

FINAL REPORT

A330 RUNWAY EXCURSION AT YANGON AIRPORT, MYANMAR 21 MAY 2014

AIB/AAI/CAS.105

**Transport Safety Investigation Bureau of Singapore
Ministry of Transport
Singapore**

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The Transport Safety Investigation Bureau of Singapore

The Transport Safety Investigation Bureau (TSIB) is the air and marine accidents and incidents investigation authority in Singapore responsible to the Ministry of Transport. Its mission is to promote aviation and marine safety through the conduct of independent and objective investigations into air and marine accidents and incidents.

For aviation related investigations, the TSIB conducts the investigations in accordance with the Singapore Air Navigation (Investigation of Accidents and Incidents) Order 2003 and Annex 13 to the Convention on International Civil Aviation, which governs how member States of the International Civil Aviation Organization (ICAO) conduct aircraft accident investigations internationally.

In carrying out the investigations, the TSIB will adhere to ICAO's stated objective, which is as follows:

"The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability."

Accordingly, it is inappropriate that TSIB 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.

SYNOPSIS

During landing on Runway 21 at Yangon Airport, Myanmar, on 21 May 2014 at about 0943 hours local time, an Airbus A330 drifted to the right and eventually veered off the paved runway surface for about 600 metres and then was steered back onto the runway. However, the aircraft lost its green hydraulic system and thus its nose wheel steering capability, and was eventually towed to the gate. There were no injuries.

The Department of Civil Aviation (DCA) of Myanmar did not formally investigate into the occurrence, but facilitated the investigation by the then Air Accident Investigation Bureau of Singapore (now Transport Safety Investigation Bureau (TSIB)) which classified the occurrence as a serious incident.

AIRCRAFT DETAILS

Aircraft type	: Airbus A330-300
Operator	: Singapore Airlines
Registration	: 9V-STS
Number and type of engines	: 2 x Rolls-Royce Trent 700 engines
Date and Time of occurrence	: 21 May 2014, 0943 hours (local)
Location of occurrence	: Yangon Airport, Myanmar
Type of flight	: Scheduled Passenger
Persons on board	: 265

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1 **FACTUAL INFORMATION**

All times used in this report are Myanmar times. Myanmar time is six and a half hours ahead of Coordinated Universal Time (UTC).

1.1 **History of the flight**

- 1.1.1 The aircraft was flying from Singapore to Yangon in Myanmar. The flight crew comprised a Captain as Pilot-in-command (PIC) on the left seat, a Captain as Co-pilot on the right seat, and a First Officer (FO) on an observer seat behind the PIC and Co-pilot. The PIC was the pilot flying and the Co-pilot the pilot monitoring.
- 1.1.2 On approaching Yangon Airport, the aircraft was cleared by Yangon Approach Control for a precision approach using the Instrument Landing System (ILS) to Runway 21.
- 1.1.3 The approach controller cleared the aircraft to descend to 3,000 feet and to intercept the ILS. During the descent the flight crew could see passing showers, and obtained the current Automatic Terminal Information System (ATIS) weather information. According to the ATIS:
- (a) Wind was 3 knots from the direction of 080°; and
 - (b) Visibility at the aerodrome was 6,000 metres¹.
- 1.1.4 At about 14,000 feet in the descent, the approach controller informed the flight crew that there was rain to the east and that it was approaching the airfield. The flight crew was also informed that the visibility had reduced to 4,000 metres. The approach controller did not mention any wind information.
- 1.1.5 The aircraft was established on the ILS at 2,500 feet. The approach controller asked the flight crew to report when they had the runway in sight. The approach controller also informed the flight crew that there was rain over the aerodrome and visibility was 3,000 metres. The flight crew acknowledged the information.
- 1.1.6 At 1,100 feet during the approach to Runway 21, the PIC disconnected the autopilot and flew the approach manually. (Note: During the autopilot phase, the aircraft was already adopting the crab technique (see paragraph 1.10.1) to keep the aircraft aligned with the runway centreline despite the crosswind.)
- 1.1.7 At about 800 feet, the flight crew reported runway in sight and the approach controller cleared the aircraft to land on Runway 21. The flight crew had expected to be transferred to the tower frequency before obtaining the landing clearance, so they asked the approach controller

¹ This visibility figure did not accord with what the flight crew had observed out of the aircraft window.

whether they were to stay on the approach frequency during the landing. The approach controller confirmed that they were to stay on this frequency.

