The "Normal Take-Off" portion in Section IV ("Flying Your BEECHCRAFT") of the OM stated that the pilot should "check to see that the fuel boost pumps are ON" as the airplane is being lined up on the runway.

METEOROLOGICAL INFORMATION

The 1200 recorded weather at SQL included winds of 7 knots from 350 degrees; clear skies; temperature of 29 degrees C; dew point 14 degrees C; and an altimeter setting of 29.85 inches of mercury.

COMMUNICATIONS

The operation of the SQL ATCT was contracted to, and conducted by, a company called Serco, Inc. Subsequent to the accident, Serco provided transcripts of the radio communications between SQL ATCT and the accident airplane. According to the transcripts, the flight's first radio transmission was made at 1142:40, when it called ground control for a radio check, followed by a request for taxi clearance. At 1142:54, the airplane was cleared to taxi to runway 30, and in response to the ground controller's question, the flight radioed that it was destined for E16 via the "ridgeline on the west side."

At 1148:43, the flight transmitted to the local controller that it was "number one on the east ready" for departure. Sixteen seconds later, the local controller cleared the airplane for takeoff, and 6 seconds after that, the flight transmitted that it was "moving." At 1149:59, which was 54 seconds after its "moving" call, the flight transmitted "and eight three two bravo ready to depart." This was followed 3 seconds later by the local controller's transmission "Queen Air three two bravo roger that runway three zero cleared for takeoff." At 1150:05, the flight transmitted "three two bravo going." No further transmissions from or to the airplane were recorded. At 1151:14, in response to the loss of the airplane, the local controller transmitted "all aircraft calling inbound to San Carlos tower stand by."

NTSB review of the recordings and the transcripts confirmed the accuracy of the transcripts, and also that there were few other aircraft on the respective communication frequencies during the period when the accident airplane was active on those frequencies. The son of the front left seat occupant confirmed that the voice on the radio was that of his father.

AIRPORT INFORMATION

According to FAA Airport/Facilities Directory information, SQL was equipped with a single runway, designated 12/30, which was paved, and measured 2,600 feet long. Airport elevation was 5 feet above mean sea level (msl). The airport was equipped with a non-federal ATCT, which was operating at the time of the flight.

WRECKAGE AND IMPACT INFORMATION

On-Site Examination

The impact site was located about 4,200 feet beyond the runway end, and offset about 1,300 feet to the right (northeast) of the extended runway centerline. Recovery divers reported that the lagoon had a depth of about 10 feet, and the bottom was silt and mud. The airplane was removed from the lagoon about 30 hours after the accident. Multiple documents, many of which were maintenance records for the airplane, were also recovered from the lagoon.

On-site examination of the airplane revealed crush damage, primarily in the up and aft direction, to the nose, cabin, wings, and engine nacelles. According to recovery divers, the engines remained attached to the airplane only by cables, and the divers cut the cables in order to extract the wreckage from the lagoon. All propeller blades remained in their respective propeller hubs, and each hub remained attached to its respective engine. All aerodynamic control surfaces remained attached to the airframe by their respective hinges and/or links. A continuity check of the primary flight control system, which was limited in scope by the impact damage, did not reveal any evidence of any pre-impact anomalies or failures. The airplane, engines, and propellers were transported to a secure facility for subsequent detailed examination.

Detailed Off-Site Examination

Detailed examination accounted for all major sections and components of the airplane. The forward fuselage (including the cockpit), wings, and engine nacelles sustained the most significant damage. The aft fuselage and empennage were relatively undamaged. The landing gear and flaps were found to be in their retracted positions at the time of impact.

Nose and wing damage patterns were consistent with a nose-down, right-wing down impact attitude. The cabin roof was partially separated from the fuselage. The cabin door damage was consistent with it being closed at the time of impact.

