ing methods, which will lead to the formation of images conveying a large quantity of information.

To solve successfully the problems to be undertaken in the coming five-year plan and to ensure the technical progress of all branches of the motion-picture industry, the NIKFI will greatly increase the quality and efficiency of the investigations and developments it carries out, improve the organization and co-ordination of the scientific-research and experimental-construction work undertaken by the Institute and its branches, the construction bureau and the cinematographic establishments, and strive for a further increase in the part played by the Institute as the leading organization in the field of ciné techniques and the ciné photo industry.

standards and recommended practices

Proposed American Standards

Two Proposed American Standards are published here for a trial period and public review. Comments should be addressed to Alex E. Alden, Staff Engineer, at Society Headquarters prior to May 20. These proposals are currently under review by ASA Sectional Committee PH22; consequently, all comments received through this publication will be resolved by that committee prior to further processing.

The proposals, PH22.11, Dimensions for 16mm Motion-Picture Projection Reels (200- to 2,000-ft capacity) and PH22.-73, Dimensions for 35mm Motion-Picture Film, Perforated 32mm, 2R-2994, are proposed revisions of existing standards. PH22.73 is, in fact, a complete reaffirmation of the technical information differing from its previous version only in an editorial manner to facilitate its use. PH22.11, however, has been expanded to specify reels up to 2,000-ft capacity and, in some cases, dimensions have been modified. It is recommended that this proposal be reviewed carefully.—*A.E.A.*

International Standardization

The International Organization for Standardization (ISO), whose activities in the field of cinematography were described in the January 1962 Journal (pp. 32–37), adopted three recommendations which are published here for the general information of the SMPTE membership.

Recommendation R 358, Maximum Aspect Ratio of Projector Aperture for Projection of 35mm Nonanamorphotic Motion-Picture Films, does not parallel any American Standard, although the practice described is generally followed within the United States; Germany, Japan and New Zealand opposed approval of this recommendation.

Recommendation R 359, Projected Image Area for 16mm Film, not approved by France, is in general agreement with the equivalent American Standard PH22.8-1957. Recommendation R 360, Location of Recording Heads for Four Magnetic Sound Records on 35mm Film, is in full agreement with the similar American Standard PH22.108-1958 and was approved by the following ISO Member Bodies: Belgium, Brazil, Canada, Chile, Czechoslovakia, France, Germany, Italy, Japan, Netherlands, New Zealand, Rumania, Sweden, United Kingdom, USA and USSR.

The members' attention is directed to the fact that only the technical content of the recommendations is published here. Copies of the complete documents are available from the American Standards Association, 10 East 40th Street, New York, N.Y. 10016.—*A.E.A.*

Proposed American Standard Dimensions for

16mm Motion-Picture Projection Reels (200- to 2,000-Ft Capacity)

PH22.11

Revision of PH22.11-1953

1. Scope

This standard specifies the dimensions for 16mm motion-picture projection reels having capacities from 200 to 2,000 ft of film inclusive.

2. Dimensions

The dimensions shall be as specified in Fig. 1 and Tables 1, 2, and 3.

