



Federal Aviation Administration

Memorandum

Date: [June 21, 2016](#)

To: Manager, New York ACO, ANE-170

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Leung Lee, ANE-171

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for Flight Control System Failure Criteria on Models BD-700-2A12 and -2A13 airplanes, FAA Project #s AT7180NY-T\AT7285NY-T

ELOS Memo #: AT7180NY-T-CL-SM-02

Regulatory Ref: Title 14, Code of Federal Regulations, (14 CFR) §21.21 (b), 25.671, 25.1309

This memorandum informs the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate (TAD) on the establishment of an equivalent level of safety (ELOS) finding for the Bombardier Inc. Models BD-700-2A12 and -2A13 airplanes.

Background

The Bombardier Inc. Models BD-700-2A12 and -2A13 airplanes must be shown capable of continued safe flight and landing, without requiring exceptional piloting skill or strength, for single failures and certain combinations of failures not shown to be extremely improbable. The requirements for consideration of failure conditions in the flight control systems are covered specifically by Title 14, Code of Federal Regulations (14 CFR) Part 25 Section 25.671 and in general by Section 25.1309.

For certification of Models BD-700-2A12 and -2A13 airplanes, Bombardier Inc. has requested an equivalent level of safety finding (ELOS) to the requirements of §25.671 at Amendment 25-23 based on a proposal from the Aviation Rulemaking Advisory Committee (ARAC), which provides requirements on general control system design and functionality, as well as guidelines on what should be an acceptable risk level after the occurrence of any single failures in the flight control system, combinations of failures in the flight control system or adjacent systems, and after certain control jams. The use of ARAC recommendations in lieu of current 14 CFR regulations is allowed per the terms described in the policy letter 00-113-1034 and Notice of

Availability dated April 29, 2003. The ARAC Flight Controls Harmonization Working Group (FCHWG) recommendations pertaining to §25.671 are considered to be an improvement of the existing 14 CFR §25.671 requirements.

Applicable regulation(s)

§21.21 (b), 25.671, 25.1309

Regulation(s) requiring an ELOS finding

§ 25.671 at Amendment 25-23

Description of compensating design features or alternative standards which allow the granting of the ELOS finding (including design changes, limitations or equipment need for equivalency)

Bombardier Inc. determined to use § 25.671(a), (b), (c)(1), and (d) as proposed by the FCHWG in their report to the Transport Airplane and Engine Issues Group (TAEIG), along with the use of the associated AC guidance proposed in that report, in lieu of 14 CFR 25.671(a), (b), (c)(1), and (d) at amendment level 25-23. Further, Bombardier Inc. also used § 25.671(c)(3) and (c)(4) as proposed by the FCHWG, along with the use of the associated proposed AC guidance, in lieu of 14 CFR 25.671(c)(3) at amendment level 25-23.

Regarding § 25.671(c)(2), the FCHWG report to the TAEIG proposed the following:

- I. The airplane must be shown to be capable of continued safe flight and landing after -
“Any combination of failures not shown to be extremely improbable. Furthermore, in the presence of any single failure in the flight control system, any additional failure states that could prevent continued safe flight and landing shall have a combined probability of less than 1 in 1000.”

The FAA believes that by adopting a clear definition of acceptable risk level for subsequent failures, the proposed approach has the advantage of 1) addressing latency, and 2) eliminating possible dubious judgments in the determination of probable failures. However, it is not evident that this is sufficient to provide an equivalent level of safety to the existing § 25.671(c)(2).

Therefore, the FAA proposes the following additional criteria:

- II. Failure conditions that are classified as catastrophic and that occur as a result of two failures, either of which are latent, must be highlighted in the system safety assessment, subject to review by the FAA. This review will ensure that any such failure conditions are, in fact, extremely improbable by assessing 1) the failure rates and service history of each component, 2) the inspection type and interval for any component whose failure would be latent, and 3) any possible common cause or cascading failure modes.

The criteria was derived from guidance material developed by ARAC for use in the proposed revision to AC 25.1309. All significant latent failures involved in hazardous and catastrophic conditions will be identified and recorded in the system level safety analysis.

Explanation of how design features or alternative standards provide an ELOS to that intended by the regulation

The Flight Controls Harmonization Working Group (FCHWG) recommendations pertaining to § 25.671 are considered to be an improvement of the existing 14 CFR 25.671 requirements, without significant additional compliance costs for the applicant and with the benefit of clearer FAA/EASA harmonized guidance. The ARAC FCHWG report provides requirements on general control system design and functionality, as well as acceptable risk level after the occurrence of single failures in the flight control system, combinations of failures in the flight control system or adjacent systems, and after certain control jams. Additionally, it contains two new requirements that address mode change awareness and control surface position awareness.

For the additional requirements for § 25.671 (c)(2), by adopting a clear definition of acceptable risk level for subsequent failures, the proposed approach has the advantage of 1)addressing latency, and 2) eliminating possible dubious judgements in the determination of probable failures.

The FAA considers that the use of § 25.671(a), (b), (c)(1), (c)(3), (c)(4), and (d) proposed by the FCHWG, plus the combined approach (paragraph I. and II. above) for § 25.671(c)(2), will provide an equivalent level of safety to the requirements of § 25.671.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned ELOS finding in project Issue Paper CL-SM-02 titled Flight Control System Failure Criteria. This memorandum provides standardized documentation of the ELOS finding that is non-proprietary and can be made available to the public. The TAD has assigned a unique ELOS memorandum number (see front page) to facilitate archiving and retrieval of this ELOS. This ELOS memorandum number should be listed in the type certificate data sheet under the Certification Basis section in accordance with the statement below:

Equivalent Level of Safety Findings have been made for the following regulation(s):
§ 25.671 at Amendment 25-23 Control Systems
(documented in TAD ELOS Memorandum AT7180NY-T-CL-SM-02)

Original signed by Jon Regimbal

June 21, 2016

Transport Airplane Directorate,
Aircraft Certification Service

Date

ELOS Originated by NYACO	ACO Manager Gaetano Sciortino	Routing Symbol ANE-170
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