

**Aviation Safety Investigation Report
199501887**

**Boeing Co
B747**

26 June 1995

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Occurrence Number: 199501887 **Occurrence Type:** Incident
Location: Melbourne, Aerodrome
State: VIC **Inv Category:** 3
Date: Monday 26 June 1995
Time: 0536 hours **Time Zone** EST
Highest Injury Level: None

Aircraft Boeing Co
Manufacturer:
Aircraft Model: 747-400
Aircraft Registration: 9M-MPH

**Serial
Number:**

Type of Operation: Air Transport High Capacity International Passenger
Scheduled
Damage to Aircraft: Minor
Departure Point: Kuala Lumpur MALAYSIA
Departure Time:
Destination: Melbourne VIC

Crew Details:

<u>Role</u>	<u>Class of Licence</u>	<u>Hours on Type</u>	<u>Hours Total</u>
Pilot-In-Command	ATPL	262.0	15623

Approved for Release: Wednesday, July 31, 1996

FACTUAL INFORMATION

History of the flight

The flight departed Kuala Lumpur at 1310 UTC with 302 passengers, 19 cabin attendants and two pilots on board. Following an uneventful cruise and descent, the aircraft was vectored and cleared for a visual right circuit for runway 27 at Melbourne. The Melbourne automatic terminal information (ATIS) was information Tango which read: "runway two seven, wind three four zero degrees one zero to one five knots all crosswind, QNH 1016, temperature seven, cloud one okta at four thousand, runway three four available for departures north on request....." The crosswind was well below the aircraft's maximum demonstrated landing limit of 30 kts.

The pilot in command was flying the aircraft. He disengaged the autopilot on base leg to fly the remainder of the approach manually. The runway 27 instrument landing system (ILS) frequency was selected for localiser and glideslope guidance on final approach.

To correct for the crosswind from the right, the pilot applied the crab technique which is one of the accepted methods for landing the aircraft in crosswind. In his approach brief to the co-pilot, the pilot in command stated that he aimed to make a positive touchdown because of the short runway. The aircraft touched down firmly in a left wing low attitude. After touchdown the underside of both engines on the left wing (engine numbers one and two) scraped the runway surface. There were no abnormal engine instrument indications at this time or during subsequent taxiing. The aircraft vacated the runway at taxiway November, 1,646 metres from the runway threshold. The pilots were not aware at this stage that the engines had touched the runway surface.

Approaching the parking bay the crew received a cockpit indication that the left main body landing gear brakes were hot. After the aircraft had parked, engineering personnel noted the damage to the lower sections of numbers one and two engine pods.

Injuries to persons

There were no injuries to any crew members or passengers in this occurrence.

Aircraft information

The aircraft was a Boeing 747-400 registered 9M-MPH. It was manufactured in 1994 and had a current certificate of airworthiness. It had flown 3,019.39 hours/480 cycles since new and 246.07 hours/41 cycles since its last maintenance check. The maximum authorised landing weight was 285,762 kgs. The calculated landing weight at the time of the incident was 249,625 kgs. There were no reported defects to the aircraft at the time of the incident.

Damage to aircraft

The aircraft suffered minor damage to the number one engine nose cowl, and reverser cowl and to the number two engine nose cowl and fan cowl. The air grills at the bottom of the nose cowls of both engines had broken off.

Runway inspection

The engine scrape marks on the runway were clearly visible during a runway inspection. The scrape mark from number one engine commenced 36.7 metres beyond the 1,500-ft runway marking and was clearly defined for 40.2 metres. The scrape mark for number two engine commenced 54 metres beyond the 1,500-ft runway marking and was well defined for 8 metres. Based on these marks it was calculated that the aircraft touched down 3.7 metres left of the centreline.

Personnel information

Pilot in command

The pilot in command was 52 years of age. He joined Malaysian Airlines in 1976. He held a current airline transport pilot licence. He held a current instrument rating and a valid medical certificate. Prior to flying the Boeing 747-400 he flew the Douglas DC 10 for approximately three years and prior to that he flew the Boeing 737 for approximately 10 years.

He completed his training on the Boeing 747-400 on 19 May 1995. At the time of this incident his total flying experience was 15,623 hours of which 262 hours were on the Boeing 747-400. In the 90 days prior to the incident he flew 175 hours and 36 minutes. This included 18 landings by day and 11 landings by night. In the 28 days prior to the incident he flew 77 hours and 10 minutes. Prior to the flight, the pilot in command had two days off. There was no evidence that he was suffering from fatigue.

