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Aircraft — LED based taxiing lightsystem — General requirements

Aéronefs — Système de lumière de roulage à base de LED — Exigences générales

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Foreword

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This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 1, *Aerospace electrical requirements*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is the standard of the LED (Light Emitting Diode) Taxi and RTO lights (Runway Turnoff Lights) for aerospace.

LEDs are attractive to users because of their lower power consumption and reduced maintenance efforts as well as their long operating life. However, Taxi and RTO lights require their light source to provide not only a large amount of luminous flux, but also high luminous intensity. Since recent LEDs achieve high luminous intensity, LEDs have come to be adopted as light sources of Taxi and RTO lights.

This document intends to establish a functional requirement set for modern Taxi and RTO lights which adopt LEDs as the light source.

In addition, this document is applied not only to the LED light source, but it can be applied also to other new light sources appearing in the future.

Aircraft — LED based taxiing lightsystem — General requirements

1 Scope

This document specifies characteristics and interface requirements for the LED taxiing light system.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7137:1995[1)], *Aircraft — Environmental conditions and test procedures for airborne equipment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
taxiing light system
system which consists of taxiing lamps and runway turnoff lamps

3.2
RTO light
runway turnoff light

3.3
LED
light emitting diode

[SOURCE: ISO 23570-2:2005, 4.7]

3.4
luminous intensity
photometric measure of the luminous flux per unit area of light travelling in a given direction

3.5
Illuminance
total luminous flux incident on a surface per unit area

1) Endorsement, in part, of the publication EUROCAE ED-14/RTCA DO-160 (a document published jointly by the European Organization for Civil Aviation Electronics and the Radio Technical Commission for Aeronautics).

4 General requirements

4.1 General

Adopting LEDs as the light source, Taxi and RTO lights acquire lower power consumption, reduced maintenance efforts and improved flexibility in design.

Since the existing standard is premised on using a sealed beam lamp for the light source, the functional requirements which correspond to the advantage of LEDs shall be established in this document.

4.2 Operating life

The effective operating life is defined as the time span until the unit no longer meets the photometric minimum performance parameters.

The photometric performance parameters include luminous intensity and chromaticity locus.

The initial luminous intensity and the initial chromaticity locus for LED based lights shall be established. Decrease of the luminous intensity and changes of the chromaticity locus shall also be established, taking into account for aging characteristics of decreasing luminous intensity and changes of chromaticity locus in each components (LEDs, lens, control circuits and so on) because how fast the luminous intensity and the chromaticity locus degrade depend on the characteristic of the LED devices which designers select.

An example for the luminous intensity is shown in Figure 1. An example for the change of chromaticity locus is shown in Figure 2.

4.3 Illuminance distribution

The characteristics of horizontal illuminance distribution shall meet the requirement as shown in Figure 3 using the following formula:

$$E_\alpha \geq \cos(\alpha \times 1{,}145) \times E_C \quad (1)$$

where

E_α is the illuminance distribution inside the illuminated area in direction of α from nose;

α is the horizontal angle in direction of a ray of luminaire light from airplanes' longitudinal axis on the ground plane;$-74° < \alpha < 74°$;

E_C is 54 lux, which corresponds to the conventional requirement of minimum illuminance at "SAE/ARP 693 locations".

$$E_{74°} \geq E_{\alpha\,max} \times 0{,}1 \quad (2)$$

The characteristics of vertical illuminance distribution shall meet requirement as shown in Figure 4.

The enhanced characteristics of horizontal illuminance distribution shall meet the requirement as shown in Figure 5 using the following formula:

$$E_\alpha \geq \cos(\alpha \times 1{,}145) \times E_E \quad (3)$$

where

E_α is the illuminance distribution inside the illuminated area in direction of α from nose;

α is the horizontal angle in direction of a ray of luminaire light from airplanes' longitudinal axis on the ground plane;

E_E is 70 lux, which corresponds to the enhanced requirement of minimum illuminance at "SAE/ ARP 693 locations".

$$E_{74°} \geq E_{\alpha\,max} \times 0{,}1 \quad (4)$$

4.4 Countermeasure for ultraviolet rays

In case a plastic lens is applied, the plastic lens shall be resistant against ultraviolet rays coming from solar radiation or other for the period of the operating life required unless otherwise specified.

