

for all three colors (that is, light output varies in proportion with signal level<sup>2,5</sup>).

#### 2.4: Telecine Optical and Electrical Characteristics

The ideal-color-telecine shall be specified as having the following characteristics:

(1) The "taking curves" (that is, the spectral sensitivities of the three color channels) shall be the C.I.E. 1931<sup>1</sup> color matching functions  $\bar{x}(\lambda)$ ,  $\bar{y}(\lambda)$ ,  $\bar{z}(\lambda)$ .

(2) The light output of the projector shall be the spectral emission function of a D6500 source.

(3) The camera tube voltage outputs shall be linearly proportional to the incident light.

(4) The camera tube output signals shall be mixed in a linear matrix. The coefficients of this matrix depend upon the specified chromaticities of the standard color monitor phosphors (see 2.3.1 above) and the shape of the camera taking curves. For the ideal-color-telecine, this matrix takes the following form:

$$\begin{bmatrix} E_{R \text{ out}} \\ E_{G \text{ out}} \\ E_{B \text{ out}} \end{bmatrix} = \begin{bmatrix} 3.240 & -1.537 \\ -0.894 & 1.815 \\ 0.112 & -0.228 \end{bmatrix} \begin{bmatrix} E_{R \text{ in}} \\ E_{G \text{ in}} \\ E_{B \text{ in}} \end{bmatrix} + \begin{bmatrix} -0.499 \\ 0.032 \\ 1.030 \end{bmatrix}$$

(5) The gray-scale characteristic of the ideal-color-telecine shall be defined by the equation  $V = 132T^{0.4}$ , where  $V$  is the output signal voltage in % of the black to white excursion, and  $T$  is diffuse film transmittance, i.e.

$$T = 1/\text{antilog}_{10} \text{ Density}$$

*Note:* Film density is measured in terms of diffuse visual density with a densitometer calibrated in accordance with Recommendation R5-1954 of the International Standards Organization.

*Note:* When  $V$  is 100%, the diffuse visual density is 0.3; when  $V$  is 0% the diffuse visual density is  $\infty$ .

*Note:* The nonlinearity between  $V$  and  $T$  is the result of gamma correction.

(6) The ideal-color-telecine is defined in terms of a three-channel system to

avoid color rendition errors in other systems.

(7) The matrixed gamma-corrected signals are encoded according to D.O.T. Broadcast Specification 12, issue 2.

(8) All of the above electronic circuits are assumed to be free of all undesired characteristics which might affect the signal. Also, the optical circuits are assumed to be free of flare, ghosts and other undesired characteristics which might affect the image. Thus the ideal-color-telecine should perform precisely the operations specified above.

#### 2.5: Color Rendering Index<sup>4</sup>

For the ideal color telecine, the color rendering index ( $I_{TCR}$ ) equals 100.

#### References

1. *Proceedings*, Commission Internationale de l'Eclairage, 8th Session, Cambridge, 1931.
2. CTP 1 — "Viewing room for evaluation of 16mm color film for television."
3. CTP 2 — "Viewing conditions for evaluation of color television pictures."
4. CTP 6 — "The measurement of color rendition in color telecine" (to be issued later).

## standards and recommended practices

### Draft American National Standard

A Draft American National Standard is published here for a trial period and public review. Comments should be addressed to Alex E. Alden, Staff Engineer, at Society Headquarters before October 30, 1970. The proposal has been submitted to American National Standards Committee PH22. Consequently, all comments received through *Journal* publication will be reviewed prior to conclusion of action by this committee.

PH22.106, Dimensions of Projectable Anamorphic Image Area on 35mm Motion-Picture Film, 2.35:1 Aspect Ratio, has been revised to conform in format with other similar standards. It should be noted that the height of the area has been decreased to lessen flashes on the screen caused by positive splices.

### Approved SMPTE Recommended Practice

On August 2, 1970, the Society's Board of Governors approved SMPTE Recommended Practice RP 16, Specifications of Tracking Control Record for 2-In. Quadruplex Video Magnetic Tape Recordings. The only change from the previous issue is the addition of the following statement to Section 4.2:

"To assist in certain restricted types of color editing, alternate frame pulses may be omitted. Since omission of alternate frame pulses may result in slightly lengthened lock-up time in tape replay, users may wish to obtain prior agreement before distributing such tapes."

RP 16 was published in the September 1968 *Journal*. Copies of SMPTE Recommended Practices may be acquired from Society Headquarters upon request.

