



Report 00-007

Piper PA 32-260

ZK-DSQ

overrun on landing

Great Mercury Island

1 July 2000

Abstract

On Saturday 1 July 2000 at 1457, Great Barrier Airlines PA 32 aeroplane ZK-DSQ was on a charter flight to Great Mercury Island with 4 passengers when it overran the uphill grass runway on landing. No injury occurred, but the aircraft was substantially damaged.

The overrun resulted from excessive tailwind, and the pilot's decision to land was probably based on an incorrect assessment of the tailwind component on the runway.

Safety issues identified include:

- the definition of the tailwind limitation in the airline's operations manual
- the performance data in aircraft flight manuals
- the calibration of the automatic weather station on Great Mercury Island.

Safety recommendations were made to address these issues.

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Contents

List of Abbreviations	ii
Data Summary	iii
1. Factual Information	1
History of the flight	1
Personnel information	2
Aircraft information	2
Aerodrome information	2
Meteorological information	3
Additional information	3
2. Analysis	3
3. Findings	5
4. Safety Recommendations	6

List of Abbreviations

AC	Advisory Circular
CAA	Civil Aviation Authority
CASO	Civil Aviation Safety Order
kg	kilogram(s)
m	metre(s)
MOT/CAD	Civil Aviation Division of the Ministry of Transport
Part	Civil Aviation Rule Part
P-chart	light aeroplane performance chart

Data Summary

Aircraft type, serial number and registration:	Piper PA 32-260, 1012, ZK-DSQ
Number and type of engines:	one Lycoming O-540-E4B5
Year of manufacture:	1972
Date and time:	1 July 2000, at 1457
Location:	Great Mercury Island airstrip, latitude: 36° 35.5' south longitude: 175° 45.3' east
Type of flight:	air transport, charter
Persons on board:	crew: 1 passengers: 4
Injuries:	nil
Nature of damage:	substantial, wing and fuselage
Pilot's licence:	commercial pilot licence (aeroplane)
Pilot's age:	30
Pilot's total flying experience:	940 hours (about 250 hours on type)
Investigator-in-charge:	J J Goddard

1. Factual Information

History of the flight

- 1.1 On Saturday 1 July 2000 the pilot commenced duty at 0730, and was rostered to fly different PA 32 aircraft on routine flights from Auckland Airport to Great Barrier Island and to North Shore, followed by another flight from Auckland to Great Mercury Island, to Whitianga, then back to Auckland. Because of fog the departure from Auckland was delayed until after 0900, after which the first flight proceeded normally in light wind conditions, arriving at North Shore at 1028.
- 1.2 The pilot travelled by road from North Shore back to Auckland Airport, where he prepared ZK-DSQ for the next flight leg to Great Mercury Island. He checked the local weather forecast, which was for developing easterly winds with stratiform cloud and rain; however, the Auckland weather at 1300 was a light north-east wind with a few clouds at 2000 feet.
- 1.3 One of the 2 adult passengers, who were travelling with 2 children, telephoned a colleague on Great Mercury Island shortly after 1400, who reported some rain with increasing wind. He then telephoned the automatic weather station on Great Mercury Island airstrip which reported the wind as south-south-east, 16 to 18 knots, with a gust of 21 knots in the last 20 minutes. He advised the pilot of this weather report before departure.
- 1.4 At 1415 the aircraft left Auckland Airport for Great Mercury Island, flying at 800 to 1000 feet. The pilot subsequently reported that the wind was light and variable across to the Coromandel Peninsula, which he flew across north of track because of cloud covering the high ground. On the east coast he assessed the wind on the sea as moderate, from the south-south-east. He advised the passengers that if he was not happy with conditions on Great Mercury Island they would go to Whitianga.
- 1.5 As they approached the airstrip on Great Mercury Island the pilot positioned the aircraft on the downwind leg for landing uphill to the west. He assessed the wind from the windsock as a crosswind with a tailwind component, from the south-south-east at about 10 to 12 knots. After a normal base leg, he committed the aircraft to landing by lowering full flap on final approach. He reported that the final approach seemed normal, at normal airspeed, until short final when increased tailwind was encountered. This was followed by a fast touchdown, further into the runway than he had intended.
- 1.6 The pilot raised the flaps and attempted to brake on the uphill landing roll on the wet grass. He had to use reduced braking to correct for skidding, and the aircraft was travelling slowly but unable to be stopped as it reached the top of the runway.
- 1.7 The aircraft continued downhill 18 m past the top of the runway to collide with the boundary fence at the end of the airstrip, slewing to the right as the right wing struck a post. The aircraft travelled a further 26 m downhill past the fence before coming to a stop. The occupants were unhurt, and got out promptly.
- 1.8 Some 10 minutes after arrival, the same passenger checked the wind indications on the automatic weather station at the top of the airstrip, which he reported as south-south-east, 24 knots, with a gust of 29 knots in the last 20 minutes. He said they encountered rain just as they landed on the airstrip.

