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RP 12-1997
Revision of RP 12-1992

SMPTE RECOMMENDED PRACTICE

Screen Luminance for Drive-In Theaters — Film

1 Scope

1.1 This practice specifies the luminance (measured brightness) of the projection screens for drive-in theaters intended for the projection of motion-picture film at 24 frames/sec.

1.2 The practice defines luminance ratios among portions of the total screen area, and defines the acceptable variations as viewed from positions within the audience area.

1.3 The practice applies to both diffusing and directional screens.

1.4 Recognizing the complexities and difficulties of drive-in projection, the practice describes criteria for evaluation of performance that is less than optimum, based upon a minimum luminance level and a maximum luminance variation.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this practice. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this practice are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

ANSI/IESNA RP-16-1996, Nomenclature and Definitions for Illuminating Engineering

3 Measurement

3.1 Measurement of screen luminance and color of projection light is made with the projector in complete operation with its lens set at focus position, but with no film in the aperture, and under ambient light conditions similar to those existing during show time.

3.2 Screen luminance shall be measured with a photometer having the spectral luminous efficiency of the standard observer (photopic vision) as defined in ANSI/IESNA RP-16.

3.3 The acceptance angle of the photometer shall be 2° or less. When in use within a theater, the instrument shall be so located along the line of sight to the screen area being measured as to accept light from a screen area no larger than a circle whose diameter is 10% of the screen width.

4 Luminance level

4.1 In an ideal situation, when permitted by the technology of motion-picture projection, and when the viewing environment is sufficiently close to that of the indoor theater, the screen luminance and distribution shall be that specified in ANSI/SMPTE 196M, 16 fL ± 2 fL (55 cd/m^2 ± 7 cd/m^2), as measured from a position on the longitudinal centerline of the ramp area and midway between the foremost and rearmost ramps.

4.2 The recommended minimum luminance at the center of the screen shall be 7 fL (24 cd/m^2), as measured from the central position defined in 4.1.

4.3 When maximum compromise must be made, as discussed in annexes A.1 and A.2, the luminance at the center of the screen, measured from any car position, shall in no case be less than 4.5 fL (15 cd/m^2).

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5 Luminance distribution

5.1 The luminance at a distance of 10% of the screen width from the side edges of the screen, and on its horizontal axis, as measured from the central position defined in 4.1, shall be compared with the center luminance reading obtained, and shall fall within the range of 55% to 100% of that reading. The distribution of projection illumination shall be symmetrical about the geometric center of the screen.

5.2 The minimum luminance measured from any car position to any point on the horizontal centerline of the screen within the 10% points defined in 5.1 shall be no less than 33% of the maximum luminance on the horizontal centerline measured from that same position.

6 Spectral distribution

The light reflected from the screen shall have a spectral distribution approximating that of a blackbody at a color temperature of 5400 K ± 400 K, the use of a short-arc xenon or carbon-arc light source being assumed.

7 Multiple projector adjustment

7.1 When the presentation involves changeovers among two or more projectors operating to the same screen format, their luminances as measured in 4.1 shall agree within a maximum range of 10%.

7.2 When the presentation involves changeovers among two or more projectors operating to different screen formats or areas, their luminances as measured in 4.1 shall agree within a maximum range of 15%.

7.3 The apparent color of the projection light from projectors intended for interchangeably sequential operation shall be consistent with one another within a range of no more than 400 K.

Annex A (informative)
Additional data

A.1 Standard luminance

As a minimum goal for theater maintenance and adjustment, it is a consensus that there is a working threshold for luminance below which picture quality is noticeably degraded. Under this condition, the operation becomes very sensitive to sky light, neighboring luminances interfere, adjustment of projection equipment becomes more critical, and mood or key variations in the prints become distracting and the presentation begins to lose its artistic purpose. Permissible luminance range is limited by the criterion that a good release print must provide acceptable quality when projected at any luminance within the range.

A.2 Operating luminance

Picture quality is most desirable in drive-in theaters where it is possible to achieve the luminance levels of indoor theaters. This practice recognizes, however, that there are many drive-in theaters wherein screen sizes, viewing conditions, and other factors dictate limitations not encountered in conventional indoor theaters. When a very large screen area, long projection throw distance, extended viewing distance, and high ambient light level are involved, it is necessary to achieve maximum efficiency in all elements of the system to ensure acceptable projection results.

The values in 4.2 and 5.2 represent an operating compromise that may be useful. They also describe the minimum condition for an acceptable projected image where stray and ambient light can be considered negligible.

A.3 Directional screens

A maximum permissible luminance distribution range on a given screen is specified in 5.1 and 5.2. This condition can be achieved by several procedures, including one or more of the following: choice of a screen with a suitable reflection pattern, limitation of the seating area so that no patron views the picture from an angle at which the luminance is outside the tolerance of the standard, and screen curvature.

Present directional screens show a large variation in gain with changes in the projection and viewing angles, necessitating the 3:1 luminance range in 5.2 when gain screens are fitted into existing theaters. Even this range effectively limits the maximum luminance gain of the screen; and the wider the theater becomes, the lower the maximum luminance gain must be to meet luminance specifications with most existing directional screens.

A.4 Luminance photometer

The measurement of luminance with uncertainty of less than 10% requires a good photometer. Since there are no true Lambertian surfaces, and even the theatrical matte screens may depart by more than 10%, the brightness will vary with the angle of observation. A photometer having a large field angle will indicate the average luminance within its field, and if this includes a large area of the screen (or of the screen and surround), this average may be substantially different from the observed brightness. It has been found that within the geometric restrictions under which photometers are used in theaters, their luminance indication correlates well

with the observed brightness if the field angle of the photometer is about 2° or smaller.

A photometer having a small field angle may receive light from such a small screen area as to detect luminance differences due to defects in the screen, imaging of the projection source, etc. When measuring the luminances required in clauses 4 and 5, the luminances of immediately adjacent areas should be observed to be sure the reading is relevant.

A.5 Ambient light

Recognizing the limitations in an outdoor environment, every effort should be made to keep ambient light on the screen to a minimum. This may be done by careful placement of the screen and controlling light sources in and around the theater. Distracting light sources (signs, street lights, etc.) should be shielded, or kept out of the field of view of the audience.

Annex B (informative)
Bibliography

ANSI/SMPTE 196M-1995, Motion-Picture Film — Indoor Theater Projection — Screen Luminance and Viewing Conditions