Report 01-010

Embraer EMB-820C Chieftain ZK-RDT

door-open-in-flight incident near Auckland

31 October 2001

Abstract

On Wednesday 31 October 2001, at about 0800, Air National Chieftain ZK-RDT, operating as Origin 457, was on a scheduled passenger flight from New Plymouth to Auckland when the cabin door opened in flight. Passengers held the door in a slightly ajar position for about 10 minutes while the aeroplane was landed at Auckland.

The incident resulted from wear and distortion of door latch components, which had not been detected and rectified.

A safety issue identified was the need for more awareness by both pilots and engineers of mechanical deterioration of items such as the door latch mechanism.

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.

Contents

Figures

Data Summary

Aircraft type, serial number and registration:	Embraer EMB-820C Chieftain (licence-built PA 31-350), 820127, ZK-RDT
Number and type of engines:	two Lycoming L/TIO-540-J2BD
Year of manufacture:	1982
Date and time:	31 October 2001, about 0800
Location:	on approach to Auckland Airport
Type of flight:	scheduled passenger transport
Persons on board:	passengers: 7 crew: 1
Injuries:	nil
Damage:	local damage to door and fuselage floor structure
Pilot's licence:	Commercial Pilot Licence (Aeroplane)
Pilot's age:	29
Pilot's total flying experience:	2850 hours 200 hours on type
Investigator-in-charge:	J J Goddard

All times in this report are New Zealand Daylight Time (Universal Coordinated Time + 13).

1. Factual information

1.1 History of the flight

1.1.1 On Wednesday 31 October 2001, Air National Chieftain ZK-RDT had been chartered by Origin Pacific Airways to operate its scheduled flight Origin 457 from New Plymouth to Auckland. The aircraft had similarly been flown from Auckland to New Plymouth on the previous evening, and had remained overnight, with the pilot, at New Plymouth.

1.1.2 The pilot started work at 0630, with a pre-flight inspection of the aircraft before the scheduled 0700 departure. He was in the cockpit of the aircraft when the Origin Pacific ground handler boarded the passengers. The ground handler closed the cabin door; the pilot heard the normal door-closing noise and observed the "cabin door" annunciator light on his instrument panel go out. The pilot completed his passenger pre-take-off briefing, which included asking them to wear their seatbelts for the whole flight.

1.1.3 The departure from New Plymouth and the cruise sector of the flight, which was in mostly clear conditions at 7000 feet, were uneventful. During the descent to Auckland, Air Traffic Control required the aircraft to enter the Waiuku holding pattern at 4000 feet.

1.1.4 After leaving the holding pattern the aircraft was being radar vectored towards an instrument approach for runway 23 when the radar controller requested a speed reduction to 130 knots. The indicated airspeed was 150 knots, so the pilot selected 10° of flap. As the flap extended the pilot heard a bang, and a passenger called that the door had come open. The pilot looked round to the cabin and asked everybody to keep calm. He asked the passenger seated next to the door if she could pull it closed by the supporting cables.

1.1.5 This passenger, assisted by 2 others, was able to hold the door in a slightly ajar position, but could not close it completely. They held the door thus for about 10 minutes while the aircraft was landed and taxied to the gate at Auckland Airport.

1.1.6 No injury resulted, but passengers were alarmed by the open door.

1.2 Personnel information

1.2.1 The pilot of ZK-RDT held Commercial Pilot Licence (Aeroplane), number 31334, issued in August 1992. His associated Class 1 Medical Certificate was valid to 16 June 2002. He held an Instrument Rating and a "C" category Instructor Rating. His aircraft type ratings included the PA31-350 Chieftain type. He had flown 2850 hours, including 350 hours on multi-engine aircraft, of which some 200 hours were on the PA31-350 type, with the majority on ZK-RDT.

1.2.2 The pilot flew on both Air National and Great Barrier Airlines operations, and was based in Whitianga.

1.3 Aircraft information

1.3.1 ZK-RDT was an Embraer EMB-820C, serial number 820127, twin-engine aeroplane manufactured in Brazil in 1982 under licence from Piper. It was essentially the same as a Piper PA31-350 Navajo Chieftain. It was imported into New Zealand in April 1994, when it had flown 1477 hours total time in service. At the time of this incident it had flown 3962 hours.

