National Transportation Safety Board
Aviation Accident Final Report

Location:	Apison, TN	**Accident Number:**	ATL05FA032
Date & Time:	12/02/2004, 1324 EST	**Registration:**	N421SD
Aircraft:	Cessna 421B	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	5 Fatal, 1 Serious
Flight Conducted Under:	Part 91: General Aviation - Business		

Analysis

The airline transport pilot (ATP) stated the airplane was between 200 to 300 feet on initial takeoff climb when the right engine lost power and the airplane yawed to the right. The pilot lowered the nose of the airplane to gain airspeed, pulled the right power lever rearward and nothing happened. The pilot did not feather the right propeller and started moving switches in the vicinity of the boost pump switches. The ATP passenger stated, he did not think the left engine was producing full power. He scanned the instruments with his eyes looking at the manifold pressure gauges. "One needle was at zero and the other was at 25-inches. The manifold pressure should have been 39-inches of manifold pressure. The ATP passenger observed trees to their front and thought the pilot was trying to make a forced landing in an open field to their left. The ATP passenger realized the airplane was going to collide with the trees. Just before the airplane collided with the trees, the pilot feathered the right engine. The ATP passenger observed the right propeller going into the feather position, and the propeller came to a complete stop. Examination of the right engine revealed no anomalies. Examination of the left engine revealed the starter adapter gear teeth had failed due to overload.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's improper identification of a partial loss of engine power on initial takeoff climb resulting in a collision with trees and the ground. A factor was a partial failure of the left engine starter adapter due to overload.

Findings

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

Findings
1. (F) 1 ENGINE
2. (F) ENGINE ACCESSORIES,ENGINE STARTER - OVERLOAD

Occurrence #2: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - EMERGENCY

Findings
3. OBJECT - TREE(S)
4. (C) EMERGENCY PROCEDURE - IMPROPER - PILOT IN COMMAND
5. TERRAIN CONDITION - GROUND

Factual Information

HISTORY OF FLIGHT

On December 2, 2004, at 1324 eastern standard time, a Cessna 421B, N421SD, registered to Georgia Cumberland Conference of Seventh Day Adventist, operating as a 14 CFR Part 91 business flight, collided with trees and the ground while attempting a forced landing in the vicinity of Apison, Tennessee. Visual meteorological conditions prevailed and an instrument flight rules flight plan was filed. The flight plan was not activated. The airplane was destroyed and there was a post-crash fire. The commercial pilot, and four passengers were fatally injured. The airline transport pilot-rated passenger (ATP) reported serious injuries. The flight originated from Collegedale Municipal Airport, Collegedale, Tennessee, on December 2, 2004, at 1318.

The ATP passenger seated in the right front cockpit seat stated the pilot departed from runway 03 without completing an engine run-up. The airplane was between 200 to 300 feet on initial takeoff climb when the right engine lost power and the airplane yawed to the right. The pilot lowered the nose of the airplane to gain airspeed, pulled the right power lever rearward and nothing happened. The pilot did not feather the right propeller and started moving switches in the vicinity of the boost pump switches. At one point the ATP passenger stated, he did not think the left engine was producing full power. He scanned the instruments with his eyes looking at the manifold pressure gauges. "One needle was at zero and the other was at 25-inches. The manifold pressure should have been 39-inches of manifold pressure. I assumed the zero reading on the manifold pressure was the right engine." The ATP passenger observed trees to their front and thought the pilot was trying to make a forced landing in an open field to their left. The ATP passenger thought the airplane would skim the top of the trees and they would be able to complete the forced landing to the open field. He then realized the airplane was going to collide with the trees. Just before the airplane hit the trees, the pilot feathered the right engine. The ATP passenger observed the right propeller going into the feather position, and the propeller came to a complete stop. As soon as the airplane came to a stop he observed he pilot slumped over in his seat, and then observed the airplane was on fire. He immediately exited the airplane, and departed the crash site seeking assistance.

