SMPTE RECOMMENDED PRACTICE

RP 46-1990

Density of Color and Black-and-White Films, Prints and Slides for Television

1. Introduction

Although this practice recommends certain densities and density ranges for television films, it is important to understand that it may be difficult to find suitable areas in production films, as opposed to fixed test patterns, to measure and correlate with these specifications. The significance of the densities specified in this practice should therefore be considered with regard to the factors discussed in the Appendix.

2. Scope

This practice specifies the optimum density range of color and black-and-white 16-mm and 35-mm motion-picture films, prints, and slides intended for telecine reproduction. Ideally, such prints would also reproduce high-quality directly projected images. However, the use of lower-contrast color print stock or black-and-white stock developed to lower contrast, while improving telecine reproduction, may result in prints not meeting acceptable criteria for high-quality theatrical projection.

3. Measurement Method

The method of density measurement shall be in accordance with American National Standard for Photography — Density Measurements — Geometric Conditions for Transmission Density, ANSI IT2.19-1989. The spectral quality of the densitometer should conform to American National Standard for Photography — Spectral Conditions, ANSI/ISO 5/3-1984, ANSI PH2.18-1985, for visual density.

4. Color Density Requirements

4.1 The density corresponding to television white level should be 0.15 to 0.30 (see Note 2). This value is not intended to apply to specular highlights and other small areas where details need not be reproduced, and is dependent on the characteristics of the particular film system.

4.2 The maximum density of a film is determined by the scene contrast and the film-transfer characteristic. Shadow areas in which significant pictorial details are not present and where the reproduction of detail is not essential, may have densities greater than 2.4. However, it must be recognized that in such shadow areas the image gradation and color may be distorted or lost entirely and will appear close to television black level (see Note 2). The density range for optimum detail reproduction with modern telecine equipment is expected to be between 0.15 and 2.4.

5. Black-and-White Density Requirements

Silver-image films scatter light such that, depending upon the telecine optics, the effective densities in the upper scale region may be increased in the telecine over those measured in a singly diffuse densitometer. For color dye images, the light scatter factor (Callier Q) is approximately 1.0 and there would be little difference in the effective densities between different optics.

The densities to be recommended for black-and-white films will be somewhat lower in the higher density, or lowlight region, than those recommended for color films. Since the light scattering factor is diminished for low densities, the recommended highlight densities should be approximately the same as for color film.

Notes:

1. This practice applies primarily to prints intended for display and does not discuss nor is it relevant to the use of color or black-and-white negatives or master positives when used for direct transfer to video.

2. Television white level corresponds to 100% signal voltage output from the telecine. Television black level corresponds to 0% signal voltage from the telecine, which, after encoding for the transmitted signal, is placed at setup; i.e., 7.5 IRE.

Revision and Consolidation of
RP 46-1985 and RP 7-1982
Approved May 31, 1990

Appendix

(This Appendix is not part of the SMPTE Recommended Practice, but is included for information only.)

When printed from a given negative, the print image density range will depend on the print film characteristics and the print exposure and developing. The highlights of the image will fall on the toe portion of the print film sensitometric curve, and lighter and lighter image points will fall successively further down the toe into regions of lower incremental contrast, resulting in less and less highlight detail in the televised image. A similar condition applies in the lowlight or shadow region of the image, where the shoulder of the print film characteristic and the diminishing ability of the telecine to resolve these heavier densities, produce less and less shadow detail in the televised image.

In an analysis of the print density range for the purposes of this practice, those image points which should fall within the specified density range can be defined only arbitrarily. It would be a question of defining those areas where lower highlight densities or higher shadow densities would result in unacceptably low detail contrast, which is a subjective decision.

It has been recommended that the lightest object on the motion-picture stage in which detail is to be retained should be equivalent to a Munsell 7.0, or about 60% reflectance. When an object of that reflectance illuminated by the key light is photographed, its resulting print density can be made to meet the highlight density recommendation of this document. With that condition established and with suitable lighting contrast control, production photography and printing should produce the recommended print density range and optimum telecine reproduction.

It should be noted that the highlight and shadow densities cannot be independently varied at the film laboratory, because when the print has been exposed for a desired highlight density, the shadow densities will be a function of the negative density range and the print film characteristic. With the exception of the choice of low or normal contrast print film, the cinematographer will be the only one who can set the print density range, which will be by the adjustment of the lighting contrast on the motion-picture stage.

In general, prints meeting these recommendations will appear somewhat light and lower in contrast than films intended for theatrical projection. In particular, prints on low-contrast stock will have somewhat thin or transparent shadows, without the solid black shadows of a projection print, and less color contrast. Program production and film laboratory personnel should have the opportunity to become familiar with the appearance of films printed in this recommended density range when viewed in direct projection and to see the transformation which the telecine makes to restore the subjective visual contrast when reproducing these prints.

