SMPTE RECOMMENDED PRACTICE — RP 82-1990

Specifications for 16-mm Projector Alignment and Screen Image Quality Test Film

Introduction

This test film is designed to provide the same degree of performance evaluation for 16-mm projection systems that is presently available for 35-mm projection systems utilizing SMPTE Recommended Practice on Specifications for 35-mm Projector Alignment and Screen Image Quality Test Film, RP 40-1971(R1977). It is also intended as an engineering tool to permit quantitative measurements of projector adjustments that affect the visual image.

1. *Scope*

1.1 This practice describes the artwork and dimensions for constructing a test chart to be used as the original subject for the manufacture of the test film.

1.2 The practice also describes the types of photographic materials and densitometry necessary to manufacture the film.

2. *Description*

2.1 The test pattern on the film shall be as shown in Figs. 1 and 2.

2.2 The background checkerboard pattern provides a 50-percent transmission of the incident radiant energy which is more nearly consistent with the projection performance of an average release print. The pattern also provides a quick reference for overall image focus and quality.

2.3 The resolution charts are modified high-contrast NBS Resolution Charts with a luminance ratio of 100:1 which have been trimmed to exclude low-order resolution below 34 lines per millimeter (see Fig. 3).

2.4 The wedge steps placed on each side and above and below the center resolution chart are designed to measure quantitatively vertical image unsteadiness and horizontal weave. The actual length of the wedges and their placement around the center resolution chart are not critical, but the total width of the wedge shall equal the size of one background square, and each step shall be 20 percent of the total width of the wedge. (One square equals 1 percent of the image height.)

2.5 The diamond patches are to be inserted as a densitometric control in the exposure and processing of the original test film.

2.6 The test chart shall be photographed as a 16-mm camera original on a film manufactured in accordance with American National Standard for Motion-Picture Film (16-mm)—Perforated 1R, ANSI/SMPTE 109-1986. The film shall be capable of a modulation transfer of at least 80 percent at 80 lines per millimeter when exposed to a high-contrast resolution chart at a reduction ratio of 25:1 and then properly processed. In preparation, the film shall be used in such equipment and with such procedures as will maintain optimum resolution and steadiness.

2.7 The chart shall be photographed with a camera aperture as specified in American National Standard for Motion-Picture Film (16-mm) — Camera Aperature Image and Usage, ANSI/SMPTE 7-1988.

2.8 The test film shall be produced as a 16-mm camera original.

2.9 The vertical centerline of the pattern shall be 0.314 ± 0.002 in (7.98 ± 0.05 mm) from the reference edge of the film shown in ANSI/SMPTE 7-1988.