### SMPTE Recommended Practices Reaffirmed

On August 2, 1970, the Board of Governors, taking the recommendation of the SMPTE Engineering and Standards Committees, reaffirmed without change the following Recommended Practices:

RP 9 Dimensions of Double-Frame 35mm 2 × 2 Slides for Precise Applications in Television (published in the August 1966 *Journal*)

RP 21 Dimensions of 35mm Rewind Spindles (published in the August 1966 *Journal*)

RP 22 Specifying Graph Paper Used in Inter-Laboratory Exchange of Plotted Sensitometric Data (published in the December 1966 *Journal*)

Upon recommendation of the 16 and 8mm and Standards Committees, the Board reaffirmed without change on April 26, 1970, SMPTE Recommended Practice RP 18, Test Film for Checking 16mm Motion-Picture Photographic Sound Projectors (published in the November 1964 *Journal*).

### Proposed SMPTE Recommended Practice

A Proposed Recommended Practice is published here for a trial period and public review. Proposed SMPTE Recommended Practice RP 40, Specifications for 35mm Projector Alignment and Screen Image Quality Test Film, is an updated modification of the SMPTE All-Purpose Projector Alignment Test Film. Additional visual data were incorporated to evaluate the performance of a projection system in terms of screen image quality. It is intended as an engineering tool to permit quantitative measurements of projector adjustments that affect the visual image.

Comments are invited and should be addressed to Alex E. Alden, Staff Engineer, at Society Headquarters prior to October 30, 1970. If no adverse criticism is received by that date, the Proposed Recommended Practice will be submitted to the Board of Governors for final approval.

### Withdrawal of SMPTE Recommended Practice

On August 2, 1970, the SMPTE Board of Governors approved the recommendation by the Photo-Instrumentation and Standards Committees that RP 3-1957, Lens Mount Surface for High-Speed Motion-Picture Cameras, be withdrawn. The withdrawal was recommended because the specifications were not being followed. RP 3 was published in the SMPTE *Journal* of August 1957. — A.E.A.

# Projectable Anamorphic Image Area on 35mm Motion-Picture Film

## 2.35:1 Aspect Ratio

PH22.106  
Revision of  
PH22.106-1965

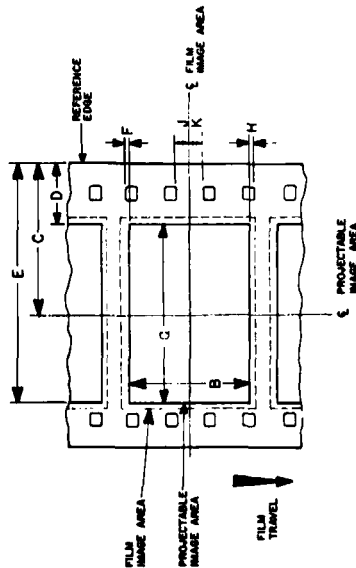
### 1. Scope

This standard specifies the maximum dimensions of the film image area intended for projection from a 35mm anamorphic motion-picture print with a compression ratio of 2:1 and an aspect ratio of 2.35:1, and the placement of this

area relative to the perforations and the reference edge of the film.

### 2. Dimensions

The dimensions shall be as given in the figure and table.



PROJECTABLE AREA ON FILM AS SEEN LOOKING THROUGH THE FILM TOWARD THE LENS

Dimensions	Inches	Millimeters
B	0.700 max	17.78 max
D	0.318 min	8.08 min
E	1.138 max	29.41 max
F = H	within 0.012	within 0.30
The following values are included for convenience		
a	0.838 nom	21.29 nom
c*	0.738 nom	18.75 nom
i = k	nominally equal	nominally equal

\*See Appendix

### 3. Relationship to Other Standards

3.1 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.)

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 considerations of good practice in avoiding frame overlap, encroachment upon areas reserved for sound 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 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, the slant of the marginal rays accepted by the projection lens, etc.

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 non-rectangular (for example, an irregular four-sided figure bound by either straight or

3.2 The following standards define image areas for other important phases of motion-picture operations, and are consistent with this standard and with one another under currently acceptable commercial practices:

- Dimensions of 35mm Motion-Picture Camera Aperture Images, PH22.59-1966
- Dimensions of Exposed Areas for Picture and Photographic Sound on 35mm Motion-Picture Prints Made on Continuous Contact Printers, PH22.111-1965 (Reaffirmed 1969)

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 non-planar, 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.

NOTE 4: Film Perforations. Film intended for projection with this image area is normally perforated as specified in American National Standard Dimensions for 35mm Motion-Picture Film, DH-1870, PH22.1-1964 (Reaffirmed 1969); American National Standard Dimensions for 35mm Motion-Picture Film, KS-1870, PH22.36-1964 (Reaffirmed 1969), and American National Standard Dimensions for 35mm Motion-Picture Film, CS-1870, PH22.102-1964 (Reaffirmed 1969).

NOTE 5: Print Preparation. Prints conforming to this standard are prepared for use as specified in American National Standard Dimensions for Four-Track Magnetic Sound Records for 35mm Release Prints, PH22.137-1963 (Reaffirmed 1969).

