ACCIDENT

Aircraft Type and Registration:	Britten Norman 2B-26 Islander, J8-VBI	
No & Type of Engines:	2 Lycoming 0-540-E4C5 piston engines	
Year of Manufacture:	1980 (Serial no: 2025)	
Date & Time (UTC):	29 September 2021 at 2133 hrs	
Location:	John A. Osborne Airport, Montserrat	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 1	Passengers - 6
Injuries:	Crew - None	Passengers - 1 (Minor) 5 (None)
Nature of Damage:	Aircraft damaged beyond economic repair	
Commander's Licence:	Commercial Pilot's Licence	
Commander's Age:	42 years	
Commander's Flying Experience:	2,650 hours (of which 712 were on type) Last 90 days - 105 hours Last 28 days - 22 hours	
Information Source:	AAIB Field Investigation	

Synopsis

On landing at John A Osborne Airport, Montserrat, the pilot was unable to maintain directional control of the aircraft, later reporting the left brake felt "spongy". The aircraft veered off the right side of the runway and came to rest in an adjacent drainage ditch.

An inspection of the aircraft's braking system revealed a slight brake fluid leak from one of the pistons in the left outboard brake calliper. This would have prevented full brake pressure being achieved on the left brakes, resulting in an asymmetric braking effect. Difficulty in maintaining directional control was compounded by the use of an incorrect braking technique on landing.

The investigation identified shortcomings with the operator's manuals, procedures and regulatory oversight.

One Safety Recommendation is made.

History of the flight

The pilot was based at V.C. Bird International Airport, Antigua and on the day of the accident reported for a planned split duty at 1100 hrs (0700 hrs local time). The pilot operated a return flight to the nearby island of Barbuda followed by a return flight to the island of Montserrat, both flown on J8-VBI. The aircraft was operated with a single pilot

and no cabin crew, as was normal. The pilot then went off duty at 1355 hrs and returned home before reporting for duty again at 1930 hrs to operate the same sequence of flights he had flown in the morning.

After an uneventful return flight to Barbuda, the aircraft departed Antigua at 2114 hrs (1714 hrs local) for John A Osborne Airport, Montserrat, with the pilot and six passengers on board. The aircraft cruised at 2,000 ft enroute and the pilot recalled there were good visual meteorological conditions throughout the 19 minute flight. On arriving at Montserrat there were no other aircraft operating in the vicinity of the airport and the pilot positioned the aircraft visually on a downwind leg for Runway 10.

The pilot reported he commenced the approach, flying an approach speed of 65 kt, reducing to 60 kt as the aircraft touched down. The runway surface was dry and the pilot described the landing as “smooth”. After the main landing gear touched down, but prior to the nosewheel contacting the runway, the pilot applied the brakes. He reported that the left brake felt “spongy” and did not seem to act, but that the right brake felt normal. The pilot was unable to maintain directional control of the aircraft which veered to the right two seconds after touchdown, departing the runway a further three seconds later. The aircraft continued across the adjacent grassed area before impacting an embankment close to the runway (Figure 1).