A witness stated he was walking in his front yard when he heard an airplane approaching. " The engine sounded like it was surging." The airplane approached his home from the south going north, and was located above the tee line. The witness observed the airplane make a left bank estimated at 20-degres degrees. The airplane disappeared from view behind the trees and smoldering smoke pursued. The witness called the emergency 911 operators, and notified them of the accident. He then observed an individual coming from the direction of the crash site and saw a ball of fire when the airplane exploded.

Another witness who lives near the airport stated he and his wife were in their home when they heard an airplane approaching. He assumed that the airplane had departed from Collegedale Municipal Airport. The airplane sounded like a twin-engine airplane and it sounded as if the airplane was flying low. He went outside and observed the airplane flying towards him. The left engine was turning but he could not see propeller blades as if it was idling, and the engine sounded like a Harley engine. The right engine was not running. It appeared the pilot was trying to start the right engine. The propeller would turn and stop. It did this about two times. The airplane was about 100 feet high and was descending fast. The airplane was observed to

start a left turn towards an open field in the vicinity of Pine Hill Road and McDonald Road. The witness stated he knew the airplane was in trouble and he told his wife that the airplane was going to crash. The airplane disappeared from view and he heard it hit the ground and subsequently observed smoke rising in the general area of Pine Hill Road and McDonald Road. He called the airport to report the accident and his neighbor called the 911 emergency operators.

PERSONNEL INFORMATION

Review of information on file with the FAA Airman's Certification Division, Oklahoma City, Oklahoma, revealed the commercial pilot was issued a commercial pilot certificate on August 30, 1994, with ratings for airplane single engine land, airplane multiengine land, and instrument airplane. In addition, the pilot held a flight instructor certificate issued on May 30, 2003, with ratings for airplane single engine land, and instrument airplane. The pilot also held an advanced ground instructor instrument certificate issued on June 19, 1992. In addition, the pilot held a mechanic airframe and power plant certificate issued on June 30, 1989. The pilot held a first class medical certificate issued on April 6, 2004, with no limitations. The pilot's last biennial flight review was completed on September 1, 2004.

Review of information on file with the FAA Airman's Certification Division, Oklahoma City, Oklahoma, revealed the airline transport pilot rated passenger was issued an airline transport pilot certificate on August 23, 2002. In addition, the pilot holds a commercial pilot certificate with ratings for airplane single engine land and rotorcraft helicopter issued on August 23, 2002. The pilot holds a ground instructor certificate for advanced instruments issued on June 2, 1993. In addition, the pilot holds a flight instructor certificate with ratings for airplane single engine land, rotorcraft helicopter, and instrument airplane issued on March 10, 2004. The pilot holds a first class medical with no restrictions issued on July 1, 2004, and the pilot's last biennial flight review was not determined.

AIRCRAFT INFORMATION

A review of the airframe maintenance records revealed the last annual inspection was performed on September 22, 2004, at Hobbs meter 6741.4 hours. According to the maintenance manger for Georgia Cumberland Conference of Seventh Day Adventist, the airplane had flown 67.2 hours since the annual inspection. The left engine had 832 hours at the time of the accident. The right engine had 1,084 hours at the time of the accident. The total airframe hours at the time of the accident was 6,808 hours. The Hobbs meter at the crash site was not recovered. The airplane was last refueled with 79.9 gallons of 100 low lead fuel on December 2, 2004, at Chattanooga, Tennessee. The main fuel tanks were topped off to 50 gallons per side, and the auxiliary fuel tanks contained 30 gallons of fuel per side.

Review of the engine logbook revealed Teledyne Continental Motors had completed Critical Service Bulletin (CSB) SB 94-4, STARTER ADAPTER SHAFTGEAR AND CRANKSHAFT GEAR INSPECTION on the right engine and installed new gears on April 16, 2000. Teledyne Continental Motors completed CSB 94-4B on the left engine on April 24, 2001. The operator's maintenance personnel had not recorded as completed the CSB94-4D or the Cessna Multi-Engine Service Bulletin MEB94-7 during the100-hour inspection or annual inspection. The Critical Service Bulletin states in a WARNING, "Compliance with this bulletin is required to prevent possible failure of the starter adapter shaft gear and or crankshaft gear which can result in metal contamination and or engine failure." According to records on file with the

