



AIRCRAFT ACCIDENT

REPORT

No. 89-112

**CESSNA 207 ZK-DAX
and
CESSNA 207 ZK-DQF**

Milford Sound, Southland Province

30 December 1989

**Transport Accident Investigation Commission
Wellington - New Zealand**

Transport Accident Investigation Commission
Wellington

Chief Commissioner
Transport Accident Investigation Commission

The attached report summarises the circumstances surrounding the midair collision involving Cessna 207 ZK-DAX and Cessna 207 ZK-DQF over Milford Sound on 30 December 1989 and includes suggested findings and safety recommendations.

This report is submitted pursuant to Section 8(2) of the Transport Accident Investigation Commission Act 1990 for the Commission to review the facts and endorse or amend the findings and recommendations as to the contributing factors and causes of the accident.

10 July 1991

R CHIPPINDALE
Acting Chief Executive

APPROVED FOR RELEASE AS A PUBLIC DOCUMENT

16 July 1991

M F DUNPHY
Chief Commissioner

AIRCRAFT: Cessna 207/Cessna 207		OPERATOR: Waterwings Airways/Air Fiordland	
REGISTRATION: ZK-DAX/ZK-DQF		PILOT:	
PLACE OF ACCIDENT: Over Milford Sound, Southland Province		OTHER CREW: Nil/Nil	
DATE AND TIME: 30 December 1989, 1532 NZDT		PASSENGERS: Six/Six	
SYNOPSIS: The Office of Air Accidents Investigation was informed of the accident at 1554 hours on 30 December 1989. Mr J J Goddard was appointed Investigator in Charge and commenced the field investigation on the following day. The two aircraft were departing from the Milford Sound area for Queenstown when a collision occurred. ZK-DAX was landed safely but ZK-DQF fell into the Sound. The occupants of ZK-DQF were killed in the accident.			
1.1 HISTORY OF THE FLIGHT: See page 4.	1.2 INJURIES TO PERSONS: ZK-DAX / ZK-DQF Pilot: 1 Nil / 1 Fatal Pax: 6 Nil / 6 Fatal	1.3 DAMAGE TO AIRCRAFT: ZK-DAX / ZK-DQF Substantial / Destroyed	1.4 OTHER DAMAGE Nil
1.5 PERSONNEL INFORMATION: See page 6.			
Pilot in Command Flight Times (ZK-DAX)		Pilot in Command Flight Times (ZK-DQF)	
	Last 90 days	Total	
All Types	92	1120	All Types
On Type	76	718	On Type
1.6 AIRCRAFT INFORMATION: See page 7.			
1.7 METEOROLOGICAL INFORMATION: See page 7.		1.8 AIDS TO NAVIGATION: Nil.	1.9 COMMUNICATIONS: See page
1.10 AERODROME: See page 8.	1.11 FLIGHT RECORDERS: Nil.	1.12 WRECKAGE AND IMPACT INFORMATION: See page 9.	
1.13 MEDICAL AND PATHOLOGICAL INFORMATION: Nil.		1.14 FIRE: Fire did not occur.	1.15 SURVIVAL ASPECTS: The accident was unsurvivable for the occupants of ZK-DQF.
1.16 TESTS AND RESEARCH: See page 10.	1.17 ADDITIONAL INFORMATION: See page 12.	1.18 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES: Nil.	
2. ANALYSIS: See page 13.	3. FINDINGS: See page 16.		
4. SAFETY RECOMMENDATIONS: See page 17.			5. REGULATORY: See page 18.

* All times in this report are NZDT (UTC + 12 hours)

1. FACTUAL INFORMATION

1.1 *History of the flight*

1.1.1 A number of aircraft were at Milford Sound Aerodrome awaiting passengers for scenic flights to Queenstown or Te Anau. Amongst these aircraft were ZK-DAX and ZK-DQF which each awaited six Japanese passengers. Most passengers were on launch trips which returned at 1500 hours.

1.1.2 ZK-DAX was the tenth aircraft to depart. It was taxied for runway 29 with three other aircraft and took off after them at 1525 hours. The departure flight path was normal: after a 60° right turn to Harrison Cove it was turned left and flown back to near the aerodrome, then right along the Arthur Valley climbing towards the Mackinnon Pass.

1.1.3 ZK-DQF was the thirteenth aircraft to depart. It was taxied similarly with two other aircraft and took off following an aircraft flown by a supervising company pilot at 1527 hours.

1.1.4 The initial departure flight path was as for ZK-DAX, but after the supervising pilot had turned his aircraft at Harrison Cove he established by radio telephone (RTF) that the preceding group of aircraft were unable to cross the Mackinnon Pass because of deteriorating weather and would return to fly down Milford Sound to the coast.

1.1.5 The supervising pilot advised Milford Flight Service by RTF that he would turn left over the aerodrome and head down the Sound. He then confirmed with the pilot of ZK-DQF that he would be following him.

