National Transportation Safety Board
Aviation Accident Final Report

Location:	Lake Worth, FL	**Accident Number:**	ERA13FA082
Date & Time:	12/08/2012, 1334 EST	**Registration:**	N297DB
Aircraft:	CESSNA 421C	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

The twin-engine airplane was released to the pilot (who was also the airplane owner) after an annual inspection and repainting of the airplane had been completed. Before the accident flight, which was the second flight after maintenance, the pilot performed an engine run-up for several minutes before taxiing to the end of the departure runway for takeoff. According to witnesses, the airplane lifted off about halfway down the runway and initially climbed at a normal rate. Several witnesses then observed the airplane suddenly yaw to the left for 1 or 2 seconds, and the airplane's nose continued to pitch up before the airplane rolled left and descended vertically, nose-down, until it disappeared from view. One witness, a flight instructor, said, "The airplane just kept pitching up, and then it looked like a VMC [the airplane's minimum controllable airspeed with only one engine operating] roll."

Examination of the left engine revealed signatures consistent with contact between the piston domes and the valves. The crankcase halves were separated and the No. 1 cylinder main bearing was rotated, and damaged and distorted severely, with bearing fragments located in the oil sump. Bearing material was also extruded from its steel backing. The No. 3 cylinder main bearing showed accelerated wear and wiping of the bearing material. Damage and signatures consistent with excessive heat due to oil starvation were observed on the No. 1 and No. 3 cylinder main bearing journals as well as the No. 1 and No. 2 cylinder connecting rod journals. The camshaft gear was also damaged, with five gear teeth sheared from the gear. A review of engine maintenance records revealed that no maintenance had been performed on the engine that would have required breaking of crankcase thru-bolt torques (such as cylinder removal) since its most recent overhaul, which was completed more than 3 years and 314 flight hours before the accident flight. The reason for the engine failure could not be determined because of the impact and postaccident fire damage.

Examination of the wreckage revealed that the landing gear was in the down and locked position, the left engine propeller blades were in the feathered position, and the left fuel selector valve was in the off position. Examination of the manufacturer's Pilot Operating Handbook revealed that if properly configured, with the landing gear retracted, the airplane would have been capable of a 500 foot-per-minute rate of climb with only one operating engine

on the day of the accident. As found, the airplane was not configured in accordance with the after-takeoff checklist or the engine failure after takeoff checklist.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's failure to follow established engine-out procedures and to maintain a proper airspeed after the total loss of engine power on one of the airplane's two engines during the initial climb. Contributing to the accident was the total loss of engine power due to a loss of torque on the crankcase bolts for reasons that could not be determined because of impact- and fire-related damage to the engine.

Findings

Aircraft	Gear extension and retract sys - Incorrect use/operation (Cause) Recip eng front section - Damaged/degraded (Factor)
Personnel issues	Use of checklist - Pilot (Cause) Incorrect action performance - Pilot (Cause)
Not determined	Not determined - Unknown/Not determined

Factual Information

HISTORY OF FLIGHT

On December 8, 2012, at 1334 eastern standard time, a Cessna 421C, N297DB, operated by a private individual, was destroyed when it collided with trees and terrain following a loss of control after takeoff from North Palm Beach County Airpark (LNA), Lantana, Florida. The commercial pilot was fatally injured. Visual meteorological conditions prevailed, and no flight plan was filed for the personal flight, which was conducted under the provisions of Title 14 Code of Federal Regulations Part 91.

The pilot took delivery of the airplane from a maintenance facility that had just completed an annual inspection and repainting of the airplane. According to the owner of the facility, who was a certificated pilot and an airframe and powerplant mechanic, the pilot completed the preflight inspection and the airplane was towed outside. The pilot started the airplane, but then shutdown to resolve an alternator charging light. Afterwards, the pilot stated that he planned to fly to Okeechobee, Florida, complete a few landings, and then continue to Miami.

