



**Report 00-014**

**Piper PA23 Aztec**

**ZK-DIR**

**nose undercarriage collapse after landing**

**Gisborne Aerodrome**

**14 December 2000**

### **Abstract**

On Thursday 14 December 2000, at 1804, Piper PA23-250D Aztec ZK-DIR landed at Gisborne Aerodrome. Shortly after landing its nose undercarriage leg collapsed aft. The pilot and 4 passengers on board the aircraft were uninjured.

Nothing conclusive was found showing why the undercarriage leg collapsed. Three scenarios are discussed as possible causes. The more likely possible cause was that play in the drag strut bushes somehow contributed to a mechanical down lock malfunction, but this could not be replicated during testing.

No safety issues were identified.



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## Data Summary

<b>Aircraft type, serial number and registration:</b>	Piper PA23-250D Aztec, 27-4242, ZK-DIR
<b>Number and type of engines:</b>	2 Lycoming IO-540-C4B5
<b>Year of manufacture:</b>	1969
<b>Operator:</b>	Sunair Aviation Limited
<b>Date and time of occurrence:</b>	14 December 2000, 1804 <sup>1</sup>
<b>Location:</b>	Gisborne Aerodrome latitude: 38° 39.9' south longitude: 177° 58.7' east
<b>Type of flight:</b>	air transport, charter
<b>Persons on board:</b>	crew: 1 passengers: 4
<b>Injuries:</b>	crew: nil passengers: nil
<b>Nature of damage:</b>	substantial to the aircraft
<b>Pilot's licence:</b>	Commercial Pilot Licence (Aeroplane)
<b>Pilot's age:</b>	30
<b>Pilot's total flying experience:</b>	780 hours (80 hours on type)
<b>Investigator-in-charge:</b>	K A Mathews

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<sup>1</sup> 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 Thursday 14 December 2000, at 1804, Piper PA23-250D Aztec ZK-DIR landed at Gisborne Aerodrome, with the pilot and 4 passengers on board. The aircraft departed from Hamilton Aerodrome at about 1615 and landed at Rotorua Aerodrome, before continuing to Gisborne.
- 1.1.2 The flight to Gisborne proceeded normally. The pilot reported no in-flight difficulties or aircraft defects. Approaching Gisborne Aerodrome the pilot lowered the undercarriage early, just as the aircraft speed reduced below the maximum undercarriage lowering speed of 130 knots. This action was taken to help slow the aircraft for a descent to the appropriate circuit height. Initial approach flap was also selected early in the approach sequence.
- 1.1.3 The approach checks were completed and the pilot said she confirmed the 3 green undercarriage position lights were glowing, indicating that all 3 undercarriage legs were in the down locked position. The aircraft joined the circuit downwind for runway 32. The pilot said that on short final approach to land she completed the short final approach checks, which included checking that the 3 green undercarriage position lights were glowing. The pilot said she did not hear the undercarriage unsafe warning horn sound, nor did the passengers report hearing any horn.
- 1.1.4 The pilot reported good weather conditions except for some wind shear and turbulence on short final approach. The aircraft landed on the runway centreline near the approach threshold. The pilot said the aircraft touched down more firmly than normal, landing on the main wheels followed by the nose wheel lowering onto the runway.
- 1.1.5 About 10 seconds after landing, as the aircraft was slowing but still with a reasonable amount of forward speed, the nose undercarriage leg collapsed aft toward its retracted position. The leg did not retract fully into its housing but swivelled unsupported rearwards, allowing the nose of the aircraft to drop onto the runway. The aircraft slewed about 30 degrees to the right and came to rest just right of the runway centreline. No fire occurred. The occupants were uninjured.
- 1.1.6 The pilot said she was not aware of any problem until the nose undercarriage collapsed, which surprised her. She said she did not select the undercarriage up after landing.

## **1.2 Damage to aircraft**

- 1.2.1 Both propellers struck the runway and the propeller blades were destroyed. The lower nose cone skin and supporting structure were damaged from scraping on the runway.