1.1.6 ZK-DAX, the last aircraft of the group in the Arthur Valley, had been turned after the first aircraft of the group had passed, to follow it back down the Arthur Valley to Milford Sound. The pilot had broadcast by RTF of his return as he passed Lake Ada, some 5 nautical miles (nm) from the aerodrome and this transmission had initiated the action taken by the supervising pilot and the pilot of ZK-DQF in turning over the aerodrome to head down the Sound.

1.1.7 As ZK-DAX emerged from the Arthur Valley it was turned left to fly straight down the Sound in level flight at about 2700 feet amsl and at about 125 knots. The pilot sighted four aircraft ahead of him; a Twin Otter and three Cessnas. He did not at any stage see ZK-DQF, but the nearest Cessna ahead was probably that flown by the supervising pilot and that which ZK-DQF was following.

1.1.8 A videotape made by the passenger in the right front seat of ZK-DAX showed that the two aircraft flew abeam each other at the same height and speed; initially on parallel tracks. A small heading change by ZK-DQF then caused the aircraft to converge, still abeam each other.

1.1.9 The two aircraft collided, without any apparent avoiding manoeuvres, and ZK-DQF fell, probably with a wing separated, to the sea below. Its occupants were killed in the accident.

1.1.10 ZK-DAX, although substantially damaged, was capable of manoeuvre and continued flight. It was landed safely at Milford Sound Aerodrome, with no injury to the occupants.



▷▷▷ STANDARD ROUTE TO MACKINNON PASS

----- ZK-DQF TURN BACK AT AERODROME

- · - · - ZK-DAX TURN BACK AT LAKE ADA

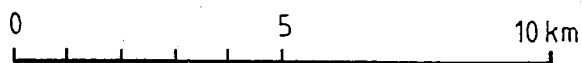


FIGURE 1

1.1.11 The accident occurred in daylight at about 1532 hours NZDT at a position 5 km north-north-west of Milford Sound Aerodrome at an altitude of 2700 feet amsl. National Grid Reference 866157, NZMS 1 Sheet S113 "Tutoko", latitude 44°38'S, longitude 167°53'E.

1.5 Personnel information

1.5.1 [redacted], 25, was pilot in command of ZK-DAX. He held Commercial Pilot Licence - Aeroplane number 15225 which was valid until 2 August 1990. He also held an Instrument Rating. His logbook Type Rating Certificate was endorsed for groups A, B, C, E, and F aeroplanes, which included the Cessna 207 type.

1.5.2 He was medically examined for the renewal of his licence on 3 August 1989 and was assessed fit.

1.5.3 His total flying experience was 1120 hours, of which 718 hours was on the Cessna 207 or 206 type.

1.5.4 During the previous 90 days he had flown for 92 hours, with 76 hours on this type.

1.5.5 During the previous 7 days he had flown for 6 hours, with 5 hours on this type. He had last flown on 25 December 1989.

1.5.6 He had learned to fly at Queenstown and the majority of his flying had been in the area. His approval to operate at Milford Sound Aerodrome was issued on 1 October 1985.

1.5.7 His last flight check in accordance with Civil Aviation Regulation 76 was completed successfully on 1 September 1989.

1.5.8 [redacted], 21, was pilot in command of ZK-DQF. He held Commercial Pilot Licence - Aeroplane number 21115, valid to 16 May 1990. He also held an Instrument Rating. His logbook Type Rating Certificate was endorsed for aircraft in groups A, B, C and E, and for the Cessna 208 type. The Cessna 207 type was endorsed on 30 December 1989.

1.5.9 He was medically examined for the renewal of his licence on 17 May 1989 and was assessed fit.

1.5.10 His total flying experience was 456 hours, of which 4.65 hours was on the Cessna 207 type.

1.5.11 During the previous 90 days he had flown for 26 hours, with 4.65 hours on the Cessna 207 type.

1.5.12 During the previous 7 days he had flown for 2.90 hours, all on ZK-DQF on 30 December 1989. He had last flown on 22 December 1989.

1.5.13 He was engaged by Air Fiordland as a pilot on 15 December 1989. His training on the Cessna 207 type included 1 hour dual training and 0.75 hour solo circuit practice. In addition, he received 1.5 hours dual training on 30 December 1989 on handling the aircraft at Milford Sound. This constituted his Milford Sound approval and his flight check in accordance with Civil Aviation Regulation 76.

1.5.14 Other training he received with Air Fiordland included fourteen flights to and from Milford Sound as a supernumerary crew member, with a senior company pilot, to familiarise him with routes and procedures. In addition he received briefings on routes, procedures and local weather.

1.5.15 After completing his Milford Sound check, he flew ZK-DQF on revenue flights from Te Anau to Milford Sound, Milford Sound to Queenstown, and Queenstown to Milford Sound before departing on the accident flight.

1.6 Aircraft information

1.6.1 Cessna 207 ZK-DAX, serial number 20700131, had a non-terminating Certificate of Airworthiness in the Standard category and a valid Maintenance Release. Maintenance documentation recorded normal maintenance carried out in accordance with the Maintenance Manual.

