06-008	**Piper PA23-250-E Aztec, ZK-PIW, landing gear collapse, Ardmore Aerodrome**	**21 December 2006**

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

Report 06-008

Piper PA23-250-E Aztec

ZK-PIW

landing gear collapse

Ardmore Aerodrome

21 December 2006

Abstract

On Thursday 21 December 2006, Piper PA23-250-E, registration Aztec ZK-PIW, was part-way through a training flight when after an intermediate landing the pilots observed an indication warning of a possible fault with the nose landing gear. The fault was rectified and the aircraft diverted to Ardmore at the request of an engineer. During the flight to Ardmore, a second landing gear indication fault occurred, this time with the right landing gear.

The pilots were satisfied that the right landing gear was down and locked, so continued to land at Ardmore. During the landing roll the right landing gear collapsed and the right wing came in contact with the ground, however the pilots were able to keep the aircraft on the runway. There was minor damage to the aircraft and no injury to the pilots.

Although the reason for the landing gear collapse could not be specifically identified, the evidence suggested it was a combination of faulty and worn landing gear components. The safety issue identified was the need to develop improved maintenance and operating practices for ageing aircraft in New Zealand. A safety recommendation was made to the Director of Civil Aviation to address this issue.

Piper PA23-250-E Aztec ZK-PIW
After landing at Ardmore

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Abbreviations

CAA	(New Zealand) Civil Aviation Authority
CAR	Civil Aviation Rule
CFR	(United States) Code of Federal Regulations
FAA	(United States) Federal Aviation Administration
FAR	(United States) Federal Aviation Regulation
IFR	instrument flight rules
kg	kilogram(s)
NTSB	(United States) National Transportation Safety Board
UNICOM	Universal Communication Service
US	United States
UTC	coordinated universal time

Glossary

CAR Part 121	Air Operations – Large Aeroplanes. An aeroplane having a seating configuration of more than 30 seats, excluding any required crew member seat, or a payload capacity of more than 3410 kilograms (kg)
CAR Part 125	Air Operations – Medium Aeroplanes. An aeroplane having a passenger seating configuration of 10 to 30 seats, or a payload capacity of 3410 kg or less and a maximum certificated take-off weight greater than 5700 kg
CAR Part 135	Air Operations – Helicopters and Small Aeroplanes. An aeroplane having a seating configuration of 9 seats or less, excluding any required crew member seat, and a maximum certificated take-off weight of 5700 kg or less, except for a single engine aeroplane used for an air operation carrying a passenger under instrument flight rules (IFR), or a helicopter
FAR Part 121	Operating Requirements: Domestic, Flag, and Supplemental Operations
FAR Part 129	Operations: Foreign air carriers and foreign operations of United States (US) registered aircraft engaged in common carriage
FAR Part 135	Operating Requirements: Commuter and on-demand operations and rules governing persons on board such aircraft

Data Summary

Aircraft registration:	ZK-PIW
Type and serial number:	Piper PA23-250-E Aztec, 27-7305089
Number and type of engines:	2 Textron Lycoming IO-540
Year of manufacture:	1973
Operator:	Commercial Helicopters Limited (trading as Mountain Air)
Date and time:	21 December 2006, 1325[1]
Location:	Ardmore Aerodrome latitude: 37° 01´ 47´´ south longitude: 174° 58´ 24´´ east
Type of flight:	flight instruction
Persons on board:	crew: 1 students: 1
Injuries:	nil
Nature of damage:	minor
Pilot's licence:	Air Transport Pilot Licence (Aeroplane)
Pilot's age:	63
Pilot's total flying experience:	17 258 (61 hours on type)
Investigator-in-charge:	I R M^{c}Clelland

[1] Times in this report are New Zealand Daylight Time (UTC + 13 hours) and are expressed in the 24-hour mode.

Factual Information

1.1 History of the flight

1.1.1 On Thursday 21 December 2006, Piper PA23-250-E Aztec, registration ZK-PIW, was being used for multi-engine IFR training by Mountain Air (the operator). The operator also used the aircraft for regular passenger and freight operations, typically between Auckland and Great Barrier Island.

1.1.2 At about 0900 ZK-PIW departed from Auckland International Airport with an instructor and student on board, bound for Great Barrier Aerodrome on Great Barrier Island. The plan was to fly under IFR to Great Barrier, conduct an instrument approach and land. After landing, the student would swap with another student pilot who lived on the island. A second instructional flight would then be flown before landing at Great Barrier Island again, changing students and returning to Auckland (see Figure 1).

