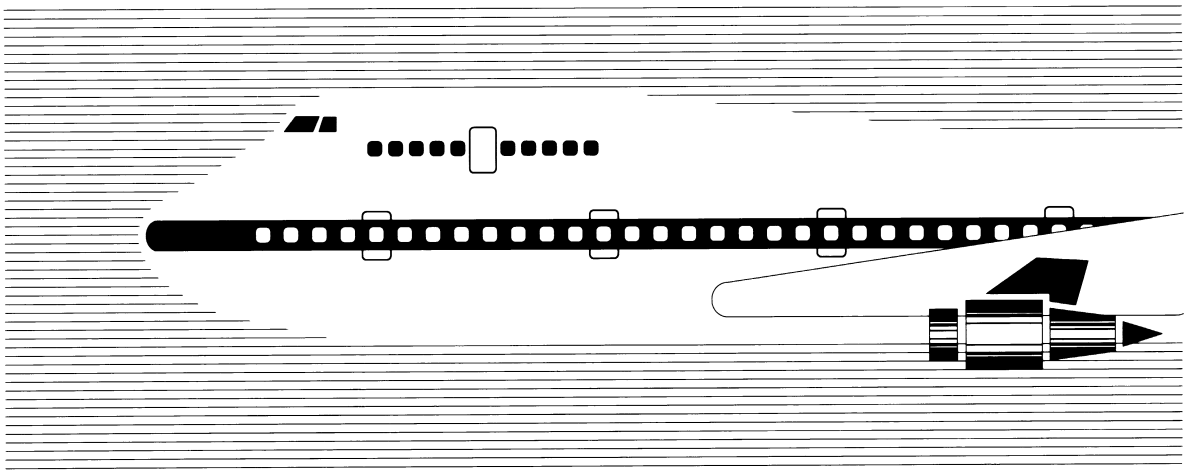
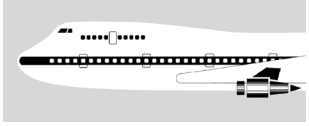
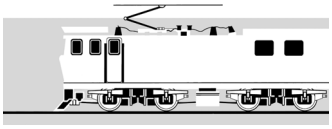


AVIATION OCCURRENCE REPORT

04-001 **Piper PA23-250E Aztec, ZK-DGS, landing gear collapse during taxi, Paraparaumu Aerodrome** **9 January 2004**


TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

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 04-001

Piper PA23-250E Aztec

ZK-DGS

landing gear collapse during taxi

Paraparaumu Aerodrome

9 January 2004

Abstract

On Friday 9 January 2004 at about 1915, ZK-DGS a Piper PA23-250E Aztec landed at Paraparaumu Aerodrome. The aircraft taxied to the fuel pumps and as it was coming to a stop the right main landing gear collapsed rearwards. The 2 pilots on board were uninjured.

The main landing gear drag brace forward attachment bolt failed because of fatigue, possibly from stress caused by out of round bushings in the drag brace. The aircraft had been rebuilt following serious accident damage in 1995. These components were possibly re-used during this rebuild and stress initiators might have been created during the accident that then led to the bolt eventually failing.

A safety issue identified was the use of parts from accident-damaged aircraft. A safety recommendation was made to the Director of Civil Aviation addressing this issue.

Contents

Figures

Abbreviations

kg	kilogram(s)
PIC	Pilot-in-Command
PF	Pilot flying
UTC	Coordinated Universal Time

Data Summary

Aircraft registration:	ZK-DGS
Type and serial number:	Piper PA23-250E Aztec, 27-7304959
Number and type of engines:	2 Lycoming IO-540-C4B5
Year of manufacture:	1973
Operator:	Sunair Aviation Limited
Date and time:	9 January 2004 at about 1915[1]
Location:	Paraparaumu Aerodrome latitude: 40°54′ south longitude: 174°59′ east
Type of flight:	air transport, freight
Persons on board:	crew: 2 passengers: 0
Injuries:	crew: nil passengers: nil
Nature of damage:	substantial
Pilot-in-Command's licence:	Commercial Pilot Licence (Aeroplane)
Pilot-in-Command's age:	24
Pilot-in-Command's total flying experience:	1785 hours (850 on type)
Investigator-in-charge:	K A Mathews

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

1 Factual Information

1.1 History of the flight

1.1.1 On Friday 9 January 2004 ZK-DGS, a Piper PA23-250E Aztec, was on a scheduled freight service from Napier to Paraparaumu, continuing to Palmerston North. On board were 2 pilots.

