Appendix

(This Appendix is not part of the American National Standard, but is included for information only.)

A1. The dimensions given in this standard, excluding Dimensions A′ and E′, represent the practice of film manufacturers in that the dimensions and tolerances are for film stock immediately after perforation. The punches and dies themselves are made to tolerances considerably smaller than those given, but since film is a plastic material, the dimensions of the slit and perforated film stock never agree exactly with the dimensions of the slitters, punches, and dies. Film can shrink or swell due to loss or gain in moisture content or can shrink due to loss of solvent. These changes invariably result in changes in the dimensions during the life of the film. The change is generally uniform throughout a roll.

A2. It will be noted that among the various standards for slitting and perforating film stock there are often two standards that seem much alike in wording. The difference lies in the longitudinal pitch which is either 0.1664 or 0.1667 in (4.227 or 4.234 mm). In general, the longer pitch is for print stock and the shorter pitch is for negative or intermediate stock.

The choice of pitch for negative or intermediate motion-picture film depends, within certain limits, on the type of printer to be used. Where release step-printers are used and the film is stationary when exposed, the choice of pitch is not strictly limited. Where the film moves continuously over a cylindrical surface at the time of printing (sprocket-type contact printer), there are three major considerations involved in choosing the pitch. These considerations are: (1) the sprocket diameter and tooth engagement, (2) the film thickness and (3) the film shrinkage and the rate at which shrinkage occurs.

Maximum steadiness and definition are secured on a sprocket-type printer when the negative stock is somewhat shorter in pitch than the positive stock in the approximate proportion of the thickness of the film to the radius of curvature. For printing on a 72-tooth sprocket (circumference of about 12 in [305 mm]) with film 0.0055 to 0.0065 in (0.140 to 0.165 mm) thick, the optimum pitch differential is 0.3 percent. The use of the ideal pitch differential for the negative would minimize slippage between the positive stock and negative during the printing operation, thus reducing the amount of blurring and jumping in the vertical axis of the picture or sound image. (This error is to be differentiated from the jump caused by nonuniformity of successive pitches, Dimension B.)

Experience has shown that the average pitch derived from Dimension L of the intermediate can vary ± 0.1 percent from the ideal pitch, which is 0.3 percent shorter than the positive stock, without blurring of picture and sound image being easily detected.

For many years this desired difference in pitch was caused by the shrinkage of the negative film during processing and aging. Current film bases shrink less than the earlier ones and hence a shorter initial pitch becomes desirable. To satisfy this requirement for picture or sound negatives, it is common manufacturing practice to aim for a pitch value 0.2 percent shorter than the positive stock onto which they will be printed. The additional shrinkage that occurs during processing and the aging that takes place before the release prints are made then bring the pitch differential close to the optimum and desired value of 0.3 percent. Accordingly, the pitch chosen for the negative or intermediate stock is 0.1664 in (4.227 mm).

Low-shrinkage negative film perforated to these dimensions should not thereafter shrink appreciably more than 0.2 percent under normal use conditions, and for a reasonable life span, so that the optimum pitch differential from the positive stock of 0.3 ± 0.1 percent is maintained. (The film should be measured after equilibration with air at the conditions prevailing at the time of perforating.)

A3. The uniformity of pitch, hole size, and margin (Dimensions B, C, D, and E) is an important variable affecting steadiness. Variations in these dimensions, from roll to roll, are of little significance compared to variations from one perforation to the next within any small group of consecutive perforations. As an example, the uniformity of the margin is uniquely critical for optical printing. During the printing process, the placement of the image on the film is usually with respect to successive lateral pairs of perforations at one-frame intervals. During subsequent projection, however, the portion of the image projected is usually located, not by these perforations, but by the edge of the film. The lateral steadiness of the projected image is, therefore, directly related to the frame-to-frame uniformity of the margin.

A4. The tolerance for the slit width after processing was established to provide the laboratory with the maximum flexibility for the least critical application of commercial 8-mm Type S prints. For some commercial applications, such as photographic sound use, it will be necessary for the laboratory to consider much tighter tolerances. For these more critical uses, film shrinkage characteristics must be taken into account, and the film slit within ± 0.001 in (0.03 mm) variability.