All four fuel tanks were compromised, but all four filler caps were found installed in their respective receptacles. The rotary-style left fuel boost pump control switch was found set to the "MAIN" position, while the right control switch was found set to the "OFF" position. At the accident site, the left fuel selector valve handle (located on the fuel management control panel in the cockpit) was found between the "MAIN" and "OFF" positions. At the off-site examination, the left fuel selector valve was removed and disassembled, and the port was found to be partially open to the left wing auxiliary fuel tank. At the accident site, the right fuel selector valve handle was found in the "OFF" position. At the off-site examination, the right fuel selector valve was removed and disassembled, and the port was found to be partially open to the right wing auxiliary fuel tank. The possibility of uncommanded movement of the valve control handles and the valves themselves, due to impact forces and system disruption, precluded positive determination of their actual takeoff or in-flight settings.

The battery switch key was found in its receptacle; its position appeared consistent with ON. The magneto switch for each engine was set to its respective BOTH position. The cockpit throttle and propeller controls were all found close to their forward travel limits. The two idle cut-off switches were found in the "up" (ON) position.

Aside from cuts associated with recovery, or fractures consistent with one-time overload, flight control continuity was established for all flight controls. There were no indications consistent with the control gust lock being installed at the time of impact.

The flight control cockpit trim indications were found as follows; rudder approximately 11 degrees right, aileron approximately 60 percent right wing down, and elevator approximately 2 degrees nose up. Aerosurface trim actuator measurements yielded the following results: rudder trim approximately 5 degrees left, aileron trim approximately 1 to 2 degrees left wing down, and elevator trim approximately 6 degrees nose up. Hawker Beechcraft was unable to provide an estimated elevator trim position for takeoff based on the estimated takeoff weight and center of gravity. However, normal procedure requires the pilot to set the pitch trim indicator within the green band on the indication system for takeoff. The possibility of uncommanded movement of all trim surfaces and indicators due to impact forces and system disruption precluded positive determination of their actual takeoff or in-flight settings.

Exclusive of recovery cuts, or fractures with features consistent with one-time overload, continuity was established for the engine throttle and propeller controls. Although the cast throttle arm for the left engine was fracture-separated, subsequent metallurgical evaluation revealed "fracture features and adjacent yielding of the arm material consistent with an overstress fracture" and that "No indications of preexisting cracking such as fatigue were noted."

Engines and Propellers

The left and right engines sustained moderate impact and salt-water-immersion damage, and neither engine could be hand-rotated. Visual examination revealed no evidence of any case penetrations or other pre-impact catastrophic mechanical malfunctions, or fire. The combustion chambers and valves were mechanically undamaged, with no evidence of foreign object ingestion or detonation. The crankshafts and camshafts were intact, and there was no

evidence of lubrication deprivation. All accessories remained attached to each respective engine, all accessory gears were intact and undamaged, but determination of accessory functionality was precluded by water immersion damage. No evidence of any pre-impact abnormalities or malfunctions that would have precluded normal operation was observed on either engine.

Both propellers had evidence of being driven toward a low blade angle during impact, and there was no indication that either propeller was feathered. Both propellers had frontal damage, and damage patterns consistent with rotation at the time of impact. Both propellers had mild bending and twisting consistent with low or moderate power at the time of impact. The right propeller blades had less damage than the left propeller blades. According to the propeller manufacturer's representative, there were no viable external or internal witness marks to enable a determination of any pre-impact blade angles.

Refer to the accident docket for detailed engine and propeller information.

ADDITIONAL INFORMATION

Accident Eyewitness Observations

There were numerous witnesses to the accident sequence, including several pilots, and the two controllers in the SQL ATCT. Many of the witnesses were significantly closer to the end of the flight path than the controllers were; many were in the immediate vicinity of the lagoon, since it was surrounded by office buildings, and the accident occurred about lunchtime.

