Federal Aviation Administration

Memorandum

Date: August 6, 2013

To: Manager, Small Airplane Directorate, ACE-100

From: Manager, Wichita Aircraft Certification Office, ACE-115W

Prepared by: Craig Henrichsen, Aerospace Engineer, Wichita ACO, ACE-119W

Subject: Extension of Equivalent Level of Safety (ELOS) ACE-07-11 to include the Cessna Model J182T with the SMA Model SR305-230-E Compression Ignition Engine.

ELOS Memo #: ACE-07-11A

Regulatory Ref: 14 CFR 23.1397(c), Amendment 23-0

This memorandum requests your office to review and concur with extending the ELOS finding ACE-07-11 to the Cessna Aircraft Company Model J182T with a new technology Whelen Model 71011 Series Light-Emitting Diode (LED) rear position light.

Background:

As indicated in the project notification letter submitted early last year, Cessna Aircraft Company (CAC) has applied to the Wichita Aircraft Certification Office (ACO) to amend the Type Certificate (TC) for the Model 182 (3A13) to include the Model J182T. The Model J182T will be similar to the Model T182T, except it will include all the design change required to support the installation of a SMA Model SR305-230-E Compression Ignition engine and a Hartzell Propeller Model HC-()3YR-1C/7690J. This ELOS finding is requested so the proposed installation can meet the requirements defined in Title 14 of the Code of Federal Regulations (14 CFR) part 23.

To achieve this goal, a 14 CFR 21.101 analysis identified the following ELOS finding. CAC requests the Federal Aviation Administration acceptance and issuance of this ELOS finding.

Applicable Regulation:

The installed position light system is required to meet § 23.1397 at amendment 23-0. Subparagraph (c) of this regulation requires the following:

"Each position light color must have the applicable International Commission on Illumination chromaticity coordinates as follows:

(c) *Aviation white*--
"*x*" is not less than 0.350;
"*x*" is not greater than 0.540; and
"$y-y_0$" is not numerically greater than 0.01, "y_0" being the y coordinate of the Planckian radiator for which $x_0=x$."

Regulations Requiring an ELOS Finding:

The CAC certified a new technology LED based rear position light including lens cover on the Cessna Models 182T and T182T with ELOS finding ACE-07-11. This proposed position light with lens cover is identified as Whelen Model 71011 series. Section 23.1397(c), amendment 23-0 (which is included in the certification basis of the T182T airplane) prescribes chromaticity requirements that effectively define the color Aviation White.

Cessna Aircraft Company has applied for an ELOS finding with § 23.1397(c), amendment 23-0 and requests FAA consideration of this design feature for the new model J182T.

Description of Compensating Design Features:

The § 23.1397(c), amendment 23-0 requirement states that the light color must have applicable International Commission on Illumination chromaticity coordinates. In the regulation, these requirements are expressed as:

"'x' is not less than 0.350;
'x' is not greater than 0.540; and
'$y-y_0$' is not numerically greater than 0.01, 'y_0' being the y coordinate of the Planckian radiator for which $x_0=x$."

The TSO color requirements are contained in AS8037 paragraph 3.3.1. They are expressed in terms of color boundary as:

Aviation White

Yellow Boundary	x = 0.500
Red Boundary	y = 0.382
Purple Boundary	y = 0.047 + 0.762x
Blue Boundary	x = 0.285
Green Boundary	y = 0.150 + 0.640x
and	y = 0.440

The diagram (Figure 1) shows the boundary of § 23.1397(c), amendment 23-0 requirements and the boundary permitted by TSO-C30c. The TSO boundary, dictated by the AS8037 requirements has a significant overlap with the § 23.1397(c), amendment 23-0 requirements,

however, there are portions of the two requirements that do not overlap. Since the requirement to produce the lights is defined by AS8037, Cessna believes that while some light assemblies might meet the requirements of § 23.1397(c), per amendment 23-0, others might only meet the requirements dictated by the TSO, which would result in non-compliance.

