

FINAL REPORT

AAIU Synoptic Report No: 2009-025

State File No: IRL00908074

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In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 11 September 2008, appointed Mr. Leo Murray as the Investigator-in-Charge to carry out a Field Investigation into this Serious Incident and prepare a Synoptic Report. The sole purpose of this Investigation is the prevention of aviation accidents and incidents. It is not the purpose of the Investigation to apportion blame or liability.

Aircraft Type and Registration:	Boeing 737-8AS, EI-DYD
No. and Type of Engines:	2 x CFM 56-7B26
Aircraft Serial Number:	33632
Year of Manufacture:	2008
Date and Time (UTC):	11 September 2008 @ 10.33 hrs
Location:	Dublin Airport, Co. Dublin
Type of Flight:	Public Transport
Persons on Board:	Crew – 6 Passengers – 148
Injuries:	Crew – Nil Passengers – Nil
Nature of Damage:	Nil
Commander's Licence:	JAA Airline Transport Pilot Licence
Commander's Details:	Male, aged 41 years
Commander's Flying Experience:	10,114 hours, with 7,680 on type
Notification Source:	Airside Duty Manager, Dublin Airport
Information Source:	AAIU Field Investigation

SYNOPSIS

During take-off, the Tail Skid Assembly shoe on the underside of the aft fuselage came in contact with the runway surface. The aircraft continued on its departure, and levelled off at Flight Level¹ (FL)120, where the Flight Crew then completed the 'Tailstrike on Takeoff' checklist. While completing this checklist the aircraft was depressurised. After communication with the Cabin Crew, the passenger oxygen masks were deployed manually. The Flight Crew declared an Emergency and returned to Dublin Airport where the flight landed without further incident.

¹ **Flight Level:** Three-digit representation of aircraft altitude referenced to standard pressure.

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1. FACTUAL INFORMATION

1.1 History of the Flight

Prior to the incident flight, the aircraft turnaround had been delayed due to one of the inbound passengers requiring a lift-off and assistance of a wheelchair. To facilitate the turnaround, most of the outbound passengers boarded the aircraft via the rear steps and the aft entry door. This resulted in many of the passengers occupying seats in the aft cabin, however the distribution was in accordance with the loading rules.

The incident flight, from Dublin to Stansted, was the last of four sectors to be operated by the Crew that day. The aircraft departed Dublin off Runway (RWY) 28 with the Commander occupying the left seat as Pilot Flying (PF). The flight was cleared to climb on departure to FL230. The take-off was made with Flap 5 selected and a low engine thrust rating (22K). The aircraft became airborne at 10.33 hrs. As the aircraft rotated on take-off, the Flight Crew were aware of a bump but were not sure what had occurred. With the aircraft in a stable climb, and the 'after take-off checks' completed, the Commander handed control of the aircraft to the Co-Pilot, thus allowing the Commander to assess the problem (**Section 1.8.2 Decision making and Problem Solving Procedures**). This assessment took some time; within 4 minutes of take-off the aircraft was passing 10,000 ft. It took a further 8 seconds before the Commander concluded that a tail strike had most likely occurred. Air Traffic Control (ATC) cleared the Flight Crew to execute an early right turn and to proceed on course. The Commander initially attempted to make contact with the Cabin Service Supervisor (CSS) but at the time she was engaged in her after take-off passenger address (PA). The Commander made contact with the No. 2 Cabin Service Attendant (CSA) who confirmed that a tailstrike had taken place. The Commander then resumed the role of PF and called for the Non-Normal Checklist (NNC) procedure for 'Tailstrike on Takeoff'. The aircraft climbed to FL120 and remained level for 40 seconds before commencing a descent under clearance from ATC.

While accomplishing the 'Tailstrike on Takeoff' NNC checklist, the pressurisation outflow valve was opened thus depressurising the cabin. As the aircraft was not above 14,000 ft the passenger oxygen system did not deploy automatically. With the loss of cabin pressure, the 'cabin altitude warning horn' sounded. The Commander, as the PF, called for the 'Rapid Depressurization' NNC, the recall items of which required the Flight Crew to don oxygen masks before completing the checklist.

