U.S. Department of Transportation
Federal Aviation Administration

Memorandum

Subject:	Action: Review and Concurrence, Equivalent Level of Safety Finding for the Forward Position Light System Installed on the Hawker Model 800XP Model Airplane FAA Project Number SA8841SE-T	Date:	December 21, 2004
		Reg Ref:	§§ 25.1389(b), 25.1391, 25.1393, 25.1395
From:	Manager, Transport Airplane Directorate, ANM-100	Reply to Attn of :	Suk Jang, ANM-130S
To:	Manager, Seattle ACO, ANM-100S	ELOS Memo #:	SA8841SE-T-S-1

Background

Aviation Partners, Inc. (API) has requested an Equivalent Safety Finding (ESF) to the above referenced requirements. The winglet-equipped Hawker 800XP left and right forward position light intensities do not meet the minimum intensity requirements specified in §§25.1389(b)(1) & (b)(2) and §§25.1391 & 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 the following areas:

a) Incursion of the red position light into the inboard Area A and B, and outboard Area B.
b) Incursion of the green position light into the inboard Area A and B, and outboard Area B.

Applicable regulation(s)

§§ 25.1389(b), 25.1391, 25.1393, 25.1395

Regulation(s) requiring an ELOS

§§ 25.1389(b), 25.1391, 25.1393, 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)

Minimum Intensity Level

With regard to the minimum intensity requirements of §§25.1389(b)(1) & (b)(2) and §§25.1391 & 25.1393:

The forward position light installations on the Raytheon (Hawker) 800XP (both left and right) do not meet the minimum required intensity levels of §§25.1389(b)(1) & (b)(2) and §§25.1391 & 25.1393 near the dihedral limit for the forward lights over a very narrow vertical (0 to 15 degrees) azimuth angle at 100 to 110 degrees horizontal. The area where the minimum intensity requirement is not met is less than 1 steradian around the center azimuth line, covering the angles 100 to 110 degrees measured outboard from straight ahead and vertically between approximately 0 and 15 degrees above and below horizontal. The critical vertical angle varies slightly between left and right hand installation, as the green light has more peak light intensity than the red. The total coverage area where the minimum intensity is not met is about 0.91 steradians, which is about 1.52% of the required coverage area.

The position lights, when installed on the subject aircraft, have small outages in comparison to the requirements in the regulations listed above. These outages are manifested in the extreme angle of the requirements, vertically at 0 degrees and horizontally at 110 degrees from the aircraft center.

<u>Intensity in Overlap Areas</u>

With regard to the maximum allowable overlapping angels of §§25.1389(b)(3) and 25.1395:

The photometric analysis shows four outages of overlap for the forward position lights in areas ‘A’ and ‘B’. These outages are very small, compared to the requirements in the regulation and represent only 1 degree of total viewing angle requirements. For the areas where the green and red lights overlap, the position light installation of the Raytheon (Hawker) 800XP maintains positive overlap intensity margin at all dihedral angles, i.e., the main beam signal is always greater than the overlapping signal for all vertical angles between +/- 40 degrees, the smallest positive margin where the overlap measurement exceeds the §§ 25.1395 limit is 51.27 candelas for the red-green overlap area. These signal intensity margins are significantly higher than the basic intensity requirements of the §§25.1389 and ensure that the main beam color will always be easily perceived.

In addition, the coverage areas where the maximum overlap limit is exceeded are limited to 2 degree angles, except for outboard area B where the candela exceedance is less than 1 candela and where the target airplane would not likely be visible to the other flight crew.

Area ‘B’ for both the red and green lights have minor outages above and below the horizon, and are located at the threshold areas, just over the 10 degree boundry and drops off signifigantly after 2 degrees. The subject position lights are mount rotated slightly inboard due to the geometric restriction (narrow) of the leading edges, hence the outboard light is a consequence of reflection off the surrounding structure of the aircraft. This same geometric restriction is the same for any position light mounted in the leading edge of this specific aircraft model type. To prevent internal glare, the aluminum skin and attach hardware was finished with non-reflective black enamel.

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

With regard to the minimum intensity requirements of §§25.1389(b)(1) & (b)(2) and §§25.1391 & 25.1393:

Both position lights exceed the peak intensities to a very large extent over the majority of the required areas, up to 826% of the required light output for green and 681% of the required output for red. The minimum candela requirement in the far horizontal angle area 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 area, which has a marginal amount of light that nearly meets the requirement. 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 Raytheon (Hawker) 800XP position light installation provides a significantly greater level of visual conspicuity than that required by §§25.1389(b)(1) & (b)(2) and §§25.1391 & 25.1393, and hence provides the basis for a finding of equivalent level of safety for these regulations.

Intensity in Overlap Areas

With regard to the maximum allowable overlapping angels of §§25.1389(b)(3) and 25.1395:

The position light installation of the Raytheon (Hawker) 800XP aircraft does not meet the maximum overlap intensity levels of §§25.1389(b)(3) and 25.1395 but the intensity levels provided by the API H800-0353 Position Lights provide an intensity level in the main beams that are much greater than them 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. The outages for the area 'A' for both lights are in the transition region near -11 degrees; falling off sharply to the maximum allowed within a few degrees, and the outages for area 'B' are at angles of 20-25 degrees which does not include any portion of the fuselage or cockpit, which is 38.9 degrees inboard of the light, presenting no glare or light interference to the cockpit displays.

While the position light installation does not literally comply with the §§25.1395 limits, the intensities supply a greater level of safety than that required by regulation and hence provide a basis for a finding of equivalent safety.

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned Equivalent Level of Safety Finding 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 Transport 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 Type Certificate Data Sheet under the Certification Basis section (TC's & ATC's) or 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), 25.1391, 25.1393, 25.1395 (documented in TAD ELOS Memo SA88416918SE-T-S-1).

Original Signed by
Stephen Boyd 12/21/2004

Manager, Airplane & Flight Crew Interface Branch, ANM-111 Date

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