

## AIRCRAFT ACCIDENT REPORT No 6/2007

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### REPORT ON THE ACCIDENT TO AIRBUS A320-211, REGISTRATION JY-JAR AT LEEDS BRADFORD AIRPORT ON 18 MAY 2005

<b>Registered Owner and Operator:</b>	Jordan Aviation, Hashemite Kingdom of Jordan
<b>Aircraft Type:</b>	Airbus A320-211
<b>Nationality:</b>	Jordanian
<b>Registration:</b>	JY-JAR
<b>Place of Accident:</b>	Leeds Bradford International Airport, UK
<b>Date and Time:</b>	18 May 2005 at 1143 hrs All times in this report are UTC unless otherwise stated

#### Synopsis

The accident was notified to the Air Accidents Investigation Branch (AAIB) by Air Traffic Control at Leeds Bradford International Airport at 1155 hrs on 18 May 2005. The following Inspectors participated in the investigation:

Mr J J Barnett	Investigator-in-Charge (until 30 April 2007)
Mr A P Simmons	Investigator-in-Charge (from 30 April 2007)
Mr J M Firth	Operations
Mr A N Cable	Engineering
Mr J R James	Flight Recorders

While landing on Runway 14 at Leeds Bradford Airport the aircraft touched down just beyond the end of the marked touchdown zone with low autobrake selected. Manual wheel braking commenced shortly after mainwheel touchdown. At a groundspeed of around 70 kt the brakes ceased operating, for about 17 seconds. A pronounced dip in the runway surface initially prevented

the pilots from seeing the runway end. When it became apparent to the commander that it would not be possible to stop before the end of the runway, he deliberately did not select alternate braking, as this would have caused loss of nosewheel steering, but instead used nosewheel steering to turn the aircraft sharply to the right. The aircraft skidded sideways and came to a halt with its nosewheels off the runway, shortly before the end of the paved surface and the start of a steep down slope.

The cause of the braking loss could not be positively established but it was consistent with the effects of excessive noise in the electrical signals from the mainwheel tachometers used to sense groundspeed. Two of the tachometer driveshafts were found bent and it was known that this encouraged a resonant condition that could cause tachometer signal errors above the groundspeed at which they would be detected by the aircraft's monitoring systems. Should the condition

affect both main landing gears simultaneously, the brake control system logic could generate an erroneous aircraft reference speed, which could activate the anti-skid system and release the brakes. Fluctuation in the signal errors would prevent the system from detecting and correcting the braking loss or providing a warning to the crew.

It was found that there were a number of other known anomalies with the brake control and monitoring system that could cause either brake failure or locking of the wheels, some of which had resulted in previous incidents and accidents. The aircraft manufacturer and the Airworthiness Authority had defined and implemented corrective actions, and redesigned tachometer driveshafts and updated software intended to correct some of the faults were available, but had not been incorporated on a substantial number of aircraft, including JY-JAR. The findings raised concerns about the aircraft manufacturer's procedures intended to ensure design quality and continued airworthiness.

The investigation identified the following causal factors:

1. Excessive wheel tachometer signal noise, caused by a bent tachometer driveshaft on each main landing gear assembly, resulted in loss of braking using the Normal system.
2. Inadequate fault tolerance within the brake control system led to the sustained loss of Normal braking during the landing ground roll.
3. There was no flight deck indication of brake system malfunction, and this delayed the crew's recognition of the loss of braking.

4. There was a lack of effective action to fully rectify brake system anomalies apparent from previous incidents and accidents.

Seven Safety Recommendations were made.

### **Findings**

1. The operating flight crew members were properly licensed and adequately rested to operate the flight.
2. The multi-lingual constitution of the crew did not adversely effect crew communications during the accident.
3. Neither flight crew member had landed at Leeds Bradford Airport before, so they were unfamiliar with the line-of-sight characteristics of Runway 14.
4. The aircraft was below the maximum landing weight appropriate for the runway in the prevailing conditions and its centre of gravity was within permitted limits.
5. The speed of the aircraft over the landing threshold was consistent with the achievement of scheduled landing performance.
6. The aircraft touched down just beyond the end of the marked touchdown zone, approximately 400 m beyond the Aiming Point and 700 m beyond the displaced runway threshold.
7. The LO autobrake setting selected for landing was inappropriate for the conditions but manual braking was commenced about 4 seconds after touchdown and should have been adequate to stop the aircraft on the runway.