Following the depressurisation of the aircraft, the environmental conditions in the cabin rapidly deteriorated. The CSS quickly realised that the cabin had depressurised and went forward to the crew intercom to contact the Flight Crew. The Flight Crew at this stage were busy donning their oxygen masks and did not hear her initial call on the intercom. She called again and banged on the flight deck door before communication was established. She informed the Commander that a decompression had occurred and that the masks had not dropped in the Cabin. After this call from the CSS the Flight Crew deployed the passenger oxygen system manually. Some passenger oxygen masks did not deploy as three Passenger Service Units (PSU) failed to open (**Section 1.2.2 Passenger Oxygen System**). During descent the Commander briefed the CSS in preparation for the return to Dublin. The Flight Crew declared an emergency (Mayday) and were given radar vectors for an approach to RWY 28 at Dublin Airport, where the aircraft landed at 10.54 hrs.

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The Airport Fire Service provided a full turn out in preparation for the aircraft landing. Following an uneventful landing, the Flight Crew requested the Airport Fire Services to make a visual inspection of the aircraft including the brakes. The aircraft had been airborne for 21 minutes. Once the aircraft was parked on stand, one passenger requested medical assistance, which was provided. All passengers deplaned through the forward entry door, no passengers required hospitalisation.

1.2 Technical Information

1.2.1 Tail Skid Assembly

The Boeing 737-800 series incorporates a 'Tail Skid Assembly' which provides a degree of protection to the fuselage in the event of an over rotation. The assembly consists of a cartridge, fairing, skirt enclosure and shoe. The cartridge contains crushable honeycomb material, which compresses when the shoe makes sufficiently hard contact with the runway surface. A red and green decal on the skirt indicates the relative severity of a tailstrike, the aircraft is serviceable if the green area is visible (**Photo No. 1**).

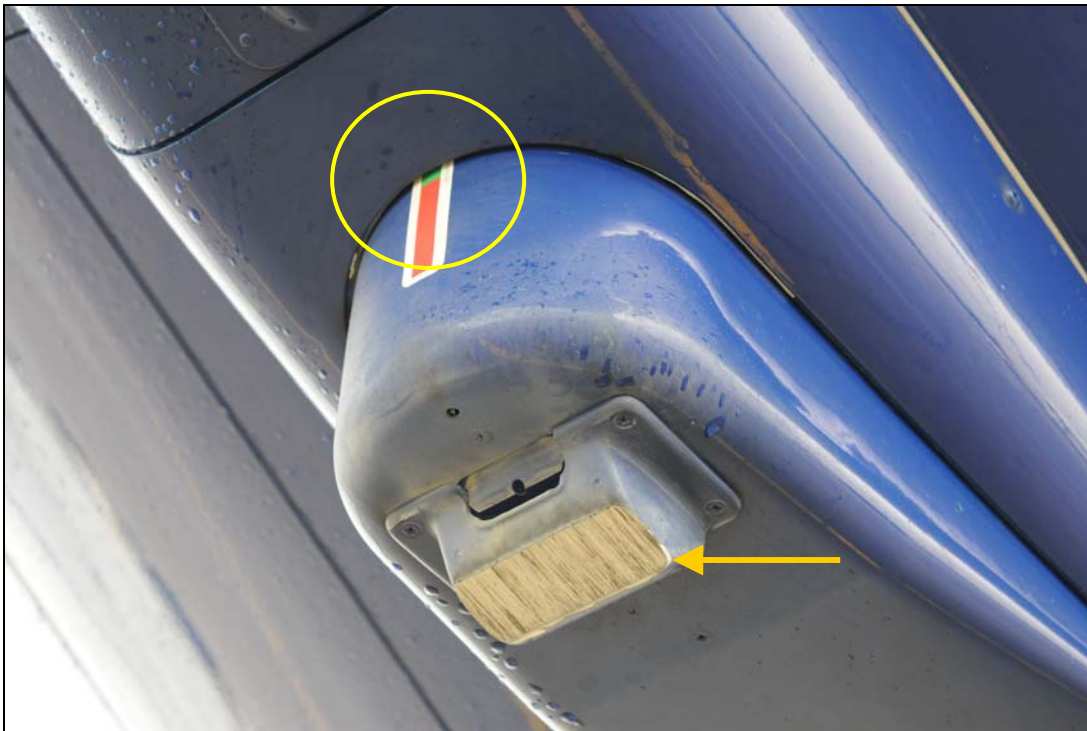


Photo No. 1: Tailskid Skirt Assembly as inspected by the AAIU.
Note contact shoe scraping (indicated by arrow) and green decal visible.

The Boeing 737-800 and -900 series are more susceptible to tailstrikes on take-off due to longer fuselage length than other versions of the 737. The selection of Flap 5 for take-off gives a minimum tail clearance of 51 cm on rotation at take-off. This clearance reduces to 33 cm if Flap 1 is used. Because of this, the Operator uses Flap 5 as a standard flap setting for take-off except where Flap 1 must be used for performance reasons. If Flap 1 is used, the take-off must be performed by the aircraft Commander.

