Australian Government

Australian Transport Safety Bureau

# Engine failure and forced landing of Beech Aircraft 76, VH-BDS

49 km NW of Cessnock Airport, NSW, 1 June 2018


**ATSB Transport Safety Report**

Aviation Occurrence Investigation

AO-2018-047

Final – 15 January 2019

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*


**Publishing information**

**Published by:** Australian Transport Safety Bureau
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**Addendum**

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# Engine failure and forced landing of Beech Aircraft 76, VH-BDS

## What happened

On the evening of 1 June 2018, a twin-engine Beech Aircraft 76 (Duchess), registered VH-BDS, departed Coonamble Airport, New South Wales (NSW) with a pilot and two passengers on board. The aircraft was conducting a private flight to Cessnock Airport, NSW.

Prior to departure, the pilot reviewed the fuel quantity and checked the fuel for contamination. The aircraft had about 190 L on board (anticipated fuel use for the flight was 107 L). The aircraft had no known maintenance issues.

The pilot did not provide a safety briefing to the passengers. As he had not loaded headsets, he provided them earmuffs (not connected to the aircraft intercom) for hearing protection. The pilot occupied the front left seat with the passengers seated in the front right and rear right seats.

At about 1730 Eastern Standard Time (EST),[1] 8 minutes before last light,[2] the aircraft departed Coonamble and climbed to a cruising altitude of 7,500 ft in visual meteorological conditions.[3]

At about 1816, the pilot slightly reduced power and began descending the aircraft for Cessnock. At about 1821, he felt the aircraft yaw toward the right and observed the right engine indications showing a loss of power.

The pilot immediately commenced the engine failure checklist, which included selecting engine mixtures to full rich, increasing propeller RPM for both engines and advancing the throttles. He then confirmed the landing gear and flaps were retracted. The pilot also considered carburettor icing as a reason for the power loss and selected carburettor heat ‘on’ and ‘off’ (see the section titled *Carburettor icing*). The engine did not respond so he then conducted the engine failure checklist again. He also selected the fuel to cross-feed from the left fuel tank.

As the right engine did not respond, the pilot elected to secure the failed engine and configure the aircraft for single-engine flight. When securing the engine, the pilot moved the mixture to idle cut-off, the propeller control to the feather position (see *Propeller Feathering* section) and the throttle to idle. He reported that he did not confirm that the right propeller had actually feathered. After securing the failed engine, the pilot did not attempt to unfeather the propeller, or restart the failed engine.

In order to maintain altitude, the pilot focussed on targeting the single-engine best rate of climb speed. He also ensured that airspeed did not reduce and affect aircraft controllability. The pilot observed that in order to maintain the required speed, the aircraft could not maintain altitude and continued to descend. In order to arrest the descent, the pilot increased power on the left engine to maximum but the aircraft continued descending.

The pilot considered diverting to Scone Airport but due to the proximity of housing near that airport, and his familiarity with Cessnock Airport, he decided to continue to Cessnock.

1 Eastern Standard Time (EST): Coordinated Universal Time (UTC) + 10 hours.

2 Last light: the time when the centre of the sun is at an angle of 6° below the horizon following sunset. At this time, large objects are not definable but may be seen and the brightest stars are visible under clear atmospheric conditions. Last light can also be referred to as the end of evening civil twilight.

3 Visual Meteorological Conditions (VMC): an aviation flight category in which visual flight rules (VFR) flight is permitted – that is, conditions in which pilots have sufficient visibility to fly the aircraft while maintaining visual separation from terrain and other aircraft.

As the aircraft descended thorough about 5,500 ft, the pilot calculated that the descent rate would not allow the aircraft to clear high terrain between its position and Cessnock. At 1827, he declared MAYDAY[4] and advised air traffic control that he did not believe the aircraft could reach Cessnock.

At about 1830, the pilot elected to conduct a forced landing. At that time, the aircraft was positioned above the Ravensworth Mines. The pilot was familiar with the location and knew that flat areas, clear of vegetation, were located next to the mines.

While it was about 40 minutes after last light, enough daylight remained for the pilot to select a generally suitable landing area. He then selected a clear area and configured the aircraft for landing with the landing gear retracted.

With no intercom-connected headsets to communicate with the passengers, the pilot did not attempt to warn them and focused on flying the aircraft. The front seat passenger later reported that he was not aware of the impending forced landing.

The aircraft touched down in a grassy field on the underside of the fuselage and slid over a slope. The pilot yawed the aircraft sideways in an attempt to slow down but it continued over the slope before coming to rest (Figure 1). The pilot and passengers then evacuated the aircraft using the left cabin door; they were not injured but the aircraft was substantially damaged.

**Figure 1: VH-BDS at the accident site**


Source: Pilot

### *Engine and propeller examination*

Photographs and video footage of the aircraft taken immediately after the accident showed the right propeller in the fine pitch position and not the expected feathered position (Figure 2). The engineer who recovered the aircraft reported that fuel was present in both fuel tanks and both engine carburettors.