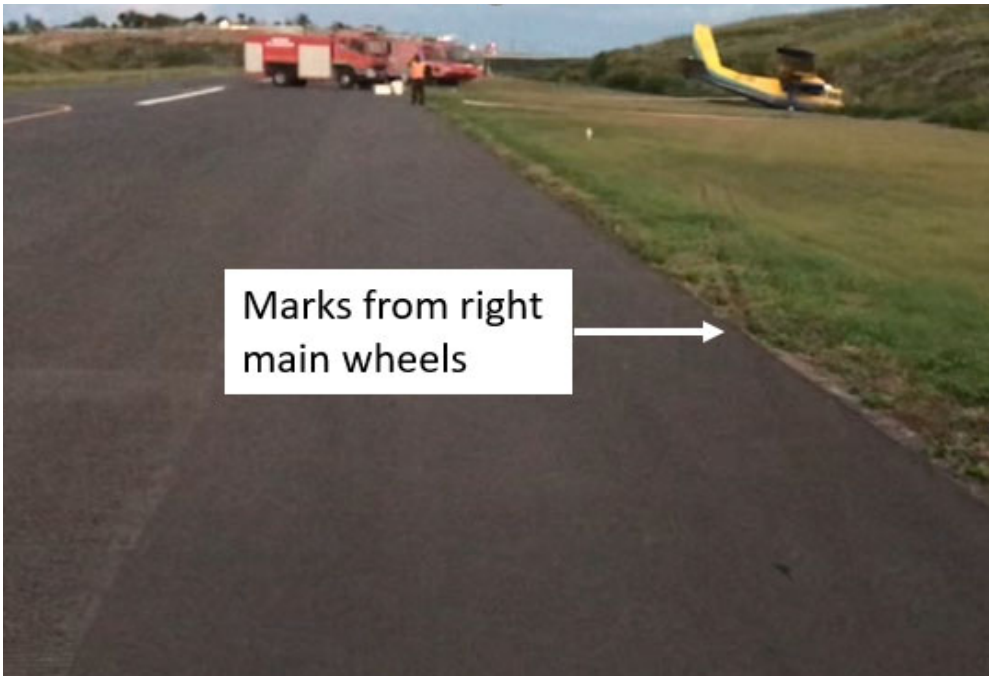

Figure 1

Still image captured from a video showing the aircraft’s departure point from Runway 10 and final resting place

After the aircraft had come to a stop, the pilot shut down the engines using the normal shut down procedure. The left main gear had collapsed and rendered the left cabin exit unusable (Figure 2). The pilot evacuated through the flight deck door which was on the left

of the aircraft. The six passengers were able to evacuate through the right cabin exit. The airport fire service then arrived at the aircraft, less than one minute after the accident.

Figure 2
Collapsed left main landing gear blocking left cabin door

Accident site

Tyre marking on the paved surface of Runway 10 indicated that the wheels of the right main landing gear began to skid approximately 153 m from the runway threshold. These markings also indicated the aircraft had veered to the right and off the paved surface approximately 242 m from the threshold. The skid marks fluctuated in density, consistent with modulating brake pressure. The marks from the left mainwheels were less well defined, but there was a short indication of a skid from the left inboard mainwheel at the start of the ground markings and a further short skid indication just after the left main gear crossed the runway centreline. The less frequent skid marks from the left wheels and the veer to the right indicated more braking was coming from the right brakes than the left. The nose wheel is not braked but there was a mark indicating it touched down at the same time the left main wheel was already crossing the runway centreline.

After the aircraft departed the paved surface, marks in the grass show that the right main wheels continued to be braked more than the left main wheels, whose marks more closely match those of the unbraked nose wheel (Figure 3).

The tyre marks indicated the aircraft continued veering right until it came to rest in a drainage ditch close to the boundary of the airport; this was just over 160 m from the beginning of the skid marks. There was no fire.