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Other factors such as low take-off mass, aft Centre-of-Gravity (C of G) position or rapid thrust application can increase the probability of a tailstrike. In the event of a tailstrike, the procedure to be followed by the Flight Crew is contained in the Quick Reference Handbook (QRH) under 'Tailstrike on Takeoff'. This procedure states the condition under which the checklist is to be used: '*Airplane tail has contacted the ground during takeoff*'. It then notes as a caution: '*Do not pressurise airplane due to possible structural damage.*' The 'Tailstrike on Takeoff' NNC is reproduced in **Appendix A**.

1.2.2 Passenger Oxygen System

Passenger oxygen for emergency use is provided by chemical oxygen generators located in the Passenger Service Unit's (PSU's) situated in the overhead panels. There is one PSU per seat row on each side of the aisle. Crew stations and toilets are also equipped with PSU's. Each PSU in a passenger seat row contains four oxygen masks, one for each seat and a spare.

Deployment of the system allows the masks to drop from each PSU. Each generator must then be individually activated by pulling down any one of the four masks. After activation of a PSU, oxygen is supplied for 12 minutes to those masks and cannot be shut off. If the passenger oxygen system is deployed and a PSU oxygen mask compartment does not open, the PSU may be opened manually by inserting a small pointed object (less than 0.125 inches diameter) through one of the holes adjacent to the oxygen door test stop. The passenger oxygen system will deploy automatically if the cabin loses pressure and reaches an equivalent altitude of 14,000 ft. The system may also be deployed manually by the Flight Crew at any time, by selecting the Passenger Oxygen Switch to 'ON'. During the operation of the chemical oxygen generator, an unusual odour may be detected in the air. Where a cabin has been depressurised, a mist due to condensation will normally form due to the lower air pressure.

1.3 Field Investigation

The AAIU were informed of the occurrence by the Airside Duty Manager, Dublin Airport Authority (DAA) shortly after the aircraft landed and by the Operator. One Inspector of Air Accidents inspected the aircraft at Dublin Airport and interviewed the Flight Crew and Cabin Crew. External inspection of the aircraft revealed no damage to the underside of the fuselage, with superficial scoring of the tailstrike 'shoe' and the Tailskid indicator green band visible (**Photo No. 1**).

The Chief Fire Officer was present and stated that passenger oxygen masks did not deploy in certain rows, a total of three PSU's. The three PSU's that did not deploy affected the following seats: 6A, 6B, 6C, 11A, 11B, 11C, 16D, 16E, and 16F. When the aircraft was back on the ground, reselection of the Passenger Oxygen Switch by the Flight Crew deployed these masks. The aircraft was later moved to the Operator's hangar where the Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR) units were removed for downloading. All PSU's were subsequently replaced by the Operator and no faults were found with the system. It could not be established why three of the PSU failed to open initially when the system was deployed manually. The Manufacturer has had a few reports of PSU compartment doors not deploying correctly during decompression events. Usually these are confined to a single PSU. The root cause can be difficult to identify, one known cause is an incorrectly stowed oxygen mask. In this case, it was not possible to identify a cause, because the doors of these PSU's were subsequently deployed.

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1.4 Crew Interviews

1.4.1 General

The Aircraft Crew returned to the Operations building and made themselves available for interview by the Investigation. The Operator's Flight Safety Office also made all relevant paperwork regarding the flight available. The crew compliment on the flight was standard, comprising two Flight Crew and four Cabin Crew. The Flight Crew were interviewed together. Both Flight Crew members gave an account of their flying experience to date and gave detailed accounts of the incident flight.

1.4.2 Commander

The Commander who completed the Co-Pilot's Line Check the previous day was also the Pilot Flying (PF) on the incident flight. The Flight Crew performed a standard Flap 5 take-off on RWY 28 with no 'Assumed Temperature'² thrust reduction due to the crosswind being in excess of 10 kts. The Commander stated in his report that they had detected a 'bump' on rotation and were unsure of what had caused it. The take-off was continued followed by an early right turn out as cleared by ATC. Following completion of the 'after take-off' checks, control was given to the Co-Pilot whereupon the Commander attempted to contact the CSS. As the CSS was engaged in her after take-off announcements, it took some time for the Commander to confirm with the aft CSA's that a tailstrike had occurred. Following this communication, the Commander again assumed PF duties and informed ATC that they would be levelling at FL120. The 'Tailstrike on Takeoff' checklist was then completed. *'I requested an immediate descent, but the outflow valve had already been opened and the cabin alt was climbing through 6,000-7,000 ft. The No. 1 [CSS] called on the intercom if we were OK in the cockpit, because there was 'smoke' in the aft cabin. At the same time the Cabin High Alt warning came on. I called for the NNC Recall items for 'Rapid Decompression' and we descended over the sea to a lower altitude. I overrode the guard switch to 'Passenger Oxygen' and deployed the passenger oxygen masks. A Mayday call was declared to Dublin ATC.'*

