Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

# AVIATION INVESTIGATION REPORT
# A14O0178

## GEAR-UP LANDING

## AIR CREEBEC INC.
## BEECHCRAFT KING AIR A100, C-FEYT
## TIMMINS VICTOR M. POWER AIRPORT
## TIMMINS, ONTARIO
## 26 SEPTEMBER 2014

Canada

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Cat. No. TU3-5/14-0178E-PDF

ISBN 978-0-660-04226-8

This document is available on the website of the Transportation Safety Board of Canada at www.tsb.gc.ca

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## **Gear-up landing**
## Air Creebec Inc.
## Beechcraft King Air A100, C-FEYT
## Timmins Victor M. Power Airport
## Timmins, Ontario
## 26 September 2014

## *Summary*

The Air Creebec Inc. Beechcraft King Air A100 aircraft (registration C-FEYT, serial number B-210) was operating as Air Creebec flight 140 on a scheduled flight from Moosonee, Ontario, to Timmins, Ontario, with 2 crew members and 7 passengers on board. While on approach to Timmins, the crew selected "landing gear down," but did not get an indication in the handle that the landing gear was down and locked. A fly-by at the airport provided visual confirmation that the landing gear was not fully extended. The crew followed the Quick Reference Handbook procedures and selected the alternate landing-gear extension system, but they were unable to lower the landing gear manually. An emergency was declared, and the aircraft landed with only the nose gear partially extended. The aircraft came to rest beyond the end of Runway 28. All occupants evacuated the aircraft through the main entrance door. No fire occurred, and there were no injuries to the occupants. Emergency services were on scene for the evacuation. The accident occurred during daylight hours, at 1740 Eastern Daylight Time.

*Le présent rapport est disponible en français.*

# *Factual information*

## *History of the flight*

The Air Creebec Inc. Beechcraft King Air A100 aircraft (King Air), registration C-FEYT, serial number B-210, had flown on 4 flights that day without any reported discrepancies. On departure from Moosonee, Ontario, the landing gear had retracted with no faults observed. As the aircraft approached Timmins Victor M. Power Airport, flight 140 was cleared by Toronto Area Control Centre to descend to 5000 feet above sea level (asl). When the crew made visual contact with the airport, the captain cancelled the instrument flight rules (IFR) flight plan and switched frequency to Timmins flight service station (Timmins Radio).

At 4.5 nautical miles (nm) back from Runway 28, and at an altitude of 2000 feet asl, the crew selected flaps to "approach" and "landing gear down". The crew heard the landing gear motor operating for approximately 5 seconds before it stopped. The landing gear handle red light remained on, indicating that the landing gear was in transit. There were no green lights for any of the landing gear components, indicating that they were not down and locked. At approximately the same time, both the generator off lights on the annunciator panel illuminated and the load metres indicated zero.

The captain took control of the aircraft, as the first officer had been the pilot flying (PF). The aircraft was levelled at 2000 feet asl and flown overhead of the airport. An attempt to reset the 2 generators was unsuccessful, and there was no indication of a fire or electrical odour in the aircraft. The captain contacted Timmins Radio and declared an emergency. The aircraft remained at circuit altitude while the crew performed the emergency procedures to reset the generators. Knowing that the previous reset attempt had been unsuccessful, the crew began to shed electrical loads by shutting off unnecessary equipment. The crew was aware that the aircraft was now operating on battery power only.

The captain engaged the alternate landing gear extension system. However, when the captain attempted to move the handle, it was jammed. The aircraft remained within the traffic circuit, and the crew stayed in contact with Timmins Radio. They reported that they were operating on battery power only and could potentially lose all communications. The crew reset the landing gear relay circuit breaker located on the pilot's sub-panel and again attempted to lower the landing gear using the normal system, but were unsuccessful. Another fly-by of the airport confirmed that the landing gear position had not changed from nose gear partially extended and main gear doors open.

The crew briefed the passengers and advised them on the brace position for landing and the evacuation procedure once the aircraft came to a stop. The aircraft flew the approach for Runway 28 with the flaps remaining in the "approach" setting. As the aircraft flew over the threshold, the captain (PF) reduced both engines to idle, and the first officer moved the propeller levers to the feather position and the condition levers to cut-off. The captain then switched all electrical power off and maintained directional control of the aircraft using the rudder. With the nose gear partially extended, the aircraft touched down on the runway 1530 feet beyond the threshold, and settled on the main landing gear doors at 3130 feet

beyond the threshold. It continued down the runway, then slid off the end of the runway, continuing for approximately 40 feet before coming to rest (Photo 1). All of the occupants exited the aircraft through the main cabin door and were met by emergency services. The accident occurred at 1740.[1]

**Photo 1. Front view of the occurrence aircraft off the runway**

The aircraft was equipped with a cockpit voice recorder (CVR), which was shipped to the TSB Laboratory for data download and analysis. The CVR data provided information on the period from the point when the landing gear was selected to extend until just prior to touchdown when electrical power was shut off by the captain.

