



**NO. 94-021**

**EMBRAER EMB-110P1**

**ZK-KIP**

**AUCKLAND INTERNATIONAL AIRPORT**

**28 SEPTEMBER 1994**

## **ABSTRACT**

An Embraer EMB-110P1 (Bandeirante) ZK-KIP, while approaching Auckland International Airport on the evening of 28 September 1994, experienced an undercarriage malfunction. The right main wheel could not be lowered by either normal or emergency means, and the aircraft was subsequently landed "wheels-up" at 1949 hours without injury to either of the two crew members on board. A safety issue identified was post-maintenance inspection.

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

AIRCRAFT ACCIDENT REPORT NO 94-021

<b>Aircraft Type, Serial Number and Registration:</b>	Embraer EMB-110P1, 110-286, ZK-KIP
<b>Number and Type of Engines:</b>	2 Pratt & Whitney PT6A-34
<b>Year of Manufacture:</b>	1980
<b>Date and Time:</b>	28 September 1994, 1949 hours*
<b>Location:</b>	Auckland International Airport Latitude: 37° 01' S Longitude: 174° 47' E
<b>Type of Flight:</b>	Air Transport—scheduled airline
<b>Persons on Board:</b>	Crew: 2
<b>Injuries:</b>	Crew: Nil
<b>Nature of Damage:</b>	Substantial
<b>Pilot-in-Command's Licence:</b>	Commercial Pilot Licence (Aeroplane)
<b>Pilot-in-Command's Age:</b>	35
<b>Pilot-in-Command's Total Flying Experience:</b>	3480 hours 650 on type
<b>Information Sources:</b>	Transport Accident Investigation Commission field investigation
<b>Investigator in Charge:</b>	Mr A J Buckingham

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

## 1. NARRATIVE

- 1.1 On 28 September 1994, ZK-KIP operating as Eagle Airlines Flight 908, departed Hamilton at 1803 hours for Auckland. On board were the Captain and First Officer only.
- 1.2 The aircraft was cleared for an ILS/DME approach to runway 05 at Auckland International Airport, and at the appropriate stage of the approach, the crew selected the undercarriage down. The left main wheel and the nosewheel lowered normally, but an unsafe indication was shown for the right main wheel. A low run was made past the control tower, and the controller verified that the right main wheel was not extended. Recycling the undercarriage selector had no effect on the unsafe indication.
- 1.3 The aircraft was climbed clear of the circuit, and held at 4000 feet in the vicinity of Surrey NDB (22 nm to the south-east), in which position the crew was able to establish VHF communications with the company's base at Hamilton Airport. The crew were unable to rectify the problem, despite working through the published emergency procedures and attempting actions suggested by the maintenance staff.
- 1.4 Following discussions with operations and maintenance staff, the Captain decided that a "wheels-up" landing at Auckland was the preferred option. The "wheels-up" landing is the safest procedure in the event of an undercarriage malfunction of this type. A number of factors including weather, rescue firefighting facilities and the availability of suitable lifting equipment led to the decision to use Auckland in preference to other airports.
- 1.5 At 1949 hours, the aircraft landed "wheels-up" on runway 05, the crew shutting down the engines and electrical systems in the flare just prior to touchdown. The aircraft slid some 400 m before stopping, after which the crew vacated without injury. Rescue firefighting services were on hand and as a precaution, sprayed the aircraft with foam immediately it came to rest.
- 1.6 The bulk of the damage was confined to the propellers, the lower surfaces of the engine nacelles and the inboard flap hinge brackets. A VHF antenna and strobe light on the lower fuselage surface were damaged, but the fuselage itself did not contact the runway.
- 1.7 The runway was closed for arrivals until 2245 hours, but a limited number of departures were made using the remainder of runway 05 to the north-east of the stranded aircraft.
- 1.8 The aircraft was raised using airbags, to allow the undercarriage to be inspected. During the raising of the aircraft, one of the operator's maintenance engineers manually released the right main undercarriage doors, and retrieved a large torch (3-cell Maglite™) from within the wheel well. Once the torch had been removed, it was possible to lower the undercarriage successfully.
- 1.9 The torch had been left in the wheel well during minor maintenance prior to departure from Hamilton. Between flights, the crew had taken the aircraft to the maintenance hangar to have a flap travel microswitch adjusted. While working within the wheel well, the maintenance engineer had stood the torch in a recess in the structure, within the right angle formed by an engine breather pipe which vented externally through the outboard side of the well. In this position, the torch was shining upward, and leaning out into the wheel well at about 30° from the vertical.
- 1.10 The adjustment was made, and the aircraft was handed over to the flight crew for the flight to Auckland. A full pre-flight inspection was not performed at this time, as it was not normal practice to do so between sectors. In any case, the torch, which had a black anodised finish, would have been easily missed on a normal preflight inspection.

1.11 At some time between 1800 and 1830 hours, the engineer who had been working in the wheel well realised that he had not retrieved the torch, and immediately informed the Maintenance Controller of his concern. The latter contacted the company's flight operations department, only to find that the aircraft had already taken off.

1.12 An apron and runway check was carried out in case the torch had fallen out during taxi or take-off, but it was not found. Another engineer in Auckland was telephoned and asked if he could check the aircraft after landing and recover the torch if it was there, but by this time it was apparent that the aircraft was experiencing some difficulty with the undercarriage.

1.13 Both the torch and the recess in which it had been placed were examined next morning, and it was clear that the torch had prevented the right main wheel from being lowered. On retraction, it was possible for the mainwheel tyre to move the torch aside as it retracted into the wheel well, but when it reached the full up position, the torch was able to drop back into the space in the wheel centre.