Obviously, routine production of television programs encompasses a wide range of photographic effects: high-key and low-key illumination, bright day and dark night scenes, and mood effects may all produce image density ranges which fall outside the recommendations of this document. The ultimate objective is for the telecine reproduction of these low-contrast, lighter prints with such varieties of scene content to match subjectively the appearance of normal contrast prints in theatrical projection. Arbitrary or autocratic imposition of certain requirements for printing can lead to unnecessary conflicts between engineering and production personnel. The function of the television system is not for the display of test patterns, but as a conduit for the presentation of dramatic productions, where the subjective analysis of image quality is as important as technical specifications.

An effective way to measure the density range of a program print is to use a telecine system as a densitometer in the following steps:

Still frame a printed gray scale of known densities in the telecine. The densities of the lightest and darkest steps of the scale should be near those specified in this practice, and the pattern should contain a black element or surround of significantly higher density than the darkest step of the scale.

Using the manual controls, set the telecine so that the lightest step of the gray scale is at 90 units on the IRE oscilloscope scale and the black element at setup.

Temporarily insert a 0.1 density neutral density (ND) gelatin filter in the image path close to the film. The voltage change on the IRE scale will enable a rough calibration of the upper portion of the scale for print density. The result, depending on the gamma setting of the telecine, should be in the range of 10 units on the IRE scale for a 0.1 density change, so that 80, 90, and 100 IRE units will represent approximately 0.3, 0.2, and 0.1 density.

Remove the gray scale film and ND filter and run the program print for analysis without any further adjustment of the telecine controls. The IRE voltage readings can be correlated with the image of various scene elements as the film progresses. There will most likely be some voltage readings above 90 IRE units, indicating that there are image points lighter than the recommended lowest density. Although some of these will be specular highlights in which no detail need be reproduced, it can be determined whether the print could have been made lighter or darker to place the lightest useful highlights at the optimum density.

A similar analysis at the lower end of the scene can indicate whether the print would benefit by being printed on low-contrast film, and whether more fill light should be used during photography to separate desired shadow detail from black. It may well be, of course, that for some scenes, little or no shadow detail would be desired, and the lighting contrast would intentionally be high.

SMPTE RECOMMENDED PRACTICE

RP 130-1990

Dimensions of Tape Splices on 16-mm and 8-mm Type R Motion-Picture Film, Projection Type

1. Scope

1.1 This practice specifies the significant dimensions of mated cut splices for 16-mm and 8-mm type R motion-picture film made with an adhesive tape and intended for projection and exhibition.

1.2 There are a number of methods for splicing triacetate or polyester motion-picture film that have found practical and commercial acceptance and that meet the operational requirements for the physical strength of the bond. This practice is not intended to recommend one method over another, but rather to emphasize the requirements common to all tape splices.

2. Application

Inasmuch as the film is usually a print, the primary objective is for the splice to be unobtrusive in the projected image area and the reproduced sound. Film guiding and positioning are usually achieved through the film seeking an equilibrium position through edge guiding for lateral positioning, and perforation reference against a loose fitting tooth or claw for vertical positioning. Splices used for projection applications may have slightly broader width tolerances than those used for laboratory applications.

3. Dimensions

3.1 The dimensions shall be as given in the figures and Table 1 and apply to freshly-made splices on processed films and leaders having a nominal shrinkage of not more than 0.2%.

3.2 The transverse cut to provide the mated pairs of film for the tape splice shall fall within the area defined by Dimensions A, C, and D. However, if the mated cut is not a straight cut made on one frameline, the cut configuration shall intrude into only one of the two adjoining picture frames and the splice shall be as inconspicuous as possible. (See Appendix A6.)

3.3 Edges of the two spliced films shall not be offset laterally by more than 0.002 in (0.05 mm) (Dimension G) unless a difference in the lateral shrinkage of the two strips makes it impossible to maintain the tolerance. (See Appendix A2.)

3.4 The angle between the respective edges of the spliced film shall be 180° ± 4'. Thus, the spliced film shall be aligned to the extent that, when one portion of the film is placed against a straight edge, the other portion will not deviate more than 0.006 in (0.15 mm) in 6 in (152 mm).

3.5 The splice should have a negligible gap between the mated cuts of the film ends to prevent hinging and there should not be any film overlap at the splice. Films joined by tape splices are not acceptable for use as originals in commercial printing operations or those intended for magnetic striping. (See SMPTE Recommended Practice RP149-1988, Dimensions of Transverse Cemented Splices on 16-mm and 8-mm Type R Motion-Picture Film, for such usage.)

3.6 The width of the tape used shall encompass the full width of the film on one side, and may exclude the perforation area and the area of the magnetic records and balance stripes on the opposite side. Splices with tape on one side only are not functional in projection and are unacceptable.