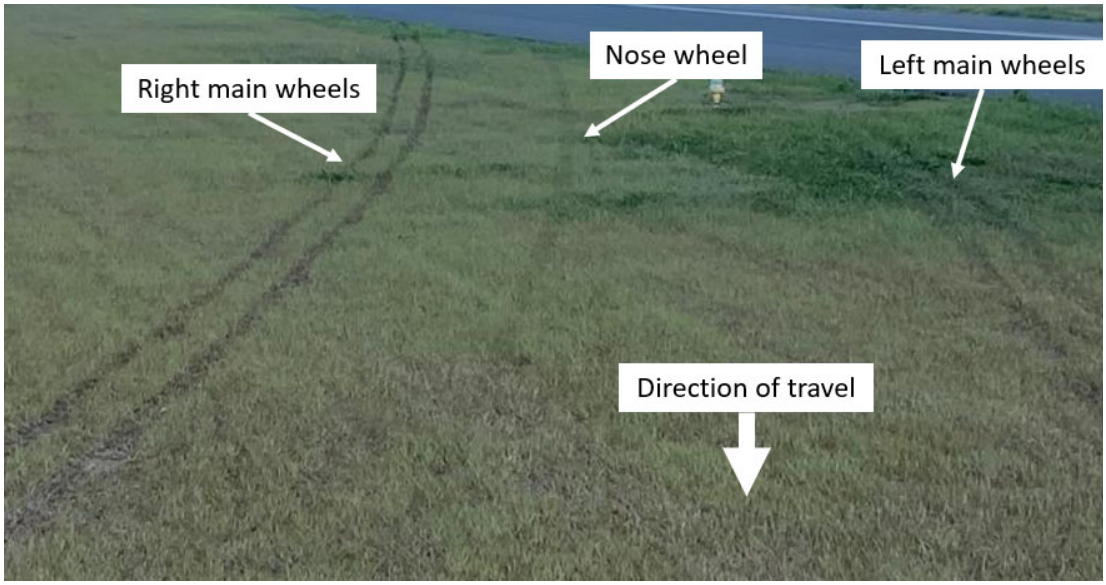

Figure 3

Wheel marks in grass beside runway showing evidence of asymmetric braking

Recorded information

The aircraft was not fitted with either a flight data recorder or a cockpit voice recorder; neither was required to be fitted under the applicable regulations. The pilot, however, was using a portable touchscreen GPS navigation device, which recorded position and time at intervals based on changes in position, rather than after a specified distance or time interval.

The data from the GPS device was downloaded and, together with airport CCTV footage and video taken from within the cabin by a passenger, an approximate track of the aircraft's ground track was generated (Figure 4).

Figure 4

GPS ground track based on CCTV (white crosses) and GPS (yellow circles)

The last point recorded on the GPS device before touchdown positioned the aircraft on the approach at about 50 ft aal. The next recorded point, 11 seconds later, was after the aircraft had landed, and about three seconds before it went off the edge of the runway. From the CCTV footage it was evident the aircraft first touched down on the right main landing gear and then the left, less than a second later. After a period of three seconds, tyre screeching can then be heard on the onboard passenger video which lasted for about half a second, after which the nose gear touched down. This was quickly followed by a second short period of tyre screeching and then another (each about half a second in duration) before the aircraft was seen to veer off the righthand edge of the runway.

The passenger video included footage of some of the aircraft flight instruments, providing confirmation of an approach speed of 65 kt.

Aircraft information

The Islander is a twin-engine light commuter aircraft that has good short takeoff and landing characteristics. It seats a maximum of nine passengers. A door on the front left of the aircraft allows access to the two pilot seats, whilst access to the passenger seats is through a door midway along the cabin on the right and a door at the rear of the cabin on the left. All the aircraft doors are nominated as emergency exits. The aircraft is constructed primarily of aluminium and has conventional fixed landing gear. The single nose wheel is steerable and the twin main wheels on each main landing gear are braked.

The brake system consists of master cylinders attached to each of the pilot's rudder pedals. Operation of the left brake pedal supplies brake fluid under pressure to the left brake calliper. Pistons in the calliper push friction pads against a brake disc in proportion to the pressure applied to provide braking. Likewise, operation of the right pedal supplies pressure to the right brakes to provide braking. The pilot operates the individual brake pedals to obtain the required braking action. During the landing roll, this would normally be both equally together to ensure the aircraft stops in a straight line. The co-pilot's rudder pedals are also fitted with master cylinders and operation of these pedals supplies pressure to the brakes in a similar way to the pilot's but through shuttle valves which allow the highest pressure applied to supply the brakes. In common with other similar aircraft, there is no anti-skid system and as a result, the pilot is required to adjust the brake pressure manually to ensure the braked wheels do not skid. A parking brake is available and when applied it maintains any pressure applied to the brakes (Figure 5).

Aircraft maintenance

The aircraft's Certificate of Airworthiness was in date and the aircraft was being maintained in accordance with an approved maintenance schedule. The most recent scheduled inspection was a 50 hour Check A, which was completed on 28 September, the day before the accident. At the same time the left outboard mainwheel wheel was replaced as its tyre was worn to limits. The brake friction pads on the same wheel were replaced as they were also worn to limits.

