FINAL REPORT

AAIU Formal Report No: 2004-006
AAIU File No: 2002/0059
Published: 20/2/2004

Operator:	Ryanair
Manufacturer:	Boeing
Model:	B737-200 ADV
Nationality:	Irish
Registration:	EI-COA
Location:	Charleroi, Belgium.
Date/Time (UTC):	29 November 2002 @ 11:40 hrs

SYNOPSIS

The scheduled passenger flight from Dublin (EIDW) with 128 passengers, 5 crew and 4 supernumerary crew members landed normally on runway (RWY) 25 at Charleroi Airport/Brussels South (CRL) at 11.40 hrs. After landing, the First Officer, who was the pilot-flying the aircraft (PF), handed over control to the Captain somewhere prior to runway exit S2 and she elected to vacate the runway at exit S1, which is at the end of the runway. During this left turning off manoeuvre the nose wheel and right main landing gear departed the paved taxiway surface onto the soft grassy area. ATC was advised and the aircraft engines were shut down. The passengers disembarked the aircraft normally and were bussed to the terminal. The airport was then closed to traffic until 13.48 hrs when RWY 25 was declared fully operational again.

NOTIFICATION

The incident was notified to the Air Accident and Incident Investigations Unit (Belgium) by the Charleroi Airport Authorities on 29 November 2002 and by the Operator to the Irish Air Accident Investigation Unit (AAIU) on the same day. While the incident occurred on Belgian territory the Air Accident and Incident Investigations Unit (Belgium) agreed, after consultation with the AAIU, to delegate the investigation to the State of Registry (Ireland), in compliance with Chapter 5, Annex 13 to the Convention on International Civil Aviation (ICAO). Mr Richard Taverniers, Chief Inspector of Accidents, is the Belgian Accredited Representative to the investigation.

The Chief Inspector of Accidents, Mr Kevin Humphreys, appointed Mr Frank Russell, Inspector of Accidents, as Investigator-In-Charge (IIC).

1. FACTUAL INFORMATION

1.1 History of the Flight

The Flight Crew reported for duty at 05.45 hrs and this was their 3rd flight of a 4 sector day. The flight departed Dublin at 10.10 hrs for CRL. The centre cockpit jumpseat was occupied by a supernumerary crew member who took no part in the flight crew activities. The First Officer was the PF for this leg, the flight was uneventful and he carried out a normal landing at 11.40 hrs on RWY 25. The landing was carried out with 30° flap. Autobrake was not selected. Airport authorities noted that, at the time of landing, the runway was wet as there had been light drizzle over the airport area, and that a heavier shower was developing over the threshold area of RWY 07.

After touchdown the speedbrake deployed as normal and the PF selected reverse thrust. Deceleration was described as normal. Prior to reaching exit S2, at a speed of approximately 80 kt, the Captain took control. As the runway surface was wet she elected to continue towards the runway end and vacate at S1, a distance of approximately 2,500 feet further on. At approximately 70 kt. reverse thrust was cancelled, brakes were applied and released as the Captain was aware of a following Company aircraft on the ILS and did not wish to delay unnecessarily on the runway. Nearing the turnoff for S1 the Captain reapplied the brakes and, in her words, "*they never reapplied*". Repeated application and continuous heavy brake pedal pressure failed to produce any braking effect. The Captain commenced a turn towards exit S1 using the nose wheel tiller only, recalling that the speed was 60 kt. or less. The aircraft partially vacated RWY 25 and departed the taxiway onto the grassy threshold area, with the nose and part of the starboard wheel assembly in the grass.

The crew advised ATC of their predicament and while necessary assistance was being dispatched, the crew shut down both engines. Power was available from the APU. The Airport Fire Service attended. Due to the location of the aircraft the Authorities closed the airport for operations. Aircraft on approach were diverted into a holding pattern. Passengers were disembarked normally and then bussed to the terminal. Later, when the aircraft was towed to the apron and the runway/taxiway was cleared, RWY 25 was declared fully operational at 13.48 hrs.