1.1.3 The flight from Auckland to Great Barrier Island proceeded without incident. After landing at Great Barrier Aerodrome, ZK-PIW was taxied across the grass to the terminal area. Approaching the terminal, the 2 pilots on board noticed the green nose wheel position light extinguish, indicating that the nose leg was not locked down.

1.1.4 The student shut down the aircraft and the 2 pilots, assisted by the local pilot, inspected the nose gear assembly. They noted that the landing gear was physically down and locked, but the nose gear door appeared to not be fully open. No other anomaly was observed. The instructor called the operator's maintenance provider to inform them of the situation and seek advice. An engineer who was familiar with ZK-PIW suggested that the failed landing gear position light might have been caused by a sticky micro-switch located on the nose wheel assembly. The engineer advised the instructor to clean and spray the nose gear door linkages and micro-switch with a lubricant, to see if this would free up the door and obtain a green nose indicator position light.

1.1.5 The pilots cleaned and sprayed the subject areas and were able to open the nose gear doors fully. They then turned on aircraft power and observed the 3 gear position indicator lights illuminated green; electrically confirming the landing gear was down and locked. The instructor called the engineer again and informed him that the nose door was fully open and the 3 green lights were showing. The engineer advised the instructor that he would like the aircraft returned to the maintenance provider's base at Ardmore Aerodrome so he could conduct a fuller check of the landing gear. He also recommended that the landing gear remain down for the approximately 25-minute flight to Ardmore, which the instructor agreed to do.

1.1.6 At about 1245 ZK-PIW departed Great Barrier Island under visual flight rules with the instructor and student on board. The student remained the flying pilot for the flight. As the aircraft was levelled at a cruise altitude of 3500 feet, both pilots saw the green right main landing gear position light extinguish. The pilots swapped landing gear indicator light bulbs but the right gear light remained blank. The pilots believed that a faulty micro-switch was again the most likely cause of the light failing, as the landing gear control lever had not been moved since being selected down for the landing on Great Barrier Island.

1.1.7 Approaching Ardmore Aerodrome, the instructor called the Ardmore Universal Communication Service (UNICOM) and advised that they were inbound and did not have a gear locked down indication on one of the main wheels. The UNICOM operator replied that, in accordance with the aerodrome emergency plan, ZK-PIW should not land unless the pilots had a full landing gear down and locked indication. The instructor informed the UNICOM operator of the sequence of events, and that they had a positive confirmation that the landing gear was down and locked on leaving Great Barrier Island and the gear position should not have changed.

1.1.8 The UNICOM operator and instructor agreed that a low flyover would be flown to check the position of the landing gear. As ZK-PIW flew overhead, the UNICOM operator used his binoculars to inspect the aircraft. He reported that the landing gear appeared to be down and "looked normal". The student then re-positioned ZK-PIW for landing on runway 21.

1.1.9 The student flew a standard approach and selected full flap for the landing. The aircraft landed normally on the 2 main wheels, shortly followed by the nose wheel touching down. The landing gear warning horn did not sound when the student closed the throttles for landing, indicating to the 2 pilots that the gear was still locked down. However, as the aircraft slowed to a fast taxi speed, the aircraft slowly sank down on the right side. The instructor immediately pulled the right propeller control lever through to feather and shut down the right engine. He shut down the left engine soon afterwards. The right wing contacted the runway at about the same time as the right propeller stopped rotating. The aircraft veered right but came to a halt before leaving the runway. The pilots turned off all the remaining switches and vacated the aircraft.

1.1.10 The UNICOM operator saw the aircraft starting to slump down to its right, so he immediately activated the aerodrome crash alarm and called local emergency services. The Police, Fire Service and ambulance were reported to be on the scene within 10 to 15 minutes. There was, however, no fire or injuries.