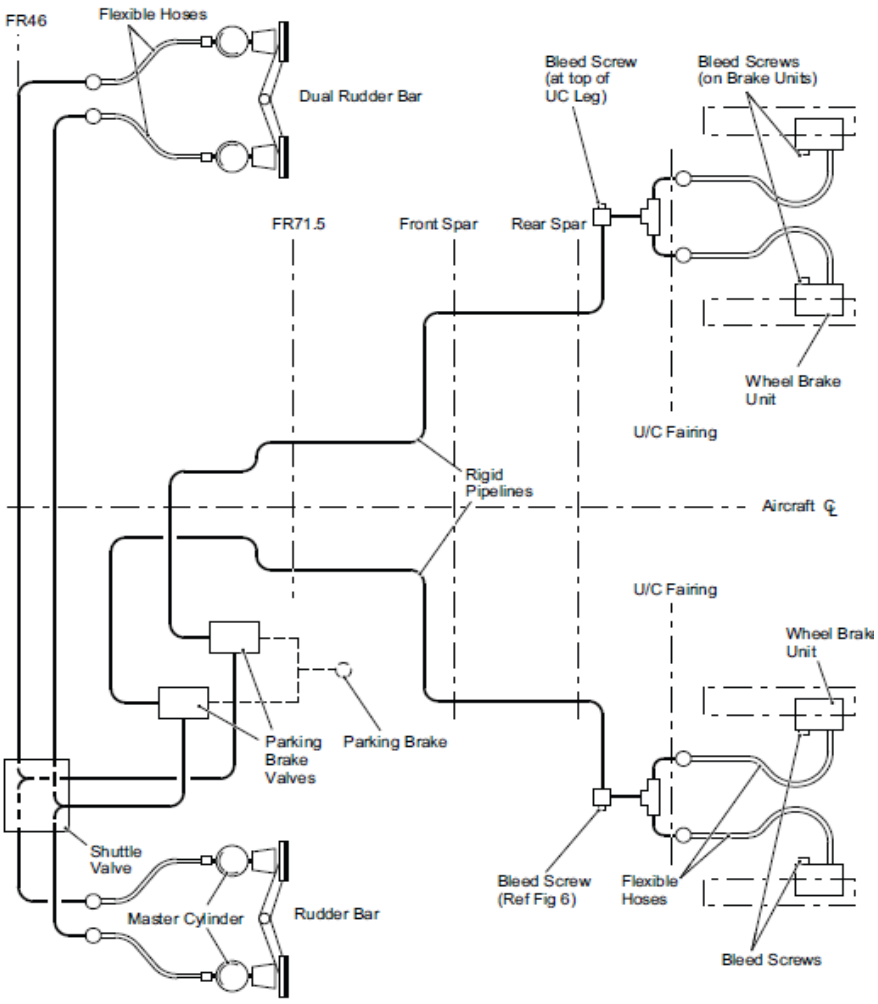

Figure 5

Schematic diagram of braking system

Aircraft examination

The AAIB did not travel to the accident site due to COVID-19 considerations. Examination of the aircraft was conducted under the supervision of the Accredited Representative from the East Caribbean Civil Aviation Authority.

Due to damage sustained in the accident it was not possible to function test the pilot's left brake system, but the pilot's right brake system was found to operate normally. The left and right brake systems were visually inspected, and no leaks were apparent. Selected components from the left brake system were removed from the aircraft and shipped to the UK for more detailed inspection.

Detailed component examination

Both master cylinders from the pilot's pedals were dismantled and examined. They were found to be in similar condition, there was contamination within the fluid reservoirs but because the components had not been blanked for transport it could not be determined

whether it was there before the accident. The main seals and main bores were in satisfactory condition. The dust seals around the input rod from the pilot's pedals were in poor condition (Figure 6).

