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ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2010-019
Preliminary

# Collision with terrain, VH-ANB Darwin Aerodrome, Northern Territory 22 March 2010

## Abstract

On 22 March 2010, at 1009 Central Standard Time, an Embraer - Empresa Brasileira de Aeronautica EMB-120ER Brasilia with two crew, prepared to take off on a training flight from runway 29 at Darwin Aerodrome, Northern Territory. The crew were the only occupants. The training captain advised the aerodrome controller that the departure would incorporate asymmetric flight (simulated engine failure) and was approved by the controller to perform the manoeuvre.

After becoming airborne, witnesses reported seeing the aircraft roll and diverge left from its take-off path. They watched as the aircraft continued rolling left, and entered a steep nose-down attitude. It disappeared into trees, south of the runway threshold from where a column of black smoke was seen shortly afterwards.

Aerodrome rescue and fire fighting services were in attendance very shortly thereafter and extinguished the fire. Both pilots were fatally injured and the aircraft was seriously damaged due to impact forces and an intense post-impact fire.

The investigation is continuing.

## FACTUAL INFORMATION

*The information contained in this preliminary report is derived from initial investigation of the occurrence. Readers are cautioned that there is the possibility that new evidence may become available that alters the circumstances as depicted in the report.*

### History of the flight

On 22 March 2010, at 1009 Central Standard Time[1], an Embraer - Empresa Brasileira de Aeronautica EMB-120ER Brasilia (Brasilia), registered VH-ANB (ANB), prepared to take off from the taxiway E2 intersection of runway 29 at Darwin Aerodrome, Northern Territory on a planned airwork flight, under the instrument flight rules. The two crew were the only occupants. The flight was a training flight to revalidate the captain's command instrument rating. The supervisory pilot/training captain, who occupied the copilot's or right seat, advised the aerodrome controller (ADC) that the departure would incorporate asymmetric flight (a simulated engine failure), and was approved by the ADC to perform the manoeuvre.

Witnesses reported that the takeoff appeared 'normal' until a few moments after becoming airborne, when the aircraft rolled and diverged left from its take-off path. They watched as the aircraft

1 The 24-hour clock is used in this report to describe the local time of day, Central Standard Time, as particular events occurred. Central Standard Time was Coordinated Universal Time (UTC) + 9 and a half hours.

continued rolling left, and entered a steep nose-down attitude. The witnesses lost sight of the aircraft in trees to the south of the upwind end of the runway, from where a column of black smoke was seen shortly afterwards.

Aerodrome rescue and fire fighting services were in attendance very shortly thereafter and extinguished the fire. Both pilots were fatally injured and the aircraft was seriously damaged[2] due to impact forces and an intense post-impact fire (Figure 1).

**Figure 1: Aerial view of wreckage**

## Aircraft information

The Brasilia is a 30-passenger seat, twin-turbopropeller aircraft manufactured in Brazil. There were 21 of these aircraft on the Australian register at the time of the accident that were operated by regional airlines. Brasilia ANB, serial number 120-116 (Figure 2), was manufactured in 1989 and was first registered in Australia on 2 August 1993. At the time of the accident it had accumulated 32,799.4 hours total time in service and 33,700 cycles since new.

The aircraft was equipped with two Pratt and Whitney Canada model PW118A gas turbine engines, each rated at 1,800 shaft horsepower and driving, through a reduction gearbox, a four-bladed Hamilton Standard constant speed, full-feathering, reversing propeller. The propeller blades were of composite construction.

The aircraft trim sheet, which was prepared by the captain under check, showed that the:

- aircraft's take-off weight was 9,663 kg, including 1,633 kg (1,814 L) of fuel and 80 kg of ballast in the rearmost baggage section
- aircraft was loaded within weight and centre of gravity limits.

2 The *Transport Safety Investigation Regulations 2003* definition of 'seriously damaged' includes the 'destruction of the transport vehicle'.

Figure 2: VH-ANB[3]


## Wreckage examination

The wreckage was located in bush land on level ground within the aerodrome boundary. Damage to foliage and ground impact marks were consistent with a steep impact trajectory. Damage to the aircraft was consistent with a relatively low forward speed at impact, and the aircraft being in a right wing-low, nose-down attitude of about 65°.

A high intensity, fuel-fed fire that followed the collision with the ground destroyed most of the fuselage and cabin, the right wing and the inboard section of the left wing (Figure 3).

The cockpit, apart from the overhead panel, was destroyed by impact forces and by fire. Both the left and right engines and propeller assemblies were also severely damaged by impact forces and by fire. The landing gear was in the retracted position and the flaps were extended to 15° at the time of impact. All flight control surfaces were accounted for on the accident site.

The aircraft engines and propeller hubs were removed and transported to a secure location for possible further examination. The aircraft rudder power control unit and rudder hydraulic actuators were removed for testing and examination.