4.5 Electromagnetic interference

The system shall be tested for conducted emissions in accordance with the requirements of ISO 7137:1995, Table 1, Section 16, Category B limits unless otherwise specified.

4.6 Colour

It shall be white and allow sufficient perception of colour of airport's markings.

4.7 Environmental condition

The requirements of ISO 7137 shall be adopted and applicable item shall be set in consideration of installed area in an aircraft unless otherwise specified.

4.8 Countermeasure for collision

In case a plastic lens is applied as the countermeasure for collision, the plastic lens shall withstand the environmental condition.

4.9 Electrical power source

The luminaire shall meet all the performance requirements as specified ISO 7137 unless otherwise specified.

5 Quality assurance provisions

5.1 Performance characteristics

5.1.1 General

When performing component testing, the specimen shall be mounted on simulated conditions with the real environmental conditions.

For purposes of demonstrating compliance, all photometric and colour measurements shall be made after a minimum warm up period.

30 minutes for LED sources or after the light has reached thermal stabilization, whichever is longer. Stabilization shall be defined as the point in which light output does not change by more than 3 % over a 15 minute period.

5.1.2 Illuminance performance

When performing illuminance testing, the measurement could be conducted on Taxi light and RTO light separately. In this case, the evaluation shall be conducted on combined illuminance of Taxi light and RTO light. The number of measurement point in each testing shall be 3 as minimum. And more measurement point could be set according to aircraft requirement.

5.1.3 Colour

Both Taxi light and RTO light shall meet the requirement on light colour.

5.1.4 Operating life

When performing operating life testing, the specimen shall meet its luminous intensity requirement and chromaticity requirements throughout the operating lifetime. LED attenuation caused by deterioration and temperature condition including LED junction temperature shall be considered.

5.2 Electrical characteristics

5.2.1 General

When performing component testing, the specimen shall be mounted on simulated conditions with the real environmental conditions.

5.2.2 Electromagnetic interference

The electromagnetic interference performance shall be tested in accordance with ISO 7137 requirements.

5.2.3 Electrical power source

The electrical power source performance shall be tested in accordance with ISO 7137 requirements.

5.3 Mechanical and thermal characteristics

5.3.1 General

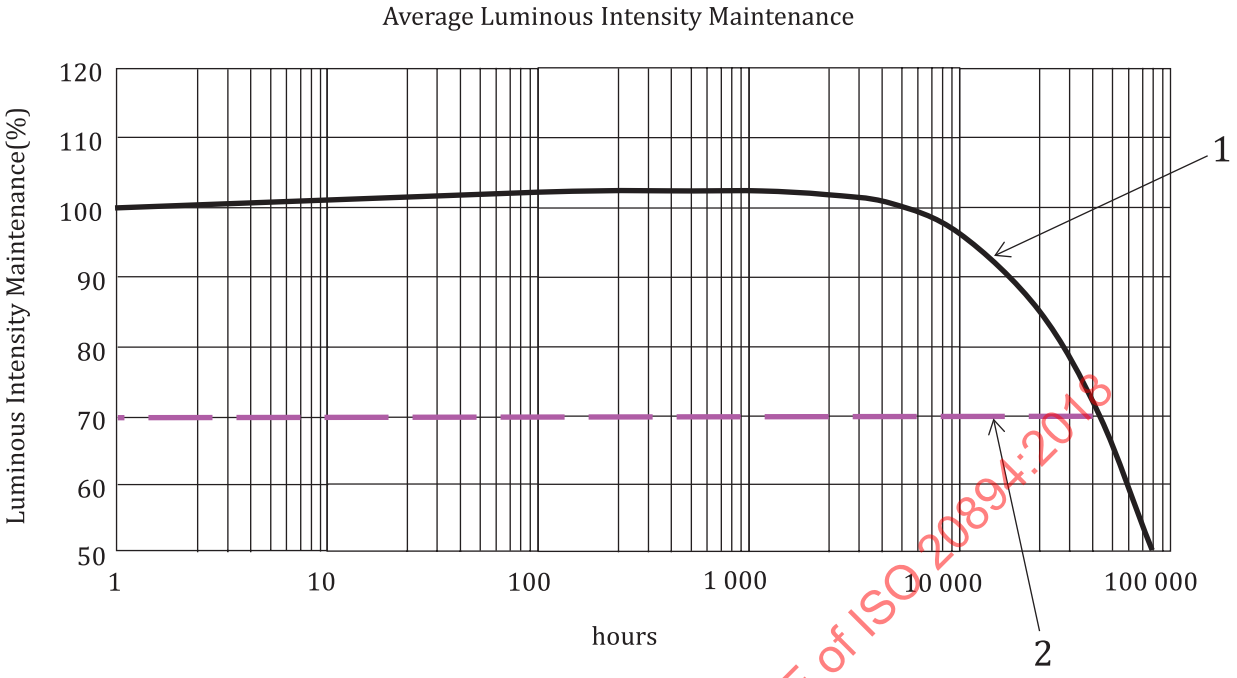
When performing component testing, the specimen shall be mounted on simulated conditions with the real environmental conditions.

