	DROPOUT THRESHOLD		
	-22 dB/ 7 μs	-16 dB/ 5 μs	- 20 dB/ 3 μs
CORRELATION COEFFICIENT	.929	.970	.750
SLOPE	.580	.939	.8
INTERCEPT	- 11.0	.6	14.1

Fig. 3. Dropout Threshold Correlation.

of objectionable dropout activity in a tape is affected by the amount of tip penetration being used. As we know, the actual amount a tip penetrates a tape decreases over the life of the video head when standard SMPTE alignment is maintained. A new video head produces approximately 3 mils penetration and a head near the end of its life penetrates the tape approximately 1 mil. Theory would predict that as the head to tape pressure is decreased because of lesser penetration, the amount of dropout activity would increase. This is borne out in actual practice.

As an adjunct to the testing previously described, the various dropout thresholds were also examined to determine their sensitivity to tip penetration. The tape samples previously described were rerun at record tip penetrations of 1.5, 1.75, 2.0, 2.5, and 3.0 mils in a designed experiment. The results of this test are shown in Fig. 4 as it applies to the 16-dB 5-μs dropout.

This curve also illustrates the vital importance of making any comparative measurements at a constant tip penetration to achieve consistent evaluation of dropout activity.

It is also important to mention that this is primarily a function of the record mode. In other words, a recording made with high penetration could be played back on a low tip head with very little change in dropout activity.

Recommendations

Based on the information just presented the Tape and Reels Subcommittee offers the following proposed recommendations.

(1) Since it is the opinion of this subcommittee that the user should not be restricted to one particular test signal in evaluating tape with an electronic counter on a video recorder, the RF detection method is to be recommended. This will permit the user to evaluate tapes from his library during the playback of actual program material. When this is done, however, the user should keep in mind the head height variable when operating at SMPTE alignment.

(2) Since most users evaluate new tape by utilizing a 75% saturated color bar test signal in the high-band mode, it is recommended that the electronic counter be adjusted in a manner that correlates as much as possible with the "color" dropout. As pointed out, tests indicate that when counting

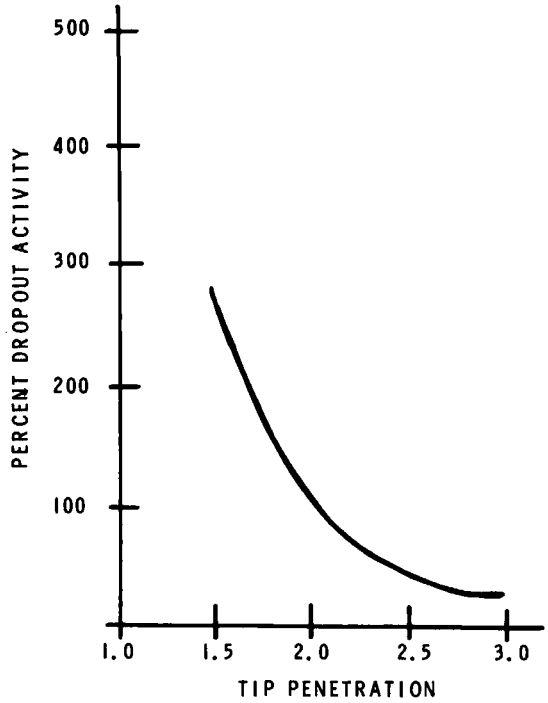

Fig. 4. Dropouts Versus Tip Penetration.

at the switcher output of high-band machines, the counter should operate with a depth setting of 16 dB and width setting of 5 μs for adequate correlation and is therefore recommended. Since when detecting "color" dropouts the tape is being examined more critically than when counting "regular" dropouts, obviously both will be counted at this setting. As seen in the previous description, the 16-dB, 5-μs dropout setting offers excellent correlation with visual observation while achieving a counting ratio of 1/1 with visual observation.

Since the "high frequency" dropout is virtually not noticed in program material and because dual level counting equipment is not presently available to the user, no attempt has been made to define this dropout in terms of depth and width.

(3) To insure the utmost consistency in dropout testing, it is recommended that 2-mil tip penetration be maintained. This will minimize the effect of tip height on dropouts. We quickly point out that this suggestion of running with a simulated 2-mil peneration, is for testing tape only. It is still recommended that SMPTE standard alignment be used for normal operation.