### *Examination of recorders*

The aircraft was fitted with a cockpit voice recorder (CVR) and a separate flight data recorder (FDR). The CVR and FDR were located in the aircraft's tail section and had sustained minor damage from the accident and post-impact fire. Both recorders were recovered from the accident site, secured and transported to the Australian Transport Safety Bureau's facilities in Canberra for examination and data download.

The CVR records the total audio environment in the cockpit area. This can include crew conversation, radio transmissions, aural alarms and engine noise. The CVR that was installed in ANB retained the last 30 minutes of information in solid-state memory, operating on an endless-loop principle.

3 Photograph courtesy of Martin Eadie.

Figure 3: Aircraft wreckage

The CVR was downloaded and examination of that download showed that the audio from the accident flight had been successfully recorded. The 30-minute recording covered cockpit preparation, engine start, taxiing and the flight. Prior to departure the crew's conversation included briefing for the simulated engine failure exercise and subsequent training manoeuvre.

The FDR system comprised the FDR, a Teledyne flight data acquisition unit (FDAU), aircraft sensors and a triaxial accelerometer. The programming of the 17-channel FDAU determined what parameters were recorded. In ANB, the recorded parameters included:

- pressure altitude
- indicated airspeed
- magnetic heading
- pitch attitude
- roll attitude
- control wheel position (aileron control)
- control column position (elevator input)
- rudder pedal position
- pitch trim position
- vertical acceleration
- longitudinal acceleration
- lateral acceleration
- flap position
- engine parameters (including torque, propeller RPM (NP), inter-turbine temperature (T6), and low pressure (NL)/high pressure (NH) spool speeds
- outside air temperature
- microphone keying (time of radio transmissions).

The data that was recovered from the FDR contained 25 hours of aircraft operation covering the accident flight and 15 previous flights. The FDR used a tape-based recording medium, and the analogue signal recovered from the tape needed to be converted into digital data. Fluctuations in analogue signal quality or tape speed can typically result in data drop-outs. Not unexpectedly, there were several data drop-outs in the accident flight data.

The CVR and FDR information showed that a simulated left engine failure exercise was conducted during the accident flight. The simulated left engine failure commenced about 1 second after the aircraft became airborne.

Analysis of the CVR and FDR data is ongoing and will include:

- the recovery of all the FDR data from the accident flight
- a comparison of the engine performance and operation recorded during the simulated engine failure with that recommended by the manufacturer for a simulated engine failure exercise.

## Pilot information

The supervisory pilot/training captain commenced employment with the operator in January 2006. He held an Air Transport Pilot Licence (Aeroplane) that was endorsed for command of Brasilia aircraft, and a valid Class 1 medical. He was approved to conduct training and checking of other company pilots for the renewal of command instrument ratings (CIR). The operator's records showed that he had 3,085 hours on the Brasilia, of which 2,685 hours were in command. His total aeronautical experience was 5,664 hours.

The captain undergoing the check for renewal of his CIR had been employed by the operator since December 2004. He held an Air Transport Pilot Licence (Aeroplane) that was endorsed for command on Brasilia aircraft, and a valid Class 1 medical. The operator's records showed that he had a total of 3,749 hours on the Brasilia, of which 2,902 hours were in command, and a total aeronautical experience of 8,217 hours.

## Weather

The Darwin automatic terminal information service (ATIS) that was current at the time of the accident, reported a wind of 320° true at a speed of 5 kts, a visibility greater than 10 NM (19 km) with FEW[4] clouds at a height of 2,000 ft and a temperature of 30 °C.

## Asymmetric Training

The supervisory pilot/training captain was observed briefing the captain in the company briefing area prior to the flight. The supervisory pilot/training captain's written whiteboard briefing was seen by another company pilot, who reported it as being typical of the training captain's thorough preparation.

The planned flight consisted of normal and simulated emergency procedures to ascertain the proficiency of the captain under check for the annual renewal of his CIR, and of his competency on the aircraft type. A number of emergency training manoeuvres, including a simulated engine failure at takeoff, known as a '$V_1$-cut'[5], were planned as part of the sequence.

Asymmetric flight, whether from a simulated or actual engine failure, involves an element of risk. In the case of the in-flight simulation of engine failures, the risk is normally mitigated by limitations imposed on the simulation, such as procedures incorporating safety margins, and the careful selection and approval of pilots conducting the training.

The ATSB has published numerous reports of accidents and serious incidents that occurred during asymmetric flight. Of significance was a 2007 occurrence involving Brasilia aircraft, registered VH-XUE, that sustained a single-engine power loss due to fuel starvation, and the flight crew was required to carry out a single-engine go-around at Jundee, Western Australia (See http://www.atsb.gov.au/publications/investigation_reports/2007/aair/ao-2007-017.aspx). As a result of that occurrence, the ATSB issued a recommendation to the Civil Aviation Safety Authority that the lack of mandatory simulator training be addressed.

