SERIOUS INCIDENT

Aircraft Type and Registration:	Britten-Norman Islander BN-2B-26, VP-MNT
No & Type of Engines:	2 Lycoming O-540 piston engines
Year of Manufacture:	1987 (Serial no: 2186)
Date & Time (UTC):	16 October 2012 at 1340 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 - None
Nature of Damage:	None
Commander's Licence:	Federal Aviation Administration Commercial Pilots Licence with Air Safety Support International validation
Commander's Age:	31 years
Commander's Flying Experience:	700 hours (of which 348 were on type) Last 90 days - 92 hours Last 28 days - 31 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft developed a nose wheel shimmy during landing. Considering the risk of an overrun and mindful of the hazardous terrain at the end of the runway the pilot elected to steer the aircraft onto grass at the runway edge. The aircraft was undamaged and there were no injuries.

The Regulations and procedures

The Governor of Montserrat, under the *Montserrat Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 2007*, is required to carry out an investigation and appoint persons as Inspectors of Air Accidents for the investigation of accidents or incidents occurring in Montserrat. The extent of investigations and the procedure to be followed is determined by the Governor for the purpose of the prevention of accidents and incidents. The Governor of Montserrat has, since February 2009, appointed the Chief Inspector of the UK Air Accidents Investigation Branch (AAIB) to be the Chief Inspectors of Accidents for Montserrat. The AAIB has trained and approved a locally based Accident Investigation Manager (AIM) to manage accidents and incidents pending the arrival of AAIB inspectors from the UK.

The investigation

The Montserrat AIM was notified of the incident soon after it occurred and alerted staff at the AAIB's headquarters in the UK. The AAIB deployed an inspector, who was already in Antigua conducting a separate investigation, to Montserrat.

History of the flight

The aircraft was on a scheduled commercial air transport flight from VC Bird Airport, Antigua, to John A Osborne Airport, Montserrat. This was the aircraft's third sector of the day; it had flown from Antigua to Montserrat and back previously. The pilot flew as a passenger from Antigua to Montserrat on the first sector and then operated the second and third sectors.

The weight and balance document showed that the pilot, six passengers and 160 lbs of baggage were on board. The fuel load on landing was calculated to be 60 USG, and the landing weight of 6,289 lbs was below the authorised maximum landing weight. The fuel quantity on board was sufficient for the next scheduled flight to Antigua.

Weather conditions at John A Osborne were fine, with good visibility and no low cloud. Runway 10 was in use and the surface wind, transmitted by the air traffic controller as the aircraft made its approach, was from 130° at 7 kt. The pilot recalled that at the time of landing, the runway was 'a bit wet' from previous rain showers; other witnesses recalled that the runway was dry.

The aerodrome had no instrument approach procedures, and the approach was conducted visually. The pilot reported that because the wind was relatively calm he configured the aircraft for landing early, selecting full flap and the propellers fully fine, and that he completed the landing checks. He stated that during the approach he kept the aircraft's groundspeed, displayed on the GPS receiver, at between 60 and 65 kt[1]. He recalled that the indicated airspeed during the approach was between 65 and 70 KIAS; he did not recall the touchdown speed.

The pilot, and other witnesses, recalled that the aircraft touched down within the normal touchdown zone; the tower controller reported that touchdown occurred 'just beyond the APAPI' (Abbreviated Precision Approach Path Indicators). The pilot reported that, after touchdown on the main landing gear, he started applying brakes before lowering the nosewheel onto the runway. He recalled that as the nosewheel came into contact with the runway, an 'awful shimmying' began. He released the brakes and raised the nosewheel clear of the runway. He re-applied the brakes gently and lowered the nosewheel again. The shimmy returned, reportedly worse than previously. The pilot attempted to maintain a pitch input to keep weight off the nosewheel.

Footnote

[1] The pilot's guide published by the GPS manufacturer did not state how the displayed groundspeed was derived; some units display a groundspeed value which has been averaged over a period of time, meaning that the displayed speed would not react instantly to changes in the aircraft's true groundspeed.

The pilot then perceived that the aircraft would not stop before the end of the runway. So he elected to manoeuvre it off the runway to avoid running over the cliff beyond the runway end. He turned the aircraft to the right onto the grass south of the runway stop-end (Figure 1).

Once the aircraft came to a halt, the pilot shut down the engines, retracted the flaps, and asked his passengers whether they were OK. He then led the passengers away from the aircraft.

Figure 1

The aircraft at rest after the runway excursion

Landing technique

In discussion about landing technique on the Islander aircraft, the pilot stated that he habitually endeavoured to keep the nosewheel off the runway after landing until the brakes were applied, after which he would lower the nosewheel gently. He also described that, during an approach, the groundspeed was 'most important' and he paid attention to the groundspeed rather than the indicated airspeed. He said that, although he had experienced nosewheel shimmy previously, on this occasion it was 'uncontrollable'; he had not been able to 'touch the pedals'.