1.6.2 Cessna 207 ZK-DQF, serial number 20700053, had a non-terminating Certificate of Airworthiness in the Standard category, but which related to a Maintenance Manual of a previous operator. The aircraft was included in Air Fiordland's Maintenance Manual however, and documentation recorded normal maintenance in accordance with it. The Civil Aviation Division of the Ministry of Transport were advised of this in February 1989 but by administrative oversight had not issued a new Certificate of Airworthiness. A valid Maintenance Release was held.

1.6.3 Each aircraft was loaded below the maximum permitted mass, and within the approved centre of gravity range.

1.6.4 ZK-DAX was painted white, with no external trim colours.

1.6.5 ZK-DQF was painted white, with brown and orange stripes on each side of the fuselage and around each wing tip.

1.6.6 ZK-DAX was equipped with diagonal non-inertia reel harness and lap belts for the pilot and front passenger.

1.6.7 ZK-DQF was equipped with lap belts only for all occupants.

1.6.8 Neither aircraft was equipped with strobe anti-collision lights.

1.7 Meteorological information

1.7.1 An anticyclone in the central Tasman Sea gave generally fair weather with a moderate south-west to westerly airflow over the area. Cumulus cloud developed to produce scattered showers by mid afternoon. The normal sea breeze/valley wind set in at Milford Sound from the north-west by midday.

1.7.2 Routine weather reports from Milford Sound were:

1500 HOURS

Wind:	340°M 15 knots, gusting 26 knots
Visibility:	20 km
Weather:	Precipitation visible
Cloud:	4 octas cumulus 3500 feet 7 octas cumulus 5000 feet
QNH:	1018.6 Hpa

1600 HOURS

Wind: 340°M 15 knots
Visibility: 18 km
Weather: Rain
Cloud: 1 octa stratocumulus 2500 feet
3 octas cumulus 3500 feet
8 octas cumulus 5000 feet
QNH: 1019.6 Hpa

1.7.3 Pilot reports at about the time of the accident were of a main cloud base at about 4500 feet, with good visibility in the Sound except for a small shower at the mouth.

1.7.4 The videotape from ZK-DAX showed overcast conditions with good lighting and good visibility. The image of ZK-DQF was clearly visible and contrasted with the background of dark bush on the mountainside.

1.10 Aerodrome information

1.10.1 Milford Sound was a public aerodrome in Fiordland National Park, located on the only level ground at the head of Milford Sound, a fiord surrounded by precipitous mountains 6000 to 7000 feet high. It comprised a single runway 792 m long, oriented 108°/288°M, and an aircraft parking area at mid-runway. There was no taxiway, so runway access for take-off was by back-tracking on the runway.

1.10.2 An Aerodrome Flight Information Service was provided by the Flight Service Station at the time of the accident. This was located in a tower building with a reasonable view of the aerodrome and some of the surrounding area.

1.10.3 No navigation aids were installed and operations into the aerodrome were visual flight rules (VFR) only. Weather minima were 2500 foot ceiling and 16 km visibility.

1.10.4 Conventional traffic circuits and straight final approach or climbout paths were not possible because of close high terrain. Use of the aerodrome was restricted to approved pilots only.

1.10.5 Low level access was by the Arthur or Cleddau Valleys from the south-west or south-east, or up the Sound from the West Coast 15 km north-west of the aerodrome. The most common route, the Arthur Valley, involved crossing the Mackinnon Pass, 3500 feet high, and was the lowest southerly route.

1.10.6 The changeable nature of weather in this mountainous coastal region meant that cloud could form rapidly to close passes such as the Mackinnon. In that case, an alternative but longer route out was via the mouth of the Sound to the coast then south via the Hollyford Valley. This route was about 1000 feet lower and thus less susceptible to low cloud.

1.10.7 The predominant use of the aerodrome was for tourist access from Wanaka, Queenstown and Te Anau. A number of local charter operators had developed this tourist business so that on a fine day twenty or more aircraft might be operated into Milford Sound. While the typical, daily total number of

aircraft movements was not large, a marked peak in traffic density occurred mid-afternoon because tourist itineraries included launch trips, which all returned at 1500 hours. On 30 December 1989, 17 aircraft departed between 1515 and 1535 hours, out of a total of 40 aircraft departures for the day.

1.12 Wreckage and impact information

1.12.1 ZK-DQF was not recovered, but the location of the fragmented wreckage was established on the sea bed of Milford Sound at a depth of 1000 feet, as a result of the search by the Royal New Zealand Navy, using a remotely operated submersible vehicle.

1.12.2 ZK-DAX, which landed back safely at Milford Sound, sustained substantial damage, to the forward fuselage and propeller, from the collision. None of the damage markings could be correlated conclusively with specific items of the airframe of ZK-DQF as it was not recovered. However parallel scratches on the upper right engine cowling were consistent with the corrugated left aileron or flap of ZK-DQF moving sideways across it.

