

**MINISTRY OF COMMUNICATIONS AND
TRANSPORT
Tanzania Civil Aviation Authority**

ACCIDENT INVESTIGATION BRANCH

CIVIL AIRCRAFT ACCIDENT No. CAV/ACC/14/04

**REPORT ON THE ACCIDENT TO CESSNA 208B AIRCRAFT
REGISTRATION 5H-AXL WHICH OCCURRED ON 28 MAY**

**2004 AT LOIBORSOIT VILLAGE, SIMANJIRO DISTRICT,
TANZANIA
(Lat.03 52.900 S Long. 036 25.688 E)**

SUMMARY

The aircraft had just reached the cleared cruising altitude of 12500 ft when a loud bang was heard, which was followed by the loss of engine power. The engine subsequently stopped and could not be re-started in flight.

The pilot executed a force landing on a Masai steppe. Towards the end of the landing roll the nose wheel struck a raised lip of earth on a terraced field and separated from its fuselage attachment point, causing the propeller and the nose to strike the ground.

There was no fire and all the 10 occupants disembarked uninjured. Examination of the engine showed that the compressor turbine disc had failed in flight.

The report concludes that the engine failure was caused by the creep fracture and release of a compressor turbine blade into the engine gas path, and its subsequent impact with the adjacent and downstream components.

AIRCRAFT ACCIDENT REPORT No. ACC/14/04

Aircraft: Cessna 208B

Registered Owner: Anette & Wolfgang Fehlber
Jager 5, D-53577weg
Neustadt/Wied
Germany

Operator: Air Excel
P.O. Box 12721 Arusha
Tanzania

Crew: 1- Uninjured

Passengers: 9- Uninjured

Place of accident: Loiborsoit Village, Simanjiro District, Tanzania.
(03 52.900S 036 25.688E)

Date and Time: **17 March 2004 at about 0615 hours.**

ALL TIMES IN THIS REPORT ARE UTC

1. HISTORY OF THE FLIGHT

5H-AXL was operating a charter flight to transport tourists from Arusha to Ruaha. It was carrying one pilot and nine passengers. The take-off, climb out and the initial phase of the flight were normal. About 20 minutes into the flight at FL125 (12 500 feet amsl) when the pilot had already made a power reduction and was in the process of trimming the aircraft for level flight, a loud bang was heard that was accompanied by a loss of engine power. Eyewitnesses on the ground also heard this loud bang. The pilot immediately switched on the ignition to no avail. He set the power lever to IDLE, at the same time checking the Ng, which read 0%. The indications from other instruments and the annunciator panel showed that the engine was not running. Efforts to restart the engine failed and the pilot took advantage of the high altitude to circle around in order to find a convenient field for executing a forced landing.

The pilot subsequently located a Masai steppe overlooking Loiborsoit village in Simanjiro. After briefing the passengers about the imminent forced landing the pilot made a touch down on a grass field. After rolling for about 400 meters 5H-AXL ran into a terraced field from which maize had been harvested. Tire marks on the ground indicated that it was here that the nose landing gear struck raised lip of earth and sheared from its fuselage attachment point. It subsequently penetrated into the forward baggage pod compartment.

The aircraft came to rest some 480 meters beyond the point of initial touch down. The pilot opened the cockpit door and all passengers disembarked safely. There was no fire and there were no injuries. All the occupants were transported by road back to Arusha where they boarded another aircraft for their flight to Ruaha.

The aircraft sustained damage to its nose landing gear which separated and the propeller, whose two blades were bent. One of the tubular members of the the engine bearer frame was bent and the baggage pod was damaged when it scraped the ground.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	1	9	N/A

1.4 Other damage

There was no third party damage.

1.5 Personnel information

Pilot was born on

1.6 Aircraft information

The aircraft, a Cessna 208B serial No. 208B-powered by one Pratt & Whitney of Canada PT6A-114A engine was manufactured by the Cessna

Aircraft Company at Wichita, Kansas, USA

It was first registered in Tanzania on 11 July 1997 in the name of Regional Air Services Ltd, P.O. Box 14755 Arusha Tanzania. A Certificate of Registration No. 446 was issued.

