



National Transportation Safety Board Aviation Accident Final Report

Location:	Greensburg, IN	Accident Number:	CHI08LA144
Date & Time:	06/01/2008, 1030 EDT	Registration:	N102VE
Aircraft:	CESSNA 208B	Aircraft Damage:	Substantial
Defining Event:	Loss of engine power (total)	Injuries:	1 None
Flight Conducted Under:	Part 91: General Aviation - Skydiving		

Analysis

The pilot reported that the airplane, which was used for sky diving operations, was climbing through 7,000 feet mean sea level (msl) when he heard an explosion followed by a metal grinding noise coming from the engine section of the airplane. He felt the airplane vibrate, and smoke began to fill the cabin. He reported that the engine was not producing any power so he shut the fuel off and performed procedures to rid the cabin of smoke. He leveled the airplane at 5,000 feet msl and set the flaps to 20-degree so that the 14 skydivers could exit the airplane. He attempted a forced landing to runway 18 (3,433 feet by 40 feet, asphalt). The airplane was too high and fast during the approach so he executed a forced landing to a cornfield off the departure end of runway 18. When the airplane landed in the cornfield, the propeller and left wing impacted the terrain, and the airplane sustained substantial damage. Inspection of the engine revealed that the compressor turbine (CT) blades failed as a result of blade creep. The engine manufacturer had issued Service Information Letters (SIL) concerning recommended borescope inspection procedures to inspect CT blades for blade creep and fatigue cracks. The airplane's owner reported that he was unaware of the SIL's, and did not perform the borescope inspections that were recommended by the engine manufacturer's SIL.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The total loss of engine power during the en route climb due to a compressor turbine failure as a result of blade creep. Also causal was the inadequate maintenance performed by the airplane's owner.

Findings

Aircraft	Turbine section - Failure (Cause) Turbine section - Fatigue/wear/corrosion (Cause) Turbine section - Incorrect service/maintenance (Cause)
Personnel issues	Maintenance - Owner/builder (Cause)

Factual Information

On June 1, 2008, about 1030 eastern daylight time, a Cessna 208B, N102VE, operated by Skydive Greensburg, had a loss of engine power and sustained substantial damage when it nosed over in a cornfield after a forced landing near the Greensburg-Decatur County Airport (I34), Greensburg, Indiana. The 14 Code of Federal Regulations (CFR) Part 91 skydiving flight with 14 skydivers on board the airplane departed I34 on a local flight at 1015. The pilot was not injured and all the skydivers parachuted safely from the airplane after the complete loss of engine power. Visual meteorological conditions prevailed at the time of the accident and no flight plan was filed.

The pilot reported that it was the second flight of the day and that the airplane performed normally during the first flight. The pilot reported that during the accident flight, the airplane was climbing through 7,000 feet mean sea level (msl) when he heard an explosion and immediately heard a metal grinding noise coming from the engine section of the airplane. He felt the airplane vibrate and smoke began to fill the cabin. He reported that the engine was not producing any power so he shut the fuel off and performed procedures to rid the cabin of smoke. He leveled the airplane at 5,000 feet msl and set in flaps 20 so that the skydivers could exit the airplane. After the skydivers had exited the airplane, he retracted the flaps and turned off the electrical system. He decided to make a forced landing on runway 18 (3,433 feet by 40 feet, asphalt) at I34. He turned the electrical system back on and tried to lower the flaps but the flap circuit breaker had popped. He tried to reset the circuit breaker but without success. Oil from the engine started to coat the windshield so he could not see out the front windshield. When he approached runway 18 he realized that his airspeed was too high to make a landing on the runway. He executed a forced landing to a cornfield off the departure end of runway 18. When the airplane landed in the cornfield, the propeller and left wing impacted the terrain.

A witness located at I34 took a series of photographs of the accident airplane as it made its approach to runway 18 and its forced landing in the field. The photographs indicated that the flaps were in the fully extended position.