Figure 6

A dust seal from one master cylinder showing degraded condition

The calliper assembly of the left outboard brake was examined as it appeared to have a slight leak from one of its pistons (Figure 7). When the piston was removed, the piston bore had scoring in the area where the leak was apparent (Figure 8). The piston's 'O' ring seal was found to be flattened rather than the circular cross section of a new seal (Figure 9).

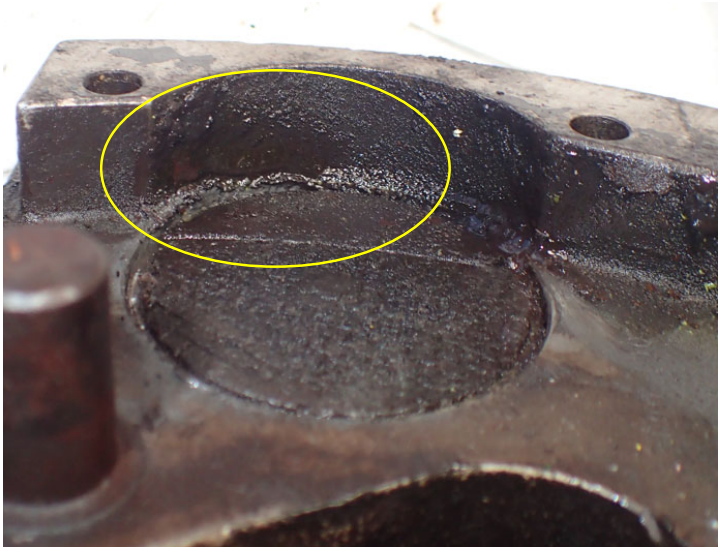

Figure 7

Leak apparent from piston of left outboard calliper

Figure 8

Scoring in piston bore in area of leak

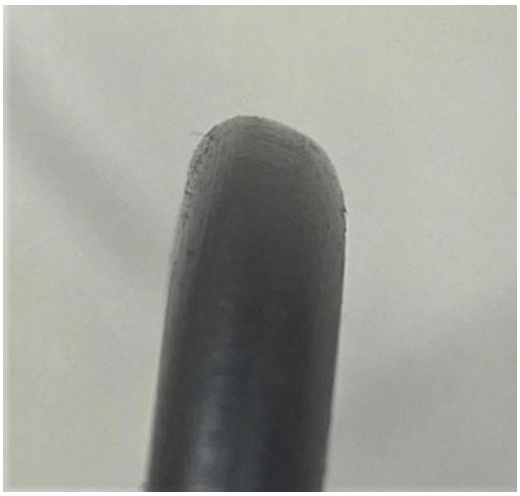

Figure 9

Flattened cross-section of piston 'O' ring seal

Personnel

The pilot gained his CPL in 2008 since which time he had flown a variety of aircraft types around the Caribbean. His licence and medical were both valid at the time of the accident.

The pilot first qualified on the Islander in 2019, since which time he had gained 712 hours as PIC on the type. He underwent an assessment by the operator to fly to John A Osborne Airport on 25 September 2019 conducted during two flights that day to the airport. Details of these flights were not recorded, but would have not been sufficient to comply with Governor's Instruction Mon 004 which included a requirement to complete at least five landings (three to Runway 10 and two to Runway 28) as well as a go-around from an approach to each runway.

The pilot's last annual line check was completed on 17 January 2021 on a flight from Guadeloupe to Antigua. The report stated that he '*operated as per the operator SOPs and within AFM limitations*' and no concerns were noted.

The pilot also operated regularly to Barbuda Codrington Airport on the island of Barbuda which, with a runway length of 1,640 ft, is slightly shorter than that at John A Osborne Airport.

Meteorology

The METAR for Montserrat Airport published at 2100 hrs reported a light wind of 5 kt from 050°, good visibility and 2-3 oktas of cumulonimbus clouds at 1,600 ft. The temperature was 29°C and there were cumulonimbus clouds reported to the north-east, south and north-west of the airport.

