

## Recommended Practices

Two Proposed Recommended Practices are published here for a trial period and public review. RP 11, Tape Vacuum Guide Radius and Position for 2-In. Quadruplex Video Magnetic Tape Recording, is a reaffirmation of the earlier issue being modified editorially to conform with other documents in the video-tape recording field. RP 27.1, Specifications for Operational Alignment Test Pattern for Television, is the first of a series of precision test patterns being developed by the Television Committee. Particular note should be taken of the subcommittee report published in this issue of the *Journal*. The report deals not only with this one pattern but reviews all of the work and deliberation of the subcommittee.

Comments should be addressed to Alex E. Alden, Staff Engineer, at Society Headquarters prior to January 22, 1968. If no adverse criticism is received by that date, the Proposed Recommended Practices will be submitted to the SMPTE Board of Governors for final approval.

## Approved USA Standards

Published here for your information are six USA Standards approved on October 16, 1967, by the United States of America Standards Institute:

- PH22.148-1967, Specifications for Film Image Area Used for Review Room Viewing of 35mm and 16mm Motion-Picture Prints Intended for Television Transmission;
- PH22.149-1967, Dimensions for 8mm Motion-Picture Film Perforated Super 8, 1R-1667;
- PH22.150-1967, Dimensions for 16mm Motion-Picture Film Perforated Super 8, 2R-1667 (1-3);

- PH22.151-1967, Dimensions for 16mm Motion-Picture Film Perforated Super 8, 2R-1664 (1-3);
- PH22.155-1967, Specifications for Projector Usage of Super 8 Motion-Picture Film;
- PH22.157-1967, Dimensions of Camera Aperture Image on Super 8 Motion-Picture Film.

Inasmuch as compliance with USA Standards is purely voluntary, these standards will become truly effective if very broad publicity is given to their existence. USASI and the SMPTE would appreciate any personal influence to promote the use of these standards where such action is appropriate and proper. Copies of the standards may be obtained for a nominal fee from the United States of America Standards Institute, 10 E. 40th St., New York City, 10016.

## USA Standards Reaffirmed

On October 16, 1967 the United States of America Standards Institute, taking the recommendation of the SMPTE Engineering Committees and the USASI Standards Committee PH22, reaffirmed without change the following standards:

- PH22.2-1961, 35mm Photographic Sound Motion-Picture Film, Usage in Camera (published in the Nov. 1961 *Journal*)
- PH22.3-1961, 35mm Photographic Sound Motion-Picture Film, Usage in Projector (published in the July 1961 *Journal*)
- PH22.52-1960, Cross-Modulation Tests for 16mm Variable-Area Photographic Sound Prints (published in the Oct. 1954 *Journal*)—A. E. A.

**PROPOSED**  
**SMPTE RECOMMENDED PRACTICE**  
**RP 11**  
*Revision of RP 11-1962*  
**Tape Vacuum Guide Radius and Position**  
**for 2-In. Quadruplex Video Magnetic Tape Recording**

at the midpoint of its width. The center of curvature of the vacuum guide shall lie between the axis of rotation of the heads and the vacuum guide.

Vacuum Guide Radius		Eccentricity	
Inches	Millimeters	Inches	Millimeters
1.0334	26.248	0.0000	0.000
1.0333	26.246	0.0001	0.003
1.0332	26.243	0.0002	0.005
1.0331	26.241	0.0003	0.008
1.0330	26.238	0.0004	0.010
1.0329	26.236	0.0005	0.013

Note: These dimensions are based on a nominal tape thickness of 0.0014 in. (0.036mm) and a radius of rotation of the magnetic head pole tips of 1.0329 in. min. to 1.0356 in. max.

1. *Scope*  
This recommended practice specifies the tape vacuum guide radius and position for recording video records on 2-in. quadruplex-magnetic tape.