The 25-year-old pilot held a commercial certificate with airplane single-engine and multi-engine land ratings. He was a certificated flight instructor with airplane single-engine, multi-engine, and instrument instructor ratings. He held a first-class medical certificate that was issued in March 25, 2008. He had a total of about 1,089 flight hours. Within the previous 90 days he had flown about 85 flight hours in the C-208B, which was his total time in make and model.

The single-engine Cessna 208B, serial number 208B0618, was manufactured in 1997. It had two pilot's seats in the cockpit and was configured for sky diving operations. The maximum gross takeoff weight of the airplane was 8,750 pounds. The engine was a flat rated 675 shaft horsepower Pratt & Whitney PT6-114A engine. The last annual maintenance inspection was performed on February 7, 2008, with a total time of 7,175.0 hours. The engine had about 3,075.3 hours since overhaul at the time of the accident. The aircraft total time at the time of the accident was 7,221 hours.

A Federal Aviation Administration (FAA) airworthiness inspector traveled to the accident site on the same day the accident occurred. Due to heavy rains and flooding, the airplane wreckage was not recovered to a hangar at I34 for about two weeks. On June 18, 2008, the FAA inspector and representatives from the airplane and engine manufacturers conducted an

inspection of the airplane.

The inspection revealed control cable continuity to the ailerons, rudder, elevator, and elevator trim. The flap lever was found in the FULL position, the flap indicator was found near FULL, and the flap actuator was found in the full flaps position. Using the accident airplane's battery, when electrical power was applied, the flap lever was moved to each position from FULL to UP, and back, twice. The flap actuator moved to each position and the circuit breaker did not trip. However, the flap surfaces were disconnected from the flap actuator since the wings had been removed to facilitate the recovery from the field to the hangar.

The emergency power lever (EPL) was found secured with a shiny, clean frangible wire. A dull colored, mud-splattered piece of frangible wire of the same shape was found on the floorboard of the cockpit. The pilot reported that he had never operated the EPL on the airplane. The pilot and the airplane's mechanic reported that they had never found the frangible safety wire broken on or removed from the EPL.

The altimeters and the #2 airspeed indicator were missing from the wreckage during the inspection on June 18. The FAA inspector reported that he observed them in the airplane on the day of the accident. The missing instruments were not recovered during the course of the investigation.

The inspection of the engine revealed that the propeller and turbine section could not be rotated. The propeller was feathered and each blade was slightly bent in the direction of rotation. The engine was sent to the engine manufacturer for teardown.

The engine examination was performed on August 5, 2008, in Bridgeport, West Virginia, at the Pratt and Whitney Engine Services facility. The inspection revealed that the compressor turbine (CT) guide vane ring (part number 3029051, serial number 2D008) displayed impact damage and erosion of material from the outer ends of the vane airfoils. The CT shroud had a deep impact mark at the 2 o'clock position, and additional dents and rubs were evident around the circumference of the shroud. The CT (disk part number 3013411, serial number 40B690) had rubbed with both the CT and power turbine (PT) vanes. The CT blades were all fractured at varying heights, from just above the blade root to approximately mid-span of the airfoil.

The CT disk with blades, the CT shroud, turbine vane, and combustor exit duct were sent to the National Transportation Safety Board's (NTSB) Materials Laboratory for inspection. The inspection revealed that the CT disk was intact and showed circumferential rub marks. The trailing side of the CT disk had a blue tint at the inner side of the web, and the remainder of the disk was light brown in color. An orange/tan colored deposit was observed in the inner bore of the disk, and similarly colored deposits were observed in the vicinity of the blade platforms and root serrations. Except for the one missing blade (removed to identify the blade part number), all of the remaining blades on the CT disk were fractured in the airfoils at locations ranging from just above the platform to approximately 85% of the airfoil span. Multiple parallel cracks were observed on the convex sides of the blades. The trailing edges were mostly damaged with material missing from most of the span on each airfoil. Fracture surfaces on the blades were generally rough and uniform in color. Several of the blades with longer portions of the airfoil remaining showed wrinkling and bulging of the surface coating and thinning of the blade adjacent to the fracture near the trailing edge, features consistent with creep. Many blades with longer remaining airfoils showed some metal flow and balls of re-solidified metal at the fracture surfaces. The inspection of individual CT blades revealed areas of wrinkling and cross-

sectional thinning adjacent to the fracture surface, which is consistent with necking at high temperatures.