Georgia-Cumberland Conference of Seventh-Day Adventist, the Conference entered into a contract agreement with an individual for his services to serve as Aviation Manager providing maintenance and service on N421SD and 4 days of pilot time each month. The Aviation Manager stated Chattanooga Aero Service and Star Avionics worked on the airplane allot, to include oil changes. Chattanooga Aero Service stated they had not performed any annual inspections on N421SD. In addition, the Aviation Manager stated, the annual inspections followed the Cessna Aircraft Company Ground Handling Servicing and Inspection procedures listed on page 2-21A. The airframe and power plant mechanic who performed the annual inspection on N421SD on September 22, 2004, stated the Aviation Manager for N421SD did not want the Service Information Letters, Cessna Service Bulletins, and Supplier Service Bulletins complied with since they were not mandatory requirements.

The pilot filed 3 Direct User Access System (DUATS) instrument flight rules (IFR) flight plans on December 2, 2004. The first flight was from Chattanooga, Tennessee, to Calhoun, Georgia, proposing off at 07:00, with 20 minutes en route, and 3 hours of fuel on board. The second IFR flight plan was proposed off Calhoun, Georgia, at 07:45 to Collegedale, Tennessee, with 17 minutes en route, and 2 hours 45 minutes of fuel on board. The third flight plan was from Collegedale, Tennessee, to Knoxville, Tennessee, proposing off at 12:30, with 27 minutes en route and 4 hours of fuel on board. No weather briefing was obtained from the DUATS system.

METEOROLOGICAL INFORMATION

The Chattanooga, Tennessee 1335 surface weather observation was wind light and variable at 3-knots, visibility 10 miles, few clouds at 11,000, temperature 52-degrees Fahrenheit, dew point temperature 32-degrees Fahrenheit, altimeter 30.10.

WRECKAGE AND IMPACT INFORMATION

The wreckage of the airplane was located in a wooded area 2.3 nautical miles north of Collegedale Municipal Airport, and adjacent to 5418 Mc Donald Road, and 10820 Pine Hill Road in Apison, Tennessee.

Examination of the crash site revealed the airplane collided with trees on a heading of 020-degrees magnetic separating the outboard 3 feet of the left wing, left main fuel tip tank, nose cone, and left and right baggage door. The airplane came to rest inverted on a heading of 200-degrees magnetic. Browning of vegetation was present and "v" cuts were present on tree branches located along the crash debris line. The crash debris line extended 230 feet.

The airplane was fire damaged from the nose baggage area extending aft to the tail cone. The nose wheel separated from the nose section. The elevator and rudder flight control cables were intact from the control column aft to the third bulkhead. The left side aileron control cables separated 5 feet inboard of the outboard aileron bell crank adjacent to the left engine nacelle. The right side aileron control cables were cut in the vicinity of the third bulkhead. The left and right fuel selector handles were not located. The left fuel selector valve was in the auxiliary position. The right selector valve was in the off position.

The right wing was fire damaged and separated from the fuselage 3½ feet outboard of the right engine nacelle. The right engine separated from the engine nacelle and was located against the left engine and propeller assembly. The right propeller separated from the propeller crankshaft flange. The outboard 7 feet of the right wing was fire damaged, separated, and located next to

the empennage. The inboard and outboard flap remained attached to the aft spar and were extended 9-inches at the trailing edge. The right aileron separated from its hinge points. The right aileron control cables were separated 3 feet outboard of the engine nacelle and extended inboard to the engine nacelle. The auxiliary fuel tank and main fuel tank were ruptured and fire damaged. The outline of the auxiliary fuel tank was visible with discolored fire damaged paint. The right engine nacelle fuel tank was not installed. The right main landing gear was in the retracted position.

The right propeller was forwarded to the manufacturer for examination. Examination of the right propeller spinner revealed no rotational crushing. All three-propeller blades remained attached to the propeller hub. The propeller blades were in the feathered positioned. One propeller blade was bent aft 15-degrees opposite the direction of rotation. Another propeller blade was bent forward towards the tip with wood embedded in-between the propeller hub and the spinner. The remaining propeller blade was bent forward with lengthwise scarring present on the aft side of the propeller blade. The propeller governor was damaged, disassembled, and no anomalies were noted.