Revision of RP 82-1985
Approved March 9, 1990

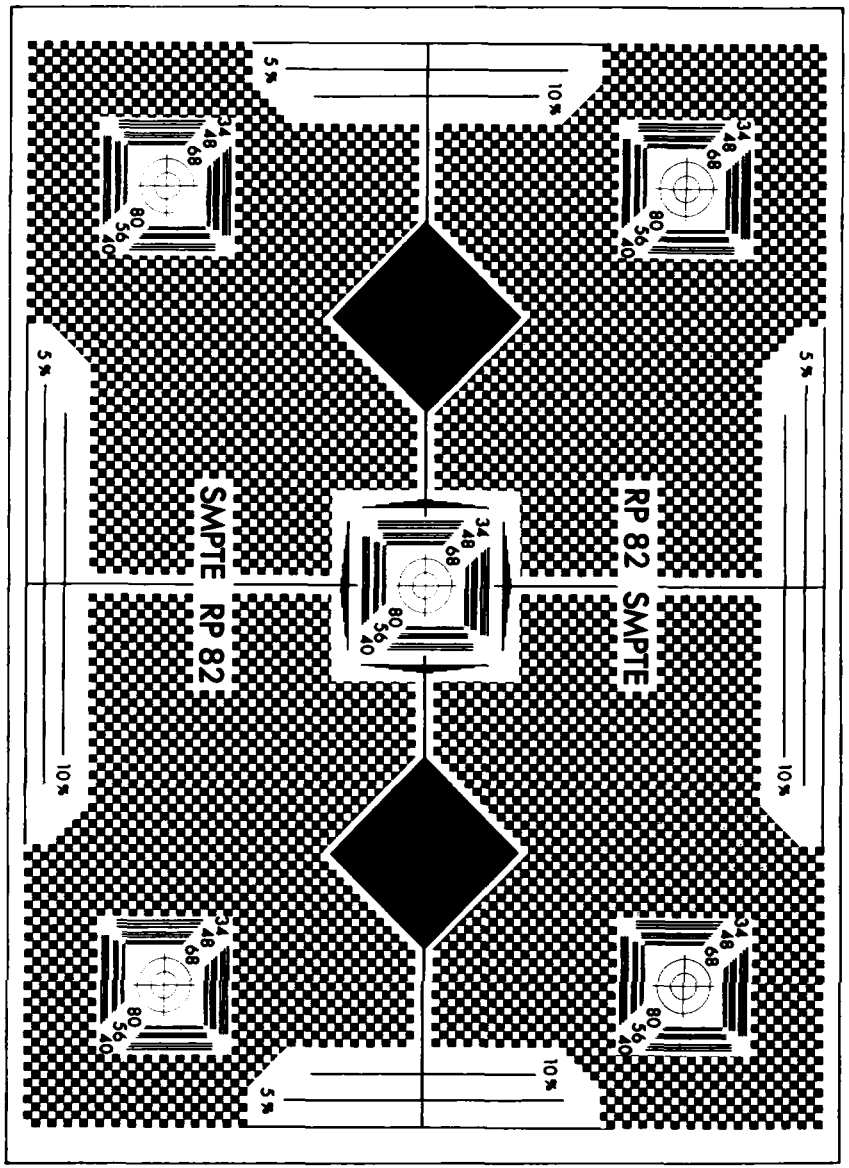


Fig. 1

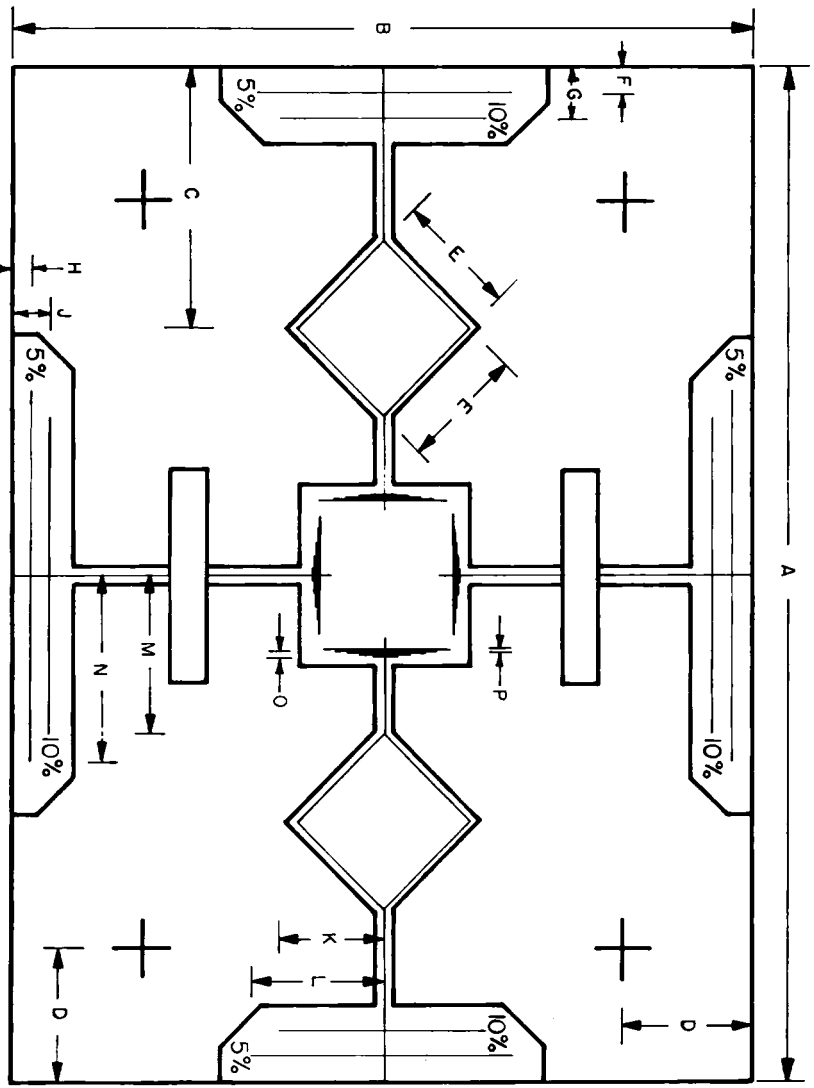


Fig. 2

Dimensions	Inches	Millimeters
A	0.380 ± 0.002	9.65 ± 0.05
B	0.285 ± 0.001	7.24 ± 0.03
C	0.10 nom	2.5 nom
D	0.05 nom	1.3 nom
E	0.0475 nom	1.206 nom
F	0.0095 ± 0.0005	0.241 ± 0.013
G	0.0190 ± 0.0005	0.483 ± 0.013
H	0.0071 ± 0.0005	0.180 ± 0.013
J	0.0142 ± 0.0005	0.361 ± 0.013
K	0.04 nom	1.0 nom
L	0.05 nom	1.3 nom
M	0.06 nom	1.5 nom
N	0.07 nom	1.8 nom
O*	0.00285	0.0724
P*	0.00057	0.0145

*Derived from Sec. 2.4.

3. *Dimensions*

3.1 The dimensions of the original test chart shall be 25X the dimensions listed in Fig. 2. (This requirement is necessary because the NBS Resolution Test Charts are designed for a 25X reduction.)

3.2 The original or 1:1 copy of the NBS Resolution Test Charts shall be cropped as specified in Fig. 3. The modification shall be similar to that illustrated in Fig. 4.

3.3 The modified NBS Resolution Test Charts shall be placed on the original test chart as specified by the dimensions in Fig. 2.

3.4 The gray patches shall be at least the dimensions specified in Fig. 2 in order to be readable in current 1-mm aperture densitometers after a 25X reduction.

3.5 The checkerboard background on the test chart shall contain 100 squares vertically and 134 horizontally.