1.2 Injuries To Persons

No injuries were reported to the investigation.

1.3 Damage To Aircraft

There was no structural damage to the aircraft. Both nose wheels and the No.4 main wheel were replaced due to contamination. The aircraft was returned to service on 1 December 2002.

1.4 Other Damage

Not applicable.

1.5 Personnel Information:

1.5.1 (Commander)

Personal Details:	Female, aged 42 years
Licence:	Airline Transport
Last Periodic Check:	23 May '03
Medical Certificate:	25 May '03

Flying Experience:

Total all types:	7,250	hours
Total all types PI:	3,000	hours
Total on type:	5,850	hours
Total on type PI:	3,000	hours
Last 90 days:	140	hours
Last 28 days:	70	hours

Duty Time:

Duty Time up to incident:	6.55	hours
Rest period prior to duty:	15	hours

1.5.2 (First Officer)

Personal Details:	Male, aged 21 years
Licence:	UK CPL
Medical Certificate:	29 November '02

Flying Experience:

Total all types:	900	hours
Total on type:	600	hours

1.6 Aircraft Information

Boeing 737-200 ADV, fully serviceable and certified for CAT II operations.

1.7 Meteorological Information

The Belgian Meteorological Service at Charleroi provided the following Met conditions for 11.00 and 11.40 hrs respectively.

11.00 hrs	**Wind:**	190° 06kt.
	Vis:	15 Km.
	Clouds:	FEW 1300 BKN 2000
	Temp:	9° C
	Dewpoint:	7° C
	QNH:	1019 hPa

11.40 hrs	**Wind:**	190° 05 kt
	Vis:	06 Km
	Clouds:	SCT 1300 ft, Light drizzle.
	Temp:	9° C
	Dewpoint:	7°
	QNH:	1013 hPa

1.8 Aerodrome Information

Charleroi/Brussels South, RWY 25/07, 2550 x 45 metres long. Exit S1 is at the end of RWY 25, which is ILS equipped.

1.9 Flight Recorders

The aircraft was fitted with a Cockpit Voice Recorder (CVR) and a Flight Data Recorder (FDR), as standard. Both recorders were retrieved by the Belgian Authorities and sent to the UK AAIB facility at Farnborough for downloading of data. The CVR recordings relevant to the incident had been overwritten and were of no benefit to the investigation. The FDR data was downloaded, and copied to AAIU. Relevant information obtained is produced, in part, at **(Appendix A)**.

1.10 Organisation and Management

Both the Operator and the aircraft manufacturer Boeing make much reference to braking techniques and systems in their respective Training and Operations Manuals.

(a) The Operator's Operations Manual, Chapter 8, Para 8.3.0 (c)(10), states, inter alia;

> "*Pilots should be aware that the aircraft stopping capability usually far exceeds that routinely used for deceleration, and that reverse thrust is most effective at the highest speeds while the wheel braking force increases as speeds decreases. This is particularly the case on wet runways*"
>
> and also
>
> "*that, the deceleration characteristic of distance-against-speed is such that most of the landing roll is spent at the higher speeds, and hence by implication, a need to initiate the stopping procedures without delay after touchdown*".
>
> and
>
> "*Runway turn-offs are built to different designs. Pilots should be prudent about aircraft turn-off speed until they are familiar with the turn-offs on specific runways*".

(b) The Boeing Flight Crew Training Manual discusses braking techniques.

Under "Manual Braking" Boeing states, inter alia:

> The following technique for manual braking provides optimum braking for all runway conditions:
>
> "*Immediately after main gear touchdown, smoothly apply a constant brake pedal pressure for the desired braking. For short or slippery runways, use full brake pedal pressure.*
>
> - *Do not attempt to modulate pump or improve the braking by any other special techniques.*
> - *Do not release the brake pressure until the airplane speed has been reduced to a safe taxi speed.*
> - *The antiskid system stops the airplane for all runway conditions in a shorter distance than is possible with either antiskid off or brake pedal modulation*
>
> and
>
> *If the pilot modulates the brake pedals, the antiskid system is forced to readjust the brake pressure to establish optimum braking. During this re-adjustment time, braking efficiency is lost*".

