Aviation Investigation Final Report

Location:	Roosevelt Roads, Puerto Rico	**Incident Number:**	SEA05FA074
Date & Time:	April 12, 2005, 10:50 Local	**Registration:**	N1241X
Aircraft:	Cessna 208B	**Aircraft Damage:**	None
Defining Event:		**Injuries:**	4 None
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled		

Analysis

The airplane experienced a total loss of engine power during a domestic passenger cross-country flight. Following the loss of power, the pilot successfully landed the airplane at a nearby Naval Air Station. The pilot reported that during cruise flight, he heard a loud bang and oil became visible on the aircraft's windshield. He stated that concurrent with the loud bang, the propeller came to an abrupt stop. Postaccident examination of the engine revealed extensive corrosion and mechanical damage throughout the compressor and power turbine assemblies. The compressor disk assembly was essentially intact, however, all of the compressor turbine blades were fractured and displaced. The fracture surfaces were all approximately .250 inches above the corresponding blade platform. Examination of the fractured compressor turbine blades revealed the blades fractured in a tensile overload condition. The overload fractures associated with the compressor turbine blades was due to a weakening of the underlying base material due to the presence of sulphidation corrosion. The sulphidation corrosion was evident through approximately half of the thickness of the blades airfoil reducing the blades effective load bearing capabilities. The material composition of the turbine blades met drawing requirements and no metallurgical anomalies were found.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: The fracture of multiple compressor turbine blades while the airplane was in a cruise flight configuration resulting in a loss of engine power. Sulphidation type corrosion was a factor in failure of the blades.

Findings

Occurrence #1: LOSS OF ENGINE POWER
Phase of Operation: CRUISE

Findings
1. (C) COMPRESSOR ASSEMBLY,BLADE - FRACTURED
2. (F) COMPRESSOR ASSEMBLY,BLADE - OVERLOAD
3. (F) COMPRESSOR ASSEMBLY,BLADE - CORRODED

Occurrence #2: FORCED LANDING
Phase of Operation: DESCENT - EMERGENCY

Factual Information

HISTORY OF FLIGHT

On April 12, 2005, about 1050 Atlantic standard time, a Cessna 208B - Grand Caravan airplane, N1241X, experienced a total loss of engine power during a cross-country flight. Following the loss of power, the pilot successfully landed the airplane, without further incident or damage to the airplane, at Roosevelt Roads Naval Station, Roosevelt Roads, Puerto Rico. The airplane is registered to First Bank of Hazelwood, Missouri, and was being operated by MN Aviation, San Juan, Puerto Rico, as a Title 14, CFR Part 135, scheduled domestic passenger flight. The airline transport pilot (ATP) and three passengers aboard the airplane were not injured. Visual meteorological conditions prevailed and a visual flight rules (VFR) flight plan was activated. The flight originated from Vieques, Puerto Rico, approximately 10 minutes prior to the power failure and subsequent forced landing. The pilot's planned destination was San Juan, Puerto Rico.

The pilot reported in a written statement "...at a cruising altitude of 2000' and 150 kts IAS [knots indicated airspeed], all engine instruments were reading normal parameters for a cruise power of 1650 torque. At this time I experienced a load bang with the characteristic power loss, deceleration and noise associated with a flameout." The pilot reported that concurrent with the loud bang, oil became visible on the aircraft's windshield and the propeller came to an abrupt stop.

AIRCRAFT INFORMATION

The airplane, a 1998 Cessna 208B Grand Caravan, was equipped with a Pratt & Whitney Canada PT6A-114A gas turbine engine rated at 675 shaft horsepower. Maintenance records showed the engine was originally manufactured and equipped with compressor turbine blades (part number 3045741-01) incorporating the CPW 550 coating, which, according to the manufacturer, provides increased resistance to sulphidation. The engine maintenance records showed that in August 2002, during a hot section inspection (HSI), the engine was reconfigured utilizing CPW 333 coated compressor turbine blades (part number 3102401-01), which, according to the manufacturer, does not have sufficient resistance to sulphidation under adverse environmental operating conditions. The engine received three additional hot section inspections subsequent to the August 2002, HSI. All three included the use of CPW 333 coated blades.

TESTS AND RESEARCH

The engine was removed from the airframe and shipped to Pratt & Whitney Canada (P&WC), St. Hubert, Quebec, Canada for examination and teardown. Representatives from the National

Transportation Safety Board, Pratt & Whitney Canada, MN Aviation and Cessna Aircraft Company were in attendance for the teardown, which took place on June 1-2, 2005.