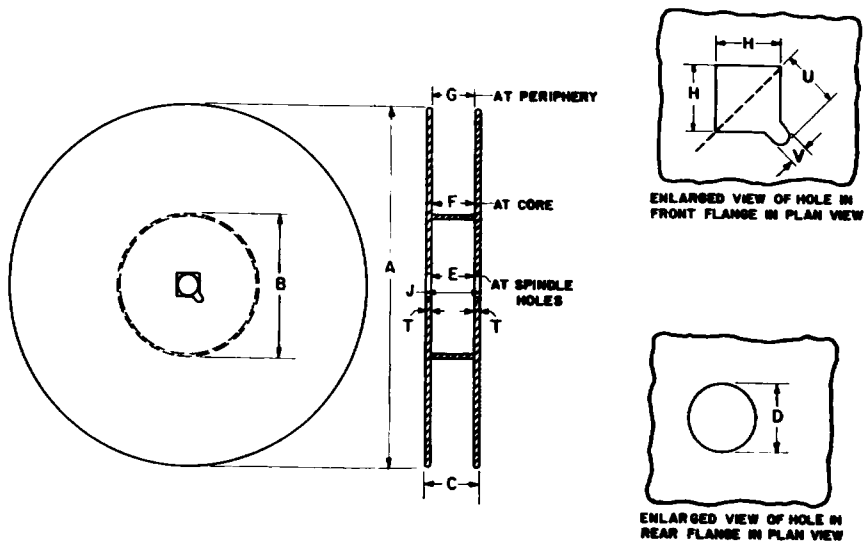


Fig. 1. Figure shows plan view and cross section of reel.

Table 1

"400 Series"

Capacity	Dimensions	Inches	Millimeters
200 ft (60 m)	A	$5.000 \begin{smallmatrix}+0.031\\-0.000\end{smallmatrix}$	$127.00 \begin{smallmatrix}+0.79\\-0.00\end{smallmatrix}$
	B	1.750 ± 0.250	44.45 ± 6.35
	Lateral runout	0.057 max	1.45 max
400 ft (120 m)	A	$7.000 \begin{smallmatrix}+0.031\\-0.000\end{smallmatrix}$	$177.80 \begin{smallmatrix}+0.79\\-0.00\end{smallmatrix}$
	B	$2.500 \begin{smallmatrix}+0.000\\-0.075\end{smallmatrix}$	$63.50 \begin{smallmatrix}+0.00\\-1.905\end{smallmatrix}$
	Lateral runout	0.080 max	2.03 max

Table 2

"2000 Series"

Capacity	Dimensions	Inches	Millimeters
800 ft (240 m)	A	$10.500 \begin{smallmatrix}+0.031\\-0.000\end{smallmatrix}$	$266.70 \begin{smallmatrix}+0.79\\-0.00\end{smallmatrix}$
	B	$4.875 \begin{smallmatrix}+0.000\\-0.375\end{smallmatrix}$	$123.83 \begin{smallmatrix}+0.00\\-9.53\end{smallmatrix}$
	Lateral runout	0.120 max	3.05 max
1200 ft (360 m)	A	$12.500 \begin{smallmatrix}+0.000\\-0.125\end{smallmatrix}$	$311.15 \begin{smallmatrix}+0.00\\-3.17\end{smallmatrix}$
	B	$4.875 \begin{smallmatrix}+0.000\\-0.250\end{smallmatrix}$	$123.83 \begin{smallmatrix}+0.00\\-6.35\end{smallmatrix}$
	Lateral runout	0.140 max	3.56 max
1600 ft (480 m)	A	$13.750 \begin{smallmatrix}+0.250\\-0.000\end{smallmatrix}$	$355.60 \begin{smallmatrix}+6.35\\-0.00\end{smallmatrix}$
	B	$4.875 \begin{smallmatrix}+0.000\\-0.250\end{smallmatrix}$	$123.83 \begin{smallmatrix}+0.00\\-6.35\end{smallmatrix}$
	Lateral runout	0.160 max	4.06 max
2000 ft (600 m)	A	$15.000 \begin{smallmatrix}+0.031\\-0.000\end{smallmatrix}$	$381.79 \begin{smallmatrix}+0.79\\-0.00\end{smallmatrix}$
	B	$4.875 \begin{smallmatrix}+0.000\\-0.250\end{smallmatrix}$	$123.83 \begin{smallmatrix}+0.00\\-6.35\end{smallmatrix}$
	Lateral runout	0.171 max	4.34 max