The engine manufacturer, Pratt & Whitney Canada (P&WC), issued Service Information Letters (SIL's) that pertained to the issues of PT6A CT blade fractures and recommended maintenance practices. The SIL's were:

1. SIL No. PT6A-053R3: "Emergency Power Lever (EPL) Fuel Control Manual Override System" issued Feb 24/1998, Rev 3. Nov 10/2004
2. SIL No. PT6A-116R2: "Borescope Inspection in Conjunction with Fuel Nozzle Check" issued Jan 24/2003, Rev 2. Apr 1/2008.
3. SIL No. PT6A-125: "PT6A Compressor Turbine (CT) Blade Fractures" issued Jan 21/2004.
4. SIL No. PT6A-146: "PT6A-114 AND 114A Compressor Turbine Blade Maintenance" issued Oct 25/2006.

SIL No. PT6A-125 describes the conditions that lead to and may accelerate blade creep. It states, "During engine operation, CT blades are exposed to both high temperatures from hot gases and stresses due to centrifugal forces from engine speed. The cumulative time effect of this heat and stress cause the CT blade material to creep that is detectable by airfoil elongation also referred to as stretch." It further stated, "It is essential to use the correct power setting procedures to assure the integrity of the engine. Engines operated regularly beyond the recommended power settings in the P.O.H. [Pilot Operating Handbook], but still below the defined temperature redline settings and engine maintenance manual over-temperature chart limits, may experience accelerated CT Blade creep. This effect is cumulative and could likely lead to reduced CT Blade life or CT Blade fracture and total loss of engine power occurring prior to the blade inspection interval stated in the maintenance manual or overhaul manual."

SIL No. PT6A-146 stated, "Adherence to recommended maintenance practices is essential in the early detection and control of hot section oxidation and sulphidation that may lead to blade distress. The erosion of CT vane airfoil material can result in fatigue-related fractures of CT blades, while sulphidation can weaken blade structure and lead to overload fractures of the airfoil." It further states, "The Engine Maintenance Manual (EMM) recommends periodic refurbishment of fuel nozzles and concurrent borescope inspections of hot section components including CT vane and blade airfoils. While proper fuel nozzle maintenance serves to protect hot section components from thermal distress, borescope inspection is a fundamental tool in detecting airfoil oxidation and sulphidation. In certain cases, borescope inspection is also effective in identifying CT blade trailing edge cracks (reference SIL PT6A-116).

SIL No. PT6A-116R2 states, "Despite P&WC's efforts to emphasize the importance of Borescope inspections, it has become evident during the investigation of recent Compressor Turbine (CT) Blade fracture events (which occurred in 2007) that not all operators are performing the recommended borescope inspection at the same time as their scheduled fuel nozzle maintenance." It states further, "P&WC wishes to remind operators that borescope inspection is required per the EMM in conjunction with the fuel nozzle inspections as defined in the periodic inspection Table 601 (Reference the EMM Section 72-00-00).

NOTE 1 of the Table 601, Periodic Inspection, of the EMM Section 72-00-00 states, "Do the periodic borescope inspection of the hot section components in conjunction with the following tests (Ref.2.B.)," i.e., fuel nozzle maintenance.

SIL's remain advisory in nature and maintenance procedures are considered to be "recommended" and not mandatory requirements for aircraft owners and operators who are regulated under the 14 CFR Part 91 regulations. Likewise, the manufacturer's maintenance manual procedures are recommended procedures under Part 91 regulations, whereas under Part 135 or Part 121 regulations, the maintenance procedures in the maintenance manuals are considered as mandatory requirements.