### Appendix

(The Appendix is not a part of this American National Standard, but is included to facilitate its use.)

#### 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. Note that the centerline of the projectable image area is displaced from the centerline of the film by 0.050 in. (1.27mm) nominal.

#### 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. 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.



2.8.2.1. The printing light shall be chosen so that after processing in the recommended manner, there is cancellation of the image spread in the resolution targets specified in 2.3 and 2.4, at 80 lines per millimeter. The gray patch density specified in 2.5 provides a convenient densitometric control for the exposure and processing after the characteristics of the system have been established.

2.8.3 The projection print shall be prepared by splicing together 100 ft of the black-and-white film as specified in 2.8.1 followed by 100 ft of the dye image film as specified in 2.8.2. Projection prints shall be made in accordance with American National Standard Dimensions of Exposed Areas for Picture and Photographic Sound on 35mm Motion-Picture Prints Made on Continuous Contact Printers, PH22.111-1965 (Reaffirmed 1969).

3. Dimensions

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

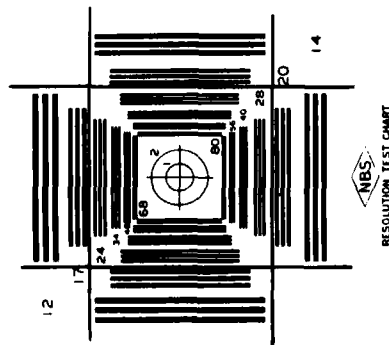


Figure 3

3.2 The reference figures, adjoining the horizontal and vertical lines, indicate the projector aperture dimensions in units of 0.001 in. and shall be multiplied by 25 to provide the dimensions for making the original test chart.

3.3 All vertical lines in the test chart, except in the resolution test charts, shall be one half the thickness (0.0012 in.) of the horizontal lines to compensate for the 2:1 image spread in anamorphic systems.

3.4 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.

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

3.6 The 27 percent reflective gray patches shall be at least the dimensions specified in Fig. 2 in order to be readable in current 1mm-aperture densitometers after a 25X reduction.

3.7 The checkerboard background shall contain 200 squares across the width of the test chart (0.889 in.).

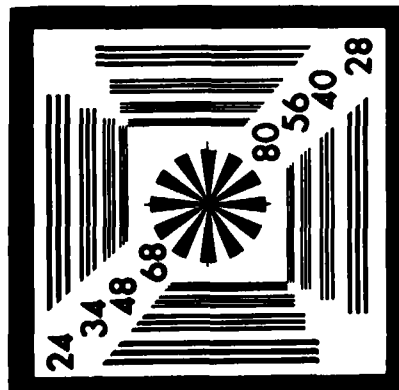


Figure 4

Appendix

The Appendix is not a part of this SMPTE Recommended Practice, but is included to facilitate its use.

Control of Resolution and Definition in the Preparation of Test Prints

A1. It has been found that producing test prints 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 test target must have a lens of suitable design and correction to provide a modulation transfer of at least 80 percent at 80 lines per millimeter 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 to be applicable, and are measured in accordance with American National Standard Method of Determining Transmission Density of Motion-Picture Films, PH22.27-1960 (Reaffirmed 1969). Selection of a film for producing the negative must take into consideration not only the requirements of Section 2.6, but also image spread characteristics such that in conjunction with the print films at image densities that are useful, there is substantial image spread cancellation in the resolution range of interest.

A study of many film products has indicated that a film such as Eastman Type 5160 is applicable when exposed so that the density of the gray patch is 0.67 after recommended processing for 7.5 minutes in a developer such as D-97 to a 1b control gamma of 2.5.

A4. Selection of a film for producing the black-and-white print must take into consideration not only the requirements of Section 2.8.1 but also the image spread characteristics compatible with the negative and projection characteristics suitable for theatrical projection.

A study of many film products has indicated that a film such as Eastman Type 5160 is applicable when exposed so that the density of the gray patch derived from the negative specified in A3 is 0.85 after processing for 3.5 minutes in a developer such as D-97 to a 1b control gamma of 2.5.

Satisfactory results have been obtained only with a step-contact printer employing positioning pins.

A5. Selection of a film for producing the dye-image print must take into consideration not only the requirements of Section 2.8.2 but also image spread characteristics compatible with the negative and projection characteristics suitable for theatrical projection.

A study of many film products has indicated that a film such as Eastman Type 5385 is applicable when exposed through a filter pack that limits the image to the magenta layer, to a red, green, and blue density such that the gray patch derived from the negative specified in A3 is  $R = 0.17$ ,  $G = 1.00$ , and  $B = 0.34$ , when read in the densitometer after processing of the film in accordance with the manufacturer's recommendations.

Satisfactory results have been obtained only with a step-contact printer employing positioning pins.