

# Letter to the Editor

Re: Scaling Techniques for Subjective Judgments of Imaging Quality  
(Paper by J. Edward Jackson, in the *Journal* for November 1974,  
pp. 891-894.)

Dear Sir:

J. Edward Jackson's paper in the November 1974 *Journal* is a welcome dissertation on the philosophy of subjective scaling of motion-picture and television displays. Its title will naturally lead experimenters in need of guidance to turn to the paper for advice, and the final section "Obtaining Good Data" will be of particular value to them.

The exact arrangements to be adopted for a given class of visual subjective studies is a matter that is invariably hotly debated. My personal conclusion is that usually it will be worth accepting a specification regarded as not quite ideal if there is a good prospect that it will be adopted by most experimenters. So long as different workers continue to employ motley conditions, precise and meaningful intercomparison and verification of results will remain impossible.

In the field of broadcast television, the matter is particularly vital because of the necessity for agreed relationships between the many impairments that may arise in transmission and the subjective effects they produce. Such information is essential for the efficient planning and maintenance of point-to-point links and broadcast networks. Accordingly, appropriate studies were commenced by the International Radio Consultative Committee (CCIR) of the ITU some 15 years ago and have been summarized in successive versions of Report 405. The 1970 (New Delhi) meeting outlined the essential details of a preferred method which later formed the nucleus of Recommendation 500, "Method for the Subjective Assessment of the Quality of Television Pictures," adopted at the XIIIth Plenary Assembly in Geneva last year.

The Recommendation applies to laboratory experiments and

also, where appropriate, to operational assessments. Alternative five-category grading scales are listed, appropriate to the "method of successive categories" and also to multidimensional scaling by "uniresponse." There is also a comparison scale containing seven grades, suitable (extending Jackson's terminology) for "very-fine-tuner" operations. Other details include a table specifying viewing conditions in quantitative terms.

For the future, it is to be hoped that the Recommendation will be extended in equally succinct terms to include procedures for analysis, presentation and application of results. I agree with Dr. Jackson that analysis can be fairly straightforward, but, noting the variety of methods that exist here also, I wonder how long it will be before published results can be relied upon to be truly standardized.

Although full details would have been inappropriate to Dr. Jackson's "tutorial" paper, I feel that *Journal* readers would have welcomed a reference to the new CCIR Recommendation.

17 January 1975

J. W. ALLNATT

Telecommunications Headquarters

Research Department

Brook Road, Dollis Hill,

London NW2 7DT, England

*Note:* CCIR Documents, including Recommendation 500 from the XIIIth Plenary Assembly in Geneva (1974), are available from the CCIR in Geneva and from the United Nations Bookstore in New York City.—*Edit.*

## standards and recommended practices

### Approved American National Standards

On 28 May 1975, the American National Standards Institute approved five new standards which are primarily editorial revisions of the earlier issues: PH22.37-1975, Dimensions of Raw Stock Cores for Motion-Picture Film (revision and consolidation of PH22.37-1963 (R1969) and PH22.38-1964 (R1969)); PH22.100-1975, Screen Luminance and Viewing Conditions for 16-mm Review Rooms; PH22.135-1975, Position, Dimensions and Reproducing Speed of Magnetic Sound Record on 8-mm Type R (Regular 8) Motion-Picture Film; PH22.159.3-1975, Specifications for 8-mm Type S (Super 8) Model I Motion-Picture Film Camera Cartridge Pressure Pad Flatness and Camera Aperture Profile; and PH22.164-1975, Position, Dimensions and Reproducing Speed of Magnetic Sound Record on 8-mm Type S (Super 8) Motion-Picture Film.

Inasmuch as compliance with American National Standards is purely voluntary, these standards will become truly effective when broad publicity is given to their existence. ANSI and SMPTE would appreciate any personal influence to pro-

mote the use of these standards where such action is appropriate. Copies of the standards may be obtained for a nominal fee from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

### Proposed Withdrawal of American National Standards

The SMPTE Standards Committee has accepted the recommendation of the Sound Committee that PH22.128-1962 (R1969), Specifications for 8-mm Flutter Test Film, Perforated IR-1500, Magnetic Type; PH22.129-1962 (R1969), Specifications for 8-mm Azimuth Test Film, Perforated IR-1500, Magnetic Type; PH22.130-1962 (R1969), Specifications for 8-mm 400-Cycle Signal Level Test Film, Perforated IR-1500, Magnetic Type; and PH22.131-1962 (R1969), Specifications for 8-mm Multifrequency Test Film, Perforated IR-1500, Magnetic Type, be withdrawn on the basis that there appears to be no need for the standards inasmuch as no test films were ever developed in accordance with the specifications nor is there an indication that any are planned.

Comments should be addressed to Alex E. Alden, *Staff*

Engineer, at Society Headquarters prior to 1 December 1975. The recommendation has been submitted to American National Standards Committee PH22. All comments received through *Journal* publication will be reviewed before conclusion of action by that committee.

### Reaffirmed SMPTE Recommended Practices

On 24 July 1974, the Society's Board of Governors, accepting the recommendation of the Standards Committee, approved the reaffirmation of four SMPTE Recommended Practices: RP 6-1967, Reference Carrier Frequencies and De-Emphasis Characteristics for 2-in Quadruplex Video Magnetic Tape Recording (published in July 1967 *Journal*); RP 19-1965, Specifications for 8-mm Registration Test Film (published in January 1966 *Journal*); RP 20-1965, Specifications for 16-mm Registration Test Film (published in January 1966 *Journal*); and RP 32-1969, Specifications for a Super 8 Test Film for Projectors and Printers (published in September 1969 *Journal*).

Copies of these and other SMPTE Recommended Practices may be purchased from Society Headquarters for \$1.00 each. A 20% discount is offered on the purchase of the entire set.

### Approved International Standards

The International Organization for Standardization (ISO) approved two International Standards, the technical content of which is published here for your information.

ISO 3026-1975, Cinematography — Printed 8-mm Type S Image Area on 35-mm Motion-Picture Film Perforated

8-mm Type S, 2R-4.227 (1664) or 5R-4.234 (1667) — Position and Dimensions, is in complete agreement with American National Standards PH22.179 and PH22.180.

ISO 3027-1975, Cinematography — Magnetic Stripes and Recording Head Gaps for Sound Record on 8-mm Type S Motion-Picture Prints — Positions and Width Dimensions, is in complete agreement with American National Standards PH22.162 and PH22.181.

The International Standards published here were developed by Technical Committee 26 on Cinematography. The work of this committee is administered by the Engineering Department of the SMPTE which functions as the secretariat in ANSI's name. A report of the last meeting of the committee was published in the February 1974 *Journal of the SMPTE*. The next meeting is scheduled for 17 May 1976 in Paris, France.