Revision of RP 130-1985
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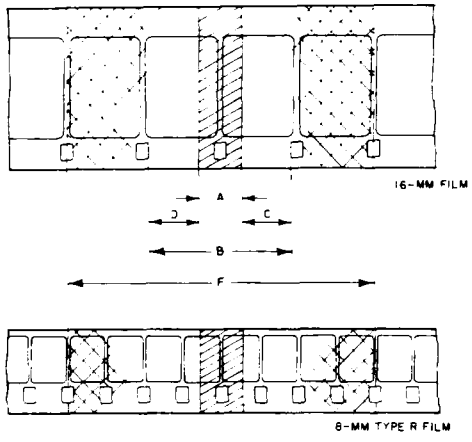

Fig. 1
Splice and Tape Area

Fig. 2
Overall Thickness

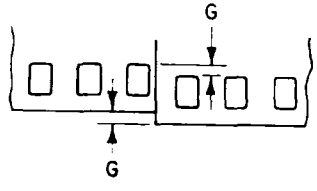

Fig. 3
Alignment Dimension

Table 1

Dimensions	Inches	Millimeters
A	0.150 max	3.81 max
B	0.548 ± 0.002	13.92 ± 0.05
C	0.349 min	8.86 min
D	0.349 min	8.86 min
E	0.010 max	0.25 max
F	1.198 ± 0.002	30.43 ± 0.05
G	0.002 max	0.05 max

3.7 Except as described in 3.9, the dimensions of the tape applied to secure the splice shall be such as not to interfere with film dimensions (especially perforations) as specified in American National Standards for Motion-Picture Film (16-mm) — Perforated IR, ANSI/SMPTE 109-1986; Motion-Picture Film (16-mm) — Perforated 2R, ANSI/SMPTE 110-1986; and Motion-Picture Film (16-mm) — Perforated 8-mm Type R, 2R, ANSI/SMPTE 239-1989, and shall fall within the area described by Dimension F.

3.8 The tape shall be wide enough to cover at least a frame on each side of the splice. For esthetic considerations, tape ends should not intrude into the picture area. Tape splices shall be made with an optically clear, transparent tape resulting in a splice capable of withstanding tension at least 50% greater than projector gate tension for that film width. The tape shall adhere uniformly to the film and be applied in such a manner as to prevent corrugations or entrapped air bubbles.

3.9 Splices made with tape wrapped around either edge of the film are not recommended since they interfere with guiding. However, if the perforated edge is used to form the wrap-around tape splice, it is recommended that the splice add no more than 0.002 in (0.05 mm) to the film width. The overall width of the spliced area should not exceed 0.632 in (16.05 mm) on 16-mm motion-picture film and 0.319 in (8.10 mm) on 8-mm type R motion-picture film. If the film is trimmed after the wrap-around splice has been made, the film width shall not be less than 0.626 in (15.90 mm) on 16-mm motion-picture film and not less than 0.312 in (7.92 mm) on 8-mm type R film, and shall not affect the perforated edge of the film.

Appendix

(This Appendix is not part of the SMPTE Recommended Practice, but is included for information only.)

A1. Maintaining continuity of pitch across the splice requires that the perforation interval within which the splice lies be equal to the perforation intervals in the unspliced portions. This may be difficult to measure, however, inasmuch as forming the bond may slightly distort perforation walls in those perforations nearest the bond (because of mechanical action) and, therefore, introduce uncertainty into the measurement.Dimension B controls the longitudinal registration of the two films being spliced. It is measured to the perforations that are most commonly used for registration on splicing blocks, and to the nearer edges of these perforations because they are the edges generally used.

A2. The lateral alignment that is most significant for the projection and exhibition mode of film use is the avoidance of any offset of the film edges before and after the splice. Dimension G. Therefore, for projection applications, this is the most convenient control parameter. (See Fig. 3.)

A3. When spliced film is bent into an arc of approximately 2-in (50-mm) diameter, it should flex smoothly, with no excessive stiffness or tendency to fold. Tape should always be applied to both sides of the film.

A4. When tape splices are used, care should be taken to keep perforations clear of foreign matter. This requires careful alignment of preperforated tape, or clean, precise perforating of the tape by the splicer.

A5. Splices should be inspected frequently for defects including dirt, discoloration, edge lifting, etc. With tape splices, it is important to inspect for stretching, hinging, oozing of adhesive, and widthwise expansion which can cause a hangup in projection. Currently available perforated or unperforated transparent polyester tape with pressure-sensitive adhesive is recommended.

A6. The transverse cut may be made in numerous configurations. Fig. 4 shows some typical configurations.

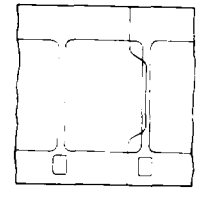

Fig. 4
Typical Splice Cut Configurations

A7. Visual disruption of the projected image caused by the splice will be minimized if the length of the splicing tape, Dimension F, is kept as short as possible within the requirements of splice performance and strength. It is anticipated that, as adhesives are improved, the length of the splicing tape may be reduced to one or two frames. Ideally, the ends of the tape should fall on the framelines to minimize visual disruption.