The ATSB did not conduct an inspection of the propeller feathering system or engine.

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4 MAYDAY: an internationally recognised radio call announcing a distress condition where an aircraft or its occupants are being threatened by serious and/or imminent danger and the flight crew require immediate assistance.

**Figure 2: Right engine after the accident showing the propeller**

Source: YouTube

## *Meteorological conditions*

The weather forecast for the cruise and descent segments of the flight indicated broken cloud at altitudes between 5,000 ft and 8,000 ft, with an expected freezing level[5] of 7,000 ft. The pilot reported that the weather was better than forecast with cloud above the selected cruising level, and that he was able to maintain visual conditions throughout the flight.

The dewpoint[6] recorded at the Bureau of Meteorology's Singleton, NSW, weather station (35 km southeast of the accident site) at 1820 (approximate engine failure time) was 3.9 °C.

## *Carburettor icing*

Induction icing, often referred to as carburettor icing, is the accumulation of ice within the induction system of an engine fitted with a carburettor. This ice forms as the decreasing air pressure and introduction of fuel reduces the temperature within the system. The temperature may reduce sufficiently for moisture within the air to freeze and accumulate. This build-up of ice restricts airflow to the engine, leading to a reduction in engine performance and possible engine failure. Environmental conditions influence the likelihood of carburettor ice forming (see the Civil Aviation Safety Authority (CASA) *Carburettor icing probability chart* - shown in Figure 3).

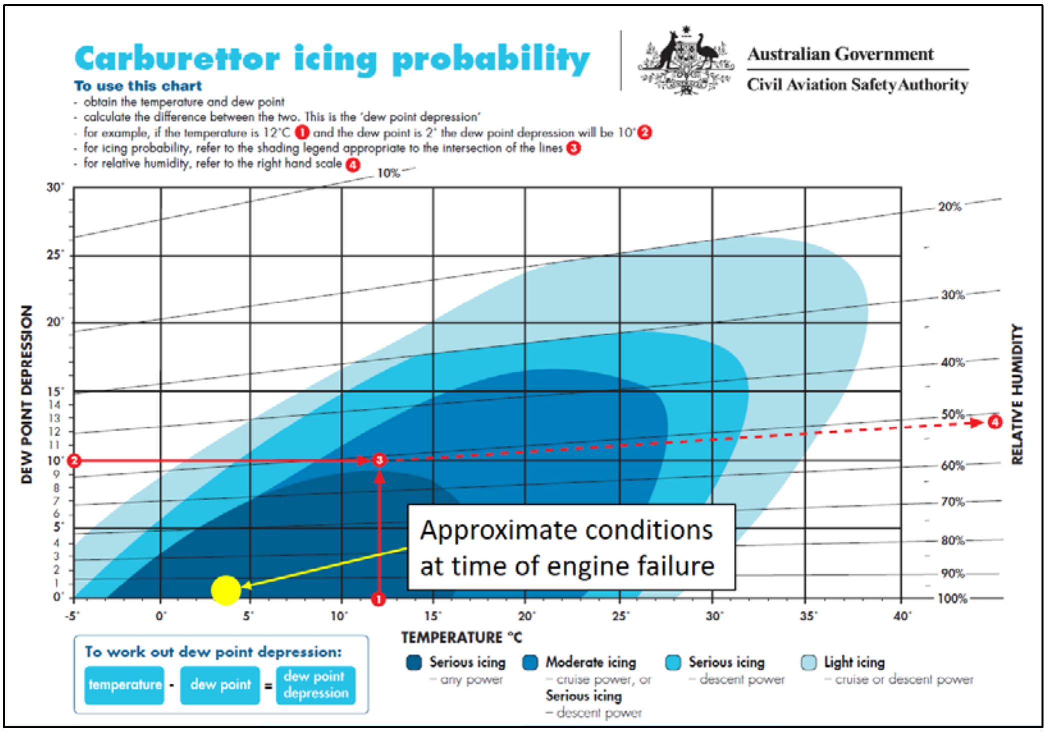
At the time of the engine failure, the aircraft was descending through, and just below, the forecast freezing level. The forecast and observed cloud level, along with analysis of the recorded weather observations, indicated that the aircraft was operating in an atmosphere of high relative humidity.

The carburettor icing probability chart shows that the aircraft was descending in conditions of serious carburettor icing at descent power (Figure 3).

5 Freezing level is the altitude, for a specific location, at which the temperature has reduced to zero degrees Celsius.

6 Dewpoint: the temperature at which water vapour in the air starts to condense as the air cools. It is used, among other things, to monitor the risk of aircraft carburettor icing or the likelihood of fog.

