

**Gain Determination of Front Projection Screens**



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*Introduction*

Screen gain is a ratio of the test luminance to the luminance of a Lambert diffuser under the same viewing conditions. Screen gain usually varies, depending upon the angle of view, because of the laws of reflection and the nature of the screen surface. Thus, a maximum screen gain value can be misleading because it is an incomplete description.

**1. Scope**

This practice specifies a method for measurement of screen gain.

**2. Formula**

$$\text{Gain} = \frac{\text{Luminance of test screen}}{\text{Luminance of Lambert diffuser}}$$

**3. Measurement**

- 3.1 The test screen shall be illuminated with projector light rays perpendicular to the screen surface (see Appendix A5).
- 3.2 The luminance of the screen sample shall be measured at 5-degree intervals. The measurements shall be in horizontal and vertical planes

that pass through the perpendicular to the screen surface.

- 3.3 The maximum gain shall be labeled as such. Average useful gain shall be the gain seen by the audience under projection conditions (see Appendix A1).

- 3.4 In testing screens already installed in theaters, the methods specified in Secs. 3.1 and 3.2 may be altered to accept the existing projection angle and seating arrangement (see Appendix A1).

**1. Instruments**

- 1.1 The goniophotometer shall measure only the luminance of the perpendicularly illuminated area on the screen.
- 1.2 The photometer (see Sec. 4.1) shall have a spectral response of a standard observer with photopic vision (see Appendix A6).
- 1.3 A diffuse reference standard similar to a Lambert diffuser, which reflects all incident light so that the luminance is the same regardless of the angle of view, shall be used and shall be specified with the screen gain. The standard could be MgO, BaSO<sub>4</sub>, MgCO<sub>3</sub>, standardized matte white cardboard or a matte white screen of calibrated reflectance.

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**Appendix**

(The Appendix is not a part of this SMPTÉ Recommended Practice, but is included for information purposes only.)

A1. In order to obtain a representative gain value for a theater, one might measure the center screen luminance from the center and sides of the middle row in the audience and average these values with the luminance measured from the center of the back and front rows.

A2. When a goniophotometer is used to measure luminance, the photometer may see all of the perpendicularly illuminated spot on the screen sample at all angles. Therefore, the luminance readings may have to be corrected by dividing by the cosine of the angle. If the photometer sees only the small center of the perpendicularly illuminated area, the correction is not required.

A3. Useful angles in locating good audience coverage for a gain screen are the angles which provide the necessary recommended screen luminance (see American National Standard Screen Luminance and Viewing Conditions for Indoor Theater Projection of Motion-Picture Prints, ANSI PH122.196-1978). In most cases, the angles would

be limited to those which provide more than one-half the maximum gain. In some situations, curving the screen is necessary in order to utilize screens with gain factors over 1.1.

A4. Some subjective gain errors may occur because a typical theater audience has a mesopic eye response, determined by how long the viewer is in the theater, the ambient light, the subtended screen size, film subject matter, and the projector lumen output. Therefore, some observers may not agree with the numerically calculated gain.

A5. Retroreflective screens, such as glassbeaded screens, reflect maximum gain back to the projector, regardless of projection angle.

A6. References to instrument spectral response and required theater illumination are listed in ANSI PH122.196-1978.