According to the mechanic, the pilot performed a ground run of the airplane for several minutes before taxiing to the approach end of Runway 3 for takeoff. The airplane lifted off about halfway down the runway and climbed at a "normal" rate. The mechanic then observed the airplane suddenly yaw to the left "for a second or two" and the airplane's nose continued to pitch up before rolling left and descending vertically, nose-down, until it disappeared from view.

Several witnesses provided similar accounts to a Federal Aviation Administration (FAA) inspector and the local sheriff's department. One witness, a certificated flight instructor said, "The airplane just kept pitching up, and then it looked like a VMC roll."

PERSONNEL INFORMATION

The pilot held a commercial pilot certificate with ratings for airplane single-engine land and sea, airplane multiengine land and instrument airplane. His most recent FAA third-class medical certificate was issued on February 27, 2008. An examination of the pilot's logbook revealed that he had logged 1,217 total hours of flight experience, of which 175 hours were in multiengine airplanes.

AIRCRAFT INFORMATION

According to FAA and maintenance records, the airplane was manufactured in 1980. Its most recent annual inspection was completed December 3, 2012, at 7,039.9 aircraft hours. The airplane had accrued 2.2 hours of flight time after the inspection.The No 2 (right) engine was overhauled at RAM Aircraft, Waco, Texas, on September 13, 2006. At the time of its most recent annual inspection, the engine had accrued 966.3 hours since major overhaul (SMOH).The No. 1 (left) engine was overhauled at RAM Aircraft, Waco, Texas, on October 16, 2009. At the time of its most recent annual inspection, the engine had accrued 312.6 hours SMOH.Oil samples were taken from each engine at the most recent annual inspection, and sample testing was completed at Aviation Oil Analysis, Phoenix, Arizona, on October 29, 2012. According to the report, for metals and contaminants content, "All values appear normal." The owner of the maintenance facility where the annual inspection was completed held FAA commercial pilot, flight instructor, and airframe and powerplant certificates. In an interview,

he said he performed a test flight with the accident pilot at the completion of the annual inspection. Prior to takeoff on the test flight, the propeller rpm was matched on both engines on the ground, but after takeoff the left engine showed 100 rpm above maximum when the right engine was at maximum.

Once the rpm was matched manually by the pilot, the fuel flow on the left engine was about 1.5 to 2.0 gallons per hour below that of the right engine. The fuel flow rate on the left engine was also below that prescribed in the engine maintenance guidance. (SID 97-3).

The airplane was flown for 1.2 hours, and during the flight cabin pressurization, prop synchronization, flight controls, and the autopilot were tested. About mid-flight, the left alternator segment light illuminated, and the ampmeter/voltmeter showed a drop in voltage. About 5 minutes later, the light extinguished, and the ampmeter/voltmeter showed normal voltage for the remainder of the flight.

After landing, the airplane was shut down, and the accident pilot was told that the propeller rpm and the fuel flow needed adjustment on the left engine only. There were also some cosmetic corrections that needed to be made.

After the corrections were made and prior to delivery of the airplane to the pilot, a complete run-up was performed, and the maintenance records were reviewed to confirm all the work that was done during the annual inspection.

The airplane was equipped with two hydraulic pumps, and therefore the hydraulic system would remain pressurized with only one engine operating.

METEOROLOGICAL INFORMATION

At 1332, the weather reported at Palm Beach International Airport (PBI), 5 miles north of LNA included a scattered cloud layer at 2,600 feet and a broken ceiling at 3,500 feet. The wind was from 110 degrees at 11 knots. The temperature was 27 degrees C, the dew point was 20 degrees C, and the altimeter setting was 29.97 inches of mercury.

WRECKAGE INFORMATION

The wreckage was examined at the accident site on December 9, 2012, and all major components were accounted for at the scene. The airplane was consumed by postimpact fire back to the aft pressure bulkhead. The wing spars were intact, and control cable continuity was established from the cockpit to the flight control surfaces. Examination of the main landing gear actuators revealed positions consistent with a down-and-locked configuration.

