SAE Aerospace
An SAE International Group

AEROSPACE RECOMMENDED PRACTICE

SAE ARP711 | REV. B

Issued 1991-09
Revised 2011-10

Superseding ARP711A

(R) Illuminated Signs

RATIONALE

This document is being revised to clarify sign uniformity,contrast ratio and LED requirements. This document only addresses Part 25 and Part 29 airplanes.

1. SCOPE

This SAE Aerospace Recommended Practice (ARP) covers the general design and performance characteristics of illuminated information signs for service in the passenger compartment of passenger transport aircraft.

"Illuminated information signs" are lighted signs used to inform occupants of the passenger compartment. Signs may use symbols or letters to convey messages.

This ARP does not apply to "EXIT" signs which are the subject of ARP503.

2. REFERENCES

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of the other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

ARP503 Emergency Evacuation Illumination

ARP6253 LEDs and Aircraft Applications

2.2 AIA Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

AIA 82-29 Standards for Symbology and Graphic Sinage Aboard Commercial Aircraft

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

2.3 FAR Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

FAR Part 25 Federal Aviation Regulations

FAR Part 29 Federal Aviation Regulations

2.4 Other Documents

DO-160 Environmental Conditions and Test Procedures for Airbourne Electronics/Electrical Equipment and Instruments

Color Usage Research Lab, NASA Ames Research Center - -Luminance Contrast: see website below http://colorusage.arc.nasa.gov/luminance_cont.php.

3. SPECIFIC RECOMMENDATIONS

FAR 25.791(a) and FAR 25.791(b) state requirements for passenger information signs. Illuminated information signs are classified into three categories.

a. Illuminated translucent characters (letter or symbol) on a nonilluminated or opaque background

b. Non-illuminated or opaque characters on an illuminated background

c. Illuminated translucent characters on an illuminated translucent background

3.1 Sign Symbology and Graphics

Passenger compartments should be provided with "NO SMOKING" and "FASTEN SEAT BELT" signs. "RETURN TO CABIN" or "RETURN TO SEAT" and "NO SMOKING" signs should be provided in each lavatory. Signs reading "LAVATORIES-VACANT-OCCUPIED" should be installed and visible to respective passenger areas. When illuminated, the signs should be clearly visible to all persons from whatever distance or angle the viewing may occur, including daylight ambient lighting conditions. It is desirable to not have the signs installed in direct sunlight. Common examples of sign graphics listed above.

3.1.1 Fasten Seat Belt

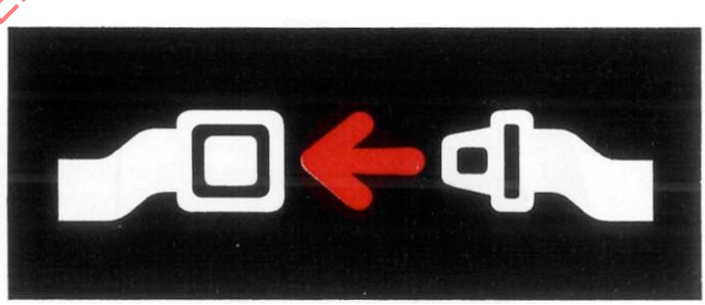

FIGURE 1 – FASTEN SEAT BELT

3.1.2 Lavatory Occupied

FIGURE 2 – LAVATORY OCCUPIED

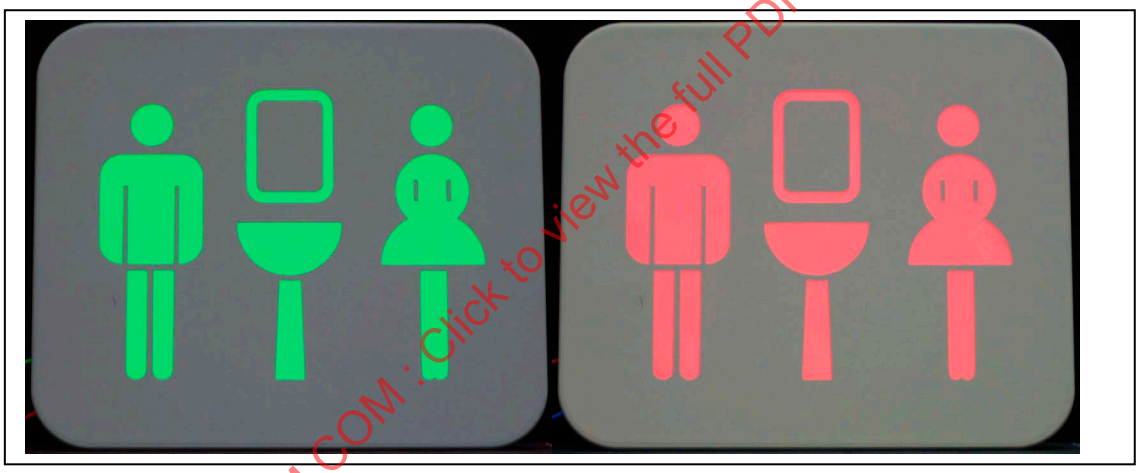

FIGURE 3 - LAVATORY OCCUPIED (ALTERNATE RED/GREEN PICTOGRAM)

3.1.3 Return To Seat

FIGURE 4 – RETURN TO SEAT

3.2 Sign Controls

An "ON-OFF" switch should be installed in the pilot's overhead panel to control the "FASTEN SEAT BELT," "RETURN TO CABIN," and "NO SMOKING" signs. "LAVATORIES-VACANT-OCCUPIED" should be controlled by respective lavatory lock latches. The circuitry for "NO SMOKING," "FASTEN SEAT BELT," and "RETURN TO CABIN" should be connected to the call chime circuitry to audibly alert passengers. The signs may flash for 10 seconds after activation before achieving steady illumination.