During descent the Flight Crew made a complete turn approx 15 nm east of Dublin to allow the Cabin Crew time to prepare the Cabin for landing. Upon landing the Fire Services were requested to perform a visual inspection of the aircraft and brakes before the aircraft proceeded to the apron. In addition to his Initial Safety Report, the Commander also submitted an additional report emphasizing the passenger seating towards the rear of the aircraft, resulting in a more aft C of G position.

1.4.3 Co-Pilot

The First Officer (Co-Pilot) stated that this was the fourth day that this particular Flight Crew were rostered together. The first two days were training flights, on the third day the Commander carried out a Line Check (LCK1, or first Line Check) as part of the Co-Pilots training programme, thus the incident flight was his first regular line flight.

² **Assumed Temperature:** Method of reducing the takeoff thrust by assuming a temperature that is higher than the actual outside air temperature.

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'As we departed from RWY 28 the takeoff roll and the rotation rate appeared normal to me. During the rotation I felt a very slight bump, which I did not recognise. It felt like we had run over a runway joint at speed. There were no abnormal engine or other indications and we continued the takeoff and climbed away following our cleared SID³ (LIFFY 2A). On changeover to Dublin Radar, we accepted a clearance to make a right turn towards Manchester and climb to FL230. After I had completed the after takeoff checklist, the Captain handed me controls and radios and spoke with the Cabin Crew on the service interphone. When the Captain rejoined me on comms, he took controls and radios, called for the QRH Tailstrike on Takeoff NNC and told ATC that we needed to stop our climb at FL120. I read the checklist aloud with the Captain and actioned the items. The No. 1 'dinged' the flight deck several times and banged on the flight deck door.

The Captain went off comms to talk to the No.1; when he came back on comms he manually deployed the passenger oxygen masks and called for the QRH Rapid Depressurisation NNC. At the same time, the Cabin Altitude⁴ Warning horn began to sound. I donned my oxygen mask and actioned the recall items. The Pressurisation mode selector was already in MAN [Manual] from the Tailstrike on Takeoff NNC. I did not attempt to close the outflow valve. The passenger signs were still on as we had not completed the 'ten' [10,000 ft] checks.

1.4.4 Cabin Service Supervisor (CSS)

The CSS was seated with CSA No. 4 at the front of the cabin. In her statement she confirmed the aft loading of the aircraft referred to by the Commander. She described the take-off:

'For take-off I heard a noise, like we hit something. The noise wasn't strong. I said to my No. 4 it could be a bird strike or tail strike. But everything was normal. After take-off the Captain released the crew and I started doing my after take-off PA'.

The CSS stopped her announcement when she heard the Commander calling the No. 2. She proceeded to the rear of the aircraft to find out what had happened on take-off and what had been discussed. The CSS was in the centre of the cabin when the cabin became depressurised. When she reached the rear of the Cabin she saw her colleague trying to manually open PSU's with an ID card. She realised that a decompression had occurred and ran to the front of the aircraft. Her other colleague was also trying to open a PSU:

'I ran to the front, I needed to inform the Captain that we were having a rapid decompression. When I reach the front of the cabin I saw No. 4 trying to drop masks from our jumpseat, it didn't work. She was feeling very weak, she needed oxygen.'

The CSS attempted to contact the Flight Deck by interphone and when no response was received she banged on the door. Only then was communication established, she informed the Flight Crew that they were experiencing a decompression and to drop the masks. The masks were then deployed manually by the Flight Crew, the CSS put on her oxygen and observed that some passengers were confused on how to put on their oxygen masks.

³ **SID:** Standard Instrument Departure (specifically the 'LIFFY 2A' routing from RWY 28)

⁴ **Cabin Altitude:** As an aircraft climbs, pressure in the cabin is gradually reduced to a set value. The altitude equivalent to this reduced pressure is termed the 'Cabin Altitude'.

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1.4.5 Cabin Service Attendant's (CSA's)

The three CSA's were interviewed together. The Investigation also examined written reports completed by the cabin crew. All the CSA reports were detailed and gave frank accounts of the event. Subsequent to the depressurisation the CSA's attempted to manually open the PSU's using ID Cards and other objects. The PSU's may be opened manually if necessary by inserting any small pointed object through one of the holes adjacent to the oxygen door test stop.

