Federal Aviation Administration

Memorandum

Date: May 16, 2013

To: Manager, Transport Standards Staff, International Branch, ANM-116

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Robert Jones, ANM-112

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for flight control system failure criteria on Airbus Model A350 series airplanes, FAA Project Number TC0544IB-T.

ELOS Memo #: TC0544IB-T-SF-5

Reg. Ref.: § 25.671(c)(2)

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 Airbus Model A350 aircraft.

Background

Title 14, Code of Federal Regulations (14 CFR) section 25.671(c)(2) requires that the airplane is shown to be capable of continued safe flight and landing after "Any combination of failures not shown to be extremely improbable, excluding jamming (for example, dual electrical or hydraulic system failures, or any single failure in combination with any probable hydraulic or electrical failure)."

Airbus has proposed an ELOS finding to the requirements of § 25.671(c)(2) based on a proposal from the Aviation Rulemaking Advisory Committee (ARAC). The ARAC proposal provides guidelines on what should be an acceptable risk level after the occurrence of any single failure in the flight control system.

Applicable regulations

§§ 25.671(c)(2), 25.1309

Regulation requiring an ELOS finding
§ 25.671(c)(2).

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)

Airbus will demonstrate compliance of the Model A350 airplane flight control system and equipment with 14 CFR 25.671(c)(2), Amendment 25-114, by following the draft harmonized set of Failure Condition criteria for the flight control system, recommended by the ARAC, for coverage of combinations of failures which are not shown to be Extremely Improbable, addressed by § 25.671(c)(2). The draft harmonized rule states:

"§ 25.671(c). The airplane must be shown by analysis, test, or both, to be capable of continued safe flight and landing after any of the following failures, including jamming, in the flight control system and surfaces (including trim, lift, drag, and feel systems) within the normal flight envelope, without requiring exceptional piloting skill or strength. Probable failures must have only minor effects and must be capable of being readily counteracted by the pilot.
….
(2) 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. This paragraph excludes failures of the type defined in (c)(3)."

Compliance with the draft harmonized § 25.671(c)(2) rule will be documented in the Model A350 systems safety assessment document. The combined probability of less than 1 in 1000 criteria for latent failures will also be addressed in the Model A350 Common Data Document.

In addition to above, the following summarizes the additional steps proposed for the safety analysis:

1) The Model A350 flight control system safety assessments will highlight all significant latent failures that could leave the airplane one failure away from a catastrophic failure condition.

2) During the final system safety assessment review with the authorities, Airbus will highlight the maintenance aspects, failure rates, common cause/cascading failure analysis and significant latent failures.

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

Paragraph § 25.671(c)(2), as proposed by the ARAC Recommendation provides a definition of acceptable risk level for subsequent failures. The FAA accepts this

definition of acceptable risk level for subsequent failures; however, the FAA does not agree that this definition by itself is sufficient to provide an equivalent level of safety to the existing § 25.671(c)(2). Therefore, the following criteria are added:

> Failure conditions that are classified as catastrophic and that occur as a result of two failures, either of which is 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 the failure rates and service history of each component, the inspection type and interval for any component whose failure would be latent, and any possible common cause or cascading failure modes.

These criteria are derived from guidance material recently developed by ARAC for use in the proposed revision to Advisory Circular (AC) 25.1309. This guidance states, "The use of periodic maintenance or flight crew checks to detect significant latent failures when they occur is undesirable and should not be used in lieu of practical and reliable failure monitoring and indications. Where this is not accomplished, the system safety assessment should highlight all those significant latent failures that leave the airplane one failure away from a failure condition classified as catastrophic. These cases should be discussed with the FAA as early as possible after identification."

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned ELOS finding in project issue paper SF-5, 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 finding. This ELOS memorandum number should be listed in the type certificate data sheet under the Certification Basis section in accordance with the statement below:

ELOS Findings have been made for the following regulation:
§ 25.671(c)(2), General; (documented in TAD ELOS Memo TC0544IB-T-SF-5).

Original signed by
Victor Wicklund May 22, 2013

Transport Airplane Directorate Date
Aircraft Certification Service

ELOS Originated by Transport Standards Staff:	Project Engineer: Robert C. Jones	Routing Symbol: ANM-112