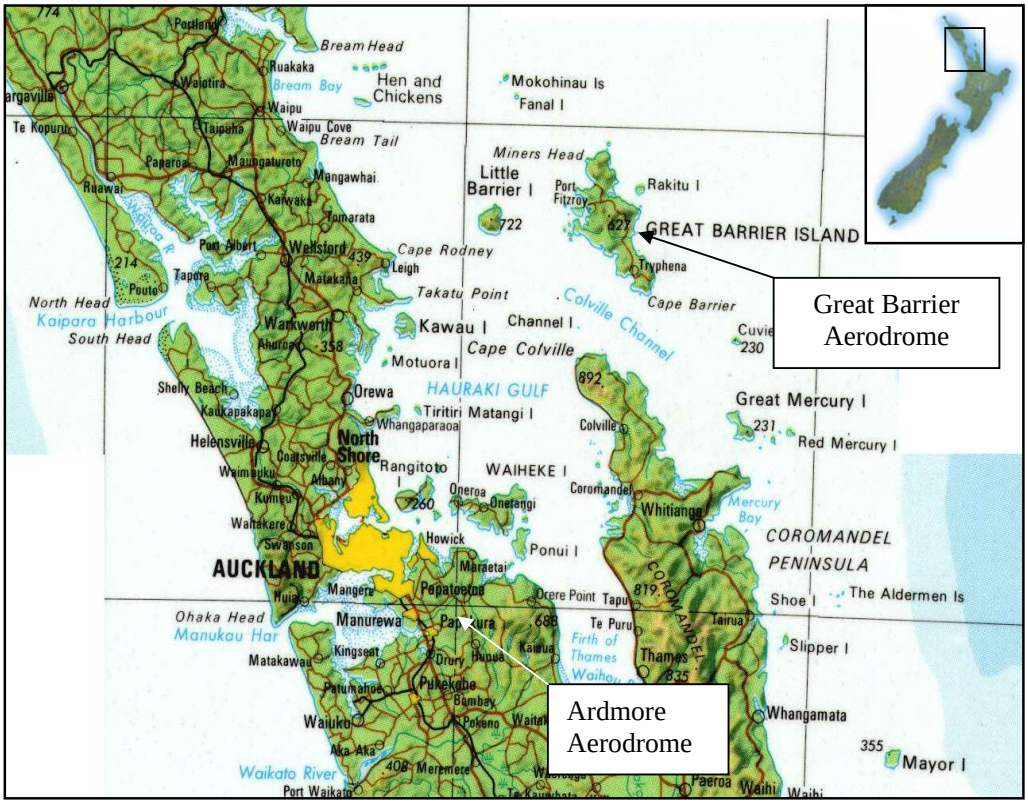

Figure 1
Location Map

1.2 Damage to aircraft

1.2.1 There was minor scraping to the underside of the aircraft and right propeller blades.

1.3 Other damage

1.3.1 No other damage was sustained.

1.4 Personnel information

1.4.1 The instructor was aged 63. He held an Air Transport Pilot Licence (Aeroplane), an A category flying instructor rating, a current instrument rating and a Class 1 medical certificate valid until April 2007.

1.4.2 The instructor had been employed by the operator in April 2006, and in July 2006 was appointed the Chief Pilot IFR. In this position he was responsible for the instrument flight training of fellow company pilots.

1.4.3 At the time of the accident the instructor had flown some 17 258 hours, including 61 hours on the PA23 Aztec type aircraft. In the previous 90 days he had flown about 73 hours, including 14 hours on the PA23 Aztec. He reported that he was well rested and in good health on the day of the accident.

1.5 Aircraft information

1.5.1 ZK-PIW was a Piper PA23-250-E Aztec, serial number 27-7305089, low-wing, twin-engine aircraft, constructed in the US in 1973.[2] The aircraft was powered by 2 Textron Lycoming IO-540 reciprocating engines. ZK-PIW was fitted with 6 seats, with the passenger seats able to be removed to facilitate the carriage of freight.

1.5.2 ZK-PIW had been issued with a standard category Certificate of Airworthiness, which was non-terminating provided the aircraft was maintained and operated in accordance with the prescribed maintenance manual. A review of the aircraft records indicated that ZK-PIW had been maintained in accordance with its approved schedule and had accumulated 7485 flight hours at the time of the accident.

1.5.3 The most recent inspection, a 50-hour Event 1 inspection, had been completed on 31 October 2006. The next inspection was due on 30 April 2007 or at 7505 hours, whichever came first. The next Annual Review of Airworthiness was due on 6 April 2007.[3] The aircraft technical log, held on the aircraft and used for daily operations, recorded no limitations or defects that were relevant to the landing gear.

1.5.4 The aircraft maintenance logbook recorded that in June 2006 the operator's maintenance provider had completed some unscheduled work on ZK-PIW. The work included the removal, examination, repair and replacement of some items from the right main landing gear assembly. The logbook also recorded that as part of an Event 4 inspection completed on 11 August 2006, routine landing gear retraction tests were completed and a check of the associated powerpak[4] found the hydraulic fluid level to be satisfactory.

1.5.5 The maintenance logbook recorded that on 29 August 2006 the aircraft flaps were unable to be retracted. The exterior of the hydraulic powerpak and piping was inspected and found satisfactory. The hydraulic fluid level was found to be low, but no visible leaks were observed. The hydraulic fluid was replenished and 5 extensions and retractions of the landing gear and flaps were carried out and found satisfactory. On 27 September 2006, down-lock springs on the left main landing gear were replaced after "failure to produce green light" when down and locked. A subsequent test determined the system was operating satisfactorily.