Almost all witnesses agreed that the airplane engines were loud or very loud, and for many, that was what initially drew their attention to the airplane. Persons familiar with the Beech 65 reported that the airplane is noticeably louder than many other general aviation airplanes. Almost all the witnesses reported that the airplane banked rapidly and steeply to the right, and then the nose fell through to a steep nose-down attitude. Several witnesses, including more than one pilot, observed unusual airplane yaw or turning movements before the rapid right bank. Several witnesses noted roll oscillations before the steep right bank, and some of them also observed the unusual yaw motions. Although one witness reported that the airplane was "corkscrewing," most, including the pilots and the controllers, were certain that the airplane did not spin during its descent into the lagoon.

All witnesses reported that the descent path into the lagoon was steep, and that the airplane attitude was significantly nose-down. No witnesses reported any parts separations, smoke, or fire, and many witnesses explicitly stated that they did not observe any smoke.

Engine Failure Procedures

Section V ("Unusual Operating Conditions") of the OM contained a portion entitled "Engine Failure During Takeoff," which provided definitions and procedures for that event. The OM

defined minimum control speed as "the airspeed below which the airplane cannot be controlled in flight, with one engine operating at take-off power and the other engine with its propeller windmilling."

The OM specified that for cases of "insufficient runway remaining and you have gained best angle-of-climb airspeed for single engine and are airborne -IMMEIATELY CLEANUP THE AIRPLANE (RETRACT LANDING GEAR, FEATHER WINDMILLING PROPELLER) AND FOLLOW NORMAL SINGLE-ENGINE PROCEDURE." The OM explained in a note that "With the airplane clean you can climb. With gear down and propeller windmilling, you will not be able to maintain altitude."

Performance Information

Wing Flaps and Takeoff Procedures

The airplane was equipped with electrically-operated trailing edge flaps that consisted of two sections (inboard and outboard) on each wing. Step 4 of the "Before Take-off Check" in OM Section II specified "Flaps - check operation. Set as desired." No other guidance regarding takeoff flap settings was included in that Section or Section IV. Section V ("Unusual Operating Conditions") contained a portion entitled "Unusual Take-Off Conditions," which addressed "obstacle, short-field and unimproved field takeoffs." The OM specified the use of "65% flaps" for all three of those operations, and stated that flap retraction should be delayed until the airplane had achieved "sufficient airspeed to maintain flight with at least minimum single engine control speed."

Takeoff and Climb Performance

Section VI ("Operational Data") included takeoff performance charts for "Normal Take-Off" and "Short Field Take-Off." The flap settings in those charts were consistent with the settings specified in Section V, but the charts did not include any guidance regarding the conditions that suggested or necessitated the use of the short-field takeoff procedures. The charts specified a takeoff speed of 95 mph indicated airspeed for the normal takeoff, and 80 mph for the short field takeoff. The charts specified a gross takeoff weight of 7,700 pounds, and did not provide any adjustment factors for lower weights.

For the ambient conditions, the chart-derived (interpolated from "NO WIND" and "10 MPH HEADWIND" charts) normal takeoff distance to 50 feet altitude was approximately 1,600 feet, including a ground roll of approximately 1,230 feet. The chart-derived short field takeoff distance to 50 feet altitude was approximately 1,440 feet, including a ground roll of approximately 1,060 feet.

The "Two Engine Climb Performance" charts in Section VI did not specify any flap settings. According to those charts, the airplane was capable of an initial climb rate of approximately 1,650 feet per minute (fpm), with a best angle of climb speed of approximately 93 mph, and a best rate of climb speed of approximately 124 mph. According to the single engine performance

charts, the airplane was capable of an initial climb rate between approximately 130 and 340 fpm, with a best angle of climb speed of approximately 101 mph, and a best rate of climb speed of approximately 117 mph.

Evaluation of the ATC ground tracking radar data indicated that for the first 26 seconds after takeoff, the airplane was in a climb of approximately 1,100 feet per minute (fpm). The maximum indicated altitude was 500 feet; which was reported for two consecutive points, 1151:01 and 1151:06. Calculated groundspeed values ranged between about 140 and 90 mph; those values were associate with the first and last viable radar data points respectively. Most of the radar data indicated a climb groundspeed of about 90 to 115 mph.