2. *Mechanical Dimensions*  
2.1 The radius of the tape vacuum guide shall be 1.0334, +0.0000, -0.0005 in. (26.248, +0.000, -0.013mm).  
2.2 The position of the vacuum guide shall be set so that the eccentricity of its center of curvature with respect to the axis of rotation of the video heads is as indicated in the table. The eccentricity shall be such that the extension of a line joining the center of curvature of the vacuum guide and the axis of rotation of the heads intersects the tape

### Appendix

(This Appendix is not a part of Proposed SMPTE Recommended Practice RP 11, Tape Vacuum Guide Radius and Position for 2-In. Quadruplex Video Magnetic Tape Recording, but is included to facilitate its use.)

Achievement of tape reproducing interchangeability requires, among other things, that means be provided to accommodate variations of (a) the radius of rotation of the magnetic head pole tips, (b) the radius of the vacuum guide and (c) tape thickness. These effects are compensated by the stretching of the tape into a slot cavity in the vacuum guide by virtue of the radius of rotation of the magnetic head pole tips projecting beyond the unstretched oxide surface of the tape as held in the vacuum guide. Over the limits normally encountered, the stretching provides automatic compensation if the vacuum guide is positioned to give the minimum geometric distortion in the reproduced picture.

*Specifications for Operational Alignment  
Test Pattern for Television*

1. *Scope*

This recommended practice describes the format, dimensions and optical densities for a test pattern transparently to be used as an operational alignment tool for television systems.

2. *Purpose*

The purpose of this practice is to provide a simplified test pattern to facilitate day-to-day opera-

tional checks and adjustments of focus, resolution response, mid-band streaking, astigmatism, field uniformity, scanning size, linearity, and interlace in live and film television systems.

3. *Description*

3.1 Pattern. A reproduction of the test pattern is shown in Fig. 1.

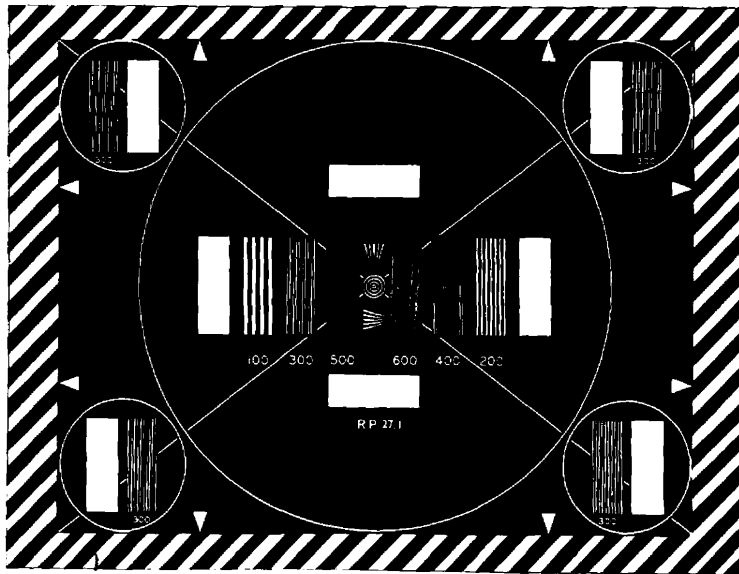


Fig. 1—Reproduction of Test Pattern

3.2 Background Density. The background of the test pattern is black to minimize interference when evaluating the television waveform display. (See 5.2.)

3.3 Reference White Bars. White bars of equal size are located on each side, above and below the central spatial frequency bursts and in each of the four corners. The bars are provided to establish a reference white level and to evaluate the white signal uniformity of the system. The two bars located above and below the central spatial frequency bursts are also used to evaluate mid-band streaking.

3.4 Spatial Frequency Bursts. All spatial frequency bursts are calibrated in television lines per picture height and are located in the central portion of the test pattern and at each of the four corners. The central bursts are arranged with the highest line numbers nearest the center of the pattern where optical and electrical performance is maximum. The spatial frequency bursts located in each of the four corners are horizontally positioned so that they do not overlap each other when viewed on a waveform monitor triggered at a horizontal rate.

3.5 Electrical Alignment. A bull's-eye pattern is located at the center of the test pattern to facilitate pickup tube beam alignment.

