



# Federal Aviation Administration

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## Memorandum

Date: June 16, 2009

To: Manager, Seattle ACO, ANM-100S

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Suk Jang, ANM-130S

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for the Forward Position Light System Installed on Boeing Model 757-200/-300 Airplanes

ELOS Memo#: ST8664SE-T-S-2, Rev. 1

Regulatory Ref: §§ 25.1389(b)(2) and (3), 25.1393, 25.1395

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This memo has been revised to include the applicability of this equivalent level of safety finding to the 757-300 aircraft.

The purpose of this memorandum is to inform 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 Aviation Partners Boeing (APB) winglet-equipped Boeing Model 757-200/300 airplanes.

### **Background**

Aviation Partners Boeing has requested an equivalent safety finding (ESF) to the above referenced requirements. The winglet-equipped 757-200/-300 right forward position light intensities do not meet the minimum intensity requirements specified in §§ 25.1389(b)(2) and 25.1393 from certain viewing angles. Also, left and right forward position light overlapping intensities exceed the maximum allowable overlapping intensities specified by §§ 25.1389(b)(3) and 25.1395 in certain areas.

### **Applicable regulation(s)**

§§ 25.1389(b)(2) and (3), 25.1393, and 25.1395

## **Regulation(s) requiring an ELOS**

§§ 25.1389(b)(2) and (3), 25.1393, and 25.1395

### **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-equipped 757-200/-300 forward position light system consists of red and green dual lamp lights mounted on the left and right wing tips, respectively. This position light system is similar to the earlier 737-700 forward position light system, except that the strobe position light was relocated out of the lens assembly.

Each position light assembly has two independent, high output halogen lamps, to provide functional redundancy in the event of a lamp failure. The lamps are spaced span wise on the leading edge. The outboard lamp is positioned slightly aft of the inboard lamp relative to the fuselage due to the sweep of the wing. Both lamps are housed within an appropriately colored glass cover.

#### Minimum Intensity Level - §§ 25.1389(b)(2) & 25.1393

Section 25.1389(b)(2) specifies that the minimum level of intensity for each position light in the vertical planes must meet § 25.1393 to allow detection of the aircraft at a safe distance and to allow an observing aircraft to detect the relative orientation of the observed aircraft. The forward position lights on the winglet-equipped 757-200-300 are designed to meet the distribution and intensity requirements with both lamps operative or with only one lamp inoperative at any position. However, with the outboard green lamp inoperative, the remaining inboard green lamp does not meet the minimum vertical intensity requirements at dihedral angles of 108.7 to 110 degrees, at angles from 5 to 15 degrees above horizontal. The minimum intensity required for this area is 4.0 cd while the actual was recorded at 2.7 cd, thus resulting in 1.3 cd deficiency which is considered to be very small and in the extreme angle of the requirements.

#### Maximum Intensity in Overlap Areas - §§ 25.1389(b)(3) and 25.1395

Section 25.1389(b)(3) specifies that the maximum overlap between adjacent signals must not exceed the limits of § 25.1395 to provide clarity of observed aircraft position signals. The forward position lights on the winglet equipped 757-200/300 are designed to meet the overlap requirements with both lamps operative or with only one lamp inoperative at any position. Of the possible functional combinations, the following four (4) configurations were found to exceed overlap requirements:

1. Outboard red lamp operative overlap in dihedral angle R, areas A and B
2. Both red lamps operative in dihedral angle R, areas A<sup>(\*)</sup> and B.
3. Inboard green lamp operative in dihedral angle L, area B.

4. Both green lamps operative in dihedral angle L, areas A and B<sup>(\*)</sup>.

Note: “(\*)” denotes the worst-case configuration:

- 1) A<sup>(\*)</sup> - Overlap exceedances in area A occurred between 10 and 14.7 degrees dihedral angle, 36cd per 19cd maximum allowed.
- 2) B<sup>(\*)</sup> - Overlap exceedances in area B occurred between 20 and 22 degrees dihedral angle, 8.2cd per 5.5cd maximum allowed.

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

#### Minimum Intensity Level - §§ 25.1389(b)(2) & 25.1393

The right forward position light intensities exceed the minimum intensity requirement to a very large extent over the majority of the required areas, up to approximately 750% (300cd, actual peak vs. 40cd, minimum requirement). The area affected by the minimum candela requirement in the far right horizontal angle is very small in relation to the total area of the requirements and is compensated for by the large amount of light in the adjacent main area. Geometrically, the identification of the aircraft can be observed from all the required angles, given the motion of the aircraft and the brightness of the main beam of each light.

Accordingly, the APB’s winglet-equipped 757-200/-300 forward position light installation provides a significantly higher level of visual conspicuity than that required by §§ 25.1389(b)(2) and 25.1393, and hence provides the basis for a finding of equivalent level of safety for these regulations.

#### Maximum Intensity in Overlap Areas - §§ 25.1389(b)(3) and 25.1395

The APB’s winglet-equipped 757-200/-300 forward position light does not meet the maximum overlap intensity levels of §§ 25.1389(b)(3) and § 25.1395 but the intensity level of the main beams of the position lights provide much higher intensity brightness than the minimums required by § 25.1391. This high intensity of light provided in the required coverage areas more than compensates for the small intensity exceedances in the overlap areas, with the dual lamp design. The outages for the area ‘A’ for red light is in the transition region at 10 degree dihedral, falling off sharply to 14.7 degree, and the outages for the area ‘B’ for green light is at the threshold areas, 20 - 22 degrees which is considered to be insignificant (8.2cd actual per 5.5cd maximum allowed). The signal intensity margins are considerably higher than the basic intensity requirements of the § 25.1389 and ensure that the main beam color will always be easily perceived.

While the position light installation does not literally comply with the § 25.1395 limits, the signal intensity margins are higher than that required by the regulations, and hence provide a basis for a finding of equivalent safety.

**FAA approval and documentation of the ELOS**

The FAA has approved the aforementioned ELOS findings in issue paper S-2 for APB’s winglet equipped 757-200 certification program (ST8664SE-T) and in issue paper G-5 for APB’s winglet equipped 757-300 certification program (SA10302SE-T). This memorandum provides standardized documentation of the ELOS for both these programs that is non-proprietary and can be made available to the public. The Transport Airplane Directorate 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 Certificate. An example of an appropriate statement is provided below.

Equivalent Safety Findings have been made for the following regulation(s):  
§§ 25.1389(b)(2) and (3), 25.1393, 25.1395 (documented in TAD ELOS Memo ST8664SE-T-S-2).

Original Signed by

*Robert Jones*

June 17, 2009

Manager, Transport Airplane Directorate,  
Aircraft Certification Service

Date

ELOS Originated by Seattle ACO:	Suk Jang	ANM-130S
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