3.6 The horizontal and vertical lines indicating 5- and 10-percent reductions in image length or height shall be placed on the test target in accordance with the dimensions specified in Fig. 2.

Note: A test film conforming to this practice is available from the Society of Motion Picture and Television Engineers.

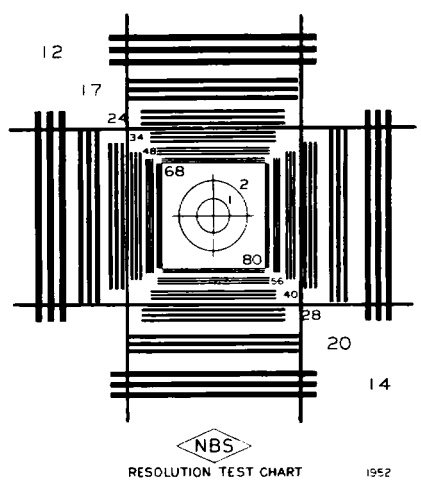


Fig. 3

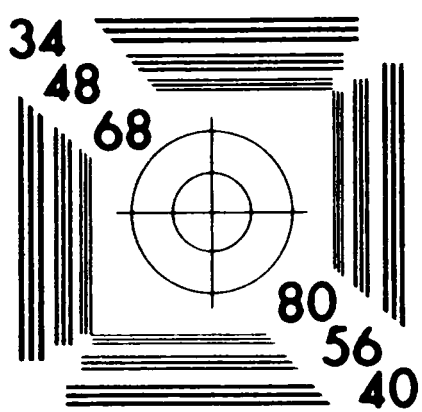


Fig. 4

Appendix

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

A1. It has been found that producing test films with resolution at 80 lines per millimeter requires careful selection of the materials and equipment used, and careful control of the operations. Inasmuch as a measuring tool should be better than the system it is designed to measure, it is desirable that the test film meet the specifications detailed herein, although normal theatrical program release prints will not usually meet these specifications.

A2. The camera used to photograph the high-contrast test target must have a lens of suitable design and correction to provide an image of sufficient resolution to allow a modulation transfer of at least 80 percent at 80 lines per millimeter on the processed film image over the entire field. The camera mechanism must provide steady images, preferably ensured by pin registration.

