National Transportation Safety Board
Aviation Accident Final Report

Location:	Sheffield, MA	**Accident Number:**	ERA09LA523
Date & Time:	09/15/2009, 1435 EDT	**Registration:**	N336DN
Aircraft:	CESSNA 208	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of engine power (total)	**Injuries:**	6 None
Flight Conducted Under:	Part 135: Air Taxi & Commuter - Non-scheduled		

Analysis

The pilot and the five passengers, who were employees of an industrial services company, were returning from a job site with hazardous materials used for blasting operations. The airplane was in a climb, at an altitude of 8,500 feet, when it experienced a catastrophic engine failure. The pilot declared an emergency and subsequently performed a forced landing to a field. During the landing, the airplane's right wing struck a tree and separated. All occupants exited the airplane without injury; however, the airplane became fully engulfed in fire, which consumed the majority of the airplane. The airplane was equipped with a turbine engine that, at the time of the accident, had been operated for about 7,620 hours since new and 65 hours since it was overhauled about 19 months prior to the accident. Impact damage was observed to the interior of the engine exhaust duct. In addition, the exhaust duct contained portions of a fractured power turbine blade. Additional examination of the engine revealed damage consistent with a distressed 1st stage sun gear, and associated compressor turbine and power turbine damage. Examination of the sun gear teeth output splines revealed that they were too damaged to determine the cause of their deterioration. It was noted that the sun gear found on the accident engine was previously removed from another engine due to "spalled gear teeth" about 7 years prior to the accident. The condition of the sun gear when installed on the accident engine could not be determined.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A total loss of engine power due to a failure of the 1st stage sun gear output splines for unknown reasons, which resulted in a power turbine overspeed condition, with subsequent blade distress/release.

Findings

Aircraft	Reduction gear and shaft - Failure (Cause)
Not determined	Not determined - Unknown/Not determined (Cause)

Factual Information

HISTORY OF FLIGHT

On September 15, 2009, about 1435 eastern daylight time, a Cessna 208, N336DN, operated by North American Flight Services Inc., experienced a loss of engine power while climbing, and performed a forced landing in Sheffield, Massachusetts. The airplane was destroyed by a postcrash fire and the certificated commercial pilot and five passengers were not injured. Visual meteorological conditions prevailed and an instrument flight rules flight plan was filed for the flight that departed Republic Airport (FRG), Farmingdale, New York, destined for the Saratoga County Airport (5B2), Saratoga Springs, New York. The on-demand air taxi flight was conducted under the provisions of 14 Code of Federal Regulations Part 135.

The airplane was based at 5B2. The pilot and the five passengers were employees of an industrial services company. At the time of the accident, the occupants were returning from a job site, and the airplane was transporting electric detonators, ammonium nitrate and nitromethane used for blasting operations.

The pilot reported that the airplane departed FRG at 1405, and he initiated a climb to 9,000 feet without any abnormalities. As the airplane was climbing, at an altitude of about 8,500 feet, the pilot heard two "whooshing" sounds, about 5 seconds apart. The engine then began to experience torque fluctuations. Shortly thereafter, the engine torque dropped to idle, and the pilot heard a "loud bang" and felt a "burst vibration."

The pilot declared an emergency to air traffic control and was told that the closest airport was located about 10 miles north, in Great Barrington, Massachusetts. The pilot informed air traffic control that the airplane would not be able to reach Great Barrington, and he subsequently performed a forced landing to a field.

During the landing, the airplane's right wing struck a tree and separated. All occupants exited the airplane without injury; however, the airplane became fully engulfed in fire, which consumed the majority of the airplane.

PERSONNEL INFORMATION

The pilot, age 30, held a commercial pilot certificate, with ratings for airplane single-engine land, airplane multiengine land, and instrument airplane. He also held a flight instructor certificate, with ratings for airplane single-engine, airplane multiengine, and instrument airplane.

The pilot reported 3,100 hours of total flight experience, which included about 25 hours in the same make and model as the accident airplane, all accumulated within the 90 days prior to the accident. His most recent Federal Aviation Administration (FAA) second-class medical certificate was issued on March 26, 2009.

AIRCRAFT INFORMATION

The eight-seat, all-metal, high-wing, fixed-gear airplane, serial number 20800001, was manufactured in 1984. It was powered by a Pratt & Whitney Canada PT6A-114A, 675-horsepower engine, equipped with a McCauley three-bladed propeller assembly.

The airplane was purchased by the owner, without an engine, from an operator located in

Switzerland, on June 19, 2008. It was maintained under a continuous airworthiness maintenance program. At the time of the accident, the airplane had been operated for 10,182 hours.

