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Report

Accident on **5 September 2010**
at **Anse-Bertrand (971)**
to the **Cessna 208B** registered **F-OIXZ**
operated by **Tropic Airlines**

BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile
Ministère de l'Ecologie, du Développement durable et de l'Energie

Safety Investigations

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SPECIAL FOREWORD TO ENGLISH EDITION

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.

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Glossary

ADRS	Aircraft Data Recording Systems
EASA	European Aviation Safety Agency
AIR	Airborne Image Recorder
AMM	Aircraft Maintenance Manual
BIFSD	Basic In Flight Shutdown
CSN	Cycles Since New
CT	Compressor Turbine
DME	Distance Measuring Equipment
ECTM	Engine Condition Trend Monitoring
EMM	Engine Maintenance Manual
FDR	Flight Data Recorder
HSI	Hot Section Inspection
IFR	Instrument Flight Rules
ITT	Inter Turbine Temperature
METAR	Aerodrome routine meteorological report
MTBF	Mean Time Between Failure
NDT	Non Destructive Test
ICAO	International Civil Aviation Organisation
OVH	Overhaul
OSAC	French civil aviation safety organisation (Organisme de the Sécurité de l'Aviation Civile)
SB	Service Bulletin
SIL	Service Information Letter
SEP	Single Engine Piston
SET	Single Engine Turbine
SNL	Service News Letters
TBO	Time Between Overhaul
TSN	Time Since New
TSO	Time Since Overhaul
VFR	Visual Flight Rules

Synopsis

Date
5 September 2010 at 19 h 26[1]

Place
Anse-Bertrand (971)

Type of flight
Public transport of passengers
Scheduled flight FWI 706
Pointe-à-Pitre – Saint-Barthélemy

Aircraft
Cessna 208B registered F-OIXZ

Owner
Natexis SA

Operator
Tropic Airlines

Persons on board
Pilot + 6 passengers

[1]All times in this report are UTC, except where otherwise specified. Four hours should be subtracted to obtain the legal time applicable in Guadeloupe on the day of the event.

SUMMARY

Flight FWI 706, departing from Pointe-à-Pitre aerodrome (971) and bound for Saint-Barthélemy aerodrome (971) was undertaken in the framework of a public transport passenger flight. Eleven minutes after takeoff, the pilot stated that the aeroplane was climbing towards 7,000 ft, about 13 NM from the coast when the engine shut down. He broadcast a mayday message and turned back. Near the coast, the pilot noticed that he would not be able to reach the aerodrome and made a forced landing in a field. The aeroplane struck the ground and slid about 35 m before coming to a stop. The pilot and three passengers were slightly injured. The aeroplane was badly damaged.

The accident was caused by creep on the compressor turbine blades that led to the in-flight engine shutdown. The causes of the creep could not be determined.

The BEA addressed three Safety Recommendations to EASA and to Transport Canada relating to:

- the replacement of compressor turbine blades;
- improvements in the inspection programme for blades of the previous generation while awaiting their replacement;
- the installation of parameter recorders.

1 - FACTUAL INFORMATION

1.1 History of flight

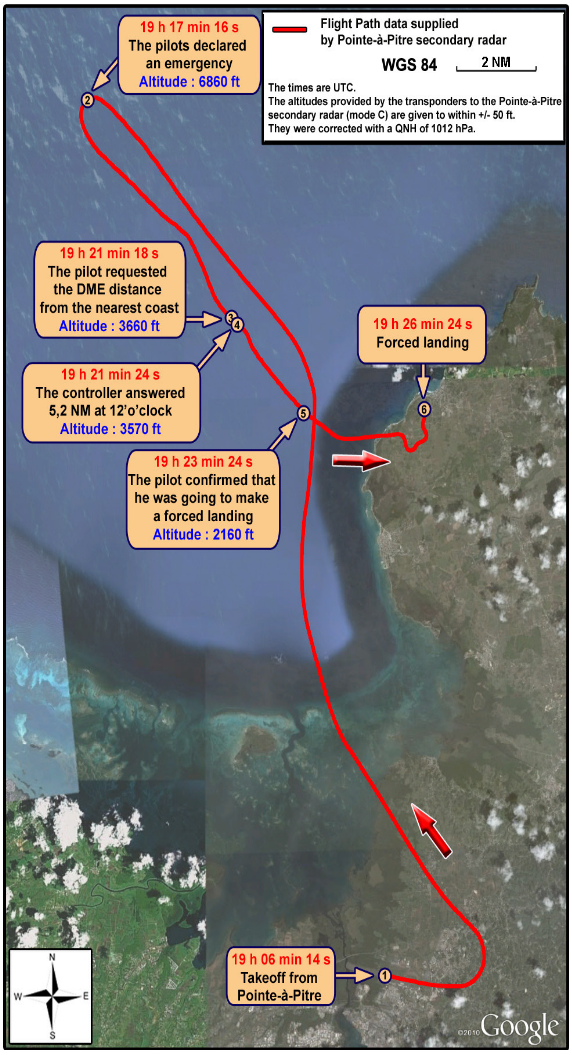
The aeroplane was operated by Tropic Airlines under a charter contract with the airline CAIRE. The accident flight was a scheduled passenger public transport flight between Pointe-à-Pitre and Saint-Barthélemy, with average flying time of 45 minutes under VFR at 8,500 ft. One pilot and six passengers were on board. This flight was the third of the day. The previous flight, performed at the end of the morning, had been normal.

At 19 h 06, the pilot took off from runway 11 and headed towards the north of the island.

At 19 h 17, at around 7,000 ft in climb, the pilot heard a noise like an explosion, noticed a sudden drop in engine power then a complete shutdown and the propeller feathering. About 13 NM from the nearest coast, he turned back in order to try to reach the departure aerodrome. During the turn, he applied the engine failure procedure but did not manage to restart it. He made a mayday call on the radio, informed the passengers of the situation and prepared them for a forced landing. The aeroplane glided for about eight minutes before reaching the coast.

At about 950 ft, the pilot chose a field of sugar cane for the landing.

At 19 h 26, the aeroplane struck the ground and slid for about 35 m before coming to a stop. The passengers and the pilot evacuated the aeroplane.



1.2 Injuries to persons

Injuries	Crew members	Passengers	Other persons
Fatalities	0	0	0
Serious	0	0	0
Light/None	1	6	0

The pilot and three passengers were slightly injured on impact with the ground.

1.3 Damage to aircraft

The airplane was badly damaged.

1.4 Other damage

Some crops were destroyed.

1.5 Personnel information

Captain

Male, aged 26

- ATPL (A), issued 2 February 2007.
- ATPL theory issued 11 July 2006.
- Single-engine IR issued 10 June 2010, valid until 31 May 2011.
- Cessna SET type rating issued 2 June 2009, valid until 31 May 2011.
- SEP land type rating issued 10 June 2010, valid until 31 May 2012.
- Last Class 1 medical certificate issued 18 December 2009, valid until 31 December 2011.
- Experience:
  - total: 1,764 flying hours including 1,110 as captain;
  - on type: 848 flying hours including 840 as captain;
  - in the last 6 months: 242 flying hours;
  - in the last 3 months: 86 flying hours;
  - in the last 30 days: 54 flying hours.

He had been employed by Tropic Airlines since July 2008.

1.6 Aircraft Information

1.6.1 General

The Cessna 208B is a ten-seat (pilot + nine passengers) short-haul single-engine turboprop aeroplane that carries passengers in VFR only or cargo. The aeroplane is equipped with a Pratt and Whitney Canada PT 6A-114A turboprop with a McCauley propeller.