Montserrat has a tropical climate with significant rainfall throughout the year, particularly between July and November.

Airfield information

Background information

John A Osborne Airport opened in 2005 and was built after the previous airport, W H Bramble Airport, was destroyed in 1997 by a volcanic eruption. It is the only airport on Montserrat. The location of the original airport is uninhabitable due to the risk of further volcanic eruptions and the island's mountainous terrain limited potential sites of the new airport.

Figure 10

John A Osborne Airport

John A Osborne Airport has a single asphalt Runway 10/28 and sits at an elevation of 550 ft amsl. The runway was resurfaced in 2021 with grooves cut into the surface to improve runway friction in wet conditions. Both runways have a take-off run available (TORA) of 553 m / 1,814 ft and a LDA of 540 m / 1,771 ft, being constrained in length by a steep downhill gradient at either end. Recent improvements to the runway include renewed and re-positioned approach guidance lighting, and 'throw away' markings to help guide pilots judge when to go around.

Runway friction assessment

The airport conducted a Grip Test friction assessment of the runway surface shortly after the accident. The results indicate the runway friction was good and therefore it was not considered a factor in this accident.

Governor's Instruction MON 004

The requirements for operating to John A Osborne were defined in Governor's Instruction MON 004, issued on 24 February 2020. This included details of the risk assessment required to be submitted by operators to Montserrat's aviation regulator, Air Safety Support International (ASSI). It also provided specific pilot training and experience requirements, training captain requirements and details of the related supporting documentation.

The operator stated it was not familiar with Governor's Instruction MON 004 and had not submitted any of the required pilot training documents required. The operator had, however, submitted a risk assessment to ASSI on 26 February 2020 although this did not adequately assess a number of the points required. These included:

- Arithmetic errors in performance calculations
- Omission of aircraft performance for wet runway conditions
- Omission of non-punitive approach to go-arounds from unstable approach
- AFM crosswind limitations
- Actions to be taken following an engine failure after take off

In response, ASSI reported that other operators to the airport were not similarly affected but that they were reviewing their processes to ensure full compliance with the Governor's Instruction's for all future operations at Montserrat. This included, with the operator involved, the nomination and approval of training captain(s), the completion of the necessary 'check flight' forms for each pilot and the submission of a satisfactory risk assessment.

Operator airfield specific briefing sheet

The operator had a briefing sheet which detailed specific procedures for operating to and from Montserrat. It stipulated a list of criteria in which a takeoff or landing shall not be carried out, including when the runway is contaminated. However, this list did not prohibit landing on a wet runway. The briefing sheet detailed the braking procedure for landing on a dry or wet runway as follows:

'After touchdown the nosewheel is to be lower to the runway and wheel brake applied progressively throughout the deceleration process while applying slow back pressure on the yoke to transfer the weight back on the main wheels.'

Aircraft performance

The BN2B-26 Islander is a performance class B[1] aircraft. Performance requirements include a safety factor of 43% of the unfactored landing distance required (LDR). The Approved Flight Manual (AFM) performance charts included the 43% safety factor. There was no performance data available for landing distance required with reduced braking capability.

The landing weight of the aircraft was 6,293 lbs, which had a factored LDR on a dry runway of 1,480 ft, 291 ft less than the LDA of 1,771 ft.

Operating procedures and aircraft manuals

Performance

The Operations Manual (OM) contained no Standard Operating Procedure (SOP) requiring pilots to conduct performance calculations.

The AFM on board the aircraft contained the procedures and data to allow the calculation of dry runway performance. It did not contain data allowing the calculation of performance on wet or contaminated runways. The relevant regulations[2] state that, where there are no wet runway performance figures provided in the AFM, the LDA shall be at least 115% of the LDR. Under these requirements, at the aircraft's published maximum landing weight (MLW), the LDR exceeded the LDA if the runway was wet.

The operator stated that they operated when runways were wet, but not when runways were contaminated. This prohibition was not written in the operations manual, nor a method for determining when a runway was contaminated.