1.5 Passenger Accounts

A number of witnesses who were passengers on the flight contacted the AAIU and provided detailed accounts. The following comments were made by one passenger, but are representative of all passenger statements received. The following extracts from that statement are significant:

'One of the cabin crew ran forward from the rear galley to the front of the cabin and I was aware of shouting from the rear of the plane. This Stewardess then came onto the intercom from the front of the cabin and asked for everyone to put on their oxygen masks. The masks themselves had not dropped at this point and she repeated the request a couple of times, pointing at the overhead area. There was a lot of resulting confusion and I noticed a number of passengers opening the overhead containers for the life jackets and some people were even unwrapping them'. 'I checked behind that my colleagues were ok and turning back around I could see that the passengers in the row in front of me (i.e. the front most of the two rows of emergency exit seats, Row 15 DEF) did not have masks on and were striking the overhead cabinets with their fists to try and get them to open. When these efforts failed and with the assistance and direction of other passengers, they moved down the cabin to some spare seats where the masks had deployed. Looking around the cabin I could see several other people on their feet and moving around the cabin. The aircraft at this point was making a rapid descent and making a series of tight turns over the sea'.

1.6 Aircraft loading

A 737-800/900 with an aft C of G position can be more susceptible to a tailstrike than would otherwise be the case. The Operator uses an approved 'adjusted weight' method of calculating the aircraft weight and balance. Put simply, the weight of each item added to the aircraft empty weight is adjusted slightly to take into account the C of G change of that additional weight. Depending on passenger numbers, seating restrictions (referred to as Rule 1 and Rule 2) apply. While allowing passengers free seating in the cabin, the 'adjusted weight' method ensures that the certified weight and C of G limits are not exceeded and determines the horizontal Stabilizer Trim (Stab Trim) setting⁵ for take-off. The Incident flight was loaded as follows: standard crew complement of two flight crew, four cabin crew, 148 passengers (including one infant), and 52 pieces of baggage loaded in Forward Hold No. 2. Calculation of the above reveals a basic Stab Trim setting of 5.4 units, which is corrected to 5.9 units for take-off with Flap 5 at 22K engine thrust rating. This figure is within the Stab Trim setting range of 4.9 to 6.5 permitted at the calculated take-off weight of 61,255 kg. Because of the aft seating of passengers, the actual Stab Trim position would have been slightly different to the 5.9 units calculated, but still within permissible limits.

⁵ **Stabilizer Trim setting:** Calculated position of the Stabilizer Trim wheel for Takeoff. This position depends on the aircraft C of G and Flap setting used for takeoff.

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1.7 Licence Information

The Commander held a JAA Airline Transport Pilot Licence (Aeroplanes) issued in Denmark and valid until 26 October 2012. The Commander also held a type rating for the Boeing 737 300-900, Instrument Rating (Multi-engine, Aeroplane) valid until 30 September 2009, and a Class I Medical Certificate valid until 1 September 2009.

The Co-Pilot held a JAA Commercial Pilot's Licence (Aeroplanes) issued in Ireland and valid until 13 June 2012. The Co-Pilot also held a type rating for the Boeing 737 300-900, valid until 30 September 2009, and ratings for single and multi-engine landplanes with associated Instrument Ratings. His Class I Medical Certificate was valid until 13 January 2009.

1.8 Crew Training

1.8.1 General

Training provided by the Operator for Flight and Cabin Crew is of a high standard. Training for Flight Crews involves initial type qualification with ground school and simulator based training. Initial line training, which the Co-Pilot had just completed, involves a number of flight sectors followed by a number of line checks. All Flight Crews undergo recurrent training, with both ground school and simulator checks. Specific training regarding Tailstrikes is given in Annual Recurrent Simulator Training, Command Upgrade Courses, Operator Conversion Courses and Type Rating Courses as part of the Operator's overall training programme.

1.8.2 Decision making and Problem Solving Procedures

Following confirmation that the aircraft is at a safe height and configuration the Operator requires Flight Crews to follow a standard problem solving or decision-making procedure. This procedure is defined using the acronym PIOSEE (Problem-Information-Options-Select-Execute-Evaluate). The first step in the process is to accurately identify the problem, gather all relevant information using all resources, identify all options and risks associated, select the best course of action, execute the plan in a timely and efficient manner and evaluate the effect of that plan at regular intervals.