1.12.3 Brown and yellow paint smears on the upper cowling were similar to the painted trim colours on the wing tip fairings of ZK-DQF.

1.12.4 The propeller blades of ZK-DAX were each bent forwards some 50 mm at the tips and showed marks consistent with numerous strikes on light alloy structures, with a few strikes on heavier structure.

1.12.5 The lower cowling and engine mount structure of ZK-DAX had received a heavy impact from the right and below, consistent with the left main wheel of ZK-DQF. This had displaced the engine and partially fractured the engine mount structure.

1.12.6 No witness marks were found on ZK-DAX anywhere behind the forward fuselage.

1.16 Tests and research

1.16.1 The videotape made by the right front seat passenger in ZK-DAX was analysed frame by frame, with measurements being made of the image of ZK-DQF. These were compared with images of airframe items on the same frames, to establish distances between the two aircraft.

1.16.2 The time between the camera first panning onto ZK-DQF and the collision was 33 seconds. During this time the camera was panned away occasionally but ZK-DQF was in frame for three separate periods. It appeared that the camera had run continuously for the whole time.

1.16.3 The camera was generally aimed to the right side of ZK-DAX and a view over the nose or tail was not included. No obvious turn by ZK-DAX was observed, but minor heading changes could have occurred in the light turbulence without being detected. ZK-DQF remained closely abeam ZK-DAX, in its 3 o'clock position. The image was initially just ahead the wing strut but moved slightly aft to be overlapped by the strut as the aircraft closed. ZK-DQF remained nearly at the same height as ZK-DAX throughout, being initially at the same height but slightly higher for part of the third period. The maximum difference in height could not be measured, but was estimated as about two feet.