3.6 Horizontal and Vertical Wedges. Horizontal and vertical wedges are located near the center of the test pattern to facilitate beam alignment for minimum astigmatism. The horizontal wedge can also be used to check scanning interlace.

3.7 Circles and Diagonal Lines. Circles and diagonal lines are provided to check system geometry. They are dark gray to minimize interference when evaluating the television waveform display. (See 5.4.)

3.8 Boundary Arrows and Black-and-White Border. The eight boundary arrows and black-and-white border provide a check on system centering, scanning size, and equipment clamp performance. (See 5.3.)

3.9 Pattern Identification. The identification number of this document shall appear on the slide in the area specified in Fig. 2.

3.10 Manufacturer's Identification. Identification of the manufacturer shall appear on the slide mount outside the pattern area.

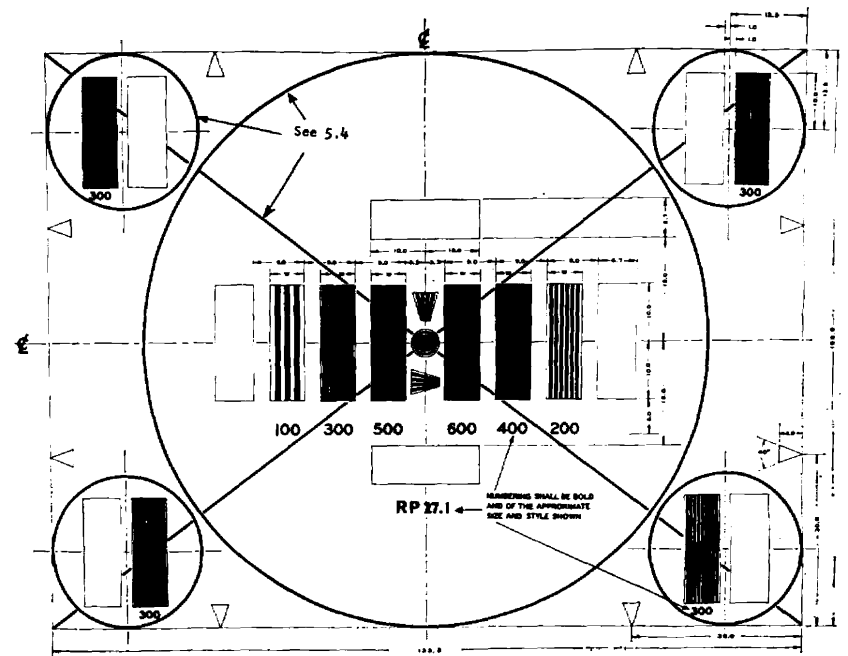


Fig. 2—Dimensional Drawing of Test Pattern

## 4. Format

- 4.1 The dimensions of the test pattern shall be as shown in Figs. 2 and 3. All dimensions are in percentage of picture height. One hundred percent picture height is equal to the outside diameter of the largest circle. No dimensions, dimension lines, or centerlines are to appear on the final product.
- 4.2 Image Size. The size of the area inside the black-and-white border, as indicated by the eight boundary arrows, shall be as follows:
- 4.2.1. 2x2 in. test slides and 8x10 in. test transparencies shall have Category 1 dimensions, as specified in USA Standard Dimensions and Optical Specifications of Test Slides and Transparencies for Television, PH22.144-1965.
- 4.2.2. 35mm test films shall have dimensions in accordance with Section 3.3 of USA Standard Dimensions for Television Image Area on 35mm Motion-Picture Film, PH22.95-1963. 16mm test films shall have dimensions in accordance with Section 3.3 of USA Standard Dimensions for Television Image Area on 16mm Motion-Picture Film, PH22.96-1963.
- 4.3 Black-and-White Border. Height and width dimensions of the black-and-white border for 2x2 in. slides and 8x10 in. transparencies are specified in USA Standard Dimensions and Optical Specifications of Test Slides and Transparencies for Television, PH22.144-1965.