Complete copies of all International Standards are sold through the American National Standards Institute, 1430 Broadway, New York, NY 10018. — Alex E. Alden, *Staff Engineer*

## Erratum

### International Standard ISO 1019-1975E

August 1975 *Journal*, pp. 624, 625.

An incorrect first page was printed for ISO 1019-1975E. To simplify as much as possible the reader's task in referring to this Standard, we here present the entire three pages of the Standard as they should have appeared.

## Cinematography — Spools, daylight loading type for 16 mm motion-picture cameras — Dimensions

### 1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard specifies the dimensions and characteristics of daylight loading spools of nominal capacities, 15 m (50 ft), 30 m (100 ft), 60 m (200 ft), and 120 m (400 ft) for 16 mm motion-picture film.

The dimensions specified are in substantial agreement with those given for microfilm camera supply and take-up spools in ISO/R 1116, 35 mm and 16 mm microfilms, spools and reels (see annex).

1.2 Spools for high-speed cameras should be carefully balanced and are not necessarily covered by this International Standard.

### 2 REFERENCES

ISO 69, *Cinematography — 16 mm motion-picture raw stock film — Cutting and perforating dimensions*.

ISO 3647, *Cinematography — Spindles for 16 mm motion-picture camera spools and projector reels — Dimensions*.<sup>1</sup>

### 3 DIMENSIONS AND CHARACTERISTICS

3.1 The spindle and keyway holes shown in the figure shall be incorporated in both flanges<sup>2</sup> and shall be aligned. (Some laboratories use 35 mm rewind equipment for winding 16 mm film; often the spindles on this equipment have long keys.) A second keyway, in the corner of the spindle hole opposite the required keyway, is optional, but if used, shall be incorporated in both flanges.

3.2 If rivet heads or other fastening devices extend beyond the outer surfaces of the flanges, they shall lie at a diameter larger than the minimum K diameter and shall be within the boundaries defined by other portions of the volume of rotation diagram.

3.3 Dimension F refers to a slot in the spool core for attaching the film. The slot sides, starting immediately adjacent to each flange and running a minimum distance 6.0 mm (0.24 in) from each flange toward the other, shall be straight, parallel and 0.7 to 1.5 mm (0.03 to 0.06 in) apart. The slot sides may diverge over remaining (central) portions of the slot.

3.4 Dimensions J and J<sub>1</sub> represent the thickness and effective thickness respectively of the spool within the

K diameter area which is centred on the spindle hole axis of each flange.

3.5 A reference plane of rotation for each flange is defined by a plane perpendicular to the axis of the spindle and coincident with the surface of a flat 15.0 mm (0.59 in) diameter support which is in contact with the flange and centred on the spindle hole axis of the flange.

The dimension P is the distance measured outwardly from this reference plane<sup>3</sup> of rotation to the farthest plane of rotation described by any point on the flange outside the K diameter area when the spool is rotated on an accurate, tight-fitting spindle. This includes rivets or other fastening devices, variations in flange thickness, flatness, and lateral run-out of the flanges.

Selection of a dimension P value is dependent upon the thickness of the material used for the flanges. According to the flange material thickness:

- a) the K diameter area may be depressed (with P greater than zero), or
- b) the outside surfaces of the flanges may be flat from spindle hole axis to periphery (with P equal to zero), or
- c) in the case of flanges made of very thin material, the K diameter area may be raised rather than recessed (effectively, P less than zero).

3.6 The maximum effective thickness of spools (including all the characteristics mentioned in 3.5) outside the K diameter area has not been stated because it is a function of a spool's specific J<sub>1</sub> value between the 15.0 mm (0.59 in) diameter reference zones on each flange. The largest overall effective thickness, however, will be J<sub>1</sub> max. + 2 X P max. = 19.5 mm (0.77 in).

3.7 The eccentricity of the core with respect to the spindle hole axis, Z, shall not exceed a total radius variation (total indicator reading) of 0.8 mm (0.03 in) for all spool sizes.

3.8 Flanges shall be opaque and their surfaces shall have low reflectance characteristics.

NOTE — When the loaded camera is viewed from the side, with the lens to the left and the bottom of the housing downward (regardless of whether or not the spool loading mechanism is visible from that side), both the supply and take-up spools rotate in a clockwise direction.

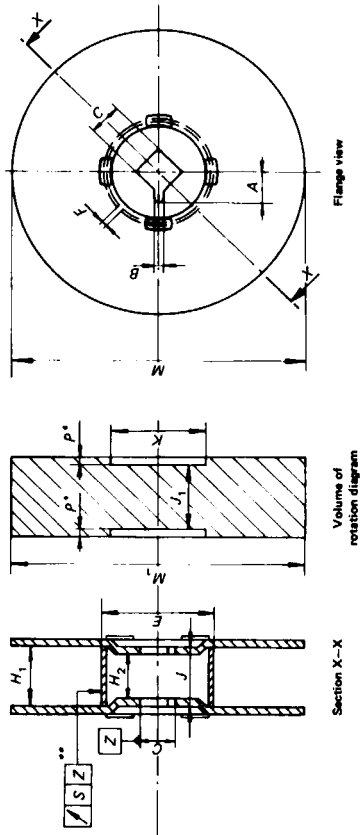
<sup>1</sup> At present at the stage of draft.

<sup>2</sup> Some spools exist which have one flange with the construction recommended in 3.1, but the other flange with a round hole which has a diameter equal to dimension C. This older design is recognized temporarily, but is not recommended for future construction.

<sup>3</sup> The reference plane from which P is measured is not necessarily coincident with all points within the K diameter area but only needs to be coincident with those which are in contact with the reference support which has a diameter smaller than K.

ANNEX

Spools for microfilm often employ offset drive holes and/or a drive slot as described in ISO/R 1116. Such holes are optional in spools described in this International Standard covering spools for motion-picture films. Manufacturers who might wish to make a single type of spool for both purposes would need to take the drive holes or slot into account when planning the size of fastening devices and the size of the *K* diameter area described in this International Standard. That is, the minimum diameter of the *K* area (and thus the circle described by the inner edges of fastening devices, if any) would have to be large enough (about 28.5 mm (1.12 in) minimum) to avoid interference with a drive slot.



\* See 3.5 for explanation of *P*.  
 \*\* See 3.7.