Before joining Malaysian Airlines the pilot in command flew with the Royal Malaysian Air Force. The landing incident at Melbourne was the first recorded incident of his flying career. There were no deficiencies noted in his company training records.

This was the first time the pilot in command had flown the Boeing 747/400 into Melbourne. His last flight to Australia was to Perth in a DC 10 on 18 September 1994.

Co-pilot

The co-pilot was 26 years of age. He held a current commercial pilot licence, a current instrument rating and a valid medical certificate. He had previously flown Boeing 737-400 aircraft with Malaysian Airlines. He completed his training on the Boeing 747/400 on 21 February 1995. At the time of this incident his total flying experience was 2,053 hours of which 305 hours was on the Boeing 747-400. In the 28 days prior to the incident he flew 21 hours and prior to the incident flight he had four days off. There was no evidence that he was suffering from fatigue. There were no deficiencies noted in his company training records.

Training and experience

The pilot in command's endorsement onto the B747 included ten 2-hour sessions in the simulator as a fixed base trainer (without the motion turned on), and eight 4-hour sessions in the full flight simulator mode (simulated flights with the motion turned on). During the simulator sessions, crosswind inputs were provided during takeoffs, approaches and landings.

After successful completion of simulator sessions, training was continued on the aircraft when about 10 touch-and-go landings were flown. This training included a simulated power loss on one engine (by retarding the engine power lever) on takeoff. The pilot in command handled the aircraft well on this training/check flight, which the airline calls the "Certificate of Test".

After this training/checking was completed, the pilot was cleared for line operations. The line/training operations on scheduled service was for a minimum of six sectors followed by a two sector check. The check was completed on 19 May 1995.

There was nothing contained in training records kept by the operator reflecting any weakness or adverse performance by either pilot during their flying careers with the operator. The performance of the pilot in command was regarded to be of a standard high enough for the operator to appoint him to the positions of flight instructor and examiner of airmen on their Boeing 737 aircraft.

Crew resource management (CRM)

The company conducts CRM courses for all pilots and both pilots had completed the training. When they were asked by air traffic control if runway 27 was suitable for their operation, the pilot in command said it was but the co-pilot suggested they use runway 34 because it was much longer. The pilots discussed their different views and then the pilot in command decided upon runway 27. The co-pilot stated that he was in agreement with the decision, that he felt quite free to express his opinion with the pilot in command and that there were no communication barriers between them.

In his approach brief, the pilot in command stated that because the length of runway 27 was shorter than many runways used for Boeing 747 operations, he aimed to make a positive touchdown. Later, when the incident was under investigation, the pilot in command believed that he had concentrated on achieving a positive touchdown on a short runway to the exclusion of a crosswind landing.

This was the first time that the two pilots had flown together. The company had no strict policy on crew pairing and once pilots were qualified on the aircraft type and the route, any two pilots could form a crew. However, the company tried to ensure that at least one member of a crew was experienced in the operation to be conducted.

Meteorological information

The incident occurred at night at 0535 EST. The meteorological information contained in the Melbourne ATIS broadcast specified that the wind was "three four zero degrees one zero to one five knots, all crosswind". This was consistent with information provided in a Bureau of Meteorology report obtained after the incident.

Melbourne Tower gave the aircraft a landing clearance approximately two minutes prior to touchdown. During that transmission the aircraft was advised that the wind was "three four zero degrees one two knots all crosswind..."

Aids to navigation

The aircraft was fully equipped with the relevant navigational aid receivers to enable an ILS approach to be flown. Melbourne runway two seven is equipped with an ILS which was serviceable at the time of the approach.

Communications

All communications between the crew and air traffic control were normal. The automatic voice recorder (AVR) tapes showed that the crew first made contact with Melbourne Control at Bordertown. At this time they were advised that runway 27 was in use and were asked if that runway was suitable for their operation. They responded that they could accept runway 27. From there on, progressive clearances were issued to the aircraft to descend and track for a right downwind leg for a night visual approach for runway 27. When the aircraft was three miles north of the field the crew were asked if they had the runway in sight. They responded that they did and were then cleared for a visual approach and asked to report turning base. When they reported turning base they were advised of the current wind velocity and cleared to land.

Aerodrome information

Melbourne Airport has two runways: 16/34 and 09/27. Runway 27 is aligned 263 degrees, is 2,286 metres long and 45 metres wide. The runway is equipped with high intensity runway lights, high intensity approach lights, runway centreline lights and a three degree T-VASIS. The runway has no appreciable slope.