For 35mm and 16mm motion-picture films, the black-and-white border shall extend to the dimension of the negative image as specified in USA Standard Dimensions of 35mm Motion-Picture Camera Aperture Images (Style A), PH22.59-1966, and USA Standard Dimensions of 16mm Motion-Picture Camera Aperture Image, PH22.7-1961.

- 4.4 Corner Circles. Each of the four corner circles shall be located so that its outside diameter is tangent to the perimeter of the pattern in its respective corner.
- 4.5 Diagonal Lines. Diagonal lines shall be drawn between opposing corners as shown in Fig. 2 and shall not intersect any of the pattern elements.
- 4.6 Line Widths. Line widths for the circumference of the five circles and the diagonal lines shall be  $0.50 \pm 0.05$  percent.
- 4.7 Spatial Frequency Burst. Each spatial frequency burst width "W" is nominally equal to 6 percent of picture height plus one additional half cycle of white to provide a burst pattern which starts and ends with a white half cycle. The ratio of the width of the black half cycle to the width of the white half cycle shall be  $1.00 \pm 0.05$ . A tabulation of the nominal dimensions in terms of picture height is listed in Table 1.

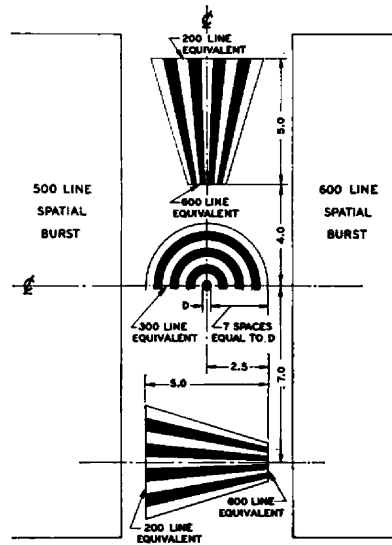


Fig. 3—Enlargement of Central Portion of Fig. 2

Line Number	Line Width in Percent of Picture Height	Burst Width "W" in Percent of Picture Height
100	1.00	7.00
200	0.50	6.50
300	0.33	6.33
400	0.25	6.25
500	0.20	6.20
600	0.17	6.17

## 5. Optical Densities

- 5.1 Optical Densities. All densities shall be as specified in SMPTE Recommended Practice RP 7, Density and Contrast Range of Black-and-White Films and Slides for Television. (See Note.)
- 5.2 Background. The background shall be in accordance with the maximum diffuse density specification of RP 7.
- 5.3 Reference White Bars and Boundary Arrows. The eight reference white bars and boundary arrows shall be in accordance with the minimum diffuse density specification of RP 7.

- 5.4 Circles, Diagonal Lines and Lettering. Circles, diagonal lines and lettering shall have a density of  $0.5 \pm 0.05$  less than the background density specified in 5.2 above.
- 5.5 Spatial Frequency Bursts, Wedges, Bull's-eye, and Black-and-White Border shall have a black density in accordance with the maximum diffuse density and a white density in accordance with the minimum diffuse density specification of RP 7.

Note: Since the test pattern does not include any glint or specular highlights, there should be no information less than the minimum diffuse highlight density, as specified in RP 7. Similarly, since the test pattern does not include any small lowlight areas, there should be no information more than the maximum diffuse lowlight density, as specified in RP 7.

# USA standard

Approved October 16, 1967

Specifications for

USAS

PH22.148-1967

UDC 771.537:778.5:771.523

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## Film Image Area Used for Review Room Viewing of 35mm and 16mm Motion-Picture Prints Intended for Television Transmission

