

**Saab 2000,
G-LGNO**

**Approx 7nm east of
Sumburgh Airport,
Shetland**

15 December 2014

Serious Incident

Investigation Synopsis

The aircraft was inbound to land on Runway 27 at Sumburgh when the pilots discontinued the approach because of weather to the west of the airport. As the aircraft established on a southerly heading, it was struck by lightning. When the commander made nose-up pitch inputs the aircraft did not respond as he expected. After reaching 4,000 ft amsl the aircraft pitched to a minimum of 19° nose down and exceeded the applicable maximum operating speed (VMO) by 80 kt, with a peak descent rate of 9,500 ft/min. The aircraft started to climb after reaching a minimum height of 1,100 ft above sea level.

Recorded data showed that the autopilot had remained engaged, contrary to the pilots' understanding, and the pilots' nose-up pitch inputs were countered by the autopilot pitch trim function, which made a nose-down pitch trim input in order to regain the selected altitude.

Five Safety Recommendations are made relating to the design of the autopilot system and the certification requirements for autopilot systems.

Safety Recommendation 2016-050

Justification

Therefore, the following safety recommendation was made:

Safety Recommendation 2016-050

It is recommended that the European Aviation Safety Agency review the design of the Saab 2000 autopilot system and require modification to ensure that the autopilot does not create a potential hazard when the flight crew applies an override force to the flight controls.

Date Safety Recommendation made: 30 August 2016

LATEST RESPONSE

Response received: 07 February 2017

The European Aviation Safety Agency has performed a preliminary review of the design of the Saab 2000 autopilot system, together with a review of the in-service experience of the Saab 2000 and a benchmark of the other certified autopilot systems, in light of the Loganair incident and associated investigation report. While it was found that some simple improvements to the design could possibly further enhance safety and should be further evaluated in cooperation with the TC holder, it is not believed that an extensive change such as enabling autopilot disengagement by pilot input force on the control column would be commensurate.

Safety Recommendation Status **Closed**

AAIB Assessment **Partially Adequate**

Action Status

Feedback rationale

(EU Regulation 996/2010 article 18 refers).

RESPONSE HISTORY

N/A

(SRIS Reference: GB.SIA-2016-0050)

Safety Recommendation 2016-051

Justification

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Therefore, the following safety recommendation was made:

Safety Recommendation 2016-051

It is recommended that the European Aviation Safety Agency review the autopilot system designs of aircraft certified under part 25 or equivalent regulations and require modification if necessary to ensure that the autopilot does not create a potential hazard when the flight crew applies an override force to the flight controls.

Date Safety Recommendation made: 30 August 2016

LATEST RESPONSE

Response received: 25 April 2022

The European Union Aviation Safety Agency (EASA) has reviewed the current autopilot designs certified by EASA, and the history of similar events among the large transport aeroplanes fleet to assess the risks associated with the current designs.

The review process has led to the publication of Airworthiness Directive 2018-0240 (as recommended by Safety Recommendation UNKG-2016-050) related to SAAB 2000. Additionally, Acceptable Means of Compliance (AMC) 25.1329 has been amended (as recommended by Safety Recommendation UNKG-2016-054).

Apart from these actions, EASA could not identify other European Union design that is susceptible to the same situation, and which would require any change.

Since the analysis commenced before the United Kingdom (UK) left the European Union (Brexit), it initially included British designs. The review of the BAe 146 led the Civil Aviation Authority of the UK to issue on Feb 2022 the Airworthiness Directive (AD) number G-2022-0002, which was adopted by EASA and published at the following link: <https://ad.easa.europa.eu/ad/G-2022-0002>.

The AD mandates the application of Service Bulletin (SB) 22-072-36262A (initial issue dated 14 September 2021) which introduce a modification to the autopilot disconnect logic to ensure disconnection when the electric pitch trim switch on either pilot control wheel is operated and thus prevent the potential unsafe condition.

Safety Recommendation Status Closed

AAIB Assessment Adequate

Action Status Planned Action Completed

Feedback rationale

(EU Regulation 996/2010 article 18 refers).

RESPONSE HISTORY

Response received: 26 October 2021

The European Union Aviation Safety Agency (EASA) has reviewed the current autopilot EASA certified designs, and the history of similar events among the large transport aeroplanes fleet to assess the risks associated with the current designs.

