



Federal Aviation Administration

Memorandum

Date: March 3, 2011

To: Manager, Seattle Aircraft Certification Office, ANM-100S

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Marcia Smith, ANM-150S

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for the Boeing Model 737-300 Airplane with Aviation Partners Boeing (APB) Winglets for Use of Analysis to Demonstrate Safe Flight in Icing Conditions (FAA Project No. SA6508SE-T)

ELOS Memo#.: SA6508SE-T-S-1

Reg. Ref.: §§ 21.21(b)(1) and 25.1419

The purpose of this memorandum is to inform 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 737-300 airplane equipped with Aviation Partners Boeing (APB) winglets.

Background

Aviation Partners Boeing (APB) has submitted a request for an ELOS finding to Title 14, Code of Federal Regulations (14 CFR) 25.1419 for the Model 737-300 airplane equipped with winglets to allow use of analysis only in lieu of analysis and flight testing in measured natural atmospheric icing conditions to demonstrate safe flight in icing conditions.

Section 25.1419 identifies certification requirements for operation in icing conditions. Section 25.1419(a) requires analysis to establish that the ice protection for the various airplane components is adequate considering the various airplane operational configurations. Section 25.1419(b) requires flight testing in measured natural atmospheric icing conditions to verify the analysis, to check for icing anomalies, and to demonstrate that the ice protection system and its components are effective. Section 25.1419(b) also requires additional laboratory and flight testing as needed. Typically, analysis is conducted to predict the ice shapes that will form on unprotected surfaces. Dry air flight testing is then conducted with predicted artificial ice shapes to evaluate airplane performance and handling characteristics. Flight testing in measured natural

atmospheric icing conditions is performed to confirm that analysis correctly predicted the artificial ice shape used in the dry air flight test.

Advisory Circular (AC) 25.1419-1, paragraph 3.f, allows use of similarity analysis in lieu of flight testing if the applicant can show that the proposed configuration is sufficiently similar to a configuration which was previously flight tested. However, the installation of the winglets on the 737-300 results in a configuration that differs significantly from past configurations and as such, use of analysis alone would require FAA approval of an ELOS.

Applicable regulation(s)

§§ 21.21(b)(1) and 25.1419

Regulation(s) requiring an ELOS finding

§§ 25.1419

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

The APB winglet is a highly swept, non-deiced surface attached at the wing tip, similar to wingtips previously certified on the 737-300IGW, 737-800, and 737-700 airplanes. Flight testing on past projects has shown that addition of winglets can result in improved handling and performance characteristics, or as a minimum, no decrement to the airplane handling and performance characteristics. Typically, ELOS findings are granted based on compensating factors in design. In this case, the design was not changed, however the tools used to verify analysis have improved since the regulation was implemented. Provided that a sufficiently conservative analysis is performed, use of analytical methods may, in part, be an acceptable substitute for flight testing in measured natural atmospheric icing conditions in order to establish the small incremental differences between the baseline airplane configuration, and the winglet equipped airplane. In order to substantiate the ELOS, APB will show the analysis along with the validation methodology provide a suitable alternative to flight testing in measured atmospheric icing conditions.

Explanation of how design features or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation

The FAA considered the winglet-equipped 737-300 design, and determined that an ELOS for § 25.1419 can be granted to allow use of analysis in lieu of flight testing in measured natural atmospheric icing conditions. The analysis provided by APB will show that there is little direct lift generated by the winglet, that the winglet is not operated near maximum lift, and that the ice accretion shape has little effect on airplane handling unless the winglet is operating at or near the winglet's maximum lift. The analysis will also show that the drag increase resulting from the contaminated winglets does not exceed the wing drag benefit resulting from the uncontaminated winglets. In addition, APB will show that the contaminated winglets do not stall within the normal operations envelope with expected sideslip, yaw, and sideslip and yaw rates. APB analysis will also address potential flutter concerns. The FAA has determined that the conservatism of the analysis

regarding the effect of the winglet ice shapes on airplane handling and performance serves as a compensating factor and an acceptable alternative to flight testing in measured natural atmospheric icing conditions.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned ELOS in project Issue Paper S-1. This memorandum provides standardized documentation of the ELOS 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 limitations and conditions section of the STC. An example of an appropriate statement is provided below.

Equivalent Level of Safety Findings has been made for the following regulation:
§ 25.1419 (documented in TAD ELOS Memo SA6508SE-T-S-1)



Manager, Transport Airplane Directorate,
Aircraft Certification Service

MARCH 17, 2011

Date

ELOS Originated by Seattle ACO:	Project Engineer Don Eiford	Routing Symbol ANM-150S
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