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[2] Piper Aircraft Corporation ceased operation and was taken over by New Piper Aircraft Incorporated in 1995. The company was renamed Piper Aircraft Incorporated in August 2006.

[3] An annual audit on an aircraft to ensure it conformed to its type certificate and that all required maintenance and documentation was completed or current. It also included a general inspection of the aircraft.

[4] The powerpak was located behind the instrument panel and directed hydraulic fluid under pressure to the flap and landing gear systems. The powerpak also served as a reservoir and was operated by levers protruding through the face of the instrument panel.

1.5.6 On 9 October 2006 the maintenance logbook again recorded that the flaps were unable to be retracted. The flap actuator assembly was removed and a temporary replacement actuator fitted. The powerpak was replenished with one quart of hydraulic fluid and a test found the flap system to be operating satisfactorily. The original actuator was stripped, cleaned and inspected. New "O" rings were fitted and the actuator reinstalled on the aircraft. No further problems with the flaps or landing gear were reported until the landing at Great Barrier on 21 December, 38 flying hours later.

Landing gear

1.5.7 The Piper PA23-250 aircraft was fitted with a hydraulically actuated, fully retractable tricycle landing gear. When the landing gear selector lever was moved, hydraulic pressure was directed by the powerpak to either raise or lower the gear. The aircraft was also fitted with a hydraulic hand pump and landing gear emergency lowering system. The main landing gear legs retracted forward into their housings, while the nose leg retracted rearwards. Once the landing gear had moved to the position determined by the selector lever, pressure would build up, causing the selector lever to return to the neutral position, thus trapping fluid under pressure in the section of the system actuated.

1.5.8 With the landing gear down, mechanical over-centre drag struts would lock the landing gear legs in the down position. To prevent the gear being retracted while the aeroplane was on the ground, an anti-retraction valve prevented a build-up of hydraulic pressure in the retraction system while the weight of the aeroplane was on its wheels (see Figures 2 and 3).

1.5.9 Four landing gear position lights, 3 green lights and one amber light were located below the throttle levers to indicate the position of the landing gear legs. With the landing gear fully retracted, the amber light would illuminate. A green light would illuminate when its respective landing gear leg was in the down and locked position and its micro-switch contact made. When the landing gear was in an intermediate position, no light would illuminate.

1.5.10 A landing gear unsafe warning horn would sound and a red light on the landing gear selector lever would illuminate if the landing gear was not selected down and either throttle was retarded to below 15 inches of manifold pressure.[5] The 3 landing gear micro-switches were connected in parallel to a common junction box and then to the throttle switch block. Therefore, to prevent the warning horn sounding and warning light illuminating with the gear selected down, only one of the 3 landing gear legs needed to be in the down and locked position and its micro-switch made.

[5] Below 15 inches of engine manifold pressure would generally equate to the throttle levers being closed for landing.

