**Federal Aviation Administration**

# Memorandum

Date: January 4, 2011

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

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Joe Jacobsen, ANM-111

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for the Airbus Model A350 series, Reduced Margins between $V_{MU}$ and $V_{LOF}$ for Geometry Limited Airplanes (FAA Project Number TC0544IB-T)

ELOS Memo#.: TC0544IB-T-F-13

Reg. Ref.: § 25.107(e)(1)(iv)

This memorandum informs the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate on the establishment of an equivalent level of safety finding for the Airbus Model A350 aircraft.

**Background**

Airbus has requested, by letter to the FAA dated November 25, 2008, the use of a recommendation for a rule and advisory material change by the Flight Test Harmonization Working Group (FTHWG) to Section 25.107(e)(1)(iv), as developed in "The Fast Track Harmonization Program," for certification of the A350 airplane. This proposed change allows the use of reduced margins between the takeoff rotation speed, $V_R$, and the liftoff speed, $V_{LOF}$, for geometry limited airplanes.

**Applicable regulation**
§ 25.107(e)(1)(iv)

**Regulation requiring an ELOS finding**
§ 25.107(e)(1)(iv)

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

Based on the recommendation for a rule and advisory material change of the FTHWG, as presented in the ARAC Working Group Report and discussed below, the following apply:

14 CFR 25.107(e)(1)(iv) A speed that, if the airplane is rotated at its maximum practicable rate, will result in a $V_{LOF}$ of not less than –

(A) 110 percent of $V_{MU}$ in the all-engines-operating condition, and 105 percent of $V_{MU}$ determined at the thrust-to-weight ratio corresponding to the one-engine-inoperative condition; or

(B) If $V_{MU}$ is limited by the geometry of the airplane (i.e., tail contact with the runway), 108 percent of $V_{MU}$ in the all-engines-operating condition and 104 percent of $V_{MU}$ determined at the thrust-to-weight ratio corresponding to the one-engine-inoperative condition.

In conjunction with the above rule change to Section 25.107(e)(1)(iv), the advisory material contained in the Flight Test Guide, Chapter 2., Section 2., Paragraph 10(b)(5)(viii), which pertains to VMU testing for geometry limited airplanes, should be replaced with the following:

(viii) $V_{MU}$ Testing for Geometry Limited Airplanes.

(A) For airplanes that are geometry limited (i.e., the minimum possible $V_{MU}$ speeds are limited by tail contact with the runway), § 25.107(e)(1)(iv)(B) allows the $V_{MU}$ to $V_{LOF}$ speed margins to be reduced to 108 percent and 104 percent for the all-engines-operating and one-engine-inoperative conditions, respectively. The $V_{MU}$ demonstrated must be sound and repeatable.

(B) One acceptable means for demonstrating compliance with §§ 25.107(d) and 25.107(e)(1)(iv) with respect to the capability for a safe liftoff and fly-away from the geometry limited condition is to show that at the lowest thrust-to-weight ratio for the all-engines-operating condition:

(1) During the speed range from 96 to 100 percent of the actual liftoff speed, the aft under-surface of the airplane should be in contact with the runway. Because of the dynamic nature of the test, it is recognized that contact will probably not be maintained during this entire speed range, and some judgment is necessary. It has been found acceptable for contact to exist approximately 50 percent of the time that the airplane is in this speed range.

(2) Beyond the point of liftoff to a height of 35 ft., the airplane's pitch attitude should not decrease below that at the point of liftoff, nor should the speed increase more than 10 percent.

(3) The horizontal distance from the start of the takeoff to a height of 35 feet should not be greater than 105 percent of the distance determined in accordance with § 25.113(a)(2) without the 115 percent factor.

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

Airbus has requested the use of a recommendation for a rule and advisory material change by the Flight Test Harmonization Working Group to Section 25.107(e)(1)(iv), as a basis for an equivalent level of safety finding for the A350 airplane certification. The FAA has offered a procedure to allow the applicant to provide the justification for the equivalent safety finding, or an exemption, for recommended rule and advisory material changes under the "Fast Track Harmonization Program." This option is available provided the following conditions are met:

1. It is requested by the applicant.
2. The ARAC proposal has been forwarded by the Transport Aircraft and Engine Issues Group (TAEIG) to the FAA as a formal recommendation.
3. The ARAC proposal is considered an equivalent or higher level of safety by the FAA or, if not, it is proposed by the applicant in a petition to the FAA for Exemption as being in the public's interest and without adverse affect on safety.

