National Transportation Safety Board
Aviation Accident Final Report

Location:	Big Bear Lake, CA	**Accident Number:**	LAX07FA035
Date & Time:	11/14/2006, 1013 PST	**Registration:**	N642BD
Aircraft:	Cessna 421B	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	3 Fatal
Flight Conducted Under:	Part 91: General Aviation - Executive/Corporate		

Analysis

Witnesses said that it appeared that the left engine sustained a loss of power just after rotation and liftoff. The airplane initially had a positive rate of climb, but then immediately yawed to the left as it cleared 30-foot-high power lines that were perpendicular across the flight path. The airport is at the east end of a lake in a mountain valley; the airplane departed to the west and was flying over the lake. The airplane was about 2 miles from the runway when witnesses observed dark smoke coming from the left engine, and the smoke increased significantly as the flight continued. The airplane banked hard left with the wings perpendicular to the ground, and then nosed in vertically. The landing gear remained down throughout the accident sequence. On site examination revealed that the top spark plugs for the left engine were black and sooty. A detailed examination revealed that the left turbocharger turbine wheel shaft fractured and separated. Extreme oxidation of the fracture surfaces prevented identification of the failure mode; however, the oxidation was the result of high temperature exposure indicating that the fracture occurred while the turbocharger was at elevated temperature during operation. The multiple planes exhibited by the fracture also were not consistent with a ductile torsional failure as would be expected from a sudden stoppage of either rotor. No evidence of a mechanical malfunction was noted to the right engine. The Cessna Owners Manual for the airplane notes that the most critical time for an engine failure is a 2-3 second period late in the takeoff while the airplane is accelerating from the minimum single-engine control speed of 87 KIAS to a safe single-engine speed of 106 KIAS. Although the airplane is controllable at the minimum control speed, the airplane's performance is so far below optimum that continued flight near the ground is improbable. Once 106 KIAS is achieved, altitude can more easily be maintained while the pilot retracts the landing gear and feathers the propeller. The best single-engine rate-of-climb is 108 KIAS with flaps up below 18,000 feet msl. Section VI of the manual provides operational data for single-engine climb capability. The data was only valid for the following conditions: gear and flaps retracted, inoperative propeller feathered, wing banked 5 degrees toward the operating engine, 39.5 inches of manifold pressure if below 18,000 feet, and mixture at recommended fuel flow.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:
Failure of the turbine wheel shaft in the left turbocharger during the takeoff initial climb for undetermined reasons, and the pilot's failure to attain and maintain safe single engine airspeed that led to a loss of control.

Findings

Occurrence #1: LOSS OF ENGINE POWER(PARTIAL) - MECH FAILURE/MALF
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. 1 ENGINE
2. (C) EXHAUST SYSTEM,TURBOCHARGER - FRACTURED

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: MANEUVERING

Findings
3. (C) AIRSPEED(V2 MIN) - NOT OBTAINED/MAINTAINED - PILOT IN COMMAND
4. (C) AIRCRAFT CONTROL - NOT MAINTAINED - PILOT IN COMMAND

Occurrence #3: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Findings
5. TERRAIN CONDITION - GROUND

Factual Information

HISTORY OF FLIGHT

On November 14, 2006, about 1013 Pacific daylight time, a Cessna 421B, N642BD, collided with terrain near Big Bear Lake, California. The owner was operating the airplane under the provisions of 14 Code of Federal Regulations (CFR) Part 91. The airline transport certified pilot and two passengers were killed; the airplane was destroyed. The cross-country personal flight departed Big Bear Municipal Airport about 1000, with a planned destination of Las Vegas, Nevada. Visual meteorological conditions prevailed, and no flight plan had been filed.

A friend indicated that this was to be the first flight together for the owner and his new pilot. The airplane had recently been relocated to its new home base at Apple Valley, California. The pilot flew from Apple Valley to Big Bear to pickup the owner and a friend for an overnight trip to Las Vegas. The friend said that the pilot landed at 0920. He observed the airplane as it landed and taxied to the ramp; he noted no anomalies. He talked briefly with the pilot, and the pilot did not indicate that he encountered any difficulties with the airplane on the flight. The friend left prior to the airplane's departure.