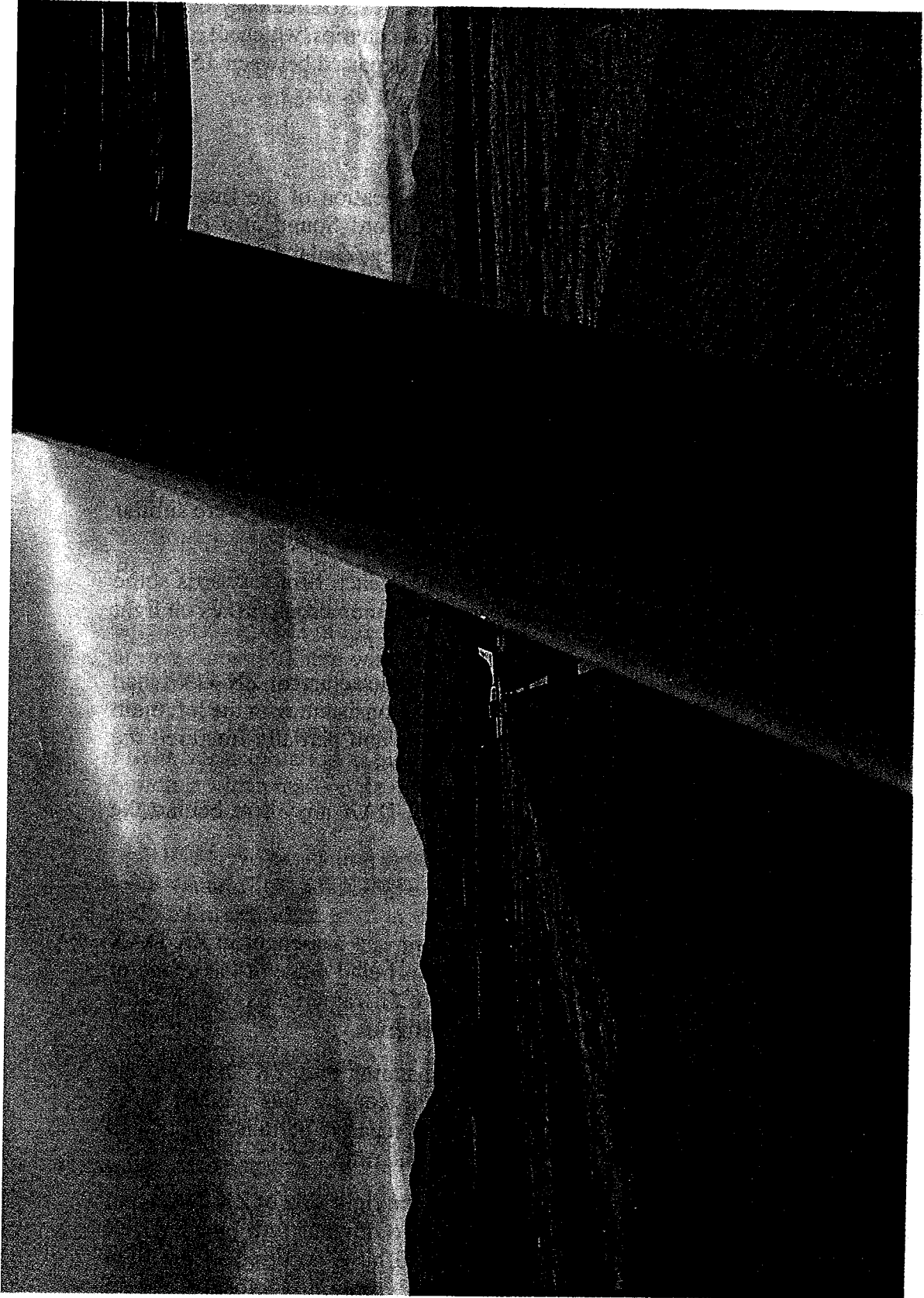


FIGURE 2

Simulation of ZK-DAX passenger's video; aircraft 280m apart, about 20 seconds before collision (80mm lens used)

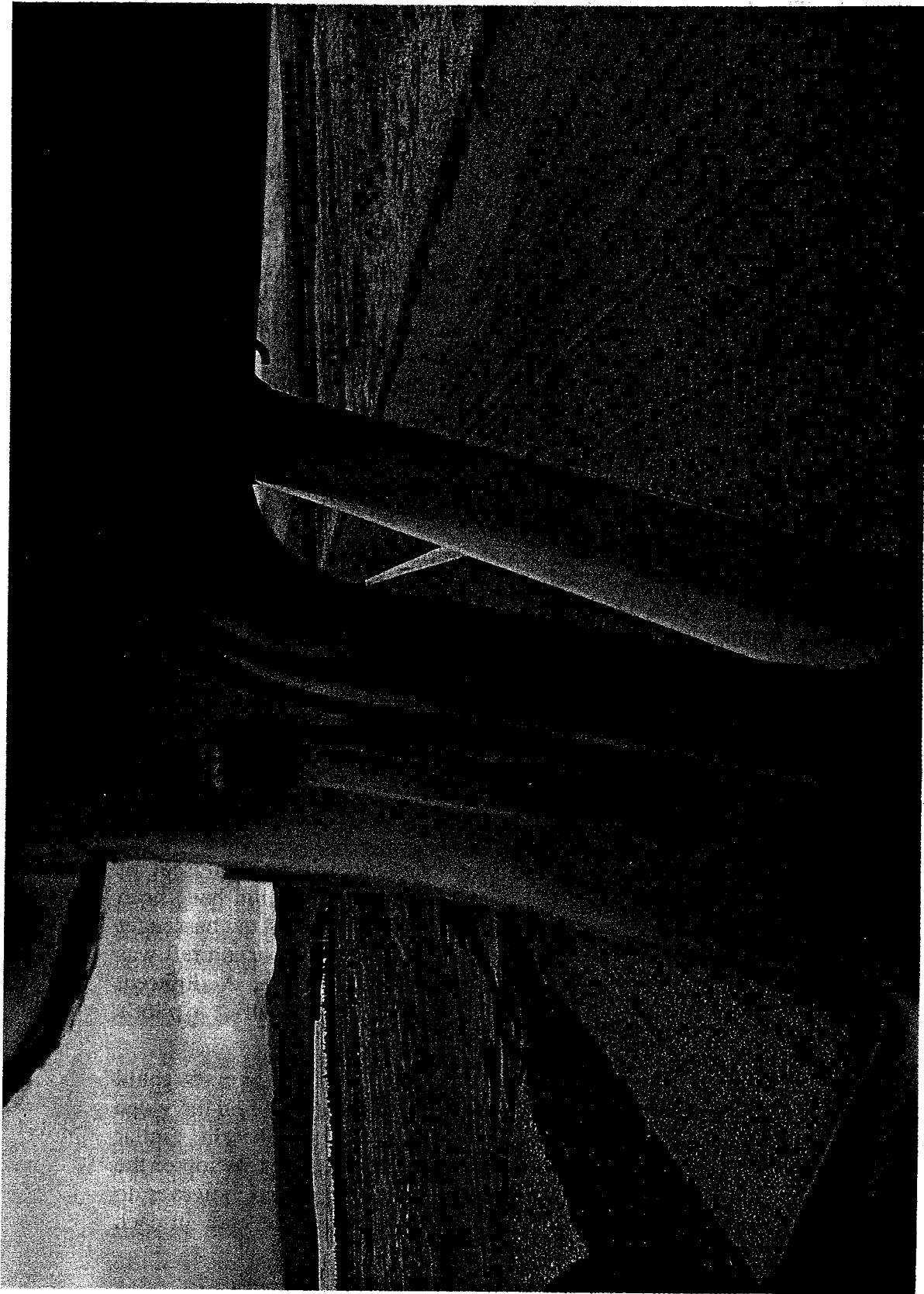


FIGURE 3

View from the simulated eyepoint of the pilot of ZK-DAX; aircraft positions as in Figure 2. (35mm lens used)

1.16.4 The first period, of eight seconds, showed ZK-DQF to be approximately 338 m away and not closing.

1.16.5 The second period, at about 12 seconds, showed ZK-DQF at approximately 287 m away, and to have made a slight heading change towards ZK-DAX.

