
Excessive right aileron required on Boeing 737-400, EI-BXB, at Dublin Airport.

Micro-summary: A flight control system failure on this Boeing 737 resulted in a tendency to roll left.

Event Date: 1998-11-27 at 0945 UTC

Investigative Body: Air Accident Investigation Unit (AAIU), Ireland

Investigative Body's Web Site: <http://www.aaiu.ie/>

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AAIU Report No. 2000/008
AAIU File No. 19980066
Published: 02/08/2000

Aircraft Type and Registration: B737-400, EI-BXB

No. and Type of Engines: Two CFM 56 Turbofans

Aircraft Serial Number: 24521

Year of Manufacture: 1989

Date and Time (UTC): 27 Nov 98, 09.45 hours

Location: RWY 28 Dublin Airport

Type of Flight: Public Transport

Persons on Board: Crew 2 Pilots and 6 CCM
Passengers 147

Injuries: Crew Nil Passengers Nil

Nature of Damage: Nil

Commanders Licence: ATPL

Commanders Age: 40 years

Commanders Flying Experience: 8795 hours

Information Source: Aircraft Operator

Notification: The incident was notified to the AAIU by the Operators operations controller.

Synopsis

At 09.45 hours on 27th November 1998, EI-BXB was on the approach to RWY 28 at Dublin Airport. The aircraft was being flown by the First Officer. At 500 ft he found that abnormal right aileron had to be applied and held until the aircraft was safely on the ground.

1. **Factual Information**

At approx 500 ft on the approach to RWY 28 at Dublin Airport, the First Officer, who was handling the aircraft, brought to the attention of the aircraft's commander the fact that he required an input of 5 to 6 units of right aileron to maintain wings level. There were no other adverse handling problems but this degree of right aileron had to be held until the aircraft was safely on the ground. Because the aircraft was so close to touchdown, there was little time to troubleshoot the problem during approach. A standard approach, landing and taxi were carried out.

On examination of the aircraft the cause of the problem was traced to the outboard spoiler on the LH wing (position "0"--see Fig. 2). The spoiler was found with its control surface disconnected from its actuator. The spoiler actuator was found to have had the eye-end separated from the actuator shaft. This was caused by severe corrosion on the threaded portions of the shaft and on the eye-end. The actuator had been installed since delivery in Oct 1989.

1.1 **Aircraft Information**

1.1.1 **Spoiler and Speed Brake System**

Spoiler panels are installed to supplement the ailerons for lateral control and also to provide increased drag and reduced lift when used as speed brakes. Five hydraulically powered spoilers are installed on each wing. They are numbered from left to right for identification, 0 to 4 on the left wing and 5 to 9 on the right wing.

Spoilers used in flight are 2,3,6 and 7. The remaining six (0,1,4,5,8 and 9) are used on the ground only as lift dumping i.e. when landing. The failed spoiler was one of these. The ground spoilers have two positions, fully retracted (see sketch) or fully raised. The fully raised position for all the ground spoilers is 60 degrees. Ground Spoilers "0" is actuated directly by a single-acting actuator. Hydraulic power is supplied by aircraft System A. The ground spoiler is attached to the wing structure by four hinge fittings aft of the rear spar and is located forward of the outboard flap. The actuator is attached directly to the spoiler and wing structure at the centre of the spoiler. When the spoiler is down, the down limit is provided by bottoming the piston in the actuator. When activated, the actuator piston extends fully and pushes the spoiler 60° into the airflow thus increasing the drag and reducing the lift. If the rod end separates from the actuator, the spoiler will move to an intermediate position that is neither fully retracted nor fully raised. The position of this aerodynamic neutral point varies with flight conditions and flap settings.

1.1.2 Technical History

Investigations carried out by the Aircraft Operator following the incident, showed that the aircraft manufacturer previously had observed "Outboard Ground Spoiler Actuator Piston Rod End Separation" on a B737-200 and published a report in November 1991. Similar components are installed in the 300, 400 and 500 series of the B737. The manufacturer's recommendation was to apply a sealant around the rod-to-piston interface area. In order to alleviate further problems from thread corrosion, several operators also applied an additional compound to the threads during actuator overhaul.

The ground spoiler actuator of this aircraft did not have sealant applied as the component had been installed since new in Oct '89. Spoiler actuators are an "on condition" item and have a history of good reliability in the aircraft Operator's fleet of B737's.

