SMPTE RECOMMENDED PRACTICE

RP 12-1983

Screen Luminance for Drive-In Theaters

1. *Scope*

1.1 This recommended 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. *Measurement*

2.1 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.

2.2 Screen luminance shall be measured with a photometer having the spectral luminous efficiency of the standard observer (photopic vision) as defined in American National Standard Nomenclature and Definitions for Illuminating Engineering, ANSI/IES RP-16-1980.

2.3 The acceptance angle of the photometer shall be 2 degrees 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 percent of the screen width.

3. *Luminance Level*

3.1 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 American National Standard Screen Luminance and Viewing Conditions for Indoor Theater Projection of Motion-Picture Prints, ANSI PH22.196-1978, 16 ± 2 footlamberts (55 ± 7 candelas per square meter), as measured from a position on the longitudinal centerline of the ramp area and midway between the foremost and rearmost ramps.

3.2 The recommended minimum luminance at the center of the screen shall be 7 fL (24 cd/m²), as measured from the central position defined in Section 3.1.

3.3 When maximum compromise must be made, as discussed in Appendixes A1 and A2, 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/m²).

4. *Luminance Distribution*

4.1 The luminance at a distance of 10 percent of the screen width from the side edges of the screen, and on its horizontal axis, as measured from the central position defined in Section 3.1, shall be compared with the center luminance reading obtained, and shall fall within the range of 55 to 100 percent of that reading. The distribution of projection illumination shall be symmetrical about the geometric center of the screen.

4.2 The minimum luminance measured from any car position to any point on the horizontal centerline of the screen within the 10-percent points defined in Section 4.1 shall be no less than 33 percent of the maximum luminance on the horizontal centerline measured from that same position.

Copyright © 1983 by the
SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS
862 Scarsdale Avenue, Scarsdale, NY 10583, (914) 472-6606

Revision of RP 12-1972
Approved 28 September 1983

5. *Spectral Distribution*

The light reflected from the screen shall have a spectral distribution approximating that of a black-body at a color temperature of 5100 K ± 400 K, the use of a short-arc xenon or carbon-arc light source being assumed.

6. *Multiple Projector Adjustment*

6.1 When the presentation involves changeovers among two or more projectors operating to the same screen format, their luminances as measured in Section 3.1 shall agree within a maximum range of 10 percent.

6.2 When the presentation involves changeovers among two or more projectors operating to different screen formats or areas, their luminances as measured in Section 3.1 shall agree within a maximum range of 15 percent.

6.3 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.

Appendix

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

A1. 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.

A2. Operating Luminance

Picture quality is most desirable in drive-in theaters where it is possible to achieve the luminance levels of indoor theaters. This recommended 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 Sections 3.2 and 4.2 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.

A3. Directional Screens

A maximum permissible luminance distribution range on a given screen is specified in Sections 4.1 and 4.2. 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 Section 4.2 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.

A4. Luminance Photometer

The measurement of luminance with uncertainty of less than 10 percent requires a good photometer. Since there are no true Lambertian surfaces, and even the theatrical matte screens may depart by more than 10 percent, 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 degrees 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 Sections 3 and 4, the luminances of immediately adjacent areas should be observed to be sure the reading is relevant.

A5. 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, streetlights, etc.) should be shielded, or kept out of the field of view of the audience.

SMPTE RECOMMENDED PRACTICE — RP 53–1983

Scene-Change Methods for Printing 35-mm, 16-mm and 8-mm Type S Motion-Picture Film

1. *Scope*

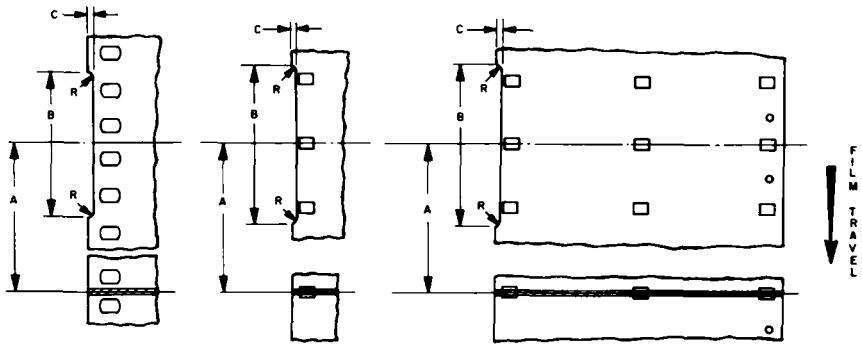
1.1 This practice specifies the dimensions and location of a scene-change notch or cueing spot for actuating the printer light-change mechanism when printing 35-mm, 16-mm, and 8-mm Type S motion-picture films. (See Appendix A1 for frame-count cueing method.)

1.2 Although this practice specifies a notch or a cueing spot for actuating the printer light mechanism, at no time should a film contain both.

2. *35-mm Motion-Picture Film*

2.1 Scene-Change Notch

2.1.1 The dimensions and location of the scene-change notch shall be as specified in Fig. 1 and Table 1. (See Appendix A2 for alternate method of forward and reverse printing.)



