standards and recommended practices

Proposed USA Standards

One new and five updated Proposed USA 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 April 26. The documents have been submitted to USASI Sectional Committee PH22; however, any objections or suggestions resulting from this publication will be considered before action by that Committee is concluded.

PH22.28, Dimensions for 35mm Motion-Picture Projection Lenses and Mounts, is a complete revision of the previous issue having been expanded to include standard space dimensions. Anyone involved with the design or use of 35mm projection lens should review this proposal carefully.

PH22.31, Specifications for Motion-Picture Safety Film, is basically a reaffirmation of the previous issue. This version, however, covers all perforated image-producing sensitized stock including leaders and magnetically-coated film.

PH22.100, Screen Luminance and Viewing Conditions for 16mm Review Rooms, is also a completely revised proposal requiring careful consideration. It should be noted that the luminance at the center of the screen has been raised to 16 ± 2 footlamberts.

PH22.118, Dimensions for 65mm Motion-Picture Film, KS-1870, and PH22.119, Dimensions for 70mm Motion-Picture Film, KS-1870, are mainly reaffirmations of earlier issues with some editorial revisions to permit greater facility in use.

PH22.158, Dimensions for 35mm Motion-Picture Film Perforated 8mm, 5R-1500, is a new proposal describing a film used in multiple printing of 8mm film and finally slit to that width.—*A.E.A.*

Proposed USA Standard Dimensions for

35mm Motion-Picture Film Perforated 8mm, 5R-1500

PH22.158

1. Scope

This standard specifies the cutting and perforating dimensions for 35mm motion-picture film with five rows of perforations and a perforation pitch of 0.1500 in. The film stock described in this standard is intended for the production of prints. The width of the 8mm strip after processing and slitting is, therefore, also specified.

2. Dimensions

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

2.2 The dimensions pertain to a safety film as defined in Proposed USA Standard Specifications for Motion-Picture Safety Film, PH22.31.

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

2.4 Except for Dimensions A′ and E′, the dimensions apply to raw stock immediately after cutting and perforating.

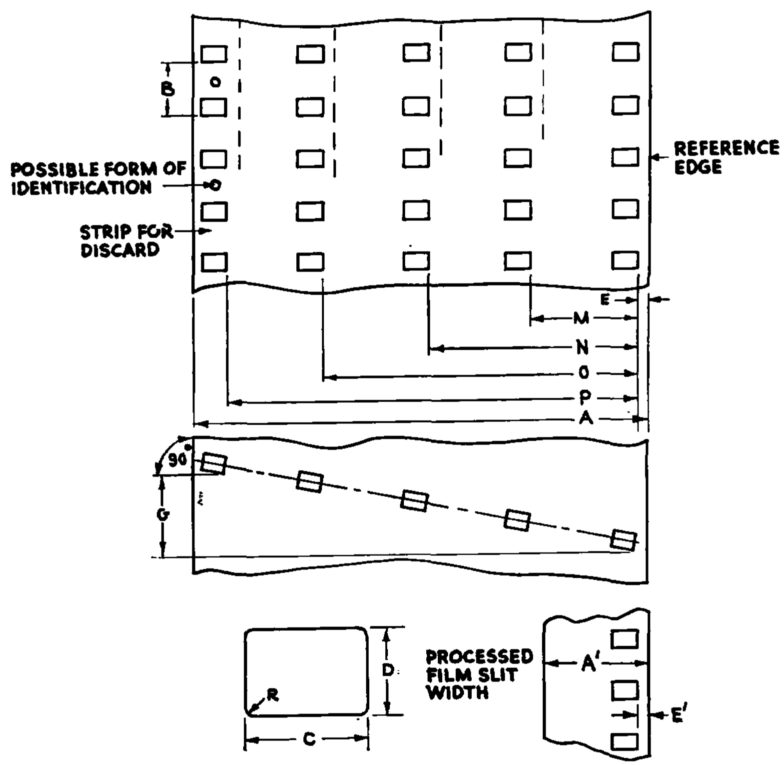
3. Discard Edge

A strip, containing the perforations in the fifth row, *is discarded after slitting four strips* of nominal 8mm width from the processed film. The discard row of perforations must, therefore, be provided with a means of identification visible on the raw film.