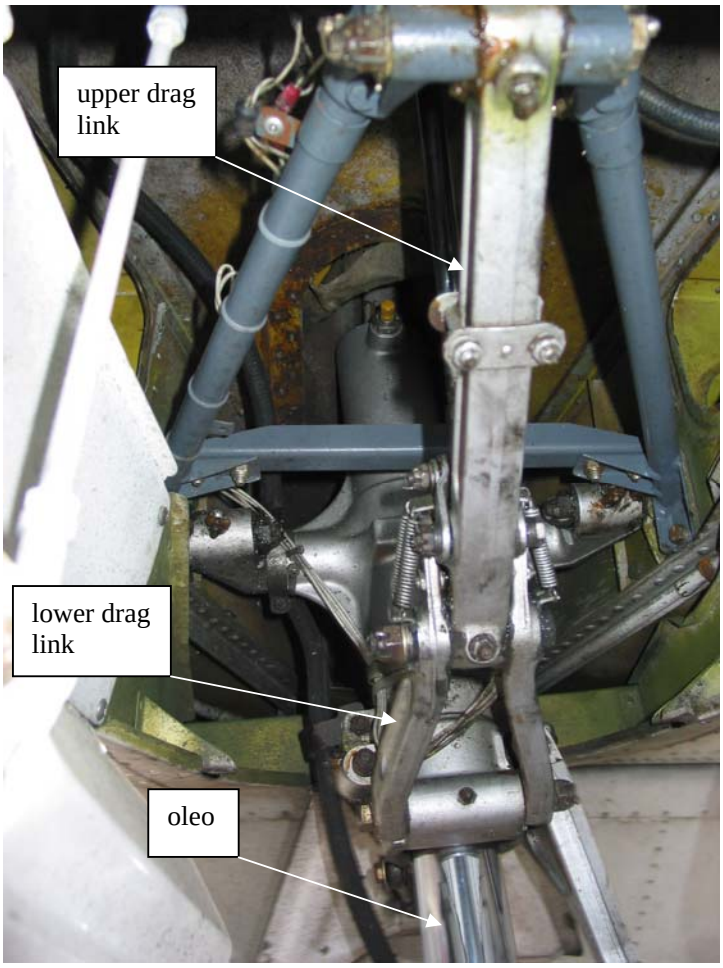

Figure 2
Right main landing gear ZK-PIW - looking aft

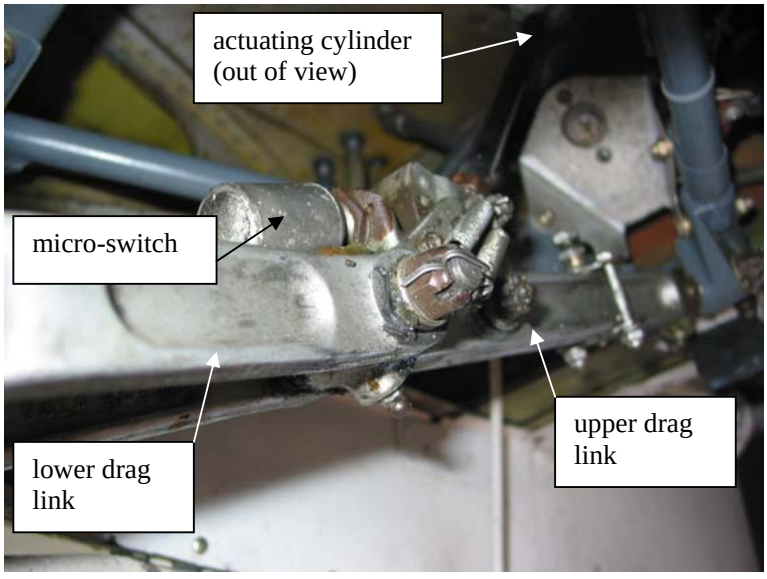

Figure 3
Right main landing gear ZK-PIW – looking upwards

1.6 Aerodrome information

1.6.1 Ardmore Aerodrome was owned and managed by Ardmore Airport Limited. The former control tower was used to house a UNICOM facility to help manage the flow of traffic at the aerodrome. Volunteers, normally local flying instructors, were rostered to operate the UNICOM facility.

1.6.2 The Aerodrome Emergency Plan, which had been last updated in August 2002, recorded that the aerodrome did not have a resident rescue fire service. Limited emergency equipment was stored in a shed and one of the operators on the aerodrome had fitted some fire-fighting equipment to a vehicle. In case of an emergency, the Fire Service, ambulance and the Police located in Papakura, about 5 kilometres away by road, were to be contacted through the 111 service.

1.6.3 The emergency plan contained a paragraph concerning aircraft with undercarriage emergencies. It stated that an aircraft that "does not have three greens, should not land until Emergency Services are in position on the airfield". Exceptions were made for low fuel endurance, deteriorating weather and other possible factors. The paragraph also noted that pilots "may consider diverting" to nearby Auckland International Airport or Whenuapai Air Force Base, which had permanent rescue fire services.

1.7 Tests and research

Aircraft examination

1.7.1 Following the incident, ZK-PIW was lifted and the right landing gear leg extended and locked in the down position. The aircraft was then removed to a maintenance facility and examined under the supervision of the Commission. The aircraft was placed on jacks and an initial examination found nothing unusual, including no hydraulic leaks around the landing gear. Electrical power was applied to the aircraft and the right landing gear locked down indicator light was noted to be unlit. The remaining 2 lights were illuminated. Adjustment of the right micro-switch resulted in the illumination of the light.

1.7.2 Hydraulic pressure was applied to the aircraft's landing gear system and several retractions and extensions were completed without problem. However, it was noted that the gear selector lever took longer than normal to return to the neutral position after the landing gear reached the selected position. A check of the landing gear warning system found it to be functioning correctly.