1.16.6 The third period, at between 26 and 29 seconds, showed ZK-DQF closing from approximately 89 to 67 m. A study of relative positions of wingtips against the fuselage suggested that the heading of ZK-DQF was converging with ZK-DAX by about 8 to 10 degrees.

1.16.7 A graph of these distances against the distance run at a true airspeed of 130 knots showed a nearly straight line convergence over the last 26 seconds from ZK-DQF's heading change up to the collision. This convergence angle was 11 degrees.

1.16.8 Two similar C207 aircraft were positioned on the ground at the three calculated distances apart, to simulate the views displayed on the videotape. The resulting views of the right hand aircraft compared well with the video, generally confirming the similar height of the two aircraft and the calculated distances (See Figure 2).

1.16.9 With the aircraft in each position, the view from the simulated eyepoint of the pilot of ZK-DAX was examined, to see if the second aircraft was normally visible. At the two greater distances the view of the aircraft was completely obscured by the right door pillar, but at the closest distance it was only partly obscured, by the top of the right window frame and the right wing strut. It was noted that in each case, however, the aircraft came readily into view when the observer leaned forward to look around the right door pillar and along the wing leading edge. This action required a deliberate physical movement of the torso, but greatly enhanced the view to the left or right side of the aircraft (See Figure 3).

1.16.10 The person operating the video camera in the right seat of ZK-DAX was simulated, to see if the pilot's field of view could have been critically restricted. The pilot was tall, with a high eyepoint and the passenger was of small stature. It was concluded that his view of the other aircraft was probably not limited at all by the passenger or the camera. A different combination of pilot and passenger sizes, however, could restrict a pilot's sideways view from his normal seated position.

1.16.11 The view of the pilot in ZK-DQF, the right hand aircraft, could not be as well simulated as that from ZK-DAX, which was based on the video images. It was noted, however, that for an observer of average height, similar to the pilot of ZK-DQF, the other aircraft was just obscured by the top of the left window at all three positions of the aircraft. Leaning forward, however, to look around the left door pillar brought the other aircraft into view in each case.

1.17 Additional information

1.17.1 The passengers in ZK-DAX watched ZK-DQF closing with their aircraft. They did not communicate with their pilot, or attempt to draw his attention to ZK-DQF. They were all Japanese citizens, with little ability to speak English.

2. ANALYSIS

2.1 These two aircraft were probably flying steadily on parallel or slightly converging courses, at similar heights, from the vicinity of Milford Sound Aerodrome for a period of about 90 seconds, the time required to fly the 5 km distance. The video tape made by a passenger in ZK-DAX confirmed this during the last 33 seconds before the collision.

2.2 The video also showed other details before the collision: the aircraft remained in each pilot's 9 o'clock or 3 o'clock position at the same level, it showed no collision avoidance manoeuvre by ZK-DQF up to four seconds before the collision. It did not show whether or not the pilot of ZK-DQF had a view of ZK-DAX. The temporary small variation in level between the aircraft probably did not affect either pilot's view significantly.

2.3 The video depicted ZK-DQF in clear contrast against the dark bush background. In the bright overcast lighting prevailing at the time, ZK-DAX would have appeared similarly to an observer in ZK-DQF. A dark bush background was behind it on the other side of the Sound.

2.4 The marks and damage to ZK-DAX implied that the left wing of ZK-DQF had passed in a span-wise manner across the engine cowling and had been struck by the propeller. The propeller may have severed major wing structure or strut, causing the wing to separate. The cowling impact, probably from the left main wheel of ZK-DQF, showed that the aircraft's fuselages came into close proximity, before parting, but without damage to ZK-DAX aft of the forward fuselage.

2.5 There was insufficient evidence to establish the attitudes of either aircraft during the collision sequence, but the relative positions of the paint smear on the upper cowling, probably from the wingtip of ZK-DQF, and the wheel impact on the lower cowling did suggest that ZK-DQF was not significantly banked at initial impact. The wheel impact probably occurred later in the sequence and its location suggested that one or both aircraft were banked away from each other at that time. This could have resulted from upward collision forces on the left wing of ZK-DQF and torque reaction forces on ZK-DAX from its propeller striking the other wing. Alternatively, the pilot of ZK-DQF might have commenced rolling his aircraft to the right.

2.6 The ground tests with two similar aircraft indicated that the pilot of ZK-DQF could not see ZK-DAX from a normal eye position, up to the closest distance tested, 80 m. At some closer distance, some portion of the aircraft must have become visible, however. The pilot should have been able to lean forward to look in front of his left door pillar as he was restrained only by a lap strap. This would have given him a view of ZK-DAX, at any stage. The absence of an avoidance manoeuvre, however, infers that he had not seen ZK-DAX up to four seconds before the collision.

2.7 The pilot of ZK-DQF probably did not see ZK-DAX in time to avoid the collision; it was possible that he did not see it at all.