The review encompassed all the large aeroplane designs certified by EASA as the primary certification authority, and it showed that apart from the SAAB 2000, there is no other European Union design that is susceptible to the same situation and which would require any change.

Regarding the SAAB 2000, the review process has led to the publication of Airworthiness Directive 2018-0240 (as recommended by Safety Recommendation UNKG-2016-050). Additionally, Acceptable Means of Compliance (AMC) 25.1329 has been amended (as recommended by Safety Recommendation UNKG-2016-054).

Since the analysis commenced before Brexit, it initially included British designs. The review of the BAe 146 is the only one for which the assessment is not yet concluded (discussions with the CAA UK are still ongoing).

AAIB Assessment – Adequate Closed

Response received: 20 December 2016

The Agency is currently reviewing the history of similar events on the large transport aeroplane fleet to assess the risks associated with the current autopilot system design. The need of the review will be evaluated based on the outcome of the above mentioned assessment.

AAIB Assessment – Partially Adequate Open

(SRIS Reference: GB.SIA-2016-0051)

Safety Recommendation 2016-052

Justification

Therefore, the following safety recommendation was made:

Safety Recommendation 2016-052

It is recommended that the Federal Aviation Administration review the autopilot system designs of aeroplanes certificated to Federal Aviation Regulation Part 25 and require modification if necessary to ensure that the autopilot does not create a potential hazard when the flight crew applies an override force to the flight controls.

Date Safety Recommendation made: 30 August 2016

LATEST RESPONSE

Response received: 29 December 2016

The FAA evaluated the autopilot system designs of airplanes certified to Title 14, Code of Federal Regulations (14 CFR) Part 25. The FAA is unaware of any transport category airplanes, besides the SAAB 2000 airplane, that does not include one or more of the following features: automatic autopilot disengagement during a force override; automatic autopilot disengagement during main pitch trim switch operation; or a cut-out system (which either stops trimming or disengages the autopilot when it detects manual control inputs opposing the trim commands).

The autopilot systems with one or more of the design features mentioned above, along with the appropriate alerting, have been shown to comply with 14 CFR 25.1329, Flight guidance system, paragraph (1) of amendment 25-119, and meet either advisory circular (AC)25.1329-1 B or 25.1329-1 C for a pitch control input override of the autopilot similar to the scenario of the subject event. In response to several autopilot override incidents in the 1990's, which resulted in National Transportation Safety Board Safety Recommendations A-99-041 through A-99-043, improvements were made to 14 CFR 25.1329 at amendment 25-119 and related guidance.

Certain airplanes were modified to comply with the latest amendment of the regulation and meet the associated AC by including one or more of the design features listed earlier. As a result, the FAA believes all autopilot systems installed in transport category airplanes, in the current U.S. fleet, meet the latest requirements except for the SAAB 2000 airplane.

The actions to review and require modification of the SAAB 2000 airplane's autopilot system were assigned to the European Aviation Safety Agency (EASA), as the State of Design for the aircraft, in AAIB's safety recommendation 2016-050. EASA continues its efforts to address the recommendation. Upon completion of EASA action, the FAA will consider corresponding action, if necessary, for all U.S.-registered SAAB 2000 airplanes.

Safety Recommendation Status Closed

AAIB Assessment Adequate

Action Status**Feedback rationale**

(EU Regulation 996/2010 article 18 refers).

RESPONSE HISTORY

Response received: 29 December 2016

The FAA is reviewing these recommendations and evaluating the autopilot system designs, as well as our guidance provided within Advisory Circular 25.1329-1C to determine the best course of action. I expect to provide an updated response to these recommendations by July 31, 2017.

AAIB Assessment – Partially Adequate Open

(SRIS Reference: GB.SIA-2016-0052)

Safety Recommendation 2016-053

Justification

Therefore, the following safety recommendation was made:

Safety Recommendation 2016-053

It is recommended that the Federal Aviation Administration amend Advisory Circular 25.1329-1C to ensure that requirement 25.1329(I) can only be met if the autopilot automatically disengages when the flight crew applies a significant override force to the flight controls and the auto-trim system does not oppose the flight crew's inputs.