(c) The Boeing 737 Operations Manual **"**Landing on Wet or Slippery Runways (cont)states, inter alia, as a Recommended Procedure:

> "*Without autobraking, immediately after nose gear touch-down, smoothly apply moderate-to-firm, steady braking until a safe stop is assured ……. do not cycle brake pedals*".

1.11 Additional Information

(a) The Irish Aviation Authority (Operations) Order 2002, SI No. 437 of 2002, Part V, Aircraft Instruments, Equipment and Safety Devices, Paragraph 52, subpara 5, (f) states that the flight recorders (iii) ….. "shall be de-activated, if practicable, after an accident or serious incident involving the aircraft in which they are installed and shall not be re-activated prior to retrieval for examination of the recorded data"

(b) The Operators Operations Manual, Chapter 11, entitled "Handling of Accidents and Occurrences", makes no reference to the action of aircrew in the post accident/serious incident situation, when practicable, to immobilising the Cockpit Voice Recorder (CVR) by pulling the appropriate circuit breaker (CB). In the subject investigation the CVR CB was not pulled by the aircrew and thus no relevant information was retained for the investigation. In fact, the Operators base engineer pulled the CVR CB when he arrived on board the aircraft.

1.12 Tests and Research

Following the incident the aircraft was withdrawn from service by the Operator for examination. Prior to removal of the brake system components a brake system check was carried out and no defects found. A similar test on the anti-skid system established that it was fully serviceable. The anti-skid/autobrake Control Unit was replaced as a precaution. The removed components, which were sent to a maintenance organization for inspection, were reported as "no fault found".

2. ANALYSIS

For the landing, which was carried out by the First Officer, Flap 30° was selected, which was the normal setting for the runway length and conditions**.**

Autobrake was not selected. Autobrake selection is at the discretion of the Captain. However, in certain circumstances, the autobrake would be selected to "MIN" if the runway was less than 6500 ft and was promulgated as WET, with a reported braking action of less than GOOD. Other than WET, these conditions did not apply in this event. After touchdown, the speed brake deployed as normal, the PF lowered the nose and selected reverse thrust. Somewhere prior to reaching exit S2, at approx 80 kt, the Captain took control and decided against braking for S2 and elected to continue towards the runway end and vacate at S1 taxiway, some 2,500 ft further on. At approx 70 kt reverse thrust was cancelled, braking was not initially applied as the Captain was aware of a following Company aircraft on the ILS and did not wish to delay unnecessarily on the runway.

The attached plot **(Appendix B)**, derived from data downloaded from the FDR, shows the speed down the runway, position of the various taxiways and calculated deceleration levels. As airspeed is not recorded accurately on the FDR below 45 kt, a constant deceleration is assumed between the last valid value and the time the aircraft came to a rest. These points are depicted as hollow diamonds on the plot. The Captain recalled turning on to S1 at 60 kt or less and this correlates with the FDR data, which shows that the turn to SI was initiated at an indicated airspeed of 50 kt. At about 70 kt and at an appropriate point as determined by the Captain, braking was commenced. However, the deceleration did not approach the previously achieved value. It was at this late phase of the landing that the stopping technique used by the Captain did not have the desired effect. Repeated brake application and finally continuous brake application failed to achieve a safe taxi speed, as the aircraft turned into exit S1 and, very quickly, the aircraft vacated the taxi-way, with its nosewheel and number 3 mainwheel in the grassy overrun area. The aircraft then stopped and the crew shutdown the engines.

The CVR was not de-activated by the crew. This would have been practicable in this event by the simple expedient of pulling a circuit breaker. The CVR on this aircraft records cockpit activities, actions and pilot communications in a 30-minute loop, when electrical power is applied to the aircraft. It is a most useful device for investigators and aircrew alike to accurately recall events leading up to an incident.