2.8 The pilot of ZK-DQF was on his first day's operation at Milford Sound, having completed his flight check earlier in the day. While his training had not been extensive, it was probably adequate to enable him to operate under supervision, in favourable conditions. He was expected to follow his

supervising pilot in the preceding aircraft. This may have channelled his attention ahead to some extent, to the detriment of his sideways lookout, but any pilot in his position would have had difficulty in seeing ZK-DAX.

2.9 The pilot of ZK-DAX stated that he did not see ZK-DQF before the collision. The ground tests did demonstrate that his view of ZK-DQF was obscured completely until six or seven seconds before the collision, when it came partly into view. The tests also showed that ZK-DQF should have been visible to him, had he leaned forward to look in front of the door pillar. This option was not readily available, however, as his upper torso was restrained by a fixed diagonal harness and deliberate slackening of the harness would have been necessary to enable him to lean forward.

2.10 The passengers in ZK-DAX watched ZK-DQF closing with their aircraft, without communicating with their pilot or warning him in any way. Probably the barrier of a foreign language or culture inhibited them from doing so, but any passenger who was not an experienced pilot may have been unaware of the risk until just before the collision. It was likely that some passengers in ZK-DQF were able to observe ZK-DAX similarly, but they may have been equally unable to provide a warning for similar reasons.

2.11 It was evident that Cessna 207 pilots were not well able to see another aircraft converging at the same height, in the 9 o'clock or 3 o'clock position while flying on a steady course. Similar restrictions to vision probably occurred with other high-wing aircraft types, but were not researched. It was evident that pilots needed to be aware of these restrictions to vision and to adopt measures to overcome them. In addition to the expedient of leaning forward to look around the door pillars another tactic available was for the pilot to bank his aircraft gently and look beneath the raised wing.

2.12 The pilots may not have been aware of the need to employ a look-out scan between the 9 o'clock and 3 o'clock positions. Some flight safety organisations had published advice that a lookout between 10 o'clock and 2 o'clock position was necessary to "see and avoid" other aircraft. While this might have covered the most common directions of conflict with other aircraft, clearly it could not suffice in the circumstances of this accident.

2.13 A convergence of two aircraft in each other's 9 o'clock and 3 o'clock positions, as in this accident, essentially required aircraft flying at a similar speed on similar courses. ZK-DAX and ZK-DQF were of the same type and loaded similarly as, indeed, were most of the aircraft operating from Milford Sound. If speed had differed by more than a few knots, then the pilot of the faster aircraft in a conflict situation should have seen the other aircraft ahead of him, rather than obscured, alongside. The courses of aircraft flying in and out of Milford Sound were essentially constrained by high, narrow valleys. This not only put aircraft onto similar courses, but it also concentrated the traffic density.

2.14 These specific factors, of constrained courses and similar aircraft performance, therefore enhanced some types of collision risk while reducing others. Overtaking and markedly converging conflicts were largely eliminated, leaving head-on, lateral convergence (9 o'clock/3 o'clock) and vertical convergence (climb/descent) situations. The head-on situation would have been much less likely if all the traffic was known to be departing, as in this case. The remaining lateral and vertical situations were the ones most difficult for a pilot to see.

2.15 The common traffic situation for a number of aircraft departing from Milford Sound aerodrome was for small groups to take off in a stream at about 30 second intervals. Pilots were thus able to remain in a stream, visually following and separated from the aircraft ahead. This situation provided adequate separation if all aircraft were on the same route and no anomalies occurred to interrupt the traffic flow.

2.16 Directly leading to this accident was such an anomaly, where deteriorating weather on the Mackinnon Pass caused the first group of aircraft to return to Milford Sound, to follow an alternative route. This group of aircraft thus merged inevitably with the next group and the informal linear spacing between aircraft was lost. Each pilot had to observe the aircraft of the other group and maintain his separation as best he could from all those near to him.

2.17 The closure of the Mackinnon Pass was not an unusual event during the time of the day when active tourist flying was taking place. When aircraft departed in significant numbers, as on the day of this accident, a similar merging of aircraft was likely to occur every time in this situation, since the information that the Pass was closed was not available until the first aircraft group approached the Pass. That group had little alternative but to return to Milford Sound, while the subsequent group was continuing to depart.

2.18 ZK-DAX and ZK-DQF probably arrived in their relative abeam positions from left turns completed at similar times; ZK-DAX turning from the Arthur Valley into Milford Sound and ZK-DQF making a 180° turn over the aerodrome to fly down the Sound. Since neither pilot saw, or was in a position to see the other aircraft readily then no action was taken by either to maintain separation.

2.19 It would not be practicable for a pilot in two such merging groups to count, and thus know he had accounted for the positions of each of the other aircraft. Even if he knew the total number involved, he could not know how many might be behind him or too far ahead to be seen. He had therefore to be especially alert to look around; to know the limitations on his view imposed by his aircraft and employ tactics to compensate.