5.3.2 Environmental condition

The environmental condition testing shall be conducted in accordance with ISO 7137 requirements.

5.3.3 Thermal analysis

The temperature of LED junction shall never exceed the maximum junction temperature of each LED. It shall be tested that the temperature of LED junction does not exceed the maximum junction temperature.

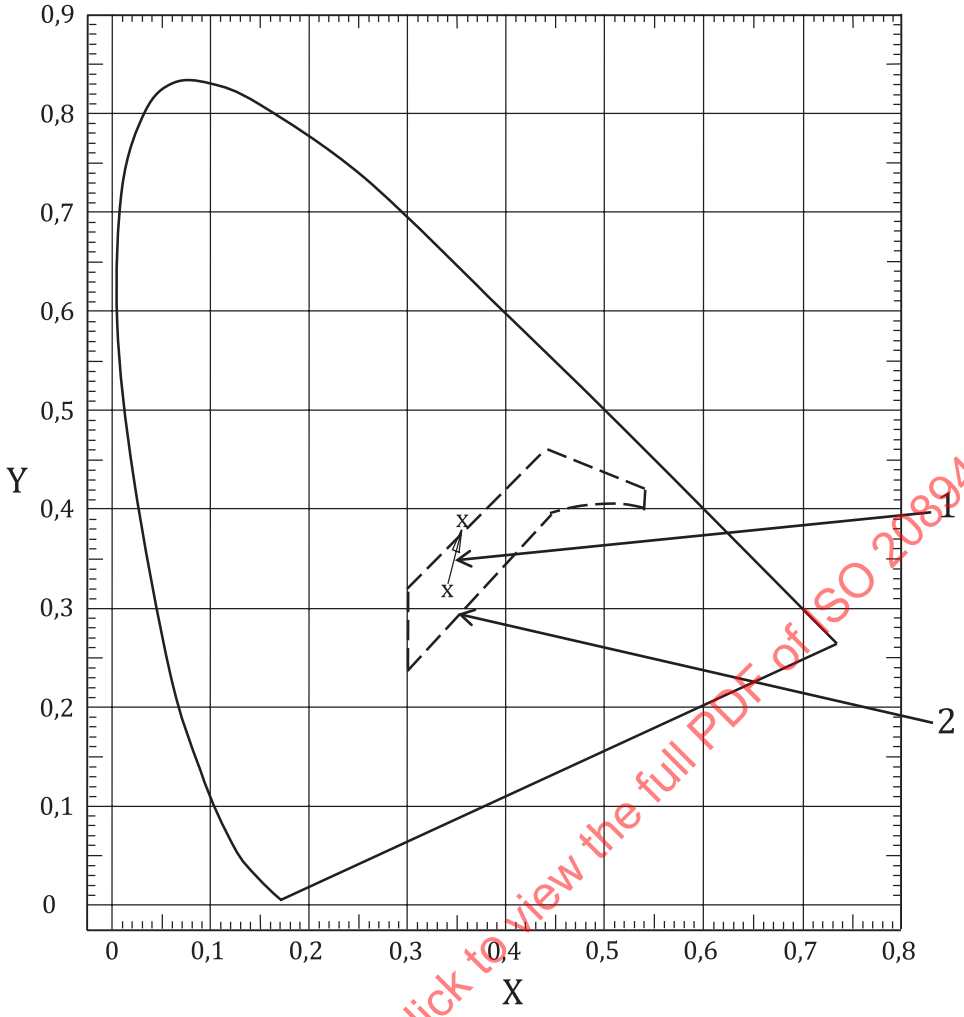


Key

1 an example of the effective operating life design

2 an example of the luminous intensity requirement

Figure 1 — Relation between a luminous intensity maintenance rate and luminous intensity initial setting



