

**AEROSPACE  
RECOMMENDED  
PRACTICE**

**SAE ARP4967**

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**Night Vision Imaging Systems (NVIS) Integrally  
Illuminated Information 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.
- 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 specification 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 specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP4168 Night Vision Goggle (NVG) Compatible Light Sources

ARP4169 Night Vision Goggle (NVG) Filters

2.1.2 U.S. Government Publications: Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL19500

MIL-D-87157

MIL-L-85762

MIL-P-5425

MIL-P-7788

MS3498

### 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 T1 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 in some visible spectrum with little emission in the near infrared. Some filtering is generally required in order to meet the NVIS radiance requirements of MIL-L-85762.

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 MIL19500, MIL-D-87157, 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 MIL-P-7788 is .230 in  $\pm$  .023 in.

4.1.1 Incandescent Panels: Standard cast acrylic sheet to MIL-P-5425 runs more to the nominal and -.023 in thickness than it does to the plus side of the tolerance. It is recommended that a thickness not to exceed .253 in 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 MIL-P-7788.

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 .100 in when required, which is well below the requirements of MIL-P-7788, 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  $u^*1=.088$ ,  $v^*1=.543$ ,  $r\leq.037$  as specified in MIL-L-85762 for NVIS green "A".

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### 4.3 Brightness of Markings:

The brightness of all markings on the panel shall be  $1.0 \text{ fL} \pm .3 \text{ fL}$  with nominal voltage applied to the connector.

### 4.4 Mounting Techniques:

MIL-P-7788 specifies grommets and captive screws per MS3498. 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  $45 \text{ mW/in}^2$  of lighted area.

### 4.6 Rated Voltage:

MIL-P-7788 specifies  $5.0 \text{ V} \pm .05 \text{ V}$  or  $28.0 \pm 1 \text{ V}$  for incandescent panels except for incandescent blue/white panels which are rated at  $4.5 \text{ V} \pm .05 \text{ V}$  and  $115 \text{ V} \pm 2 \text{ V}$   $400 \text{ Hz} \pm 5 \text{ Hz}$  for EL.

## 5. NVIS COMPATIBLE FILTERS FOR MIL-P-7788 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. 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.