1.6.2 Airframe

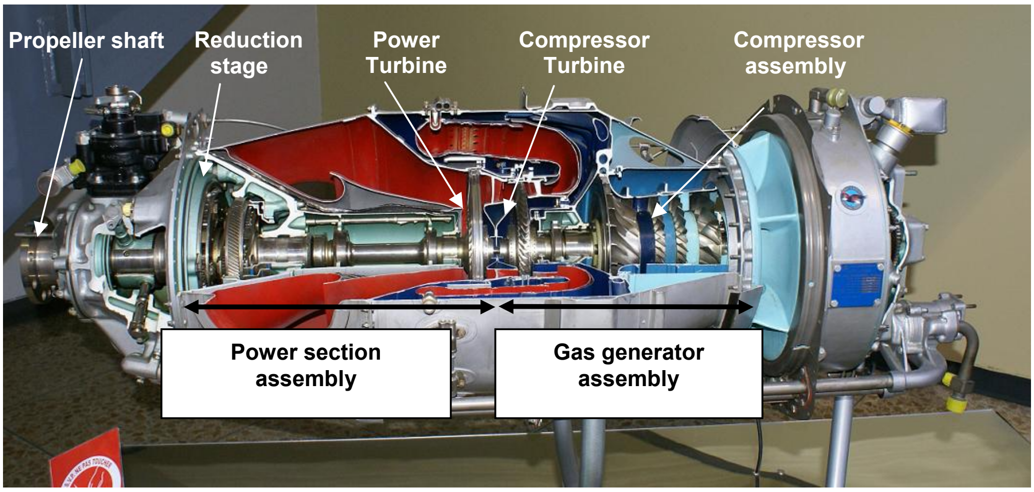
Manufacturer	Cessna Aircraft Company
Type	Cessna 208B
Serial number	208B0685
Registration	F-OIXZ
Entry into service	27 August 1998
Certificate of airworthiness Airworthiness review certificate	Issued 6 October 2006 Issued 17 August 2010 valid until 17 August 2011
Time since new (TSN) on 5 September 2010	6,891 hours
Cycles since new (CSN) on 5 September 2010	12,136 cycles
Last inspection	*"Phases 1 and 2"* and standard change of propeller 13 August 2010 at 6,824 h and 12,028 cycles
Next inspection to be carried out (100 hours)	*"Mini check"* at 6,915 h, expected within 24 hours of operation after the accident

1.6.3 Engine

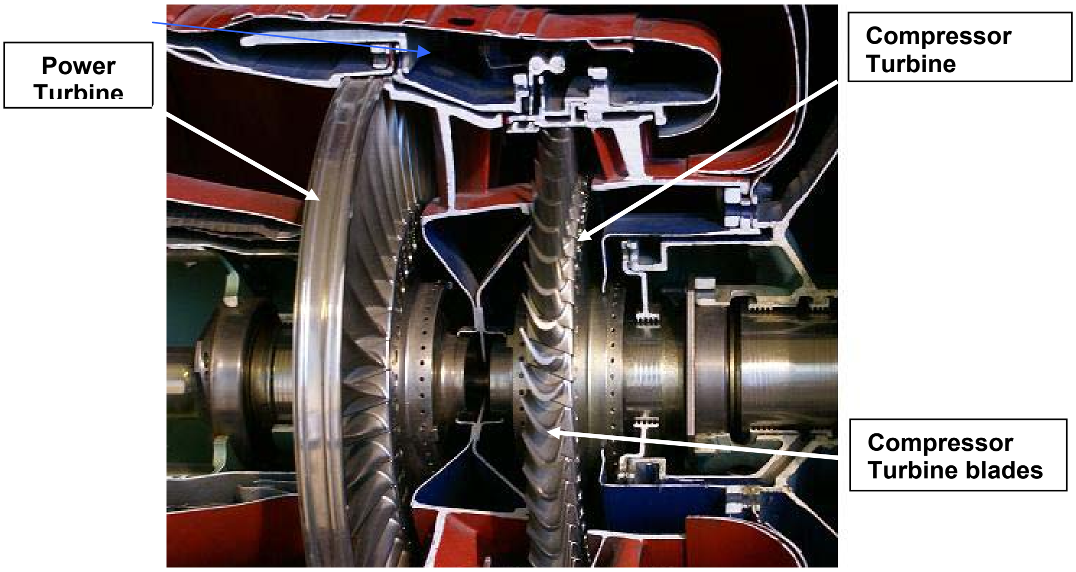
1.6.3.1 General

The Pratt & Whitney Canada PT6A-114A turboprop is a 675 hp engine with a free turbine and an annular combustion chamber. The engine is made up of two independent turbine sections, one driving the compressor in the gas generator section and the second driving the propeller shaft through a reducer assembly.

The compressor, composed of three axial stages and a centrifugal stage, is driven by a single stage compressor turbine (CT) running at about 38,100 rpm. The power turbine is linked to the propeller through a shaft running at about 33,000 rpm and driving a two-stage reducer whose outlet velocity varies from 1,700 to 1,900 rpm.



PT6A-114A Engine - General view



PT6-114A Engine – Compressor turbine stage

The main service bulletins (SB), relating to the hot section, and more specifically to the compressor turbine, include:

- SB N°1002 issued 02 December 1973 and revised on 19 December 2007: *"Rotor components – service life"*;
- SB N°1455R2 issued 12 April 1991 and revised as R2 on 06 January 1999 : *"Turboprop engine compressor turbine blade – replacement of"*;
- SB N°1521R3 issued 19 August 1997 revision 3 on 11 January 2000 : *"Turboprop engine compressor turbine disk balancing assembly and blades-replacement/ modification of"*;
- SB N°1669R6 issued 22 July 2008 revision 6 on 14 July 2009: *"Turboprop engine compressor turbine blade – replacement of"*;
- SB N°1703R6 issued 29 October 2001 revision 6 on 29 January 2010 *"Operating Time Between Overhauls and Hot Section Inspection Frequency"*.

A PT6A-114A engine can be equipped with four types of CT blades:

	Part number
Before 1991	3102401-01
After SB N°1455R2	3039901
After SB N°1521R3	3045741-01
After SB N°1669R6	3072791-01

For the first three types of blades, the evolutions involved improving the anticorrosion coating of the blade in order to limit the phenomenon of sulphidation. The latest blade type (P/N 3072791-01), introduced in 2008, offers better creep resistance.

1.6.3.2 F-OIXZ engine

The engine logbook was started on 20 June 2006.

Manufacturer	Pratt and Whitney Canada
Type	PT6A-114A
Serial number	PCE-PC0586
Part Number of the compressor turbine blades	3045741-01 (pre-SB N°1669R6)
Date of engine installation	3 January 2006 (*"newly overhauled"* TSN of 3,689 h and CSN of 4,060 cycles)
Time since new (TSN) on 5 September 2010	6,891 hours
Cycles since installation as of 5 September 2010	9,668 cycles
Time since overhaul (TSO) as of 5 September 2010	3,202 hours

1.6.4 Maintenance Manual

The Cessna Maintenance Manual, addressing maintenance operations to perform on the engine, repeats the operations defined by the engine manufacturer Pratt & Whitney Canada.

The main checks and/or inspections apart from the general overhaul, defined for engine maintenance, are mentioned in the Engine Maintenance Manual:

- Chapter 71 *"Power Plant – Adjustment/test"* and *"Power Plant- cleaning"*;
- Chapter 72 *"Engine- Inspection"*.

Chapter 72 *"Engine inspection"* requires reference to SB N°1703R6 *"Operating Time Between Overhauls and Hot Section Inspection Frequency"* which is the reference in relation to maintenance follow-up of the hot parts of the engine. It sets the frequency of the overhauls and inspections of the hot section. It also provides recommendations concerning any extension of the time between two overhauls (TBO).

In the case of the F-OIXZ engine, the maintenance operations were as follows:

Checks/Inspections	Recurrence frequency
Overhaul (OVH)	3,600 h (no calendar limit)
Hot section inspection (HSI)	1,800 h
Boroscope of hot section	400 h
Injector check	400 h
Ground performance check	100 h
Performance-restoring wash(2)	100 h
Compressor turbine desalination wash(3)	According to operating conditions, performed by the owner or the operator.

(2)This operation is aimed at limiting the effects of salt deposits and sulphidation.

(3)This operation involves washing off the accumulated deposits that cannot be eliminated by salt cleaning operations.

SB N°1703R6 also indicates the limit life of the compressor turbine:

- ❒ CT disk: 16,000 cycles;
- ❒ CT blades: no limit life.

In addition, this SB recommended the following actions for the pre-SB N°72-1669R6 engines (like the engine on F-OIXZ):

- ❒ during an HSI, performance of a metallurgical examination of 2 CT blades selected randomly from the CT disk and non-destructive testing of the other blades as described in the EMM:
  - if the metallurgical examination of 2 CT blades is not acceptable, it is required that all of the CT blades be replaced by post-SB N°1669R6 (new generation) blades;
  - if the metallurgical examination of 2 CT blades is acceptable but examinations of the other blades is not, a maximum number of 10 CT blades can be replaced by post-SB N°1669R6 blades if they are rejected for reasons other than excessive temperature or creep. If more than 10 blades are rejected, the complete set of 58 blades must be replaced by post-SB N°1669R6 blades.