- 1.1.8 At about 500 feet the aircraft flew into a rain shower and the flight crew turned on the aircraft's windscreen wipers. The runway was still visible and the PIC continued the approach.
- 1.1.9 During the approach and when the aircraft was below 500 feet, the direction and speed of the left crosswind was shifting. The PIC had to continually adjust the aircraft's heading to keep the aircraft aligned with the runway centreline².
- 1.1.10 At about 100 feet, the speed of the left crosswind wind dropped from 20 knots to 10 knots. The reduction could cause the aircraft to deviate to the left. Therefore the PIC reduced the crab angle to the runway and rolled the aircraft to the right to prevent the deviation. But the PIC had apparently over-corrected, and the aircraft began drifting to the right when the aircraft was at about 50 feet, just prior to PIC's flaring and decrabbing the aircraft for the touchdown on the runway. The Co-pilot and FO called out to the PIC to go to the left, when the aircraft was below 20 feet, but the right drift continued³. The PIC also heard a "Dual Input" aural voice message⁴ and the Co-pilot called for a go-around just before the aircraft touched down on the runway⁵. The PIC decided to land the aircraft and to subsequently deal with the realigning of the aircraft with the runway centreline.
- 1.1.11 The aircraft touched down to the right of the runway centreline, with the right landing gear at about 26 metres to the right of the runway centreline⁶ (i.e. about 5 metres from the runway edge⁷).
- 1.1.12 About one second after touchdown, the aircraft's right main landing gear exited the paved runway surface to the right. The PIC applied left rudder and the flight crew regained control of the aircraft and manoeuvred it back to the runway centreline. The aircraft then stopped on the runway at a point about 620 metres after it had re-entered the runway.

² FDR data suggests that the PIC tended to over-adjust and this resulted in an oscillation of the aircraft heading during the final approach. The oscillation was not excessive and the PIC managed to keep the aircraft aligned with the runway centreline.

³ By this time, the aircraft had already drifted to the right of the runway centreline. The PIC kicked the left rudder to bring the aircraft back to the runway centreline. However, he also applied a right roll input, which had the effect of allowing the right drift to continue.

⁴ This is corroborated by data from the flight data recorder, which shows that, just before the aircraft touched down and during the rollout, both the PIC and Co-pilot were giving opposite roll inputs through their control side sticks. The PIC's input was rightwards while the Co-pilot's input was leftwards, the net roll input being rightwards most of the time.

⁵ Data from the flight data recorder shows that the aircraft was below 20 feet when the Co-pilot called for the go-around.

⁶ Estimated from data from the flight data recorder.

⁷ The runway width was 61 metres.

1.1.13 Following the runway excursion, an Electronic Centralised Aircraft Monitor (ECAM) message “Hydraulic Green Reservoir Low” appeared. The flight crew requested for and obtained the air traffic control’s permission to stay on the runway and carried out the “Hydraulic Green Reservoir Low” ECAM procedure. The PIC asked the ground control’s permission for the aircraft to be towed to the gate. This was eventually accomplished.

1.2 Injuries to persons

1.2.1 There were no injuries in this incident.

1.3 Damage to aircraft

1.3.1 The aircraft green hydraulic system was damaged, resulting in a loss of the aircraft’s nose wheel steering capability.

1.3.2 The following was also noted:

- Damage to its innermost flap fairing canoes on the left and right sides



- The left engine’s ingestion of mud and debris



Left Hand Engine

- Gouging and cuts on several tyres



Examples of gouged and cut tyres

- Deflation of Tyre No. 7



1.4 **Other damage**

- 1.4.1 Some runway edge lights were damaged.

1.5 **Aircraft excursion information**

- 1.5.1 After the touchdown the aircraft exited the paved runway surface on the right side of the runway edge. As shown in **Figure 1**, the aircraft's right main landing gear was off the runway for a distance of about 600 metres and the left main landing gear was off the runway for a distance of about 300 metres.



1: Runway excursion ground scars

Figure 1. Runway excursion ground scars

1.5.2 Between the points where the aircraft exited and re-entered the paved runway surface, the surface of the shoulder that abutted the runway pavement was not flush with the surface of the runway and was also uneven⁸.