The operator has a system of categorisation for the airports into which they operate. The system relates to the degree of difficulty in terms of operating in and out of those airports and takes into account items such as terrain, elevation, weather and approach and landing aids. All Australian airports into which the company operate are in the least difficult category (all at sea level, no terrain problems, ample runway length, no severe weather).

Melbourne Airport noise abatement procedures specify runways 16, 27 and 09 in order, for landing. The procedures require arriving aircraft, when weather and traffic conditions permit, to be routed to avoid noise sensitive areas.

Landing performance information

Performance calculations indicated that at its calculated landing weight the target threshold speed (V_{ref}) for a 30-degree flap landing was 143 kts, and in the prevailing meteorological conditions the aircraft needed a runway length of approximately 1,820 metres for landing. The aircraft actually vacated the runway via taxiway November which is approximately 1,640 metres from the runway threshold.

The pilot used the autothrottle for the approach. Boeing procedures specify that when using the autothrottle the command airspeed bug should be positioned to $V_{ref} + 5$ kts. Approach speed corrections for wind are not required as sufficient gust protection is available with autothrottle engaged.

Visual approaches - standard procedures

The company's policy is that visual approaches are an acceptable procedure but must be backed up by all available means. This includes available radio navigation/approach aids and/or VASIS/T-VASIS which in effect means a pure visual approach is never conducted. However, there is one exception, during their training on the aircraft type pilots do one night visual approach and landing in the simulator with no backup aids.

When flying a visual approach, the normal company procedure is to select the first stage of flaps (flaps one) approaching the downwind leg and the second stage (flaps five) when on the downwind leg. Abeam the threshold the third stage (flaps 10) is selected and then the crew commence timing. After 35 seconds the next stage of flaps (flaps 20) is selected, the landing gear is lowered and the base turn is commenced. The final stage of flaps (flaps 30) is selected when established on the final approach. On this occasion, the pilot in command said that he actually timed 45 seconds before turning base.

The company policy on a stabilised approach is that the aircraft must be stabilised on final approach in the landing configuration by 500 ft above the runway threshold elevation, within half a dot deviation from centre on both the localiser and glideslope with indicated airspeed at V_{ref} to $V_{ref} + 5$ kts. If the aircraft is not within these parameters then the crew must initiate a go-around.

Crosswind landing technique

The company teaches the Boeing recommended crosswind approach and landing technique which is described in the Boeing 747 flight crew training manual. That manual states that there are "three accepted methods used in performing an approach to a landing in a crosswind. They are the crab, sideslip, and a combination of the two". The manual recommends using the same crosswind approach technique as with previously flown aircraft types.

Flight recorders

Cockpit voice recorder (CVR)

The CVR was not removed for the investigation because it remained running long after the incident and therefore no useful information was available from it.

Digital flight data recorder (DFDR)

The aircraft was equipped with a Sunstrand DFDR which was removed and read out after the incident. From the readout, a reconstruction was made of the latter part of the flight from when the aircraft was on an intercept track for final approach until touchdown/rollout.

The readout commenced from a point where the aircraft was in a shallow right turn onto final approach, passing through a heading of 242 degrees. At this point the aircraft was at a radar altitude of 1,100 ft with flaps 10 set and an airspeed of 172 kts. This was 88 seconds before touchdown. Flaps 20 was set between 52 seconds and 47 seconds before touchdown. Airspeed was 168 kts and radar altitude was between 654 ft and 550 ft and the aircraft was on the final approach leg with less than one dot localiser deviation to the left. The DFDR sample rate for flap position did not permit closer determination of times.

Flaps 30 was selected between 47 seconds and 43 seconds before touchdown at a radar altitude between 550 and 468 ft and an airspeed of 167 kts. Speedbrakes appear to have been armed about 22 seconds before touchdown at a radar altitude of 318 ft. The flaps reached the flaps 30 position 39 seconds before touchdown at a radar altitude of about 440 ft at an airspeed of 167 kt. Airspeed then reduced to 154 kts 29 seconds before touchdown and varied from 151kts to 156 kts until touchdown.

When the aircraft was first established on final approach at 654 ft radar altitude, the drift angle was six degrees to the left. The drift angle remained between six degrees and seven degrees until 272 ft radar altitude where it started to reduce to slightly over three degrees just prior to touchdown. At touchdown the bank angle was 1.2 degrees left wing down, pitch attitude 1.8 degrees nose up, heading 267 degrees and airspeed was 155 kt. Boeing advised that the normal body attitude at touchdown for flaps 30 and V_{ref} at the reported landing weight would be slightly higher than six degrees nose up.