Date Safety Recommendation made: 30 August 2016

LATEST RESPONSE

Response received: 02 August 2022

The FAA's Aircraft Certification Service continues to prepare Advisory Circular (AC) 25.1329-1C, Change 2, Approval of Flight Guidance Systems, for public review and comment, which is anticipated to be completed by the first quarter of Calendar Year 2023. Once the publication of the AC is finalized, we believe it will effectively address the AAIB's safety recommendation. We anticipate providing an update to this safety recommendation by August 31, 2023.

Safety Recommendation Status Open

AAIB Assessment Partially Adequate

Action Status Planned Action Ongoing Update Due 23 August 2023

Feedback rationale

The AAIB notes that planned action is ongoing and awaits an update by 31 August 2023.

RESPONSE HISTORY

Response received: 09 February 2022

The FAA's Aircraft Certification Service, Transport Airplane Directorate, has completed its internal review of Advisory Circular 25.1329-1C (AC), Approval of Flight Guidance Systems, and determined that a revision is necessary. As a result, the FAA is preparing for public review and comment of AC 25.1329-1C, Change 2, which includes an update of section 30.b.(2)(a), Override of the Flight Guidance System, that clarifies that during sustained application of an override force, the automatic trim should not run to oppose the flightcrew commands in any manner that would result in unacceptable airplane motion.

Additionally, the FAA coordinated AC 25.1329-1C, Change 2, with the European Union Aviation Safety Agency (EASA). EASA also included the proposed changes into their Notice of Proposed Amendment (NPA) 2020-01, which were recently incorporated and released in Certification Specifications (CS) 25,

Large Airplanes, Amendment 26, Acceptable Means of Compliance (AMC) to CS 25.1329.

The FAA believe that once the public review and comment period is completed, the publication of AC 25.1329-1C, Change 2, will effectively address the AAIB's safety recommendation.

The FAA anticipate providing an update to this safety recommendation by December 31, 2022.

AAIB Assessment – Partially Adequate Open

Response received: 15 August 2020

As discussed in our April 27, 2018, letter, the FAA's Aircraft Certification Service, Transport Airplane Directorate, completed the technical draft of revised Advisory Circular (AC) 25.1329-1C. Currently, the AC is on hold pending review under new United States Department of Transportation (DOT), guidelines, which requires additional DOT review of guidance material DOT determines to be significant. Once the DOT review is complete, the AC will be made available to the general public for comment, then it will be published.

We anticipate providing an updated response to this safety recommendation by June 2020.

AAIB Assessment – Partially Adequate Open

Response received: 27 April 2018

The FAA's Aircraft Certification Service, Transport Airplane Directorate is continuing the process of incorporating a clarification into Advisory Circular (AC) 25.1329-1C. The clarification is applicable to autopilot systems without automatic disengagement, to clarify that during sustained application of an override force, the automatic trim should not run to oppose the override of the autopilot by the flight crew. This information is currently provided in the AC, for autopilot systems with automatic disengagement, but was inadvertently not included for autopilot systems without automatic disengagement. The clarification makes the AC's guidance more consistent with the requirements for automatic flight guidance and control systems, and equipment specified in Technical Standard Order C198/RTCA DO-325.

We expect to provide an updated response to this safety recommendation by November, 1 2018.

AAIB Assessment – Partially Adequate Open

Response received: 29 September 2017

The FAA reviewed the guidance provided in AC 25.1329-1 C and have plans to update it. The AAIB's recommendation is consistent with control system designs used on modern fly-by-wire airplanes, which disengage the autopilot during a flight crew override, and do not permit the flight crew inputs to have an effect until the autopilot system is disengaged.

However, this may not be feasible for autopilot modifications and installations on derivative or legacy airplanes. Also, the recommended guidance is not the only means to ensure the autopilot does not create a potential hazard when the flight crew applies an override force to the controls (i.e., compliance to 14 CFR 25.1329(1)), as demonstrated by autopilot systems with the design features like those listed above in our response to recommendation 16.119. The FAA agrees the automatic trim should not run to oppose the flight crew override of the autopilot system that would result in an unacceptable airplane motion. This guidance is currently provided in AC 25 .1 329-1 C for autopilot systems with automatic disengagement, but was not included for autopilot systems without automatic disengagement. Therefore, the FAA plans to

update AC 25.1329-1 C to provide similar guidance for systems without automatic disengagement. This update will also make the AC more consistent with Technical Standard Order C 198, "Automatic Flight Guidance and Control System Equipment," and RTCA DO-325, "Minimum Operational Performance Standards (MOPS) for Automatic Flight Guidance and Control Systems and Equipment."