1.1.2 The Pilot-in-Command (PIC) was a senior line pilot with the operator and held a C category instructor rating. He was in the right seat supervising a new company pilot who was the pilot flying (PF).

1.1.3 The flight from Napier to Paraparaumu was uneventful. The aircraft joined the circuit visually from the north and flew downwind to land on the paved runway 34. The pilots reported the wind as a northerly at about 10 knots. Both pilots said the landing was normal with no excessive force. After landing the PF taxied via the paved runway 11 and taxiways towards the fuel pumps. The aircraft was to be refuelled and the freight off-loaded before continuing to Palmerston North. The freight on board consisted of about 90 kg of bank documents.

1.1.4 As the pilot brought the aircraft to a stop at the fuel pumps, the right main landing gear collapsed rearwards causing the right wing, engine and propeller to contact the ground. The PIC immediately checked that the landing gear lever was in the correct position with the landing gear locked down. He then shut down the left engine and the fuel to the right engine by using the mixture controls. The pilots then exited the aircraft uninjured. No fire occurred.

1.2 Damage to aircraft

1.2.1 An independent maintenance engineer at the aerodrome inspected the aircraft and found the right main landing gear drag brace forward attachment bolt had failed (see Figure 1). The aircraft was moved to a hangar on the aerodrome where the Commission inspected it on 12 January 2004.

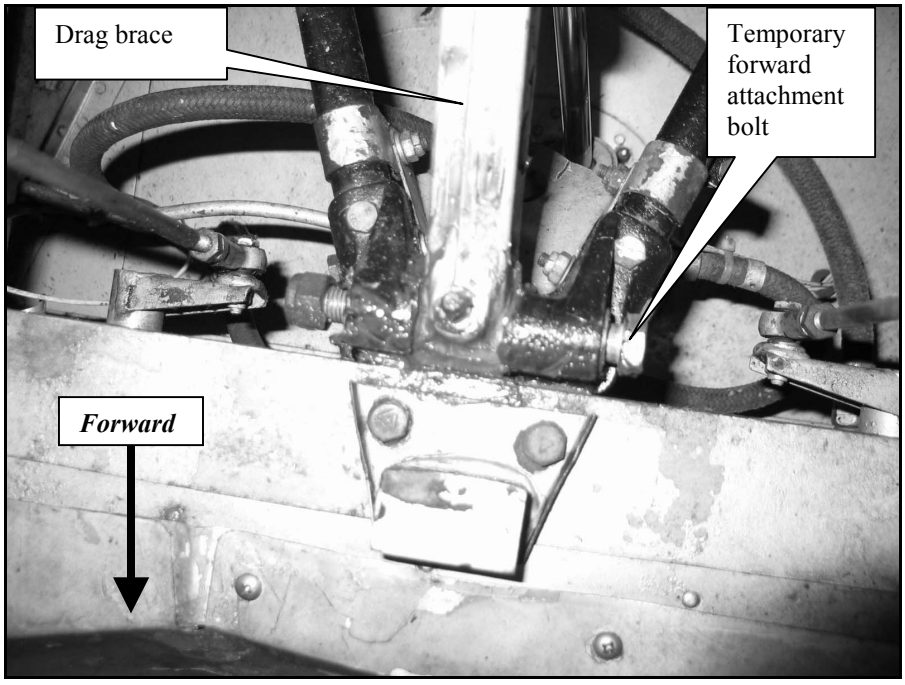


Figure 1
Drag brace forward attachment

1.2.2 A preliminary inspection of the aircraft did not reveal any defects in the main landing gear brace attachment area. The bushings around the bolt had copious deposits of grease consistent with normal maintenance and the correct grease type. The independent maintenance engineer visually checked the landing gear alignment and found it to be satisfactory. The intact attachment bolt from the left landing gear was removed for inspection.

1.2.3 The right propeller was damaged substantially after contact with the ground, and the right wing flap was damaged by the landing gear collapsing rearwards. Both these components were replaced and a temporary repair was carried out on the skin on the right wing.

1.2.4 Following these temporary repairs the operator ferried ZK-DGS to its maintenance base at Tauranga with the landing gear locked down.