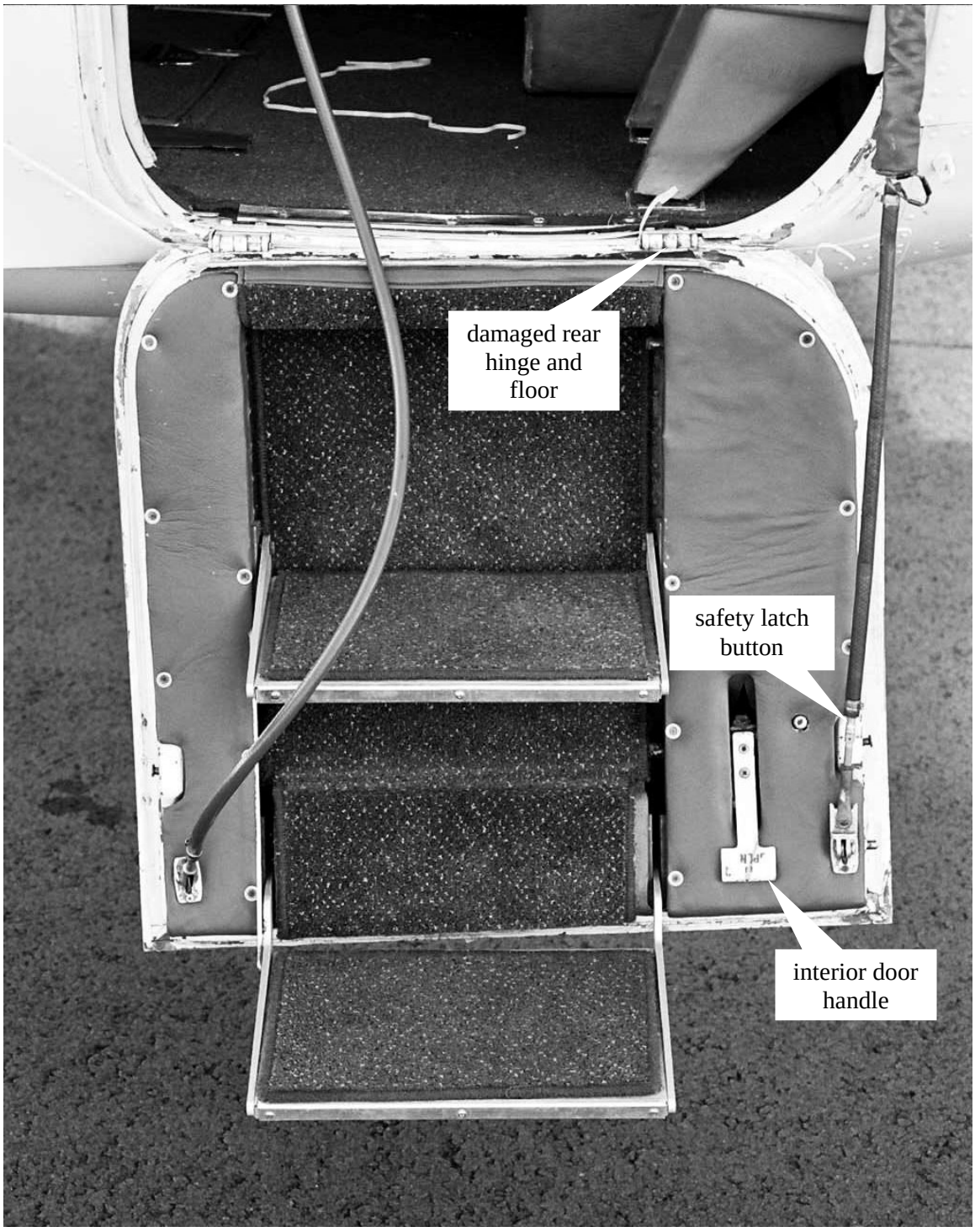

Figure 1
ZK-RDT lower cabin door after the incident

1.3.2 The cabin had 8 passenger seats, with the entrance to the cabin and cockpit at the left rear through a horizontally hinged 2-piece cabin door. The lower door hinged down, and was supported by 2 cables; it had 2 folding steps to provide airstair access to the cabin. The upper door hinged upward and was supported in the open position by a telescoping strut. The upper door was closed first, and latched by a sliding bolt. The lower door was lifted shut so that 2 protruding latch pawls engaged in shaped striker plates on the forward and rear faces of the doorway. The locking handle was then moved down externally (or up internally) to lie flush with the door. This action rotated the latch pawls eccentrically to fully engage the striker plates,

and to pull the door tightly into the doorway. Full engagement of the pawls with the striker plates also operated two microswitches to extinguish the "cabin door unsafe" annunciator light on the pilot's panel. The interior door handle was protected against unintentional operation by a safety latch, which had to be released by pushing an adjacent button before opening the door from within the cabin.

1.3.3 A review of the aircraft records indicated that all routine and normal maintenance had been carried out in accordance with the Operator's Maintenance Manual. There were no outstanding Airworthiness Directives. The last servicing, a 100-hour check, had been carried out on 30 August 2001, 24 flying hours before the incident.