1.6 Personnel Information

1.6.1 PIC

Age	: 60
Licence	: Air Transport Pilot Licence (ATPL) issued by the Civil Aviation Authority of Singapore
Aircraft ratings	: A330, B777, B747-400
Total flying experience	: 16,317 hrs
Flying experience on type	: 1,432 hrs 48 min
Licence expiry date	: 31 October 2014

⁸ Recommendation 3.2.4 of Annex 14 Volume 1, Aerodrome Design and Operations, states that "The surface of the shoulder that abuts the runway should be flush with the surface of the runway and its transverse downward slope should not exceed 2.5 per cent."

Flying hours last 24 hours : Nil
Flying hours last 7 days : Nil
Flying hours last 28 days : 19 hrs 12 min
Flying hours last 90 days : 36 hrs 6 min

1.6.2 Co-pilot

Age : 40
Licence : ATPL issued by the Civil Aviation Authority of Singapore
Aircraft ratings : A310, A330, B777, B747-400
Total flying experience : 12,505 hrs
Flying experience on type : 45 hrs
Licence expiry date : 31 July 2014
Flying hours last 24 hours : Nil
Flying hours last 7 days : 17 hrs 43 min
Flying hours last 28 days : 52 hrs 21 min
Flying hours last 90 days : 87 hrs 35 min

1.6.3 FO

Age : 40
Licence : ATPL issued by the Civil Aviation Authority of Singapore
Aircraft ratings : A330, B777
Total flying experience : 5545 hrs
Flying experience on type : 885 hrs 30 min
Licence expiry date : 30 September 2014
Flying hours last 24 hours : Nil
Flying hours last 7 days : 11 hrs 26 min
Flying hours last 28 days : 69 hrs 33 min
Flying hours last 90 days : 192 hrs 17 min

1.7 **Meteorological information**

1.7.1 The Automatic Terminal Information Service weather information at the time of the event was: wind 080° at 3 knots, visibility 6,000 metres, few clouds at 2,000 feet, temperature 27 °C, dew point 24 °C, and pressure 1,008 hectopascals.

1.7.2 Although the approach controller updated the visibility during the approach, the controller did not provide an update of the other weather details to the flight crew.

1.8 **Communications**

1.8.1 According to the flight crew, there were no issues with the communications between the flight crew and air traffic controllers throughout the approach and landing phases.

1.9 **Flight recorders**

1.9.1 The cockpit voice recorder (CVR) and flight data recorder (FDR) of the aircraft were removed by the AAIB for download and readout.

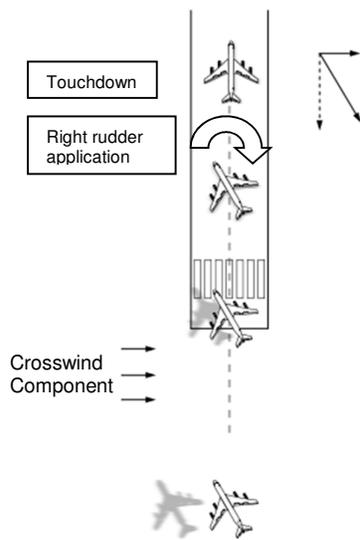
1.10 **Additional information**

1.10.1 Crab technique

1.10.1.1. In order for an aircraft to maintain the runway centreline during a crosswind landing with the wind coming from, say, the left, a pilot needs to counteract the force of the wind acting on the aircraft from the left. The pilot does so by pointing the aircraft into the direction of the wind. Thus, the aircraft is moving sideways towards the runway. Hence, this flying technique is known as “crabbing”.

1.10.1.2 If the wind is constant, the nose of the aircraft would not need to be adjusted and the aircraft would maintain a direct track to the runway. If the wind is shifting or gusting, i.e. changing its wind strength or direction, the pilot would have to adjust the nose of the aircraft to maintain the alignment with the runway.

1.10.1.3 During the flare just prior to the aircraft’s touching down on the runway, the pilot needs to “de-crab” the aircraft. In the case of a left crosswind, the aircraft’s nose would be pointing into the wind. The pilot would have to apply right rudder to realign the aircraft’s nose with the runway centreline and, at the same time, a left roll input to counter the secondary right roll effect resulting from the aircraft’s right yaw towards the runway centreline.



7: Crab landing technique

2 DISCUSSION

2.1 Go-around decision

2.1.1 When the aircraft was below 100 feet and just prior to the flare, the aircraft began to drift to the right. The Co-pilot and FO called out to the PIC to go to the left. The PIC also heard a “Dual Input” aural voice message⁹ and the Co-pilot called for a go-around just before the aircraft touched down on the runway.