FIGURE - Daylight loading spools for 16 mm motion-picture cameras

TABLE - Dimensions for daylight loading spools for 16 mm motion-picture cameras

Dimension	Nominal spool size		mm	in
A	15 m	30 m	7.6 <sup>+1.0</sup> <sub>0</sub>	0.30 <sup>+0.04</sup> <sub>0</sub>
	15 m	60 m	3.1 <sup>+0.4</sup> <sub>0</sub>	0.12 <sup>+0.02</sup> <sub>0</sub>
B	15 m	30 m	8.05 <sup>+0.15</sup> <sub>0</sub>	0.317 <sup>+0.006</sup> <sub>0</sub>
	15 m	60 m	32.0 <sup>+0.5</sup> <sub>0</sub>	1.26 <sup>+0.02</sup> <sub>0</sub>
C (see 3.1)	15 m	30 m	54.0 <sup>+0.5</sup> <sub>0</sub>	2.13 <sup>+0.02</sup> <sub>0</sub>
	15 m	60 m	0.7 <sup>+0.8</sup> <sub>0</sub>	0.03 <sup>+0.03</sup> <sub>0</sub>
E	15 m	30 m	16.05 <sup>+0.35</sup> <sub>0</sub>	0.632 <sup>+0.014</sup> <sub>0</sub>
	15 m	60 m	16.00 min.	0.630 min.
H <sub>1</sub>	15 m	30 m	18.5 <sup>+0.4</sup> <sub>0</sub>	0.73 <sup>+0.02</sup> <sub>0</sub>
	15 m	60 m	25.5 min.	1.00 min.
H <sub>2</sub>	15 m	30 m	38 min.	1.5 min.
	15 m	60 m	71.5 <sup>+0</sup> <sub>0</sub>	2.81 <sup>+0.04</sup> <sub>0</sub>
J and J <sub>1</sub>	15 m	30 m	92.0 <sup>+0</sup> <sub>0</sub>	3.62 <sup>+0.04</sup> <sub>0</sub>
	15 m	60 m	126.0 <sup>+0</sup> <sub>0</sub>	4.96 <sup>+0.04</sup> <sub>0</sub>
K	15 m	30 m	169.0 <sup>+0</sup> <sub>0</sub>	6.65 <sup>+0.04</sup> <sub>0</sub>
	15 m	60 m	0.50 max.	0.020 max.
M and M <sub>1</sub>	15 m	30 m	0.8	0.03
	15 m	60 m		

# American National Standard dimensions of raw stock cores for motion-picture films

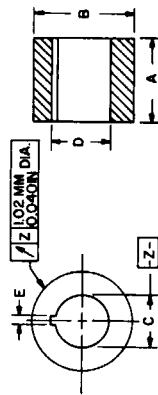
Approved May 28, 1975

Secretariat: Society of Motion Picture and Television Engineers, Inc.

Page 1 of 2 pages

## 1. Scope

This standard specifies the recommended sizes and dimensions of raw stock cores for 8, 16, 35, 65 and 70-mm motion-picture films.



Nominal Size	Dimension A		Dimension B	
	Millimeters*	Inches	Millimeters	Inches
8 mm x 50 mm (8 mm x 2 in)	7.90 + 0.00 - 0.50	0.311 + 0.000 - 0.020	50.00 ± 0.50	1.968 ± 0.020
16 mm x 50 mm (16 mm x 2 in)	15.90 + 0.00 - 0.50	0.626 + 0.000 - 0.020	50.00 ± 0.50	1.968 ± 0.020
16 mm x 75 mm (16 mm x 3 in)	15.90 + 0.00 - 0.50	0.626 + 0.000 - 0.020	75.00 ± 1.00	2.953 + 0.079 - 0.039
16 mm x 100 mm (16 mm x 4 in)	15.90 + 0.00 - 0.50	0.626 + 0.000 - 0.020	100.00 ± 1.50	3.937 ± 0.059
35 mm x 50 mm (35 mm x 2 in)	34.90 + 0.00 - 1.00	1.374 + 0.000 - 0.039	50.00 ± 0.50	1.968 ± 0.020
35 mm x 75 mm (35 mm x 3 in)	34.90 + 0.00 - 1.00	1.374 + 0.000 - 0.039	75.00 ± 2.00	2.953 + 0.079 - 0.039
35 mm x 100 mm (35 mm x 4 in)	34.90 + 0.00 - 1.00	1.374 + 0.000 - 0.039	100.00 ± 1.50	3.937 ± 0.059
65 mm x 75 mm (65 mm x 3 in)	64.90 + 0.00 - 1.00	2.555 + 0.000 - 0.039	75.00 ± 2.00	2.953 + 0.079 - 0.039
70 mm x 75 mm (70 mm x 3 in)	69.90 + 0.00 - 1.00	2.752 + 0.000 - 0.039	75.00 ± 1.00	2.953 + 0.079 - 0.039
Dimensions				
	Millimeters	Inches		
C	25.70 + 0.40 - 0.00	1.012 + 0.016 - 0.000		
D	29.50 + 0.90 - 0.00	1.161 + 0.035 - 0.000		
E	3.80 + 0.40 - 0.00	0.150 + 0.016 - 0.000		

\*Millimeter dimensions are primary.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute. Printed in USA

Copyright © 1975 by American National Standards Institute, 1430 Broadway, New York, N.Y. 10018

## 2. Dimensions

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

## 3. Concentricity Allowance

The concentricity of the inside and outside diameters of the core shall be as specified in the figure.

## Appendix

(The Appendix is not a part of this American National Standard, but is included for information purposes only.)

Means of attaching film to all cores are optional.

The keyway is provided as a means of driving the core for take-up or of providing holdback tension on a feed spindle. The dimensions of the keyway shall be adequate to clear a square-ended key.

The maximum value for Dimension A has been fixed intentionally to encourage a common manufacturing practice of keeping the maximum widths of cores very slightly less than the minimum widths of corresponding films.

The rather large tolerances on Dimension B are necessary to encompass the satisfactory existing practices of many different manufacturers. It is expected, however,

that cores made by any one manufacturer would be held to a considerably smaller tolerance range. This will help prevent large variations, including undue tapering of the core from one side to the other, of any manufacturer's product.

In the interest of standardization, it is recommended that future cores with diameters greater than 100 mm (4 in) be designed to even-millimeter (nominal inch) dimensions, such as 125, 150, 175 millimeters, etc.

Cores with keys (so-called male cores) have not been included in this standard because they are in declining use. Therefore, new equipment should be designed to accept the female core (core with keyway).

# American National Standard screen luminance and viewing conditions for 16-mm review rooms

Approved May 28, 1975

Secretariat: Society of Motion Picture and Television Engineers, Inc.

Page 1 of 4 pages

## 1. Scope

1.1 This standard specifies the luminance (brightness) level and quality of the projection screen and the viewing conditions for 16-mm review rooms.

1.2 For review rooms intended for viewing motion-picture prints for television, see Note 4.

## 2. Definitions

2.1 The measurements of screen luminance and color of projection light are made with the projector in complete operation but with no film in the aperture.

2.2 The measurement of stray light is made by projecting onto the center of the screen an image of an opaque test object placed at the center of the projector aperture, and projecting onto the rest of the screen a simulated average image. The stray light level on the screen is the measured luminance in the sharply-focused image of the opaque test object.

2.3 Theatrical projection, as used in this standard, describes one class of projection and viewing conditions under which prints previously judged in the review room may ultimately be shown in fulfillment of their major objective. Theatrical projection facilities are generally of a semi-permanent nature wherein screen luminance due to stray light and ambient illumination is controllable at a low level; for example, under 1.0 percent of screen luminance.