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, etc.), 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 USA Standard Practice for Inch-Millimeter Conversion for Industrial Use, B48.1-1933 (Reaffirmed 1947).

NOT APPROVED



	Dimensions	Inches	Millimeters
A	Film width	1.377 ± 0.001	34.975 ± 0.025
A′	Film width after slitting	0.314 ± 0.002	7.98 ± 0.05
B	Perforation pitch	0.1500 ± 0.0005	3.810 ± 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	Reference edge to first perforation row	0.0355 ± 0.002	0.902 ± 0.05
E′	Edge to perforation after slitting	0.0355 ± 0.002	0.902 ± 0.05
G	Perforation skewness	0.001 max	0.03 max
L	100 consecutive perforation pitch intervals	15.000 ± 0.015	381.00 ± 0.38
M	Lateral perforation displacement	0.3145 ± 0.001	7.988 ± 0.03
N	Lateral perforation displacement	0.6290 ± 0.001	15.977 ± 0.03
O	Lateral perforation displacement	0.9435 ± 0.001	23.965 ± 0.03
P	Lateral perforation displacement	1.2340 ± 0.001	31.344 ± 0.03
R	Radius of perforation fillet	0.010 ± 0.001	0.254 ± 0.03

PH22.158—NOT APPROVED

Appendix

(This Appendix is not a part of Proposed USA Standard Dimensions for 35mm Motion-Picture Film Perforated 8mm, 5R-1500, PH22.158, 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 except for Dimensions A' and E' which are for film after processing and apply to any slit strip. 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 0.1500 in. or 0.1497 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 an 80-tooth 35mm 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 0.1497 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 perforation to the next within any small group of consecutive perforations. As an example, the uniformity of the margin is uniquely critical for optical printing. During the printing process, the placement of the image on the film is usually with respect to successive lateral pairs of perforations at one-frame intervals. During subsequent projection, however, the portion of the image projected is usually located, not by these perforations, but by the edge of the film. The lateral steadiness of the projected image is, therefore, directly related to the frame-to-frame uniformity of the margin.

A4. The film stock described in this standard is intended for the economical production of prints. It is slit, after printing and developing, to 8mm width. If the error of slitting exceeds tolerances, one of the 8mm strips may exceed the width allowed for 8mm film and cause interference in the projector gate. In addition to errors of centering, there are errors caused by recurring variations in width. These errors will cause weave on the screen even though the maximum width of the film may not be great enough to cause interference in the projector gate.

PH22.158—NOT APPROVED

Proposed USA Standard Specifications for

Motion-Picture Safety Film

PH22.31

Revision of PH22.31-1958

1. Scope

This standard defines and specifies safety film for motion-picture use.

2. Definition

The term "safety film" as used in this standard includes all perforated film used in the motion-picture industry. Specifically included are leaders, including unperforated leaders; sensitized stock based on the silver halide, dye transfer, vesicular, or other image-producing systems; raw and processed stock, and magnetically coated perforated film.

3. Specification

3.1 "Safety film," as applied to the motion-picture industry, shall comply with USA Standard Specifications for Safety Photographic Film, PH1:25-1965.

3.2 All films intended for the motion-picture industry shall be manufactured in compliance with PH1.25-1965.

3.3 Only safety film shall be made available for and used in 16mm and 8mm motion-picture cameras and projectors.

NOTE 1: 35mm nitrate motion-picture film is no longer manufactured in the U.S. However, there are existing nitrate films still in use or in storage and there are others existing or of future manufacture which may be imported. There is no intent in this standard to limit the use of such 35mm nitrate films, but by designating them as "non-standard" it is intended to emphasize that the hazard involved in their handling requires the observance of adequate precautions and safeguards. (See "Standards of the National Board of Fire Underwriters for Storage and Handling of Cellulose Nitrate Motion Picture Film as Recommended by the National Fire Protection Association," NBFU Pamphlet No. 40, 1962.)