The engine, serial number 17310, was purchased by the operator through Northstar Aerospace, Stroud, Oklahoma, during March 2008. According to an engine logbook entry, it was overhauled by Northstar Aerospace on October 21, 2008. The overhaul was also documented on an FAA airworthiness approval tag, dated February 22, 2007. No previous logbooks or engine history was provided to the current owner. A maintenance record dated September 3, 2002, revealed that the sun gear found on the accident engine was previously removed from another engine due to "spalled gear teeth planetary gear." Mint Turbines LLC purchased the Northstar Aerospace Turbine Engine Service Group business on May 27, 2009.

The engine was installed on the accident airplane on May 1, 2009. At the time of the accident, the engine had been operated for about 7,620 hours since new, and 65 hours since overhaul.

METEOROLOGICAL INFORMATION

The reported weather at airport located about 20 miles, north-northeast of the accident site, was: wind from 330 degrees at 7 knots; visibility 10 statute miles; few clouds at 4,700 feet, broken clouds at 6,000 feet; temperature 22 degrees Celsius (C); dew point 11 degrees C; altimeter 29.94 inches of mercury.

COMMUNICATIONS

According to air traffic control summaries and communication transcripts obtained from the FAA, the airplane was cleared for takeoff from runway 32, at FRG, at 1403. The airplane was subsequently cleared to climb to an altitude of 9,000 feet, at 1429. At 1434, the pilot reported to air traffic control that he needed to make an emergency landing due to an engine failure.

FLIGHT RECORDERS

The airplane was not equipped; nor was it required to be equipped with a cockpit voice recorder (CVR), or flight data recorder (FDR).

WRECKAGE INFORMATION

The wreckage was examined by representatives from the airframe manufacturer, engine manufacturer, operator, and an FAA inspector at a storage facility located in Biddeford, Maine, on September 21, 2009.

The fuselage aft of the engine firewall, with exception of charred portions of the floor, was consumed by the postcrash fire. The inboard portions of both wings were impact damaged, and partially consumed by fire. The right wing leading edge displayed an impact signature consistent with a tree strike.

The disposition of the wreckage precluded a check of flight control continuity; however, the pilot did not report any problems with the primary flight controls during the accident. Burnt and impact damaged portions of the flap control system appeared to be consistent with a flaps retracted position.

Examination of the engine revealed impact damage to the interior of the exhaust duct. In addition, the exhaust duct contained portions of a fractured power turbine blade. The engine

was retained for further examination.

MEDICAL AND PATHOLOGICAL INFORMATION

Toxicological testing performed on the pilot by an independent laboratory, was negative for drugs and alcohol.

TESTS AND RESEARCH

The engine was examined at Pratt & Whitney Canada, Bridgeport, West Virginia, on December 2, 2010, under the supervision of an NTSB investigator. The examination revealed that the compressor blades tips were all burnt and melted to a uniform height. The downstream face of the disk was blackened with soot, and the upstream face exhibited light bluish discoloration. The majority of the power turbine blades had released at their rivet slots. Several of the blades were fractured above and below the platform and one blade was fractured at midspan of the airfoil. Examination of the 1st stage sun gear revealed that the gear teeth that mated with the 1st stage carrier planet gears were obliterated and the shaft was discolored. All of the gear teeth on the 1st stage planet gears were damaged. The "Y" and "Z" gears rotated freely, and the "X" gear was seized.

The compressor turbine disk assembly, power turbine disk assembly, and the 1st stage sun gear were further examined at Pratt & Whitney Canada's Material's laboratory, under the supervision of a Transportation Safety Board of Canada metallurgist.

The examinations revealed that the compressor turbine blade distress was consistent with the blade temperature reaching the material fusion point of the blade material. The fracture surfaces of power turbine blades were essentially featureless as a result of partially melted material due to elevated temperature. Fractographic features suggested the airfoils released due to tensile overload. Examination of the sun gear teeth output splines revealed that they were too damaged to determine the cause of their deterioration.

ADDITIONAL INFORMATION

Hazardous Material

According to first responders, one of the passengers was an explosives specialist who reported that the airplane contained a binary explosive, which consisted of individual containers of ammonium nitrate and nitromethane. In addition, explosive electric detonators were stored in a metal box, strapped to the floor of the airplane, behind the last seat.

The containers of ammonium nitrate and nitromethane were completely consumed in the postcrash fire. The metal box containing the electric detonators was found in the center of the wreckage, in-tact, with its padlock burned off. Some of the detonators were charred due to heat, and were therefore determined to be unstable. Once cooled, the Sheffield Police Department Explosives Unit removed the electric detonators to a makeshift bunker that was constructed of sand, where they were destroyed using a small amount of initiating explosive.