FILM AS VIEWED EMULSION UP

Fig. 1
Notch for 35-, 16- and 35-mm Perforated 16-mm 3R Film

Table 1

Dimensions	Inches	Millimeters
A 35-mm (6 frames)	4.500 ± 0.012	114.30 ± 0.30
A 16-mm (20 frames)	5.99 ± 0.01	152.1 ± 0.3
B 35-mm	1.000 ± 0.012	25.40 ± 0.30
B 16-mm	0.827 ± 0.005	21.01 ± 0.13
C 35-mm	0.047 + 0.000 — 0.007	1.19 + 0.00 — 0.18
C 16-mm	0.020 + 0.005 — 0.004	0.51 + 0.13 — 0.10
R	0.500 + 0.000 — 0.060	12.70 + 0.00 — 1.52

Copyright © 1983 by the
SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS
862 Scarsdale Avenue, Scarsdale, NY 10583, (914) 472-6606

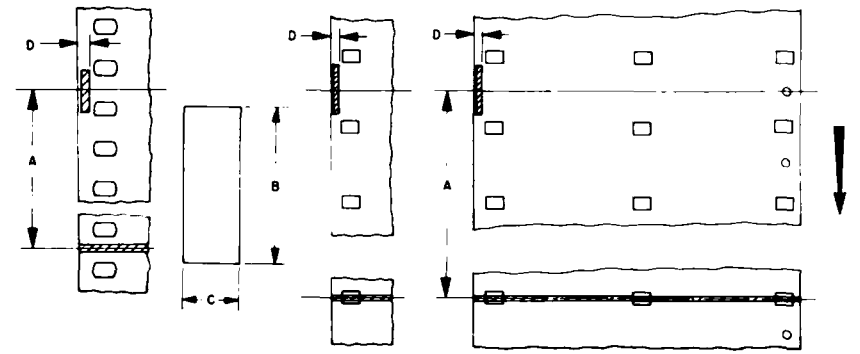
Revision of RP 53-1974
Approved 28 September 1983

2.1.2 The scene notch centerline shall be 4.500 in (114.30 mm) after the scene change with respect to the direction of film travel through the printer.

2.1.3 For forward and backward printing, a second notch placed in accordance with Fig. 1 may be added to the opposite edge of the film, and (observing the change in the direction of travel) the centerline distance between the two notches shall be two times Dimension A in Table 1.

2.2 Scene-Change Cueing Spot

2.2.1 The dimensions and location of the scene-change cueing spot shall be as specified in Fig. 2 and Table 2. (See Appendix A3 for alternate method of forward and reverse printing.)



FILM AS VIEWED EMULSION UP

Fig. 2
Cueing Spot for 35-, 16- and 35-mm Perforated 16-mm 3R Film

Table 2

Dimensions	Inches	Millimeters
A 35-mm (8 frames)*	5.97 ± 0.01	151.6 ± 0.3
A 16-mm (20.5 frames) *	6.14 ± 0.01	156.0 ± 0.3
B	0.187 + 0.000 — 0.005	4.75 + 0.00 — 0.13
C	0.062 ± 0.005	1.57 ± 0.13
D 35-mm	0.075 ref	1.90 ref
D 16-mm	0.080 + 0.000 — 0.005	2.03 + 0.00 — 0.13

*Separation between cue spot and scene change.

2.2.2 The cueing spot shall be placed 5.97 in (151.6 mm) after the scene change with respect to the direction of film travel through the printer.

2.2.3 The cueing spot preferentially shall be placed on the emulsion side of the film.

2.2.4 The cueing spot shall consist of an adhesive-backed metallic foil (preferably rounded at all *four corners*).

2.2.5 For forward and backward printing, a second cueing spot placed in accordance with Fig. 2 may be added to the opposite side of the film, and (observing the change in direction of travel) the centerline distance between the two cueing spots shall be two times Dimension A in Table 2.

3. *16-mm Motion-Picture Film*

3.1 Scene-Change Notch

3.1.1 The dimensions and location of the scene-change notch shall be as specified in Fig. 1 and Table 1. (See Appendix A2 for alternate method of forward and reverse printing.)

3.1.2 The scene notch centerline shall be centered on the 20th perforation after the scene change (5.99 in or 152.1 mm) with respect to the direction of film travel through the printer.

3.1.3 For forward and backward printing, a second notch placed in accordance with Fig. 1 may be added to the opposite edge of the film, and (observing the change in direction of travel) the centerline distance between the two notches shall be two times Dimension A in Table 1.

3.2 Scene-Change Cueing Spot

3.2.1 The dimensions and location of the cueing spot shall be as specified in Fig. 2 and Table 2. (See Appendix A3 for alternate method of forward and reverse printing.)

3.2.2 The cueing spot shall be placed 20.5 frames (6.14 in or 156.0 mm) after the scene change with respect to the direction of film travel through the printer.

3.2.3 The cueing spot shall be placed on the emulsion side of the film.

3.2.4 The cueing spot shall consist of an adhesive-backed metallic foil rounded at all four corners.

4. *35-mm Perforated 16-mm 3R (1-3-0) Motion-Picture Film*

4.1 Scene-Change Notch

4.1.1 The dimensions and location of the scene-change notch shall be as specified in Fig. 1 and Table 1. (See Appendix A2 for alternate method of forward and reverse printing.)