**Figure 3: Carburettor icing probability chart**




Source: CASA annotated by ATSB

The Duchess is equipped with a carburettor heat system which, when selected 'on', allows heated air to enter the engine induction system to reduce the likelihood of carburettor icing.

The descent checklist in the aircraft's operating handbook provided the following guidance on the use of carburettor heat.

> Carburettor heat – FULL ON or FULL OFF, AS REQUIRED

Once selected 'on', the carburettor heat should remain on until normal engine power is restored. If ice has already accumulated, engine performance may deteriorate further as the ice melts before engine performance returns to normal. This may take up to 30 seconds. The pilot reported that he applied carburettor heat as part of troubleshooting following the right engine power loss. However, he also stated that he may not have applied it for long enough.

The engine manufacturer, Lycoming, issued a service instruction, *No. 1148C Use of Carburetor Heat Control*, that applied to all its engines fitted with float-type carburettors, including VH-BDS. The service instruction also noted that the possibility of induction icing at full throttle, was very remote (may be dependent on the individual engine installation).

### *Propeller feathering*

The Duchess is equipped with full-feathering, two-bladed propellers. When an engine is shut down in-flight and the associated propeller control is moved to the feather position, the propeller blades rotate to an edge-on angle to the airflow to minimise drag. A propeller that is not feathered after an engine failure can produce sufficient drag to prevent the aircraft maintaining altitude.

Given the aircraft's weight and ambient conditions at the time of the engine failure, the aircraft's operating handbook indicated the aircraft should have been capable of maintaining altitude with the propeller of the failed engine feathered.

## Safety analysis

At about 1820, the aircraft was descending in conditions that were conducive to serious carburettor icing at the selected engine power without carburettor heat applied. Those operating conditions, in combination with the described nature of the power loss, supported a conclusion that the right engine was affected by carburettor icing that progressed to engine failure. The described performance of the left engine when full throttle was applied, however, indicated that it was unaffected by carburettor icing despite operating in the same environmental conditions, and at a similar power level. The significant difference in the behaviour of the two engines support the possibility that the power loss in the right engine may have been due to some other unidentified source.

The pilot recalled that after the engine failure, he conducted the propeller feathering actions, but did not confirm that the propeller had feathered. He did not attempt to unfeather the propeller or restart the engine after this time. Post-accident photographs and video show that the propeller was not feathered at the time of the forced landing. Additionally, the inability of the aircraft to maintain altitude was considered to be due to the significant drag associated with the unfeathered propeller. As the aircraft and its systems were not examined, a fault that may have prevented selection of the feathered position could not be ruled out.

As the aircraft descended, the pilot calculated that the aircraft would not safely clear high ground between its positon and the airport. The pilot therefore elected to conduct a forced landing with the landing gear retracted. The forced landing resulted in substantial damage to the aircraft.

## Findings

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

- During descent, the right engine of VH-BDS failed, possibly due to carburettor icing.
- After the right engine failed, the propeller was not feathered, or did not feather. The increased drag of the unfeathered propeller prevented the aircraft from maintaining altitude.
- The inability to maintain altitude led the pilot to conduct a forced landing, which resulted in substantial damage to the aircraft.

## Safety message

This accident highlights the importance of ensuring carburettor heat is used to prevent carburettor ice accumulating and leading to engine failure. If carburettor icing is encountered, or suspected, carburettor heat must be applied fully, and for sufficient time, to melt any accumulated ice. While that occurs, the performance of the engine may temporarily deteriorate further. The Flight Safety Australia article *Ice Blocked* provides useful guidance for managing carburettor icing.

Additionally, this occurrence illustrates the importance of correctly configuring a multi-engine aircraft following an engine power loss. On this occasion, the increased drag associated with the unfeathered propeller resulted in a risky forced landing.

While all occupants evacuated the aircraft uninjured, the passengers had not received a pre-flight safety briefing nor were they aware of the impending forced landing. The likelihood of injury during a landing with landing gear retracted, on unfamiliar terrain and at night, is high. Therefore, safety briefings before flight and, where possible, prior to an emergency landing are essential in preparing passengers for the landing and subsequent evacuation.

# General details

## *Occurrence details*

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|---|---|---|
| Date and time: | 1 June 2018 – 1830 EST | |
| Occurrence category: | Accident | |
| Primary occurrence type: | Collision with terrain | |
| Location: | 49 km NW of Cessnock, NSW | |
| | Latitude: 32° 29.40' S | Longitude: 150° 57.33' E |

## *Aircraft details*

| | | |
|---|---|---|
| Manufacturer and model: | Beech Aircraft Corp 76 | |
| Registration: | VH-BDS | |
| Serial number: | ME-64 | |
| Type of operation: | Private | |
| Persons on board: | Crew – 1 | Passengers – 2 |
| Injuries: | Crew – 0 | Passengers – 0 |
| Aircraft damage: | Substantial | |

# About the ATSB

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

# About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.