Personnel information

- 1.9 The pilot had completed his commercial pilot licence (aeroplane) in October 1997, and a “C” category instructor rating in June 1998. He then worked as a flying instructor based at Ardmore, flying mainly PA 38 and 28 aircraft. He started work for Great Barrier Airlines in January 2000, and was principally based at Whitianga, flying local charter flights in PA 32 and Cessna 172 aircraft.
- 1.10 He had received specific training, and had been checked to operate on Great Mercury Island airstrip with the PA 32 type by the airline flight examiner, in May 2000. Before then he had some 6 familiarisation flights with another company pilot. He had subsequently flown 4 air transport flights to Great Mercury Island. Most of his landings had been in light wind conditions; one had been with a moderate south-east wind.

Aircraft information

- 1.11 ZK-DSQ was a Piper PA 32-260 single-engine 6-seat low wing, tricycle undercarriage aeroplane. The pilot reported that there were no unserviceable items, and that the aircraft performed normally on the accident flight. The load sheet information indicated that the landing weight at Great Mercury Island was 1290 kg and the centre of gravity was within the approved limits. The maximum permitted weight was 1542 kg.
- 1.12 The aircraft landing performance data in the aircraft flight manual was presented as a family of graphs (P-charts) produced in 1984 by the then Civil Aviation Division of the Ministry of Transport (MOT/CAD) in accordance with Civil Aviation Safety Order (CASO) 4. These included factors for an up-slope up to 3%, and a tail-wind component of up to 5 knots. With these maximum factors applied, the landing distance required for air transport operations on dry grass, from a height of 50 feet, was 340 m at the landing weight of 1290 kg. Markings on the graphs indicated that an unknown person had attempted to extrapolate the slope graph to 8.75%, and the tail-wind graph to 10 knots, the applicable parameters for Great Mercury Island.
- 1.13 These P-charts, based on the superseded CASO, became obsolescent in 1990 with the introduction of the Civil Aviation Act but were endorsed by the Civil Aviation Authority (CAA) in Advisory Circular (AC) 91-3 as remaining valid for Part 91 operations. Part 135, which applied to the airline’s air transport operations, specified some different slope factors but no headwind or tailwind factors.
- 1.14 Pilots reported that after landing a PA 32 at similar weight on Great Mercury Island, in most wind conditions, an increase in engine power was usually required to enable the aircraft to be taxied up the slope to the top of the airstrip.

Aerodrome information

- 1.15 Great Mercury Island airstrip was a private airstrip situated across a promontory at the north-west end of the island. The single grass runway, oriented 090/270° magnetic, was 420 m long and sloped up at 8.75% to the west. The elevation at the top was 180 feet. Beyond the western end the ground sloped down to the sea. The final approach from the east required a final turn within about 1 km because of higher terrain, but was otherwise unobstructed and over water. The sloping ground restricted aeroplane landings to runway 27, uphill, and take-offs to runway 09, downhill, in all wind directions. A windsock and the automatic weather station were located by the top of the airstrip, with another windsock by the bottom. Both windsocks were observed to be in good condition.

- 1.16 The airline operations manual restricted air transport operations on Great Mercury Island to approved pilots only. It also specified a maximum tailwind component for landing of 10 knots, and specified aircraft configurations and the missed approach point beyond which an approach had to be continued to a landing.