NOTE 2: Because of its attendant fire hazards, nitrate film has never been manufactured in the U.S. in 16mm and 8mm widths since these are traditionally for amateur and nontheatrical use. However, small quantities of nitrate film may be in existence as a result of foreign import or from slitting operations of certain intermediate laboratory processing films. The purpose of Par. 3.3 is therefore to classify and designate as nonstandard the handling or use of all such film.

Appendix

(This Appendix is not a part of Proposed USA Standard Specifications for Motion-Picture Safety Film, PH22.31, but is included to facilitate its use.)

A1. Video magnetic tape, audio magnetic tape, digital magnetic tape, and other magnetic tapes such as those for instrument use are not included in this standard.

A2. American Standard PH1.25-1965 includes in the nitrogen analysis not only the support film but also the emulsion and any other applied coating or treatment such as protective lacquers.

NOT APPROVED

Proposed USA Standard

Screen Luminance and Viewing Conditions for 16mm Review Rooms

PH22.100

Revision of PH22.100-1955

1. Scope

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

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 objective. 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 ± 2 footlamberts (55 ± 7 nits), 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 ± 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 footlamberts (62 nits).

4. Spectral Distribution

4.1 16mm prints are made for projection with several colors of projector illuminant. (Appendix A8)

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°K to 4500°K) and a high color temperature band (5000°K to 6500°K). (Appendix A8.2)

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 ± 1 picture heights from the screen.

6.2 No stray light or illuminated area with a luminance in excess of 1 footlambert (3.4 nits) 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 be 2° nominal 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. (5 percent of frame width) and should not exceed 0.050 in. 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, 16mm 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.

Appendix

(This Appendix is not a part of Proposed USA Standard Screen Luminance and Viewing Conditions for 16mm Review Rooms, PH22.100, but is included to facilitate its use.)

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 10-20 people. The actual picture size may be small or large 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. Review Room Screens

Commercial screens are seldom perfectly diffusing and may be obtained with considerable directional reflectivity. Even commercial matte screens show some limited specular reflection, which alters the luminance distribution pattern for observers seated away from the screen axis. The effect of such directivity is to increase the luminance of those portions of the screen nearest the observer, decrease the luminance of those portions furthest from the observer, and displace the area of maximum luminance. Some screens show this effect to such a degree that the conditions of Sections 3.1, 3.2, 3.3, and 6.1 cannot be met simultaneously. Although specular screens can be satisfactorily used in a theater designed for their characteristics, they are not recommended for review rooms.

A5. Theatrical Projection

Standards for theater screen luminance, such as USA Standard Screen Luminance for Indoor Theaters, PH22.-124-1961, 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 theatres, auditoriums, classrooms, stores, offices, etc.

A6. 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.

A7. 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 $\pm$ 5 percent. The limiting conditions for the reliable use of such meters should be included in the manufacturer's specifications.

A8. Color Quality

A8.1 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.

A8.2 Projection Sources: The following sources are in commercial use for projection of 16mm prints:

	Approximate Color Temperature	*Approximate Chromaticity x*	*y*
Low Temperature Band			
Incandescent bulb	3280°K	0.42	0.40
Modified carbon arc	4450°K	0.36	0.37
High Temperature Band			
High-intensity carbon arc	5400°K	0.34	0.36
Xenon arc bulb	6200°K	0.32	0.32

PH22.100—NOT APPROVED

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 these. 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.

A8.3 Correction of Source: 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 filters 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.

A8.4 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 projected picture (measuring the included angle from the area in question to the centerline of the screen).

A9. 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 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 of the aperture, between the aperture plane and the projection lens and within 1/16 in. 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).

A10. Conversion of Units

Screen luminance in the U.S. is customarily measured in footlamberts, although in international usage, the nit is the preferred unit. One nit = 0.2919 footlamberts; 1 footlambert = 3.426 nits.

PH22.100—NOT APPROVED

Proposed USA Standard Dimensions for

35mm Motion-Picture Projection Lenses and Mounts

PH22.28

Revision of PH22.28-1958

1. Scope

This standard specifies for lenses used in 35mm motion-picture projectors:

(1) The marking on the lens.