2.4 Auditorium projection, as used in this standard, describes a second class of projection and viewing conditions under which prints previously judged in the review room may ultimately be shown in fulfillment of their major objectives. Auditorium projection facilities may be temporary

or portable but are primarily distinguished by uncontrollable stray light and ambient illumination which may be found to produce stray light luminance equal to 1 to 10 percent of screen luminance. Such conditions may be encountered in classrooms, etc.

## 3. Luminance Level

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

3.2 The luminance at the center of the screen shall be  $16 \pm 2$  footlamberts ( $55 \pm 7$  candelas per square meter), as measured within the standard observing area (defined in 6.1).

3.3 The luminance at a distance 5 percent of the screen width from the side edges of the screen, and on its horizontal axis, shall be  $80 \pm 10$  percent of the center luminance as prescribed and measured in 3.2 above.

3.4 The maximum luminance for any point on the screen measured from any point within the standard viewing area shall be no greater than 18 ft ( $62 \text{ cd/m}^2$ ).

## 4. Spectral Distribution

4.1 16-mm prints are made for projection with several colors of projector illuminant (See Appendix A7).

4.2 The color quality of the projection light in the review room should be adjusted as closely as possible to that of the final print use.

4.3 When the intended illuminant cannot be specified uniquely, it is possible as a compromise to group the sources into two bands of color quality, a low color temperature (3000 to 4500 K) and a high color temperature band (5000 to 6500 K) (See Appendix A7.2).

## 5. Stray Light

The standard review room shall be adjusted so that luminance from stray light on the screen, measured as described in 7.3, shall be no more than 0.4 percent of the screen luminance at the center of the screen.

## 6. Viewing Conditions

6.1 The standard observing area, within which all observers shall be seated during use of the facilities as a review room, shall be:

- (1) Within the limits of 15 degrees on each side of a perpendicular to the midpoint of the screen as a center, in both the horizontal and vertical planes.
- (2) Within the limits of  $3 \pm 1$  picture heights from the screen.

6.2 No stray light or illuminated area with a luminance in excess of 1 ft ( $3.4 \text{ cd/m}^2$ ) shall be visible from the standard observing area.

6.3 Observers should have an accommodation period of 5 minutes to the brightness level of normal stray light in the review room.

## 7. Measurement

7.1 Screen luminance shall be measured with a photometer having the spectral sensitivity of a standard observer as specified by the International Commission on Illumination in 1924. The acceptance angle of the photometer shall not be greater than 2° and shall be so used that it accepts light from a screen area no larger than a circle whose diameter is 15 percent of the screen height.

7.2 To determine the color quality of the reflected light from the screen, the projector shall be operated in the normal manner, except that

there shall be no film in the gate. With the film plane in focus on the screen surface, the color-temperature meter or other measuring device shall be placed so that it receives a representative sample of the reflected light returned by the screen into the audience area.

7.3 Stray light shall be measured by comparing the screen luminance with the luminance of the image of an opaque test object placed in the center of the projector aperture. The test object preferably should have a diameter of 0.020 in (0.51 mm [5 percent of frame width]) and should not exceed 0.050 in (1.27 mm). The balance of the projected beam is attenuated by any suitable neutral density film that produces through the normal projection system an average screen luminance equal to 10 percent of the luminance of the screen as defined in 2.1. All sources of illumination in the auditorium, such as exit and aisle light, shall be used in their normal manner while stray light is being measured.

NOTE 1: Because of limitations on the sensitivity of some instruments, it may at times be necessary to measure the color quality of the incident light and correct the result by the selective reflection characteristics of the screen.

NOTE 2: Color quality is preferably expressed in terms of the CIE chromaticity coordinates  $x$  and  $y$ .

NOTE 3: As discussed in 2.3 and 2.4, 16-mm prints may be used under widely varying conditions of stray light. For some purposes, it may be desirable to review certain prints under higher levels of stray light to determine whether they lend themselves to meaningful use under these viewing conditions.

NOTE 4: SMPTE Recommended Practice RP 41-1974, Evaluation of Color Films Intended for Television, defines the necessary conditions to permit critical evaluation of color balance and contrast of films intended for television use.

## Appendix

(The Appendix is not a part of this American National Standard, but is included for information purposes only.)

### A1. Review Rooms

During the preparation of motion pictures, the producer, the motion-picture film laboratory personnel, and others examine the film many times from the original test shots through many stages to the final release prints. The films are projected in a specialized theater known

as a review room. These installations are designed to permit judgments of projected picture quality and determinations of the suitability and acceptability of release prints, daily and work prints, production tests, printer and processing tests, etc. The rooms are constructed to accommodate a small reviewing group of usually 5-10 people. The actual picture size may be small or large

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute. Printed in USA



Copyright © 1975 by American National Standards Institute, 1430 Broadway, New York, N.Y. 10018

of the aperture, between the aperture plane and the projection lens and within 1/16 in (1 1/2 mm) or less of the film plane; simultaneously project a film which has been printed to give a uniform transmission of 10 percent (or by other neutral means attenuate the light in the picture aperture to 10 percent of its operating value).

A9. 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; 1 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.

projected picture (measuring the included angle from the area in question to the centerline of the screen).

A8. Stray Light

Stray light, as defined in 2.2, includes non-image-forming light, such as lens flare, re-reflected projection light, ambient light, etc. Since the factors responsible for such stray light do not change unexpectedly, it will usually be sufficient to make stray light measurements at intervals. The two measurement procedures recommended for securing the proper screen image are as follows: (1) Prepare a test film with an average neutral light transmission of 10 percent, having in the center of each frame a black, circular test object of density 3.0 or greater or (2) Mount in the projector an opaque heat-resisting disk as a test object, locating it at the center

A7. Color Quality

A7.1 Projected Pictures. It has been observed that the range in color quality of prints made for one source and projected with another can be greater than that to which a normal audience will accommodate readily. The color quality of projected pictures is influenced by a number of factors including (1) color quality of the projection light source, (2) color balance of the film print, (3) selective color transmission of the projection optics, (4) selective color reflection of the projection screen and (5) color quality of the surround in the projection area (and other factors influencing observer accommodation). Although all of these are important, in practice, the control of these factors is divided among several responsibilities. The color quality of the projection light source is determined at the time of installing the projection facility on the basis of required light output, convenience and other factors. The selective performance of the lens and screen is established by their manufacturers. The color print is usually matched to the color quality of the intended projection source as specified on the print order, but even this correction may be limited by the variation in dye absorption from sources that are visually equivalent but spectrophotometrically different.