Meteorological information

- 1.17 A ridge of high pressure from a persistent anticyclone to the south had maintained settled weather over the country for several days. An active depression was moving east across the north Tasman Sea towards North Island. The associated strengthening easterly flow, with low cloud and rain, was starting to affect Northland and Auckland.
- 1.18 The automatic weather station on the Great Mercury Island airstrip was attached to a cellular telephone, enabling remote weather reports to be obtained. At the site 5 days after the accident the wind was observed to be easterly at 20 to 30 knots, almost straight up runway 27, while the automatic weather station was reporting a south-east wind direction. The calibration history of the weather station was not established.

Additional information

- 1.19 Measurement of the wheel marks on the grass runway indicated that ZK-DSQ had touched down about 90 m past the threshold of runway 27, with some 330 m remaining to the top of the runway. The grass surface, when examined on 6 July, was grazed moderately short. It was wet but not muddy, and evidently well drained.
- 1.20 On 2 August 2000 CAA issued AC 119-3, to assist operators in meeting the Part 135 requirements. In Subpart D, Performance, it advised that existing CASO 4 P-charts remained acceptable. However in Appendix C it provided instructions and generic graphs for operators to develop new P-charts. These appeared to be drawn more accurately than the graphs from the ZK-DSQ flight manual. AC 119-3 did not present any information on how headwind or tailwind factors were derived.

2. Analysis

- 2.1 This overrun accident occurred as the result of an excessive tailwind component while ZK-DSQ was on short final approach, and when the pilot was committed to making a landing on the sloping airstrip. While the touchdown point, 90 m into the runway, may have been longer than the pilot intended, it was not unduly so and the remaining 330 m of uphill runway was more than normally required to complete the landing roll. The clear indication was that the aircraft touched down with significantly higher groundspeed than normal, which probably resulted from too much tailwind, given that the final approach was flown at normal airspeed.
- 2.2 The reduced braking experienced on the wet grass surface probably contributed to the overrun because more effective braking may have stopped the aircraft before it reached the top of the slope. However, braking on grass varies appreciably because of several factors, not just rain wetting the surface, and a margin is included in flight manual performance data to allow for this variability. The pilot's technique of raising the flaps after touchdown to optimise the braking available was appropriate, and his modulation of braking pressure to correct skidding was normal. Once the aircraft had passed the top of the runway, it was unlikely to be stopped on the following downslope before the fence was reached.

- 2.3 The principal issues relate to pilot decision-making; whether the pilot was able to make an appropriate decision about the wind to permit a safe landing at Great Mercury Island, both during pre-flight planning and during the arrival at the island.
- 2.4 The Great Barrier Airlines operations manual had one criterion, a maximum tailwind component of 10 knots. While the simplicity of this seemed attractive, it did mean that pilots had to estimate the component of the wind along the runway from the reported or observed wind direction. In this case the automatic report received before departure, 45 minutes before arrival, was “south-south-east 16 to 18 knots, gust of 21 knots ...”, from which the tailwind component could have been calculated as 8 to 10 knots, (and the crosswind as 14 to 18 knots). However a small change in wind direction, such as a temporary backing of only 20° to south-east, would bring the tailwind component to 12 to 15 knots. A more reliable operations manual restriction would have been for the airline to specify a maximum wind value from an easterly sector, for example between 030° and 150° through east.
- 2.5 Information available to the pilot on the wind for landing at Great Mercury Island came from 2 sources. The automatic weather station report was accessible at any time by telephone but, because a telephone was not available to the pilot during the flight, his data was 45 minutes old. While it was possible for him to ask his airline operations office, by radio, to telephone the automatic weather station and report the wind to him, he did not do this. In addition, the basic check carried out on the automatic weather station wind direction report in relation to the observed wind blowing up the runway suggested that a calibration test was required to ensure the automatic report was accurate, and was also reported relative to magnetic north to correlate with the runway designation.
- 2.6 The second source of wind information for the pilot was from the windsocks on the airstrip. These would have given timely but approximate information to the pilot when the aircraft was close enough for the windsocks to be seen. In order for him to properly estimate the wind direction in relation to the runway, however, it would have been necessary to fly over the airstrip to be able to look down at the windsocks. Because the pilot did not do this, but joined the circuit on the downwind leg, it is unlikely that he was able to assess the wind direction very well. He would have been able to see the angle to which the windsocks were extended, however, indicating to him the wind speed.
- 2.7 The pilot’s decision before departure to make the flight to Great Mercury Island was made with the knowledge that the reported wind was likely to give a maximum permitted tailwind component, and also that the weather was forecast to deteriorate with freshening wind and rain. A decision to not go would have been justified, but equally his plan to fly there and if conditions were found unsuitable to divert to Whitianga was reasonable, given that there was no weather deterioration apparent at that time. This plan, however, did predispose him to land at Great Mercury Island unless he found unsuitable conditions. His survey of the windsocks from the downwind leg was unlikely to adequately inform him whether the wind was suitable or not.
- 2.8 The reported increased tailwind when ZK-DSQ was on short final ensured that the landing margins were well exceeded, but it is probable that the general wind at the time, unrecognised by the pilot, was in excess of the airline’s operational limit.
- 2.9 Operating an aeroplane to Great Mercury Island required the pilot to make a conscious decision at about the final turn point to commit to a landing or make a prompt go-around. This was because a safe go-around was thereafter precluded by rising terrain. The operations manual carried appropriate advice on this. However, any airline operation which places a pilot in this situation should ensure that the specified criteria are conservative and demonstrably simple to meet. Changing the tailwind limit, as suggested in 2.4, would be an improvement.