1.3 Personnel information

1.3.1 The PIC was aged 24. He held a Commercial Pilot Licence (Aeroplane) and his last biennial flight review was conducted on 22 November 2003. At the time of the accident, he had flown about 1785 flying hours, of which 850 hours were on the Aztec aircraft type. He had flown some 17 hours in the previous 7 days.

1.3.2 The PIC had flown for the operator for about 18 months of which the last 7 had been as a senior line pilot.

1.3.3 The PF, who was under-supervision, also held a Commercial Pilot Licence (Aeroplane), and had about 570 flying hours total of which some 22 hours were on the Aztec. His biennial flight review was completed on 28 August 2003 and he had completed his Aztec type rating 3 weeks before the accident.

1.3.4 The PF had been flying for the operator for about one week, and was gaining experience before his final competency check.

1.3.5 The pilots had reported for duty at about 0445 and had flown another Aztec from Palmerston North to Napier. At Napier they had changed aircraft to ZK-DGS and flew it to Wairoa, Gisborne, Wairoa, and back to Napier. While at Gisborne they had a rest period of 10 hours 15 minutes from 0645 till 1700. The final sector from Paraparaumu to Palmerston North would normally have been completed by about 2030.

1.3.6 The PF had been the flying pilot for all 6 sectors flown that day. Both pilots considered all the landings were normal and neither pilot noticed anything unusual during the landings or while taxiing at Paraparaumu.

1.4 Aircraft information

1.4.1 ZK-DGS was a Piper PA23-250E Aztec, serial number 27-7304959, twin-engine all-metal 6-seat aircraft, constructed in the United States in 1973. The aircraft was fitted with 2 Lycoming IO-540-C4B5 reciprocating engines.

1.4.2 The Aircraft Technical Log showed the aircraft had accumulated 8 123.4 hours time-in-service at the time of the accident. The next inspection due was a 50-hour check at 8136.1 hours or on 9 June 2004, whichever occurred first.

1.4.3 The inspection schedule from the Piper Aztec Service Manual stated that the drag link bolts were to be inspected every 1000 hours. Maintenance records showed this was last done 740 hours before the accident. The operator had a number of Aztecs and some 30 000 hours of accumulated type experience. During that time his Aztec aircraft had no previous landing gear bolt failures.

1.4.4 In April 1995 ZK-DGS, while owned by another operator, had a double engine failure that resulted in an off field forced landing. The pilot reportedly had lowered the landing gear for the forced landing, which was made into a paddock. The aircraft was written off for insurance purposes but was repaired in early 1996. There was no evidence to show that either the drag brace or the attachment bolt had been replaced during the subsequent repair. The aircraft had flown some 2243 hours between the time of the repair and the bolt failure.

1.5 Tests and research

1.5.1 A metallurgist examined the failed bolt and drag brace. Examination of the fracture surface of the bolt revealed that it was a typical reverse bending multi-origin fatigue failure. Fatigue arcs had grown from both sides towards the centre of the bolt, and were separated by a small brittle fracture section, indicating the bolt had not been subjected to excessive force at the time of failure. The bolt was a 7/16-inch, high tensile close tolerance bolt, which met the correct specification.

1.5.2 The failure occurred at mid-length in the bolt, where 2 bushings met inside the drag brace. The outside surface of the bolt was polished in the area that was inside the bushings, indicating that the bolt had been in service for some time and that normal movement had occurred between the bolt and the bushings.

1.5.3 The bushings were a split type so that grease could be applied down the split line between them. Examination of the ends of the bushings showed that they were slightly elongated. When the intact bolt from the left gear was inserted into the bushings it could be moved sideways slightly. This movement occurred in one direction only, parallel to the axis of the drag brace. In other directions, the bolt was a tight fit.

1.5.4 The intact drag brace attachment bolt from the undamaged left gear was crack tested using Fluorescent Magnetic Particle Inspection. No cracking was found, but some corrosion near the head was evident as well as some marking, indicating the bolt had been rotating normally inside the bushings. The operator subsequently replaced this bolt. The evidence indicated this bolt had been in service as long as the failed bolt.

1.5.5 The aircraft service manual had specified low temperature airframe grease, MIL-G-23827, for lubricating the bushings and bolt. That grease was no longer in production so the operator used alternative grease that was approved by the manufacturer but had a slightly higher temperature range.