1.6.5 F-OIXZ engine maintenance

The maintenance was undertaken by Atmosh'Air Aviation, a PART 145 approved workshop (certificate N°FR.145.570) following the maintenance programme approved by OSAC. This maintenance programme was in accordance with the recommendations of Pratt & Whitney Canada.

A review of the maintenance documents did not bring to light any mention of engine anomalies or of excessive in-service operating temperatures.

History of main operations on the engine

Maintenance operations	Date / Potential	Main operations performed
OVH	03 January 2006 . TSN : 3,688 h . CSN : 4,060	Installation of engine The 58 CT blades installed had P/N 3045741-01.
HSI non-destructive tests and stretch measurement	13 August 2008 TSN : 5,480 h CSN : 6,841 TSO : 1,791 h	Operations performed following SB N°1703R6 . Metallurgical examination of two CT blades showed that they : - had not been subjected to a critical temperature or to overspeed, - showed no change of state characteristic of creep. . The non-destructive testing of the 56 remaining blades revealed no cracks. . The stretch measurement on these 56 blades revealed no creep.

In addition to the main maintenance operations, the following operations were performed:

❒ Boroscope inspection

The engine logbook and the work file mention carrying out boroscope inspections about every 400 hours. These were carried out by a sub-contractor since the personnel of the d'Atmosph'air Aviation maintenance unit were not qualified for this task.

The last two boroscope inspections, carried out on 10 July 2009 (TSN: 6,162 h) and 25 March 2010 (TSN: 6,627 h), did not bring to light any anomalies likely to explain the engine shutdown (see photos in appendix 2).

❒ Injector inspection

The maintenance documentation shows that the injector inspections were carried out every 400 hours. During the last inspection (TSN: 6,517 h) on 8 January 2010, the 14 injectors had been replaced.

❒ Check on ground performance

Follow-up on engine performance was undertaken by the maintenance unit technicians who noted engine performance before and after each check. The last two noted on 11 March 2010 and 11 August 2010 did not bring to light any anomalies likely to explain the engine shutdown.

❒ Compressor desalination wash

This operation consists of cleaning off any saline deposits from the compressor, after the last flight de the day, by the duty technician following the protocol recommended by Pratt & Whitney Canada. Compressor washing is noted on each maintenance logbook after the last flight.

❒ Performance recovery wash

This operation consists of cleaning off any deposits that could not be eliminated by the desalination washes. These washes were carried out systematically at every check, that's to say every 100 hours.

1.6.6 Weight and balance

On departure from Pointe-à-Pitre, the weight and balance of the aeroplane were within the limits defined by the manufacturer.

1.7 Meteorological Conditions

At the time of the accident, broken clouds were based at 2,800 ft. Visibility was greater than 10 km and surface wind was 110° at 8 kt variable between 090° and 150°.

1.8 Aids to Navigation

Not applicable.

1.9 Telecommunications

At the time of the accident, the pilot was in contact with the Pointe-à-Pitre tower controller.

1.10 Airport Information

Not applicable.

1.11 Flight Recorders

F-OIXZ was not equipped with flight recorders. European regulations do not require it.

The aeroplane was not equipped with any maintenance recorders.

In ICAO Annex 6 Part 1 – Operation of aircraft I chapter 6.3.1.2.1 – Flight recorders and aircraft data recording systems, ICAO recommends:

" … that all turbo-engined aeroplanes of a maximum certified take-off weight of 5,700 kg or less for which the individual certificate of airworthiness is first issued on or after 1st January 2016 should be equipped with:

a) a Type II FDR; or

b) a Class C AIR capable of recording flight path and speed parameters displayed to the pilot(s); or

c) an ADRS capable of recording the essential parameters defined in Table A8-3 of Appendix 8."

Note: There are four lightweight flight recording systems: aircraft data recording systems (ADRS), cockpit audio recording systems (CARS), airborne image recording systems (AIRS) and data link recording systems (DLRS). Image and data link information may be recorded on CARS or ADRS.

1.12 Wreckage and Impact Information

1.12.1 Site

The aeroplane landed in a sugar cane field in Anse-Bertrand commune 12.5 NM from Pointe-à-Pitre aerodrome. The aeroplane came to a standstill 600 m from the coast and about 70 m from a hedge behind which were some houses.

The distance between the first marks on the ground and the aeroplane was about 35 m. Pieces of debris from the baggage hold, baggage and parts of the nose landing gear were recovered between the first mark and the aeroplane.

1.12.2 Examination of the wreckage

The aeroplane was oriented at a magnetic heading of about 140° (in the opposite direction to its final trajectory). The aeroplane was configured for landing. The fuselage and the rear stabiliser were only slightly damaged. The left wing tip was broken. The leading edge of the right wing and the pod housing the weather radar were damaged. The main landing gear was bent upwards.

Examination of the debris recovered along the trajectory, of the marks on the ground and the aeroplane damage showed that the aeroplane had struck the ground with a slight pitch down attitude slightly oriented to the right.

1.13 Medical and Pathological Information

Biological analyses performed on the pilot showed the absence of any medicinal, toxic or narcotic substance.

1.14 Fire

There was no fire.

1.15 Survival Aspects

The automatic *"ARTEX G406-4 ELT"* emergency locator transmitter was recovered in *"AUTO"* position. It had not been triggered.

1.16 Tests and Research

1.16.1 Disassembly of the engine

Disassembly of the turboprop engine was carried out from 22 to 24 February 2011 at Pratt & Whitney Canada in Montreal.

The main damage was located in the hot sections, especially in the turbine compressor and the power turbine.

1.16.2 Turbine compressor stage

All the blades were fractured at varying profile heights from the middle to the base. Discoloration on each fracture was noted. Signs of impact were present on the blades' trailing edge with, in some cases, a loss of coating. The leading edges were distorted.

Metallurgical examinations enabled the following conclusions to be drawn:

- The chemical composition of the CT blades base material complied with the manufacturer's specifications;
- The CT blade fracture surface showed no signs of fatigue cracking;
- Fractographic observations indicated that the fracture of one or several CT blades was probably the cause of the tensile overload fracture of the other CT blades;
- On six CT blades, distributed uniformly on the disc and for which there remained significant material, the following was recorded:
  - signs of overheating in their peripheral section and locally in the fusion areas,
  - numerous *"micro-voids"* at grain boundaries, in the radial direction. This is a feature of creep (see paragraph 1.18.2);
- The seriousness of the damage on the CT blades made it impossible for any previous presence of a base material defect to be established. It was not possible to determine which blade (or blades) was (were) the cause of the damage to the other CT blades;
- The damage observed on the power turbine blades was the result of overload following the impacts of the fractured pieces of the compressor-turbine stage blades.

1.17 Information on Organisations and Management

Operation of Cessna 208 in the Caribbean

The Caribbean, located in the tropical zone, is characterised by a humid saline atmosphere and by high temperatures (the annual average temperature is 26 °C).

Cessna 208s are operated in the framework of public transport and also in the framework of cargo and personnel transport. The main activity of these aeroplanes consists of carrying out numerous short flights between the islands and generates a high number of engine cycles. In addition, on the aerodromes not equipped with a ground power unit, start-ups are carried out using power supplied by the aircraft battery, which may sometimes lead to high engine temperatures. These various features therefore subject the engines to severe constraints.

The pilots explained that they use their aeroplanes within the limits authorised by the flight manual. The occasional unnoticed exceeding of maximum authorised temperatures (overtemp) during specific flights cannot be ruled out however. This overtemp may weaken and accelerate the ageing of specific materials like the material that makes up the CT blades.

1.18 Additional Information

1.18.1 Captain's testimony

On the day of the accident, the Captain had already made a return flight between Point à Pitre and Saint Barthélémy. The parameters had been nominal during the engine tests.

During the accident flight, after starting up with the ground power unit, he performed the usual checks without repeating the engine tests.

He performed the checks after take-off and selected the engine parameters for climb. He connected the autopilot, selected an altitude of 8,500 ft and maintained the aeroplane at a speed of 120 kt.