The aft fuselage received fire damage. The vertical stabilizer was compressed downward and to the left 8-inches above the rudder trim actuator. The rudder was bent to the left and attached to the vertical stabilizer by the middle and lower hinge points. The balance weight remained attached to the rudder and was not deflected.

The right horizontal stabilizer separated 1½ feet outboard of the tail cone in an upward and rearward direction. Accordion crushing was present on the leading edge extending outboard to the horizontal stabilizer tip. Soot was present on the upper and lower surface of the horizontal stabilizer. The right elevator separated from its hinge points and was located in front of the right engine nacelle. The elevator trim tab remained attached to the elevator and separated from the trim tab actuator. The elevator trim tab was extended 2-inches. The elevator balance weight remained attached to the right elevator.

The left horizontal stabilizer was attached to the tail cone and received fire damage. The left elevator was attached to the inboard, outboard, and center hinges. The trailing edge of the horizontal stabilizer was crushed inward and forward with tree bark embedded in-between the stabilizer skin.

The left wing separated at the fuselage and was fire damaged. The engine and propeller assembly remained attached to the airframe. The left wing outboard of the nacelle was consumed by fire. The inboard flap was extended 9-inches at the trailing edge. The left aileron separated from its hinges and 3 feet of the aileron was fire damaged. The left aileron cables remained attached to the aileron bell crank in the outboard section of the left wing. The cables extended inboard to the engine nacelle and separated. The auxiliary fuel tank and main fuel tank were ruptured and fire damaged. The left engine nacelle fuel tank was ruptured. The left main landing gear was in the retracted position.

The left propeller was forwarded to the manufacturer for examination. The left propeller assembly remained attached to the propeller crankshaft flange and the spinner was crushed

inward. All propeller blades were loose in the propeller hub. One propeller blade tip was bent forward 7-inches inboard of the propeller tip. Another propeller blade was bent aft 11-inches outboard of the propeller hub, and the propeller blade was embedded in the ground. The remaining propeller blade was bent aft 40-degrees, 8-inches outboard of the propeller hub. No scoring or leading edge damage was present on all three-propeller blades. The McCauley propeller teardown Inspection Report stated: "The left propeller was being operated under conditions of low power at impact." The left propeller governor was damaged, disassembled, and no anomalies were noted."

The right engine was transported to the engine manufacturer for further examination. The top and bottom sparkplugs on the right engine were removed and the electrodes were "worn out-severe" on cylinders 1, 3, 5, 4, and 6, when compared to the Champion Aviation Check-A-Plug Chart. The top No. 5 cylinder sparkplug was oil soaked. The top and bottom spark plugs on cylinder No. 2 were "worn out-normal. " The No. 2 cylinder bottom sparkplug contained tan moisture laden oil. The sparkplug electrodes were dark in color. The top ignition leads Nos. 1, 3, 5, and bottom leads 2, 4, and 6 were damaged. The remaining leads were intact. The fuel pump was intact and removed from the engine. The drive coupling was intact and rotated freely when turned by hand. A trace of fuel was present in the fuel pump. The fuel pump was tested on a fuel test bench and flowed within Teledyne Continental flow pressure specifications. The fuel manifold valve and fuel nozzles were tested on a fuel test bench and flowed within Teledyne Continental flow pressure specifications. The fuel flow transducer was fire damaged. The throttle body and control assembly were damaged and separated from the engine and remained in the nacelle. The fuel control assembly was not recovered. The control link rod from the variable absolute controller to the throttle plate was intact and moved freely by hand. The turbo reference pressure "T" fitting and throttle control rod were broken.

The vacuum pump and drive coupling were intact and rotated freely when turned by hand. The oil pump drive gear and pump gear were intact. The oil pump cavity was intact with scratches. The oil pump gear teeth were intact and were not damaged. The oil pressure relief valve seat had polishing signatures and was not damaged. The oil scavenge pump drive gear and oil pump gear were intact. The oil cavity was intact and had scratches. The oil scavenge pump gear teeth were intact. The oil filter was not recovered. The oil sump was drained and contained one quart of oil and water. The oil sump was punctured 2-inches inward on the left side of the oil sump. The oil cooler was damaged. The left magneto separated from the engine and the drive shaft turned freely when moved by hand.