1.6 Additional information

1.6.1 Research into other failures of the forward attachment bolt on the drag brace over the previous 8 years, showed at least 2 failures had been reported overseas, one in 1996 and the other in 2003. The failure in 2003 was attributed to a likely one-time overload, and no information was available regarding the cause of the 1996 failure. There were no recorded failures of the forward attachment bolt in New Zealand. The collapse of an Aztec main landing gear at Napier in 1999 was due to the failure of a different, centre pivot bolt.

1.6.2 The aircraft manufacturer reported there were no current Airworthiness Directives associated with a failure of the forward attachment bolt, part number AN 177-33, on the PA-23 Aztec, nor could they find anything to suggest that failure of this bolt had ever been a matter of concern.

2 Analysis

2.1 The right landing gear collapsed rearwards because its supporting drag brace forward attachment bolt broke.

2.2 Examination of the forward attachment bolt indicated that it failed because of reverse bending fatigue. The fatigue had built up probably during many cycles over a number of years. The bending fatigue was consistent with the fact that the failure occurred near the middle of the bolt.

2.3 The forward attachment bolt was fitted through attachment points either side of the drag brace (see Figure 1). Whenever the aircraft was landed or taxied the drag brace would transfer a load onto the bolt. If the bolt was loose in the drag brace bushings the 3-point bending could eventually result in premature failure of the bolt.

2.4 The forward attachment bolt probably finally failed on landing at Paraparaumu. During the taxi to the fuel pumps it would have worked its way out of the drag brace bushings until the brace was free to move rearwards thus allowing the landing gear to collapse.

2.5 The cause of the drag brace bushings being slightly elongated could either have been due to normal wear or from being subject to a heavy loading. From the information available regarding the repair of ZK-DGS after its forced landing in 1995, the drag brace and its attachment bolt were possibly re-used. These components might have been subject to excessive stress during the forced landing which could have initiated the fatigue process in the bolt.

2.6 The Piper Aztec Service Manual stated that the drag link bolts were to be inspected every 1000 hours and replaced if required. An inspection of the drag link bushings was not specified, nor did the service manual specify any service tolerance limits for these bushings. The bushings may not have been visible during the bolt inspection unless the drag brace was moved out of position relative to the attachment points on either side. Due to the small amount that the bushings were elongated, this damage may not have been easy to detect unless the bolt was tested for movement inside the bushings while the brace was clear of the attachment points.

2.7 The operator said he planned to carry out non-destructive testing on the drag brace attachment bolts in conjunction with the required visual checks.

2.8 There was no evidence to show that the higher temperature grease or any lack of lubrication contributed to the bolt failure.

2.9 The number of reported failures of this and other drag link bolts is not considered to be excessive given the age and the number of these aircraft operating worldwide.

2.10 Had the failure occurred at a more critical stage, such as take-off or landing, a more serious accident could have occurred.

3 Findings

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

3.1 The pilots were appropriately licensed to conduct the flight.

3.2 The conduct of the flight did not contribute to the accident.

3.3 The aircraft records indicated ZK-DGS was correctly maintained.

3.4 The drag brace forward attachment bolt failed because of reverse bending fatigue. The elongation of the drag brace bushings might have allowed the reverse bending to occur.

3.5 The drag brace attachment bolt and bushings might have been damaged in an accident some 8 years earlier, and it is possible this created a stress initiator that eventually led to the failure of the bolt.

3.6 The drag brace and attachment bolt were possibly re-used during the re-build of ZK-DGS, and any damage to these parts may not have been noticed at that time.

3.7 This bolt failure was unusual, and was possibly a one-off event.

4 Safety Recommendation

4.1 On 1 July 2004 the Commission recommended to the Director of Civil Aviation that he:

4.1.1 publish guidelines for operators and maintenance facilities for the appropriate re-use and inspection of parts from accident-damaged aircraft. (028/04)

4.2 On 12 July 2004 the Director of Civil Aviation replied, in part:

4.2.1 I accept this recommendation and will ensure that a new rule under CAR Part 91 that requires accidents to be recorded in the aircraft logbook will be proposed for inclusion in the 2005/2006 rules programme. No precise time frame can be stated.

Advisory Circular 43.9A [*Modification and repair and the form CAA337]* will be amended to detail guidelines for the use and inspection of parts from accident damaged aircraft. This will be completed by June 2005.

Approved on 30 July 2004 for publication

Hon W P Jeffries
Chief Commissioner

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