(2) The permissive tolerance between actual and designated focal length.

(3) The limiting dimensions for lens mounting.

2. Marking of Prime Lenses

The focal length of the lens shall be marked on the lens barrel in a permanent manner.

3. Focal Length of Prime Lenses

3.1 The actual focal length shall not differ from the value marked on the lens by more than ± 1 percent.

3.2 Preferred values of focal lengths shall be integral multiples of ¼ in. (6mm) nominal, over the range from 2 to 7 in. inclusive.

4. Barrel Diameter

The barrel diameter (Dimension A) shall be as specified in the figure and Table 1. It is expected that in most projectors the lens mount will clamp around this barrel.

5. Limiting Space Dimensions

The limiting volume within which the lens, set at infinity, shall mount and perform its function, as intended, shall be as specified in Table 2. These are not necessarily the dimensions of any lens but, instead, specify limits beyond which there may be physical interference with the projector mechanism.

6. Anamorphic Conversion Lenses

Anamorphic converters to be attached to the prime lens must fit within the limiting space dimensions.

NOT APPROVED

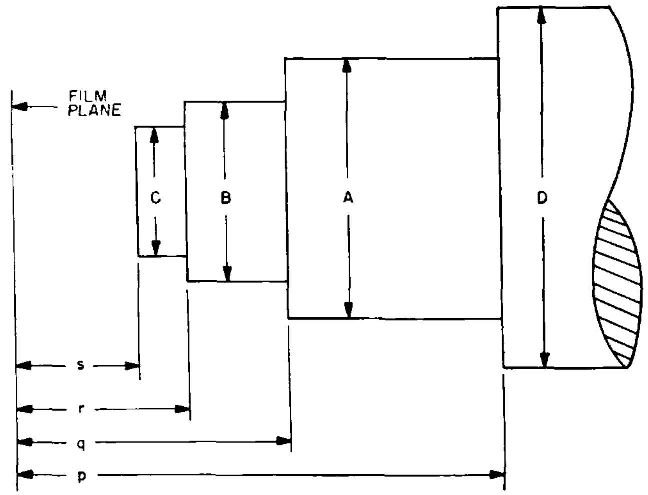


Table 1

Barrel Diameter

Dimensions	Series S Lenses Inches	Series S Lenses Millimeters	Series L Lenses Inches	Series L Lenses Millimeters
A	2.782 + 0.000 − 0.005	70.66 + 0.00 − 0.13	3.990 ± 0.005	101.35 ± 0.13

Table 2

Limiting Space

B	2.25	max	57.2	max	2.25	max	57.2	max
C	1.90	max	48.3	max	1.90	max	48.3	max
D*			Unrestricted					
p*	10.00	min	254.0	min	7.50	min	190.5	min
	2.75	min	69.8	min	2.75	min	69.8	min
q	3.75	max	95.2	max	3.75	max	95.2	max
r	1.50	min	38.1	min	1.50	min	38.1	min
s	1.20	min	30.5	min	1.20	min	30.5	min

* There is no restriction on diameter "D" or on the limiting space beyond distance "p" from the film plane.

PH22.28—NOT APPROVED

Proposed USA Standard Dimensions for

65mm Motion-Picture Film, KS-1870

PH22.118

Revision of
PH22.118-1961

1. Scope

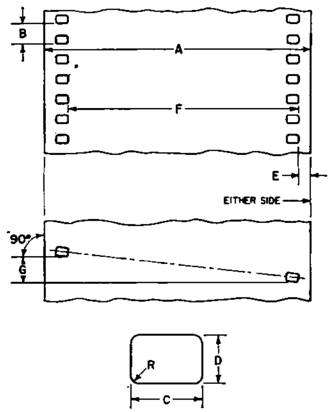
This standard specifies the cutting and perforating dimensions for 65mm motion-picture film with a KS-type perforation, and a perforation pitch of 0.1870 in.