- 2.10 The pilot skill requirements were addressed by the airline limiting the operation to approved pilots only. The pilot had been appropriately trained and checked at Great Mercury Island, but his specific and overall experience levels were low for operating to such an airstrip. The ability to make a critical decision and to reliably employ good aircraft handling skills in marginal weather does depend on experience. It would have been prudent for the airline to have limited his operational criteria for Great Mercury Island until he had more experience of the airstrip.
- 2.11 The aircraft landing performance data in the aircraft flight manual was not adequate for this operation, to inform a pilot what to expect from his aircraft on landing at Great Mercury Island, because the slope and tailwind graphs did not extend sufficiently to meet the actual runway slope or the approved tailwind limit. While the landing performance could be shown to be sufficient at the lesser slope, and therefore would have been better on the actual runway, the airline tailwind limit should not have been set in excess of the graph limit. Extrapolation of the graphs was an unsound practice, and should not have been done. A safety recommendation was made to Great Barrier Airlines to extend its aircraft flight manual performance data to match the operations undertaken.
- 2.12 The new AC 119-3, published after this accident, contained some useful information for operators to construct new aeroplane P-charts, but it did not provide basic information on wind factors used in the charts. Neither Part 91 nor Part 135 gave appropriate wind factors to be used as an alternative. Since operators were deemed responsible for producing P-charts or equivalent, this information should be made available.

3. Findings

Findings are listed in order of development and not in order of priority.

- 3.1 The pilot was appropriately licensed and trained for the operation.
- 3.2 The pilot was inexperienced in Great Mercury Island operations.
- 3.3 The aircraft was serviceable and functioning normally.
- 3.4 The aircraft was loaded within the approved limits.
- 3.5 The pilot's technique of observing the windsocks on Great Mercury Island probably led to his incorrect assessment of the tailwind component on the runway, and to his decision to land there.
- 3.6 The landing overrun resulted from an excessive tailwind on final approach.
- 3.7 The landing overrun was probably exacerbated by increased tailwind when the aircraft was on short final approach.
- 3.8 The airline's tailwind component limitation for landing at Great Mercury Island was defined in a way that provided the pilot with an opportunity to make an incorrect assessment.
- 3.9 The automatic weather information from Great Mercury Island on wind direction may have been incorrect.
- 3.10 The performance chart information in the aircraft flight manual did not extend sufficiently to address the slope and permitted tailwind at Great Mercury Island.

4. Safety Recommendations

4.1 On 8 December 2000 it was recommended to the chief executive of Great Barrier Airlines that he:

- 4.1.1 Amends the airline's operations manual limit for landing at Great Mercury Island to simple wind speed and direction rather than a tailwind component. (085/00)
- 4.1.2 Extends the performance data in aircraft flight manuals to match the operations undertaken by those aircraft. (086/00)
- 4.1.3 Gets the calibration of the automatic weather station on Great Mercury Island checked, and ensures that it reports relative to magnetic north. (087/00)

Approved for publication 22 November 2000

Hon. W P Jeffries
Chief Commissioner