SMPTE RECOMMENDED PRACTICE — RP 149-1988

Dimensions of Transverse Cemented Splices on 16-mm and 8-mm Type R Motion-Picture Film

1. *Scope*

1.1 Specifications. This practice specifies the dimensions of transverse cemented splices on 16-mm and 8-mm Type R motion-picture film.

1.2 Types. Two types of splices are specified: a laboratory splice for professional applications and a projection splice for release prints and consumer or amateur reversal films.

1.3 Excepted Splicers. It is not intended that this practice be prejudicial to diagonal, scarf, or tape splicers.

2. *Dimensions*

2.1 Specifications. The dimensions shall be as given in the figures and tables.

2.2 Film Width at Splice. Film width at the splice shall not exceed 0.317 in (8.05 mm) for 8-mm Type R film and 0.630 in (16.00 mm) for 16-mm film. If the film has been widened during scraping, the extra width shall be removed.

2.3 Lateral Offset for Perforation Overlap. Perforation overlapping shall not be offset laterally by more than 0.002 in (0.05 mm).

2.4 Lateral Offset for Film Edges. Edges of the two spliced films shall not be offset laterally by more than 0.002 in (0.05 mm) unless a difference in the lateral shrinkage of the two strips makes it impossible to maintain the tolerance. Shoulders formed by such misalignment shall be beveled after the cement has dried.

2.5 Angle between Edges. In the plan view, the angle between the respective edges of the spliced films 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 straightedge, the other portion will not deviate more than 0.006 in (0.15 mm), which is the approximate film thickness, in 6 in (152 mm).

Approved March 28, 1988

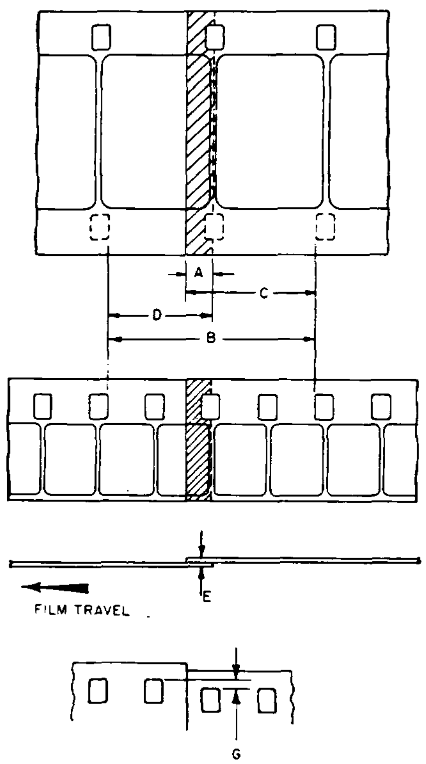

Fig. 1
Laboratory Splices

Table 1

Dimensions	Inches	Millimeters
A	0.070 ± 0.003	1.78 ± 0.08
B	0.548 ± 0.001	13.92 ± 0.03
C	0.344 ± 0.003	8.74 ± 0.08
D	0.274 + 0.000 − 0.003	6.96 + 0.00 − 0.08
E	0.012 max	0.30 max
G	0.002 max	0.05 max

Tolerances shown are not to be cumulative.