The right magneto remained attached to the engine and the drive shaft turned freely when moved by hand. Both magnetos were installed and tested on a test bench. Both magnetos produced a bright blue spark across a 7-millimeter gap through the full range of the test bench rpm. The starter adapter was damaged and turned freely by hand. The alternator was intact and turned freely by hand. The drive coupling was intact and not damaged. The tachometer generator was not recovered.

The right exhaust runner was intact. The left exhaust runner and crossover tube were damaged. The valve covers were removed and compression and suction was obtained on cylinders 1,3, 5, and 6. The No. 2 and 4 cylinders received damage and contained tan moisture laden oil. Compression and suction was not obtained on cylinders 2 and 4. The rocker arms were removed from both cylinders. The crankshaft was turned by hand and air was heard coming from cylinder 2 and 4. The crankshaft was rotated by hand and continuity was

confirmed to the gear train. The right engine was disassembled. Spot putty was present on all cylinder hold-down nuts. All cylinders were removed. All cylinders combustion chambers had combustion deposits and the bore condition was free of scoring and not damaged. The cylinder skirts were intact and not damaged and hone marks were visible in the cylinder bore ring travel areas. The intake and exhaust valve heads were intact, seated, and combustion deposits were present. The rocker box areas, valves, rocker arms, springs, and shafts were lubricated and undamaged. The No. 2 and 4 cylinder heads were damaged. The No. 2 intake and exhaust push rods were damaged. The remaining intake and exhaust cylinder push rods were not damaged. All piston heads exhibited combustion deposits and the piston skirts were free of scoring and damage. The piston rings were intact, and free in their grooves. The piston pins and plug assemblies were intact and not damaged. The lifters faces and bodies were not damaged and were lubricated.

The engine crankcase halves were intact and were separated. The crankshaft and counter weights were intact, undamaged, and were lubricated. The main bearing journals, connecting rod journals and oil passage tubes were intact and unrestricted. The crankshaft counterweight pins, plates, and snap rings were intact. The counterweights were intact, undamaged, and had free and unrestricted movement on the hangar blades. The camshaft lobes and end gear were intact, undamaged and well lubricated. The propeller shaft assembly was bent. The propeller driver gear and quill shaft was intact and not damaged. All connecting rods were intact, undamaged, and lubricated. The connecting rod bushings were intact and lubricated. The connecting rod bearings Babbitts were intact and lubricated. The main bearings Babbitts were worn.

The turbocharger system separated from the engine and remained in the nacelle. The turbo charger was intact and fire damaged. The turbocharger turbine and compressor rotated freely when turned by hand. The turbine and compressor blades were intact and fire damaged. The waste gate actuator valve-fitting boss was fractured and fire damage. The waste gate butterfly valve moved freely when operated by hand. The waste controller assembly was fire damaged and the oil return line port was damaged. The controller valve moved freely when moved by hand.

The left engine and turbocharger were removed from the engine cradle and transported to the engine manufacture for further examination. Examination of the engine revealed the engine was intact with damage to the right crankcase half at the propeller shaft assembly. A crack was observed at the right crankcase half in the location of the propeller shaft assembly gear area. The propeller gear was binding and could only be rotated about 20-degrees when turned by hand. Continuity was confirmed to the gear train when the crankshaft was turned by hand. The top spark plug leads were removed from the spark plugs. The top and bottom spark plugs on the left engine were removed and the electrodes were "worn out-severe" when compared to the Champion Aviation Check-A-Plug Chart. The No. 1 bottom spark plug was oil soaked. The electrodes were dark in color and free of carbon deposits. All ignition leads were intact and not damaged. The fuel pump was intact and removed from the engine. The drive coupling was intact and rotated freely when turned by hand. A trace of fuel was present in the fuel pump, fuel transducer, and manifold valve inlet hose. The fuel pump was tested on a fuel test bench and flowed within Teledyne Continental flow pressure specifications. The fuel manifold valve was intact. The safety wire was intact and the lead seal was missing. The fuel nozzles were intact. The fuel manifold valve and nozzles were tested on a fuel test bench and flowed within Teledyne Continental flow pressure specifications. The fuel flow transducer was fire damaged.