Shortly after touchdown there was a left wing down control wheel input of approximately 30 degrees (30 degrees control wheel position) and a left rudder pedal input of approximately 7.5 degrees. The aircraft reached a left wing down bank attitude of seven degrees. From touchdown until the airspeed reduced to 36 kts (25 seconds later) there was always significant left control wheel input, reaching a maximum 40 degrees five seconds after touchdown.

Medical information

Both pilots were examined at the operator's medical centre three days after the incident. The pilots agreed that they were adequately rested before the flight. The medical examiner confirmed that neither of them had any existing medical condition that could have affected their performance. They both said that they felt sufficiently alert during the approach and landing. The physical examination, including a screening for drugs and medications that could have had an adverse effect on performance, was negative. The medical examiner concluded that both pilots were medically fit and that neither was taking any medication or drug that could have adversely affected their performance.

ANALYSIS

The flight crew were properly trained and qualified to perform the flight. There was nothing contained in training records reflecting any weakness or adverse performance throughout their flying careers with the operator. Both had completed CRM training and although this was the first time they had flown together, they believed they worked well as a team.

The aircraft was fully serviceable as were the ground based navigational aids. The airport, airport lighting and weather were not factors in the occurrence. There was a crosswind from the right which was well below the limit for the aircraft type. Runway 27 length was more than adequate for the landing and it was equipped with all necessary lighting and approach aids. However, the evidence showed that the pilot in command regarded the runway as short and his main concern was to make a positive touchdown in order to stop safely within the available runway length.

Information retrieved from the DFDR showed that the aircraft was not stabilised on final approach within the parameters specified by the operator (V_{ref} and less than half a dot deviation on both localiser and glide slope by 500 ft). Tracking was within tolerance limits shortly after the aircraft rolled out on final approach but approach speed remained high until touchdown. Notwithstanding the high speed, the pilot in command had no difficulty in stopping in the available length. Had the pilot in command strictly followed company procedures when the aircraft was not stabilised within company parameters on final approach then he should have made a go-around. The DFDR also showed that the various stages of flap were selected later in the approach than required by the company.

The most significant information retrieved from the DFDR was that significant left aileron was applied during the landing with a crosswind from the right. This resulted in the left wing dropping and the left engines striking the runway. DFDR data showed that left aileron remained applied for 25 seconds after touchdown until the airspeed had reduced to 36 kts. It was not determined why incorrect aileron was applied. However, from the evidence of the pilot in command, it is possible that he was pre-occupied with the runway length and with stopping the aircraft safely.

CONCLUSIONS

Findings

1. The aircraft had a current certificate of airworthiness and was not carrying any reported defects.
2. The flight crew were properly licensed, qualified, and experienced to operate the flight. They were adequately rested before the flight and were not suffering the effects of fatigue at the time of the occurrence.
3. The runway was 2,286 metres long. Performance calculations indicated that the aircraft required approximately 1,820 metres for landing. The actual length of runway used for landing was approximately 1,640 metres.
4. Weather conditions were fine with one octa of cloud at 4,000 ft. There was a crosswind of approximately 12 kts from the north. This was well below the aircraft's maximum demonstrated limit for landing.
5. The two pilots were flying together for the first time. They worked well together as a team and there were no problems of a CRM nature during the flight. There were no deficiencies noted in their training records.
6. The aircraft was cleared for a visual approach after the crew reported the runway in sight when the aircraft was 3 NM north of the field.
7. The aircraft was not stabilised on final approach in accordance with company policy for a stabilised approach in that the approach speed was too high.
8. The pilot in command was primarily concerned with stopping the aircraft safely within the runway length available, even though performance calculations indicated there was adequate runway available.
9. The aircraft made a firm touchdown. Shortly after touchdown, numbers one and two engines scraped the runway as a result of left aileron application in a right crosswind.
10. This was the first time the pilot in command had flown a Boeing 747-400 into Melbourne Airport.

Significant Factors

The two left engines scraped the runway after touchdown because left aileron was applied while landing in a right crosswind. The reason for the application of incorrect aileron was not determined, but it is possible that the pilot in command was primarily concerned with stopping the aircraft safely in the runway length available to the exclusion of giving sufficient attention to the crosswind.

SAFETY ACTION

As a result of this incident the operator required the pilot in command to complete two 4-hour simulator flights with the co-pilot who was on the incident flight. He was then required to do a six-sector line check including a landing on runway 27 at Melbourne Airport.

Note:

The Bureau of Air Safety Investigation did not interview either crew member involved in this incident. All information provided by the crew members was obtained through the operator.