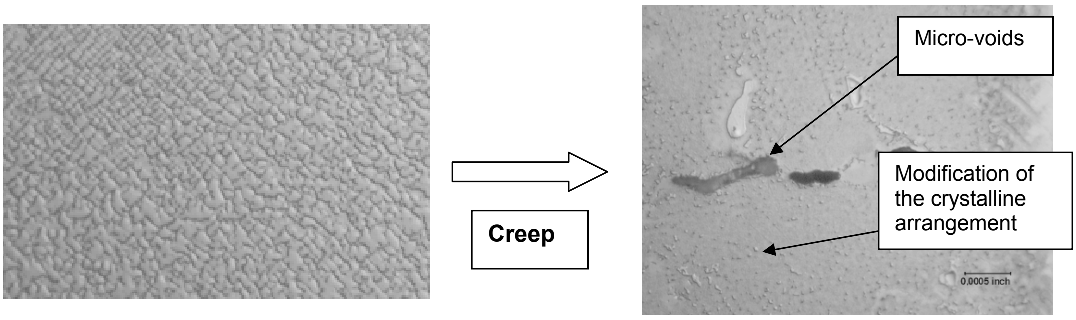
He explained that at about 7,000 ft the engine had suddenly cut out with a thud. He immediately disconnected the autopilot and started to turn back, carrying out the engine failure procedure. He contacted ATC and broadcast a mayday message.

He twice tried to restart the engine using the starter and then he concentrated on controlling the aeroplane flight path. He informed the passengers that he was going to make a forced landing.

Flying over Anse-Bertrand, he was highly perturbed by oil on the windscreen. He had trouble choosing a field to land in as the area was not very suitable. He identified a field, but thought that the aeroplane was too high. He carried out two sharp turns (60° bank) in order to lose speed and altitude. Reckoning he was flying too fast, he extended the flaps to the third detent. He no longer remembered the last flight phase and the impact with the ground.

1.18.2 The phenomenon of creep

In operation, the turbine blades are subject to high mechanical and thermal stresses mainly due to centrifugal forces and hot gases passing out of the combustion chamber. The exposure time, the thermal and mechanical stress can modify the properties of the materials and lead to irreversible modifications in the micro-structure of the blades. Thus, the phenomenon of creep is characterised by the constitution of a crystalline arrangement that results in unbonding of the material. In creep, the *"micro-voids"* (cavities) present at the grain boundaries evolve into *"micro-cracks"* that coalesce to form a crack on the blade.



Metallographic view of a cross-section of a standard blade

Metallographic view of a cross-section of blade n°47 on F-OIXZ

1.18.3 Accidents linked to failures of CT blades resulting from creep

Since 2006, two accidents linked to in-flight engine shutdowns caused by failures in CT blades as a result of creep have been reported (see appendix 4).

1.18.4 Actions undertaken by Cessna and Pratt & Whitney Canada

By April 2011, Pratt & Whitney Canada had produced 2,295 PT6A-114/114A engines. These engines totalled 13.5 million hours of operation.

Since 1990, 82 in-flight engine shutdowns have been recorded due to CT blade failures, including 27 resulting from creep.

In some cases, the installation of Engine Conditioning Trend Monitoring (ECTM) facilitated the detection of conditions favourable to creep.

The main feature of engine reliability is represented by the Basic In Flight Shutdown (BIFSD) defined as engine shutdown caused by a failure directly linked to the engine or to one of its components. It is currently 0.003 per 1,000 hours of operation.

The Transport Canada standard for certification of an engine for a single-engine aircraft, operated in public transport under IFR, requires a BIFSD of less than 0.01 per 1,000 hours of operation. There is no minimum standard required by EASA. In Europe, single-engine aircraft authorised for public transport must be operated by day and under VFR.

1.18.4.1 Publications:

Over the last few years, Pratt & Whitney Canada has published several SILs and SBs and introduced modifications to the Maintenance Manual to deal with PT6A-114/114A CT in-service blade problems. Most of these publications were repeated by Cessna Aircraft Company in SNLs.

According to Pratt & Whitney Canada, the probable source of the failures may be:

- The following pilot actions:
  - Unintentional cut-off (input on the fuel condition lever of *"Idle"* to *"Cutoff"* and then immediately back to *"Idle"*) during taxiing;
  - Hot starts;
  - Unsuitable use of the Emergency Power Lever (EPL);
  - Non-compliance with the recommendations for adjusting power in flight.
- Non-compliance with maintenance procedures.

The Service Information Letter, published by Pratt and Whitney Canada in 2004 (SIL PT A-125 *"PT6A Compressor Turbine (CT) Blade Fractures"*), provides specific information to operators on the consequences that non-compliance with operational instructions can lead to on the CT blades (see appendix 1).

This documentation also provides information on over-temperature conditions and other conditions that can cause or accelerate the phenomenon of creep. In particular, it mentions that acceleration of creep on an engine's CT blades can occur while it is regularly used beyond the power settings recommended by the flight manual but below the temperature limits. Furthermore, this documentation specifies that there is a case where damage on the CT blades, following exposure to overtemperature, may not be detected by a stretch measurement check. Only a destructive check enables the material properties to be checked.

Lastly, it should be noted that the Maintenance Manual recommends a creep check by stretch check at 5,000 hours TSN and then every subsequent 3,000 hours and at every general overhaul (for engines equipped with pre-SB N°1669R6 blades).

1.18.4.2 Conferences

Pratt & Whitney Canada have organised numerous conferences for operators throughout the world to inform them and raise awareness of the problems encountered on CT blades.

1.18.4.3 Entry into service of a new blade

All the stages of the PT6A-114/114A engine turbine compressor, manufactured from December 2008 onwards, are equipped with a new CT blade model (PN 3072791-01). These new design CT blades are monocrystalline. They have been available in retrofit since June 2009 for engines manufactured before December 2008. These blades have better resistance to creep.

Through SB N°1669R6, Pratt & Whitney Canada recommended the replacement of CT blades when the engine is in general overhaul (OVH). Replacement remains optional and at the operators' discretion in other cases (repairs or hot section inspection).

At the time of publication of this report, 370 sets (58 blades per set) of these new CT blades were in service. They have accumulated about 160,000 hours of operation. The oldest have a total TSN of 4,000 hours. No cases of creep fracture have been recorded.

1.18.5 Actions carried out by Civil Aviation authorities

The documents are provided in Appendix 5.

❒ **Transport Canada**

Transport Canada informed operators, owners, maintenance officials and overhaul workshops of the importance of suitable management of the power and maintenance of engines via two Service Difficulty Advisories: Service Difficulty Advisory N°AV-2006-06 on 05/07/2006 and Service Difficulty Advisory N°AV-2007-06 on 19/09/2007).

❒ **EASA**

EASA repeated the service difficulty advisory notice N°AV-2007-06 and issued it in a Safety Information Notice on 12 November 2007.

❒ **Federal Aviation Administration (FAA)**

The FAA notified operators, owners, maintenance officials and overhaul workshops of the potential risk of engine cut-off due to CT blade failure by publishing special airworthiness information bulletin SAIB NE-10-47 on 30 August 2010.

2 - ANALYSIS

2.1 Detection of Creep on CT blades

A significant number of engine in-flight shutdowns on Cessna 208Bs equipped with the PT6A-114A engine, due to CT blade failures, have been recorded over the last few years. These failures are made more dangerous by the fact that they occur on a single-engine aeroplane.

Cessna and Pratt & Whitney Canada have taken a significant number of steps aimed at preventing failures on CT blades:

- Publication of service bulletins and service information letters about the importance of maintenance operations;
- Reminders on the conditions of use through operational instructions;
- International conferences;
- Setting up of an optional engine parameter surveillance system;
- Entry into service of a new type blade (no cases of failure due to creep reported by Pratt & Whitney for this type of blade).

Even if the number of engine shutdowns (0.003 per 1,000 hours of operation) remains lower than the certification criteria (0.01 per 1,000 hours of operation), the significant number of events has led the Civil Aviation authorities of Canada, the USA and Europe to publish warnings for operators on the importance of respecting the manufacturer's recommendations.

The investigation showed that despite these recommendations, the deterioration of CT blades had not been detected on F-OIXZ:

- **Boroscope inspections**

The last boroscope inspection performed 264 hours before the accident to F-OIXZ did not bring to light any defects on the CT blades. A boroscope inspection can make it possible to detect;

external deterioration on the blade structure (sulphidation, damage on the leading and trailing edges, cracks…) but does not make it possible to detect a micro-structural modification of the blade.

- **Checks and follow-up on performance**

Performances ground checks, for the F-OIXZ engine, did not make it possible to identify any deterioration of the engine. The operator of F-OIXZ did not use an engine parameter recorder and did not undertake any flight performance follow-up.

- **Hot section inspections (HSI) and overhauls (OVH)**

The hot section inspections (HSI) and the overhaul (OVH) performed at the intervals recommended by Pratt & Whitney Canada did not make it possible for the CT blade defects to be detected.