1.7.3 The landing gear assembly was then further inspected and, although there was some play within the linkages, it was determined to be rigged within prescribed limits. Closer examination of the drag brace links for all the landing gear legs found that they were approaching their wear limits. As a precaution the maintenance provider had all 3 drag brace links overhauled. The right main landing gear hydraulic actuating cylinder was removed and an internal leak was located. As a result all 3 actuators were replaced. The hydraulic priority valve that allowed the landing gear doors to operate in coordination with the landing gear was bench tested and found to be leaking. After the O-rings were replaced, the valve operated within maintenance manual limits. As a further precaution the O-rings in the timer check valves for the landing gear doors were also replaced.

1.7.4 The aircraft was returned to service in early 2007. However, about one month later in March 2007, a pilot reported that the nose wheel landing light did not illuminate. The landing gear control lever was recycled and the light illuminated. The aircraft was landed without incident. The indication defect was rectified by adjusting the nose gear micro-switch. Following later routine maintenance work, the engineers elected to replace the hydraulic powerpak containing the hydraulic reservoir, landing gear and flap controllers and hand pump.

Maintenance

1.7.5 The programmed maintenance inspections for ZK-PIW consisted of a cycle of 4 inspections at 50-hour intervals, titled Events 1 to 4, plus special inspections at stipulated flight times. A minimum of one cycle was to be completed within 12 months. Event 2 called for a general inspection of the landing gear. Event 4 required a more detailed examination, including the aircraft to be placed on jacks for inspection of the gear assembly, down locks and anti-retraction system and for any leaks. Retraction checks were also to be completed. The most recent Event 4 inspection was recorded as being completed on 11 August 2006 at 7401 aircraft hours.

Ageing aircraft

1.7.6 A review of the New Zealand aircraft register identified that much of the general aviation and commercial fleets of aircraft were designed in the 1950s and 1960s. Later-model aircraft were often modified versions of these aircraft. New Zealand Civil Aviation Authority (CAA) data from the second quarter of 2006 identified 1112 New Zealand-registered aircraft that had performed some form of commercial operation. A breakdown by operational grouping was as follows:

Part 121 Large Aeroplane	117
Part 125 Medium Aeroplane	88
Part 135 Helicopters and Small Aeroplanes	489
Agricultural Operations (aeroplane and helicopter)	283
Other commercial aeroplanes and helicopters[6]	395

Note: Some aircraft were operated in more than one group.

1.7.7 Of the 1112 aircraft, 750 were over 20 years old, including 296 aircraft that were over 30 years old. The average age by operation was as follows:

Part 121 Large Aeroplane	14 years
Part 125 Medium Aeroplane	20 years and one month
Part 135 Helicopters and Small Aeroplanes	28 years and 7 months
Agricultural Operations – Aeroplanes	24 years and 5 months
Agricultural Operations – Helicopters	19 years and one month
Other Commercial – Aeroplanes	26 years and one month
Other Commercial – Helicopters	16 years and 9 months

1.7.8 According to US Federal Aviation Administration (FAA) information, many of these aircraft types are now "being used well beyond the flight hours and years envisioned when the airplanes were designed". There was also concern that "these airplanes could develop serious age related problems".

1.7.9 On 28 April 1988, a Boeing 737-200 lost part of its upper fuselage due to multiple fatigue cracks.[7] Fatigue and other associated issues had been identified as causal factors in previous accidents, but this event was generally considered to be the start of the FAA's focus on what was later called the Ageing Aircraft Programme.

1.7.10 Between 1991 and 2002 the FAA developed rules regarding maintenance record reviews and aircraft inspections for a range of aircraft models with more than 14 years' service. In February 2005, the FAA issued a new rule that, according to the National Transportation Safety Board of the United States (NTSB) "substantially changed the supplemental inspection requirements, which now only applied to transport-category, turbine-powered airplanes that were type-

[6] Those commercial operations for which the public would not normally purchase tickets, for example power line inspections and, coast guard or Police operations.
[7] Aloha Airlines Boeing 737-200 explosive decompression and near-crash in the Hawaiian Islands. Refer NTSB Aircraft Accident Report NTSB/AAR-89/03.

certified after 1 January 1958, and had a maximum seating capacity of 30 or more or a maximum payload of 7500 pounds or more".

1.7.11 On 19 December 2005, a Grumman G-73T Turbo Mallard seaplane had an "in-flight structural failure of the right wing and crashed near Miami, Florida". The NTSB, concerned that the amended FAA rules did not cover this category of aircraft, issued a safety recommendation to the FAA. The recommendation stated that the FAA:

> Require records reviews, aging airplane inspections, and supplement inspections for all airplanes operated under 14 Code of Federal Regulations (CFR) Part 121, all U.S.-registered airplanes operated under CFR Part 129, and all airplanes used in scheduled operations under CFR Part 135. This would include those airplanes operated under Part 135 that carry nine or fewer passengers and those that are operated in scheduled cargo service. (A-06-52)

1.7.12 Since the initiation of the Ageing Aircraft Programme, several aviation organisations and manufacturers have developed guidelines and programmes for maintaining and operating older aircraft, typically those over 30 years old.[8] Piper Aircraft Incorporated, which took over the type certificate and support functions of Piper products, including PA23 Aztec aircraft, advised the Commission that it had not developed an ageing aircraft programme; instead it followed "FAA guide lines" and operators were to continue using the established maintenance schedules.