The fuel control mixture shaft was bent and could not be moved by hand. The mixture shaft was in a position half way between idle cut off and full rich. The throttle bodies to fuel control and throttle body to waste gate controller link rods were intact and not damaged. The throttle valve could be moved by hand through its full range of travel. The fuel inlet finger screen was found to be bound in the fuel control housing upon removal. The finger screen contained lint. The fuel control assembly could not be flowed due to damage.

The vacuum pump and drive coupling were intact and rotated freely when turned by hand. Both air-oil separators were intact. The oil pump drive and pump gear were intact. The oil pump cavity was intact with scratches. The oil pump gear teeth were intact and were not damaged. The oil pressure relief valve and seat had polishing signatures and were not damaged. The oil pump cavity was intact with scratches. The oil scavenge pump drive gear and pump gear teeth were intact. The remote oil filter adapter and filter were intact and not damaged. The oil filter element contained ferrous material. The oil sump was drained and contained 2 ½ gallons of oil. The oil was dark in color. The sump contained ferrous metal debris and ten gear teeth from the starter adapter shaft, and two pieces of aluminum from the crankcase. The metal debris, gear teeth and aluminum were forwarded to the NTSB Materials Laboratory for further examination. The oil pick up tube was intact, undamaged, and the oil suction screen was clear and unrestricted. The oil cooler was intact and not damaged. The left and right magnetos remained attached to the engine, and both drive shafts turned freely when moved by hand. Both magnetos were installed and tested on a test bench. The left magneto produced a bright blue spark across a 7-millimeter gap through the full range of the test bench rpm. The right magneto produced a bright blue spark across a 7-millimeter gap through the full range of the test bench rpm on ignition tower 6. No spark was observed on the remaining ignition towers. The magneto cover was removed. The distributor block and gear assembly was removed. A majority of the distributor gear teeth were missing from the gear and located in the magneto housing.

The starter adapter assembly turned freely by hand and the gear teeth were separated from the starter adapter shaft gear. The starter adapter shaft gear and the crankshaft gear were removed and forwarded to the NTSB Materials Laboratory for further examination. Examination of the starter adapter gear showed "moderate fretting damage" was observed on the shaft at the damper. "Light damage" was also observed at the aft bearing location, "with the addition of axial scoring marks consistent with secondary damage from removal of the bearing." All 15 teeth gear teeth were fractured off. Almost all of the fracture surfaces were heavily smeared-over with minimal fracture features to examine. The No. 7 and No. 8 teeth were fractured further inboard into the shaft and had clear fracture features. "The fracture surfaces of these teeth were flat and ratcheted near the surface and had a rough, woody appearance towards the interior consistent with overstress. The flat regions at the root of the teeth corresponded approximately with the carburized case depth confirmed in the metallographic mounts. No evidence of fatigue arrest marks was observed." Examination of the crankshaft gear revealed that 8 out of 30 gear teeth were fractured-off. "Examination of the fracture surfaces revealed that all had relatively flat features near the surface of the gear in the carburized case region and a rough, woody in appearance further inward. Many of the fracture surfaces had smeared-over regions from heavy bending/rubbing. All fracture surfaces were consistent with overstress fracture. No evidence of fatigue was observed. The viscous damper was tested at Teledyne Congenital Motors. The viscous damper did not meet the acceptance criteria for new units. The viscous damper was forwarded to the NTSB Material Laboratory for examination.

Examination revealed the viscous damper seal viscous fluid was dried up, the damper faces were bulged out, and evidence of fretting was observed on the damper and starter adapter gear shaft. CSB94-4D states in GENERAL INFORMATION,..."Continued operation of the GTSIO-520 and GIO-550 series engines with starter adapter viscous dampers that have been overheated can lead to distress and possible failure of the starter adapter shaft gear and crankshaft teeth."