Finally, the investigation considered the wording of the section of the IAA Operations Order 2002, on flight recorders, and suggests that subsection (iii) would be more complete by naming the agency that retrieves the recorded data.

3. CONCLUSIONS

3.1 Findings

3.1.1 Both the Captain and First Officer were medically fit and licensed in accordance with IAA Requirements to undertake the flight.

3.1.2 The aircraft, a Boeing 737-200 ADV, was fully serviceable and maintained in accordance with IAA Requirements.

3.1.3 Post event technical troubleshooting by the Operator found no defects in the brake system and the anti-skid system.

3.1.4 Meteorological conditions at the event time showed a light wind with drizzle over the airfield.

3.1.5 Prior to landing, autobrake was not selected. In the prevailing conditions this decision was at the discretion of the Captain.

3.1.6 The Captain took control after landing prior to reaching exit S2 at approx 80 kt and elected to continue and vacate the runway at S1, as the runway was wet.

3.1.7 There is approx 2,500 ft of runway between exits S2 and S1.

3.1.8 At or about S2 continuous braking was not commenced, as would be the normal procedure. The Captain was aware of the following Company Aircraft on the ILS and in all likelihood would have wanted to clear at the runway end in good time.

3.1.9 The FDR data shows a small decrease in airspeed from 80 kt approx at S2 to 50 kt at the runway end. This was not a safe taxi speed.

3.1.10 When the Captain commenced braking somewhere between S2 and S1, the Manufacturers Recommended manual braking technique, of smoothly applying a constant brake pedal-pressure for the desired braking was not applied. Several attempts at reducing the speed by modulating the brakes were unsuccessful as the brake pedal pressure was being released and efficiency lost.

3.1.11 The aircraft did not attain safe taxi speed by the turn off point at exit S1.

3.1.12 The aircraft vacated taxiway S1 onto the grassy overrun area, with its nose gear and part of the main landing gear off the hard surface.

3.2 Causes

3.2.1 The late use of an inappropriate braking technique, that failed to achieve a safe taxi speed, led to the uncontrolled departure of the aircraft from the taxiway onto the grassy area.

4. SAFETY RECOMMENDATIONS

It is recommended that:

4.1 The Operator should amend Chapter 11 of its Operations Manual, Handling of Accidents and Occurrences, to include advice to aircrew to de-activate the CVR in the post accident/incident situation, in compliance with IAA requirements. **(SR No 16 of 2004)**

The Operator accepts this Safety Recommendation.