Table 3

Dimensions Common to Both Series

	Dimensions	Inches	Millimeters
C	Total thickness (including flared, rolled, or beveled edges, if any)	0.962 max	24.43 max
D	Spindle hole diameter	$0.319^{+0.000}_{-0.003}$	$8.10^{+0.00}_{-0.08}$
E	Distance between flanges at spindle holes	0.660 ± 0.015	16.76 ± 0.38
F	At core	0.660 ± 0.010	16.76 ± 0.25
G	At periphery	$0.660^{+0.045}_{-0.025}$	$16.76^{+1.14}_{-0.64}$
H	Side of square spindle hole	$0.319^{+0.000}_{-0.003}$	$8.10^{+0.00}_{-0.08}$
J	Over-all thickness at spindle holes	0.790 max	20.07 max
T	Flange thickness (adjacent to spindle holes)	0.066 max 0.027 min	1.68 max 0.69 min
U	Keyway depth	0.312 ± 0.016	7.92 ± 0.41
V	Keyway width	$0.125^{+0.005}_{-0.000}$	$3.18^{+0.13}_{-0.00}$
	Flange and core concentricity	± 0.031	± 0.79

NOTES:

1. The metric values in the tables of dimensions are converted from the inch values in accordance with conversion principles outlined in American Standard Practice for Inch-Millimeter Conversion for Industrial Use, B48.1-1933 (Reaffirmed 1947).

2. The outer surfaces of the flanges shall be flat out to a diameter of at least 1.250 in. (31.75mm). Dimension J is the thickness of the reel over the area described by this diameter.

3. Rivets or other fastening members shall not extend beyond the outside surfaces of the flanges more than 1/32 in. (0.79mm) and shall not extend beyond the over-all thickness indicated by Dimension C.

4. Except at embossings, rolled edges, and rounded corners, the limits shown here shall not be exceeded at the periphery of the flanges, nor at any other distance from the center of the reel.

5. If spring fingers are used to engage the edges of the film, Dimension F shall be measured between the fingers when they are pressed outward to the limit of their operating range.

6. The eccentricity of the flanges and core with respect to the spindle hole axis shall not exceed the total radius variation (total indicator reading) shown in Table 3 procedures. Other deformations result from poor construction. A reel that meets this standard must pass the following test:

Make three posts that are placed 120° apart and constructed so they support a short length of the rim of the reel for a distance of 1/8 in. radially. Apply a load of 1/2 pound over a central area not greater than 1 1/4 in. in diameter. Measure the vertical location of this area with a dial indicator. Add 1 pound and measure again. Repeat the process on the other flange. The additional deflection caused by the 1 pound weight over that given by the 1/2 pound weight should be less than 0.035 in.

Appendix

(This Appendix is not a part of Proposed American Standard Dimensions for 16mm Motion-Picture Projection Reels (200- to 2,000-Ft Capacity), PH22.11, but is included to facilitate its use.)

A1. While some users prefer a square hole in both flanges for laboratory work, it is recommended that they obtain such reels on special order. If both flanges have square holes, and if the respective sides of the squares are parallel, the reel will not be suitable for use on some projector spindles. This is true if the spindle has a shoulder that a flange must touch in order to supply lateral positioning for the reel. This objection does not apply if the two squares are oriented so their respective sides are at an angle.

For regular projection, however, a reel with a round hole in one flange is generally preferred. When this hole is present, the projectionist can tell at a glance whether or not the film needs rewinding. Furthermore, this type of reel helps the projectionist place the film correctly on the projector and thread it so that the picture is properly oriented with respect to the right and left sides.

A2. Nominal values for Dimensions E, F, and G were chosen to provide lateral clearance for the film, which itself has a maximum width of 0.630 in. However, a channel of the indicated width is narrow enough so that the film cannot wander laterally too much as it is wound. If the channel is too wide, it is likely to cause loose winding of the film with resultant excessively large rolls.

At the core, the tolerances applied to Dimension F are least because it is possible to control the separation fairly easily in that zone. At the region near the holes for the spindles, these tolerances are set somewhat larger to allow for slight buckling of the flanges between the core and the holes. At the periphery, the tolerances are still greater because it is difficult to maintain the distance with accuracy.

A3. The opening in the corner of the square hole, to which Dimensions U and V apply, is provided to fit the spindles of 35mm rewinds, which are used in some laboratories.

A4. Minimum and maximum values for Dimension T, the thickness of the flanges, were chosen to permit the use of various materials.