2.1.2 By urging the PIC to go to the left, the Co-pilot and FO had recognised that the aircraft’s approach to the runway had become unstabilised. However, the PIC probably had not recognised this situation yet. By the time he heard the “Dual Input” aural voice message and the Co-pilot’s call for a go-around, the aircraft was below 20 feet and was about to touch down. It was still possible to execute a go-around, but the PIC elected to land the aircraft and then to align the aircraft with the runway centreline.

2.1.3 While it is a matter of judgment call on the part of a pilot as to whether he should go around or proceed to land when the aircraft was about to touch down on the runway, this incident highlights the preferable option of a go-around when the approach has become unstabilised.

2.2 Runway Excursion

2.2.1 Just before the aircraft touched down, both the PIC and Co-pilot were giving opposite roll inputs through their control side sticks. The net roll input was rightwards most of the time.

2.2.2 The practice of two pilots applying inputs into the control side stick is not in accordance with the aircraft manufacturer’s standard operating procedures nor the operator’s training. The Co-pilot’s left roll input was likely an attempt on his part to help correct the aircraft’s right drift, having realised that the PIC had not applied sufficient correction.

2.2.3 This net rightwards input for the roll allowed the aircraft to continue drifting to the right just prior to the touchdown. The right drift led to the aircraft’s touching down near the right edge of the runway. The momentum of the aircraft kept the aircraft moving towards the right, leading to its excursion from the runway.

2.3 Side stick handling

⁹ Data from the flight data recorder suggests that the Co-pilot was applying a left roll input into his control stick to try to bring the aircraft towards the left.

2.3.1 As mentioned in Footnote 2 in paragraph 1.1.9, there could be a tendency on a pilot's part to over-adjust with side stick inputs, which could lead to an oscillatory effect. Such a tendency could be due to the way the side stick is held. Holding the side stick too tightly could make it difficult to input just the right amount.

2.3.2 As mentioned in paragraph 1.1.10, the aircraft had already drifted to the right of the runway centreline at the time of the aircraft's flaring. The PIC recognised the need to realign the aircraft with the runway and kicked the left rudder to bring the aircraft back to the runway centreline with the intent of bringing the aircraft back to the centreline. However, he also applied a right roll input, which had the effect of allowing the right drift to continue. This could have been an instinctive input as a result of de-crabbing training (a left rudder input to be coupled with a right roll input and, conversely, a right rudder input to be coupled with a left roll input). The PIC should preferably have rolled the aircraft to the left and flown the aircraft back to the centreline before de-crabbing. However, it is doubtful whether there was enough time for this manoeuvre, given that the aircraft was less than 20 feet from the ground. It therefore cannot be overemphasised that a much preferred option is to always go around whenever an approach has become unstabilised.

2.4 **Runway shoulder**

2.4.1 Between the points where the aircraft exited and re-entered the paved runway surface, the surface of the shoulder that abutted the runway was not flush with the surface of the runway and was also uneven. This condition of the shoulder did not seem to meet the recommended practice spelt out in paragraph 3.2.4 of Annex 14 Volume 1.

3 SAFETY ACTIONS

During the course of the investigation and through discussions with the investigation team, the following safety actions were initiated by the aircraft operator and the aircraft manufacturer.

3.1 Following the incident, the operator has taken the following actions:

- (a) Including exercises during flight crew recurrent training pertaining to landing in strong, gusty and varying crosswind conditions;
- (b) In respect of all its aircraft, using Flight Data Monitoring programme to monitor for trends in deviation from runway centreline during the approach and landing phases; and
- (c) In respect of its aircraft by the same aircraft manufacturer and with a view to preventing inadvertent roll input, including in its current training programme material that highlights the following:
 - Proper pilot seating position;
 - Proper way to hold a side stick; and
 - Possibility of inadvertent roll inducement during pitch changes.

4 SAFETY RECOMMENDATIONS

A safety recommendation is for the purpose of preventive action and shall in no case create a presumption of blame or liability.

- 4.1 The aerodrome operator consider improving the conditions of the shoulder of Runway 03/21 to meet the ICAO requirement in Recommendation 3.2.4 of Annex 14 Volume 1.
[TSIB Recommendation RA-2017-036]