Thus the F-OIXZ engine, which had a total of 6,891 hours at the time of the accident, had undergone an HSI at 5,480 hours. During this HSI, a metallurgical inspection of 2 CT blades was made. The 56 other blades had been subject, in advance, to a stretch check (creep detection) and NDT tests. These checks were judged to be satisfactory and the 56 original blades and 2 new ones had been installed on the CT disk. After 1,411 hours of operations, one or more of these blades failed as a result of creep.

In December 2008, Pratt & Whitney introduced new blades (P/N 3072791-01). These newly designed blades have better creep resistance. All engines manufactured after December 2008 have been equipped with this type of blade and, since June 2009, these blades have been available as a retrofit. Up to August 2012, feedback showed that no cases of failure through creep were reported.

However, installation of these new blades is only recommended by the engine manufacturer when the engine is being overhauled and is at the discretion of operators in other cases (repair or hot section inspections). For aeroplanes that fly little, the replacement might therefore only happen after several years.

In addition, installation of this type of blade allows the operator to avoid the inspections at 3,000 and/or 5,000 hours and metallurgical examinations of the two blades sampled during the HSI. As a result, a fleet of engines equipped only with this type of blade would present the advantage of simplifying the maintenance documents (in particular SB N°1703R6).

2.2 Failure of the CT Blades

The extent of the damage on the CT blades on F-OIXZ did not make it possible to determine the conditions that led to the creep phenomenon. Two scenarios might explain this phenomenon:

- Between the last HSI, when no defect was detected, and the accident, engine use beyond the power settings recommended in the flight manual may have generated operating temperatures higher than the threshold defined by the manufacturer. These excessive temperatures would then have led to creep until the failure of the blades.

  The lack of a flight data parameter recorder and the examination of the engine did not make it possible to confirm this scenario.

- It is also possible that a defect on a blade was the cause of its failure by creep at temperatures below the maximum threshold fixed by the manufacturer. Despite all the preventive measures, the number of failures due to creep on first generation CT blades remains one of the main causes of engine shutdowns in flight. In the case of F-OIXZ, creep could not be detected in time, despite maintenance of the CT blades in accordance with the manufacturer's recommendations. All of these preventive operations (preventive maintenance and checks) thus have their limitations.

3 - CONCLUSION

3.1 Findings

- The pilot possessed the licences and qualifications required to undertake this flight.
- The meteorological conditions were favourable for the flight to be undertaken.
- The aircraft had a valid airworthiness certificate.
- The aircraft was maintained in accordance with the maintenance as programmed and defined by Pratt & Whitney Canada.
- The CT blade stretch test, performed 1,411 operating hours before the accident, did not make it possible to detect creep on one or more blades.
- A failure of one or more CT blades as a result of creep was the cause of the overload failure of the other CT blades that led to the engine shutdown.
- Six CT blades showed damage due to creep.
- The pilot applied the emergency procedure for in-flight engine shutdown.
- Not being able to reach an aerodrome, the pilot a made a forced landing in a sugar cane field.
- In the absence of a flight parameter recorder, it was not possible to obtain information on the engine parameters during the accident flight and the previous flights.
- Since 1990, 82 cases have been reported of this type of in-flight engine shutdown due to failures in CT blades, including 27 involving creep.
- In 2008, Pratt and Whitney Canada introduced into service a new type of CT blade whose resistance to creep is better.

3.2 Causes of the Accident

The accident was due to the failure of one or more CT blades through creep that led to the in-flight shutdown of the engine.

The causes of the creep could not be determined. It could have been caused by exceeding the engine's threshold temperature during operations or by non-detection during a maintenance operation.

4 - SAFETY RECOMMENDATIONS

Note: In accordance with Article 17.3 of European Regulation (EU) 996/2010 of the European Parliament and Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation, a safety recommendation shall in no case create a presumption of blame or liability for an accident, a serious incident or an incident. The addressee of a safety recommendation shall inform the safety investigation authority which issued the recommendation of the actions taken or under consideration, under the conditions described in Article 18 of the aforementioned Regulation.

4.1 Replacement of the CT blades

The investigation did not bring to light any failings in the operator's execution of the maintenance operations. In 2008 Pratt & Whitney Canada introduced new monocrystalline CT blades (P/N 3072791-01) for PT6A-114/114A engines, whose resistance to creep was improved. Until August 2012, no cases of failure as a result of creep were reported on the engines equipped with these new blades. Their installation is not, however, mandatory and is recommended only during the general overhaul of the engine. For operators performing few flying hours, this change may only be required after several years.

Consequently, the BEA recommends that:

- **EASA and Transport Canada make mandatory the installation of new monocrystalline blades on PT6A-114/114A engines; [FRAN-2013-10]**

- **EASA and Transport Canada ensure that the inspection programme for previous generation blades on PT6A-114/114A engines be improved while awaiting their replacement. [FRAN-2013-11]**

4.2 Installation of Flight Data Recorder

The presence of a flight recorder would have made it possible to obtain information on the engine parameters during the accident flight and the previous flights. In fact, any use of the engine beyond the range of power settings detailed in the flight manual may at times have generated excessive temperatures and resulted in premature wear that could have led to creep on the CT blades. In ICAO Annex 6, installation of a flight recorder (FDR type II, or AIR class C or ADRS) is recommended for turboprop aeroplanes whose maximum takeoff weight is equal to or less than 5,700 kg and whose first airworthiness certificate would be issued on or after 1st January 2016. The European Regulation does not require that aeroplanes be equipped with them in this case, even where the aeroplane is operated for commercial air transport.

Consequently, the BEA recommends that:

- **EASA extend the obligation to carry a flight data recorder on board all aircraft operated for commercial air transport. [FRAN-2013-12]**

List of Appendices

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Appendix 1

Summary of Cessna and Pratt & Whitney Canada's SIL and SB

Service Newsletter (Cessna) and Service Information Letters (PWC)

Date	1.Cessna 2.PWC	Heading
20/07/2010	1.SNL 10-9 2. n°GENPT6A028	Reminder of the principles governing use of torque recommended by the P.O.H. as priority parameter instead of temperature (ITT)
02/04/2007	1.SNL 07-8 2. SIL n°PT6A-146	PWC CANADA PT6 compressor turbine blade maintenance: ▪ recommendations concerning the p/n 3102401-01, 3039901 and 3045741-01 blades ▪ reminder of recent experience of use of engine performance beyond the limits set out by the AFM and of unsuitable maintenance ▪ reminder of the fundamental aspect to carry out: o boroscope tests at the same time as the checks on the injectors o regular washes o reminder that the use of Engine Conditioning Trend Monitoring (ECTM) is an important aspect in anticipating problems relating to the hot sections ▪ Proposal to review the SB1703 (extension TBO) to condition it for: o a maintenance programme including an injectors checks and boroscope inspection o an ECTM via a DAC (Designated Analysis Center) ▪ Reminder that the Hot Sections Inspection (HSI) must be carried out every 1,800 hours with removal of the 2 blades for metallurgical analysis ▪ Reminder that, if the ECTM is used to complement the injectors and boroscope checks, the operators may be exempt from the check below based on the engine history
07/08/2006	1.SNL 06-10 2. SIL PT6A-116R1	Boroscope inspection in conjunction with the injector checks: ▪ Highlights the damage encountered on the CT vane ring (stator) trailing edge and the consequences on the possible degradation of airflow which can, locally, cause constraints on the blades with risks of fatigue crack initiation
22/03/2004	1.SNL 04-1 2. SIL PT6A-125	Compressor turbine blade fractures: ▪ Reminder of excessive temperature conditions (overtemperature) ▪ Specifies that this situation can not be detected by a dimensional (stretch check) inspection ▪ Recommends a destructive check to verify the material properties ▪ Specifies the conditions which can cause (or indeed accelerate) creep ▪ Reminder that the Maintenance Manual recommends verification of creep (also called "stretch check" or check by expansion at 5,000 hours Time Since New (TSN) and subsequently every 3,000 hours and at each engine overhaul ▪ Reminder to follow procedures relating to limits (exceeding power settings even if below temperature redline settings); otherwise possibility of creep ▪ Defines the corrections to follow in the event of inadvertent shutdown and restart

Pratt & Whitney Canada
A United Technologies Company

S.I.L NO. PT6A-125

SERVICE INFORMATION LETTER

Subject PT6A Compressor Turbine (CT) Blade Fractures

Applicability All PT6A engines

Introduction

Pratt & Whitney Canada (P&WC) wishes to provide operators of all PT6As with operational recommendations that stem from recent investigations of certain CT Blade fractures that have occurred on the Small PT6A Family of engines. These recommendations are made to help operators become more aware of the impact that certain operational situations may have on CT blade reliability, and consequently help reduce the future occurrences of Hot Section distress. All pilots of PT6A powered aircraft and the Owner/Chief Pilot/Maintenance Director or their delegates should carefully review these recommendations.