2. Dimensions

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

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

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



	Dimensions	Inches	Millimeters
A	Film width	2.558 ± 0.002	64.97 ± 0.05
B	Perforation pitch	0.1870 ± 0.0005	4.750 ± 0.013
C	Perforation width	0.1100 ± 0.0004	2.794 ± 0.010
D	Perforation height	0.0780 ± 0.0004	1.981 ± 0.010
E	Edge to perforation	0.117 ± 0.003	2.97 ± 0.08
F	Width between perforations	2.214 ± 0.003	56.24 ± 0.08
G	Perforation skewness	0.002 max	0.05 max
L	100 consecutive perforation pitch intervals	18.700 ± 0.015	474.98 ± 0.38
R	Radius of perforation fillet	0.020 ± 0.001	0.51 ± 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, etc.), 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 USA Standard Practice for Inch-Millimeter Conversion for Industrial Use, B48.1-1933 (Reaffirmed 1947).

NOT APPROVED

Appendix

(This Appendix is not a part of Proposed USA Standard Dimensions for 65mm Motion-Picture Film, KS-1870, PH22.118, 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 that seem much alike in wording. The difference lies in the longitudinal pitch, which is either 0.1870 in. or 0.1866 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, and (3) the film shrinkage and the rate at which shrinkage occurs.

Maximum steadiness and definition are secured on a sprocket-type printer when the negative stock is somewhat shorter in pitch than the positive stock in the approximate proportion of the thickness of the film to the radius of curvature. For printing on a 64-tooth 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 0.1866 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 perforation to the next within any small group of consecutive perforations. As an example, the uniformity of the margin is uniquely critical for optical printing. During the printing process, the placement of the image on the film is usually with respect to successive lateral pairs of perforations at one-frame intervals. During subsequent projection, however, the portion of the image projected is usually located, not by these perforations, but by the edge of the film. The lateral steadiness of the projected image is therefore directly related to the frame-to-frame uniformity of the margin.

A4. Film of this size is generally used as a camera negative. There are two advantages in using this larger size. One is the possibility of producing large prints by contact printing for exhibition in special theaters designed to provide the audience with a large viewing angle. The other purpose is to serve as an original from which 35mm prints can be produced by reduction with less grain and better definition than can be obtained by making contact prints from 35mm negatives.

Prints may be made on 70mm film. The appropriate film is described in Proposed USA Standard Dimensions for 70mm Motion-Picture Film, Perforated 65mm, KS-1870, PH22.119. Note that the 70mm film used with 65mm negative differs in its dimensions from the two earlier films described by USA Standard Dimensions for 70mm Unperforated and Perforated Film for Cameras Other Than Motion-Picture Cameras, PH1.20-1963, Type I and Type II. The perforations of the related 70mm film have the same size and pitch as those described by PH1.20-1963, Type II, but the margin and distance between perforations are different. Consequently Dimension F is the same in both 65mm KS-1870 and KS-1866 films and also for 70mm film, perforated 65mm, KS-1870. The increased space provided by a larger margin E is used to make room for magnetic sound records.

Note that the image usually placed on this film is five pitches high. The manufacture of the film is based on this idea and best results accrue from using this format.

PH22.118—NOT APPROVED

Proposed USA Standard Dimensions for

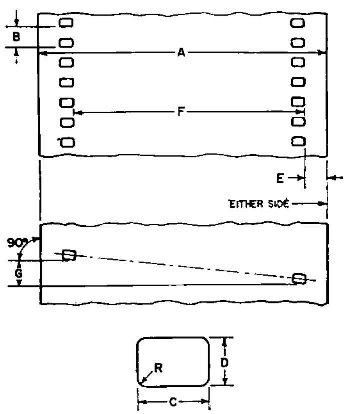
70mm Motion-Picture Film, Perforated 65mm, KS-1870

PH22.119

Revision of PH22.119-1961

1. Scope

This standard specifies the cutting and perforating dimensions for 70mm motion-picture film perforated 65mm, with a KS-type perforation, and a perforation pitch of 0.1870 in.