Stall Speeds

Stall speed data in Section III ("Performance Specifications and Limitations") cited a wings-level, gear and flaps retracted, stall speed of 83 mph with power on, and 96 mph with power off at a weight of 7,700 pounds. Corresponding stall speeds for bank angles of 15, 30, and 45 degrees were listed as 84.5, 89 and 99 mph for power on, and 98, 103, and 114 mph for power off, respectively. The uncertainties associated with wind information and the ATC radar-derived speeds precluded determination of an accurate airspeed time history for the airplane, but the derived groundspeed values toward the end of the climb were similar to the stall speed range for the airplane. The radar-derived flight track and descent profile indicated that the airplane turned rapidly to the right and then descended at a rate of approximately 3,000 fpm.

Single Engine Operating Airspeeds

Chapter 12 ("Transition to Multiengine Airplanes") of the FAA Airplane Flying Handbook (AFH, FAA-H-8083) contained the following information:
"The basic difference between operating a multiengine airplane and a single-engine airplane is the potential problem involving an engine failure. The penalties for loss of an engine are twofold: performance and control. The most obvious problem is the loss of 50 percent of power, which [significantly] reduces climb performance.... The other is the control problem caused by the remaining thrust, which is now asymmetrical. Attention to both these factors is crucial to safe one engine inoperative (OEI) flight."

The AFH further noted that:
"Twin-engine airplanes have several additional performance "V" speeds unique to OEI operation. These speeds are differentiated by the notation "SE," for single engine."

Excerpted key AFH definitions or descriptions included:

VXSE - Best angle-of-climb speed with one engine inoperative.

VYSE- Best rate-of-climb speed with one engine inoperative. Marked with a blue radial line on most airspeed indicators. Above the single-engine absolute ceiling, VYSE yields the minimum rate of sink.

VSSE– Safe, intentional one-engine-inoperative speed. Originally known as safe single-engine speed. Now formally defined in Title 14 of the Code of Federal Regulations (14 CFR) Part 23, Airworthiness Standards, and required to be established and published in the AFM/POH. It is the minimum speed to intentionally render the critical engine inoperative.

VMC – Minimum control speed with the critical engine inoperative. Marked with a red radial line on most airspeed indicators. The minimum speed at which directional control can be maintained under a very specific set of circumstances outlined in 14 CFR Part 23, Airworthiness Standards. There is no requirement in this determination that the airplane be capable of climbing at this airspeed. VMC only addresses directional control.

Single-Engine Airspeed Guidance Available to the Pilot

According to a representative of the airplane manufacturer, the applicable FAA-approved Airplane Flight Manual (AFM) for the airplane as it was equipped (according to the FAA airworthiness documentation Form 337s) was part number (P/N) 65-001021-45, with AFM Supplements P/N 65-001021-11 and -13. The applicable Beechcraft Queen Air Model 65 (Serial numbers LC-81 thru LC-162) Owner's Manual (OM) was P/N 65-001021-27. A copy of an OM was recovered from the airplane; the cover pages were not recovered, so the part number could not be determined. Comparisons of controlled pages indicated that the recovered OM was not P/N 65-001021-27. Comparison of the single engine speeds from the recovered OM with the values from the appropriate OM revealed that the recovered OM did not contain any information regarding VSSE (Safe, intentional one-engine-inoperative speed), while the applicable OM did specify a VSSE.

Several pages of pilot operating or checklist information, one of which was marked with Beech P/N 65-001021-23, were recovered on site. A representative of the airplane manufacturer stated that the recovered document was not specifically applicable to the accident airplane. In addition, a handmade "Climb Speeds" chart was recovered in the wreckage. Comparisons of the pertinent values on those recovered pages with the applicable guidance did not reveal any discrepancies. Refer to the accident docket for substantiating information.