A7.2 Projection Sources. The following sources are in commercial use for projection of 16-mm prints:

Low Temperature Band	Approximate Color Temperature	Approximate Chromaticity x	y
Incandescent bulb (including lamphouse optics)	3450 K	0.41	0.41
Modified carbon arc	4450 K	0.36	0.37
High Temperature Band			
High-intensity carbon arc and corrected xenon arc bulb	5400 K	0.34	0.36

It is recommended that the review room projection light source be matched in color quality to that intended as the exhibition source for the print. When this source cannot be uniquely specified, it is current practice to consider the two color temperature bands as indicated above and prepare the print for one of them. It has been observed that a print may be acceptable if projected within the band for which it was balanced, but usually it is unacceptable over the full range of sources.

A7.3 Correction of Sources. When color quality of the source is modified by the use of filters to more closely approximate the desired value, care must be taken that fillers are not inserted between the film and the projection screen unless they are especially designed to have no degrading effect upon the image-forming quality of the projection system.

A7.4 Choice of Surround. The surround for both review rooms and final projection areas should present an essentially neutral color balance to the observers seated in the standard observing area, with no significant areas of selective color reflection within 30° of the

depending upon the space available, but the viewing conditions are chosen to duplicate as nearly as possible actual theater viewing from the most desirable seating locations. All viewing conditions can be precisely controlled, and it is generally practical in review rooms to hold variables to a minimum tolerance.

A2. Normal Print

To provide interchangeability in motion-picture projection, it is desirable that print quality conform to that of a normal print so that theaters can operate at known projection conditions and will thereby be able to exhibit projected pictures of good pictorial quality. It has not been possible to specify this normal print in terms of its optical density and other objective measurements because of the difficulties of specifying artistic quality in scientific terms. Accordingly, the normal print is defined as that print which conveys the desired artistic impression when projected under review room conditions as described by this standard.

A3. Image Luminance

Note that this standard specifies screen luminance with the projector operating and no film in the aperture. When films are projected, the average image luminance is considerably below this level and approximates the conditions of 7.3 for measurement of stray light.

A4. Theatrical Projection

Standards for theater screen luminance, such as American National Standard Specifications for Screen Luminance for Indoor Motion-Picture Theaters, PH22.124-1970, are intended to reproduce for the theater audience the same artistic impression given in the review room. It is anticipated that there will be only one review room condition, but that there may be several theater conditions, providing as nearly as possible identical pictorial impressions under such widely different viewing conditions existing in indoor theaters, auditoriums, classrooms, stores, offices, etc.

A5. Prints for High Ambient Light Viewing

When stray light levels are high, there is very little that can be accomplished in preparing the print to compensate. Proper provision for such usage patterns must be made in the original picture planning, direction and cinematography, and usually implies a restriction on subject matter.

A6. Meter Acceptance Angle

The maximum permissible acceptance angle of the luminance photometer depends upon the instrument design and method of use, the size of the screen and other factors. Suitable baffling against external sources and for control of internal reflections is essential. The acceptance angle of a suitable instrument must be such that a reduction in this angle (followed by necessary recalibration) does not change the magnitude of any reading specified in Section 2 by more than ± 5 percent. The limiting conditions for the reliable use of such meters should be included in the manufacturer's specifications.

# American National Standard position, dimensions and reproducing speed of magnetic sound record on 8-mm type R (regular 8) motion-picture film

Approved May 28, 1975 Secretariat: Society of Motion Picture and Television Engineers, Inc.

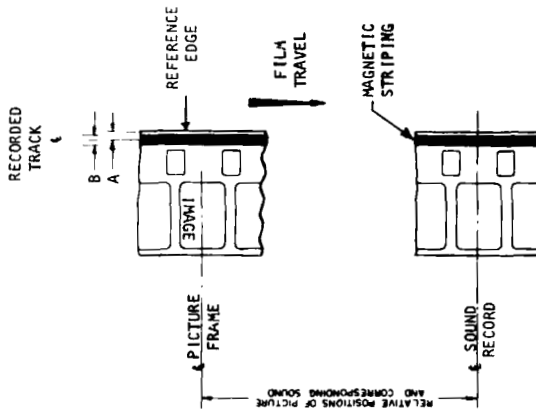
Page 1 of 2 pages

## 1. Scope

- 1.1 This standard specifies the position, dimensions and reproducing speed of the magnetic sound record on 8-mm Type R (regular 8) motion-picture film having a nominal 30-mil (0.76-mm) width magnetic stripe.
- 1.2 This standard also specifies the longitudinal picture-sound displacement on the film.

## 2. Sound Record

- 2.1 The lateral location and width of the magnetic sound record shall be as specified in the figure and table.
- 2.2 The recording shall be made so that the azimuth of the record is at an angle of  $90^\circ \pm 5'$  to the reference edge of the film. (The  $90^\circ$  angle is established from a datum guide or rail 6 pitches in length.)
- 2.3 With the direction of travel as shown in the figure, the magnetic striping shall be on the surface of the film facing toward the projector lamp for direct front projection with conventional optics.



Dimensions	Inches	Millimeters
A	$0.015 \pm 0.001$	$0.38 \pm 0.03$
B*	0.019 min	0.48 min

\*See Appendix A2.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute. Printed in USA.

Copyright © 1975 by American National Standards Institute, 1430 Broadway, New York, N.Y. 10018

## 3. Reproducing Speed

The recording shall be made so that the sound record will reproduce properly at 24 perforations per second (approximately 18 feet [5.5 meters] per minute or 3.6 inches [9.1 centimeters] per second). This is equivalent to the projection speed of the picture film of 24 frames per second.

## 4. Longitudinal Picture-Sound Displacement

The magnetic sound record on the film shall precede the center of the corresponding picture by a distance of 56 frames  $\pm 1/2$  frame.

## Appendix

The Appendix is not a part of this American National Standard, but is included for information purposes only.

### A1. Record Width

The width of the recorded area must be measured with great care as it enters directly into the calculation of flux per meter width.

When the recording head gap is narrower than the width of the coating or stripe, as is normal for all motion-picture test films, there is a measurement complication involving both the uncertainties in seeing the track and in determining the recording fringing.

If the recording head is available, the track width is best measured indirectly by measuring the gap width and adding to this dimension twice the thickness of the test record's magnetic coating. This correction will usually be 0.0003 to 0.0006 inch (0.008 to 0.015 mm).

If the recording head is unavailable, the recorded record may be made visible by the use of a carbonyl iron suspension. Care should be taken to apply the minimum quantity that makes the recording visible, so that the developed image is not wider than the actual recorded area.

### A2. Reproducing Head Gap Width

Dimension B applies to records produced in equipment using the same head for recording and reproducing. In

### A3. Erase Heads

Erasing head gaps used to erase the records specified in this standard should be substantially wider than the record specified.