The aircraft flight manual

The flight manual for the aircraft did not contain any advice or procedures concerning actions in the event of nosewheel shimmy on takeoff or landing. With respect to approach speeds, the flight manual stated:

> *'Final approach*
>
> *After selection of flaps DOWN (56 deg), the speed may be progressively reduced to the appropriate threshold speed quoted in section 5.'*

Interpolation of the graph provided in section 5 showed that the threshold speed appropriate for the landing weight was 58 KIAS.

Nosewheel shimmy

Nosewheel shimmy is an oscillation in the nosewheel assembly which is felt as vibration through the airframe and, in aircraft such as the Islander, rudder and brake pedals. It occurs typically during landing or takeoff, usually within a speed range. According to one American aircraft manufacturer, factors which affect the onset of shimmy include:

- the design and geometry of the landing gear
- tyre pressure
- tyre centring
- aircraft groundspeed
- roughness of the surface over which the aircraft is moving
- looseness or slack in the landing gear system
- pilot technique
- the effect of any shimmy damper fitted to the aircraft

The manufacturer of the Islander stated that it had found no evidence of a history of nosewheel shimmy affecting Islander aircraft.

Engineering investigation

Aircraft description and maintenance history

The Islander is a high-wing twin-engined aircraft with fixed landing gear. The nose landing gear has a single wheel; each main landing gear has two wheels. The main landing gear wheels are equipped with conventional hydraulically-operated brake units, one per wheel. Pressure applied on toe pedals, which are mounted above the rudder pedals, operates the wheel brakes in pairs (left and right main landing gear respectively). No anti-skid system is fitted.

An optional Garmin GPS 350 was fitted to the instrument panel on VP-MNT. The aircraft was not equipped with a Flight Data Recorder or Cockpit Voice Recorder; neither was required by regulations.

The maintenance log and worksheet showed that before the aircraft departed Montserrat on the morning of the incident flight the main oleo pressure was confirmed to be correct.

Examination of the aircraft

An airworthiness inspector from the Eastern Caribbean Civil Aviation Authority (ECCAA) was appointed to assist the investigation and examined the aircraft before it was moved. A licensed engineer, who carried out line maintenance for the operator, assisted the airworthiness inspector.

The aircraft had come to rest south of the Runway 10 stop end. There were two sets of skid marks on the runway which transitioned to wheel tracks at the runway edge, ending at the main wheels of the aircraft.

Both sets of brakes were examined and appeared to be in a satisfactory condition. Both brake reservoirs were inspected and also found to be satisfactory. There were no leaks evident at either the brake units or the reservoirs. The rest of the aircraft was examined for damage but none was found. The aircraft was then pushed off the grass on to the runway surface and pulled by hand to the apron.

The tyres were examined for wear or flat spots and appeared to be satisfactory. The nose of the aircraft was supported on a trestle and the nose landing gear examined for play; none was apparent. Hydraulic fluid had leaked from the oleo assembly onto the 'Fescolized' portion[2] of the nose landing gear strut, as shown in Figure 2. It was not possible to determine if the leak had resulted from the incident but there was no evidence that the fluid had been blown back by airflow as might occur in flight. The operator's engineer, who had conducted checks on the aircraft that morning, recalled that there was no evidence of such a leak during his checks. The aircraft brakes operated satisfactorily when checked.

Figure 2

The nose landing gear oleo

The operator decided to replace the nose landing gear assembly, but facilities for that task were not available on Montserrat. Following taxi trials, during which the aircraft behaved normally, it was flown to the operator's contracted maintenance facility where the work was carried out. The pilot who flew the aircraft to the maintenance facility reported that it behaved normally, with no shimmy apparent. The maintenance organisation did not report any abnormality discovered during the component change.

Footnote

[2] An electroplated portion of the oleo.

The aerodrome

History

John A Osborne Aerodrome was opened in 2005 following volcanic eruptions that covered Montserrat's previous aerodrome in pyroclastic flow. The consequences of those eruptions, and the possibility of further volcanic activity, also rendered approximately two thirds of the island uninhabitable. The island's topography meant that few possible locations for a new aerodrome remained after the eruption. The site of John A Osborne was chosen for the new aerodrome following surveys which established that the location was the only viable one[3], although the runway length and aerodrome size were restricted by the terrain.

The aerodrome has a small terminal building, air traffic control tower, and fire station. The aerodrome's regular traffic is Islander aircraft operating to and from other Caribbean islands, notably Antigua, which is Montserrat's nearest neighbour. The largest aircraft accommodated is the de Havilland Twin Otter. The aerodrome also supports helicopter operations.