A5. The outside diameter of the flanges was made as large as permitted by past practice in the design of projectors, containers for reels, rewinds, and similar equipment. This was done so that the values of B could be made as great as possible. As a result, there is less variation throughout the projection of a roll in the tension to which the film is subjected by the take-up mechanism. This is especially true if a constant-torque device is used.

A6. Film tension in a projector should be kept low to avoid perforation damage. In order to maintain low tension, it is necessary to keep the ratio of core diameter (Dimension B) to flange diameter (Dimension A) as large as possible. Rather widely separated limits for core diameter are allowed in the values given in the tables in some cases. While these are not intended to be manufacturing tolerances, they describe currently available reels that give satisfactory performance. In the design of new large reels, it is recommended that the paper listed as Reference 2 below be consulted.

REFERENCES:

1. C. F. Vilbrandt, "The projection life of 16mm film," *Jour. SMPE*, 48: 521-542, June 1947.

2. J. S. Chandler, "Projecting 16mm film with large reels," *Jour. SMPTE*, 65: 320-327, May 1956.

Proposed American Standard Dimensions for

35mm Motion-Picture Film, Perforated 32mm, 2R-2994

PH22.73

Revision of PH22.73-1958

1. Scope

This standard specifies the cutting and perforating dimensions for 35mm motion-picture film having two rows of 16mm type perforations, one row near each edge of the 35mm film and a perforation pitch of 0.2994 in.

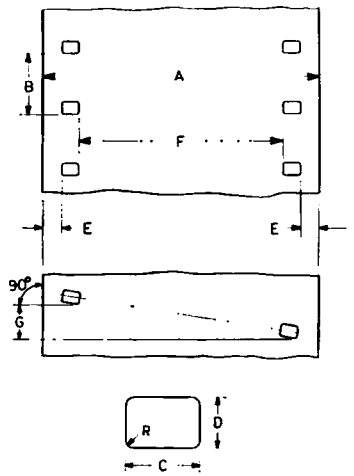
2. Dimensions

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

2.2 These dimensions pertain to a safety film as defined in Appendix A5.

2.3 These dimensions apply to material immediately after cutting and perforating.

2.4 Dimension L represents the length of any 100 consecutive perforation pitch intervals.



	Dimensions	Inches	Millimeters
A	Film width	1.377 ± 0.001	34.98 ± 0.03
B	Perforation pitch	0.2994 ± 0.0005	7.605 ± 0.013
C	Perforation width	0.0720 ± 0.0004	1.829 ± 0.010
D	Perforation height	0.0500 ± 0.0004	1.270 ± 0.010
E	Edge to perforation	0.096 ± 0.002	2.44 ± 0.05
F	Width between perforations	1.041 ± 0.002	26.44 ± 0.05
G	Perforation skewness	0.001 max	0.03 max
L	100 consecutive perforation pitch intervals	29.94 ± 0.03	760.5 ± 0.8
R	Radius of perforation fillet	0.010 ± 0.001	0.25 ± 0.03

NOTE 1: The title of this standard was established by the application of a nomenclature system developed for all film dimension standards: Each title provides an indication of the film width, a code designation for the perforation shape (BH, KS, DH, or CS) or the number of rows of perforations (1R, 2R or 4R), depending upon which is the significant factor, and the perforation pitch without the decimal point.

NOTE 2: The metric values in the table of dimensions are converted from the inch values in accordance with conversion principles outlined in American Standard Practice for Inch-Millimeter Conversion for Industrial Use, B48.1-1933 (Reaffirmed 1947).

Appendix

(This Appendix is not a part of Proposed American Standard Dimensions for 35mm Motion-Picture Film, Perforated 32mm, 2R-2994, PH22.73, but is included to facilitate its use.)

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

A2. It will be noted that among the various standards for slitting and perforating film stock there are often two standards which seem much alike in wording. The difference lies in the longitudinal pitch which is either 0.2994 in. or 0.3000 in. In general, the longer pitch is for print stock and the shorter pitch is for negative stock.