### A4. Reference Standards

Motion-picture prints conforming to this standard are usually made on film made in accordance with American National Standard Dimensions for 16-mm Motion-Picture Film Perforated 8-mm Type R (Regular 8), 28-1500, PH22.17:1974; magnetically striped in accordance with American National Standard Dimensions of Magnetic Striping of 8-mm Motion-Picture Film, Perforated 18-1500, PH22.88:1963 (R1969), and projected in accordance with American National Standard Specifications for Projector Usage of 8-mm Motion-Picture Film Perforated One Edge, PH22.22:1964 (R1969).

# American National Standard specifications for 8-mm type S (super 8) model I motion-picture film camera cartridge pressure pad flatness and camera aperture profile

Approved May 28, 1975

Secretariat: Society of Motion Picture and Television Engineers, Inc.

Page 1 of 2 pages

## 1. Scope

This standard specifies the dimensions and characteristics necessary for the appropriate flatness of 8-mm Type S (super 8) film cartridge pressure pads as well as the required clearances for motion-picture film in the aperture area.

## 2. Dimensions

**2.1** The dimensions shall be as given in the figure and tables and shall apply to a cartridge that is fully assembled but does not contain film.

**2.2** Datum surface A passes through the center of the cartridge locating slot and forms the centerline of the picture aperture area.

**2.3** The zero plane is to be established by Surfaces 1, 2, and 3, as defined by 0.060-in (1.52-mm) circles, dimensionally centered as shown in the figure.

**2.4** Dimension G specifies the clearance for film in the picture aperture area. The minimum value for this dimension should be established by taking the maximum film thickness to be used by a manufacturer and adding 0.0005 in (0.013 mm). This permits the manufacturer to vary Dimension G according to the thickness of his film product.

**2.5** The upper and lower pad areas extend from Dimension C to the top and bottom of the cartridge aperture opening.

**2.6** Dimension H is intended to apply from the film surface of a flat cartridge pressure pad.

**2.7** The plus values given for the pressure pad film surface flatness tolerances are to be directed toward the lens.

**2.8** Surface 4 of the cartridge pressure pad and Boss 4 of the camera aperture are established to aid in seating the cartridge pressure pad to the camera aperture plate. They serve no function once the pressure pad is in operating position.

**NOTE 1:** It is considered good practice to relieve the camera aperture plate above and below the picture area to allow a clearance for film transport and minimize the possibility of film pinching. Dimension F specifies the amount of recess for this purpose.

**NOTE 2:** Surfaces 1, 2 and 3, shown to establish the zero plane for the purpose of measurement of the super 8 film cartridge pressure pad film surface flatness, are circles having a diameter of 0.060 in (1.52 mm). The actual camera aperture plate bosses may deviate from this shape and size.

**NOTE 3:** It is intended that the cartridge pressure pad be flat, or be molded as a flat plane. Pits or depressions, however, which do not interfere with the film flatness, are acceptable. Bumps or protrusions are not acceptable. Tolerances for the flatness on the super 8 film cartridge pressure pad film surface are specified to account for slight warpage in molding if the pressure pad is made from a plastic material.

**NOTE 4:** In addition to this standard, there are available the following documents relating to super 8 film camera cartridges:

- PH22.159.1-1968 (R1973), Specifications for Super 8 Motion-Picture Film Camera Cartridge and Cartridge Camera Fit

**CAUTION NOTICE:** This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute. Printed in USA

Copyright © 1975 by  American National Standards Institute, 1430 Broadway, New York, N.Y. 10018

PH22.159.3-1975

PH22.159.2-1968 (R1973), Specifications for Cartridge Aperture and Pressure Pad and Position of Film in the Super 8 Motion-Picture Film Camera Cartridge

PH22.159.4-1968 (R1973), Dimensions and Characteristics of the Take-Up Core Drive for Super 8 Motion-Picture Film Camera Cartridges

PH22.159.5-1974, Specifications for Camera Run Length, Perforation Cut-Out and End-of-Run Notches in 8-mm Type S (Super 8) Motion-Picture Film Model 1 Camera Cartridges (50-Ft, 15-M Capacity)

PH22.166-1970, Specifications for Super 8 Motion-Picture Film Camera Cartridge Notches for Exposure Control and Stock Identification

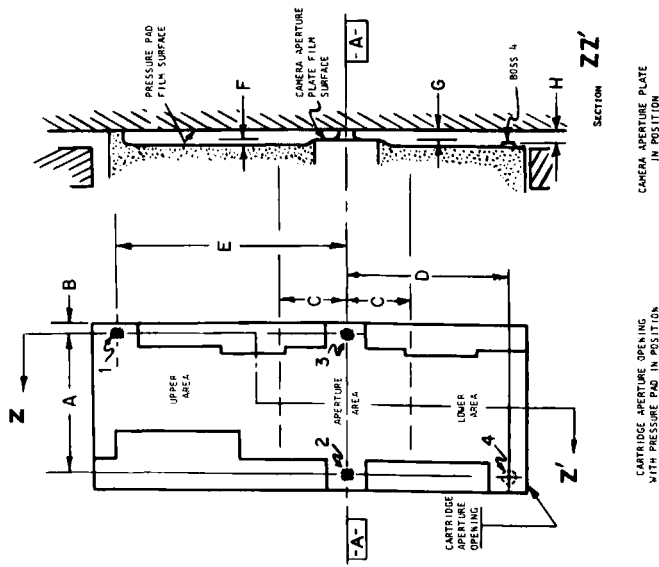


Table 1

Dimensions	Inches	Millimeters
A	0.378 ± 0.001	9.60 ± 0.03
B	0.030 ± 0.002	0.76 ± 0.05
C	0.153 nom	3.89 nom
D	0.393 ± 0.001	9.98 ± 0.03
E	0.590 ± 0.001	14.99 ± 0.03
F	0.005 min	0.13 min
G	0.004 min	0.10 min
H	0.004 min	0.10 min

Table 2

Flatness Tolerances on Pressure Pad Film Surface		
Areas	Inches	Millimeters
Aperture Area (within Dimension C)	+ 0.0000	+ 0.000
Upper Area	+ 0.0010	+ 0.025
Lower Area	- 0.0002	- 0.05
	- 0.0004	- 0.10

# American National Standard position, dimensions and reproducing speed of magnetic sound record on 8-mm type S (super 8) motion-picture film

Approved May 28, 1975 Secretariat: Society of Motion Picture and Television Engineers, Inc.

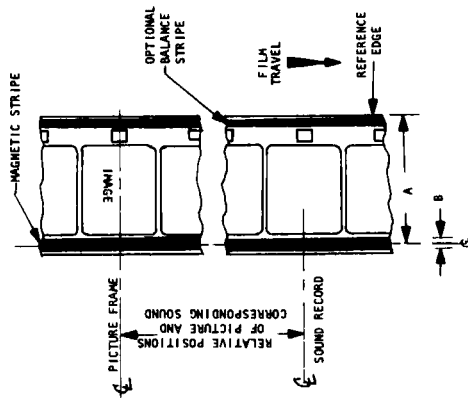
Page 1 of 2 pages

## 1. Scope

- 1.1 This standard specifies the position, dimensions and reproducing speed of the magnetic sound record on 8-mm Type S (super 8) motion-picture film having a nominal 27-mil (0.69-mm) width magnetic stripe.
- 1.2 This standard also specifies the longitudinal picture-sound displacement on the film.