Both engines were significantly damaged by postcrash fire. All three propeller blades of the left engine were attached at the hub, and in the "feathered" position. The right engine's propeller blades were destroyed by impact and fire. One blade was separated and not recovered. The remaining blades showed positions consistent with low pitch.Examination of the right fuel selector valve revealed that it was in the "main" position. Examination of the left fuel selector valve revealed that it was in the "off" position.

Preliminary external and borescope examinations of both engines revealed continuity throughout and no mechanical anomalies. The engines were retained for detailed examination at a later date.

MEDICAL AND PATHOLOGICAL INFORMATION

The Office of the District Medical Examiner, West Palm Beach, Florida, performed the autopsy on the pilot. The autopsy revealed the pilot died from blunt force and thermal injuries. The FAA Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, performed forensic toxicology on specimens from the pilot. Thirty percent (30%) carbon monoxide, and 3.86 (ug/ml) cyanide were detected in the specimens tested. These levels are consistent with exposure to products of combustion.

TESTS AND RESEARCH

The engines were examined in Mobile, Alabama from February 19 to 22, 2013 under the supervision of an FAA inspector. Each was a 520 cubic-inch, six-cylinder, horizontally-opposed, air-cooled, fuel-injected, turbo-charged, geared engine that produced 375 horsepower at 3,350 rpm.Examination of the No. 2 (right) engine revealed no preimpact mechanical anomalies.Examination of the No. 1 (left) engine revealed signatures consistent with contact made between the piston domes and the valves. The crankcase halves were separated and the No. 1 cylinder main bearing was "rotated," and "damaged and distorted severely," with bearing fragments located in the oil sump. Bearing material was extruded from its steel backing. The No. 3 main bearing displayed signatures consistent with accelerated wear and "wiping" of the Babbitt material.Damage and signatures consistent with excessive heat due to oil starvation were displayed on the No. 1 and No. 3 main bearing journals, as well as the No. 1 and No. 2 connecting rod journals. The camshaft gear was damaged, with five gear teeth found sheared from the gear.Examination of maintenance records revealed that the manufacturer's main bearings and rod bearings were installed in the engine during overhaul. Further examination of the records revealed that no maintenance was performed on the engine that would have required breaking of crankcase thru-bolt torques (such as cylinder removal) since overhaulThe item 98 write-up on the most recent annual inspection invoice stated, "Investigate no oil pressure on left engine; reprime left oil pump, filter, standpipe."When interviewed, the proprietors at the maintenance facility said that the airplane's engines sat idle for an extended period (weeks) due to the annual inspection and the painting of the airplane. Because engine oil has a tendency to "settle" in the sump, and cause the oil pump to lose its prime, the engines were motored. When motored, the left engine showed no oil pressure. The oil system was then primed, and oil pressure was restored prior to engine start.

Examination of maintenance records revealed that as of the most recent inspection, all Airworthiness Directives were complied with and up to date.

ADDITIONAL INFORMATION

The manufacturer's normal procedure for "TAKEOFF:1. Power – SET FOR TAKEOFF2. Mixtures – CHECK fuel flows in the white arc3. Engine Instruments – CHECK4. Air Minimum Control Speed – 80 KIAS5. Takeoff and climb to 50 feet – 100 KIAS at 7450 pounds"The manufacturer's normal procedure for "AFTER TAKEOFF:1. Landing Gear – RETRACT2. Best Angle-of-Climb Speed – 86 KIAS at sea level to 92 KIAS at 20,000 feet with obstacle3. Best Rate-of-Climb Speed With Wing Flaps Up – 111 KIAS at sea level and 7450 pounds"The manufacturer's emergency procedure for "ENGINE FAILURE DURING TAKEOFF (Speed below 100 KIAS or Gear Down):1. Throttles – CLOSE IMMEDIATELY2. Brake or Land and Brake – AS REQUIRED"The manufacturer's emergency procedure for "ENGINE FAILURE AFTER TAKEOFF (Speed above 100 KIAS with Gear Up or In Transit):1. Mixtures – FULL RICH2. Propellers – FULL FORWARD3. Throttles – FULL FORWARD4. Landing Gear – CHECK UP5. Inoperative Engine:a. Throttle – CLOSEb. Mixture – IDLE CUT-OFFc. Propeller