1.3.4 Logbook and jobsheet records showed the following additional maintenance carried out on the cabin door since the aircraft's arrival in New Zealand in 1994:

• repair support cable brackets mounting structure	April 1994
• replace upper door support rod end	April 1994
• replace fractured lower door hinges	June 1999
• replace support cables	Nov 1999
• adjust lower door microswitch	Nov 1999
• replace airstair steps	July 2000
• repair damaged floor structure around lower door hinges	Dec 2001

1.3.5 Maintenance of the cabin door was required on an on-condition basis, while routine 100-hour checks specified a functional inspection of the door. The Piper Navajo Chieftain Service Manual contained instructions on removal, installation and adjustment of the upper and lower doors and the door latch assembly.

1.4 Cabin door examination

1.4.1 After the incident the appearance of the lower door was consistent with having opened forcibly; the forward support cable anchor was broken from the fuselage structure and the lower door rear hinge was distorted and partly separated from the cabin floor. The resulting misalignment prevented the lower door from being closed.

1.4.2 The latch pawls both operated with either door handle, but were bent by some 10°. The interior door handle could be operated without first pushing the safety latch button. The striker plates were secure on the doorway, but showed appreciable wear. The forward striker plate was grossly worn, with some 40% of the engaging tongue missing, compared with a new plate. The striker plate surface which engaged with the pawl was worn to present an inclination of about 60°, rather than a 90° face (see Figure 2).

1.4.3 The rear hinge was removed to allow temporary alignment of the lower door, which then fitted the doorway without obvious distortion. The latch pawls engaged the striker plates, so that the door felt secure when latched closed.

1.4.4 The safety latch mechanism was examined after removal of cover panels. Most components exhibited wear and distortion, and the nut intended to secure the safety latch adjustment bushing was missing. The rivets attaching the safety latch support plate were loose, and the latch chassis within the door was bent out of shape. This damage was consistent with long-term forced operation of the interior door handle without the safety latch button being pushed first.

1.5 Other information

1.5.1 The passenger seated by the door reported that she had not touched the door handle, or leaned against the door before it opened.

1.5.2 The Air National Operations Manual required the operating crew to close the aircraft doors before departure. On this flight the ground handler closed the door, and the pilot observed the appropriate annunciator light indication. The ground handler had received specific training in closing the door on ZK-RDT.

1.5.3 The pilot reported that he had not observed that the safety latch on the interior door handle did not work because whenever he opened the door he always pushed the safety latch button first. He had occasionally seen passengers trying to open the door without pushing the button first.