The Tapes and Reels Subcommittee has submitted the Proposed Recommended Practice RP 7, Electronic Method of Dropout Detection and Counting, to the VTR committee based on the data and comments included in this paper. That proposal follows.

standards and recommended practices

Proposed SMPTE Recommended Practices

Two Proposed SMPTE Recommended Practices are published for a trial period and public review:

RP 12, Screen Luminance for Drive-In Theaters, is a substantial revision of the 1962 issue and should be reviewed by all concerned with the subject. RP 47, Electronic Method of Dropout Detection and Counting, is a new proposal developed in an attempt not only to standardize a method of counting electronic dropouts in magnetic materials but also to establish an acceptable definition. A tutorial paper prepared by the subcommittee which drafted the proposal is also published in this issue of the *Journal*.

Comments should be addressed to Alex E. Alden, Staff Engineer, at Society Headquarters prior to July 15, 1972. If no adverse criticism is received by that date, the Proposed Recommended Practices will be submitted to the SMPTE Board of Governors for final approval. — A.E.A.

PROPOSED
SMPTE RECOMMENDED PRACTICE — RP 12

Screen Luminance for Drive-In Theaters

Introduction

This recommended practice has been developed by the Society's Film Projection Practice Committee as one of a group of screen brightness standards and practices to help theater designers, managers, projectionists, equipment manufacturers and service engineers in establishing the most favorable viewing conditions for theater patrons. Although the optimum viewing conditions by definition duplicate those of the review room (in which final technical and artistic judgments of the print are made), it is recognized that the drive-in theater, unlike other installations, does not have full control over its viewing environment and may be subject to various practical compromises. By indicating both the theoretical luminance objective together with the suggested limits of compromise, it is hoped this practice will be a guide in establishing the best compromise between the larger outdoor screens and the light output limitations of modern projection equipment.

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 35mm and/or 70mm 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. *Purpose*

The purpose of this recommended practice is to specify luminance levels which are compatible with those specified in American National Standard Screen Luminance and Viewing Conditions for 35mm Review Rooms, PH22.133-1963 (Reaffirmed 1969), under which theatrical print aims are established, but at the same time to recognize the wider tolerances that may be permissible and required in the drive-in theater. It is intended that the tone scale, contrast, and pictorial quality of the projected image from release prints in the drive-in theater represent as closely as possible the quality anticipated during their production and review room evaluation.

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.

3.2 Screen luminance shall be measured with a photometer having the spectral luminous efficiency of the standard observer (photopic vision) as defined in Section 3.7.2 of American National Standard Nomenclature and Definitions for Illuminating Engineering, Z7.1-1967.

3.3 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.

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 ultimate goal is to have the same screen luminance for all theaters. At present, this high level can be realized in only a few unique installations.

4.1.1 The luminance objective for the center of the screen shall be that specified in American National Standard Specifications for Screen Luminance for Indoor Motion-Picture Theaters, PH22.124-1970, 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.

4.2 For the design of new theaters with presently available facilities, and as a basis for the upgrading of existing theaters, the objective should be to attain sufficient luminance so that stray or surround light is not objectionable, and that, with a minimum accommodation time, the picture appears to be approximately of the quality observable in a review room.

4.2.1 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 4.1.1.

4.3 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.

4.3.1 When maximum compromise must be made, as discussed in Appendixes A1 and A4, 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).

5. *Luminance Distribution*

5.1 The distribution of projection illumination shall be symmetrical about the geometric center of the screen.

5.2 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 4.1.1, shall be compared with the center luminance reading obtained, and shall fall within the range of 55 to 100 percent of that reading.

5.3 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 5.2 shall be no less than 33 percent of the maximum luminance on the horizontal centerline measured from that same position.

5.4 There shall be no objectionably noticeable changes or discontinuities across the junction of adjacent panels of which the screen surface may be constructed.

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 4.1.1 shall agree within a maximum range of 15 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 4.1.1 shall agree within a maximum range of 25 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*

Possible luminance levels are limited by a minimum value below which the visual process becomes less efficient, and by a maximum value above which flicker becomes objectionable. 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.

The same prints are used for drive-in theaters as for indoor theaters and the prints are therefore suitable for the higher luminance ranges that are found in indoor theaters. When new equipment provides higher luminance, it is expected that the screen luminance in more drive-in theaters will be above the minimum limits specified.

A2. *Release Prints*

Release prints intended for viewing in theaters adjusted in accordance with this recommended practice should be examined or checked under the conditions specified in ANSI PH22.133-1963.

A3. *Other Variables*

In addition to the luminance distribution, the pictorial quality of projected pictures is influenced by the color of the projection light, the color and characteristics of the screen surface, the presence of stray light, the nature of the surround, and other factors not presently described by standards.

A4. *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 4.2.1 and 5.3 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.

