

7 March 2012
66-ZB-H200-ASI-18649

Mr. Joe Sedor
Investigator In Charge
National Transportation Safety Board
490 L'Enfant Plaza, SW
Washington DC 20594-003
Via E-mail: sedorj@ntsb.gov



Subject: Boeing Submission for American Airlines 757-200 N668AA Landing
Overrun Incident at Jackson Hole, Wyoming – 29 December 2010

References: a) NTSB Tech Review Meeting (conference call), 13 February 2012

Dear Mr. Sedor:

As requested in reference a), please find enclosed a copy of The Boeing Company's submission on the subject landing overrun incident. This submission is being sent only to you, and it is our understanding that you will distribute it to the NTSB board members.

We would like to thank the NTSB for giving us the opportunity to make this submission. If you have any questions, please don't hesitate to contact us.

Best regards,

<original signed by>

Chief Engineer
Air Safety Investigation

Enclosure: Boeing Submission to the NTSB for the subject incident



**Submission to the
National Transportation Safety Board
for the**

**American Airlines (AAL) 757-200 N668AA
Landing Overrun at Jackson Hole, Wyoming
29 December 2010**

**The Boeing Company
7 March 2012**



INTRODUCTION

On December 29, 2010, at approximately 11:38 am mountain standard time, American Airlines flight 2253, a Boeing 757-200, registration N668AA, overran runway 19 upon landing at Jackson Hole Airport (KJAC), Jackson Hole, Wyoming. The airplane came to rest approximately 350 feet past the runway overrun area in deep snow. There were no injuries to the 176 passengers and 6 crew members on board, and the airplane received only minor damage. The 14 Code of Federal Regulations Part 121 regularly scheduled passenger flight had originated from Chicago O'Hare International Airport, Chicago, Illinois.¹

Submission Abstract

- The Boeing Company, as the airplane manufacturer, is an invited party to the investigation and provides technical and operational assistance to the National Transportation Safety Board (NTSB) in their investigation.
- The conclusions presented in this submission are based on factual information received from the NTSB, Boeing expertise, the use of analytical tools and a methodical investigation process.
- The airplane air/ground system, the autobrake system, and the thrust reverser system performed as designed.
- The auto speedbrake system did not function as expected on touchdown even though the speedbrake lever was armed.
- The speedbrakes could have been manually deployed.
- If the speedbrakes had deployed the airplane could have stopped on the pavement.
- Speedbrake lever deployment was not correctly verified after touchdown and the speedbrakes were not manually deployed.
- The overrun occurred because the speedbrakes were not deployed after touchdown.

¹ NTSB Aircraft Performance Study, dated June 13, 2011



BOEING ASSISTANCE WITH THIS INVESTIGATION

The National Transportation Safety Board (NTSB) is conducting the investigation into this American Airlines 757-200 incident. Assisting the NTSB in its investigation are the Federal Aviation Administration (FAA), the Transportation Workers Union (TWU), the Allied Pilots Association (APA), Boeing and other designated parties.

As the manufacturer of the 757-200 airplane, Boeing's specific role in this investigation has been to provide technical information regarding the airplane design and operation to assist the NTSB.

Furthermore, the NTSB requested that all parties submit proposed findings to be drawn from the factual information established during the course of the investigation. Boeing has responded to the NTSB request with this document, which

- Provides an assessment of the factual information and other pertinent data.
- Identifies knowledge gained from the investigation.
- Identifies conclusions and recommendations supported by the knowledge gained from the investigation.

BOEING ASSESSMENT

The Boeing assessment of the incident is based on the facts as documented in the NTSB's factual reports. These reports are observations of the airplane and incident site, post-incident examination of airplane systems and components, flight data recorder (FDR) data and the cockpit voice recorder (CVR) transcript.



APPROACH CONDITIONS

Examination of the FDR data confirmed that the approach met the stabilized approach criteria and touchdown occurred within 600 feet beyond the displaced threshold, leaving at least 5,700 feet of runway and 300 feet of overrun ahead of it.² $V_{REF 30}$ was 131 knots, the airspeed at touchdown was 132 knots, or 1 knot above V_{REF} . Winds were about 40 degrees off runway heading at 6 knots.³ The analysis showed the airplane landed within the touchdown zone and the speed after touchdown was within reason.