A mechanic witness stated that the airplane departed runway 26. He was familiar with the airplane, and watched it take off. The airplane rotated about 3,000 feet from the departure end of the runway, and the flaps appeared to be up. He noted nothing unusual until the airplane rotated. Just after liftoff, he said that the sound of one engine changed. It didn't sound "right," but it didn't backfire. The airplane had a positive rate of climb, but then immediately yawed extremely to the left. It veered to the left, which is a standard maneuver at Big Bear to avoid overflying a school. As the airplane approached a causeway that was just west of the end of the runway, the mechanic became concerned that it might not clear 30-foot-high power lines that were perpendicular to the flight path. The airplane was still yawed to the left. The landing gear was still down, and remained down as long as the mechanic could observe the airplane. It was about 2 miles from the runway when he noted dark smoke coming from the left engine, and the smoke increased significantly as the flight continued. The airplane got far enough away that he could barely see it, but he could still follow the smoke trail. The airplane began a right turn by Windy Point. He temporarily lost sight of it behind another point of land as it continued the right turn. When he acquired it again, he could see it in a platform view. Seconds after it disappeared behind trees, he observed an explosion.

Witnesses further down the lake observed the airplane. They saw puffs of smoke coming from an engine, and the airplane appeared to be banked about 30 degrees to the right. A couple of witnesses estimated that the altitude was no more than 175 feet above ground level (agl). Some reported that the wings were rocking; others thought that the tail of the plane was wagging left and right. One thought that the landing gear was down; another thought that the gear was up. The airplane drifted toward the north side of the lake, and then made a hard left turn with the wings perpendicular to the ground. The roll continued until the nose went straight down; one witness said that the airplane hit the water and the shoreline at the same time.

PERSONNEL INFORMATION

A review of Federal Aviation Administration (FAA) airman records revealed that the 52-year-old pilot held an airline transport pilot certificate with a rating for airplane multiengine land and a commercial pilot certificate with a rating for airplane single-engine land. The pilot held a certified flight instructor (CFI) certificate with ratings for airplane single-engine land, multiengine land, instrument airplane, and basic ground.

The pilot held a second-class medical certificate issued on January 24, 2005. It had the limitations that the pilot must wear corrective lenses and possess glasses for near and interim vision.

No personal flight records were located for the pilot. The IIC obtained the aeronautical experience listed in this report from a review of the FAA airmen medical records on file in the Airman and Medical Records Center located in Oklahoma City, Oklahoma. The pilot reported on his medical application that he had a total time of 4,700 hours.

AIRCRAFT INFORMATION

The airplane was a Cessna 421B, serial number 421B0658. It is believed that the logbooks were in the airplane, and burned. A review of maintenance work orders indicated that the total airframe time was 4,556.2 hours at the last annual inspection on May 25, 2006. The hour meter read 1,112.4 hours at the last inspection.

The left engine was a Teledyne Continental Motors GTSIO-520H, serial number 600468. Total time recorded on the engine at the last inspection was 2,545 hours, and time since major overhaul was 744 hours.

The right engine was a Teledyne Continental Motors GTSIO-520H, serial number 600340. Total time recorded on the engine at the last inspection was 2,553 hours, and time since major overhaul was 744 hours.

AIRPORT INFORMATION

The Airport/ Facility Directory, Southwest U. S., indicated that Big Bear City Airport had an Automated Weather Observation System (AWOS)-3, which broadcast on frequency 132.925. The Big Bear City runway 26 was 5,850 feet long and 75 feet wide. The runway surface was asphalt.

WRECKAGE AND IMPACT INFORMATION

The airplane came to rest on the shoreline, which was about a 4-foot rocky slope that angled up from the water an estimated 20 degrees. The right wing outboard of the nacelle and the right propeller were in the water. The nose was on the rocky shoreline; the fuselage and left wing were on the shore. The fuselage was upright and oriented 240 degrees. The empennage partially separated, and the leading edges of the horizontal and vertical stabilizers were pointing toward the ground. The right engine was nose down 90 degrees to the wing with the propeller flange in the water. Both propellers separated; the left propeller was in the rocks on the shoreline. Its hub shattered and liberated all three blades.

Fire consumed the left aileron, the cabin interior, part of the rudder, and part of the vertical stabilizer.

MEDICAL AND PATHOLOGICAL INFORMATION

The San Bernardino County Coroner completed an autopsy. The FAA Forensic Toxicology

Research Team, Oklahoma City, performed toxicological testing of specimens of the pilot.

Analysis of the specimens contained no findings for carbon monoxide, volatiles, and tested drugs.