Tests and Research

Having received the unserviceable components the aircraft's manufacturer forwarded a report, part of which concluded:

The threads of the piston rod and rod end were corroded and damaged. The ball of the spherical bearing could not be rotated by hand. Corrosion products were present in the keyway of the rod end.

Additional Information

There exist two assembly standards in the worldwide 737 fleet

- those actuators with sealant applied
- those actuators with no sealant applied

The Aircraft Operator action therefore included:

- (a) A fleet inspection of all actuators, not having sealant applied, on a unit age basis as priority.
- (b) A sample of actuators with sealant to be inspected to verify the effectivity of the sealant.

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Shop procedure would henceforth include the use of the additional compound on the threads of the piston shaft bore as mentioned by the aircraft manufacturer's notice of November 1991

Fleet Inspection Results

The results of the above action were:

1. The majority of outboard actuators inspected did not have a sealant applied.
2. 25% of the inboard actuators inspected had no sealant applied.
3. The only actuator that had corrosion on the threads was the unit in the "0" position on EI-BXB and this did not have sealant applied.

The review and analysis in conjunction with the aircraft manufacturers focused attention on all outboard actuators. Outboard actuators were replaced with actuators that were put through the revised workshop process that included the application of the above compound in the shaft bore in addition to the sealant at the eye-end.

Inboard actuators on each aircraft in the operators 737 fleet were also inspected for evidence of corrosion at the eye-end/thread area. No evidence of corrosion was found.

The only other cases of corrosion were found on actuators on position "9" on EI-BXA and position "0" on EI-BXB (this aircraft). In the case of the former minor corrosion was found only on the base of the bore and not on the threads.

2. ANALYSIS

This incident was caused by corrosion on the threads of the eye-end bolt and internal corrosion on the threads of the actuator shaft. The eye-end departed from the shaft in flight and caused the spoiler to deploy of its own accord and interfere with the airflow over the wing. The onset of corrosion was facilitated by the absence of sealant.

This spoiler, being in the outboard position, had a maximum effect on the aerodynamic balance of the aircraft to such an extent that the pilot had to apply 5 to 6 units of opposite aileron to hold the wings level. The aircraft was within 500 ft of touchdown when this incident occurred giving the crew little enough time to carry out additional checks.

3. CONCLUSIONS

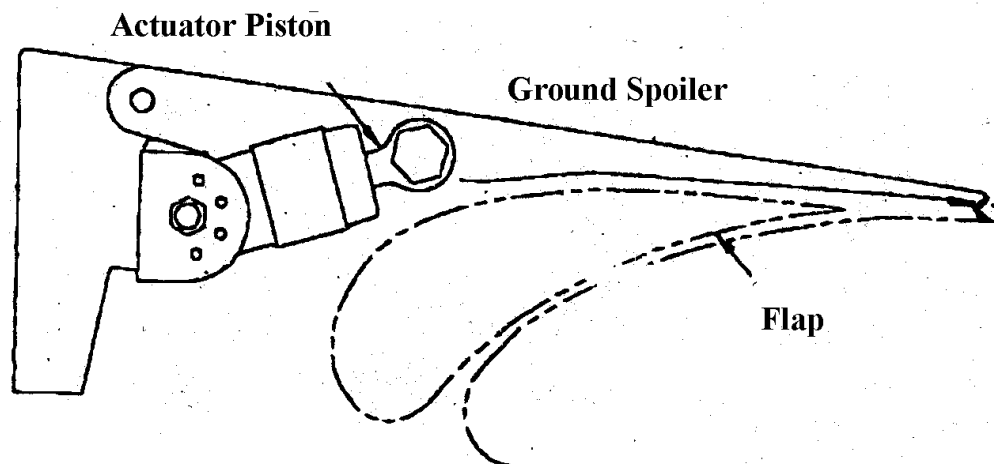
The inspection programme carried out by the aircraft operator was satisfactory and of sufficient depth to enable the operator to state that "the only actuator that had corrosion on the threads was the unit in the "0" position on EI-BXB, the failed unit, and this had not got sealant applied.

The inspection programme also indicated that the geometry of the inboard spoilers and their actuators renders moisture ingress in the rod bore less likely. This should enable the Aircraft Operator to concentrate on the outboard spoilers during aircraft maintenance inspections. However, it would appear that the corrosion problem found on EI-BXB was a relatively isolated incident.