## *Damage to aircraft*

The following aircraft components were substantially damaged during the landing:

- Propeller blades
- Engines
- Main and nose landing gear doors
- Flaps
- Underbelly skin and antennas.

## *Airport*

Timmins Victor M. Power Airport is an uncontrolled airport with a flight service station[2] and 2 available runways. Runway 03/21 is 6000 feet long and 150 feet wide. Runway 10/28 is 4907 feet long and 150 wide. Both runways are asphalt-covered. The airport has an elevation of 968 feet asl. There are no fire/emergency services affiliated with the airport. Radio communications are provided by Timmins Radio. Timmins Radio is contacted by airborne aircraft, which provide their position from the airport, direction, and altitude. This information is transferred to other aircraft in the vicinity on initial radio contact. Timmins Radio also provides current airport weather, and during this occurrence, contacted City of Timmins Emergency Services.

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[1] All times are Eastern Daylight Time (Coordinated Universal Time minus 4 hours).

[2] An ATS unit that provides services pertinent to the arrival and departure phases of flight at uncontrolled aerodromes and for transit through a mandatory frequency (MF) area (Source: Transport Canada, TP 14371E, *Transport Canada Aeronautical Information Manual*, [02 April 2015], Gen 5.0).

## *Weather information*

The aviation routine weather report (METAR) for Timmins at 1700, approximately 40 minutes before the aircraft landed, was as follows: wind 260° True at 5 knots, visibility 15 statute miles, broken ceiling at 4800 feet above ground level, temperature 24 °C, dew point 16 °C, and barometric pressure 30.19 inches of mercury.

## *Air Creebec*

Air Creebec Inc. is a regional airline based in Val-d'Or, Quebec, operating scheduled and charter services to 16 destinations in Quebec and Ontario. The company operates 19 aircraft under CARs subparts 705, 704, and 703.

As required under CARs subpart 705, Air Creebec has a safety management system (SMS). Its SMS incorporates a combination of guidelines from Transport Canada (TC) and from the International Air Transport Association Operational Safety Audit (IOSA) Standards Manual, and encompasses all of the company's aircraft operations, related equipment, and departments.

## *Flight crew information*

Both pilots were certified and qualified for the flight in accordance with existing regulations. The captain had been an employee of the operator since February 2013 and a captain on the King Air since March 2013. His total flying time was approximately 2400 hours, of which 1000 hours were on the King Air. The first officer had been an employee of the operator for approximately 1 year and had accumulated a total of 580 flying hours, of which 300 hours were as first officer on the King Air.

## *Landing gear system*

Beechcraft King Air A100 aircraft are equipped with a retractable, tricycle landing gear that is operated via an electrical motor and a gearbox assembly. The main landing-gear actuators are driven by torque shafts from the motor gearbox. The nose gear actuator is driven by a duplex chain from a sprocket on the gearbox torque shaft. Depending on the direction of rotation from the gearbox, the landing gear can extend or retract. Control of the system comes from the landing-gear handle in the cockpit. A 200-ampere circuit breaker protects the system from overload. In addition, a safety switch located in the right main gear strut breaks control of the landing-gear circuit when compressed, preventing inadvertent gear retraction while the aircraft is on the ground.

The landing-gear system is also equipped with an alternate (manual) extension system as a backup to the normal system. When selected, it removes electrical power from the landing-gear circuit and allows the pilot to extend the gear through a handle in the cockpit floor.

When the pilot pumps the handle, the landing gear is extended until the 3 green lights in the cockpit illuminate, indicating that the gear is down and locked.[3]

## *Examination of the landing-gear extension system*

Before the aircraft was removed from the scene, investigators took off the cabin floor panel, which covers the landing-gear motor and transmission. A wire bundle that was routed through the area of the landing-gear motor and transmission had caught on the rotating torque shaft that drives the landing-gear screw jacks to extend or retract the landing gear (Photo 2). As the bundle had wrapped itself around the shaft, it had pulled wires connected to the 2 generator voltage regulators, disconnecting the generator control circuits. One of the voltage regulators had been pulled from its floor mount.

**Photo 2. Wire bundle wrapped around the landing-gear torque shaft**


The shaft is in sections, each of which is joined by 2 bolts that go through a shaft joint perpendicularly to each other. The bolts are secured in place by nuts. The purpose of the shaft joints is to facilitate the removal of the torque shaft in sections during maintenance, such as during landing-gear component replacement or when adjusting the travel of the landing-gear screw jack actuators.

After the landing-gear shaft system seized and the 2 generators were disabled, the aircraft's only source of electrical power was the single battery. The battery powered the aircraft for approximately 30 minutes, which, under an emergency electrical condition, is the normal length of time a fully charged battery is expected to power aircraft systems. Electrical load shedding will extend battery power.

## *Aircraft maintenance*

The aircraft was manufactured by the Beechcraft Aircraft Corporation in 1975. According to TC registry records, Air Creebec had been the registered owner of the aircraft since October 2013. During its life in service, the aircraft had accumulated approximately 14 985 flight hours and 15 570 cycles. Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The last inspection was an A Check, completed on 20 September 2014.

