SAE Aerospace
An SAE International Group

AEROSPACE RECOMMENDED PRACTICE

ARP4967 REV. A

Issued 1995-01
Reaffirmed 2004-01
Revised 2007-03

Superseding ARP4967

(R) Night Vision Imaging Systems (NVIS) Integrally Illuminated Information Panels

RATIONALE

This document is to support the engineering design effort for the creation of NVIS compatible panels.

1. SCOPE

This document is intended to highlight critical design issues that a panel designer should understand when designing panels for NVIS applications. It is not intended to be a discussion of the benefits of one lighting technology versus another. See ARP4168 for a more complete discussion of these lighting technologies.

1.1 Purpose

1.1.1 This document covers design considerations for NVIS panels when utilizing incandescent, electroluminescent, or LED light sources that, when filtered, produce NVIS compatible panels that meet the requirement specified in MIL-L-85762 or MIL-STD-3009.

1.1.2 Definition

NVIS compatible integrally illuminated information panels are panels where the spectral wavelengths, luminance level, and uniformity will not interfere with the intended use of night vision goggles, and allow the crew member to view the panel with the unaided eye.

1.1.3 Reference

For a more complete discussion of the properties of incandescent and electroluminescent lamps, see ARP4168.

2. REFERENCES

2.1 Applicable Documents

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 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.

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

2.1.1 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.

ARP4168 Night Vision Goggle (NVG) Compatible Light Sources

ARP4169 Night Vision Goggle (NVG) Filters

AS7788 Panels, Information, Integrally Illuminated

2.1.2 U.S. Government Publications

Available from Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, http://assist.daps.dla.mil/quicksearch/

MIL-STD-3009 Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible

MIL-PRF-5425 Plastic Sheet, Acrylic, Heat Resistant

MIL-PRF-19500/708 Displays, Diode, Light Emitting, Solid State, Red, Numeric and Hexadecimal, With On Board Decoder/Driver

MIL-L-85762 Lighting, Aircraft, Interior, Night Vision Imaging System (NVIS) Compatible

NASM3498 Screw Assembly, Panel

3. LIGHT SOURCES

3.1 Lamps, Incandescent

The designer needs to select a lamp that is compatible with the available power, which normally in incandescent applications is 5.0 or 28.0 V. In type IV or V panels, it is recommended to use T 1 short length wire terminal bulbs which, because of their size, are readily adaptable to NVIS compatible filters which are available. Selection of lamps should also take into consideration that some NVIS filters also will absorb a significant amount of available light. Maximum power consumption limits on the panel manufacturer should not be too restrictive.

3.2 Lamps, Electroluminescent

The phosphors used in thick film electroluminescent lamps have spectral energy distribution emissions which are essentially contained within visible spectrum with little emission in the near infrared. However, some filtering is generally required in order to meet the NVIS radiance requirements of MIL-L-85762 or MIL-STD-3009.

Thick film EL lamps are AC operated devices and, therefore, AC power (typically 115 V/400 Hz) must be available to the panel. This is normally accomplished by either aircraft power or by the use of small low voltage DC to AC inverters.

3.3 Lamps, Light Emitting Diodes

LED lamps may be either hermetic or plastic encapsulated packages with leads for either through hole or surface mount assembly.

The LED lamps should be selected for light output and color and undergo reliability screening as may be deemed necessary.

Screening should be performed in accordance with either MIL-PRF-19500/708 or as detailed in the LED lamps specification.

3.4 Further Data

It is recommended that additional details relative to light sources can be found in ARP4168.

4. DESIGN CONSIDERATIONS

4.1 Panel Thickness

The thickness allowed by AS7788 is 0.230 inches ± 0.023 inches.

4.1.1 Incandescent and LED Panels

Standard cast acrylic sheet to MIL-P-5425 runs more to the nominal and -0.023 inches thickness than it does to the plus side of the tolerance. It is recommended that a thickness not to exceed 0.253 inches be allowed to accommodate the various lengths of cylindrical filters which are available to the panel manufacturers and still allow a sufficient amount of material in between the top and bottom of the filter as specified in AS7788.

4.1.2 Electroluminescent Panels

EL lamps are a flat area light source and thus panels utilizing them do not require light piping and/or cylindrical filters. This allows EL panels to be made as thin as 0.100 inch when required, which is well below the requirements of AS7788, or the recommended design thickness for incandescent panels.