The report contained the following finding: 1.3 (ug/ml) cyanide detected in blood.

TESTS AND RESEARCH

On Scene Examination

During the wreckage examination, investigators removed the top spark plugs from the right engine. All spark plugs were clean with no mechanical deformation. The spark plug electrodes were gray, which corresponded to normal operation according to the Champion Aviation Check-A-Plug AV-27 Chart.

Investigators removed the top spark plugs from the left engine. All spark plugs had no mechanical deformation. All of the spark plugs were black and sooty.

The left turbo compressor partially turned, but the turbine was loose and rocked when manually manipulated.

Follow-up Examination

Investigators examined the wreckage at Aircraft Recovery Service, Littlerock, California, on December 14, 2007.

Airframe

Investigators established control continuity from the control surfaces to the deformed cockpit area. The landing gear were down; the landing gear actuators were in the extended position. The left and right flaps were in the up positions; the controls and indicators were destroyed. The fuel selector valves were cable operated; mechanical distortion to the wings and fuselage prevented determination of the valves positions.

Factory Examination of Engines and Turbochargers

TCM personnel examined the engines under the supervision of the IIC at the factory in Mobile, Alabama, on January 29 and 30, 2007. TCM submitted a written report, and the IIC concurred with the facts in the report. Kelly Aerospace personnel examined the turbochargers under the supervision of the IIC at the TCM factory on January 29, 2007. Kelly Aerospace prepared a written report, and the IIC concurred with the facts in the report.

Left engine

TCM personnel cut away the exhaust assembly in four places to facilitate removal. The risers had sooty black deposits. The induction manifold intercooler attachment flange had impact damage. The induction risers were undamaged. The crankshaft to camshaft timing was verified by the alignment of the gear's timing marks. TCM personnel installed the magnetos onto a test bench, and both magnetos produced spark at all posts through a full range of revolutions per minute (rpm).

The oil filter housing was breached, and the oil filter adapter exhibited thermal damage. TCM personnel cut the oil filter housing open, and cut the filter element from the canister. They examined the oil filter element, and noted that it contained flakes and slivers from what appeared to be from the number four crankshaft main bearing. They noted no anomalies within the oil pump. The oil sump was crushed and breached. The oil pick-up tube was crushed. The oil suction screen was unrestricted.

The fuel pump sustained thermal and mechanical damage. The fuel manifold cover was sheared from the body leaving three of the retaining screws fractured at the body mating surface. The plunger assembly was fractured in two at the inlet ports. The lower portion of the plunger with the needle valve, spring, and spacer remained in the manifold body. The diaphragm spring was intact and undamaged. The upper portion of the plunger assembly (including the diaphragm) exhibited mechanical damage. The fuel nozzles were unrestricted, and exhibited normal operating signatures. They noted that a mixture of "B" and "C" nozzles was installed, but correct installation demanded one or the other.

The number three and number four main bearing support mating surfaces exhibited rough surfaces from fretting. The fore and aft number 4 main bearing support surfaces and mating surfaces had scoring and exhibited bearing fretting in the crankcase. The number four main bearing support lock-slot was elongated, which TCM personnel said indicated bearing shift. The number four right side main bearing shell was fragmented. The number four left main bearing shell had extensive movement signatures front and back, loss of free length exposing babbit with 50 percent of copper loss, and the rest of the steel backing.

The inspection of this engine did not reveal any abnormalities that would have prevented normal operation and production of rated horsepower prior to the damage caused at impact.

Left Turbocharger

Kelly Aerospace personnel noted that there were scoring marks on the compressor inlet wall from contact made by the compressor wheel. All of the blade profiles (including the splitter blades) on the compressor wheel sustained rub-damage where they came into intimate contact with the inner wall of the compressor housing. There was rotational scoring on the back of the compressor wheel along with a dark mark, which they presumed the fire caused. The oil passages under the outboard thrust bearing at the center of the back plate were clear and unobstructed. The turbine-end aluminum journal bearing showed evidence of abrasive (scoring) wear with two distinct circumferential tracks etched partially around its outer diameter and oil cooked to the outer surface. There was no indication of operational damage to the thrust bearing system. The turbocharger turbine wheel head separated from the shaft at the turbine wheel hub adjacent to the piston ring groove. The fracture surface exhibited rub marks, and was heavily oxidized, providing no evidence to the unaided eye as to the failure mode. Several sweeping blade marks were visible on the wall of the turbine housing. These witness marks indicated that the turbine wheel rubbed the housing at high speeds. There were corresponding witness marks on the turbine wheel. The housing had areas of discoloration that appeared to be indicative of a high temperature exhaust leak as opposed to a post impact fire. Evidence of turbine wheel rub with the static structures was noted on the profiles of the turbine wheel blades and on the turbine hub back face. Three of the inducer blades had a wear step worn into their underside where they contacted the turbine shroud. A light to moderate dusting of exhaust deposit was uniformly distributed on all surfaces of the wheel. There was an appreciable amount of corrosion on the wheel. Several inducer blades showed evidence of accumulation of unknown whitish colored material.