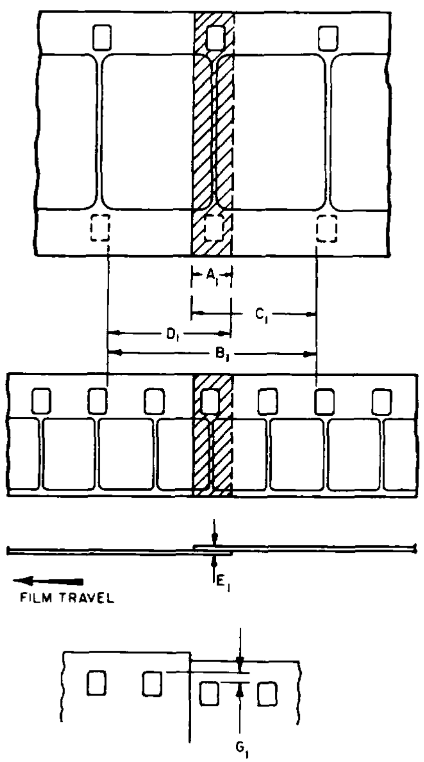

Fig. 2
Projection Splices

Table 2

Dimensions	Inches	Millimeters
A_1	0.100 + 0.000 − 0.005	2.54 + 0.00 − 0.13
B_1	0.548 ± 0.001	13.92 ± 0.03
C_1	0.324 + 0.000 − 0.003	8.23 + 0.00 − 0.08
D_1	0.324 + 0.000 − 0.003	8.23 + 0.00 − 0.08
E_1	0.012 max	0.30 max
G_1	0.002 max	0.05 max

Tolerances shown are not to be cumulative.

Appendix

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

A1. *Dimension B (or B_1)*

Dimension B (or B_1) 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, which are generally used for registration.

A2. *Dimensions C and D*

Dimensions C and D were chosen to give a splice which has one edge along the frameline. This provides the so-called invisible splice when printing A and B rolls of original photography.

A3. *Orienting the Films*

It is desirable to orient the films in splicing so that a magnetic head scanning the film would, at a splice, drop down onto the trailing film rather than bump up onto it.

A4. *Preventing White Line*

In order to prevent the appearance of a white line on the screen, the scraped area should be 0.001 to 0.003 in (0.03 to 0.08 mm) narrower than the area covered by the overlapping film. Presence of this narrow uncemented area will not shorten the life of the splice.

A5. *Striped Film*

If the film being spliced contains a stripe, the stripe must be removed from the base of the film falling on top of the mating piece.

A6. *Splicing Technique*

Emulsion and binder must be completely removed by scraping in order to ensure a strong, long-lasting cement bond. The surface on the base side of the film to be joined must also be thoroughly cleaned. Sometimes it may be helpful to roughen the base surface slightly when certain films resist satisfactory splicing.

SMPTE RECOMMENDED PRACTICE RP 150–1988

Channel Assignments and Test Leader for Magnetic Film Masters Intended for Transfer to Video Media Having Stereo Audio

1. *Scope*

This practice specifies left- and right-channel assignments for stereo usage on magnetic film masters intended for transfer to video media. It also gives recommended test signals for use on the head leader of the magnetic master.

2. *Track Assignment*

2.1 Track 1 shall contain the record intended for the left loudspeaker, and track 2 shall contain the record intended for the right loudspeaker, with left and right determined from the position of a viewer watching a screen. When more than two tracks are recorded, all odd-numbered tracks shall contain information for the left loudspeaker, and all even-numbered tracks shall contain information for the right loudspeaker.

2.2 The identity of the track numbers is contained in the document which specifies the position, dimensions and reproducing speed for the track format in use, e.g., Proposed American National Standard for Motion-Picture Film—Magnetic Audio Records—Two, Three, Four and Six Records on 35-mm and One Record on 17.5-mm Film, SMPTE 86.

3. *Head Leader*

3.1 The first test section of leader shall be a 1-kHz sine-wave signal recorded at reference level. The tone shall be recorded simultaneously and in phase on the channels of the master for a duration of 10 s. The reference level is specified in SMPTE Engineering Guideline EG 9-1985, Audio Recording Reference Level for Post-Production of Motion-Picture Related Materials.

3.2 The second section shall identify the channels audibly by sequencing in time one beep on the left channel and two beeps on the right channel.

3.3 The third section shall be a 10-kHz sine-wave signal recorded at a relative flux level equal to reference level, with the recorded characteristic frequency response of American National Standard for Motion-Picture Film (35-mm) — Recorded Characteristic — Magnetic Audio Records, ANSI PH22.208M-1984, applied. The tone shall be recorded simultaneously and in phase on the channels of the master for a duration of 20 s.

3.4 The fourth section shall be pink noise recorded simultaneously and in phase on the two channels of the master for a duration of 30 s. It shall be recorded at the reference level as read by a vu meter at 15 dB below the reference level, with the recorded characteristic specified in 3.3 applied. (The objective of using a pink-noise test signal is to obtain a reference signal with equal energy in equal logarithmic frequency intervals within the audio bandwidth.)