A3. Image densities referred to in this Appendix are intended for a more precise definition of one system shown to be applicable, and are measured in accordance with American National Standard for Photography — Density Measurements — Geometric Conditions for Transmission Density, ANSI PH2.19-1986.

Selection of a film for producing the test film must take into consideration the requirements of Sec. 2.6.

A study of many film products indicates that a high-contrast panchromatic film is applicable but, for adequate control of line widths, resolution, etc., there must be careful control of both exposure and processing. Quality control may be achieved conveniently by inserting a gray patch having a density of about 0.94 on the film when all the conditions have been met. For a reflective target and for film processed as recommended to a lb control gamma of 3.3, this has been achieved with a gray patch having a reflectance of 32 percent. For a transmission target, a gray area of a different density may be needed to provide the identical test films.

A4. If constructing an original reflecting test chart with a negative image is desirable, it should be pointed out that negative NBS Resolution Test Charts are unavailable. However, they can be manufactured from an original positive by a competent graphic arts studio familiar with the requirements of size and resolution.

SMPTE RECOMMENDED PRACTICE

RP 116-1990

Dimensions of Photographic Control and Data Record on 35-mm Motion-Picture Camera Negatives

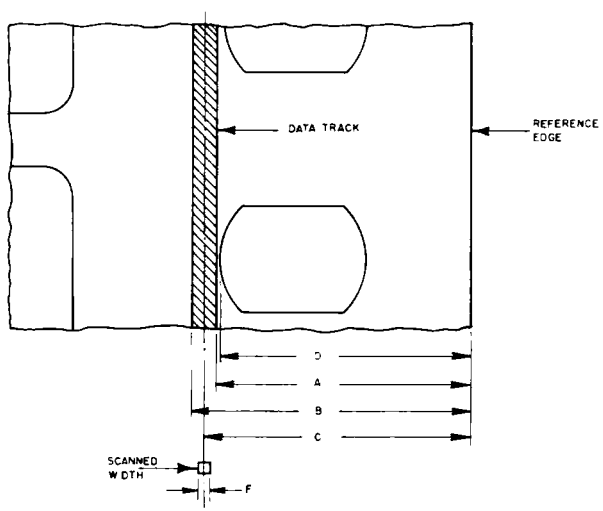
1. *Scope*

This practice specifies the lateral location and dimensions of a photographic control and data record on 35-mm motion-picture camera negatives, the width scanned by the control and data recorder and reproducer, the camera aperture, and the reproducer spectral sensitivity.

2. *Data Record*

2.1 The dimensions and lateral location of the control and data record shall be as specified in the figure and table.

2.2 The recording and reproducing slit images shall be positioned at an angle of 90° ± 1° to the reference edge of the film.



Dimensions	Inches	Millimeters
A	0.191 ± 0.001	4.85 ± 0.03
B	0.211 ± 0.001	5.36 ± 0.03
C	0.201 ± 0.001	5.11 ± 0.03
D	0.189 ref	4.80 ref
F	0.005 ± 0.001	0.13 ± 0.03

Revision of RP 116-1983
Approved March 9, 1990

3. *Camera Aperture*

Cameras intended for recording a control and data record must have a modified aperture which positions the picture edge next to the sound record area at 0.214 in (5.44 mm) minimum from the reference edge of the film. This is Dimension D as specified in American National Standard for Motion-Picture Film (35-mm) — Camera Aperture Images, ANSI/SMPTE 59-1989.

4. *Reproducer Spectral Sensitivity*

The peak or maximum response of the combination of the control and data track reproducer, light source, filter, and receptor shall be at 550 + 130 — 0 nanometers. The integrated response of this combination to all wavelengths greater than 800 nm shall be less than 5 percent of the total integrated response measured from 400 to 800 nm.

Appendix

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

The spectral response specified in Section 4 is intended to ensure that the control and data track will be adequately reproduced whether the track image is formed of dyes, silver, or dyes and silver. Restriction of the infrared response is necessary because the dyes used in conventional color motion-picture films do not absorb infrared light effectively. Since dirt and scratches on the film will absorb infrared light, restriction of the infrared response will improve the signal-to-noise ratio of the system.

