Air Accident Investigation Unit Ireland

INCIDENT REPORT
Boeing B737-8AS, EI-DYI
Charleroi Airport, Belgium (EBCI)
1 March 2010 @ 08.40 hrs

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

AAIU Report No: 2012-010
State File No: IRL00910019
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In accordance with the provisions of SI 460 of 2009, the Chief Inspector of Air Accidents, on 18 March 2010, appointed Mr. Paul Farrell as the Investigator-in-Charge to carry out an Investigation into this Serious Incident and prepare a 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 B737-8AS, EI-DYI
No. and Type of Engines:	2 x CFM 56-7B
Aircraft Serial Number:	36571
Year of Manufacture:	2008
Date and Time (UTC):	1 March 2010 @ 08.40 hrs
Location:	Charleroi Airport, Belgium (EBCI)
Type of Operation:	Scheduled Passenger
Persons on Board:	Crew - 6 Passengers - 140
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	Minor, but of a serious nature
Commander's Licence:	Air Transport Pilot Licence
Commander's Details:	Male, aged 27 years
Commander's Flying Experience:	3,400 hours, of which 2,200 were on type
Notification Source:	Safety Occurrence Report submitted by the Operator
Information Source:	Operator's Safety Occurrence Report, Operator's detailed report on the technical follow-up, The US National Transportation Safety Board (NTSB), aircraft Manufacturer

SYNOPSIS

In flight the crew noticed unusual airframe vibration and diverted. Subsequent investigation revealed that the aft attachment lugs on the left elevator tab control had failed.

NOTIFICATION

The AAIU received a notification of this event from the Operator, which made reference to the inflight vibration and diversion. At the time of the initial report filed by the flight crew the operator was unaware of the extent of the aircraft damage. As Belgium was the state of occurrence, this report was forwarded (on 3 March 2010) by the AAIU to their Belgian counterparts. The Belgian authorities had also received a report of the diversion from the airport authority on 2 March 2010. On 12 March 2010, the NTSB advised the AAIU that the event was deemed to be a significant one and that an emergency Airworthiness Directive (AD) was being issued requiring inspection of a range of aircraft. On 18 March 2010, the Belgian authorities formally delegated this Investigation to the AAIU. As the Manufacturer's investigation was well advanced at that time it was decided that this Investigation would monitor the Manufacturer's investigation and would provide a public report on the details of the event and subsequent findings.

1. FACTUAL INFORMATION

1.1 History of the Flight

EI-DYI was on a scheduled passenger flight between Eindhoven (EHEH) and Madrid (LEMD) on 01 March 2010. During the flight the crew noticed abnormal airframe vibration and diverted to EBCI, where it landed normally.

1.2 Aircraft Inspection

A member of the Operator's engineering staff from the United Kingdom travelled to EBCI and conducted the Manufacturer's prescribed conditional inspections for an airframe vibration. During these inspections the left-hand (LH) stabiliser tab control mechanism was found to be damaged. Consequently, it was decided that further inspection and repair/maintenance was required.

1.3 Technical Follow-up

The Aircraft Manufacturer requested and received a download of the Flight Data Recorder (FDR) data in order to determine the maximum load conditions experienced during the flight. Analysis of the recorded data showed that the vibration was greatest at an indicated airspeed (IAS) of approximately 300 kts. As a result of the FDR data analysis the Manufacturer stipulated additional inspections of the LH and right-hand (RH) stabilisers, the elevator and the tab control mechanisms. In addition, the Operator requested, and the Manufacturer provided, supplemental inspection criteria required to return the aircraft to service.

The primary damage that was discovered was to the elevator tab control mechanism, where the frame assemblies 251A2431-11 and 251A24311-12 were broken from the tab mechanism assembly, and accelerated wear was found to the elevator tab mechanism, thought to be as a result of oscillation of the elevator tab.

The damaged control mechanism was replaced and all functional tests as required by the Manufacturer were completed. The Operator then conducted a non-revenue ferry flight from EBCI to Stansted (EGSS) to conduct additional inspections as requested by the Manufacturer, with the involvement of the Manufacturer's Aircraft-On-Ground (AOG) team.

Figure No. 1 shows a general schematic of the location of the failed components on the aircraft and a more detailed engineering drawing of the assembly. **Photo No. 1** provides details of the nomenclature used in this report.