– Feather6. Establish Bank – 5 [degrees] toward operative engine7. Climb to Clear 50-Foot Obstacle – 100 KIAS8. Climb at One Engine Inoperative Best Rate-of-Climb Speed – 111 KIAS9. Trim Tabs – ADJUST 5 [degrees] toward operative engine…10. Inoperative Engine – SECURE as follows:a. Fuel Selector – OFF (Feel for Detent)"A WARNING at the end of the procedure stated: "The propeller on the inoperative engine must be feathered, landing gear retracted and wing flaps up or continued flight may be impossible."Using weather conditions that were current at the time of the accident, interpolation of the airplane manufacturer's "RATE-OF-CLIMB – ONE ENGINE INOPERATIVE" chart revealed that with the landing gear retracted, and the propeller on the inoperative engine feathered, the airplane was capable of an approximate climb rate of 400 feet per minute. With the landing gear down and locked, as found, the airplane was capable of an approximate climb rate of 50 feet per minute.The FAA Airplane Flying Handbook defined VMC as: "Minimum control speed. The minimum flight speed at which the airplane is controllable with a bank of not more than 5 [degrees] into the operating engine when one engine suddenly becomes inoperative and the remaining engine is operating at takeoff power… At low airspeed and high-power conditions, the downward moving propeller blade of each engine develops more thrust than the upward moving blade…When the right engine is operative and the left engine is inoperative, the turning force is greater… In other words, directional control is more difficult when the left engine (the critical engine) is suddenly made inoperative."

History of Flight

Initial climb	Loss of engine power (partial) Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)
Post-impact	Fire/smoke (post-impact)

Pilot Information

Certificate:	Commercial	**Age:**	33
Airplane Rating(s):	Multi-engine Land; Single-engine Land; Single-engine Sea	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2	**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 1219 hours (Total, all aircraft), 100 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	CESSNA	**Registration:**	N297DB
Model/Series:	421C	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	421C0826
Landing Gear Type:	Retractable - Tricycle	**Seats:**	8
Date/Type of Last Inspection:	12/03/2012, Annual	**Certified Max Gross Wt.:**	7450 lbs
Time Since Last Inspection:	2 Hours	**Engines:**	2 Reciprocating
Airframe Total Time:	7040 Hours at time of accident	**Engine Manufacturer:**	Teledyne Continental Motors
ELT:	Installed, not activated	**Engine Model/Series:**	GTSIO-520
Registered Owner:	Subway Development of Southeast Florida, Inc.	**Rated Power:**	375 hp
Operator:	Subway Development of Southeast Florida, Inc.	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	PBI, 20 ft msl	**Distance from Accident Site:**	5 Nautical Miles
Observation Time:	1332 EST	**Direction from Accident Site:**	352°
Lowest Cloud Condition:	Scattered / 2600 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	Broken / 3500 ft agl	**Visibility (RVR):**	
Wind Speed/Gusts:	11 knots /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	110°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.97 inches Hg	**Temperature/Dew Point:**	27°C / 20°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Palm Beach, FL (LNA)	**Type of Flight Plan Filed:**	None
Destination:	Miami, FL (TMB)	**Type of Clearance:**	None
Departure Time:	1332 EST	**Type of Airspace:**	

Airport Information

Airport:	Palm Beach County Park Airport (LNA)	**Runway Surface Type:**	Asphalt
Airport Elevation:	14 ft	**Runway Surface Condition:**	Dry
Runway Used:	03	**IFR Approach:**	None
Runway Length/Width:	3256 ft / 75 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	On-Ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	26.601389, -80.075556

Administrative Information

Investigator In Charge (IIC):	Brian C Rayner	**Report Date:**	01/13/2014
Additional Participating Persons:	Luigi Palma; FAA/FSDO; Miramar, FL Henry Soderlund; Cessna Aircraft Company; Witchita, KS Mike Council; Continental Motors Inc.; Mobile, AL		
Publish Date:	01/13/2014		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=85763		