## **1.3 Pilot information**

- 1.3.1 The pilot was aged 30. She held a Commercial Pilot Licence (Aeroplane), C category flying instructor rating, instrument rating and a Class 1 Medical Certificate valid until 17 May 2001.
- 1.3.2 At the time of the accident the pilot had amassed some 780 flying hours, including 80 hours on the Aztec aircraft. She had been working for the operator since March 2000, flying both the Aztec and a Partenavia aircraft.

## **1.4 Aircraft information**

- 1.4.1 ZK-DIR was a Piper PA23-250D Aztec, serial number 27-4242, twin-engine all-metal 6-seat aircraft, constructed in the United States in 1969. The aircraft was fitted with Lycoming IO-540-C4B5 reciprocating engines.

- 1.4.2 The aircraft had been issued with a non-terminating Certificate of Airworthiness in the standard category. The aircraft records indicated that ZK-DIR had been maintained in accordance with its approved schedule and that it had accumulated 10 309.8 hours, time-in-service at the time of the accident. The last inspection, a 100-hour check, was completed on 25 November 2000. The next inspection was due on 25 May 2001 or 10 324.9 hours, whichever came first.
- 1.4.3 The aircraft was equipped with a hydraulically actuated, fully retractable tricycle undercarriage, including a hydraulic hand pump and an emergency extension system. The main undercarriage legs retracted forward and upward into their respective housings. The nose undercarriage leg retracted aft and upward into its housing and extended forward to a near-vertical position. Once the undercarriage was in the down locked position the undercarriage selector lever would move to neutral, and relieve all hydraulic pressure. Mechanical over centre drag struts locked the undercarriage legs in the down position.
- 1.4.4 Four undercarriage position lights, 3 green lights in a row and one white light just above the centre green light, were situated under the throttle levers in the cockpit to indicate the position of the undercarriage legs. In the up position the white light would glow. No lights would glow if any undercarriage leg was in transit between up and locked down. A green light would glow when its respective undercarriage leg was in the down locked position. An undercarriage unsafe warning horn would sound and a red light on the undercarriage selector lever would glow, if either throttle was retarded to below about 15 inches of manifold pressure when any one of the 3 undercarriage legs was not in the down locked position.
- 1.4.5 There were no reports of any previous undercarriage difficulties. Several weeks before the accident the left main undercarriage microswitch, which actuated its respective green cockpit light, was replaced.

## **1.5 Aerodrome information**

- 1.5.1 At Gisborne Aerodrome the Palmerston North to Gisborne main railway line ran across bitumen runway 32, about 436 metres from the runway threshold.
- 1.5.2 ZK-DIR touched down on runway 32 before the railway line, and the nose undercarriage collapsed before the aircraft crossed the line.

## **1.6 Tests and research**

- 1.6.1 A preliminary inspection of the aircraft after the accident did not reveal any nose undercarriage mechanical defects, although some play in the nose undercarriage drag strut bushes was observed. The undercarriage position indicator lights worked normally. The undercarriage selector lever was in the normal (neutral) undercarriage down position.
- 1.6.2 Following temporary repairs the undercarriage was mechanically locked in the down position and the aircraft flown to a repair facility at Hamilton Aerodrome.
- 1.6.3 At Hamilton, repair facility engineers inspected the aircraft and tested the undercarriage system under the Commission's supervision. The undercarriage extended and retracted normally, although on 2 initial tests when pressure was applied against the nose leg extending, the undercarriage selector lever returned to neutral before the nose undercarriage locked down. During multiple subsequent tests the nose undercarriage leg extended and locked down normally, with the same pressure applied to the nose leg. During those tests, all 3 undercarriage legs locked down normally, the green lights glowed and the selector handle returned to neutral, relieving all hydraulic pressure. The hydraulic pump was within specifications. The hydraulic filter was clean.