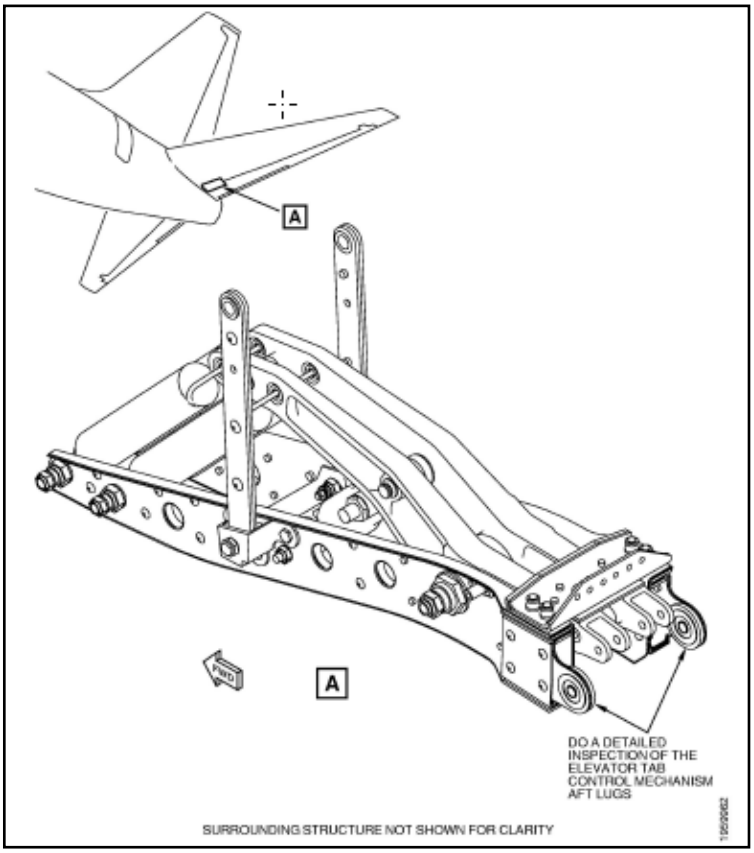

Figure No. 1: Schematic of failed assembly and its aircraft location

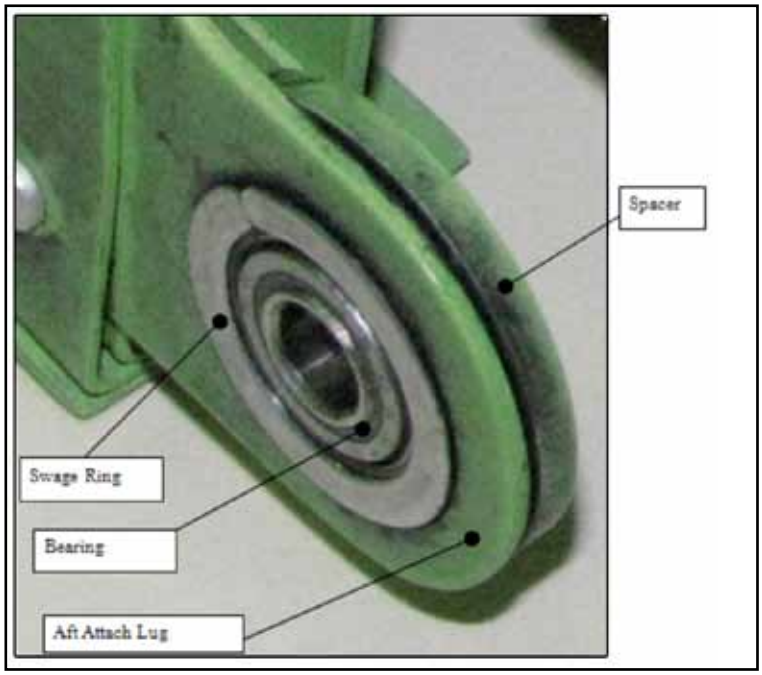

Photo No. 1: Nomenclature used in this report

1.4 Inspection of Other Aircraft

As part of the Manufacturer's investigation, it was recommended that the Operator carry out inspections of 11 aircraft of the same type. The purpose of these inspections was to look for signs of wear on the same components identified in this event. The Manufacturer provided technical assistance to the Operator in carrying out these inspections. Subsequent to these inspections, on 12 March 2010, the Manufacturer issued Boeing Service Bulletin (SB) 737-27A1296 and the US Federal Aviation Administration (FAA) issued Emergency AD 2010-06-51. In relation to the anomalies which had been identified, the Emergency AD noted "*This condition, if not corrected, could result in a loss of aircraft control and structural integrity.*" EI-DYI was in the effectivity range of this AD. The SB required "*detailed inspections of the bearings in the elevator control tab mechanism aft attach lugs. Look for gaps and loose parts. If there are gaps or loose parts, replace the elevator control tab mechanism.*"