1.7.13 Between 2000 and 2006, the Commission investigated 8 events where there had been a landing gear or undercarriage mechanical malfunction or failure during taxi, approach or landing.[9] They all resulted in some damage to the aircraft concerned, but no injury to the occupants. The average age of the 8 aircraft was 28 years, with the oldest aircraft being 42 years. The Commission investigated 2 events in the equivalent preceding time period, 1993 to 1999.[10] [11]

2 Analysis

Landing gear collapse

2.1 The flight was a routine training flight in an aircraft that was also used for the carriage of passengers and freight. The flight proceeded uneventfully until taxiing in for a change of student at Great Barrier Island. The rectification of the nose wheel indicator fault was appropriately handled and the engineer showed caution in asking for the aircraft to be flown to Ardmore with the landing gear extended for further examination.

2.2 There was no evidence that the problem with the nose wheel indication light was related to the later collapse of the right landing gear after landing at Ardmore. The swapping of light bulbs during the flight to Ardmore was a good idea and eliminated this as the fault. However, the instructor could also have re-selected the landing gear selector lever to down. Doing so would have re-pressurised the hydraulic down line and could have provided enough additional pressure to ensure the gear was fully down and stayed down.

2.3 The pilots understandably thought that lack of a green right landing gear light was another micro-switch fault. This assumption was supported by the need later to readjust the micro-switch and when the landing gear rigging was found to be within documented tolerances, albeit on the limits.

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[8] An example of material produced was the "Best Practices Guide for Maintaining Aging General Aviation Airplanes", developed by various American aviation organisations in conjunction with the FAA. The aircraft manufacturer Cessna had also produced an ageing aircraft maintenance programme for its products.
[9] Refer TAIC reports 00-006, 00-014, 02-002, 02-008, 02-013, 04-001, 05-007 and 06-002.
[10] Refer TAIC reports 94-007 and 94-018.
[11] The investigations concerned commercial operations only. There was no evidence to suggest the trend for private or unreported minor events was any different. The possibility of a landing gear malfunction resulting in damage and not being reported was considered unlikely.

2.4 The landing gear warning horn was a gross error check to ensure the gear was selected down before landing. Because the landing gear lever was selected down and 2 of the 3 micro-switch contacts had been made, the warning horn would not have activated. Checklist actions direct a pilot, after having selected the landing gear either up or down, to check the condition of the landing gear lights and identify any anomaly.

2.5 The collapse of the right landing gear leg as the aircraft slowed could therefore have been caused by a number of faults that combined to overcome the mechanical down lock. The internally leaking actuator would have allowed pressure within the actuator to equalise over time. The faulty powerpak, possibly indicated by the selector lever being slower to return to the neutral position, could have also vented pressure from the down line or increased pressure in the up line. These possibilities, combined with the worn drag brace links, permitted sufficient fore and aft movement of the gear leg to break the over-centre down lock and allow the leg to start collapsing.

2.6 The powerpak was still functioning, as indicated by the pilots still being able to raise and lower the flaps without problem. The decision to replace the powerpak following the later nose wheel indication incident helped ensure the hydraulic system and the landing gear were performing to specifications.

2.7 The final decision to land after the UNICOM operator had voiced his concerns was understandable but questionable. If there was any doubt about the status of the landing gear, it would have been wise to wait for local emergency services to arrive or divert to a nearby aerodrome with trained aircraft rescue fire service personnel available. The pilots believed the landing gear was locked down because they had visually checked it on Great Barrier Island and had not moved the gear lever during the flight to Ardmore. The flyover and visual check showed nothing out of the ordinary; however, it was of limited value in this case as it would have been difficult to detect anything other than a large misalignment of the landing gear leg.

2.8 The standard operating procedure for aircraft landing with unsafe gear indications at the aerodrome was put in place to mitigate the risk of a landing accident that would require emergency services and might result in injury of some degree. The fact that there was no injury and minimal damage to the aircraft was a combination of good luck and good management of the event by the instructor.