Proposed American National Standard

for motion-picture film (35-mm) — camera aperture images and usage

SMPTE 59

Revision and Consolidation of ANSI/SMPTE 59-1989 and ANSI/SMPTE 219-1985

1. Scope

1.1 This standard specifies the dimensions of the camera aperture images and the relative positions of the vertical and horizontal centerlines of the intended image area with respect to the reference edge and the perforations of the camera negative film for 35-mm motion-picture cameras.

1.2 Motion-picture cameras used for different purposes require different aperture sizes. This standard specifies the image dimensions resulting from three styles of apertures used for the following purposes:

Style A: Nonanamorphic sound motion pictures

Style B: Anamorphic sound motion pictures

Style C: Instrumentation photography and special processes

1.3 This standard also specifies the position of the photographic emulsion and the frame rate for 35-mm motion-picture cameras.

2. Referenced American National Standard

This standard is intended for use in conjunction with the following American National Standard:

ANSI PH22.40-1984, Motion-Picture Film (35-mm) — Photographic Audio Records — Release Prints

3. Dimensions

The dimensions shall be as specified in Figs. 1 and 2 and the tables. They shall apply to measurements of the images formed on fresh film, properly exposed and processed.

4. Emulsion Position

The emulsion shall be toward the camera lens, as shown in Fig. 3.

5. Frame Rate

The standard frame rate for motion-picture photography is 24 frames per second. However, it is recognized that nonstandard frame rates are sometimes used for specific applications. For example, 24, 25, or 30 frames per second may be used for motion pictures intended for television; higher or lower frame rates may be used for special motion-picture effects and analysis. The use of nonstandard frame rates requires notification and agreement of all parties concerned with the use of the particular film.

Note: The displacement of 0.050 in (1.27 mm), Dimension G, of the vertical centerline of the image area for styles A and B is in accord with current usage of low-shrinkage film base. However, there are in use many cameras in which the vertical centerline is displaced by 0.055 in (1.40 mm), which is the dimension used prior to the development of low-shrinkage film base.

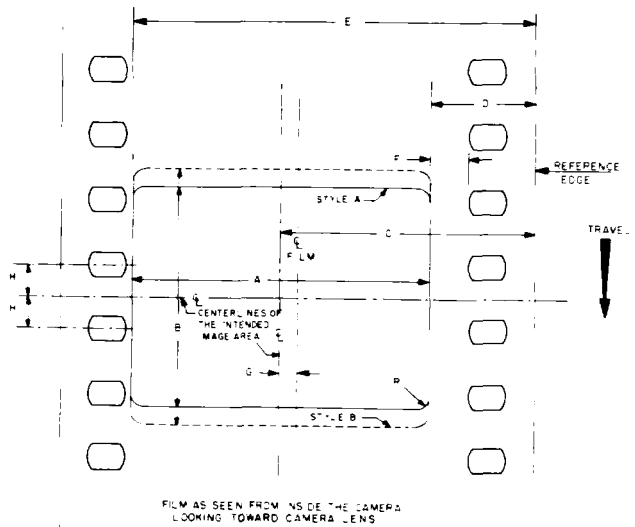


Fig. 1
Styles A and B Camera Aperture Image Area

Table 1
Style A

Dimensions	Inches	Millimeters
A	0.864 nom	21.95 nom
B	0.63 $^{+0.02}_{-0.00}$	16.0 $^{+0.5}_{-0.0}$
C	0.738 ± 0.002	18.75 ± 0.05
D	0.307 max	7.80 max
E	1.171 min	29.74 min
F	0.115 nom	2.92 nom
G	0.050 nom	1.27 nom
H	0.093 ± 0.002	2.36 ± 0.05
R	0.03 max	0.8 max