The pilot contacted the operator, who faxed material safety data sheets (MSDS) to the Sheffield Police Department station. All shipment documentation was destroyed in the fire. Neither copy of the hazardous material shipping paper nor the Notification of Pilot-in-Command (NOTOC) was available to first responders.

The incident commander reported that hazardous materials communications were facilitated by the immediate availability of company representatives at the accident site. Additionally, a

company explosives control officer arrived at the accident site by about 1545, and provided technical advice to the unified command.

According to the chief pilot of North American Flight Services (NAFS), an NOTOC and dangerous goods declaration was completed prior all flights departing from 5B2, and when the airplane returns to 5B2, the paperwork is removed and filed. The chief pilot explained that since NAFS operated under 14 CFR Part 135, rather than 14 CFR Part 121, he believed that an exemption applied to NAFS concerning the retention and distribution of hazardous materials shipping papers and NOTOCs. In addition, since NAFS did not have a station a FRG, he was concerned about leaving hazardous materials security sensitive paperwork with unaffiliated third parties.

Title 49 CFR Part 175.33 indicated the required items to be contained in a hazardous materials shipping paper, commonly referred to as a declaration of dangerous good. A NOTOC may be combined with the hazardous materials shipping paper into a single document. Hazardous materials regulation 49 CFR 175.33(c) required that the aircraft operator must retain a copy of the shipping paper at or through its principle place of business and must make the shipping paper available upon request, to an authorized official of a federal, state or local government agency at reasonable times and locations. The regulation also required that the hazardous material information be readily accessible at the airport of departure and intended airport of arrival for the duration of the flight leg.

Title 49 CFR Part 175 did not contain any exemptions to compliance with hazardous materials shipping paper and notification of pilot-in-command requirements.

History of Flight

Enroute-climb to cruise	Loss of engine power (total) (Defining event)
Emergency descent	Off-field or emergency landing
Landing-landing roll	Collision with terr/obj (non-CFIT)
Post-impact	Fire/smoke (post-impact)

Pilot Information

Certificate:	Commercial	**Age:**	30, 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 2 With Waivers/Limitations	**Last FAA Medical Exam:**	03/26/2009
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	09/02/2009
Flight Time:	3100 hours (Total, all aircraft), 25 hours (Total, this make and model), 2900 hours (Pilot In Command, all aircraft), 50 hours (Last 90 days, all aircraft), 30 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	CESSNA	**Registration:**	N336DN
Model/Series:	208	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	20800001
Landing Gear Type:	Tricycle	**Seats:**	8
Date/Type of Last Inspection:	05/01/2009, Continuous Airworthiness	**Certified Max Gross Wt.:**	8000 lbs
Time Since Last Inspection:	65 Hours	**Engines:**	1 Turbo Prop
Airframe Total Time:	10182 Hours at time of accident	**Engine Manufacturer:**	Pratt and Whitney Canada
ELT:	C126 installed	**Engine Model/Series:**	PT6-114A
Registered Owner:	NORTH AMERICAN FLIGHT SERVICES INC	**Rated Power:**	675 lbs
Operator:	NORTH AMERICAN FLIGHT SERVICES INC	**Operating Certificate(s) Held:**	On-demand Air Taxi (135)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	PSF, 1194 ft msl	**Distance from Accident Site:**	20 Nautical Miles
Observation Time:	1454 EDT	**Direction from Accident Site:**	10°
Lowest Cloud Condition:	Few / 4700 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	Broken / 6000 ft agl	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	330°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.94 inches Hg	**Temperature/Dew Point:**	22°C / 11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Farmingdale, NY (FRG)	**Type of Flight Plan Filed:**	IFR
Destination:	Saratoga Spgs, NY (5B2)	**Type of Clearance:**	IFR
Departure Time:	1405 EDT	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Destroyed
Passenger Injuries:	5 None	**Aircraft Fire:**	On-Ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	6 None	**Latitude, Longitude:**	42.118889, -73.694722 (est)

Administrative Information

Investigator In Charge (IIC):	Luke Schiada	**Report Date:**	01/07/2011
Additional Participating Persons:	Steve Levine; FAA/FSDO; Windsor Locks, CT Seth D Buttner; Cessna Aircraft Company; Wichita, KS Timothy Flatley; North American Flight Services; Ballston Spa, NY John R Britten; Transportation Safety Board of Canada; Gatineau, Quebec, CN, Jeff Davis; Pratt & Whitney Canada; Bridgeport, WV Val Guertsman; Transportation Safety Board of Canada; Ottawa, Ontario, CN,		
Publish Date:	01/07/2011		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=74743		