4.2 Color of Illumination

The lettering, numbering, and marking on the panel shall be white in daylight when the lighting units are not energized. When the lighting units are energized, the light transmitted through the panel markings and all elements illuminated by the panel shall fall within the area of the 1976 CIE chromaticity diagram described as u'1=.088, v'1=.543, r≤.037 as specified in MIL-L-85762 for NVIS green "A". Special consideration in the paint selection must be included since the white paint used for non-NVIS panels can fluorescence when illuminated with NVIS filters. Color selection for the paint should be in accordance to AS7788, paragraph 3.7.2.1 that allows either color No. 37875 or 37925.

4.3 Brightness of Markings

The brightness of all markings on the panel shall be 1.0 fL ± 0.5 fL with nominal voltage applied to the connector. The average of all the markings shall be 1.0 fL ± 0.2 fL.

4.4 Mounting Techniques

AS7788 specifies grommets and captive screws per MS3498 (replaced by NASM3498). Manufacturers may offer a variety of alternative mounting techniques.

4.5 Power Requirements

Power draw at rated voltage varies between the two technologies.

4.5.1 Incandescent Panels

Power requirements will vary based on panel layout which determines the quantity of lamps and filters.

4.5.2 Electroluminescent Panels

Power requirements are roughly 45 mW/in^2 of lighted area.

4.5.3 LED Panels

Power requirements will vary based on panel layout which determines the quantity of LEDs and filters.

4.6 Rated Voltage

AS7788 specifies 5.0 V ± .05 V or 28.0 V ± .1 V for incandescent panels except for incandescent blue/white panels which are rated at 4.5 V ± .05 V and 115 V ± 2 V 400 Hz ± 5 Hz for EL.

5. NVIS COMPATIBLE FILTERS FOR AS7788 PANELS

5.1 Filters for Incandescent Lamps

The incandescent lamps used in type IV and type V panels need to be filtered to achieve NVIS compatibility as defined by MIL-L-85762 or MIL-STD-3009. Filters, made of NVIS compatible filter material are used to encapsulate the lamps.

The NVIS compatible material transmits the lamp's energy in the wavelength region where NVIS has little or no sensitivity, typically in the blue and green regions of the visible spectrum. The filter material suppresses the red and near-infrared energy from the lamp to reduce the amount of energy which is emitted in the NVIS response region.

The spectral distribution of an incandescent lamp varies as a function of applied voltage. As a result, the color coordinates of the filtered lamp will also vary. It is important to consider this variability when selecting a filter. For example, some filter materials will exhibit a large color shift as a function of the applied voltage. These materials are typically very blue in color. Greener appearing filters are much less susceptible to this color shift. A panel will remain in the specified color region over the entire operating range of the lamp.

Similarly, the measured NVIS radiance of the filtered lamp will also vary as a function of the applied voltage. In general, NVIS radiance (Scaled to the Specified Luminance Level) increases as voltage is reduced on an incandescent lamp. Therefore, it is possible to meet the MIL-L-85762 or MIL-STD- 3009 requirements for NVIS radiance at a particular voltage level, however, at lower voltage levels, the measured NVIS radiance of the same component can exceed the maximum allowable value. Again, this phenomenon is related to the color of the filter material. Blue filter material is much more susceptible to this variation in NVIS radiance than is green filter material.

A final consideration for the selection of filter material is the need to make the panels uniform in appearance with respect to other lighting sources in the cockpit. Typically, edge lighted panels are in proximity to other emitting light sources such as monochromatic CRTs or LED displays. Green is the most common color of these displays. Therefore, it is important that the color of the panels surrounding these displays appears as close as possible to the display color. Green filter material will provide this uniformity and will eliminate the "Christmas tree" color variation which is undesirable in an NVIS-equipped cockpit.

5.2 Filters for Electroluminescent Panels

There are a number of filters available to filter the energy from the EL source to meet the requirements of MIL-L-85762 or MIL-STD-3009. These filters generally range in thickness from 0.010 to 0.030 inches depending on the manufacturer.

The spectral energy distribution of an electroluminescent lamp does not vary as a function of the applied voltage and, therefore, the color and NVIS radiance (Scaled to the Specified Luminance Level) remain constant as the intensity is varied. This simplifies filtration requirements.