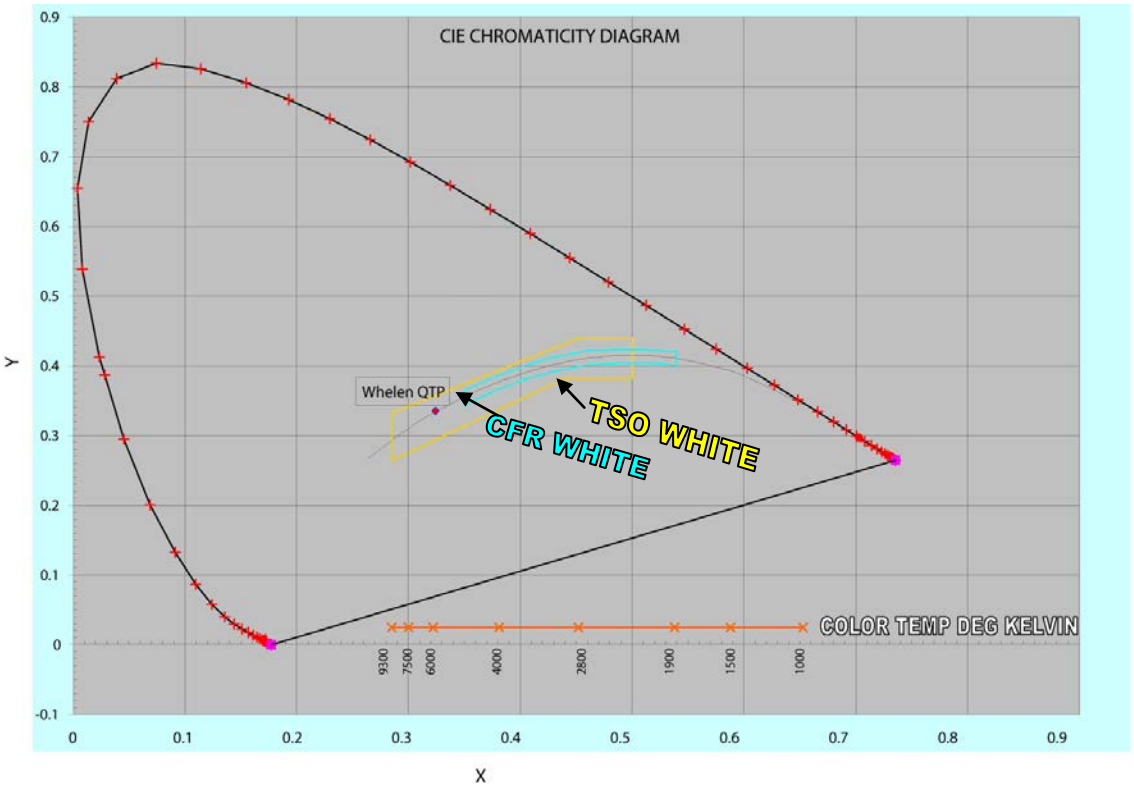

FIGURE 1

NOTE 1: BLUE – CFR WHITE LIMITS (§ 23.1397(c) amendment. 23-N/C)
NOTE 2: AMBER – TSO WHITE LIMITS

When installed on the aircraft J182T, there are no covers or lenses other than those supplied and qualified as part of the light assembly. The rear position light falls within the applicable color boundary requirements of TSO-C30c, providing an ELOS finding.

Based on information provided by Whelen and tests by Cessna, the design and properties of the new rear position light, Model 71011 series, eliminates the need for a periodic inspection, allowing it to be replaced on condition. Its light is derived from six LED(s) wired in series and arranged in a two by three light array. When one LED fails, the entire light extinguishes. Cessna has addressed necessary maintenance practices accordingly in each affected model's maintenance manual. Since the rear position lights on the applicable Cessna models consists of several LED elements, it is necessary to assure intensity and viewing angle requirements as the elements age and burn out. Prior to delivery of any aircraft with the Whelen LED position lights,

Cessna has obtained information from Whelen regarding care of the lights and will include necessary information in the maintenance manuals for the affected models.

Photometric testing of Whelen Model 71011 series shows that new light intensity is generally 30 to 60 percent above the 14 CFR minimums (Reference §§ 23.1391 and 23.1393, per amendment 23-0, as included in the model's certification bases). Data from the LED manufacturer (Lumileds) shows a degradation of light output of approximately 22 percent after 10,000 operation hours. Furthermore, these LED(s) that were tested operated with higher junction temperatures than would typically be experienced on the aircraft models listed above. The installation provides very good heat sinking to the aircraft structure and the environment at altitude provides exceptional cooling. Based on analysis, for intensity degradation, Cessna recommends replacement of light assembly after 10,000 airframe hours and this limit will be included in appropriate Cessna Maintenance Manual Component Life limit list. Cessna feels this 10,000 airframe hour limit is conservative because the position lights are generally not used during day operation.

These diodes exhibit very little color shift over long periods of time. Chromaticity measurements by the LED manufacturer and the light supplier at 0 and 13,200 hours of operation show the color shifting towards yellow-green (less than .01 for the *x* or 0.015 for the *y* coordinates), but remain within the TSO-C30c color boundaries for white. Furthermore, these LED(s) tested were operated with higher junction temperatures than would typically be experienced on the aircraft models listed above. The color shift trend shows that the chromaticity is expected to remain within the TSO-C30c white limits throughout the life of the aircraft with an imperceptible color shift after initial burn in. Furthermore, as this LED system reaches its end of life, the color shift occurs towards the yellow green direction of the CIE color chromaticity coordinates system and remains within the TSO C30c white, which the FAA has recognized within TSO-30c itself as providing an equivalent level of safety. Hence, a pilot would not misinterpret it as a red or green color. Cessna submits that the color white as defined by TSO-C30c meets the intent of § 23.1397(c), amendment 23-0 and therefore, an ELOS finding is justified.

Cessna Aircraft's Position:

The CAC believes that the ELOS to the regulations listed above remain unchanged, since these are areas of no change between the Model T182T and J182T.

Federal Aviation Administration Approval:

The chromaticity requirements are intended to provide, within limits, a standardized perception of "white" to the human eye. The FAA considers that excursion from the § 23.1397(c), amendment 23-0 requirements for the LED color white, while remaining within the requirements provided by TSO-30c for the color white, provides a light that results in an ELOS to that required by the regulation. This determination is applicable for the part number listed above and

derivative parts from the same manufacturer whose chromaticity is the same as the one discussed here and used on the Cessna Models 182T and T182T. The ACO concurs that the new Cessna Model J182T rear position light configuration has been analyzed and provides an ELOS for § 23.1397(c), amendment 0.

Earl Lawrence *8/6/13*

Manager, Small Airplane Directorate Date
Aircraft Certification Service

ELOS Originated by:	Wichita ACO Manager:	Routing Symbol:
Wichita ACO	Margaret Kline	ACE-115W