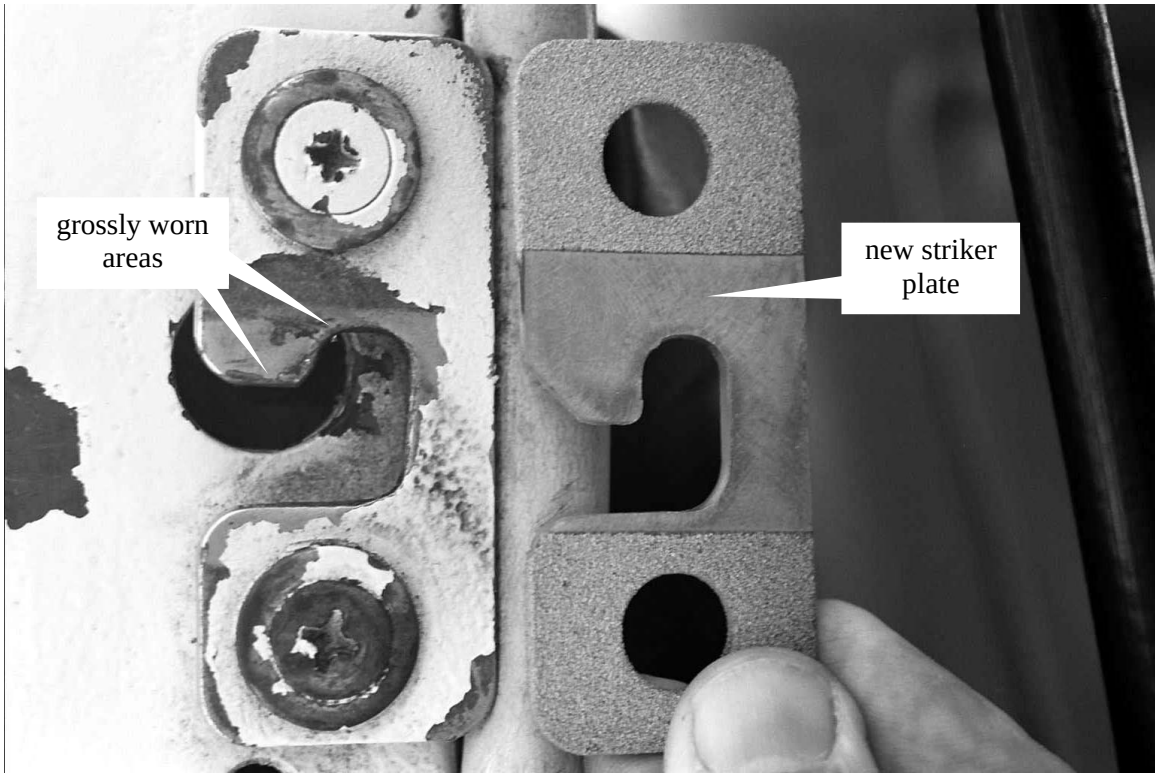

Figure 2
ZK-RDT Cabin door latch forward striker plate

2. Analysis

2.1 The possible causes of a door-open-in-flight incident like this include:

- the door being not properly closed before take-off
- passenger interference with the door during flight
- unusual manoeuvring or turbulence causing airframe distortion or large air loads on the door
- failure of the latch mechanism resulting from wear or mechanical breakage.

2.2 At New Plymouth the door was closed by the ground handler while the pilot observed the appropriate annunciator light indication accompanied by normal door-closing noises. While the airline Operations Manual did specify door closure by the operating crew rather than by ground staff, it was unlikely that any different result would have been achieved by the pilot making his way through the cabin to close the door himself. The door closure procedure was simple, and the ground handler had been trained to do it. The door was probably closed correctly before take-off.

2.3 The passenger seated by the door did not interfere with it, and the constraints of the cabin would have made it impossible for another to do so without her knowledge.

2.4 The flight conditions had been unremarkable, so significant turbulence was evidently not encountered. The aircraft was flying straight when the door opened, so no unusual manoeuvre was involved. However, initial flap extension was taking place while the indicated airspeed decreased from 150 to 130 knots. This was a normal event, within the flap operating speed range, but it would have produced some local change in the flow and pressure of air in the vicinity of the door, as well as increasing the download on the tailplane and the associated bending stress on the fuselage structure. Because the door opened at this time, these normal effects of flap extension probably triggered the event, but which also required a defective door latch mechanism as a precursor.

2.5 Although most components of the door latch mechanism exhibited wear and distortion, the grossly worn forward striker plate was probably the single component most likely to promote an unlatching of the door. The worn shape of the surface presented a 60° ramp to the latch pawl, which would produce a downward reaction force if pressure was applied to the door, tending to rotate the latch pawls towards the open position. The missing striker plate tongue area would have allowed the latch to disengage early, and some racking of the door could complete the disengagement of the rear latch.

2.6 The dysfunction of the safety latch resulted from accumulated wear and damage from mis-operation. The missing nut would probably have allowed the safety latch adjustment to back off anyway, so that even if the safety latch did work it might not have prevented the door from opening if the interior handle was mis-operated. However, the handle was not operated in this incident, so the safety latch played no part in the event.

2.7 The generally worn and damaged condition of the latch mechanism was not surprising after 20 years and nearly 4000 hours in service, because the door interior would trap dirt and promote wear, and was not readily accessible for inspection or servicing. The wear on the forward striker plate, however, should have been readily visible and its potential for causing an unlatch fairly obvious to a diligent engineer. Replacement of the plate with a new one would have involved a few minutes' work with a screwdriver. Similarly, a simple functional check of the safety latch should have logically led to an internal examination and rectification or adjustment.

2.8 While a number of door defects had been reported since 1994 by the operator' pilots, and appropriate repairs carried out, the door latch mechanism had continued to work until this incident, so a defect report on it would have been unlikely. This meant that in practice the onus for anticipating the latch failure lay with the maintenance engineers carrying out routine inspections and servicing of the aircraft. However, greater awareness of mechanical deterioration of items such as this latch mechanism by both pilots and engineers would help to ensure timely intervention to prevent incidents such as this one. A safety recommendation was accordingly made to the Director of Civil Aviation to publish educational material such as a "Vector" article on the topic.

3. Findings

3.1 The pilot was appropriately licensed and experienced for the flight.

3.2 The flight was being conducted in a normal and routine way.

3.3 The cabin door became unlatched and opened because of long-term wear and distortion of the latch components.

3.4 The worn state of the latch mechanism should have been detected and rectified by maintenance engineers performing routine inspections before this latch failure occurred.

3.5 Pilots and engineers need to be more aware of mechanical deterioration of items such as this latch mechanism to help prevent incidents of this nature.

4. Safety Recommendation

4.1 On 18 April 2002 the Commission recommended to the Director of Civil Aviation that he:

> Publish educational material such as a "Vector" article on the topic of the need for pilots and engineers to be aware of mechanical deterioration of items such as this door latch mechanism to ensure that timely remedial action is taken before failure occurs. (021/02)

4.2 On 3 May 2002 the Civil Aviation Authority advised:

> The Director will accept the recommendation as worded. The article will be published in the November 2002 issue of the magazine.

Approved for publication 05 June 2002

Hon. W P Jeffries
Chief Commissioner