- 1.6.4 No mechanical defects were found with the nose undercarriage system, although there was play in the drag strut bushes that allowed some movement of the drag strut. The manufacturer did not specify any general wear limit for the bushes, and engineers carrying out routine maintenance relied on general experience to determine if the bushes should be replaced. The microswitch that actuated the nose undercarriage position indicator light was adjusted correctly and operated normally. Once the drag strut went over centre, it provided a positive mechanical down lock to the nose undercarriage leg. Repeated attempts by engineers to cause the drag strut to unlock, without applying normal hydraulic pressure to the hydraulic actuator, were unsuccessful.
- 1.6.5 An anti-retraction valve positioned on the left undercarriage leg was designed to cut all hydraulic pressure to the hydraulic actuators, when aircraft weight was on the left undercarriage leg. The purpose of the valve was to prevent the undercarriage retracting if the undercarriage selector lever was moved to the up position, when the aircraft was on the ground. The valve was found to be defective, in that it did not prevent the undercarriage retracting when the valve was actuated.
- 1.6.6 The undercarriage selector lever was shaped like a wheel and was separate from the other controls. A double action was required to select the undercarriage up. A mechanical safety lock prevented the undercarriage lever moving to its up position, unless the lock was first pushed out of the way. The lock was held in its normal position by spring tension.
- 1.6.7 In 1995 the nose undercarriage leg on another Aztec collapsed in a similar manner to that of ZK-DIR, while it was taxiing on a grass aerodrome in New Zealand. No conclusive reason for the collapse was determined.

## **2. Analysis**

- 2.1 Nothing conclusive was found showing why the nose undercarriage collapsed after landing. Three likely scenarios are put forward as possibilities only.
- 2.2 The first possibility was that the nose undercarriage leg was not properly in the down locked position before landing. Had the nose undercarriage not locked down properly, the correctly adjusted nose undercarriage microswitch should have prevented its respective green light from glowing, and activated the undercarriage unsafe warning horn when either throttle was retarded. The Aztec nose undercarriage leg is usually the last leg to lock down, because it extends into the airflow. Consequently, after selecting undercarriage down pilots reportedly wait to observe the nose undercarriage green light. The pilot had ample time to complete the checks before landing and did not feel rushed. The pilot is certain she confirmed the 3 undercarriage lights were glowing at least twice before landing, and that the undercarriage unsafe warning horn did not sound. None of the passengers reported observing or hearing anything unusual before the collapse. This first possibility, therefore, seems unlikely.
- 2.3 If the pilot was aware the nose undercarriage had not locked down she could have used the manual hydraulic hand pump or emergency extension system. These were not used.

- 2.4 A second possibility is the undercarriage selector lever was momentarily moved inadvertently to the undercarriage up position after landing and then returned to its neutral position, thereby breaking the mechanical over centre lock. The nose undercarriage leg is normally the first leg to retract, because it retracts away from the direction of travel of the aircraft. The anti-retraction valve would normally prevent the undercarriage retracting in such a scenario, but the valve on ZK-DIR was unserviceable. However, the undercarriage selector lever was uniquely shaped, prominent and separate from the other controls, and required a double action to move it to the undercarriage up position. The lock should have prevented the lever being inadvertently knocked into the undercarriage up position. The pilot also flew a Partenavia, but none of its controls, such as the flap lever, was located in a position similar to the undercarriage selector lever on ZK-DIR. The pilot is sure she did not select the undercarriage up after the landing. This second possibility also seems unlikely.
- 2.5 The third possibility is that a combination of the landing forces on the nose undercarriage and drag strut movement, because of play in the drag strut bushes, caused the drag strut to flex sufficiently for the strut to move from its over centre position, and unlock the nose leg. This scenario was unable to be replicated during testing, but is the most likely of the 3 possible scenarios.

### **3. Findings**

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

- 3.1 Why the nose undercarriage leg collapsed after landing could not be established.
- 3.2 Play in the nose undercarriage drag strut bushes may have contributed to the nose undercarriage collapse, but could not be confirmed.
- 3.3 The aircraft records indicated ZK-DIR was appropriately maintained.
- 3.4 The pilot was familiar with the aircraft, appropriately licensed and rated.

Approved for publication 11 July 2001

Hon. W P Jeffries  
**Chief Commissioner**