Therefore, the FAA does not intend to limit the guidance in the revised AC 25.1329-1 C to the method of compliance for 14 CFR 25.1329(1) recommended in the AAIB's recommendation. However, the planned update to AC 25.1329-1 C will effectively address the AAIB's intent of recommendation 16.120, which the FAA believes, is to preserve the flight crews manual flight control of an airplane, over that of its autopilot and automatic trim systems.

AAIB Assessment – Adequate Closed

Response received: 29 December 2016

The FAA is reviewing these recommendations and evaluating the autopilot system designs, as well as our guidance provided within Advisory Circular 25.1329-1C to determine the best course of action. I expect to provide an updated response to these recommendations by July 31, 2017.

AAIB Assessment – Partially Adequate Open

(SRIS Reference: GB.SIA-2016-0053)

Safety Recommendation 2016-054

Justification

Therefore, the following safety recommendation was made:

Safety Recommendation 2016-054

It is recommended that the European Aviation Safety Agency amend the Acceptable Means of Compliance for Certification Specification 25.1329 to ensure that requirement 25.1329(l) can only be met if the autopilot automatically disengages when the flight crew applies a significant override force to the flight controls and the auto-trim system does not oppose the flight crew's inputs.

Date Safety Recommendation made: 30 August 2016

LATEST RESPONSE

Response received: 20 May 2021

The European Union Aviation Safety Agency (EASA) has published the Certification Specifications (CS) and Acceptable Means of Compliance (AMC) for Large Aeroplanes CS-25 - Amendment 26, amending AMC 25.1329. Paragraph 8.4.1 - Autopilot, 2.a, states the following:

"The sustained application of an override force should not result in a potential hazard when the flight crew manually disengages the autopilot or abruptly releases the force on the controls. During sustained application of an override force, the automatic trim should not run to oppose the flight crew commands in any manner that would result in unacceptable aeroplane motion. Mitigation may be accomplished through provision of an appropriate alert and flight crew procedure.

NOTE: The term 'sustained application of override force' is intended to describe a force that is applied to the controls, which may be small, slow, and sustained for some period of time. This may be due to an inadvertent crew action or may be an intentional crew action meant to 'assist' the autopilot in a particular manoeuvre."

The philosophy of accepting alerts and procedures as an alternative to automatic autopilot disengagement is based on cases where the autopilot design provides no disconnection triggered by force sensors. In these cases, it has to be demonstrated that the alert is appropriate (ensuring that the mistrim is not too high when it is triggered and can be recovered safely applying the procedure) and also that it is efficient and sufficiently alerting.

Safety Recommendation Status Open

AAIB Assessment Not Adequate

Action Status Not Enough Information

Feedback rationale

The referenced amendment contains the caveat "Mitigation may be accomplished through provision of an appropriate alert and flight crew procedure". The effect of this caveat is that autopilots with the same

undesirable characteristics as the occurrence aircraft (namely that neither override force nor trim operation cause autopilot disconnection) could still be approved if the aircraft is fitted with an alerting system relevant to the condition and a flight crew procedure to address the resulting circumstances. The occurrence involving G-LGNO showed that neither alerting systems nor the existence of a flight crew procedure are sufficient to overcome the normal, foreseeable and instinctive reactions of human operators to unexpected flight control behaviour or unintended flight path changes. The AAIB report highlighted that, following previous fatal and non-fatal accidents in similar circumstances, regulators required modification to the autopilot design of the types involved so that force override or trim operation returned control to the human pilot. All aircraft other than the Saab 2000 certified to CS-25 or equivalent standards, identified by the AAIB during its investigation, conform to that principle. There seems no evidential basis or technological need to allow a demonstrably less safe means of compliance with CS-25.1329, and to do so appears retrograde compared to previous regulatory responses in this area. The AAIB invites the EASA to reconsider its response, ensuring that requirement 25.1329(l) can only be met if the autopilot automatically disengages when the flight crew applies a significant override force to the flight controls and the auto-trim system does not oppose the flight crew's inputs.

RESPONSE HISTORY

Response received: 20 December 2016

The Agency will contact the FAA to jointly assess the safety issue highlighted by this safety recommendation.

AAIB Assessment – Partially Adequate Open

(SRIS Reference: GB.SIA-2016-0054)