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

Maximum steadiness and definition are secured on a sprocket-type printer when the negative stock is somewhat shorter in pitch than the positive stock in the approximate proportion of the thickness of the film to the radius of curvature. For printing on a 40-tooth 32mm sprocket (circumference of about 12 in.) with film 0.0055 to 0.0065 in. thick, the optimum pitch differential is 0.3 percent. The use of the ideal pitch differential for the negative would minimize slippage between the positive stock and negative during the printing operation, thus reducing the amount of blurring and jumping of horizontal lines in the picture or sound image. (This error is to be differentiated from the jump caused by nonuniformity of successive pitches, Dimension B.)

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

For many years this desired difference in pitch was caused by the shrinkage of the negative film during processing and aging. Current film bases shrink less than the earlier ones and hence a shorter initial pitch becomes desirable. To satisfy this requirement for picture- or sound-negatives, it is common manufacturing practice to aim for a pitch value 0.2 percent shorter than the positive stock onto which they will be printed. The additional shrinkage that occurs during processing and the aging that takes place before the release prints are made then bring the pitch differential close to the optimum and desired value of 0.3 percent. Accordingly, the pitch chosen for the negative stock is 0.2994 in.

Low-shrink negative film perforated to these dimensions should not thereafter shrink appreciably more than 0.2 percent under normal use conditions, and for a reasonable life span, so that the optimum pitch differential from the positive stock of 0.3 ± 0.1 percent is maintained. (The film should be measured after equilibration with air at 70 F and 55 percent relative humidity or at the conditions prevailing at the time of perforating.)

A3. The uniformity of pitch, hole size, and margin (Dimensions B, C, D, and E) is an important variable affecting steadiness. Variations in these dimensions, from roll to roll, are of little significance compared to variations from one sprocket hole to the next. Actually it is the maximum variation from one sprocket hole to the next within any small group of consecutive perforations that is important.

A4. This kind of film is made on 35mm stock so that it may be processed on 35mm sprocketless developing machines. It is designed for use in intermediate stages in the making of 16mm prints. This standard is based on the values adapted to "low-shrink" film base since nearly all films now manufactured in the U.S. meet the definition noted below.

For the purpose of choice of width, low-shrinkage film base is film base which when coated with emulsion and any other normal coating treatment, perforated, kept in the manufacturer's normal commercial packings for six months at 65 to 75 F, exposed, processed and stored exposed to air for a period not to exceed 30 days at 65 to 75 F and 50 to 60 percent relative humidity, and measured under like conditions of temperature and humidity, shall have shrunk not more than 0.2 percent from its original dimension at the time of perforating.

This definition of low-shrinkage film stock has been found by experience to be useful as a guide to film manufacturers in slitting their stock. Departure from this definition shall not be cause for rejection of the stock. Note that this definition of shrinkage differs from the criterion applying to the choice of longitudinal pitch, where greater periods of time are involved and where short-time tests can be deceptive.

Allowance has been made in arriving at these values for the common tendency of film to expand when exposed to high relative humidity. Allowance should be made for this factor in equipment design and in no case should 16mm equipment fail to accommodate a film of 0.630-in. width.

A5. It should be noted that it has been a firm policy of film manufacturers in the U.S. to coat film of 8mm and 16mm width on safety base (see American Standard Specifications for Safety Photographic Film, PH1.25-1956, Reaffirmed 1962). Films of larger size which ultimately become 8mm and 16mm are naturally covered by the same concept.

ISO Recommendation R 358 December 1963

CINEMATOGRAPHY

MAXIMUM ASPECT RATIO OF PROJECTOR APERTURE FOR PROJECTION OF 35 mm NON-ANAMORPHOTIC MOTION-PICTURE FILMS

1. SCOPE

1.1 This ISO Recommendation specifies the maximum aspect ratio for projector apertures for the projection of non-anamorphotic motion-pictures from 35 mm film with normal format images (camera image 22 mm × 16 mm, 0.866 in × 0.629 in).

1.2 The position of the projector aperture relative to the image printed on the film is also specified.

1.3 This ISO Recommendation excludes anamorphotic techniques.

2. MAXIMUM ASPECT RATIO

The maximum aspect ratio of the projector aperture should be 1.85/1 (see note below).