Metallurgy report

A Safety Board metallurgist examined the fractured turbine wheel shaft, and submitted a report, which is included in the public docket. Pertinent parts of the report follow.

The shaft fractured in the ring groove area near the wheel to shaft weld. The fracture was on multiple slant and flat planes. There were no curved boundaries of fracture regions that were suggestive of fatigue cracking, and the fracture was not entirely on a directly transverse plane associated with a ductile torsional overstress separation. Initial inspections found the fracture surfaces obscured by heavy debris. Successive cleaning removed significant amounts of debris. The cleaned fracture revealed heavy mechanical damage in several areas that obliterated the fracture. The metallurgist found no optically recognizable features in undamaged areas. Further examinations with the aid of a scanning electron microscope uncovered heavy oxidation of the undamaged regions of the fracture face that obscured the original fracture surfaces.

Right Engine

The right side exhaust assembly separated from the exhaust mounting flanges. The left side exhaust assembly had impact damage, and was cut away to facilitate the removal. The inside of the exhaust was unremarkable.

TCM personnel installed the magnetos onto a test bench, and both magnetos produced spark at all posts through a full range of revolutions per minute (rpm). They noted no anomalies within the oil pump. The fuel pump sustained thermal and mechanical damage. The internal components of the fuel manifold valve were not damaged, and the screen and cavity did not contain any debris. The fuel nozzles were not restricted.

The crankshaft and counterweight assembly was undamaged. The connecting rod journals, main journals, and thrust surfaces were undamaged, and showed no signs of abnormal wear or lubrication distress. The crankshaft counterweight pins, plates, and snap-rings were intact. The counterweights were undamaged and had free and unrestricted movement on the hanger blades. The oil transfer passages were open and unrestricted. There were no anomalies noted with the crankshaft main bearings, propeller drive bearings, propeller shaft bearings, connecting rod bearings, or connecting rod bushings. The propeller shaft gear flange was bent. The propeller reduction gear and drive gear were undamaged. The camshaft was unremarkable. The accessory gears had continuity.

The oil sump was crushed and breached in three places. The oil pick-up tube had impact damaged. The oil suction screen was unrestricted.

TCM personnel indicated that the inspection of this engine did not reveal any abnormalities that would have prevented normal operation and production of rated horsepower prior to the damage caused at impact.

Right Turbocharger

There were scoring marks noted on the compressor inlet wall from contact made by the compressor wheel. The blade profiles of the compressor wheel swept about 1/3 to 1/2 of the inner wall. Several blade contours sustained rub-damage where they had made contact with the compressor housing indicative of turbocharger operation at impact. There was an absence of any rotational scoring on the back of the compressor wheel. There was some discoloration of the back of the wheel. The oil passages under the outboard thrust bearing at the center of the back plate were clear and unobstructed.

The turbine-end aluminum journal bearing showed evidence of abrasive (scoring) wear. The thrust bearing system was heavily oxidized with carbonized oil. The thrust spacer, thrust collar, and inboard thrust bearing showed normal wear, exhibiting marks that were inconsequential. Several sweeping blade marks were visible on the wall of the turbine housing. These witness marks indicated that the turbine wheel rubbed the housing at high speeds. There were corresponding witness marks on the turbine wheel. There was evidence of turbine wheel rub with the static structures on five blade contours with a corresponding slight burnishing in the outlet of the turbine housing of about 1 1/4 inch in length. The turbine heat/windage shroud had no indication of contact with the turbine wheel hub.

