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ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2008-056
Final

Flight control system event – 22 km east of Melbourne Airport, Vic. – 10 August 2008

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Abstract

On 10 August 2008, an Embraer-Empresa Brasileira De Aeronautica ERJ170-100 aircraft, registered VH-ZHA, was being operated on a scheduled passenger service from Sydney NSW, to Melbourne Vic. While positioning for landing, the crew selected a 'flaps 1' setting and a number of caution messages appeared on the engine indicating and crew alerting system (EICAS) screen.

The aircraft operator found that the left number-3 slat actuator torque trip limiter had actuated enabling the caution messages to appear on the EICAS screen. The number-3 slat actuator was replaced. A strip and condition report did not identify any failure of the actuator and the failure was probably a result of operating in icing conditions. As a result of similar occurrences, the slat actuator manufacturer is re-designing the slat actuator seals.

FACTUAL INFORMATION

The information presented below, including any analysis of that information, was prepared principally from information supplied to the Bureau

Sequence of events

On 10 August 2008, at about 2050 Eastern Standard Time[1] an Embraer-Empresa Brasileira De Aeronautica ERJ170-100 aircraft, registered VH-ZHA, was being operated on a scheduled passenger service from Sydney NSW, to Melbourne Vic, with six crew and 54 passengers. During the approach into Melbourne, the flight crew selected the flaps to 'flaps 1'. When the selection was made, a number of caution messages, including 'Slat Fail', 'Spoiler Fault', 'Aircraft Operating Angle of Attack (AOA) Limit Fail' and 'Shaker Anticipated' appeared on the engine indicating and crew alerting system (EICAS) screen. The flaps were cycled up and then down again, with the caution messages reappearing. The crew advised air traffic control (ATC) that they had 'significant flight control problems' and requested that they hold at 5,000 ft to resolve the problems. ATC declared an Alert Phase[2] and assisted the crew to position the aircraft south of Melbourne, while the crew completed the relevant checklist actions. ATC also placed the airport emergency services on local standby.

A review of the quick reference handbook by the crew confirmed they would need to conduct a flap 1, zero slat[3] landing. At 2110, the crew advised ATC that they were still working through the checklists and were expecting to make a flapless landing at Melbourne. At 2130, the crew declared a PAN[4] and requested radar vectors to land. They also advised ATC that they had a reduced angle of bank limit and that they could expect a higher than normal landing speed with a normal touchdown and landing.

1 The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. Eastern Standard Time was Coordinated Universal Time (UTC) + 10 hours.

2 Apprehension exists as to the safety of the aircraft and its occupants.

3 Flap 1, zero slat is 5 degrees of flap with no slat extension and is considered to be a 'flapless' configuration.

4 Radio broadcast indicating uncertainty or alert.

During the approach, an icing accretion warning activated, which required an additional landing speed recalculation, adding to the workload of the crew. The aircraft landed at 2137.

The pilot in command subsequently advised the aircraft operator that the flight control problems reported to ATC were in reference to the caution messages rather than actual control difficulties with the aircraft.

Recorded data

The digital combined voice flight data recorder number one (DVDR 1) was removed and forwarded to the Australian Transport Safety Bureau (ATSB) for download and analysis.

A review of the recorded data indicated that during the approach into Melbourne, and while descending through 5,700 ft, the slat handle was moved by the crew for slat and flap extension to detent 1 (Flaps 1). At this time, a slat fault in channel 1 & 3 occurred and the slats failed to extend, while the flaps extended to 5 degrees.

The aircraft levelled at approximately 4,900 ft and the slat handle was returned to its detent '0' position, the flaps retracted and the slat fault indication extinguished.

Another extension of the slats and flaps was attempted, resulting again in a slat fault indication and subsequent non-extension of the slats. Ice was subsequently detected on the right wing, resulting in the ice accretion warning activation.

Maintenance action

An examination by the aircraft operator's ground engineers identified a slat jammed/under speed fault. The appropriate fault isolation manual task was completed and it was found that the left side number-3 slat actuator torque trip limiter had actuated. The fault description in the task notes revealed that this usually occurs when the slats are operated in extremely cold temperatures.

The number-3 slat actuator torque trip limiter was reset and all related fault messages were cleared. A slat/flap system test was satisfactorily completed and the aircraft was returned to service.