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[3] Beechcraft Corporation, *Beechcraft King Air A100 Series Maintenance Manual* (24 September 1999), Chapter 32.

On 05 May 2014, while the aircraft was in Moosonee, the flight crew entered a defect in the aircraft journey logbook and maintenance record. The entry read "gear selector down unserviceable". Air Creebec then obtained a ferry flight authorization, and the aircraft was flown to the operator's main maintenance base in Timmins, where Air Creebec maintenance personnel replaced the landing-gear retraction motor and returned the aircraft to service. This maintenance appears to have been the only time when extensive work was performed by Air Creebec in the area where the wire bundle and the landing-gear rotating shaft are located. Following completion of the motor replacement, maintenance personnel cycled the landing gear and found no faults with its operation. The aircraft had performed 254 landing-gear cycles without incident since the landing-gear retraction motor had been replaced.

Beechcraft maintenance documentation[4] and Advisory Circular (AC) 43.13-1B[5] provide guidance material for maintenance personnel on how to correctly secure wiring and protect it from chafing. This information is not specific to the landing-gear system and can be applied to other similar installations and systems throughout the aircraft.

## *Inspection schedule*

An A check is a visual inspection that is performed every 7 calendar days and includes operational checks of aircraft systems. It is not part of the inspection schedule provided by the aircraft manufacturer, but was incorporated by Air Creebec into its TC-approved maintenance program to improve aircraft in-service reliability.

In addition to A checks, 4 phase inspections (identified by numbers from 1 to 4) are performed every 200 flight hours. After phase 4 is completed, the schedule cycles back to phase 1. Phases 3 and 4 require the removal of floor panels in the area where the landing-gear motor and transmission are located. The removal provides viewing access to the torque shaft and wiring in this area. Records indicate that the phase 4 inspection was completed on 19 April 2014. This phase includes, but is not limited to, the checking of the security and condition of wiring, general cleanliness of the area, and security of components.

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[4] Beechcraft Corporation, *Beechcraft King Air A100 Series Maintenance Manual* (24 September 1999), Chapter 20-04-00-001.

[5] Federal Aviation Administration (FAA) AC 43.13-1B, *Acceptable Methods, Techniques, and Practices – Aircraft Inspection and Repair* (08 September 1998). This is an accepted reference publication used by maintenance personnel that provides guidelines and procedures for the performance of maintenance and repair work.

# *Analysis*

During the landing-gear extension, the rotating torque shaft that drives the screw jack actuators to lower the landing gear caught on a wire bundle that is routed through this area. The bundle likely snagged on the torque shaft bolts. As the shaft rotated after "landing gear down" was selected, the wire bundle became entangled around the torque shaft and prevented further rotation of the shaft, which consequently halted the landing-gear extension. The alternate gear extension system uses the same torque shaft system to extend the landing gear, and so it was disabled as well. The crew was therefore required to conduct a landing with only the nose gear partially extended and the main landing-gear doors open.

The wire bundle included wiring for the generator control units. This wiring was sufficiently damaged to disconnect the generator control circuits and illuminate the generator lights on the annunciator panel.

It could not be determined when or how the wire bundle shifted sufficiently to catch on the rotating shaft during the landing-gear extension. Maintenance had been performed previously in this area when the landing-gear retraction motor was replaced, and the wire bundle may have been inadvertently shifted. However, numerous flights and landing-gear cycles had been performed without incident since this maintenance.

# *Findings*

## *Findings as to causes and contributing factors*

1. During the extension of the landing gear, a wire bundle became entangled around the landing-gear rotating torque shaft, preventing full extension of the landing gear.

2. The entanglement by the wire bundle also prevented the alternate landing-gear extension system from working. The crew was required to conduct a landing with only the nose gear partially extended.

## *Other findings*

1. The wire bundle consisted of wiring for the generator control circuits, and when damaged, disabled both generators. The battery became the only source of electrical power until the aircraft landed.

# *Safety action*

## *Safety action taken*

### *Air Creebec Inc.*

After the occurrence, Air Creebec performed its own safety management system investigation, and all findings, and actions taken as a result of findings, were provided to the TSB. As part of its investigation, Air Creebec immediately performed an inspection of its 2 other Beechcraft King Air A100 aircraft, and found no faults. As a precaution, the wiring harnesses surrounding the landing-gear drive shaft were resecured to ensure that there would be no possibility of contact in future operations. The operator also submitted a safety deficiency report to TC and issued an in-house maintenance advisory to its staff to check for proximity of wiring harnesses to surrounding rotating parts. It reviewed all pertinent airworthiness directives, service bulletins and safety communiques, but did not find any information that related to this type of event.

In addition, Air Creebec contacted other operators using the same type of aircraft and made them aware of the potential for this type of event.

*This report concludes the Transportation Safety Board's investigation into this occurrence. The Board authorized the release of this report on 16 December 2015. It was officially released on 14 January 2016.*

*Visit the Transportation Safety Board's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.*