Accident Airplane Certification Basis and Single Engine Speeds

According to the FAA Type Certificate Data Sheet (TCDS), the certification basis for Beech Model 65 serial number LC-112 was Civil Air Regulation (CAR) 3, effective 1956, with a few additional amendments. Per the certification basis, the airplane manufacturer determined and published the minimum control speed (95 mph) and the safe single engine climb speed (105 mph) in the OM. The only mandatory presentation of that information was by means of a required placard on the instrument panel that stated:

"AIRSPEED LIMITATIONS, MAX, GEAR EXTENDED (NOR.) ---180 MPH (156 KNOTS) MAX, GEAR RETRACT ---150 MPH (130 KNOTS) MIN. SINGLE ENGINE CONTROL ---95 MPH (83 KNOTS) MAXIMUM MANEUVERING ---195 MPH (169 KNOTS)."

According to the manufacturer, that placard was to be mounted near the ASI on the right (copilot) side of the instrument panel, due to space limitations on the left (pilot) side of the panel.

The certification basis did not require either the red radial line denoting VMC, or the blue radial line denoting VYSE on the ASI; those markings were only mandated for airplanes certificated under Part 23, which became effective about 1964. In addition, neither the FAA nor the airplane manufacturer mandated or recommended such VMC or VYSE markings on the ASIs of the accident airplane make and model. Follow-up communication from the FAA Small Airplane Directorate stated that the FAA has "not discussed this as a possible retroactive action ... Our take from the accident studies is that because of the accident record with light/recip[rocating engine] twins, the insurance industry has restricted them to a select group of pilot/owners..."

Airspeed Indicator Markings and Placards

The airplane was equipped with two airspeed indicators (ASIs), one on each side of the instrument panel. Both were marked in mph on the outer scale, and knots on the inner scale. The required white, green and yellow arcs, as well as the radial red line for VNE (never exceed speed), were correctly depicted on each ASI, in accordance with applicable FAA regulations and manufacturer's information. Refer to the accident docket for additional details.

Neither the VMC red line nor the VYSE blue line was depicted on either ASI. According to a representative of the manufacturer, "A review of the applicable airplane Illustrated Parts Catalog, company and vendor drawings, and Beech specifications of the applicable airplane airspeed indicator... revealed no requirement [for] the blue radial. The only red radial required on the indicator was for never-exceed speed limit." No other ASI markings or airspeed-related placards were present, and there was no physical indication in the wreckage that the required placard was installed in its designated location for the accident flight.

History of Flight

Enroute-climb to cruise	Loss of engine power (partial)
Enroute-climb to cruise	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

Pilot Information

Certificate:	Airline transport; Flight instructor	**Age:**	73,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):		**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	April 15, 2010
Occupational Pilot:	UNK	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 18000 hours (Total, all aircraft), 6000 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N832B
Model/Series:	65	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	LC-112
Landing Gear Type:	Retractable - Tricycle	**Seats:**	8
Date/Type of Last Inspection:	September 15, 2009 Annual	**Certified Max Gross Wt.:**	7700 lbs
Time Since Last Inspection:		**Engines:**	2 Reciprocating
Airframe Total Time:		**Engine Manufacturer:**	Lycomin
ELT:	C91A installed	**Engine Model/Series:**	IGSO-480-A1B
Registered Owner:		**Rated Power:**	340 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	SQL,25 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	12:00 Local	**Direction from Accident Site:**	120°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	350°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.85 inches Hg	**Temperature/Dew Point:**	29°C / 14°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	San Carlos, CA (SQL)	**Type of Flight Plan Filed:**	None
Destination:	Santa Clara, CA (E16)	**Type of Clearance:**	None
Departure Time:	11:58 Local	**Type of Airspace:**	

Airport Information

Airport:	San Carlos SQL	**Runway Surface Type:**	
Airport Elevation:	25 ft msl	**Runway Surface Condition:**	
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 Fatal	**Latitude, Longitude:**	37.511943,-122.250556(est)

Administrative Information

Investigator In Charge (IIC):	Huhn, Michael
Additional Participating Persons:	James Stenhouse; FAA FSDO; San Jose, CA
Original Publish Date:	September 13, 2012
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=77193