NOTE. — This ratio will represent the proportions of the picture on the screen only when projection is at right angles to the screen.

3. POSITION OF PROJECTOR APERTURE

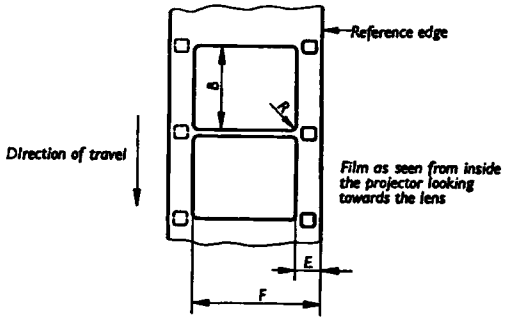
For all wide-screen aspect ratios up to the maximum of 1.85/1, the edge of the projector aperture which corresponds to the upper edge of the picture as seen on the screen should be 1.7 mm (0.067 in) from the edge of the normal format image printed on the film.

ISO Recommendation R 359 December 1963

CINEMATOGRAPHY

PROJECTED IMAGE AREA FOR 16 mm FILM

The projected image area should be in accordance with the provisions specified hereafter.



Dimensions	Millimetres	Inches
B	$7.26\ ^{0}_{-0.20}$	$0.286\ ^{0}_{-0.008}$
E	$3.1\ ^{+0.1}_{0}$	$0.122\ ^{+0.004}_{0}$
F	$12.8\ ^{0}_{-0.1}$	$0.504\ ^{0}_{-0.004}$
R	0.5 max.	0.02 max.

The angle between the vertical edges of the aperture and the edges of normally positioned film should be 0° ± ½°.

The angle between the horizontal edges of the aperture and the edges of normally positioned film should be 90° ± ½°.

NOTES

1. Dimensions *B* and *R* apply to the size of the projected area of the image; corresponding dimensions of the projector aperture are actually slightly smaller. The difference depends upon the lens used and the space provided between the surface of the emulsion and that of the aperture in order to avoid scratching. This space should be kept as small as possible so that the image of the edges of the aperture will be relatively sharp.
2. The projector aperture generally is located between the film and the light source in order to assure the maximum protection from heat; in certain cases, however, an opposite arrangement can be adopted.
3. The dimensions *E* and *F* are so chosen as to center the image on film which is slightly shrunk at the time it is projected, which conforms with normal operating conditions.

ISO Recommendation R 360 December 1963

CINEMATOGRAPHY

LOCATION OF RECORDING HEADS FOR FOUR MAGNETIC SOUND RECORDS ON 35 mm FILM

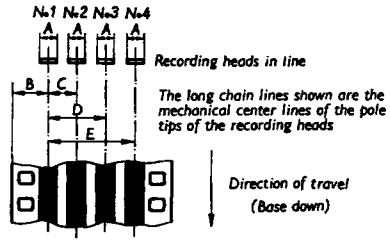
1. SCOPE

1.1 This ISO Recommendation specifies the location and dimensions of the magnetic sound recording heads for recording four magnetic sound records on 35 mm motion-picture films.

1.2 This ISO Recommendation relates the placement of the magnetic coating on the film to the direction of film travel.

2. DIMENSIONS

The dimensions are as specified in the figure and the table.



Dimensions	Millimetres	Inches
A	$3.8\ ^{+0.1}_{0}$	$0.150\ ^{+0.004}_{0}$
B	7.9 ± 0.05	0.314 ± 0.002
C	6.4 ± 0.05	0.250 ± 0.002
D	12.8 ± 0.05	0.500 ± 0.002
E	19.2 ± 0.05	0.750 ± 0.002

NOTE. — The millimetre and inch dimensions represent acceptable practice though the positions of the outer tracks differ slightly in the two systems. The advantages of round numbers in both systems justify the differences.

3. MAGNETIC COATING

With the direction of the film travel shown in the figure, the magnetic coating is on the upper face of the film base.