A Tanzania Certificate of Airworthiness No.400 was issued on 15 July 1997 to expire one year later. It had since been kept current through periodic renewals. By the time of the accident the certificate of airworthiness was valid till 30 May 2004.

On 22 March 2001 the ownership was transferred to Cessna Finance Corporation, 220 West Douglas, Suite 300 Wichita, Kansas, USA. The Lessee was Phoeni Aviation Ltd, P.O. Box 49493 Nairobi, Kenya. The Sub-Lessee was Regional Air, P.O. Box 14755 Arusha Tanzania.

1.6.1 The engine

The Pratt & Whitney of Canada PT6A -114A engine, serial number PCE PC O583, was manufactured on 30 April 1998. It arrived in Kenya in the Same year and was fitted on Cessna 208B aircraft registration 5Y-BNN in 2002. The engine was transferred to 5H-MUA in March 2002 at 3994.7 hours.

1.7 Meteorological information

It was a bright sunny day. The weather was not a factor in this accident.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

Not applicable

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

Not required by the Regulations. None fitted.

1.12 Wreckage and impact information

The aircraft appears to have stalled when it was near the ground and

impacted the terrain with the left wing followed by the nose. It subsequently impacted heaps of stones before it came to rest. The impact loads should have been severe because of the destruction of the airframe and because it came to rest within only 50 metres of the touch down point.

The propeller had no rotational damage, an indication that it was not under power at the time of impact. The right wing had separated and the left wing had been extensively damaged. The landing gear was ripped off by impact with stones and terrain.

1.13 Medical and pathological information

1.14 Fire

There was fuel spillage but there was no fire.

1.15 Survival aspects

1.16 Tests and research

The accident engine was shipped to the manufacturer's Service Investigation Facilities at St Hubert, Quebec, Canada for detailed inspection.

A strip inspection of the engine was conducted in the presence of representatives from the Tanzania Accident Investigation Branch, the Canadian TSB, the US National Transportation Safety Board and the aircraft manufacturer, Cessna Aircraft Company.

Visual examination of the engine showed minimal external impact damage. The compressor section and the combustion chamber showed only secondary damage which was directly attributable to impact loads. However, significant damage was found in the turbine section.

1.16.1 Compressor Turbine Guide Vane Ring

The vane airfoil upstream sides displayed no distress. The trailing edges and downstream faces displayed heavy gouges and tears due to contact with separated blade debris. The fractured edges were heavily burned.

1.16.2 Compressor turbine shroud

The compressor turbine shroud displayed heavy gouges and pockmarks due to contact with the separated compressor blade debris.

1.16.3 **Compressor turbine**

The compressor turbine Part Number 3013411 and Serial Number A0000C7L had blades Part Numbers: 3045741– 01.

The blades were fractured at varying heights from the root to approximately $\frac{3}{4}$ ' span. The Fracture surfaces displayed a uniform coarse granular appearance, with burning at the tips. The blade trailing edges were cracked and gouged. The blade platform upstream sides and disc outer rim were circumferentially rubbed across approximately $\frac{1}{3}$ of the disc circumference. The blades were numbered 1-58 counter-clockwise from the hub master spline for reference and removed from the disc. The manufacturer's materials Laboratory analysis determined that the blades had been subjected to extreme over temperature. However, according to the manufacturer, the blade material was determined to meet engineering drawing requirements.

1.16.4 **Power turbine**

The blades were fractured at approximately $\frac{1}{2}$ span. The leading edges were pockmarked and gouged. The fracture surfaces displayed a uniform coarse granular appearance, with burning at the tips.

1.17 **Additional information**

1.17.1 **P&WC SERVICE BULLETIN No. 1703 R2**

Pratt & Whitney of Canada Service Bulletin No. 1703 R2 called for CT blades to be overhaul inspected at 5,000 hours. There was no record of this inspection being carried out. The maintenance company said that the inspection was not carried out because the engine manufacturer, P&WC, issued this as a recommendation that was not mandatory.