4. SAFETY RECOMMENDATIONS

4.1 The aircraft manufacturer should issue a Service Bulletin to cover this problem, which would bring it to the attention of B737 operators worldwide. **(SR 10 of 2000)**

In response to this recommendation, the aircraft manufacturer stated that they had already revised the Maintenance Manual to include the new sealing procedure and issued an In Service Activity Report. They are currently reviewing this issue with regard to probability of failure and the severity of the consequences to determine if further action is warranted (e.g. Service Letter or Service Bulletin), but have not yet reached a conclusion.



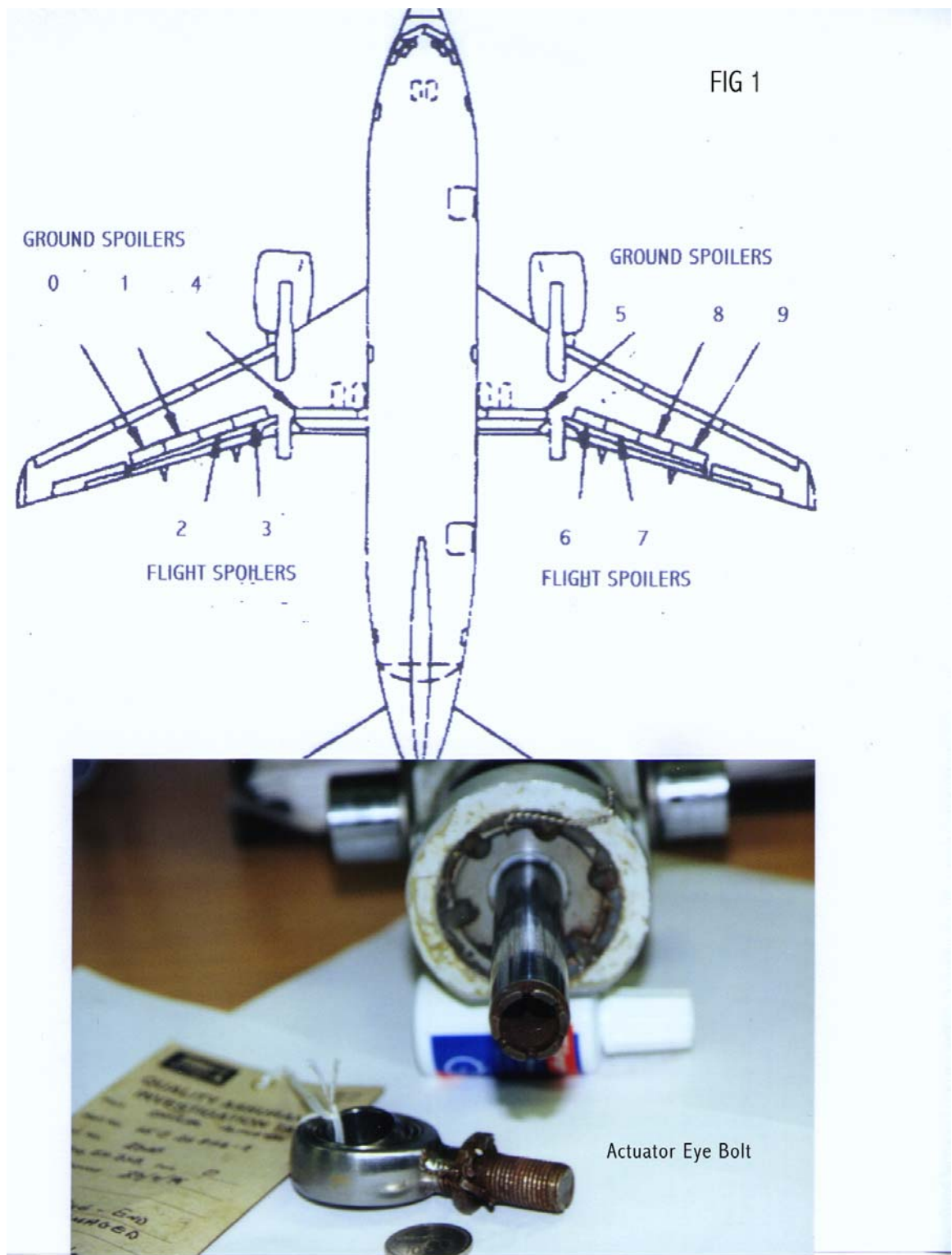


Fig 1 (Above) Spoiler Configuration EI-BXB

Fig 2 (Below) Position "0" Ground Spoiler Actuator EI-BXB