Subsequent to the Jundee occurrence, the availability of a suitable simulator has resulted in most Australian operators of Brasilia aircraft transferring significant parts of their flight training and checking to ground-based simulator training.

Asymmetric flight will continue to be a characteristic of in-flight training and checking for

4 Cloud amounts are reported in oktas. An okta is a unit of sky area equal to one-eighth of total sky visible to the celestial horizon. Few = 1 to 2 oktas, scattered = 3 to 4 oktas, broken = 5 to 7 oktas and overcast = 8 oktas.

5 $V_1$-is defined as the decision speed on takeoff at which, in a multi-engine aeroplane, should the critical engine fail, the pilot can elect to abandon the takeoff or to continue.

many sectors of the aviation industry, including some airlines. It is unlikely that in the foreseeable future, all asymmetric training will be transferred to ground-based simulators. However, the risk to pilots engaged in training and checking, where asymmetric flight is required, should not be unacceptable where pilots use approved procedures and are alert to the potential hazards.

## Further investigation

The investigation is continuing and will include the:

- continued analysis of the flight data and cockpit voice recorders
- testing of the recovered aircraft components
- examination of the aircraft's log books and maintenance documents
- examination of the operator's flight crew training records and programs.

# SAFETY ACTION

The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

## Aircraft operator

### *Fleet inspection*

Although no safety issue has been identified at this stage of the investigation in respect of the aircraft's rudder actuators, the operator has advised of the following safety action in response to this occurrence.

As a precaution, the operator immediately initiated a Rudder Hydraulic System Differential Pressure check of all rudder actuators in its Brasilia fleet. The rudder actuators of all four company aircraft were tested and found to be serviceable.

The operator also advised that, in an effort to enhance the reliability of the rudder actuators, and to improve the seals and prevent leaks, it has accelerated an upgrade program. At the time of writing this report, two of the company's aircraft had already had their rudder actuators upgraded.

### *Introduction of simulator training*

Although no safety issue has been identified at this stage of the investigation in respect of the use of aircraft simulators for asymmetric and other high risk training, the operator has already been pursuing that training option.

In May 2009, a Brasilia Simulator (SIM) was installed at an aviation training facility in Melbourne, Victoria. Although accredited by the Civil Aviation Safety Authority (CASA) for initial training, the facility did not have any approved trainers to undertake recurrent training for the operator.

In September 2009, CASA issued the training facility instructor's SIM instructor approval. The aircraft operator, who had previously entered into discussions with the training facility, was then able to proceed with negotiations for the provision of Brasilia SIM training.

In October 2009, the operator had further discussions with the training facility for the provision of both initial (including ground school and endorsement) and recurrent training in the SIM. The training facility was approved to deliver initial Brasilia endorsements independently; however, for recurrent training, instructors had to be trained and approved under the respective operator's systems.

In December 2009, the operator finalised a contractual agreement with the training facility for its Brasilia training, and sent four pilots to commence the SIM check and training approval process. Some of the SIM's visual capabilities were not fully functioning at that time.

In February 2010, three of the operator's pilots (including the check pilot who was involved in the accident) completed their SIM Check and Training and met the requirements for their CASA SIM instructor approval. The CASA delegate expected it would have taken 6 weeks to finalise and issue those approvals.

On 3 March 2010, the training facility instructor's approval to conduct the operator's recurrent training was issued but the instructor still had to complete the operator's induction course and some line flying in Darwin.

In February and March 2010, two of the operator's pilots attended the ground school and SIM endorsement training for the Brasilia in the Melbourne facility.

## Civil Aviation Safety Authority

Following the investigation of the serious incident involving a Brasilia at Jundee, Western Australia, in June 2007 (see ATSB investigation report AO-2007-017 at www.atsb.gov.au), Safety Recommendation AO-2007-017-SR-084 was issued to CASA in July 2009. That recommendation related to the lack of a regulatory requirement for simulator training.

In its latest response to that recommendation, which was received by the ATSB on 10 April 2010, CASA advised that:

> CASA released a Discussion Paper (DP) in December 2009 on the subject of mandatory flight simulator training. The DP put forward a range of options to canvas the views of industry participants. Responses to this DP closed in February 2010. Numerous responses were received from a variety of organisations and individuals, including airlines, pilots and flight simulator training providers. These responses are currently being reviewed and policy proposals are being developed.
>
> The subject of mandatory flight simulator training is a high priority for CASA and as such it is expected that a Notice of Proposed Rule Making (NPRM) will be published in the 2nd quarter of 2010. This NPRM will put forward CASA's proposed policy on this issue which will in part be derived from the comments received on the DP.
>
> Depending on the results of an assessment of business compliance costs, the proposal may be subject to a formal Regulation Impact Statement (RIS) which may prolong the rule making process.