Table 2
Style B

B	0.732 $^{-0.008}_{-0.000}$	18.59 $^{-0.20}_{-0.00}$

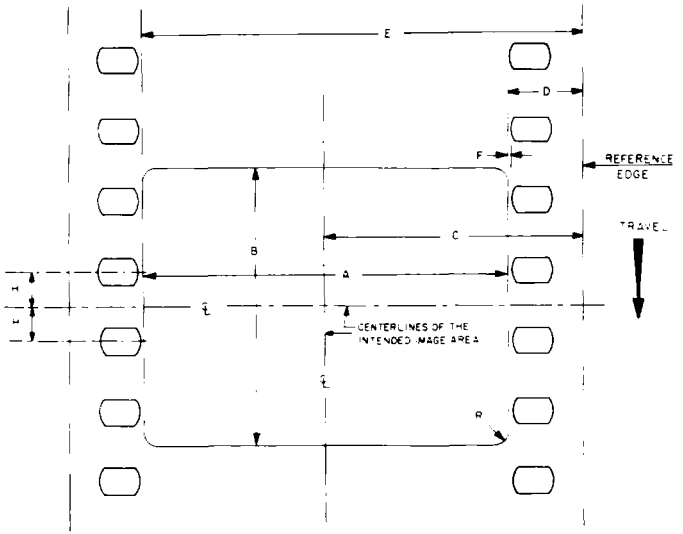


Fig. 2
Style C Camera Aperture Image Area

Table 3
Style C

Dimensions	Inches	Millimeters
A	0.981 nom	24.92 nom
B	0.735 ± 0.002	18.67 ± 0.05
C	0.688 ± 0.002	17.48 ± 0.05
D	0.198 max	5.03 max
E	1.179 min	29.95 min
F	0.009 nom	0.23 nom
H	0.093 ± 0.002	2.36 ± 0.05
R	0.03 max	0.8 max

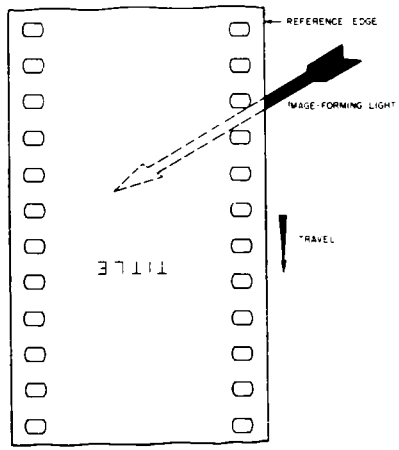


Fig. 3
Film Viewed from Inside Camera Looking Toward Camera Lens

Appendix

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

A1. Relationship Between Photographic Audio and Picture

Displacement of the picture and corresponding photographic audio as recorded in single-system cameras is dependent upon the camera design, and may vary among camera models. When prints are made, the picture-audio displacement should be in accordance with ANSI PH22.40-1984. The location and dimensions of the photographic audio record should also be in accordance with ANSI PH22.40-1984.

Proposed American National Standard
for motion-picture film (16-mm) —

projectable image area and projector usage

SMPTE 233
Revision and Consolidation of ANSI/SMPTE 10M-1985
and
ANSI/SMPTE 233-1987

1. Scope

1.1 This standard specifies the maximum dimensions of the film image area intended for projection from a 16-mm motion-picture film, and the placement of this area relative to the perforations and the reference edge of the film.

1.2 This standard also specifies the position of the emulsion and the rate of projection for 16-mm motion-picture film perforated one or two edges, and the projector thread-up distance between audio and picture for 16-mm motion-picture film with audio.

2. Referenced Documents

This standard is intended for use in conjunction with the following documents:

ANSI/SMPTE 7-1988, Motion-Picture Film (16-mm) — Camera Aperture Image and Usage

ANSI/SMPTE 41-1989, Motion-Picture Film (16-mm) — Photographic Sound Records — Prints

ANSI/SMPTE 48-1989, Motion-Picture Film (16-mm) — Printed Areas — Picture and Sound Contact Printing

ANSI PH22.96-1982, Dimensions for Television Image Area on 16-mm Motion-Picture Film

ANSI/SMPTE 109-1986, Motion-Picture Film (16-mm) — Perforated 1R

ANSI/SMPTE 110-1986, Motion-Picture Film (16-mm) — Perforated 2R

ANSI/SMPTE 112-1989, Motion-Picture Film (16-mm) — 100-Mil Magnetic Audio Record

SMPTE RP 27.3-1989, Specifications for Safe Action and Safe Title Areas Test Pattern for Television Systems

SMPTE RP 65-1987, Step Optical Reduction Printing of 35-mm Images to 16-mm Prints and Duplicate Negatives

SMPTE RP 66-1987, Step Optical Enlargement Printing of 35-mm Images from 16-mm Images

3. Dimensions

3.1 The dimensions shall be as given in Fig. 1 and the table.

3.2 The angle between the horizontal edges of the image area and the reference edge of the film shall be $90° \pm ½°$.

4. Relationship to Other Standards

4.1 This standard may be used as the basis for establishing picture areas from original photography for final viewing because it presents a description of the picture area on the projection print that is usable for the indicated purposes of the print (which is of primary importance because the projection print is the most commonly interchanged item). (See Appendix A2.)