Ageing aircraft

2.9 ZK-PIW was maintained in accordance with the prescribed maintenance manuals. The aircraft was, however, 33 years old and the review of the records indicated that an increasing amount of additional unplanned maintenance was required to keep the aircraft airworthy. Much of this was rectification of faults or defects associated with the landing gear and flaps, and the supporting hydraulic system.

2.10 Ideally a maintenance programme should be proactive and identify during scheduled servicing the potential for a defect to occur. This can prevent major disruptions to an organisation's operations and reduce the possibility of an accident occurring. The majority of aircraft flying commercially in New Zealand, especially those in Part 135 operations, were maintained in accordance with maintenance programmes that made little or no allowance for the age of the aircraft.

2.11 Of the 8 investigations by the Commission into landing gear faults between 2000 and 2006, 3 investigations were unable to determine a specific cause for the failure but identified general wear and tear as a likely significant contributing factor. A further 3 investigations identified aircraft fatigue as the primary cause. However, there was no evidence to suggest that the maintenance undertaken in each case, including for ZK-PIW, did not follow good industry practice.

2.12 The average age of the aircraft involved in the landing gear accidents investigated by the Commission was 28 years, the same as the average age for CAR Part 135 helicopter and small aeroplanes. Given the increasing number of incidents associated with ageing aircraft, the CAA, as the airworthiness authority, needs to work in conjunction with industry and aircraft manufacturers to develop enhanced maintenance programmes to ensure the continued safe operation of these aircraft. Alternatively, restrictions imposed on the operation of an aircraft could have the same effect.

3 Findings

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

3.1 The instructor was appropriately licensed, qualified and fit to conduct the flight.

3.2 ZK-PIW was recorded as serviceable for the flight.

3.3 The lack of landing gear indicator lights for the nose gear and, later, the right main gear, while seemingly unrelated micro-switch faults, could have been a symptom of the worn condition of the landing gear.

3.4 The decision to leave the landing gear down for the flight to Ardmore may have contributed to the gear collapse, because the internal leak in the actuator allowed hydraulic pressure to bleed off during the flight.

3.5 The cause of the collapse of the landing gear was not specifically identified, but the evidence indicated it was probably a combination of wear in the landing gear and hydraulic components.

3.6 The Commission has become concerned over the apparently increasing number of events where the age and worn condition of the failed landing gear were identified as significant factors.

3.7 The increasing average age of commercial aircraft in New Zealand, in particular those operating under CAR Part 135, suggests that the number of age-related defects and potential accidents will increase unless corrective action is taken. Manufacturers' maintenance procedures and operational limitations could be amended to achieve this.

4 Safety Recommendation

4.1 On 17 January 2008 the Commission recommended to the Director of Civil Aviation that he:

4.1.1 Define ageing aircraft, and in conjunction with industry and manufacturers develop guidance and regulatory documentation to help ensure the safe operation of these aircraft. (036/07)

Approved for Publication 20 December 2007

Hon W P Jeffries
Chief Commissioner

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06-002	Piper PA 23-250 Aztec, ZK-FMU, wheels-up landing, Napier Aerodrome, 13 April 2006
05-006	Fairchild-Swearingen SA227-AC Metro III ZK-POA, Loss of control and in-flight break-up, near Stratford, Taranaki province, 3 May 2005
05-008	Cessna U206G, ZK-WWH, loss of control on take-off, Queenstown Aerodrome, 10 August 2005
01-005R	Bell UH-1H Iroquois ZK-HJH, in-flight break-up, Taumarunui, 4 June 2001
05-010	Aerospatiale-Alenia ATR 72-500, ZK-MCJ, runway excursion, Queenstown Aerodrome, 5 October 2005
05-003	Piper PA34-200T Seneca II, ZK-FMW, controlled flight into terrain, 8 km north-east of Taupo Aerodrome, 2 February 2005
05-002	Cessna 172, ZK-LLB, collision with terrain while low flying, 7 km south of Gibbston, 29 January 2005
05-009	Eurocopter AS350 BA Squirrel, ZK-HGI, roll over on landing, Franz Josef Glacier, 17 August 2005
05-007	Piper PA-34-200T Seneca II, ZK-MSL, Wheels-up landing, Napier Aerodrome, 7 July 2005
05-001	Gulfstream G-IV ZK-KFB and Piper PA 28 ZK-FTR , loss of separation, near Taupo 7 January 2005
04-009	Hughes 360D, ZK-HHT, heavy landing, Wanganui River, South Westland, 21 December 2004
04-007	PA-34-200T Sceneca 11, ZK-JAN, collision with terrain, Mount Taranaki, 20 November 2004

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