The FAA has reviewed the request for an equivalent safety finding presented by Airbus, and has determined that the recommended rule change to Section 25.107(e)(1)(iv), identified as a Category 3 change, meets the criteria of 1 through 3 above. This decision is based on the recommendation for a rule and advisory material change of the Flight Test Harmonization Working Group (FTHWG) presented in the ARAC Working Group Report as follows:

1. The proposed standard continues to address the underlying safety issue in the same manner as the current regulation, but allows the prescribed minimum speed margin between $V_{MU}$ and $V_{LOF}$ to be reduced if the $V_{MU}$ speed is limited by the geometry of the airplane. In this case, the geometry of the airplane helps to prevent reaching a potentially hazardous pitch attitude at, or shortly after takeoff.

2. Although the proposed standard would allow a reduction in the $V_{MU}$ to $V_{LOF}$ speed margin for certain airplanes, it would maintain the same level of safety relative to that intended by the current standards. The reduced speed margin would apply only to airplanes for which $V_{MU}$ is limited by airplane geometry, such that a hard physical limit (fuselage contact with the runway) protects the airplane from reaching a potentially hazardous takeoff pitch attitude while still on the ground. Since the minimum required speed margin between $V_{MU}$ and $V_{LOF}$ is, in part, intended to reduce the probability for an airplane to reach a takeoff pitch

attitude beyond that which has shown to be safe, the additional protection against such a condition inherent to a geometry-limited airplane would allow the $V_{MU}$ and $V_{LOF}$ speed margin to be reduced while providing the same level of safety. Currently, the FAA allows, by equivalent safety finding, a reduction in the $V_{MU}$ to $V_{LOF}$ speed margin for the all-engines-operating condition. The proposed standard would codify this practice and extend its application to the one-engine-inoperative condition.

3. In conjunction with the above change in regulation, harmonized advisory material is proposed that would provide information on an acceptable means of showing compliance to the proposed standard. While this proposed advisory material is similar to the current guidance provided in AC 25-7A, some changes are being proposed. The most significant proposed change is the deletion of the need for safeguards protecting the geometry limited airplane against over-rotation on the ground and in the air. Simply by virtue of being geometry limited, the airplane is safeguarded from over-rotation on the ground and shortly after liftoff. Once the airplane is no longer in close proximity to the ground, it is not entirely clear what would constitute an "over-rotation." The existing requirements require adequate stall warning to be provided, so that over-rotation to the point of stall is already safeguarded.

4. Another proposed change to the AC 25-7A advisory material is to delete the need for the airplane's pitch attitude to be within 5 percent (in degrees) of the tail dragging attitude during the speed range between 96 and 100 percent of the actual liftoff speed. The intent of this criterion is to ensure that the airplane is actually geometry-limited, and that no unique flight test techniques are being used to attain the geometry-limited condition. Although the intent is a good one, strict compliance with the 5 percent allowed variation in pitch attitude is very difficult to achieve. Instead, the FTHWG considers this intent to be addressed by proposed changes to the criterion that the aft under-surface of the airplane achieves contact with the runway during the speed range between 96 and 100 percent of the actual liftoff speed. The FTHWG proposes that this criterion state that the airplane's aft under-surface should be in contact with the runway during this speed range, not just that runway contact must be made at some point in the speed range. Additional words would be added to clarify that due to the dynamic nature of the test, however, it is recognized that runway contact will probably not be maintained during this entire speed range, and that some judgment is necessary as to whether the airplane is geometry-limited.

5. Lastly, the proposed advisory material clarifies that the condition at which the compliance criteria are evaluated should be the lowest thrust-to-weight ratio for the all-engines-operating condition. This condition is expected to be the most critical condition for demonstrating a safe flyaway capability.

**FAA approval and documentation of the ELOS finding**

The FAA has approved the aforementioned equivalent level of safety finding in project issue paper F-13. This memorandum provides standardized documentation of the ELOS finding that is nonproprietary and can be made available to the public. The Transport Directorate has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrieval of this ELOS. This ELOS Memorandum number must be listed in the Type Certificate Data Sheet under the Certification Basis section (TCs & ATCs) or in the Limitations and Conditions section of the STC. An example of an appropriate statement is provided below.

Equivalent Level of Safety Findings have been made for the following regulation: § 25.107, Takeoff speeds (documented in TAD ELOS Memo TC0544IB-T-F-13)

Manager, Transport Airplane Directorate,
Aircraft Certification Service

1/4/10
Date

| | | |
|---|---|---|
| ELOS Originated by Transport Standards Staff: | Project Engineer<br>*Joe Jacobsen* | Routing Symbol<br>*ANM-111* |