2. Dimensions

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

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

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

	Dimensions	Inches	Millimeters
A	Film width	2.754 ± 0.002	69.95 ± 0.05
B	Perforation pitch	0.1870 ± 0.0005	4.750 ± 0.013
C	Perforation width	0.1100 ± 0.0004	2.794 ± 0.010
D	Perforation height	0.0780 ± 0.0004	1.981 ± 0.010
E	Edge to perforation	0.215 ± 0.003	5.46 ± 0.08
F	Width between perforations	2.214 ± 0.003	56.24 ± 0.08
G	Perforation skewness	0.002 max	0.05 max
L	100 consecutive perforation pitch intervals	18.700 ± 0.015	474.98 ± 0.38
R	Radius of perforation fillet	0.020 ± 0.001	0.51 ± 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, etc.), 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 USA Standard Practice for Inch-Millimeter Conversion for Industrial Use, B48.1-1933 (Reaffirmed 1947).

NOT APPROVED

Appendix

(This Appendix is not a part of Proposed USA Standard Dimensions for 70mm Motion-Picture Film, Perforated 65mm, KS-1870, PH22.119, 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 that seem much alike in wording. The difference lies in the longitudinal pitch, which is either 0.1870 in. or 0.1866 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, and (3) the film shrinkage and the rate at which shrinkage occurs.

Maximum steadiness and definition are secured on a sprocket-type printer when the negative stock is somewhat shorter in pitch than the positive stock in the approximate proportion of the thickness of the film to the radius of curvature. For printing on a 64-tooth 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 into 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 0.1866 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.)

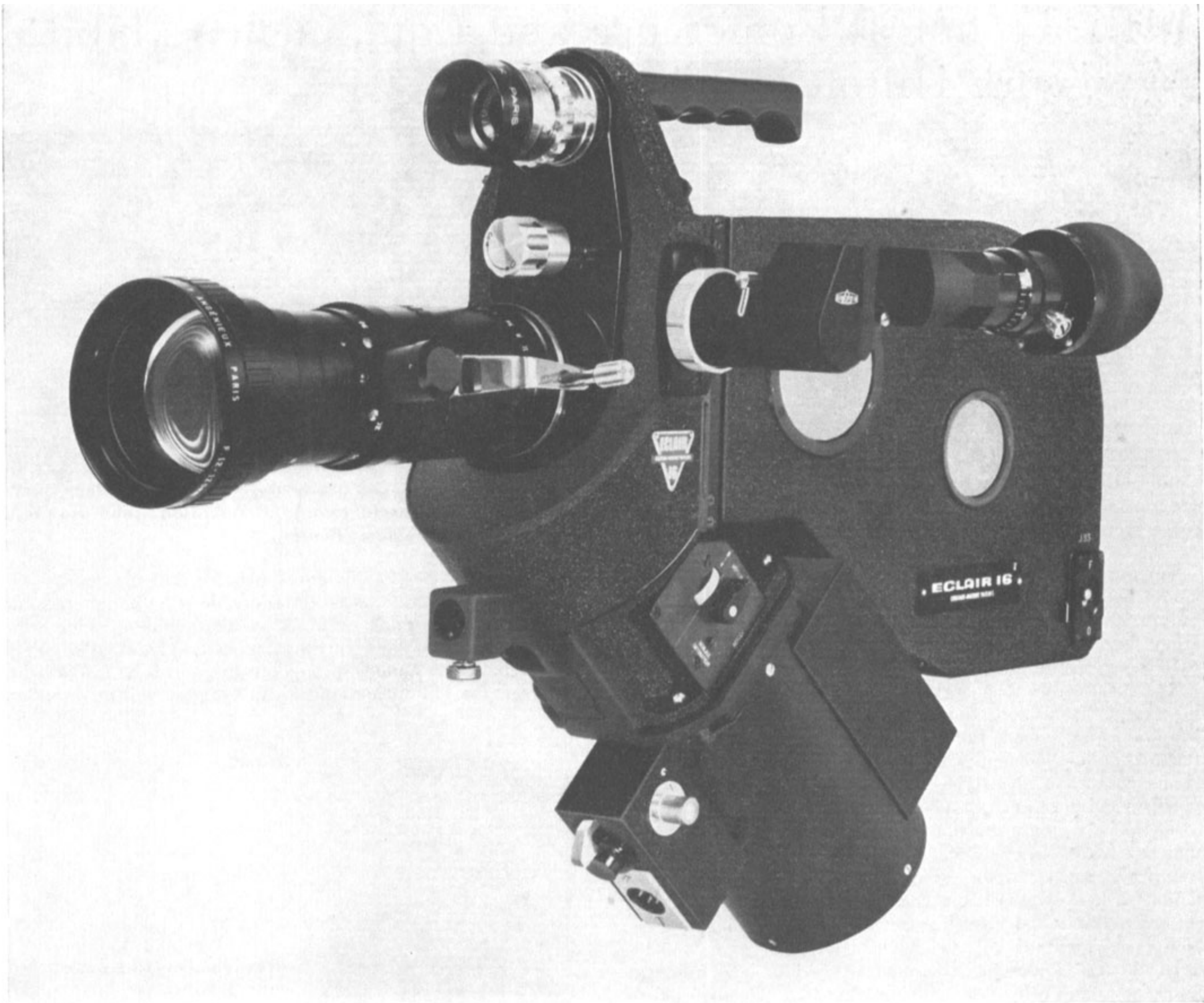
A3. The uniformity of pitch, hole size, and margin (Dimensions B, C, D, and E) is an important variable affecting steadiness. Variations in these dimensions, from roll to roll, are of little significance compared to variations from one perforation to the next within any small group of consecutive perforations.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