The Eastern Caribbean Civil Aviation Authority (ECCAA) had regulatory oversight of the operator. The ECCAA Part 9, Implementing Standards for Air Operator Certification and Administration, states that the holder should maintain an operating manual which contains:

- limitations on wet and contaminated runways
- procedures for operation on wet and contaminated runways
- takeoff and landing performance data for dry, wet and contaminated runways

Footnote

1 Aeroplanes powered by propeller engines with a maximum operational passenger seating configuration of nine or less and a maximum take-off mass of 5,700 kg or less.

2 Saint Vincent and the Grenadines Statutory Rules and Orders No. 16, Civil Aviation (Amendment) Regulations, 2014.

- speeds applicable for various flight stages (also considering wet or contaminated runways)

The ECCAA did not respond to enquiries by the AAIB on this aspect.

Pre-landing brake checks

The operator stated that pilots were trained to perform a brake check as part of the pre-landing checks. This required the brake pedals to be depressed to check the pressure in the system. There was, however, no brake check included in the operator's documented 'before landing' checklist and the pilot did not recall this check being demonstrated during training. He did not perform this check during the accident flight. The AFM 'pre-landing checks' required the brakes to be confirmed off. The manufacturer stated they would expect this check to include confirmation the parking brake is off and the aircrew toes are clear of the brakes. They further stated that a full press of the brakes with virtually no resistance could potentially indicate a brake issue.

Braking technique on landing

The AFM states '*maximum wheel braking is applied immediately after touchdown'.* The manufacturer commented that braking prior to the nosewheel touching down '*is not an approved or advised technique'* and potentially invalidates the scheduled landing performance.

The OM stated '*the nose wheel should be brought into contact with the runway promptly following main wheel contact. Using wheel brakes while holding the nose wheel off is not to be done'.*

The operator considered that the main risk from braking before the nose gear touched down was the increased likelihood of the nosewheel contacting the runway with greater force. Two experienced Islander pilots operating in the region reported that braking prior to nose wheel touchdown was not considered unusual. A similar description of braking technique on an Islander has also been described in a previous AAIB report[3].

Emergency procedure

Neither the OM nor the AFM contained a published procedure for a loss of braking. The operator stated that should a pilot identify a brake failure during the pre-landing check they should land at an airfield with an LDA in excess of 2,000 ft. This may require a go-around followed by a diversion to a suitable airfield. The operator stated the LDA of 2,000 ft had been determined through experience rather than calculation, to be a sufficient distance to stop the aircraft with only one operational brake. The pilot did not recall being trained to carry out this procedure during initial or recurrent training.

Footnote

[3] AAIB Bulletin 2/2014 VP-MNT available at: https://www.gov.uk/aaib-reports/britten-norman-islander-bn-2b-26-vp-mnt-16-october-2012 [accessed 15 Feb 2022]

Analysis

Technical aspects

Examination of the left brake components determined that the 'spongy' feel and lack of effectiveness reported by the pilot was most likely due to a slight brake fluid leak from one of the pistons in the left outboard brake calliper. This leak prevented full brake pressure being achieved and therefore reduced the braking effect from the left brakes.

The brake friction pads on the left outboard brake had been replaced the night before the accident. This process involved pushing the pistons back in to the calliper to allow for the greater thickness of the new friction pads. Since replacement, the aircraft had made six landings including one at Montserrat and two at Barbuda, which has a shorter runway than Montserrat, all without incident.

There were no reported issues with the brakes for the first six flights after the friction pad replacement and the leak appears therefore to have developed after these flights. The leak was likely due to scoring of the piston bore and the flattened piston seal, both of which could not be identified unless the calliper was disassembled.

Directional control

It is considered that the leak identified in the left braking system resulted in sufficient asymmetric braking, when both brakes were fully applied, to cause the pilot to lose directional control.