3.4.1 The level in each one-third octave band from 40 Hz to 16 kHz shall be equal, within the limits given in ANSI PH22.208M-1984.

3.4.2 The vu meter shall be as specified in IEEE Std 152-1953, Volume Measurements of Electrical Speech and Program Waves.

3.5 If companding noise-reduction systems are in use, the fifth section of leader shall be the tone generated by the noise-reduction system for its reference level for a duration of 10 s. Such tones generally have audible identifying characteristics, such as a deliberate periodic frequency shift, to identify the type of noise reduction audibly.

Approved May 24, 1988

Appendix

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

A1. Uses of Reference-Level Tone

A1.1 Sections A1.1.1 and A1.1.2 provide interactive adjustments which may have to be performed more than once to optimize the results.

A1.1.1 The reference level tone may be used for setting the preliminary head-mounting adjustments such as coarse rotation, azimuth, zenith, and height by setting the appropriate mechanical adjustments for the highest and most level-stable output.

A1.1.2 An X-Y display of the reference tone on an oscilloscope may be used for coarse azimuth setting using the following method:

Connect the preamplifier outputs corresponding to the two channels which represent the outside tracks on the film to the X and Y inputs of an oscilloscope, respectively. With the sensitivity of the preamplifier channels set to play the film at the oscilloscope connection point at equal voltages, and the sensitivity of the X and Y oscilloscope channels made equal, adjust the azimuth for a 45° diagonal line on the oscilloscope. Setting the azimuth coarsely, first at medium frequencies before adjusting at high frequencies, ensures that when fine adjustments are made for best high-frequency azimuth, they take place on the same cycle of the high frequency without the possibility of displacement by one full cycle which can lead to a false peak.

A1.2 The reference-level tone may also be used as a relative channel polarity test by using an X-Y display to check that each of the preamplifier outputs corresponding to the records, compared to a reference channel output, have the same slope, not the opposite slope, which would indicate a polarity reversal in the head or preamplifier wiring.

A2. Uses of Pink Noise

A2.1 Pink noise can be used to obtain the best overall azimuth by observing a Lissajous pattern on an oscilloscope with the X and Y axes connected to the signals from the two channels. When the reproducer sensitivity and equalization have been set for equal performance in the channels, and the azimuth is correct, a line will be displayed at a 45° angle, not a fuzzy ellipse. Pink noise has an advantage over sine-wave tones for azimuth adjustment as it produces unambiguous results. One cannot misadjust by one full cycle.

A2.2 In addition, pink noise can be used with a constant-percentage-bandwidth spectrum analyzer, such as a one-third-octave band analyzer, to set equalization adjustments.

PROPOSED

SMPTE RECOMMENDED PRACTICE RP 151

Lubrication of 35-mm Motion-Picture Prints for Projection

1. *Scope*

This practice recognizes that proper lubrication of 35-mm motion-picture prints is needed to promote good projection performance. Proper lubrication will result in improved steadiness, reduction of noise in the projector gate, reduced perforation damage, and increased projection life.

2. *Referenced Document*

This practice has similar use and intent to SMPTE Recommended Practice on Lubrication of 16 and 8-mm Motion-Picture Prints, RP 48-1984.

3. *Definitions*

3.1 Edge Waxing. The application of wax or other lubricant to the area of the processed print film that is outside the picture and sound track area. On 35-mm film, lubrication is usually applied to each edge, including the perforation area and margin, using a suitable applicator wheel. The high level of lubrication required by 35-mm prints usually requires edge-waxing.

3.2 Full-Width Lubrication. The lubrication of the entire surface of the film, including picture and sound track area. Usually the film is dipped in a solvent solution of the lubricant, buffed, and allowed to dry. Full-width lubrication is recommended for 16- and 8-mm motion-picture prints, as noted in SMPTE RP 48-1984. The amount of lubricant that can be applied to the film as a full-width application is limited because of problems with mottle, visibility, and roll slipperiness, and is usually insufficient for optimum projection life of 35-mm prints.