This was the second occurrence of this type involving the number-3 slat actuator on this aircraft. After advice received from the aircraft manufacturer, the number-3 slat actuator was replaced. The actuator was forwarded to the actuator manufacturer for examination and a strip report.

The actuator manufacturer's strip and examination report for the number-3 slat actuator, did not identify any faults.

Slat actuator history

There was a similar occurrence earlier in 2008 on the same aircraft. The same slat actuator was affected and the actuator torque trip limiter required resetting. There is no record that a flapless landing was completed as a result of that event.

The aircraft operator contacted an international operator of the same aircraft type operating in a colder climate to source information regarding similar occurrences. That operator informed the operator of VH-ZHA that they experienced slat/flap failures weekly and at times daily.

In December 2008, the slat actuator manufacturer advised their intention to issue a service bulletin to modify the actuator by incorporating a cone brake spacer to reduce premature torque limiter engagement.

In January 2009, the aircraft manufacturer released an amended Fault Isolation Manual (FIM) task to rectify any repeat events after reset of the torque trip limiter. This required replacement of the slat actuator if the torque trip limiter had tripped.

Since implementation of the FIM task, the aircraft operator has not experienced any recurrences of the fault.

The aircraft operator advised the ATSB that they are actively monitoring the slat actuator fault and are providing flight data to the aircraft manufacturer. In return, they are receiving effective advice from the manufacturer on updates for reviewing system faults and troubleshooting to avoid other potential system faults.

ANALYSIS

General

It is probable that the failure of the number-3 slat actuator to extend normally was the result of extremely cold and icing conditions. The investigation found that this type of slat actuator event is not uncommon for the aircraft type being operated in those conditions.

The slat system failure resulted in landing limitations due to the requirement to conduct a flapless approach and landing.

System operation and strip report

Activation of the slat actuator torque trip limiter prevented abnormal asymmetric extension of the slats that would have resulted in severe handling difficulties

There was a similar previous occurrence on the same aircraft involving the same slat actuator. This second occurrence resulted in a recommendation by the aircraft manufacturer to replace the slat actuator. This action has proved effective in limiting further events.

There were no faults identified by the slat actuator manufacturer during the number-3 slat actuator strip and examination.

FINDINGS

Context

From the evidence available, the following findings are made with respect to the flight control system event involving the Embraer-Empresa Brasileira De Aeronautica ERJ170-100 aircraft registered VH-ZHA. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The failure of the number-3 slat actuator to extend imposed landing limitations on the aircraft.
- It is probable that the failure of the number-3 slat actuator to extend was the result of extremely cold conditions [*Safety Issue*].

Other key findings

- Activation of the slat actuator torque trip limiter prevented abnormal asymmetric extension of the slats.

SAFETY ACTION

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

Depending on the level of risk of the safety issue, the extent of corrective action taken by the relevant organisation, or the desirability of directing a broad safety message to the aviation industry, the ATSB may issue safety recommendations or safety advisory notices as part of the final report.

Cold conditions and slat-3 actuator extension

Safety Issue

It is probable that the failure of the number-3 slat actuator to extend was the result of extremely cold conditions.

Action taken by manufacturer

The slat actuator manufacturer had initiated the redesign of the actuator to reduce torque trip limiter engagement.

The aircraft manufacturer had issued a new fault isolation task to address the fault and stop recurrence. They are also providing effective trouble-shooting advice and updates to the aircraft operator.

Action taken by aircraft operator

The aircraft operator had replaced affected slat actuators in accordance with the aircraft manufacturer's instruction to prevent any repeat events.

The aircraft operator also advised the Australian Transport Safety Bureau that they are waiting for the slat actuator modification bulletins from the

manufacturer. Until these are received they will continue to send flight data to the aircraft manufacturer for analysis. In return they are receiving advice from the manufacturer on reviewing system faults and troubleshooting to avoid other potential system faults.

SOURCES AND SUBMISSIONS

Sources of information

The sources of information for this investigation included the:

- flight crew of VH-ZHA
- aircraft operator
- recorded flight data
- Airservices Australia
- Civil Aviation Safety Authority
- Aircraft manufacturer
- Slat actuator manufacturer

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to the flight crew, the aircraft operator, the Civil Aviation Safety Authority and Airservices Australia.

A submission was received from the operator. The submission was reviewed and, where considered appropriate, the text of the report was amended accordingly.