Discussion

P&WC has completed a review of some aspects of PT6A operation that could result in either an overtemperature (referred to herein as "overtemp") condition or an acceleration of CT blade creep commonly referred to as stretch. Either scenario will lead to reduced CT Blade life, reduced engine durability/reliability, increased operating costs and could likely result in CT Blade fracture and total loss of engine power. Further, a CT Blade fracture due to an overtemp event may occur without any noted deterioration in engine performance.

It is also important to note that CT Blades subjected to an over-temperature of any type may not fracture when the overtemp occurs, but could result in a CT blade fracture/loss of engine power during a subsequent flight.

This Service Information Letter is valid until superceded or cancelled by revision.

ISSUED: Jan 21/2004 Page 1

PRATT & WHITNEY CANADA CORP.
MARIE-VICTORIN, LONGUEUIL
QUEBEC, CANADA J4G 1A1
PRINTED IN CANADA

1.Overtemp Conditions

An overtemp condition is when the temperature of the engine exceeds the Maximum allowable temperatures as defined in the Pilot Operating Handbook (P.O.H.) and the applicable Engine Maintenance Manual. All PT6A Maintenance Manuals contain Overtemp charts that provide instructions for CT blade disposition based on the severity of the event. The two charts present in all PT6A Maintenance Manuals address overtemps that occur during the normal starting sequence, and during all other operational modes. One type of overtemp event has been identified which may result in physical damage to the blades that cannot be detected by dimensional (stretch check) inspection, and therefore requires destructive testing to determine if the properties of the blade material have been weakened.

P&WC has recently received field data from an operator who had optionally installed "engine monitoring equipment" which facilitated the detection of an overtemp occurring during inadvertent cut-off and relight. During taxi the pilot inadvertently moved the fuel condition lever from Low Idle into Cutoff and back to Low Idle in a very short time resulting in a short-term sub-idle overtemp. P&WC has determined that this type of overtemp event can result in a change to the CT Blade microstructure referred to as solutioning that can also adversely affect the creep properties of the CT Blades. The Charts in the PT6A Maintenance Manuals for Overtemp do not explicitly address this condition and some operators may erroneously have used the "Overtemp on Starting " chart to determine what maintenance actions were required.

An example of CT Blades that were likely exposed to an overtemp condition are shown in Fig.1, these blades were in operation prior to being discovered during an H.S.I., cracking is evident on the trailing edge of some blades. Fig. 2 shows a CT disc assembly following a CT blade fracture event.

This Service Information Letter is valid until superceded or cancelled by revision.

Figure 1

This Service Information Letter is valid until superceded or cancelled by revision.

Figure 2

2.Conditions which lead to and may accelerate creep

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.

The maintenance manuals for small PT6As require an inspection for creep, also known as stretch check, at 5000 hour Time Since New (TSN) and subsequently every 3,000 hours.

All PT6A engine models require a similar inspection to be performed at engine overhaul.

Engine Power Setting Limits for the various flight regimes are outlined in the P.O.H.

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 of the P.O.H, 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

This Service Information Letter is valid until superceded or cancelled by revision.

CT Blade fracture and total loss of engine power occurring prior to the blade inspection interval stated in the maintenance manual or overhaul manual.

Recommendations

Overtemp Conditions
Follow the applicable Engine Maintenance Manual recommendations for all overtemp conditions.

Inadvertent Cutoff and Relights
P&WC is in the process of revising the PT6A maintenance manuals to add an instruction that will require a metallurgical analysis be conducted when this type of event has occurred.
Operators will be required to submit the CT blades to an overhaul level inspection and include a metallurgical analysis (cut-up) of two blades to determine possible changes to the microstructure
P&WC recommends that if an operator accidentally Cuts-off the engine during Taxi the engine should be allowed to completely shut down and then be restarted per applicable POH procedures.

Power Settings
P&WC recommends that operators fully adhere to the Power setting requirements specified in the P.O.H. for your specific application.

Sincerely,

PRATT & WHITNEY CANADA CORP.

Giovanni Mulas
General Manager, Small Turboprop Service Engineering
Customer Support

This Service Information Letter is valid until superceded or cancelled by revision.

Appendix 2

Boroscope inspections

The two last boroscope examinations carried out found no anomaly likely to explain the engine shutdown.

- **Inspection on 10 July 2009**
  TSN 6162

- **Inspection on 25 March 2010**
  TSN 6627

The work file relating to this boroscope examination mentioned:

- Slight cracks on the cooling ring and the leading edge of the CT stator;
- Loss of coating on the CT blades;
- To monitor changes, the next boroscope examination was before 400 hours.

The operator having already carried out this boroscope examination indicated that he used documentation provided by Pratt & Whitney Canada (Maintenance Manual - Chapter 72-00- paragraph E *"Inspections of CT blades"*) which described and categorised the damage that can be observed during a boroscope examination. The operator added that the cracks and loss of coating were within the permissible limits. He noted in the work file that the following boroscope examination should be carried out before 400 hours in accordance with the Pratt & Whitney documentation. At the time of the accident the engine had totalled 264 flying hours since this boroscope examination. The head of the servicing unit explained that he had scheduled a boroscope examination for the aeroplane's next inspection which was to be carried out within the next 24 hours of operation.

Appendix 3

Metallurgical examination of the compressor turbine blades and disc

4.0 **MATERIAL LABORATORY INVESTIGATION RESULTS**
CT Blades P/N 3045741-01

The CT blades were numbered No. 1 to 58 according to the normal convention which is clockwise, pilot view starting with blade No. 1 in line with the disk master spline (Photo No. 46). The blade heat codes were recorded as follows:

Blade No. 22; T022
Blade No. 42; TT02
Blades No. 1 & 30; W9775
Remaining blades, qty. 54; T092

Examination of the fracture surfaces showed features characteristic of overload (Photo No. 47). No evidence of fatigue was found on any of the 58 blades. Many blades exhibited fractographic features which were consistent with a tensile overload resulting from an impact on the suction (concave) side of the airfoil, most likely consequential to the initial blade(s) fracture. This is confirmed by the presence of multiple cracks parallel to the fracture surface (Photo No. 48).

Six blades were chosen amongst the longest remaining airfoil and the least impact damaged (Photo No. 49). The blades were sectioned along the trailing edge for metallographic examination (red arrows on Photo No. 49).

All of the CT blades with a significant remaining airfoil revealed overheated structure of the upper region of their airfoil. Evidence of melting at the tip of the remaining airfoil was observed and constitutional liquation was present at the interface of the coating and the base material (blades No. 39 & 47 are shown on Photo No. 50). This condition is believed to be secondary and consequential to the fracture of the blades.

Blade No. 47 exhibited aligned microvoids at grain boundaries (Photo No. 51). These voids were aligned perpendicularly to the stress axis of the blades and are characteristic of tertiary creep. Complete solutioning of the gamma prime was visible in the microstructure of blade No. 47, which confirms the secondary overheating; A normal cuboidal gamma prime was observed in the root section of the blade and used as comparison (Photo No. 53). Note that the pore shown on Photo No. 53 is round in shape and associated with the adjacent eutectic island. This feature is not related to the observed creep.

Blades No. 4, 19, 34 & 39 (Photo No. 52), revealed similar creep features (elongated and aligned microvoids) such as those found on blade No. 47. Blade No. 30 did not show any evidence of creep and it is believed that this blade was not exposed to the same engine condition (time). As such, it is believed that this blade is part of the two new blades that were installed during the last HSI.

The chemical composition of the base material of the blades met drawing requirements.