1.8.3 Non-Normal Procedures

The Flight Crew deal with Non-Normal situations with reference to the QRH. The QRH introduction gives guidance on how checklists are to be used: *'Only a few situations need an immediate response [examples given]. Usually time is available to assess the situation before corrective action is started. All actions must then be coordinated under the Captain's [Commander's] supervision and done in a deliberate, systematic manner'*.

Each Cabin Crew member has access to a copy of Operations Manual Part A (Safety and Emergency Procedures Manual). This manual contains detailed information on Regulations, location and use of Safety Equipment, and Standard Operating Procedures to be followed by Cabin Crew in the event of an emergency occurring. Section 6 of this Manual deals with Decompression. It provides information on Cabin Pressurisation, decompression and its effects, time of useful consciousness and drills to be carried out in the event of a rapid decompression. The following comment is significant regarding decompression:

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'If a slow decompression is suspected it is the responsibility of the Cabin Crew to ensure the Flight Deck is informed immediately via the interphone, where upon they will check the pressurisation system.'

Decompression Drill requires that Cabin Crew first put on their oxygen masks before sitting down and fastening their seat belt. They are instructed to then await a call from the Flight Deck for briefing. In this case a decompression situation existed but no masks had dropped. The Cabin Crew were trained to deal with such a situation, in that if the symptoms of a 'slow decompression' are evident, the Cabin Crew must make contact with the Flight Crew immediately.

1.8.4 Training changes

Since this Serious Incident occurred, the Operator has put in place some changes regarding the Training of Flight Crew and Cabin Crew. These changes are as follows:

1.8.4.1 Flight Crew Instruction (FCI)

On 26 September 2008, an FCI was issued to all Flight Crews incorporating an amended 'take-off brief', which includes actions to be taken in the event of depressurisation (Cabin Altitude Warning). The amended take-off brief is reproduced in **Appendix B**.

1.8.4.2 Cabin Crew Safety Memo

On 7 October 2008, the Chief Instructor, Cabin Safety & Standards, issued a Safety Memo to all Cabin Crew regarding notification of an emergency during the take-off roll. This Safety memo was issued to clarify the procedure for the CSS to contact the Flight Crew in the event of an emergency occurring during this critical phase of flight.

1.8.4.3 Tailstrike Avoidance (Flight Crew)

On 23 December 2008 the Operator, through the Chief Pilot, issued a memo to all pilots regarding tailstrike avoidance. This memo was intended to provide additional guidance to Pilots to prevent tailstrike events occurring. The text of this memo has since been transferred to the Operator's Line Training Techniques Document, which is issued and available to all Instructors and Line Training Captains. The following is an extract from that document:

'In crosswind conditions it is not uncommon to see large control wheel displacements (and excessive forward pressure) during the takeoff roll in an attempt to improve directional control. This is not the correct handling technique and greatly increases the possibility of a tailstrike.'

The FCTM⁶ (3.14 and 3.15) is very clear in this area. The greatest threat to a Takeoff in strong and gusty conditions is in fact tailstrike and not directional control.'

⁶ FCTM: Flight Crew Training Manual.

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The document summarises with the following points:

- *Smooth rudder control inputs combined with small control wheel inputs result in a normal takeoff with no over controlling.*
- *Any control wheel deflection more than 10 degrees (approximately 1.5 units of Aileron Trim) will activate the spoilers.*
- *Spoiler activation reduces aircraft energy, which requires a higher attitude to generate the lift required for takeoff. This increases the risk of a tailstrike.*
- *Do not rotate early or use a higher than normal rotation rate because this reduces tail clearance margin.*

1.8.4.4 QRH Revision (Flight Crew)

The title and wording of the QRH 'Tailstrike on Takeoff' NNC was changed on 24 April 2009. The *Condition* statement at the beginning of the new 'Tailstrike' checklist reads: '*A tailstrike is suspected*'. The actions' regarding the Outflow Valve Switch has been expanded to read: '*Hold in OPEN until the outflow VALVE position indicates fully open*'. The remainder of the checklist is unchanged.

1.8.4.5 Cabin Crew Instruction (CCI)

The Operator also issued a General Instruction to Cabin Crew (Ref. General 31/09) titled 'Notification of Emergency to Flight Crew', which details the formal procedure to be used to inform the Flight Crew of any emergency the Cabin Crew may be aware of. A suspected tailstrike is now a condition requiring that the Flight Crew be notified. This CCI will be included in the Operations Manual (Part A) at the next revision.