1.5 Inspection Conclusions

As a result of EI-DYI's event, and also due to the findings from the inspections of other aircraft, the Manufacturer identified that wear of the bearing swage ring at the aft attach lugs of the elevator tab control mechanism resulted in accelerated degradation of the joint, after which the bearing could migrate out of the lug or cause complete lug separation resulting in severe vibration of the elevator tab. The Manufacturer determined that the bearing swage had worn because of "*workmanship escapement and improper tool usage*" that would have occurred during component manufacture. Furthermore, the Manufacturer identified that the design specification may not have been adequate for multiple layer clamp-up, resulting in unexpected wear at the joint.

1.6 Additional Inspection Requirements

The Manufacturer received a second report, from a different operator, of a severe elevator vibration event due to fractured aft attach lugs of the elevator tab control mechanism. In the case of this second failure, the operator reported that the airplane had recently been inspected per SB 737-27A1296. The Manufacturer held a teleconference on the 8 April 2010 to highlight to all operators that the FAA was considering a revision to AD 2010-06-51 requiring removal of hardware for the aft attach area of the elevator tab mechanism and prescribing a feeler gauge check of the bearing and swage, with particular attention being paid to inspecting for gaps in the swage.

Subsequently, the Manufacturer released a second SB (737-27A1297), and the FAA released a second AD (2010-09-05) requiring these new inspections on existing aircraft within a specified time frame. The inspection procedure per SB 737-27A1297 required the use of a feeler gauge to determine the integrity of the lug bearing swage assembly, and reduced the range of the aircraft serial numbers which were affected. The reduction in the range of applicable serial numbers was due to a change in production processes and a tooling change by the component manufacturer of the swaged parts.

FAA AD 2010-17-19 was released on the 25 August 2010, superseding AD 2010-09-05. AD 2010-17-19 prescribed new inspection requirements in accordance with the Manufacturer's SB 737-27A1297 (Revision 1) on existing aircraft within a specified time frame. The Manufacturer is in the process of re-designing the tab mechanism to address the problems identified. An SB is being developed which installs a retention clip on the aft attach lugs of the tab mechanism; this should help to prevent future failures of the lugs.

2. ANALYSIS

This was a serious event which in the words of the FAA "*could result in a loss of aircraft control and structural integrity*". The Manufacturer and the FAA recognised the gravity of the situation and took immediate action. The root cause of the problem, bearing swage wear because of workmanship escapement and improper tool usage during component manufacture, was identified. Following root cause determination rapid action followed to determine and address the aircraft type implications.

3. CONCLUSIONS

(a) Findings

1. The aircraft suffered damage to the LH stabiliser tab control mechanism.
2. As a result of this damage the aircraft experienced inflight vibration and was forced to divert.
3. The root cause of the damage was identified as bearing swage wear because of workmanship escapement and improper tool usage during component manufacture.
4. The Manufacturer and the FAA implemented a programme of inspections and replacements for other aircraft which may have been affected.

(b) Probable Cause

Bearing swage wear because of workmanship escapement and improper tool usage during component manufacture.

4. SAFETY RECOMMENDATIONS

As a result of the actions taken by the Manufacturer and the FAA this Investigation does not sustain any Safety Recommendations.

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In accordance with Annex 13 to the International Civil Aviation Organisation Convention, Regulation (EU) No 996/2010, and Statutory Instrument No. 460 of 2009, Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulation, 2009, the sole purpose of these investigations is to prevent aviation accidents and serious incidents. It is not the purpose of any such accident investigation and the associated investigation report to apportion blame or liability.

A safety recommendation shall in no case create a presumption of blame or liability for an occurrence.

Produced by the Air Accident Investigation Unit

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