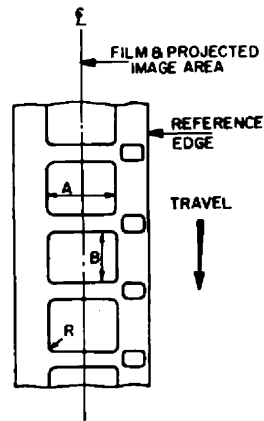
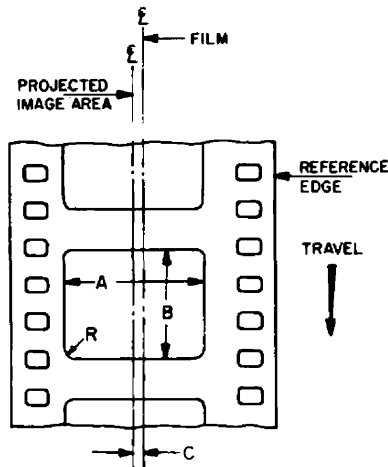
Page 1 of 2 pages

### 1. Scope

This standard specifies the dimensions of that part of the film image area used for review room viewing of 35mm and 16mm motion-picture prints intended for television transmission, and the placement of this area.

### 2. Dimensions

2.1 The dimensions shall be as specified in the figures and table.



35mm			16mm		
Inches	Millimeters	Dimensions	Inches	Millimeters	
0.713 max	18.11 max	A	0.331 max	8.41 max	
0.535 max	13.59 max	B	0.248 max	6.30 max	
0.050	1.27	C			
0.143	3.63	R	0.066	1.68	

2.2 Dimensions A, B, and R are specified in conformity with SMPTE Recommended Practice RP 8, Safe Action and Safe Title Areas for TV Transmission.

NOTE: Related USA Standards that may be helpful in the application of this standard are:

Projected Image Area of 16mm Motion-Picture Film, PH22.8-1957

Aperture for 35mm Sound Motion-Picture Projectors, PH22.58-1954

Dimensions for Television Image Area on 35mm Motion-Picture Film, PH22.95-1963

Dimensions for Television Image Area on 16mm Motion-Picture Film, PH22.96-1963

### Appendix

(This Appendix is not a part of USA Standard Specifications for Film Image Area Used for Review Room Viewing of 35mm and 16mm Motion-Picture Prints Intended for Television Transmission, PH22.148-1967, but is included to facilitate its use.)

#### A1. Viewing Conditions

During 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 to 20 people. The actual picture size may be large or small, depending upon the space available, but the viewing conditions are chosen to duplicate, as nearly as possible actual conditions whether the print is intended for theatrical viewing or television transmission. All viewing conditions are capable of being precisely controlled and should be held to a minimum tolerance.

#### A2. Action Area

This standard specifies a film area within which all significant picture action should take place, with the intent of ensuring visibility of that action on a properly

adjusted home receiver. Projectors used primarily for inspection of prints rather than for reviewing action expected to show in a typical home TV receiver should have apertures at least as large as required to project an image area of 0.792 in. by 0.594 in. from a 35mm motion-picture film (PH22.95) and of 0.368 in. by 0.276 in. from a 16mm film (PH22.96). (These are the areas actually scanned during television broadcasting and, therefore, are available for reception by sets adjusted to this extreme.) For review room purposes, the dimensions of the safe action area should be indicated at the screen and appropriate steps should be taken to ensure that the projected image on the screen is aligned properly so that only that part of the picture image area intended to fall within the safe action area actually does so. Whatever the choice of image area to be projected, the need remains for assurance that projection conditions are maintained so that all action intended to fall within the "safe action area" reaches the projection screen and can be reliably recognized as such, relative to any additional picture information reaching the screen. Consequently, during a screening, a fixed vertical position relationship must be maintained between the film image area and its associated perforations to avoid the need for further framing adjustments.

PH22.148-1967

# USA standard

Approved October 16, 1967

Dimensions for

## 8mm Motion-Picture Film, Perforated Super 8, 1R-1667

USAS  
PH22.149-1967

UDC 778.5:771.523.2

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Page 1 of 2 pages

### 1. Scope

This standard specifies the cutting and perforating dimensions for 8mm motion-picture film with super 8 perforations along one edge and a perforation pitch of 0.1667 in.