4.1.2 The scene notch centerline shall be centered on the 20th perforation after the scene change (5.99 in or 152.1 mm) with respect to the direction of film travel through the printer.

4.1.3 For forward and backward printing, a second notch placed in accordance with Fig. 1 may be added to the opposite edge of the film, and (observing the change in direction of travel) the centerline distance between the two notches shall be two times Dimension A in Table 1.

4.2 Scene-Change Cueing Spot

4.2.1 The dimensions and location of the cueing spot shall be as specified in Fig. 2 and Table 2. (See Appendix A3 for alternate method of forward and reverse printing.)

4.2.2 The cueing spot shall be placed 20.5 frames (6.14 in or 156.0 mm) after the scene change with respect to the direction of film travel through the printer.

4.2.3 The cueing spot shall be placed on the emulsion side of the film.

4.2.4 The cueing spot shall consist of an adhesive-backed metallic foil rounded at all four corners.

5. *16-mm Perforated 8-mm Type S 2R (1-3) Motion-Picture Film*

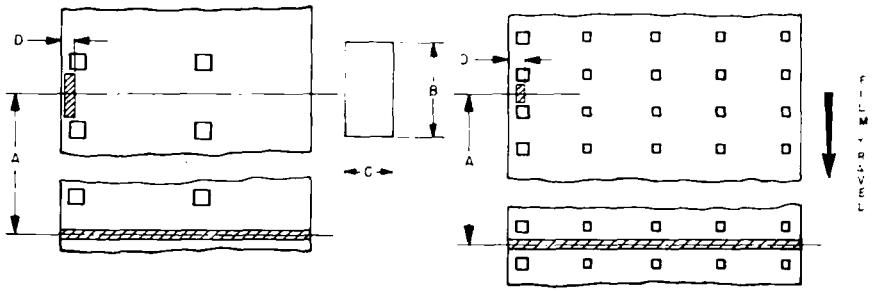
5.1 Scene-Change Cueing Spot

5.1.1 The dimensions and location of the cueing spot shall be as specified in Fig. 3 and Table 3. (See Appendix A3 for alternate method of forward and reverse printing.)

5.1.2 The cueing spot shall be centered on the 36th frameline (5.99 in or 152.1 mm) after the scene change with respect to the direction of film travel through the printer.

5.1.3 The cueing spot shall be placed on the emulsion side of the film.

5.1.4 The cueing spot shall consist of an adhesive-backed metallic foil rounded at all four corners.



FILM AS VIEWED EMULSION UP

Fig. 3
Cueing Spot for 16- Perforated 8-mm Type S 2R and 35- Perforated 8-mm Type S 5R Film

Table 3

Dimensions	Inches	Millimeters
A (36 frames) *	5.99 nom	152.1 nom
B	0.100 ± 0.005	2.54 ± 0.13
C	0.050 $^{+\ 0.000}_{-\ 0.005}$	1.27 $^{+\ 0.00}_{-\ 0.13}$
D 16-mm perforated S8	0.053 ± 0.002	1.35 ± 0.05
D 35-mm perforated S8	0.100 ± 0.005	2.54 ± 0.13

*Separation between cue spot and scene change.

6. *35-mm Perforated 8-mm Type S 5R (1-3-5-7-0) Motion-Picture Film*

6.1 Scene-Change Cueing Spot

6.1.1 The dimensions and location of the cueing spot shall be as specified in Fig. 3 and Table 3. (See Appendix A3 for alternate method of forward and reverse printing.)

6.1.2 The cueing spot shall be centered on the 36th frameline (5.99 in or 152.1 mm) after the scene change with respect to the direction of film travel through the printer.

6.1.3 The cueing spot shall be placed on the emulsion side of the film.

6.1.4 The cueing spot shall consist of an adhesive-backed metallic foil rounded at all four corners.

Appendix

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

A1. Frame-Count Cueing Method

A frame-count cueing device provides cue signals for automatic light changes, fades, and dissolves at the appropriate frame without notching or placing cueing spots on the negatives. A preprogramed memory device releases cue pulses at the correct frame location during the printing process. The scene length record may be in feet and frames or frames only as measured either from the start of the film to each successive cue (milestone method) or from the preceding light change to the next scene (batch method).

A2. Alternate Method of Notch Cueing

For forward and reverse printing, the same notch can be used. A second notch detector may be incorporated on the printer at any desirable distance from the printing aperture normally placed on the opposite side of the printing aperture in the direction of reverse film travel. Time-delay memory devices are necessary to accommodate the travel time of the film so that the scene change takes place at the proper frameline position.

A3. Alternate Method of Spot Cueing

For forward and reverse printing, the same cueing spot can be used. A second cueing spot detector may be incorporated on the printer at any desirable distance from the printing aperture normally placed on the opposite side of the printing aperture in the direction of reverse film travel. Time-delay memory devices are necessary to accommodate the travel time of the film so that the scene change takes place at the proper frameline position.