A4. Film described in this standard is used in making prints from 65mm film described in Proposed USA Standard Dimensions for 65mm Motion-Picture Film, KS-1870, PH22.118.

Note that the 70mm film used with 65mm negative differs in its dimensions from the two earlier films described by USA Standard Dimensions for 70mm Unperforated and Perforated Film for Cameras Other Than Motion-Picture Cameras, PH1.20-1963, Type I and Type II. The perforations of the related 70mm film have the same size and pitch as those described by PH1.20-1963, Type II, but the margin and distance between perforations are different. Consequently Dimension F is the same in both 65mm KS-1870 and KS-1866 films and also for 70mm film, perforated 65mm, KS-1870. The increased space provided by a larger margin E is used to make room for magnetic sound records.

Note that the image usually placed on this film is five pitches high. The manufacture of the film is based on this idea and best results accrue from using this format.

PH22.119—NOT APPROVED



Not an old design whose noisy movement has been blimped – this is a new design whose silent movement needs no blimp.

Most cameras on the market were designed before World War II. The prototype NPR appeared in 1961. Of course those pre-war designs have since been modified or scaled down from 35mm; but only the NPR's designers have been able to design a new camera from the inside out.

For example: the NPR motor's drive shaft directly turns the shutter, claw and registration pin. No gears; fewer moving parts: the classic formula for quiet running, efficiency and long wear. And the claw is wedge shaped. It slides quietly into the perforation and contacts its bottom edge before the pull-down begins. Claw chatter isn't audible in the older camera designs; noise from the movement's gears drowns it out. But in the NPR it would have been significant—so the new claw was made a part of the new design.

Ten years ago, 16mm was a dirty word. Five years ago, zoom was another. Hand-held still is, in some quarters. But things change. With the improved emulsions, sharp zoom lenses and lightweight recorders now available, wrapping the same noisy old camera inside a blimp isn't good enough. With the NPR you get blimp-free silence in a camera that weighs twenty pounds with lens and film. You also get precise reflex viewing, steady shoulder-resting, a rotating two-lens turret, a constant-speed motor with sync pulse generator and a five-second magazine change.

Franchised dealers: *east coast:* F&B CECO, Camera Mart, Camera Service Center, General Camera Corp. and SOS Photo Cine Optics; *middle west:* Behrends Inc. and Victor Duncan Co.; *west coast:* Gordon Enterprises, Mark Armistead and Brooks Camera. Or write to us for our brochure: Eclair Corporation of America, 7262 Melrose Avenue, Los Angeles 46, California

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