Disassembly and examination of the engine revealed extensive corrosion and mechanical damage throughout the compressor and power turbine assemblies. The compressor disc assembly was essentially intact, however, all of the compressor turbine blades (58 total) were fractured and displaced. The fracture surfaces were all approximately .250 inches above the corresponding blade platform. Corrosion was present throughout the first, second and third stage compressor disks, associated blades and compressor stators. The corrosion deposits were white and rust colored. The power turbine (PT) assembly was also essentially intact, however, multiple PT blades were fractured and displaced. Mechanical type damage was noted to both the compressor and power turbine guide vane assemblies.

Examination of the fractured compressor turbine blades by P&WC's Material Laboratory revealed the blades fractured in a tensile overload condition. Following the engine examination and subsequent laboratory testing, Pratt & Whitney Canada issued a report outlining the findings pertaining to the fractured compressor turbine blades. The report (dated July 29, 2005) states the overload fractures on the compressor turbine blades was due to a weakening of the underlying base material due to the presence of sulphidation corrosion. The sulphidation corrosion was evident through approximately half of the thickness of the blade airfoils "...thus reducing the blades effective load bearing capabilities." The report stated the material composition of the turbine blades met drawing requirements and no metallurgical anomalies were found.

ADDITIONAL INFORMATION

In a Service Information Letter (SIL) issued (March 1998) by Pratt & Whitney Canada, sulphidation is defined as a type of "hot corrosion" which develops in the gas path of turbine engines operated in salt rich environments. The SIL states "Sulphate salts will form in the gas path if sodium and sulphur are both present. Most aviation turbine fuels contain sulphur in sufficient amounts for sulphidation to occur if a source of sodium is present. The most common source is sea water..." The presence of the "salts" on component surfaces attacks the protective coating and progresses to the underlying base material.

Both Pratt & Whitney Canada and Cessna Aircraft Company outline preventive measures for combating sulphidation in gas turbine engines. The afore mentioned P&WC Service Information Letter summarizes procedures to minimize sulphidation by means of a turbine engine wash program. Cessna also outlines a similar procedure in the Caravan Information Manual.

According to the operator, a postflight engine wash was accomplished daily in accordance with Cessna guidelines.

Pilot Information

Certificate:	Commercial	**Age:**	59,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	September 1, 2004
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	December 1, 2004
Flight Time:	7745 hours (Total, all aircraft), 2450 hours (Total, this make and model), 7095 hours (Pilot In Command, all aircraft), 165 hours (Last 90 days, all aircraft), 26 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N1241X
Model/Series:	208B	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	208B-657
Landing Gear Type:	Tricycle	**Seats:**	8
Date/Type of Last Inspection:	April 1, 2005 Continuous airworthiness	**Certified Max Gross Wt.:**	8750 lbs
Time Since Last Inspection:	16 Hrs	**Engines:**	1 Turbo prop
Airframe Total Time:	3777 Hrs at time of accident	**Engine Manufacturer:**	Pratt & Whitney Canada
ELT:	Installed, not activated	**Engine Model/Series:**	PT6A-114A
Registered Owner:	First Bank Leasing	**Rated Power:**	675 Horsepower
Operator:	MN Aviation	**Operating Certificate(s) Held:**	On-demand air taxi (135)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:	Scattered / 3500 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	180°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.88 inches Hg	**Temperature/Dew Point:**	31°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Vieques, PR (VQS)	**Type of Flight Plan Filed:**	VFR
Destination:	San Juan, PR (TJSJ)	**Type of Clearance:**	VFR
Departure Time:	10:41 Local	**Type of Airspace:**	

Airport Information

Airport:	Roosevelt Roads Airport TJNR	**Runway Surface Type:**	Asphalt
Airport Elevation:	39 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	25	**IFR Approach:**	Visual
Runway Length/Width:	11000 ft	**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	None
Passenger Injuries:	3 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 None	**Latitude, Longitude:**	18.245,-65.643333

Administrative Information

Investigator In Charge (IIC):	Hogenson, Dennis
Additional Participating Persons:	Ariel Alvarez; San Juan FSDO; San Juan , PR Robert August; Cessna Aircraft Company; Wichita, KS Elaine M Summers; TSB - Canada ; Dorval Marc Gratton; Pratt & Whitney ; Longueuil Jose Maldanado; MN Aviation; San Juan , PR Clint Crookshanks; NTSB - AS-40; Denver , CO
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