4. *Lubricants*

4.1 Recommended Lubricant. A solution of a hard wax dissolved in a suitable solvent is the recommended lubricant. No other wax or lubricant was found in the literature to be as safe, effective, or inexpensive as paraffin wax. The most commonly used solvent for dissolving and applying the wax is inhibited methyl chloroform (1,1,1-trichloroethane), a solvent often used for cleaning motion-picture film. Proper care should be exercised in handling this solvent, to minimize exposure of personnel or environment to the solvent or its vapor. An inhibited grade of solvent should be used to minimize the possibility of solvent decomposition and the release of toxic fumes.

4.2 Unsuitable Lubricants. The lubricant and solvent used should have no adverse effect on the film, and should be effective in prolonging the projection life of the print. Mineral oils (motor oil, projector oil) may dissolve and leach out the oil-soluble dyes in the film, and should not be used. Nonvolatile oils (mineral or silicone) may cause mottle or undesirable sticking together of the film surfaces, which may cause dirt particles to adhere to the film. Some materials may attack the film base or emulsion, or have an adverse effect on image stability or projection life. Avoid using solvents that are flammable or explosive, or that pose a health or environmental hazard (e.g., benzene or carbon tetrachloride).

5. *Film Cleaning*

The lubricant should be removable by normal film-cleaning operations, such as solvent cleaning. After cleaning, the film should be relubricated prior to the next projection.

6. *Edge-Waxer Design*

The edge-wax is usually applied to the film at a point near the end of the processing operation, using an applicator wheel rotating in a reservoir of edge-wax solution. The applicator wheel applies the wax solution only to the perforation and margin area of the film. The wax solution is usually applied only to the emulsion side of the film, with some transfer of the wax to the base side of the film expected when the film is wound up into a roll. The wax solution is allowed to partially dry on the film prior to wind-up, so it will not migrate into the picture or sound track area.

Many laboratories apply edge-wax to the film just prior to the film wind-up on the processing machine. Equipment is available from several suppliers, or may be custom built. Care should be taken to monitor and control the application of the edge-wax.

Edge-wax may also be applied to the processed film as a separate operation, using equipment that is currently available.

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7. *Edge-Wax Application*

The amount of wax applied to the film is a function of the concentration of the edge-wax solution, the applicator wheel speed, the film transport speed, and the surface properties of the applicator wheel. Concentrations of up to 50 grams of wax per liter of solvent may be used with the optimum concentration dependent on applicator design, machine speed, and effectiveness of the final result as described in Sections 8 and 9.

Edge-wax should not be applied to prints which will later have magnetic striping or protective overcoats applied, as the wax will prevent proper adhesion of these materials. Edge-wax should not be applied to 35-mm film which will be slit for 16- or 8-mm use. These films should be lubricated in accordance with SMPTE RP 48-1984. Edge-waxing is not necessary for prints intended only for use on continuous motion telecines.

8. *Properties of Properly Edge-Waxed Film*

The dried wax deposit should be just visible as a haze on both the emulsion and base side of the film. The wax deposit should be only in the perforation and margin area, and should not bleed into the picture or sound track area. When wound with normal tension, large rolls of film should not dish when handled, and there should be no excessive build up of wax during projection.

The effectiveness of the lubrication in prolonging projection life should be evaluated by using the Film Projection Life Test (see Section 9). Properly lubricated prints should have at least twice the projection life of unlubricated prints. Insufficient wax application will give less than optimum performance. Excessive wax application may intrude into the picture or sound track area, or result in wax flaking or buildup in the projector.

9. *Test Methods*

The Film Projection Life Test is the most reliable method for determining the effectiveness of the lubrication in improving projection life. Simple measurements of the coefficient of friction of the emulsion and base side of the film (e.g., paper-clip friction or sled friction) may not accurately measure the effectiveness of the film lubrication in actual use, although they may be of use in monitoring wax application.

The Film Projection Life Test is fully described in the reference given in Section 10.

10. *Reference*

Many technical papers have been published on the subject of film lubrication. One of the most recent, which also surveys previous work, is "Lubrication of 35-mm Release Prints for Extended Projection Print Life" by Edward Mino and Rodney S. Perry, in the October 1983 SMPTE Journal, pp 1051-1057.