2. ANALYSIS

It is evident from the circumstances of the accident that the force landing was necessitated by the engine failure shortly after take off.

The tarmac road in the vicinity was the best possible choice for the force landing provided, of course, a stretch of it with no vehicles could be located in the short time available since the aircraft had not gained sufficient altitude for powerless manoeuvres. The presence of engine oil on the wind screen prevented the pilot from seeing distant vehicles on the road.

The loud bang and the subsequent splash of engine oil on the wind screen were indications of engine seizure in flight.

It was therefore imprudent to use the emergency power lever (EPL) whose function is to add more fuel into the combustion chamber for the purpose of boosting power.

In the immediate aftermath of engine power loss, pilots' reaction (from training) is to use the EPL to restore power. However, as is evident in this case, the application of the EPL served to add more fuel to a damaged system that was already spooling down. This resulted in excessively high temperatures which led to the overheating of the already damaged compressor turbine blade(s). Much of the investigation evidence was thus lost.

The pattern of the damage, starting from the CT disc to many components downstream, is typical of one that is initiated by the fracture of one or more blades from the CT disc.

Laboratory tests failed to identify the particular blade(s) that fractured first thereby initiating the entire failure sequence. This was because the fracture surfaces of the subject blade(s) were destroyed by the high speed impact of broken parts and the subsequent over temperature caused by the application of the EPL. Pratt & Whitney Laboratory analysis determined that the blade materials met engineering drawing requirements. No original defects were observed.

At the time of the accident, the engine had logged 6308 hours. It had 192 to go before overhaul. Service Bulletin No. 1703 R2 (Page 5 paragraph 3 E) called for overhaul inspection at 5,000 hours. This inspection was not carried out.

According to the aircraft maintenance organization, the CT disc was not sent for the 5,000 hours inspection because the requirement was a manufacturer's recommendation.

Indeed the manufacturer issued SB No. 1703 R2. However, he did not make it mandatory. In fact there was also no Airworthiness Directive issued in support of the Bulletin. For this reason, the maintenance organization supporting 5H-MUA had the discretion of not complying with the SB. In the circumstances, TCCA could also not mandate this Service Bulletin.

In any case, there is no evidence to indicate that this non-compliance had any bearing on the failure of the CT blade(s).

2. CONCLUSIONS

(a) Findings

- (i) The pilot was properly licensed and qualified to undertake the flight.
- (ii) The aircraft was properly maintained and its documentation was in order.
- (iii) The aircraft was correctly loaded and its centre of gravity was within the allowed limits.
- (iv) The aircraft made a successful take off from Lake Manyara Airport.
- (v) The engine suffered a complete loss of power during climb.
- (vi) The pilot used the emergency power lever in an effort to restore power.
- (vii) The pilot attempted to land on a tarmac road which was directly

below
the aircraft flight path.

- (viii) Whilst manoeuvring to avoid a truck that on the road, the aircraft stalled and crashed.
- (ix) The engine failure in flight was initiated by the fracture and release of one or more compressor turbine blades into the gas path and their subsequent impact with adjacent and downstream components.

(b) Cause(s)

The accident was caused by the aircraft stalling and crashing whilst trying to avoid a truck on the road. The attempt to land on the road was necessitated by the loss of power arising from the engine CT blade(s) failure in flight.

The cause of the CT blade(s) failure could not be determined due to severe overheating and impact damage to the blade airfoils. The failure of the pilot to see the landing sight clearly through the wind screen due to the splash of engine oil on the wind screen was a major contributory factor.

3. SAFETY RECOMMENDATIONS

It is recommended that:

- (1) In the light of the pilot's instinctive use of the emergency power lever, there is need to revise pilots' training programs, giving particular emphasis to situations when the EPL should NOT be used.
- (2) There is need to install electronic boxes on this type of aircraft to record engine parameters so that all abnormal operations at any one time that can induce stress in critical parts can be monitored.