1.8.4.6 Cabin Crew Ground Training

During May 2009, the Operator updated material used in Cabin Crew Ground Training syllabus. Slides with animation are used to clarify topics covered in the Safety and Emergency Procedures (SEP) Manual. The potential for decompression and Hypoxia to occur between 10,000 ft and 14,000 ft are taught to all Flight and Cabin Crew. Specifically, Cabin Crew are taught to learn the different types of decompression, the causes and effects of such decompression, decompression drill, to understand Hypoxia, and its effects, and to be familiar with the oxygen systems on board the Operators aircraft.

2. ANALYSIS

2.1 Tailstrike event

The initial event on this flight, the tailstrike with the runway, was not a serious event in itself. However, the chain of events following the tailstrike led to this occurrence becoming a Serious Incident where many of the passengers were anxious and upset.

Regarding the tailstrike itself, the longer Boeing 737-800/900 series is more susceptible to tailstrikes than the shorter-fuselage versions. A tailstrike is not necessarily a serious event, in this particular case the tailstrike shoe contact was light enough for the indicator to remain in the green band. Inspection of the aircraft by the Investigation revealed only a light scoring of the tailskid 'shoe' with no damage to the underside of the aircraft.

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Although this event did require a return to the departure airport and an entry made in the aircraft Technical Log, no repairs would have been necessary. A statement made by the Commander, and confirmed by the CSS, indicated the aircraft had an aft C of G. While the aircraft was loaded correctly and within permissible load and trim limits, the aft loading may have made the aircraft slightly more susceptible to a tailstrike than would otherwise be the case.

2.2 Subsequent Events

The Commander was correct in handing over control of the aircraft to the Co-Pilot after take-off. At this stage though, it would have been more appropriate to level off the aircraft at a safe altitude, identify fully the nature of the problem, and then complete any checklists as required. At a low altitude the aircraft would not have pressurised to any significant extent, therefore opening the outflow valve as required by the NNC would not have been problematic. In any event the aircraft continued to climb at a high rate.

As the Flight Crew levelled off at FL120, the aircraft was now pressurised. A few moments considering the consequences of the actioning the checklist would have shown that the aircraft would be depressurised within seconds upon opening the outflow valve. The caution note in the NNC stating not to pressurise the aircraft, is primarily in case the fuselage has been damaged to such an extent that a sudden decompression may subsequently occur.

In this particular case, there was no damage to the fuselage. The NNC is designed to configure the pressurisation system to *prevent pressurisation* of the airframe occurring. With the aircraft already pressurised, selecting the pressurisation mode to 'manual' and opening the outflow valve depressurised the aircraft.

This resulted in the 'cabin altitude' increasing to match the aircraft altitude as the pressurised air in the cabin escapes. Once the 'cabin altitude' reached 10,000 ft the 'Cabin altitude warning horn' activated resulting in a second NNC being called for and actioned by the Flight Crew. Crucially, the Flight Crew did not consider fully the consequences of manually opening the outflow valve, nor the fact that as the aircraft had been levelled below 14,000 ft the passenger oxygen system would not deploy automatically. The activation of the 'Cabin altitude warning horn' and actioning of an additional NNC checklist provided additional distraction and increase in workload that could have been avoided with a clearer appreciation of the pressurisation situation at the time.

The Cabin Crew were aware that something unusual had occurred on take-off. Communication with or from the flight deck at that time would have been proactive in the Flight Crew's timely identification of the problem. Notwithstanding this, the prompt intervention of the CSS after the decompression in communicating with the Flight Deck was a significant contributing factor in the resolution of this Serious Incident. The Flight Crew became reactive to additional problems of their own making rather than proactive in the resolution of the initial event. When the Flight Crew initially actioned the 'Tailstrike on Takeoff' checklist at FL120 the aircraft was pressurised. With the situation as it stood, the aircraft was at FL120 with the tailstrike checklist to be completed. Even at this stage, had a few moments been spent considering the consequences of actioning the checklist, it should have been readily apparent that the aircraft would be depressurised on opening the outflow valve.

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It is apparent that the CSS alone quickly realised the seriousness of the situation when the cabin was depressurised and took the correct action in immediately informing the Flight Crew. Other cabin crew members (CSA's No. 2, 3 and 4) were somewhat reactive during the emergency but did not readily appreciate that communication with the flight deck was the absolute priority for deployment of the passenger oxygen. Inspection of the cabin by the AAIU revealed all PSU's deployed, but only after re-activation of the Passenger Oxygen switch while the aircraft was on the ground. Depressurisation normally produces a mist due to condensation. This, coupled with the unusual odour of the chemical oxygen generators functioning, can be alarming to passengers. While a depressurisation event is not commonly experienced occurrence, these factors would be normal during such an event.