Photo No. 46
General view of the CT disk and blades

Photo No. 47
Typical condition of the CT blade fracture surfaces

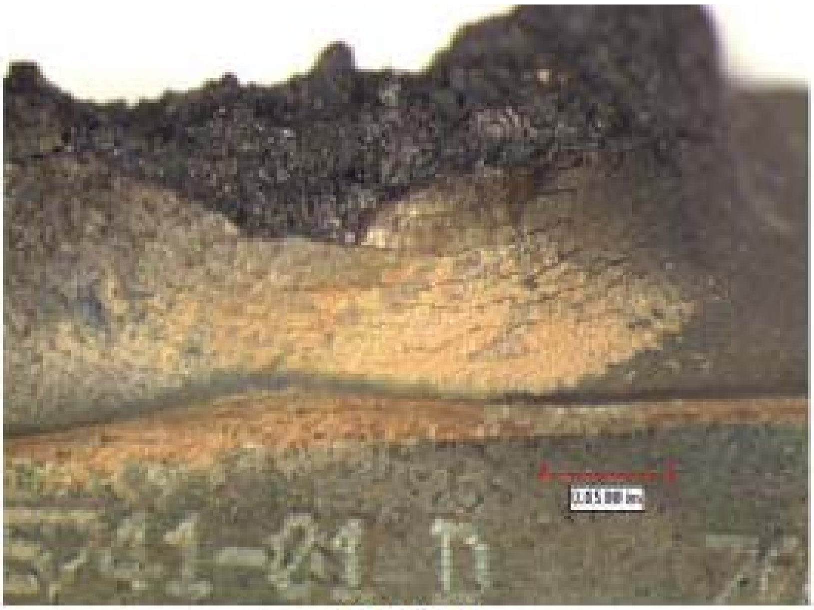

Photo No. 48
Multiple cracks parallel to the fracture surfaces

Photo No. 49
Six blades chosen for metallographic examination

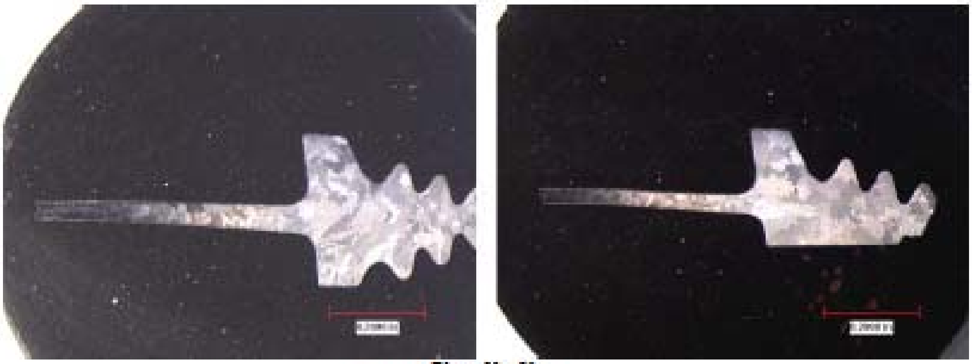

Photo No. 50
Blades No. 39 & 47 cross sections

Photo No. 51
Blade No. 47 showing microvoids

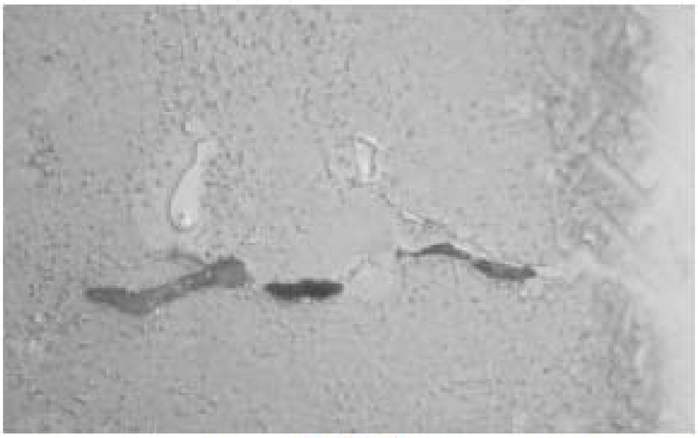

Photo No. 52
Blade No. 47 showing microvoids and a complete solutioning of the gamma prime

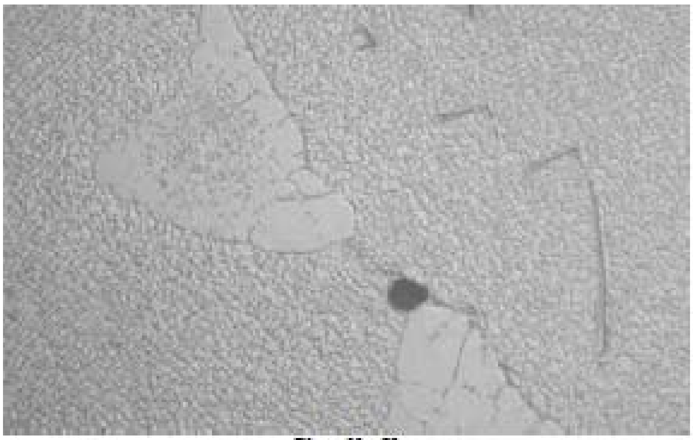

Photo No. 53
Blade No. 47 showing a normal gamma prime in the root section

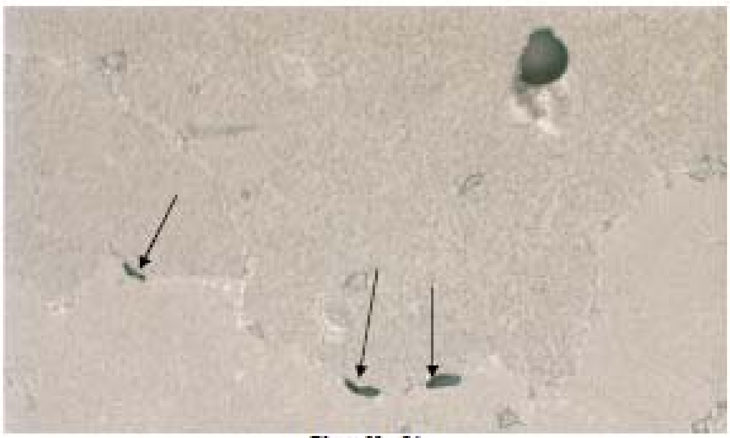

Photo No. 54
Blade No. 39 showing microvoids

Appendix 4

Accidents linked to CT blade failures due to creep

- **Accident on 06/01/2008 to a Cessna 208 B registered N102VE**

Full report published 15/12/2009 available on the NTSB website:

The pilot explained that climbing to 7,000 ft during a flight to drop parachutists, he heard an explosion from the engine. He felt vibrations and smoke filled the cabin. The engine cut out, he applied the procedure for in-flight engine shutdowns and tried to land on the runway. The pilot added that the aeroplane was too high and too fast during approach. He landed in a corn field close to the runway. Examination of the engine showed that the compressor-turbine stage blades had creep fracture. The engine manufacturer published Service Information Letters (SIL) relating to the recommended boroscope examination procedures. The aeroplane owner indicated that he was unaware of the existence of the SIL, and consequently had not carried out the boroscope examinations recommended by Pratt & Whitney Canada.

The National Transportation Safety Board (NTSB) determined that the in-flight engine shutdown was the result of the failure of a blade in the compressor turbine stage. This failure was caused by a creep fracture.

Inadequate maintenance contributed to the accident.

- **Accident on 24/03/2006 to a Cessna 208 B registered HC-BXD**

Report available on the Ecuador civil aviation website

The Cessna 208B, registered HC-BXD, collided with a building after taking off from Cuenca (Ecuador) airport.

Five passengers died. The pilot, copilot and 6 passengers were seriously injured. The aircraft was severely damaged.

The Ecuador investigation committee determined that the probable cause of the accident was a failure of the compressor turbine blades due to creep.

The following elements also contributed to the accident:

- The operator's inadequate maintenance;
- Non-compliance with the Hot Sections Inspection (HSI);
- Exceeding the TBO by 200 hours without complying with the technical requirements needed to obtain an extension of the TBO.

Appendix 5

Safety information issued by Canadian and European authorities

Transport Canada | Transports Canada

TP 7394

No. / N° AV-2007-06 | 1/2

Date 19 September 2007
19 septembre 2007

SERVICE DIFFICULTY ADVISORY

This Service Difficulty Advisory brings to your attention a potential problem identified by the Service Difficulty Reporting Program. It is a non-mandatory notification and does not preclude issuance of an airworthiness directive.

PT6A-114/114A

COMPRESSOR TURBINE BLADES

There have been a number of inflight shutdowns (IFSDs) and Service Difficulty Reports (SDRs) related to CT blade failures. Transport Canada Civil Aviation (TCCA) has determined it necessary to advise operators, owners, maintainers and overhaul shops of the importance of proper engine maintenance and engine power management.