3.3 Legend Display Characteristics

Depending on the sign's intended use, three types of legend displays are commonly used: (1) readable, (2) essentially unreadable, and (3) unreadable. These characteristics apply to the sign while in the unenergized or nonilluminated condition.

3.3.1 Readable

This legend is always visible; typically this type of sign is designed with maximum contrast between the legend and background.

3.3.2 Essentially Unreadable / Partial Hidden Legend

This legend is somewhat obscured; usually oversprayed to match the sign background. The legend may be visible under certain conditions, however, it is clearly obvious when the sign is energized or unenergized

3.3.3 Unreadable / Hidden Legend

This legend is invisible until the sign is energized.

3.4 Readability

Readability of an illuminated panel sign depends to a great extent on the below factors.

a. The size and proportions of characters as well as the character design configuration

b. Character spacing

c. Luminance, luminance ratios, and luminance contrast ratios between character and background

d. Cabin ambient light level

e. Viewing angle

f. Viewing distance

g Color

h. Reflectance

3.4.1 Size and Proportions of Letters

The minimum character size (letter or symbol) may be as determined by Equation 1:

$$H = 0.00407 \times D \qquad \text{(Eq. 1)}$$

where:

H = minimum character height

D = maximum viewing distance

NOTE: The recommended character height is twice the minimum height.

The proportions of a character designed for maximum readability are as follows:

a. Width: 60% of height

b. Stroke: The stroke width of the letter should be 0.125 x H with illuminated characters and 0.20 x H with an illuminated background.

3.4.2 Spacing of Characters/Symbolic Legends

For maximum viewing distance, the spacing between characters shall be balanced between approximately 15% of letter height and visual equalization or spacing of one letter to another, e.g., certain letters such as "D," "O" etc., should be positioned closer to adjacent letters.

Letters and symbolic illustrations of bold silhouette rather than fine detail are preferable for long distance legibility.

3.4.2.1 Luminance and Readability of Sign Face

The brightness of the sign has a significant influence on the readability.

A sign that is too bright can suffer loss of readability from halo effect around the letters while insufficient brightness will reduce distance of legibility.

In some cases where high background brightness is required, elimination of this halo effect is achieved by applying a black opaque stripe around the outline of the letter. Consideration should be given to the light assembly location and luminance level of the surrounding area; i.e PSU mounted, wall mounted, etc

3.4.3 Luminance

It is recommended to install the information signs in locations that are not in direct sunlight. The white emissive areas of signs should have a luminance greater than 154 cd/m^2 (45 fL). Signs installed in areas of high ambient light may require a much higher luminance. To minimize annoyance to cabin occupants at night, 222 cd/m^2 (65 fL) is the practical maximum. Consider dimming the sign at night when it is necessary to exceed 222 cd/m^2 (65 fL) for daytime use

If it is required to use signs in direct sunlight, the luminance values stated above will need to be much higher. Care should be taken in the design to allow the luminance to be much lower (see values above) and not be an annoyance when the direct sunlight ambient is removed.

3.4.4 Luminance Uniformity

a. Increasing the distance from the sign face/diffuser to the light source is a factor in obtaining uniform light distribution. This may not be applicable to Electroluminescent (EL) or Organic LEDs (OLED).

b. Where depth is limited, it is possible to improve the lighting uniformity with better optical devices such as diffusers, microlenses, refractive foils or others at the light source.

c. The lighted areas of the sign should be as uniform as practical. In general, the luminance uniformity of similar colors should be within 3:1 using Equation 2 .

3.4.4.1 Luminance Uniformity For Signs With Lighted Legends

The luminance uniformity ratio between any and all letters or symbols or parts of same color should not exceed 2 to 1 where luminance uniformity is defined in Equation 2. This applies to dark ambient lighting conditions. Figure 5 shows example test point locations. Additional locations can be designated.

$$\textit{Luminance Uniformity} = LU = \frac{L\max}{L\min} \qquad \text{(Eq. 2)}$$

FIGURE 5 - MEASUREMENT EXAMPLE – LUMINANCE UNIFORMITY-LIGHTED LEGEND

3.4.4.2 Luminance Uniformity For Signs With Lighted Background

The luminance uniformity ratio between any area of the background should not exceed 3 to 1 where luminance uniformity is defined in Equation 2: This applies to dark ambient lighting conditions. Figure 6 shows example test point locations. Additional locations can be designated.

FIGURE 6 - MEASUREMENT EXAMPLE – LUMINANCE UNIFORMITY-LIGHTED BACKGROUND

3.4.5 Contrast Ratio For Dark Ambient Lighting Conditions

The signs with both the legend characters and background illuminated, the minimum luminance contrast between the white legend characters and background should be greater 9 to 1 as shown in Equation 3. This applies to dark ambient lighting conditions and can be considered to be below 10 lux (1fc). Figure 7 shows example test point locations. Additional locations can be designated.

$$\textit{Contrast Ratio} = CR = \frac{\textit{Legend Luminance}}{\textit{Background Luminance}} \qquad \text{(Eq. 3)}$$