8. A pronounced dip in the runway prevented the pilots from seeing the end of the paved surface until late in the ground roll.
9. The Normal braking system malfunctioned at around 70 kt groundspeed causing the loss of almost all braking effect.
10. Automatic reversion to Alternate braking did not occur.
11. There was no flight deck warning of the brake malfunction.
12. The lack of a flight deck warning probably delayed the crew's recognition of the loss of braking.
13. The FCOM procedure for LOSS OF BRAKING was not completed.
14. If, after selecting MAX reverse thrust, the commander had followed the remaining actions of the LOSS OF BRAKING procedure, it should have been possible to stop the aircraft on the runway but it would have used at least 252 m of the remaining 280 m of paved surface.
15. The commander could not have known that the aircraft might have been stopped on the paved surface if he had persisted with the LOSS OF BRAKING procedure.
16. Alternate braking was not selected because of concerns that the consequent loss of nosewheel steering and anti-skid would severely reduce the directional control capability.
17. The aircraft was steered off the side of the runway overrun area using nosewheel steering.
18. The aircraft skidded sideways and came to rest with its nosewheels on a grassed area at the side of the runway overrun area shortly before a steep down slope.
19. Aircraft damage was limited to slight distortion of the nose landing gear caused by overload while running on the grassed area.
20. The driveshafts for two of the mainwheel tachometers used to sense wheel speed were found bent. This probably caused excessive noise in the tachometer electrical signals that resulted in an error in the groundspeed determined by the computerised brake control system and consequent release of the brakes by the anti-skid system.
21. Fluctuation in the tachometer signal noise probably prevented automatic correction of the Normal brake system loss and caused failure of the flight deck warning.
22. The aircraft monitoring systems were unable to detect the excessive tachometer signal noise as this occurred at a speed above the monitored speed range.
23. There were a number of other known anomalies with the brake control and monitoring system that could cause either brake failure or locking of the wheels, some of which had resulted in previous incidents and accidents.
24. The aircraft manufacturer had acted with the intention of correcting brake system anomalies identified during previous incident and accident investigations, but the corrective actions had not been entirely successful.

25. Redesigned tachometer driveshafts and updated software intended to correct some of the faults were available but had not been incorporated on a substantial number of aircraft, including JY-JAR.

### Safety Recommendations

The following Safety Recommendations were made:

#### Safety Recommendation 2007-012

The Jordanian Civil Aviation Authority should ensure that aircraft operators under their jurisdiction have procedures in place to ensure the continued airworthiness of mandatory flight recorders.

#### Safety Recommendation 2007-013

The Civil Aviation Authority should publish information within the Aeronautical Information Package relating to runways which do not comply with the provisions of CAP 168, or which have profiles that reduce the ability of pilots to assess landing performance distance remaining visually, in the form of a 'Warning'. within the 'Local Traffic Regulations' section or the 'Remarks' area of 'Runway Physical Characteristics' for all affected UK airports.

#### Safety Recommendation 2007-014

The International Civil Aviation Organization (ICAO) should re-assess the benefits and disadvantages to runway situational awareness of runway distance markers for any runway which has a profile that prevents the end of the paved surface from being in view continuously from the flight deck. If the re-assessment concludes that a net benefit is likely, the ICAO should encourage the installation of such markers at relevant civil airports.

#### Safety Recommendation 2007-015

The European Aviation Safety Agency should require the expeditious replacement of the long hollow titanium tachometer driveshaft in the braking systems of the A320 family of aircraft with a driveshaft of improved design.

#### Safety Recommendation 2007-016

The European Aviation Safety Agency should ensure the replacement of software Standards 7 or 9 with Standard 9.1 or a proven later version, in those remaining Airbus A319 and A320 brake and steering control units not yet so modified.

#### Safety Recommendation 2007-018

The European Aviation Safety Agency should consider requiring, for aircraft in the A320 family and other aircraft with similar combined Brakes and Steering Control systems, changes that allow manual selection of Alternate braking without consequent loss of nosewheel steering.

#### Safety Recommendation 2007-019

The European Aviation Safety Agency should require Airbus to take measures aimed at ensuring that anomalies in A318/319/320/321 aircraft braking systems that may lead to loss of Normal braking are clearly indicated to the flight crew.