Skydive Greensburg operated the accident airplane for skydiving operations under 14 CFR Part 91. The airplane's owner, Pacific Aero, a.k.a Kapowsin Air Sport Ltd. located in Shelton, Washington, maintained the airplane's maintenance records. The mechanic who maintained the airplane for Skydive Greensburg, in Greensburg, Indiana, performed the maintenance as Kapowsin Air Sport directed him. The mechanic reported that he had not received any directive to conduct a borescope inspection of the engine's hot section during fuel nozzle maintenance. The owner of the airplane from Kapowsin Air Sport reported that he was not aware of any requirement to perform borescope inspections when fuel nozzle maintenance was performed. The owner reported that he was not aware of the Pratt & Whitney SIL's that concerned borescope inspections.

History of Flight

Enroute-climb to cruise	Loss of engine power (total) (Defining event)
Landing	Off-field or emergency landing
Landing-flare/touchdown	Landing area overshoot

Pilot Information

Certificate:	Flight Instructor; Commercial	Age:	25, 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:	No
Medical Certification:	Class 1 None	Last Medical Exam:	03/01/2008
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	03/01/2007
Flight Time:	1089 hours (Total, all aircraft), 85 hours (Total, this make and model), 918 hours (Pilot In Command, all aircraft), 130 hours (Last 90 days, all aircraft), 59 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	CESSNA	Registration:	N102VE
Model/Series:	208B	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	208B0618
Landing Gear Type:	Tricycle	Seats:	2
Date/Type of Last Inspection:	02/07/2008, Annual	Certified Max Gross Wt.:	8750 lbs
Time Since Last Inspection:	47 Hours	Engines:	1 Turbo Prop
Airframe Total Time:	7221 Hours	Engine Manufacturer:	Pratt & Whitney Canada
ELT:	Installed, not activated	Engine Model/Series:	PT6A-114
Registered Owner:	Pacific Aero LLC	Rated Power:	675 hp
Operator:	Skydive Greensburg	Air Carrier Operating Certificate:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	BAK, 656 ft msl	Observation Time:	1000 EDT
Distance from Accident Site:	24 Nautical Miles	Direction from Accident Site:	240°
Lowest Cloud Condition:	Clear	Temperature/Dew Point:	23° C / 15° C
Lowest Ceiling:		Visibility	10 Miles
Wind Speed/Gusts, Direction:	6 knots, 280°	Visibility (RVR):	
Altimeter Setting:	29.96 inches Hg	Visibility (RVV):	
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Greensburg, IN (I34)	Type of Flight Plan Filed:	None
Destination:		Type of Clearance:	None
Departure Time:	1015 EDT	Type of Airspace:	

Airport Information

Airport:	Greenburg Decatur County (I34)	Runway Surface Type:	Asphalt
Airport Elevation:	912 ft	Runway Surface Condition:	Dry
Runway Used:	18	IFR Approach:	None
Runway Length/Width:	3433 ft / 40 ft	VFR Approach/Landing:	Forced Landing

Wreckage and Impact Information

Crew Injuries:	1 None	Aircraft Damage:	Substantial
Passenger Injuries:	N/A	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 None	Latitude, Longitude:	39.326667, -85.522500

Administrative Information

Investigator In Charge (IIC):	James P Silliman	Adopted Date:	05/12/2009
Additional Participating Persons:	Tom Himmelman; FAA-Indianapolis FSDO; Indianapolis, IN Michael Koonce; Cessna Aircraft Company; Wichita, KS Jeff Davis; Pratt & Whitney Canada; Bridgeport, WV		
Publish Date:	05/12/2009		
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 pubinquiry@ntsb.gov , or at 800-877-6799. Dockets released after this date are available at http://dms.nts.gov/pubdms/ .		

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