Runway dimensions and surroundings

The aerodrome's only runway, Runway 10/28, is 596 m long, and has a 28 m displaced threshold at each end. It satisfied the criteria for an ICAO Code 1 runway, which was not required to have Runway End Safety Areas (RESAs).

Code 1 runways are required to have surrounding runways strips extending 30 m from the runway centreline. A runway strip is provided:

> *'to reduce the risk of damage to aircraft running off a runway; and to protect aircraft flying over it during take-off or landing operations.'*

The aerodrome has a runway strip which complied with the regulations, though in places embankments had been constructed that might pose a hazard to an aircraft following a runway excursion[4]. The terrain falls away steeply beyond the ends of the strip. The ends of the runway are shown in Figure 3 and Figure 4.

Footnote

[3] One other site was identified but the development would have been prohibitively expensive in the context of the island's economy.

[4] The AAIB report on the serious incident to VP-MON , reference EW/C2011/05/04 in Bulletin 5/2012, considers these matters in greater detail.

Figure 3
The western end of the runway viewed from below

Figure 4
The eastern end of the runway

Analysis

Operational matters

The incident occurred at the conclusion of a routine, and until after touchdown, unremarkable flight. The aircraft was serviceable and the pilot appropriately qualified.

The weather conditions were good, and the wind presented a light quartering headwind component on landing. It was not possible to determine whether the runway was wet or dry, but the skid marks left by the aircraft indicated that the runway was not significantly affected by standing water.

The incident began when, as the nosewheel contacted the runway, shimmy occurred. No technical cause for the shimmy was identified and, following maintenance action, no recurrence has been reported. Following the onset of the shimmy, the pilot could have abandoned the landing.

In the absence of a decision to abandon the landing, the pilot's priority was to decelerate the aircraft. However, when the nosewheel was again lowered to the runway surface, the shimmy returned, reportedly worse than before.

The pilot's decision to steer the aircraft off the runway was prompted by his concern that an excursion beyond the runway's end could have serious consequences. Aggressive braking and the decision to steer off the runway led to a safe outcome without damage to the aircraft or harm to the passengers. It was not possible to determine whether the aircraft would have stopped in the remaining runway length available if the pilot had not steered it onto the grass at the runway's side.

The pilot's account of conducting the approach by reference to groundspeed suggested an unusual technique. Flying an approach using GPS groundspeed as the primary reference could result in the aircraft reaching indicated speeds too low for safe operation in a tailwind, or unnecessarily high in a headwind. The pilot's recollection of the indicated speed being in the range 65 to 70 KIAS suggests that in this case the indicated speed was within usual parameters. However, excessive touchdown speed would contribute to a landing using more runway length than normal. It is also possible that shimmy may occur if the groundspeed is higher than encountered in routine takeoffs and landings. An unusually high speed on touchdown could explain nosewheel shimmy on the incident landing.

Witness accounts, including that of the pilot, indicated that the aircraft touched down at an appropriate point on the runway. Although the aircraft flight manual contained no advice regarding landing technique, it is probable that holding the nosewheel off the runway surface for a prolonged period would cause a longer than normal landing roll, as the aircraft's weight would not be transferred fully to its wheels, and deceleration from the wheel brakes would be lessened. Any beneficial aerodynamic braking effects were likely to be slight at the airspeeds involved. Delaying lowering the nosewheel into contact with the runway would also mean that any shimmy would not be identified until later in the landing than would otherwise be the case, and this would reduce the time and runway distance available for

the pilot to take action in response. Witness information did not identify where, along the runway's length, nosewheel touchdown occurred.

The shimmy began with the nosewheel in contact with the runway surface. Releasing the brakes and rotating the aircraft to bring the nosewheel off the runway surface added to the actual landing distance and, because this procedure was different from normal operating techniques, rendered any landing performance calculations invalid. A prompt decision to execute a balked landing might have resulted in a safe climb away and given the pilot an opportunity to consider another approach or a diversion to a longer runway. There was sufficient fuel on board for a diversion to Antigua with reserves for a further diversion.

Engineering

The engineering investigation did not identify any malfunctions or abnormalities to account for the nosewheel shimmy. The seals in the nosewheel oleo appeared normal. The fluid evident on the nosewheel oleo may have been an artefact of the shimmy, if the motion between the piston and cylinder disrupted the sealing of the oleo to the extent that fluid escaped.

Conclusion

Severe nosewheel shimmy disrupted an otherwise routine landing. In order to avoid a possible overrun, the pilot steered the aircraft onto the grass at the side of the runway. No cause of the shimmy was established.