Liberation of CT blade(s) or portions thereof, resulted in significant downstream hot section damage. Other negative consequences have been increased maintenance and operating costs and a reduced margin of safety.

One of the primary reasons for CT blade fractures and resultant engine power loss is operating the engine beyond the power settings specified in the respective Aircraft Flight Manual (AFM). Not following the specified AFM requirements has largely contributed to incidents of blade creep and reduced blade life.

In order to reduce CT blade distress, it is essential to detect and control hot section sulfidation, oxidation and blade erosion. An important preventive practice such as regular fuel nozzle maintenance will minimize or prevent hot section distress. Regular borescope inspections, Engine Conditioning Trend Monitoring (ECTM) and turbine washes are fundamental tools in detection and subsequent prevention of CT blade failures.

AVIS DE DIFFICULTES EN SERVICE

Cet avis aux difficultés en service a pour but d'attirer votre attention sur un problème possible qui a été révélé par le Programme de rapports de difficultés en service. Il est une notification facultative et n'exclut pas nécessairement la publication d'une consigne de navigabilité.

PT6A-114/114A

AUBES MOBILES DU SYSTÈME COMPRESSEUR-TURBINE

Il y a eu un certain nombre de coupures moteur en vol et de rapports de difficultés en service (RDS) liés à des défaillances d'aubes mobiles du système compresseur-turbine. L'Aviation civile de Transports Canada (TCCA) a jugé nécessaire d'aviser les exploitants, les propriétaires, les préposés à la maintenance et les ateliers de révision de l'importance d'une saine gestion de la puissance et de la maintenance des moteurs.

La séparation d'aubes mobiles ou de parties d'aubes mobiles, du système compresseur-turbine a causé d'importants dommages en aval de la partie chaude. D'autres conséquences négatives ont été des coûts d'exploitation et de maintenance accrus, et une marge de sécurité réduite.

Une des principales raisons expliquant les ruptures d'aubes mobiles du système compresseur-turbine et la perte de puissance qui en résulte est attribuable à l'utilisation du moteur au-delà des réglages de puissances précisés dans le manuel de vol respectif. Ne pas se conformer aux exigences spécifiées dans le manuel de vol a grandement contribué à des incidents de fluage des aubes et réduit la durée de vie de celles-ci.

Afin de réduire les dommages importants à ces aubes mobiles, il est essentiel de déceler et de limiter la sulfuration et l'oxydation de la partie chaude ainsi que l'érosion des aubes mobiles. Une mesure de prévention importante, comme l'entretien régulier des injecteurs de carburant, réduit au minimum ou prévient tout dommage important dans la partie chaude. Des endoscopies régulières, un contrôle des tendances de l'état du moteur et le lavage de la turbine sont des outils fondamentaux permettant de déceler et de prévenir les défaillances d'aubes mobiles du système compresseur-turbine.

To request a change of address, contact the Civil Aviation Communications Centre (AARC) at Place de Ville, Ottawa,

Pour demander un changement d'adresse, veuillez contacter le Centre des communications de l'Aviation civile (AARC) à

In an effort to reduce CT blade events, the engine OEM has conducted maintenance and engine operating training seminars in several continents and published numerous recommendations. Many of these IFSDs could have been prevented if OEM instructions had been complied with.

En vue de réduire ces défaillances, le constructeur d'origine du moteur a tenu des ateliers de formation sur la maintenance et l'exploitation des moteurs sur plusieurs continents et a publié de nombreuses recommandations. Bon nombre de ces coupures moteur en vol auraient pu être évitées si les instructeurs du constructeur d'origine avaient été respectés.

In the past years, P&WC have published several Service Information Letters (SIL) to address PT6A-114/114A in-service problems, as follows:

Au cours des dernières années, P&WC a publié plusieurs Lettres d'information en service (SIL) pour traiter des problèmes des PT6A-114/114A en service :

SIL PT6A-53	EPL usage
SIL PT6A-116R1	Borescope Inspection
SIL PT6A-125	Inadvertent Cut-off/Relight
SIL PT6A-146	CT Blade Cut-Up at HSI

SIL PT6A-53	EPL usage
SIL PT6A-116R1	Borescope Inspection
SIL PT6A-125	Inadvertent Cut-off/Relight
SIL PT6A-146	CT Blade Cut-Up at HSI

P&WC have recently issued SIL PT6-146 titled "Compressor Turbine Blade Maintenance" advising all operator, owners and maintainers of the upcoming revisions to PT6A-114/114A Instructions for Continuing Airworthiness (ICA).

P&WC a récemment publié le SIL PT6-146, intitulé « Compressor Turbine Blade Maintenance » pour aviser tous les exploitants, propriétaires et préposés à la maintenance des révisions à venir des instructions sur le maintien de la navigabilité des PT6A-114/114A.

TCCA strongly advise all responsible persons and agencies to comply with the aforementioned SILs.

TCCA conseille fortement à toutes les personnes et à tous les organismes responsables de se conformer aux SILs susmentionnés.

Malfunctions, defects and failures occurring on aeronautical products should be reported to TCCA, Continuing Airworthiness via the CAR 591 reporting requirements. For further information, please contact a local Transport Canada Centre (TCC) or Mr. Barry Caldwell at (613) 952-4356 or Facsimile (613) 996-9178.

Les défectuosités, les défauts et les défaillances affligeant les produits aéronautiques doivent être signalés à TCCA, Maintien de la navigabilité aérienne, selon les exigences de signalement figurant dans l'article 591 du RAC. Pour plus de renseignements, veuillez contacter un Centre de Transports Canada local ou M. Barry Caldwell par téléphone au 613-952-4356 ou par télécopieur au 613-996-9178.

For Director, Aircraft Certification

Pour le Directeur, Certification des aéronefs

B. Goyaniuk
Chief, Continuing Airworthiness
Chef, Maintien de la navigabilité aérienne

Note: For the electronic version of this document, please consult the following Web address:	**Nota :** La version électronique de ce document se trouve à l'adresse Web suivante :

www.tc.gc.ca/CivilAviation/certification/menu.htm

EASA Safety Information Notice

No.: 2007-42

Issued: 12 November 2007

Subject: **Pratt & Whitney Canada (P&WC) PT6A-114 and -114A engines – Compressor Turbine Blade Failures**

Ref. Publication: Transport Canada Civil Aviation (TCCA) Service Difficulty Advisory AV-2007-06, dated 19 September 2007.

Introduction: This Safety Information Notice (SIN) refers to TCCA Service Difficulty Advisory AV-2007-06 (attached to this document as pages 2 and 3) and informs you of an airworthiness concern on P&WC PT6A-114 and -114A engines.

Applicability: Any aircraft that has one or more of the affected engines installed.

Recommendation: This Safety Information Notice is for information only.

Contact: For further information contact the Airworthiness Directives, Safety and Research Section, Certification Directorate, EASA.
E-mail: ADs@easa.europa.eu .

FAA
Aviation Safety

SPECIAL AIRWORTHINESS INFORMATION BULLETIN

SAIB: NE-10-47
Date: August 30, 2010

SUBJ: Turbine Engine Compressor Section

This is information only. Recommendations aren't mandatory.

Introduction

This Special Airworthiness Information Bulletin (SAIB) alerts you, owners, operators, and certificated repair facilities of airplanes equipped with **Pratt & Whitney Canada Corp. PT6A-114 and PT6A-114A series turboprop engines** of the potential for engine in-flight shutdowns (IFSDs) as a result of premature failure of compressor turbine (CT) blades. These engines are installed on Cessna Aircraft Company 208 and 208B Caravan airplanes. At this time, the airworthiness concern is not an unsafe condition that would warrant airworthiness directive action under Title 14 of the Code of Federal Regulations (14 CFR) part 39.

Background

The potential engine IFSDs addressed by this SAIB, are due to operating the engine beyond the power settings specified in the respective Aircraft Flight Manual (AFM) and/or inadequate maintenance practices. Operating the engine above the specified AFM limits during climb and cruise has largely contributed to incidents of accelerated CT blade creep and a reduction in the operating life of the blades. Failure to comply with operating procedures is a significant contributor to CT blade failure.

Recommendations

To prevent CT blade failure and reduce blade distress, we recommend the detection and control of hot section sulfidation, oxidation, and blade erosion. This is done in accordance with the Engine Maintenance Manual recommendations for periodic fuel nozzle maintenance, concurrent borescope inspections of hot section components including CT blade and vane airfoils, engine condition trend monitoring, and regular turbine washing per engine maintenance manual recommendations.

For Further Information Contact

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