The alternator was intact and turned freely by hand. The data plate was missing and the drive coupling was intact and not damaged. The tachometer generator was intact and the drive shaft turned freely by hand. The exhaust system and induction system were intact and not damaged. The aftercooler was intact and not damaged. The cooling fins were intact and unrestricted. The internal passages were intact and unrestricted. The propeller shaft assembly was rotated by hand and continuity was confirmed through the crankshaft.

The left engine was disassembled. Spot putty was present on all cylinder hold-down nuts and fuel manifold line "B" nuts. All cylinders were removed. All cylinders combustion chambers had combustion deposits and the bore condition was free of scoring and not damaged. The cylinder skirts were intact and not damaged and hone marks were visible in the cylinder bore ring travel areas. The intake and exhaust valve heads on all cylinders were intact, seated, and combustion deposits were present. The intake and exhaust valves heads exhibited carbon deposits. The rocker box areas, valves, rocker arms, springs, and shafts were lubricated and undamaged. The intake and exhaust cylinder push rods were not damaged.

The piston heads were dark in color and had imprints of the intake and exhaust valves on the piston heads. All piston skirts were free of scoring and damage. The piston rings were intact, and free in their grooves. The piston pins and plug assemblies were intact and not damaged. The lifter faces and bodies were not damaged and were lubricated. The engine crankcase halves were intact and were separated. The left and right crankcase halves were damaged at the idler pin location, and the right crankcase half was damaged forward of the crankcase breather. The remaining surfaces of the crankcase were intact. No fretting was observed between the crankcase halves and there was no evidence of bearing shift. The crankshaft was undamaged and lubricated. The connecting rod journals, main journals, and thrust surfaces were undamaged and did not exhibit lubrication distress. The oil passages were clear and unrestricted. The crankshaft counterweights were intact and strike damage was present on the counterweights from contact with the camshaft. The crankshaft counterweight pins, plates, and snap rings were intact. The counterweights had free and unrestricted movement on the hangar blades. The propeller shaft assembly was intact and not damaged. The propeller driver gear and quill shaft were intact and not damaged. The cam cluster gear was intact and not damaged. The intake lobes apex exhibited polishing signatures from contact with the counterweights. The large cam gear had teeth damage. All connecting rods were intact, undamaged, and lubricated. The connecting rod bushings were intact and lubricated. The connecting rod bearings Babbitt was intact and lubricated. The crankshaft main bearing exhibited wear through the Babbitt layer and the bearing was intact and lubricated. No signs of lubrication distress were present. The accessory drive gear teeth were damage and continuity was not confirmed.

The turbocharger assembly was intact and not damaged. The turbine and compressor shaft rotated freely by when turned by hand. The turbine and compressor blades were intact and not damaged. The wastegate assembly was intact and not damaged. The wastegate valve moved freely when operated by hand. The wastegate controller assembly was intact and not damaged.

The controller valve moved freely when moved by hand.

MEDICAL AND PATHOLOGICAL INFORMATION

A Forensic Pathologist from Hamilton County Medical Examiners Office, Chattanooga, Tennessee, conducted a postmortem examination of the commercial pilot on December 6, 2004. The reported cause of death was "smoke inhalation." The Forensic Toxicology Research Section, Federal Aviation Administration, Oklahoma City, Oklahoma, performed postmortem toxicology of specimens from the pilot. The results were negative for ethanol, basic, acidic, and neutral drugs. Fourteen percent carbon monoxide was detected in the blood and 0.34 (ug/ml) cyanide was detected in the blood.

The airline transport rated passenger stated he received a broken right collarbone, cuts and abrasions to his left hand and leg, and burns on his right hand. No toxicological specimens were taken or requested.

The Vital Records Office, State of Tennessee, Hamilton County, Chattanooga, Tennessee issued a Certificate of Death, on December 6, 2004, for the 4 passengers. The reported cause of death was " multiple injuries." No forensic toxicology of specimens was requested.

TEST AND RESEARCH

Review of the Model 421 OWNER'S MANUAL, SECTION 111, EMERGENCY PROCEDURES, ENGINE FAILURE AFTER TAKEOFF-SPEED ABOVE 122 MPH IAS (Without Sufficient Runway Remaining) states:"

(1.) Mixtures-RICH.