1.14 When the undercarriage was selected down, the right main wheel had to move downward a matter of only a few millimetres before the top of the torch engaged the wheel rim, preventing further travel. The torch was of a type renowned for its rugged construction, and the only damage it sustained during the several attempts to lower the undercarriage was a 2 mm deep indentation on the rim around the lens. A small area of the black anodised coating was polished back to bare metal on the battery cap end, on which it had been standing in the recess.

1.15 Corresponding marks were located on the wheel rim, and the surface on which the bottom end of the torch had been standing bore evidence of considerable downward pressure transmitted through the torch by the undercarriage. Given the disposition of the torch and the wheel, it was unlikely that there was any manoeuvre that the flight crew could have performed in order to dislodge the torch.

## 2. FINDINGS

2.1 The aircraft was operating normally prior to the difficulty in lowering the undercarriage.

2.2 The flight crew acted in accordance with standard operating procedures for an undercarriage malfunction.

2.3 A "wheels-up" landing at Auckland International Airport was the best option available to the crew in the circumstances.

2.4 The cause of the undercarriage malfunction was a torch which had been inadvertently left in the right wheel well during maintenance.

2.5 The presence of the torch was only realised by maintenance staff after the aircraft had taken off.

2.6 The torch, by becoming wedged against the wheel rim, had prevented the lowering of the right main undercarriage.

### 3. SAFETY ACTIONS

3.1 Following an internal enquiry, the operating company instituted a procedure for checking that all tools and equipment are accounted for after maintenance tasks, and requiring, where practicable, a duplicate inspection of the area(s) worked upon.

### 4. SAFETY RECOMMENDATION

4.1 It was recommended to the Director of Civil Aviation that:

He consider producing an article for "New Zealand Flight Safety" magazine on the subject of post-maintenance inspection of aircraft for ensuring that tools and equipment have been removed after maintenance (074/94).

4.2 Civil Aviation Authority responded as follows:

*"....a suitable article, addressing the subject of post-maintenance inspection of aircraft, will be published in "New Zealand Flight Safety" as a result of Safety Recommendation 074/94"*

7 December 1994

M F Dunphy  
Chief Commissioner

## ABBREVIATIONS COMMONLY USED IN TAIC REPORTS

AD	Airworthiness Directive
ADF	Automatic direction-finding equipment
agl	Above ground level
AI	Attitude indicator
AIC	Aeronautical Information Circular
AIP	Aeronautical Information Publication
amsl	Above mean sea level
ASI	Airspeed indicator
ATA	Actual time of arrival
ATC	Air Traffic Control
ATD	Actual time of departure
ATPL (A or H)	Airline Transport Pilot Licence (Aeroplane or Helicopter)
AUW	All-up weight
C	Celsius (normally preceded by °)
CAA	Civil Aviation Authority
CASO	Civil Aviation Safety Order
CFI	Chief Flying Instructor
CPL (A or H)	Commercial Pilot Licence (Aeroplane or Helicopter)
DME	Distance measuring equipment
E	East
ELT	Emergency location transmitter
ERC	En route chart
ETA	Estimated time of arrival
ETD	Estimated time of departure
F	Fahrenheit (normally preceded by °)
FAA	Federal Aviation Administration (United States)
FL	Flight level
g	Acceleration due to gravity
GPS	Global Positioning System
HF	High frequency
hPa	Hectopascals
IAS	Indicated airspeed
IGE	In ground effect
IFR	Instrument Flight Rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
ins Hg	Inches of mercury
kHz	Kilohertz
KIAS	Knots indicated airspeed
kt	Knot(s)
LF	Low frequency
LLZ	Localiser
M	Mach number (e.g. M1.2)

M	Magnetic (normally preceded by °)
MAANZ	Microlight Aircraft Association of New Zealand
MAP	Manifold absolute pressure (measured in inches of mercury)
MAUW	Maximum all-up weight
METAR	Aviation routine weather report (in aeronautical meteorological code)
MF	Medium frequency
MHz	Megahertz
mph	Miles per hour
N	North
NDB	Non-directional radio beacon
NOTAM	Notice to Airmen
nm	Nautical mile
NZAACA	New Zealand Amateur Aircraft Constructors Association
NZGA	New Zealand Gliding Association
NZHGPA	New Zealand Hang Gliding and Paragliding Association
NZMS	New Zealand Mapping Service map series number
NZDT	New Zealand daylight time (UTC + 13 hours)
NZST	New Zealand standard time (UTC + 12 hours)
NTSB	National Transportation Safety Board (United States)
OGE	Out of ground effect
PAR	Precision approach radar
PIC	Pilot in command
PPL (A or H)	Private Pilot Licence (Aeroplane or Helicopter)
psi	Pounds per square inch
QFE	An altimeter subscale setting to obtain height above aerodrome
QNH	An altimeter subscale setting to obtain elevation above mean sea level
RNZAC	Royal New Zealand Aero Club
RNZAF	Royal New Zealand Air Force
rpm	revolutions per minute
RTF	Radio telephone or radio telephony
S	South
SAR	Search and Rescue
SSR	Secondary surveillance radar
T	True (normally preceded by °)
TACAN	Tactical Air Navigation aid
TAF	Terminal aerodrome forecast
TAS	True airspeed
UHF	Ultra high frequency
UTC	Coordinated Universal Time
VASIS	Visual approach slope indicator system
VFG	Visual Flight Guide
VFR	Visual flight rules
VHF	Very high frequency
VMC	Visual meteorological conditions

VOR  
VORTAC  
VTC  
W

VHF omnidirectional radio range  
VOR and TACAN combined  
Visual terminal chart  
West