## 2. Sound Record

- 2.1 The lateral location and width of the magnetic sound record shall be as specified in the figure and table.
- 2.2 The recording shall be made so that the azimuth of the record is at an angle of  $90^\circ \pm 5'$  to the reference edge of the film. (The  $90^\circ$  angle is established from a datum guide or rail 6 pitches in length.)
- 2.3 With the direction of travel as shown in the figure, the magnetic striping shall be on the surface of the film facing toward the projector lamp for direct front projection with conventional optics.



Dimensions	Inches	Millimeters
A	$0.298 \pm 0.001$	$7.57 \pm 0.03$
B*	$0.019$ min	$0.48$ min

\*See Appendix A2.

## 3. Reproducing Speed

The recording shall be made so that the sound record will reproduce properly at 24 perforations per second (approximately 20 feet [6.1 meters] per minute or 4 inches [10.2 centimeters] per second). This is equivalent to the projection speed of the picture film of 24 frames per second.

## 4. Longitudinal Picture-Sound Displacement

The magnetic sound record on the film shall precede the center of the corresponding picture by a distance of 18 frames  $\pm 1/2$  frame.

## Appendix

(The Appendix is not a part of this American National Standard, but is included for information purposes only.)

### A1. Record Width

The width of the recorded area must be measured with great care as it enters directly into the calculation of flux per meter width.

When the recording head gap is narrower than the width of the coating or stripe, as is normal for all motion-picture test films, there is a measurement complication involving both the uncertainties in seeing the track and in determining the recording fringing.

If the recording head is available, the track width is best measured indirectly by measuring the gap width and adding to this dimension twice the thickness of the test record's magnetic coating. This correction will usually be 0.0003 to 0.0006 inch (0.008 to 0.015 mm).

If the recording head is unavailable, the recorded record may be made visible by the use of a carbonyl iron suspension. Care should be taken to apply the minimum quantity that makes the recording visible, so that the developed image is not wider than the actual recorded area.

### A2. Reproducing Head Gap Width

Dimension B applies to records produced in equipment using the same head for recording and reproducing. In commercially-produced prints intended for use on a variety of reproducers, it is recommended that a recording head be used capable of producing a 0.025-inch (0.64-mm) minimum width record having the same centerline. A recording head gap of this same minimum width takes into account edge effects or fringing.

### A3. Erase Heads

Erasing head gaps used to erase the records specified in this standard should be substantially wider than the record specified.

### A4. Secondary Sound Recording Speed

The sound speed recommendation of 24 frames per second (Section 3) is primarily intended for professional application of super 8 sound motion-picture photography. It is expected that the nonprofessional, in using single-system sound or in using post-processed magnetically striped film, will record his sound at 18 frames per second, as limited by the speed of his original photography or his desire to conserve film stock.

### A5. Reference Standards

Motion-picture prints conforming to this standard are usually made on film made in accordance with American National Standard Dimensions for 8-mm Motion-Picture Film Perforated 8-mm Type S (Super 8), IR, PH22.149-1975; magnetically striped in accordance with American National Standard Dimensions of Magnetic Striping of Super 8 Motion-Picture Film Perforated IR-1667, PH22.161-1968 (R1973), and projected in accordance with American National Standard Specifications for Projector Usage of Super 8 Motion-Picture Film, PH22.155-1967 (R1973).

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute. Printed in USA

Copyright © 1975 by American National Standards Institute, 1430 Broadway, New York, N.Y. 10018

# Cinematography — Printed 8 mm Type S image area on 35 mm motion-picture film perforated 8 mm Type S, 2R-4.227 (1664) or 5R-4.234 (1667) — Position and dimensions

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the position and size of the 8 mm Type S printed picture image area on 35 mm motion-picture negative, intermediate, or print films perforated 8 mm Type S, 2R-4.227 (1664) or 8 mm Type S, 5R-4.234 (1667).

## 2 REFERENCES

- ISO 1781, *Cinematography — Projector usage of 8 mm Type S motion-picture film for direct front projection.*
- ISO 1785, *Cinematography — Location of the printed image area for printing to 8 mm Type S on 16 mm motion-picture film perforated 8 mm Type S, 1-4.*
- ISO 1787, *Cinematography — Camera usage of 8 mm motion-picture film perforated Type S.*
- ISO 3774, *Cinematography — 35 mm motion-picture film perforated 8 mm Type S (1-3-5-7-0) — Cutting and perforating dimensions.<sup>1)</sup>*
- ISO . . . , *Cinematography — Printed area for 8 mm Type S images on 16 mm film perforated 8 mm Type S (1-3) — Position and dimensions.<sup>2)</sup>*

## 3 DIMENSIONS AND CHARACTERISTICS

- 3.1 The dimensions shall be as specified in the figure and table.
- 3.2 The dimensions which define the image area are established from the row of perforations discarded after

slitting. This row contains a wider perforation and is customarily used for lateral registration of the image.

### NOTES

- 1. Intermediate films usually contain only two rows of perforations and may have their dimensions modified slightly to ensure that they yield prints according to the dimensions and specifications.
- 2. Dimensions A, B, R and H apply to all images. The differences in values from the reference perforation, dimensions C to G and J to L, establish the minimum area to be printed. For convenience, and to avoid unnecessary addition and subtraction in applying this International Standard, a reference dimension has been supplied for a typical width of the image area.

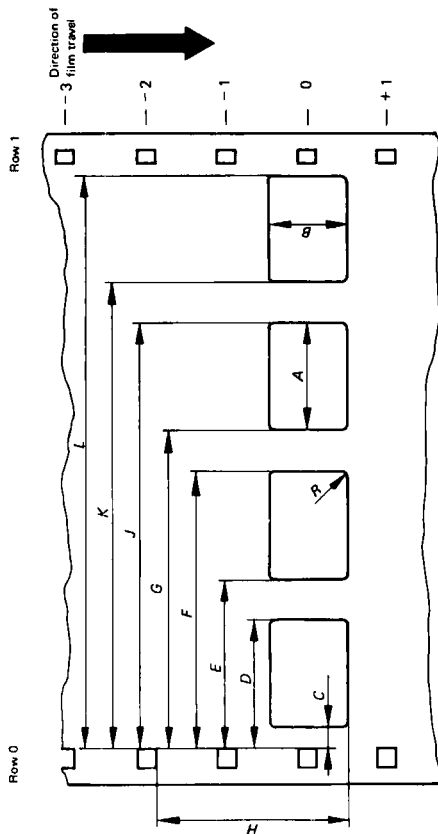
3.3 Dimension H is measured from the minus 2 perforation because this perforation position coincides with the perforation used to position the resulting 8 mm print in the projector as specified in ISO 1781.