KJAC has only one runway (1/19), which is 6300 feet long and 150 feet wide, and is composed of asphalt with a porous friction course (PFC) overlay. The runway 19 slope is 0.6% downhill.⁴

The flight crew performed a Landing performance assessment and determined that for their weight of 194,000 pounds, the required runway length on a 'wet/good' runway was 6180 feet.⁵

The last ATIS prior to landing contained: "Jackson Hole airport information Whiskey (W) at 1815 Z, wind 190 degrees at 6 knots, visibility ¾ mile with light snow, sky conditions 400 foot (AGL) broken layer, 1000 foot overcast, temperature -5 (C), dew point -7 (C), altimeter setting 29.14, landing and departing runway 19, ILS 19 in use, runway 19 mu 43/43/39 at time 1810Z by Saab friction tester. Runway conditions thin loose snow over patchy snow and ice. Pilot report at 1737 Z by a Challenger 30, runway 19, first 2/3 braking action good, last 1/3 braking action poor. Personnel and equipment working in vicinity of runway. Hazardous weather information for northwest region available from flight watch or flight service. Braking action advisories are in effect."⁶

AIRPLANE SYSTEMS

Examination of the FDR data and airplane systems after the event revealed that the airplane responded normally to crew inputs. There were no items listed on the Minimum Equipment List (MEL) for dispatch of the incident flight. The air/ground sensing system,⁷ auto-brake system⁸ and the thrust reverser system⁹ all functioned as designed. However, the auto speedbrake actuator did not deploy the speedbrakes on touchdown, even though the speedbrake lever had been armed.

Extending the speedbrakes after landing increases aerodynamic drag and reduces lift, which increases the load applied to the main gear tires and thus makes the wheel brakes more effective. The speedbrake system was armed for landing but the auto speedbrake deployment did not function upon landing. Several tests were completed on the system, both in-situ and in

² NTSB Aircraft Performance Study, dated June 13, 2011, page 6.

³ NTSB Operations/Human Performance Group, dated June 2, 2011, page 3.

⁴ NTSB Operations/Human Performance Group, dated June 2, 2011, page 16.

⁵ NTSB Operations/Human Performance Group, dated June 2, 2011, page 11.

⁶ NTSB Operations/Human Performance Group, dated June 2, 2011, page 18.

⁷ NTSB Systems Group Chairman's Factual Report, dated 08-31-2011, page 6.

⁸ NTSB Systems Group Chairman's Factual Report, dated 08-31-2011, page 11.

⁹ NTSB Systems Group Chairman's Factual Report, dated 08-31-2011, page 38.



a laboratory setting.¹⁰ Test results revealed an intermittent anomaly in the system.¹¹ Further testing at the manufacturer of the no-back clutch, part of the speedbrake mechanism assembly, revealed that the inner brake locking pin, located opposite to the output lever, displayed no flat spots and was found to rotate within its plate¹², allowing for an intermittent anomaly of the auto-speedbrake system (not automatically extending the speedbrake lever ‘aft’). This was determined to be a manufacturing issue that has since been resolved.

The event airplane’s FDR was reviewed for auto speedbrake system function during previous flights. The FDR contained data for a total of fourteen landings. A review of this data identified a total of three landings (including the incident landing) in which the speedbrake lever did not move (extend) out of its “armed” position within one second of the initial touchdown¹³ thus confirming the intermittent nature of the system anomaly. Neither of the other 2 event landings resulted in an overrun as the speedbrakes were either manually deployed or deployed upon thrust reverser activation. The intermittent auto-speedbrake anomaly does not affect the ability to manually deploy the speedbrakes.¹⁴

Under the heading “Landing Roll” on page 50.25 of the 757-767 Operating Manual, Volume I, Approach – Landing – Go-around section, it states:

“After main gear touchdown, initiate the landing roll procedure. If the speedbrakes do not extend automatically move the Speedbrake Lever to the UP position without delay. Fly the nose wheels smoothly onto the runway without delay.”

Under the heading “Speedbrakes,” it says in relevant part:

“Normally, speedbrakes are armed to extend automatically. Both pilots should monitor speedbrake extension after touchdown. In the event auto extension fails, the speedbrake should be manually extended immediately.”

