



Federal Aviation Administration

Memorandum

Date: May 18, 2015

To: Ross Landes, Manager, Seattle ACO, ANM-100S

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Caspar Wang, ANM-150S

Subject: Equivalent Level of Safety (ELOS) Finding for Use of Analysis in Lieu of Flight Testing in Measured Natural Icing Conditions on a Boeing Model 737-900 airplane, FAA Project No. SA12514SE-T

ELOS Memo #: SA12514SE-T-G-6-1

Regulatory Ref: § 25.1419(b) at Amendment 25-121

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 Boeing Model 737-900 airplane.

Background

Aviation Partners Boeing (APB) has made application to install their Split Scimitar Winglet (SSW) on the Boeing 737-900 Series airplane. APB's Split Scimitar Winglet may affect the airplanes' known ice protection analysis, may introduce icing anomalies, and may have an impact on the known effectiveness of the ice protection system and its components.

The regulatory requirements of Title 14, Code of Federal Regulations (14 CFR) part 25 at Amendment 25-121 ensure that the design is safe regarding these concerns. Section 25.1419(a) requires an analysis to establish that the ice protection for the various components of the airplane is adequate. To verify the ice protection analysis, § 25.1419(b) requires flight testing in measured natural icing conditions and, as found necessary, by one or more of the following means:

- (1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components.
- (2) Flight dry air tests of the ice protection system as a whole, or of its individual components.
- (3) Flight tests of the airplane or its components in measured simulated icing conditions.

APB has proposed methods of compliance that provide for an ELOS to the § 25.1419(b) Amendment 25-121 regulatory requirements.

Applicable Regulations:

§ 25 .1419(b) at Amendment 25-121

Regulations Requiring an ELOS Finding:

§ 25 .1419(b) at Amendment 25-121

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)

The APB Blended Split Winglet, similar to the original Blended Winglet, incorporates (1) a new Scimitar shaped tip cap, (2) a new downward oriented ventral fin assembly, and (3) a new trailing edge wedge to the lower inboard surface of the winglet. Typically, equivalent levels of safety findings are granted based upon compensating factors in the design. In this case, the design has not been changed to incorporate compensating factors, however, the tools used to verify analysis have improved since the regulation was implemented, and provided that a sufficiently conservative analysis is performed, use of these tools may be an acceptable substitute for flight testing in measured natural atmospheric icing conditions. In order to substantiate the ELOS, APB will show that their analysis along with the validation methodology provide a suitable alternative to flight testing in measured natural atmospheric icing conditions.

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

The shape and texture of artificial ice shapes will be developed and substantiated using methods found acceptable to the FAA. APB will use conservative computer codes for droplet impingement limits and ice shape predictions for the split scimitar winglet and also verify that previous icing related analysis performed on the baseline airplane are still appropriate as applicable. These methods will be shown to be conservative and address the icing conditions of 14 CFR Part 25 appendix C, that are critical to the airplane's performance and handling qualities. Subsequent flight testing with these conservative artificial ice shapes will be conducted to determine the effects of ice accretions on airplane performance and handling characteristics. Results of these tests may be used in preparing specific airplane flight manual supplemental operating procedures and limitations for flight in icing conditions.

FAA approval and documentation of the ELOS finding:

The FAA has approved the aforementioned ELOS finding in project Issue Paper G-6. 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 achieving and retrieval of this ELOS. This ELOS memorandum number must be listed in the limitations and conditions section of the supplemental type certificate. An example of an appropriate statement is provided below.

Equivalent Level of Safety Findings has been made for the following regulations:

14 CFR 25.1419(b) Amendment 25-121 (documented in ELOS Memo SA12514SE-T-G-6-1)

Original Signed by

Victor Wicklund

Transport Airplane Directorate,
Aircraft Certification Service

July 15, 2015

Date

ELOS Originated by ACO:	ACO Manager (or Project Engineer for ANM-116):	Routing Symbol:
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