2.3 Training

The Operator has been proactive in taking initiatives to prevent a Serious Incident such as this reoccurring. Since the occurrence, Cabin Crew procedures have been clarified (a) to prevent distraction during the take-off roll and (b) to ensure that timely notification is given to the Flight Crew in the event of an emergency occurring, including a *suspected tailstrike*. The Cabin Crew Ground Training module on the subject of decompression has been revised and updated.

Shortly after the occurrence, the Operator issued an FCI to all pilots regarding changes to the take-off brief, which now specifically outlines actions in the event of a decompression occurring. A memo was also sent to all pilots regarding the avoidance of tailstrike events, this procedure has since been incorporated into the Operator's Line Training Document. The QRH has been revised to allow the Flight Crew to take appropriate action if a tailstrike is *suspected*, this now ensures that Flight Crew take appropriate action immediately without having to positively identify that a tailstrike has occurred.

The Investigation is satisfied that the Operator has taken appropriate action regarding the training of Flight Crew and Cabin Crew in that procedures have been examined and revised where it has been deemed necessary. Changes to procedures have been promulgated to Flight Crew and Cabin Crew and are included in all ground and simulator based recurrent training. However, in view of the nature of this Serious Incident, the Operator should ensure that a module specific to tailstrike events is included at the earliest opportunity in its Ground Training schedule.

3. CONCLUSIONS

(a) Findings

1. The Flight Crew were properly licensed.
2. The aircraft was correctly loaded and within limits in accordance with approved procedures.
3. A low severity tailstrike occurred on take-off, which, although it required a return to the departure airport, would only have required a visual inspection to return the aircraft to service.
4. The Flight Crew elected to continue to climb when the nature of the problem was not known.

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5. The Commander did not descend to a lower altitude (which would have de-pressurised the cabin as per normal operation) prior to actioning the Tailstrike NNC.
6. The Tailstrike NNC was actioned incorrectly in that the aircraft was pressurised during the actioning of this checklist.
7. The opening of the outflow valve as required by the NNC checklist resulted in the depressurisation of the aircraft, resulting in the activation the 'Cabin Alt Warning Horn' and requiring another NNC checklist with recall items to be completed.
8. The Passenger Oxygen system was only deployed when the CSS made contact with Flight Crew.
9. Three PSU's did not deploy when the Passenger Oxygen was deployed manually.
10. With the exception of the CSS, the Cabin Crew did not deal effectively with the unexpected loss of Cabin pressurisation.
11. As a result of this Serious Incident, the Operator has revised some procedures and checklists to improve communication between Flight Crew and Cabin Crew should an emergency occur.

(b) Probable Cause

The aircraft was depressurised manually at FL120 by the Flight Crew while carrying out a Non-Normal Checklist subsequent to a low-severity tailstrike event.

(c) Contributory Causes

1. Allowing the aircraft to climb and pressurise while the nature of the problem was not clearly established.
2. Actioning a Non-Normal Checklist without fully appreciating the consequences of such action.

4. SAFETY RECOMMENDATIONS

1. The Operator should ensure that a module specific to tailstrike events is included at the earliest opportunity in its Ground Training schedule for Flight Crew and Cabin Crew. [\(SR14 of 2009\)](#)
2. The Operator should review the suitability of its Ground Training material regarding the deployment and use of Passenger Oxygen System and the duties of Cabin Crew in the event of a depressurisation. [\(SR15 of 2009\)](#)

Response:


The Operator has confirmed that it accepts the findings of the Final Report and is making the necessary arrangements to implement the safety recommendations in full.

FINAL REPORT

APPENDIX A

Extract from QRH 'Tailstrike on Takeoff' NNC

0.30

 **BOEING**
737 Flight Crew Operations Manual

Continued from previous page

-----DEFERRED ITEMS-----

==> LANDING

ENGINE START switches CONT

SPEED BRAKE ARMED

Landing gear DOWN

AUTO BRAKE Set

Flaps 15, Green light

■ ■ ■ ■

TAILSTRIKE ON TAKEOFF

Condition: Airplane tail has contacted the ground during takeoff.

CAUTION: Do not pressurize airplane due to possible structural damage.

PRESSURIZATION MODE selector MAN

OUTFLOW VALVE switch OPEN

Hold outflow valve switch in the OPEN position until outflow VALVE position indicator shows valve full open.

Plan to land at the nearest suitable airport.

■ ■ ■ ■

(The block symbol indicates that the checklist is completed)

- END -