Pilot awareness of the position of the Speedbrake Lever during the landing phase is important in the prevention of over-run. The position of the speedbrakes should be announced during the landing phase by the PM. This improves the crew’s situational awareness of the position of the spoilers during landing and builds good habit patterns which can prevent failure to observe a malfunctioned or disarmed spoiler system.”¹⁵

The CVR revealed that one of the flight crew announced ‘Deployed’ at 11:37:46.3 yet the speedbrake handle was still in the forward position.¹⁶

A landing performance analysis to find the number of feet of runway needed to stop was conducted for a variety of runway conditions, including ‘Dry’, ‘Good, but wet’ and ‘Medium, but wet’. For the event runway condition, ‘Good, but wet’ most closely matched the actual event details. Using this data, it was concluded that had the speedbrakes been deployed upon landing, the airplane would have needed 4650 feet to stop and therefore would have remained

¹⁰ NTSB Systems Group Chairman’s Factual Report, dated 08-31-2011, section D.6.3

¹¹ NTSB Systems Group Chairman’s Factual Report, dated 08-31-2011, page 24.

¹² NTSB Systems Group Chairman’s Factual Report, dated 08-31-2011, page 29.

¹³ NTSB Systems Group Chairman’s Factual Report, dated 08-31-2011, page 18.

¹⁴ NTSB Systems Group Chairman’s Factual Report, dated 08-31-2011, page 19.

¹⁵ NTSB Operations/Human Performance Group, dated June 2, 2011, page 22.

¹⁶ NTSB CVR Factual Report, dated XXX, page 12.



on the runway, even without the use of the thrust reversers. With the use of speedbrakes and thrust reverses, the airplane would have needed 3800 feet to stop.¹⁷

The thrust reversers were not deployed until 18 seconds after touchdown with 2100 feet of runway available.¹⁸ The airplane experienced a 'bounced landing,' meaning that the air/ground discrete transitioned to "Ground," then approximately 1 second later indicated "Air" for about 0.5 seconds before transitioning back to "Ground" for the remainder of the landing. The unusually quick deployment of the thrust reversers was impeded by the air/ground discrete transitioning back to 'air' which activates the sync-lock of each reverser. Once the air/ground discrete remained in 'Ground' and the flight crew cycled the thrust reversers, they deployed normally. Both thrust reversers were tested per the Maintenance Manual procedures and performed normally with no anomalies.¹⁹

¹⁷ NTSB Aircraft Performance Study, dated June 13, 2012, page 11.

¹⁸ NTSB Aircraft Performance study, dated June 13, 2011, page 9.

¹⁹ NTSB Systems Group Chairman's Factual Report, dated 08-31-2011, page 38.



KNOWLEDGE GAINED DURING THE INVESTIGATION (Findings)

The following knowledge gained is pertinent to drawing conclusions:

- The airplane overran the paved surface by 350 feet.
- The approach profile, touchdown point, touchdown airspeed and weather conditions did not contribute to the incident.
- Touchdown occurred within 600 feet beyond the displaced threshold, leaving at least 5,700 feet of runway and 300 feet of overrun ahead of it.
- A landing distance assessment had been accomplished by the flight crew, who determined that the airplane was capable of landing in the conditions present, had standard approach and landing procedures been followed.
- The previous airplane reported first 2/3 (runway) braking action good, last 1/3 braking action poor.
- The air/ground system, the autobrake system and the thrust reverser system functioned normally.
- At touchdown, the speedbrakes did not deploy automatically.
- The auto speedbrake system did not function as expected on touchdown even though the speedbrake lever was armed.
- The speedbrakes were not manually deployed after touchdown.
- Post flight lab testing on the speedbrake mechanism found a mechanical anomaly resulting in intermittent operation of the auto speedbrake system.
- Speedbrake deployment was not correctly verified after touchdown as required by standard procedures.
- The failure of the speedbrakes to deploy automatically did not affect the ability to manually deploy the speedbrakes.
- The airplane would have stopped:
with about 1650 feet remaining if speedbrakes had been deployed at touchdown, or
with about 2500 feet remaining if both speedbrakes and reverse thrust had been deployed at touchdown per standard procedures.



CONCLUSIONS

Boeing believes that the evidence supports the following conclusion for the incident:

The overrun occurred because the speedbrakes were not deployed after touchdown.

RECOMMENDATIONS

Boeing has no suggested recommendations at this time.

BOEING ACTIONS

Boeing is adding a new callout for thrust reverser status in our normal landing rollout procedure contained in the Boeing Flight Crew Operations Manual (FCOM). The revised procedure will be for the Pilot Monitoring (PM) to callout the status of the thrust reversers after the callout for speedbrake deployment. This new callout will be added to the normal landing rollout procedure for all Boeing models.

Boeing is currently writing a Fleet Team Digest (FTD) article that will contain the information concerning the no-back clutch and its possible intermittent anomaly.