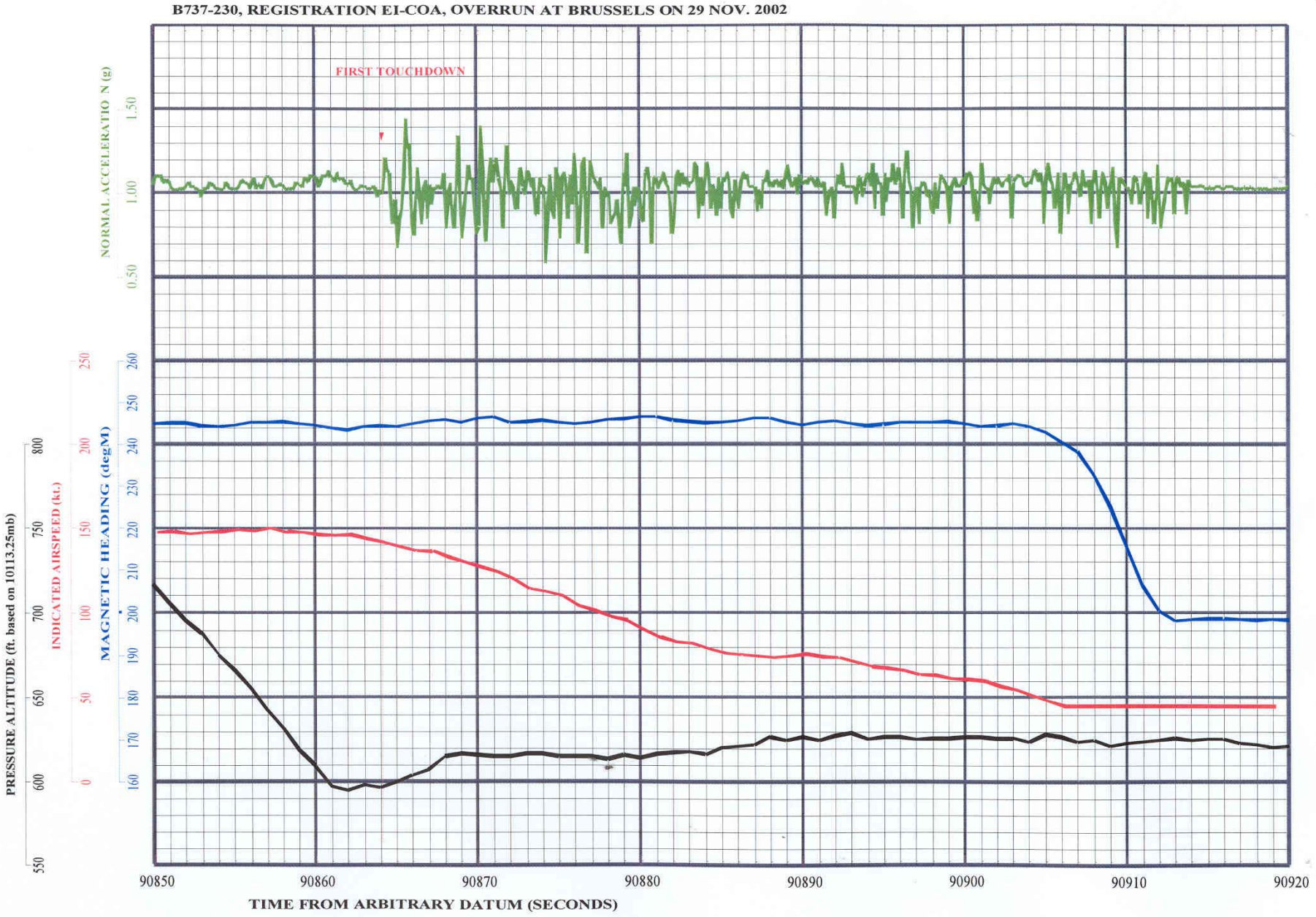
4.2 The Operator should consider the use of autobrake selection as a mandatory requirement for various landing configurations. **(SR No 17 of 2004)**

The Operator accepts this Safety Recommendation. ▭

4.3 The IAA should amend SI No. 437 of 2002, Part V, Aircraft Instruments, Equipment and Safety Devices, Paragraph 52, subpara 5 (f) (iii) flight recorders, by adding the following after……..”of the recorder data” *by the appropriate air accident investigation authority.* **(SR No 18 of 2004)**

The IAA advised the AAIU that their Operations Order 2002, S.I.437 of 2002 Article 52 (5) (g) (iii) specifies the agencies who may retrieve the recorded data after an accident or incident.

APPENDIX A


B737-230, REGISTRATION EI-COA, OVERRUN AT BRUSSELS ON 29 NOV. 2002
FIRST TOUCHDOWN
NORMAL ACCELERATIO N (g)
0.50
1.00
1.50
MAGNETIC HEADING (degM)
160
170
180
190
200
210
220
230
240
250
260
INDICATED AIRSPEED (kt.)
0
50
100
150
200
250
PRESSURE ALTITUDE (ft. based on 10113.25mb)
550
600
650
700
750
800
90850
90860
90870
90880
90890
90900
90910
90920
TIME FROM ARBITRARY DATUM (SECONDS)

APPENDIX B

RYR 737-200 EI-COA Runway Overrun