(2.) Propellers-FULL FORWARD.

(3.) Throttles-FULL FORWARD (39.5 IN. Hg.).

(4.) Landing Gear-Up.

(5.) Inoperative Engine:

(a.) Throttle-CLOSE.

(b.) Mixture-IDLE CUT-OFF.

(c.) Propeller- FEATHER.

(6.) Establish Bank-5-degrees toward operative engine.

(7.) Climb to obstacle-122 MPH IAS

(8.) Climb at Best Single-Engine Climb Speed-125MPH IAS.

(9.) Trim Tabs-Adjust (5 degrees toward operative engine).

(10.) Inoperative Engine-Secure as follows:

(a.) Fuel Selector-OFF.

(b.) Auxiliary Fuel Pump-OFF.

(c.) Magneto switches-OFF.

(d.) Alternator Switch-OFF.

(10.) As soon as Practical- Land.

In addition, the Owner's Manual states on page 3-4, The following facts should be used as a guide at the time of engine failure:...(2) altitude is more valuable to safety after takeoff than is airspeed in excess of the best single-engine climb speed since excessive airspeed is lost much more rapidly than is altitude; (3) climb or continued level flight at moderate altitude is improbable with the landing gear extended or the propeller windmilling."

Review of Cessna Engineering Flight Test Memo 380-05-085 revealed that with flaps extended 25-degrees the airplane will experience a 430 feet per minute rate of descent or a -430 feet per minute rate of climb with a windmilling propeller.

ADDITIONAL INFORMATION

The wreckage was released to Atlanta Air Recovery, Griffin, Georgia, on February 9, 2005. The airplane logbooks were released to Nashville Flight Standards District Office-03 on December 14, 2004.

Pilot Information

Certificate:	Flight Instructor; Commercial	**Age:**	36, 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 Single-engine; Instrument Airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim.	**Last FAA Medical Exam:**	04/06/2004
Occupational Pilot:		**Last Flight Review or Equivalent:**	09/01/2004
Flight Time:	4475 hours (Total, all aircraft), 2000 hours (Total, this make and model), 4250 hours (Pilot In Command, all aircraft), 120 hours (Last 90 days, all aircraft), 40 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N421SD
Model/Series:	421B	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	421BO386
Landing Gear Type:	Retractable - Tricycle	**Seats:**	
Date/Type of Last Inspection:	09/22/2004, Annual	**Certified Max Gross Wt.:**	7450 lbs
Time Since Last Inspection:	67 Hours	**Engines:**	2 Reciprocating
Airframe Total Time:	6808 Hours at time of accident	**Engine Manufacturer:**	Lycoming
ELT:	Installed, not activated	**Engine Model/Series:**	GTSIO-520-H
Registered Owner:		**Rated Power:**	375 hp
Operator:	Georgia Cumberland Conference of Seventh Day	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	CHA, 682 ft msl	**Distance from Accident Site:**	10 Nautical Miles
Observation Time:	1335 EST	**Direction from Accident Site:**	86°
Lowest Cloud Condition:	Few / 11000 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	3 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	Variable	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.1 inches Hg	**Temperature/Dew Point:**	11°C / 0°C
Precipitation and Obscuration:			
Departure Point:	Collegedale, TN (3M3)	**Type of Flight Plan Filed:**	IFR
Destination:	Knoxville, TN (TYS)	**Type of Clearance:**	IFR
Departure Time:	1318 EST	**Type of Airspace:**	Class E

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	4 Fatal, 1 Serious	**Aircraft Fire:**	On-Ground
Ground Injuries:	N/A	**Aircraft Explosion:**	On-Ground
Total Injuries:	5 Fatal, 1 Serious	**Latitude, Longitude:**	35.081111, -85.009167

Administrative Information

Investigator In Charge (IIC):	Carrol A Smith	**Report Date:**	06/08/2005
Additional Participating Persons:	Ambrose J Ray; Nashville FSDO-03; Nashville, TN Al Butler; Teledyne Continental; Mobile,, AL Emile lohman; Cessna Aircraft Company; Wichita, KS		
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/.		