4.2 The following documents define image areas for other important phases of motion-picture operations, and are consistent with one another under currently acceptable commercial practice: ANSI/SMPTE 7-1988, ANSI/SMPTE 48-1989, ANSI PH22.96-1982, SMPTE RP 27.3-1989, SMPTE RP 65-1987, SMPTE RP 66-1987.

5. Emulsion Position

For original reversal film, the emulsion side shall be toward the projection lens. For prints, the emulsion position is dependent upon the process of preparation and either emulsion-to-light-source or emulsion-to-projection-lens orientation may be encountered. (See Fig. 2 and Note 5.) The actual emulsion position should be indicated on the leader and the film container by notation or diagram.

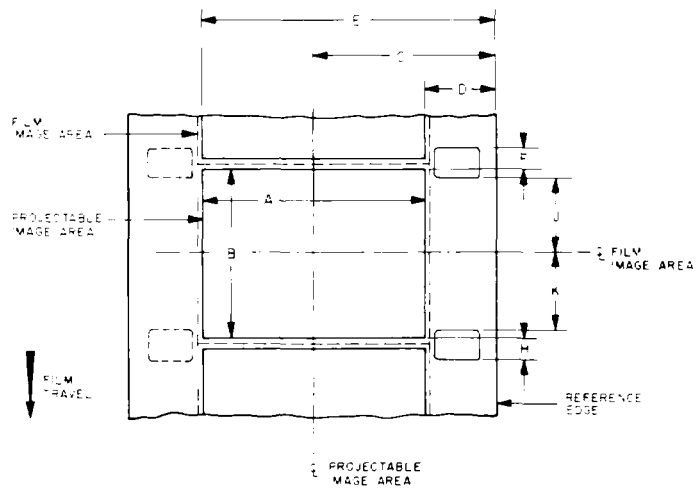


Fig. 1
Projectable Area on Film as Seen Looking Through the Film Toward the Lens

Dimensions	Inches	Millimeters
A	0.380 ref	9.65 ref
B	0.286 *max*	7.26 *max*
C	0.314 ref	7.98 ref
D	0.122 min	3.10 min
E	0.506 max	12.85 max
F = H	within 0.014	within 0.36
J = K	nominally equal	nominally equal

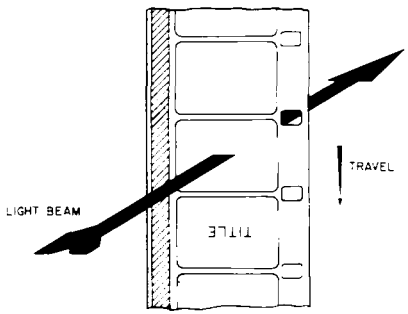


Fig. 2
Film as Seen from Projector Light Source Looking Toward Lens

6. Projection Rate

The standard frame rate for motion-picture projection is 24 frames per second. However, it is recognized that nonstandard frame rates are sometimes used for specific applications. For example, 24, 25, or 30 frames per second may be used for motion pictures intended for television; higher or lower frame rates may be used for special effects and analysis, and nonstandard rates may be used for special motion-picture systems. A rate of 18 frames per second is often used for amateur silent films. The use of nonstandard frame rates requires notification and agreement *of all parties concerned with the use of the particular film.*

7. Relationship Between Audio and Picture

The projection thread-up for motion-picture films containing an audio record shall place the audio-scanning point ahead (in the direction of film travel) of the center of the picture being projected. Counting the frame in the projector aperture as zero, the audio-scanning point shall be opposite the center of the 26th frame for photographic audio or the 28th frame for magnetic audio, as specified in ANSI/SMPTE 41-1989 and ANSI/SMPTE 112-1989. If there is a significant distance between the average observer and the loudspeaker when the audio record is reproduced, the distance from the center of the projected aperture to the audio-scanning point may need to be shortened in the projector thread-up *to bring the picture and audio into synchronization* for the average observer (because of the slower rate of travel of audio compared to that of light). If the average loudspeaker-to-audience distance is greater than 50 ft (15 m), the projector thread-up distance between projected picture and audio scan should be shortened by one frame for each nominal 50 ft of distance from loudspeaker to average audience.