Airplane Owner's Manual (AOM)

Section I of the AOM describes operating details for the airplane. The takeoff section recommends full throttle operation on takeoff in order to obtain a speed well above the minimum single-engine control speed of 87 knots indicated airspeed (KIAS) as rapidly as possible. It recommends accelerating the airplane to the safe single-engine speed of 106 KIAS while still on the ground for additional safety in case of engine failure.

Section III of the AOM provides guidance for emergency procedures. With an engine failure at a speed below 106 KIAS, and with sufficient runway remaining, it instructs the pilot to close the throttles and brake as required. Cessna issued a supplement to AOM dated November 16, 2001, that contained a warning that level flight may not be possible for certain combinations of weight, temperature, and altitude.

The steps noted for engine failure after takeoff with speed above 106 KIAS are: mixtures to full rich, propellers full forward, throttles full forward to 39.5 inches of mercury, and landing gear up. On the inoperative engine, it then instructs the pilot to close the throttle, place the mixture in idle cut-off, and feather the propeller. It continues by stating that the pilot should establish a 5-degree bank angle into the operative engine, maintain 106 KIAS to clear obstacles, climb at the best single-engine climb speed of 108 KIAS, and adjust the trim tabs at a 5-degree bank toward the operative engine. Remaining steps include securing the inoperative engine by turning the fuel selector off, auxiliary fuel pump off, magnetos switches off, alternator switch off, and land as soon as practicable.

The AOM notes that the most critical time for an engine failure condition in a multiengine airplane is a 2-3 second period late in the takeoff run while the airplane is accelerating to a safe engine failure speed. It notes that the minimum single-engine control speed of 87 KIAS is indicated by a red radial line on the airspeed indicator, but indicates that a safe single-engine speed is 106 KIAS. Although the airplane is controllable at the minimum control speed, the airplane's performance is so far below optimum that continued flight near the ground is improbable. At the safe speed, altitude can more easily be maintained while the pilot retracts the landing gear and feathers the propeller.

The AOM notes that the best angle-of-climb speed is important when obstacles are ahead on takeoff. This speed is 103 KIAS with flaps up; altitude is more important than airspeed until the obstacle is cleared. After obstacles are cleared, it states that the best single-engine rate-of-climb speed is important when it is difficult to maintain or gain altitude in single-engine emergencies. The best single-engine rate-of-climb is 108 KIAS with flaps up below 18,000 feet msl, and is indicated by a blue radial line on the airspeed indicator.

Section VI of the AOM provides operational data. One table provides single-engine climb data.

The data was only valid for the following conditions: gear and flaps retracted, inoperative propeller feathered, wing banked 5 degrees toward the operating engine, 39.5 inches of manifold pressure if below 18,000 feet, and mixture at recommended fuel flow.

Pilot Information

Certificate:	Airline Transport	**Age:**	52, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane Multi-engine; Airplane Single-engine; Instrument Airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 2	**Last FAA Medical Exam:**	01/01/2005
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	4700 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N642BD
Model/Series:	421B	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	421B0658
Landing Gear Type:	Retractable - Tricycle	**Seats:**	8
Date/Type of Last Inspection:	05/01/2006, Annual	**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	2 Reciprocating
Airframe Total Time:	4556 Hours as of last inspection	**Engine Manufacturer:**	Teledyne Continental
ELT:	Installed, not activated	**Engine Model/Series:**	GTSIO-520H
Registered Owner:	Robert F Cartwright	**Rated Power:**	375 hp
Operator:	Robert F Cartwright	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	KL35, 6752 ft msl	**Distance from Accident Site:**	
Observation Time:	0955 PDT	**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 Miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	13 knots / 24 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	250°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.13 inches Hg	**Temperature/Dew Point:**	13°C / -1°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Big Bear Lake, CA (L35)	**Type of Flight Plan Filed:**	None
Destination:	Las Vegas, NV (KLAS)	**Type of Clearance:**	None
Departure Time:	1000 PST	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	2 Fatal	**Aircraft Fire:**	On-Ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 Fatal	**Latitude, Longitude:**	34.240556, -116.943056

Administrative Information

Investigator In Charge (IIC):	Howard Plagens	**Report Date:**	09/26/2008
Additional Participating Persons:	Steve Groover; Federal Aviation Administration; Riverside, CA Emile Lohman; Cessna Aircraft Company; Wichita, KS Andrew Swick; Teledyne Continental Motors; Mobile, AL Randall Knuteson; Kelly Aerospace		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/.		

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The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available here.