### NOTES

- 1. The film travel shown in the figure is to aid in illustrating the minus 2 perforation and is the direction of motion in the projector for the resulting 8 mm print if the figure is as seen from inside a projector used for direct front projection looking through the film toward the lens.
  - 2. To provide understanding in the design and use of printers, the dimensions specified in the figure and table provide an image ideally centred vertically on the perforation with a reference dimension of 7.90 mm (0.311 in) from the positioning perforation to the horizontal centre line of the intended image.
- When film having a perforation pitch of 4.227 mm (0.1664 in) is printed, dimension H must be reduced by the change of average perforation pitch and processing shrinkage to ensure the appropriate dimension for H in release prints.

3.4 The reduced 8 mm Type S image of the original camera aperture image should be centred on the perforation centre line when the original or intermediate contains more vertical height information than is transferred to the reduced image.

<sup>1)</sup> At present at the stage of draft.  
<sup>2)</sup> In preparation.



Dimension	mm	in
A* ref.	5.79	0.228
B*	4.22 <sup>0</sup>	0.166 <sup>0</sup>
C max.	1.19	0.047
D min.	6.88	0.271
E max.	9.17	0.361
F min.	14.86	0.585
G max.	17.14	0.675
H*	9.98 ± 0.05	0.393 ± 0.002
J min.	22.83	0.899
K max.	25.12	0.989
L min.	30.81	1.213
R* max.	0.13	0.005

\* These dimensions apply to all four images.

## ANNEX

If prints are made with a step printer, the registration device should be in the minus 2 perforation with respect to the printed aperture to obtain the maximum benefit of cancellation of any variation of the perforation pitch as films are projected in accordance with ISO 1781.

# Cinematography — Magnetic stripes and recording head gaps for sound record on 8 mm Type S motion-picture prints — Positions and width dimensions

## 1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard specifies the location and width of the magnetic striping on 8 mm Type S motion-picture prints, slit and perforated in accordance with ISO 1700.

1.2 This International Standard also specifies the location and width of the magnetic recording head gaps in systems using a magnetic stripe on 8 mm Type S motion-picture film and the reproducing speed of the sound record as well as the picture sound displacement.

## 2 REFERENCES

- ISO 1700, *Cinematography — 8 mm Type S motion-picture raw stock film — Cutting and perforating dimensions.*
- ISO 1781, *Cinematography — Projector, usage of 8 mm Type S motion-picture film for direct front projection.*
- ISO 2967, *Cinematography — Magnetic stripes for sound records on 35 mm motion-picture film perforated 8 mm Type S-SR (1-3-5-7-9) — Positions and width dimensions.*
- ISO 2968, *Cinematography — Recording characteristics for magnetic sound record on 8 mm Type S motion-picture print — Specifications.*
- ISO 3068, *Cinematography — Magnetic stripes for sound records on 16 mm motion-picture film perforated 8 mm Type S-2R (1-4 and 1-3) — Positions and width dimensions.*

## 3 LOCATION AND WIDTH OF MAGNETIC STRIPING

- 3.1 The location and width of the magnetic sound stripes and balance stripes shall be as shown on page 2.
- 3.2 If the magnetic sound stripe increases the thickness of the film by more than 0.005 mm (0.000 2 in), a balance stripe shall be applied to effectively equalize the thickness of the two edges of the film. The balance stripe should have the same thickness and shall have essentially the same composition as the sound record stripe.
- 3.3 The thickness of the magnetic sound stripe and of the balance stripe shall not exceed 0.020 mm (0.000 8 in).

3.4 The magnetic stripes shall be applied to the side of the film which will be towards the light source when used in a projection system arranged for direct front projection onto a reflection-type screen.

## 4 LOCATION AND WIDTH OF MAGNETIC HEAD GAPS

- 4.1 The location and widths of the magnetic recording and universal head gaps shall be as shown on page 2.
- 4.2 The magnetic recording head gap shall be at an angle of  $90^\circ \pm 10'$  to the longitudinal axis of the film travel.

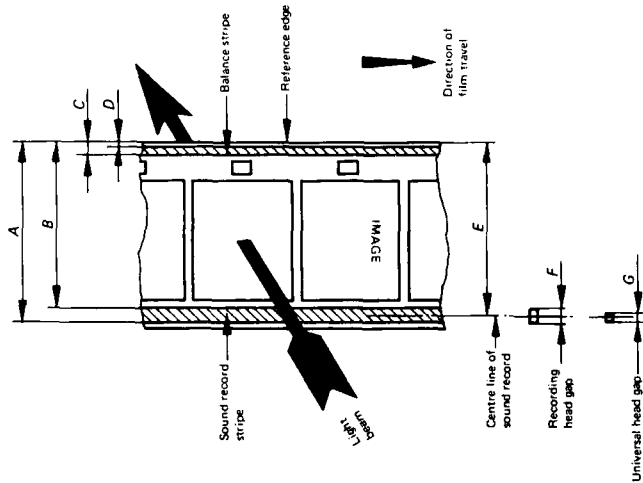
## 5 PICTURE-SOUND DISPLACEMENT

The magnetic sound record on the film shall precede the centre of the corresponding picture by a distance of  $18 \pm 1$  frames.

## 6 PROJECTION FILM SPEEDS

The nominal speed of film past the magnetic heads for reproduction shall be as specified below.

Application	cm/s	in/s	Frames (perforational) per second
<b>A Primary standards</b>			
1) Cinematography applications	10,2	4,0	24
2) Television applications			
— for 50 Hz supplies	10,6	4,2	25
— for 60 Hz supplies	10,2	4,0	24
<b>B Secondary standard (non-professional use)</b>			
	7,6	3,0	18



Dimension	mm	in
A*	7,92 ± 0,08	0,312 ± 0,003
B*	7,24 ± 0,08	0,285 ± 0,003
C	0,38 ± 0,08	0,015 ± 0,003
D	0,08 ± 0,08	0,003 ± 0,003
E	7,58 ± 0,05	0,298 ± 0,002
F	0,65 ± 0,05	0,026 ± 0,002
G**	0,53 ± 0,05	0,021 ± 0,002

\* Notwithstanding the tolerances on A and B above, the difference between dimensions A and B shall not be smaller than 0,635 mm (0,025 in) minimum.

\*\* When it is desired to employ a single head for the dual function of recording and reproducing, the universal head gap dimension shall apply.

NOTE — The tolerances for dimensions A and B are larger by 1/3 than the corresponding tolerances for the recording stripe on 16 mm and 35 mm width films because 8 mm film is commonly generated from such wide width films. The differences occurring in slitting must therefore be taken into account.

FIGURE — Location and width of magnetic striping, and recording head gaps