2.20 Visual collision avoidance obviously depended on pilots being able to see and to look assiduously for other aircraft and to take appropriate actions in good time. It depended equally on aircraft being operated in low traffic density, so that the random collision risk was low. Only a low traffic density could have ensured that a pilot had a manageable size of look/see/avoid task to perform along with his other aircraft management tasks.

2.21 The overall traffic density operating from Milford Sound Aerodrome was generally low. On 30 December 1989, a typically busy day of tourist flights, a total of 40 departures was recorded. However, 17 of these occurred between 1515 and 1535 hours, essentially creating the temporary high traffic density in which this collision occurred. This peak in traffic density did not stem from any major operational necessity, but rather from the most convenient arrangement of other tourist facilities. While the levels of arrivals and departures fluctuated throughout a typical day, no other peak of movements approached the density of the mid-afternoon departures.

2.22 The development of this traffic density peak was not only accepted by the local tourist aircraft operators, it was created by them. No airmanship

concerns for the increased collision risk appear to have affected the operators' acceptance of the situation. Unless positive action was taken to smooth the flow of traffic, by spreading the peak over a longer period, the risk of another enroute collision between tourist flights remained significant.

3. FINDINGS

- 3.1 Both pilots were appropriately licensed for the flights.
- 3.2 The pilot of ZK-DAX was experienced in this operation.
- 3.3 The pilot of ZK-DQF was newly qualified and inexperienced in this operation.
- 3.4 It was not possible to establish whether the experience levels of the pilots was a factor in this accident.
- 3.5 Both aircraft's masses and centres of gravity were within authorised limits.
- 3.6 Both aircraft were airworthy and properly maintained.
- 3.7 The Certificate of Airworthiness of ZK-DQF was invalid, but for administrative reasons only.
- 3.8 The aircraft collided while flying in steady cruising flight.
- 3.9 There was no positive evidence of the pilot of either aircraft taking collision avoidance manoeuvres.
- 3.10 The lighting and visibility were good.
- 3.11 Neither pilot saw the other aircraft in time to avoid the collision.
- 3.12 It was difficult for either pilot to see the other aircraft until a few seconds before the collision.
- 3.13 The collision occurred during a brief daily period of high traffic density.
- 3.14 ZK-DQF fell out of control into the sea as a result of collision damage.

CONCLUSION

This mid-air collision occurred because neither pilot saw the other aircraft in time. Causal factors were the pilots' restricted cockpit vision; a lack of pilot awareness to maintain an effective look-out; the unnecessarily high density of traffic and the unplanned merging of two streams of aircraft after a weather deterioration necessitated a change in route after departure.

4. SAFETY RECOMMENDATIONS

4.1 As a result of the investigation into this accident it was recommended to the General Manager of the Air Transport Division that:

He regulate the traffic density at Milford Sound by restricting the maximum number of aeroplane departures within a period of time. Six departures in any fifteen minute period was suggested to give flexibility while allowing aircraft to fly to the MacKinnon Pass and return to overhead Milford Sound without encountering dense traffic,

He publish flight safety advice to pilots explaining:

how features such as valleys, VFR lanes or edges of controlled airspace constrained aircraft onto similar courses and concentrated traffic density,

how similar performance aircraft may converge laterally or vertically where lookout was most difficult,

what steps to take to compensate for this difficulty; and

that an essential part of visual collision avoidance was a low traffic density. Good airmanship included consideration of when and where to fly, with this in mind,

Provision be made for continuous weather information to be available from key areas such as the McKinnon Pass and the Upper Hollyford Valley to ensure that the normal VFR weather minima could be observed while transiting the passes,

The Minimum requirement for a Milford rating be agreed and promulgated,

Waistbelt or similar ready access lifejackets be provided for each occupant of any air transport flight operation from Milford Aerodrome,

The radio and public address equipment should be so configured that the pilot could guard the operating frequency continuously,

Local arrangements be fostered between hotel managers, surface tour operators and the aircraft operators to spread the arrival time of passenger groups and thus avoid the pressure for bunching of aircraft departures,

The utilisation of larger aircraft with the advantage of few movements per given number of passengers be considered,

Aerodrome movements at peak traffic times be restricted to locally based operators, and

It be a requirement that air transport operators' Operations Manuals and Training Manuals detail their operational and training procedures, minimum experience levels and enroute meteorological minima for their Milford Sound operations.

5. REGULATORY

5.1 Pursuant to Section 14(5) of the Transport Accident Investigation Commission Act 1990 the operators, the pilot in command of ZK-DAX and the legal personal representative of the pilot in command of ZK-DQF were invited to avail themselves of the opportunities afforded to them thereunder.

5.2 As a result of representations received the report was amended and amplified to clarify some of the points raised.

5.3 The representations made to the undersigned are not to be taken as an admission of liability on the part of the parties concerned and their statements are without prejudice to their right to act in any way they may consider fit in any proceedings or action which may be based on the events to which this report refers.

16 July 1991

M F DUNPHY
Chief Commissioner