Note 1: Camera and Printer Apertures. The actual image on the film is significantly larger than the maximum area intended for projection, so that in placement of the images throughout the sequence of films, the tolerance is not restrictive of commercial practice. Upper limits have been established through consideration of good practice in avoiding frame overlap, encroachment upon areas reserved for audio records, flare from perforation edges, etc. Lower limits are similarly related to the avoidance of image effects at a defined edge, tolerances in film positioning, etc.

Note 2: Projector Aperture. Dimensions B, D, and E in the table define the maximum image area on the film that is available for projection. They do not define the opening in the aperture plate of a projector. The size of this opening may differ from Dimensions A and B, for example, because of the physical separation necessary between the aperture plate and the film to avoid scratching the film, or the slant of the marginal rays accepted by the lens.

Note 3: Actual Projected Area. It is recognized that, in many cases, the actual film image area that is projected may be smaller than the projectable maximum and, in some cases, may be nonrectangular (for example, an irregular four-sided figure bound by either straight or curved lines). Such departures may result from equipment considerations such as slight inconsistencies among lenses, screen sizes, etc; from geometric limitations such as the screen surface being at an angle other than 90° from the projection axis, or being nonplanar, or both; and from aesthetic considerations such as pictorial composition within more restrictive image limits. In the absence of specific instructions to the contrary, it is intended that the actual projected film image area be the largest appropriately-shaped figure that can be inscribed within the specified dimensions.

When the picture outline on the screen is defined by the projector aperture, it is customary to round the corners of the projected film area. A maximum corner radius of 0.020 in (0.51 mm) at the film plane is recommended.

Note 4: Film Perforations. Film intended for projection with this image area is normally perforated as specified in ANSI/SMPTE 109-1986 and ANSI/SMPTE 110-1986.

Note 5: Contact Prints. When a relatively small number of prints is required, contact prints are often made from 16-mm original materials, resulting in the emulsion position toward the light source. The majority of 16-mm release prints are printed by contact from a 16-mm intermediate or by reduction from a 35-mm intermediate in order to protect the originals. The resulting prints generally have the emulsion side toward the projection lens. This permits intercutting of prints and originals without requiring a change of picture or sound focus during projection.

Appendix

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

A1. Centerlines

The centerlines of the image area are given for convenience in interpreting the standard, facilitating such applications as the optical design of equipment, and assisting in the understanding of suitable mechanical embodiments related to projectable image area.

A2. Projectable Image Area

Essentially, the entire image within the maximum established by this standard will be transferred in such operations as reduction or enlargement printing (SMPTE RP 65-1987 and SMPTE RP 66-1987), for television broadcasting (ANSI PH22.96-1982), etc. Since the entire area will be presented, it is important that the projectable area include only material that meets recognized standards for technical and artistic excellence.

A3. Image Area for Television

It is recognized that home television receivers are adjusted to show a distribution of picture sizes, ranging downward from the maximum. Guides to picture composition, based upon a statistical survey of receivers in use, are presented in SMPTE RP 27.3-1989. Note that some portion of the audience will see the entire transmitted area, but for certainty in presentation of critical information over broadcast television, such information should be confined to a smaller, central area.

PROPOSED

SMPTE RECOMMENDED PRACTICE RP 159

Vertical Interval Time Code and Longitudinal Time Code Relationship

1. Scope

This practice specifies the relationship between vertical interval time code (VITC) and longitudinal time code (LTC) when recorded on television tapes for use in the 525/60 television system.

2. Referenced American National Standard

This practice is intended for use in conjunction with the following American National Standard:

ANSI/SMPTE 12M-1986, Television – Time and Control Code – Video and Audio Tape for 525-Line/60-Field Systems

3. Interchange

For the purpose of tape interchange between facilities, the VITC and LTC shall have:

(1) Complete correspondence of the time address data of each word between the two codes.

(2) No restrictions in terms of data correspondence between the user groups of each word.

(3) No restrictions on data content in terms of correspondence between the two codes within a facility.