A5. *Directional Screens*

Matte white screens will show substantially constant luminance at any one specific area on the screen for measurements from any location in the theater. Directional screens have been designed to reflect the projection light in a controlled manner to the useful areas of the audience. The practice applies to matte white and directional screens and to curved and flat screens.

Because the luminance of an area on a directional screen depends upon both the angle of illumination and the angle of viewing, the luminance distribution will change as the observer moves about the viewing area. The highest luminance will be in the center of the screen only for a limited portion of the ramps; from other positions, the highest luminance may appear in any part of the screen area.

A maximum permissible luminance distribution range on a given screen is specified in Sections 5.2 and 5.3. 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 5.3 when the more desirable 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. When screen design permits a smaller luminance range, it is intended that this recommended practice be revised accordingly.

A6. *Maximum Screen Size*

Projection light output and screen luminance gain determine the maximum screen size that can be illuminated to produce standard luminance. It is apparent that the largest matte screens available today cannot be illuminated even to the level given in Section 4.3.1.

A7. *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 4 and 5, the luminances of immediately adjacent areas should be observed to be sure the reading is relevant.

The influences of surround brightnesses on the measured luminance must be excluded. Smoke, dust, and atmospheric haze have an obvious effect on the measurement. But flare and reflections within the optical system of the photometer may cause large errors that are difficult to isolate. One method of checking the instrument consists of measuring the luminance of a dark surface both with and without an adjacent bright source. These measurement errors are functions of both the instrument and of the directional luminances of the theater. They cannot be removed by calibration unless the photometer is separately calibrated for each type of installation to be encountered.

A8. *Conversion of Units*

Screen luminance in the U.S. is customarily measured in footlamberts, although in the International System of Units (SI units), the candela per square meter is the preferred unit. One candela per square meter equals 0.2919 footlamberts; one footlambert equals 3.426 candelas per square meter. The name "nit" is sometimes applied to the unit of luminance instead of candela per square meter.

A9. *Image Luminance*

This recommended practice specifies screen luminance with no film in the projector aperture. When films are projected, the average image luminance will be considerably below this level.

PROPOSED

SMPTE RECOMMENDED PRACTICE — RP 47

Electronic Method of Dropout Detection and Counting

1. *Scope*

This recommended practice specifies the method of electronic dropout detection and counting for 2-inch quadruplex video magnetic tape recordings made in accordance with Practice HB of SMPTE Recommended Practice RP 6-1967, Reference Carrier Frequencies and De-Emphasis Characteristics for 2-in Quadruplex Video Magnetic Tape Recording.

2. *Dropout Definition*

A momentary random reduction of the recovered frequency modulated (RF) playback signal that is sufficient to cause a substantial impairment in the video output signal of a quadruplex video tape recorder.

3. *Specifications*

The dropout to be detected shall have an RF signal reduction of 16 dB or more for 5 microseconds or longer.

4. *Detection*

4.1 Recorder Alignment

4.1.1 The tip penetration shall be 2 mils for record and playback. (This penetration may not correspond to that specified in SMPTE Recommended Practice RP 11-1968, Tape Vacuum Guide Radius and Position for 2-in Quadruplex Video Magnetic Tape Recording, and adjustment of vacuum guide position may be necessary.)

4.1.2 The tip projection shall be between 1.5 and 2.5 mils (See Appendix A1).

4.1.3 Equalization shall be in accord with Practice HB of SMPTE Recommended Practice RP 6, producing a flat input-to-output response.

4.1.4 The recovered playback signal prior to limiting shall not vary more than 2 dB over four head passes, including amplitude variations due to geometrical error.

4.2 Test Signal. Any test signal may be used; color bars or sync and set up are preferred (See Appendix A2).

4.3 Electronic Dropout Counter. The dropout counter shall be capable of utilizing the above-mentioned signals and specifications.

4.4 Operation. The dropout counter shall be interfaced into the playback system of the video recorder so that a standard amplitude of the unlimited RF signal can be applied to the level detector of the dropout counter. This point is usually the video head switcher output.

Appendix

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

A1. The range of tip projection from 1.5 to 2.5 mils permits versatility in the heads used for dropout testing and is adequate in most cases. For the highest degree of repeatability, heads with a tip projection of 2.0 to 2.2 mils should be used.

A2. For dropout evaluation, the sync and set up signal gives the best repeatability and minimizes machine-to-machine variables.

A3. A detailed report by the SMPTE Tapes and Reels Subcommittee is presented in "Dropout Considerations in Video Tape Recording and Proposed Recommended Practices." *Jour. SMPTE*, May 1972.