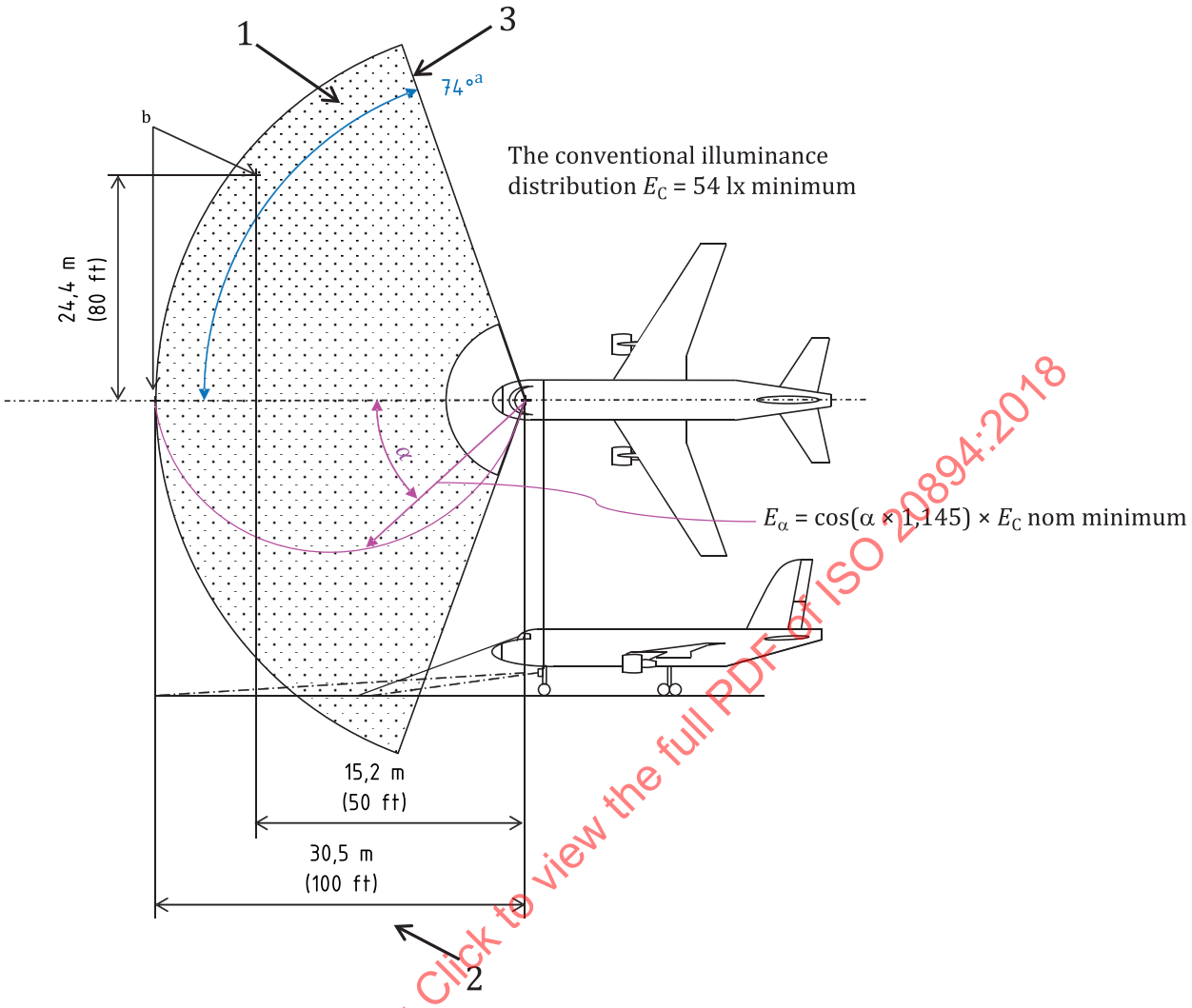
Key

1 an example for the change of chromaticity locus

2 aviation white[a] domain

[a] FAR25.1397, for example, defines aviation white in CIE1931.

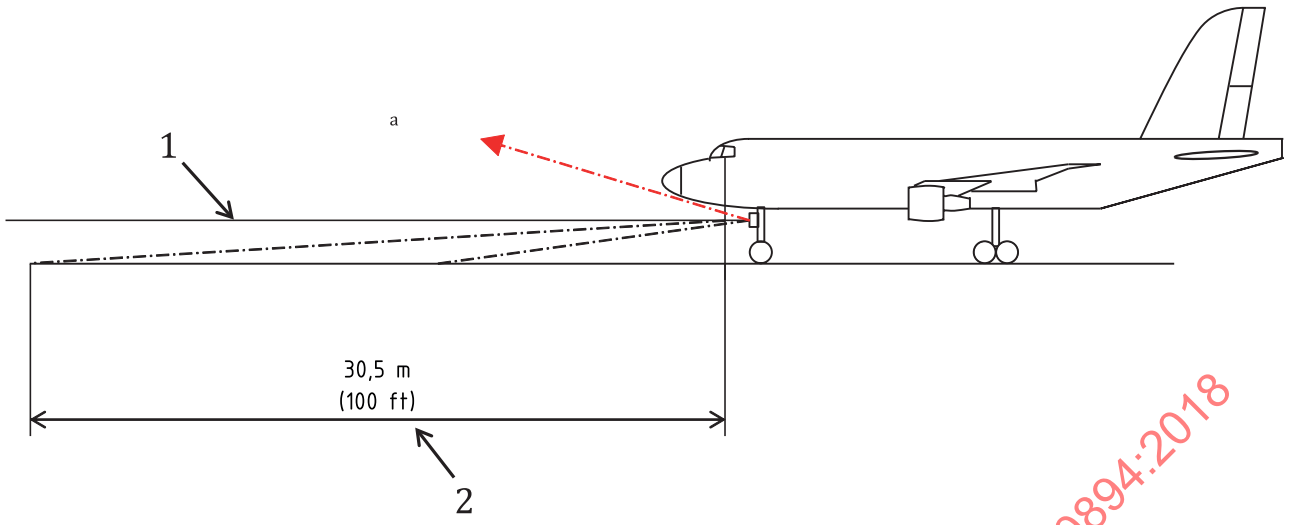
Figure 2 — An example for the change of chromaticity locus (CIE 1931, Chromaticity diagram)



Key

1 illuminated area where the illuminance distribution is required
2 radius of the illuminated circular arc centred at the cockpit
3 angle of the illuminated circular arc
a At 10 % of peak.
b SAE/ARP 693 locations (for reference).

Figure 3 — Characteristics of horizontal illuminance distribution for LED based taxiing light system



Key

1 horizontal line

2 radius of the illuminated circular arc centred at the cockpit

a No light more than 3 % of individual peak luminous intensity above horizontal plane.

Figure 4 — Vertical illuminance distribution characteristics for LED based taxing light system