The video footage from the cabin shows the effects of asymmetric braking prior to the nose wheel touching down, indicating the pilot applied the brakes almost immediately after the main gear touched down. This meant that, with the nosewheel off the ground, early application of nosewheel steering to try and maintain directional control was not possible. Aerodynamic directional control from the rudder would have also rapidly reduced as the aircraft slowed. This left the pilot with releasing the right brake as the only way to regain directional control. Due to the short nature of the runway and the steep drop at the end, this is likely to have been counter intuitive.

Whilst the operations manual published the correct braking technique, it was possible that pilots were influenced by the short nature of runways in choosing to brake before nosewheel touchdown.

Go around

There was no published brake failure procedure available to the pilot. Faced with a brake failure on touchdown, the pilot had two options. The first would have been to control and stop the aircraft on the remaining runway available. Given the limited LDA at Montserrat, this may not have been achievable. The second option would have been to go around and divert to an airfield with a longer runway.

The speed with which the event occurred and the difficulty in maintaining directional control, restricted the pilot's ability to remain on the runway. This also left little opportunity for the pilot to make the decision to abandon the landing and go around.

If the brakes had been applied in accordance with the published procedure, when the nose gear was down, then the failure would have been realised later in the landing roll, with less runway remaining. However, the pilot would have had greater directional control of the aircraft as the nosewheel steering would have been available. The aircraft would have been more likely to remain on the runway, making a go-around a more viable option. This would still have remained a challenging decision to make, especially without prior training or knowledge of the failure.

Performance

The runway was dry with measured levels of friction being good. The calculated landing distance required was 291 ft less than the landing distance available. As there was no performance data available for landing distance required with reduced braking capability it is not known whether this additional 291 ft would have been sufficient for the aircraft to have stopped on the runway. However, if this reduction in braking capability had occurred on a longer runway, or with a better runway overshoot area, using the published braking technique would be more likely to lead to a favourable outcome.

The absence of any performance procedures in the OM for wet or contaminated runway operations was considered a significant safety issue, not least because of the limited length of the runway and the abundance of rain throughout the year in Montserrat. It was also not compliant with the Civil Aviation (Amendment) Regulations, 2014, or the criteria for the issue and maintenance of an AOC as required by the ECCAA in IS Part 9. In response, the operator stated it intends to amend its Operations Manual to comply fully with the Civil Aviation (Amendment) Regulations, 2014 and ECCAA IS Part 9. The following Safety Recommendation is also made:

Safety Recommendation 2022-016

It is recommended that the Eastern Caribbean Civil Aviation Authority (ECCAA) should ensure SVG Air Operations Manual complies with Saint Vincent and the Grenadines Civil Aviation (Amendment) Regulations, 2014 and ECCAA Part 9 Implementing Standards for Air Operator Certification and Administration.

Brake check

The AFM pre-landing checks simply required the brakes to be confirmed off. Whilst not called for in the checks, the manufacturer stated that should the brakes be fully pressed as part of these checks, a lack of resistance could potentially indicate a brake issue.

Whilst not an approved procedure, had the pilot pressed the brake pedals on this occasion it is possible he would have detected the problem with the left brake, allowing him to divert to an airfield with a longer runway.

Governor's Instruction

Governor's Instruction MON 004 formed an important requirement for operating flights to John A Osborne Airport, reflecting the challenging nature of the airport. As such, the operator should have been aware of the requirements and appropriate checks made by the regulator to ensure they had been complied with. This situation has been resolved with the operator now being in full compliance and ASSI having reviewed its own compliance-checking process.

Conclusion

When the pilot applied the brakes on landing, a leak from one of the pistons of the left outboard brake calliper rendered the left brakes less effective than the right, causing the aircraft to veer to the right and depart the runway. Difficulty in maintaining directional control was compounded by the limited size of the runway and the use of an incorrect braking technique on landing.

The investigation identified shortcomings with the operator's manuals, procedures and regulatory oversight.

Safety Action

The operator has ensured it now complies with the requirements of Governor's Instruction MON 004.

The airport regulator, ASSI has reviewed its processes to ensure better compliance monitoring of commercial operators using John A Osborne Airport.

Published: 22 September 2022.