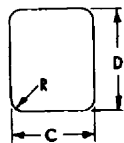
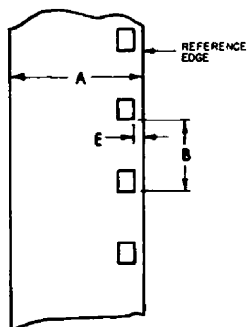
### 2. Dimensions

**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 USA Standard Motion-Picture Safety Film, PH22.31-1958.

**2.3** The 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	0.3140 ± 0.0015	7.976 ± 0.038
B Perforation pitch	0.1667 ± 0.0004	4.234 ± 0.010
C Perforation width	0.0360 ± 0.0004	0.914 ± 0.010
D Perforation height	0.0450 ± 0.0004	1.143 ± 0.010
E Edge to perforation	0.020 ± 0.002	0.51 ± 0.05
L 100 consecutive perforation pitch intervals	16.670 ± 0.017	423.42 ± 0.43
R Radius of perforation fillet	0.005 ± 0.001	0.13 ± 0.03

NOTE 1: The usual use of film stock described in this standard is for camera original film of the reversal type.

NOTE 2: 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 3: 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).

### Appendix

(This Appendix is not a part of USA Standard Dimensions for 8mm Motion-Picture Film, Perforated Super 8, 1R-1667, PH22.149-1967, 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.** 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.

**A3.** The width of 8mm film is controlled by the shrinkage characteristics of the films involved. Thus, there have been standards for the width of film stock of the "usual" shrinkage and for stock of "low-shrinkage" characteristics. The purpose was to obtain films of approximately the same width regardless of the type of film base during their useful life. The control of film shrinkage becomes critical in films used in the production of prints because of the necessity of critical adjustment of perforation pitches for films duplicated on sprocket-type printers. Because the film described in this standard would not ordinarily be used as an original intended for the production of prints, the matter of film shrinkage therefore is not critical.

It is 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 the equipment design fail to accommodate a film of 0.318-in. width under the conditions of use.

# USA standard

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USAS  
PH22.150-1967

UDC 778.5:771.523.2

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## Dimensions for 16mm Motion-Picture Film, Perforated Super 8, 2R-1667 (1-3)

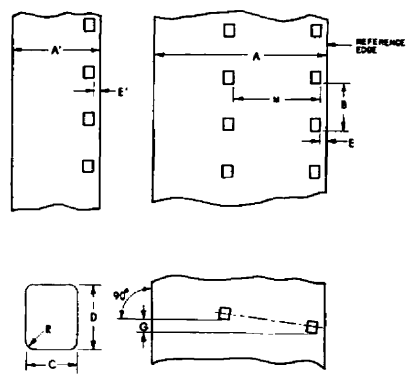
Page 1 of 3 pages

### 1. Scope

This standard specifies the cutting and perforating dimensions for 16mm motion-picture film with super 8 perforations in positions 1-3 and a perforation pitch of 0.1667 in. The width of the 8mm strip after processing and slitting is 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 USA Standard Motion-Picture Safety Film, PH22.31-1958.
- 2.3 Except for Dimensions A' and E', the dimensions apply to the 16mm film immediately after cutting and perforating. Dimensions A' and E' apply to the 8mm strip immediately after slitting.
- 2.4 Dimension L represents the length of any 100 consecutive perforation pitch intervals.



Dimensions	Inches	Millimeters
A Film width	0.628 ± 0.001	15.95 ± 0.03
A' Film width after slitting	0.314 ± 0.002	7.98 ± 0.05
B Perforation pitch	0.1667 ± 0.0004	4.234 ± 0.010
C Perforation width	0.0360 ± 0.0004	0.914 ± 0.010
D Perforation height	0.0450 ± 0.0004	1.143 ± 0.010
E Edge to perforation	0.020 ± 0.002	0.51 ± 0.05
E' Edge to perforation after slitting	0.020 ± 0.002	0.51 ± 0.05
G Perforation skewness	0.001 max	0.03 max
L 100 consecutive perforation pitch intervals	16.670 ± 0.017	423.42 ± 0.43
M Lateral perforation displacement	0.314 ± 0.001	7.98 ± 0.03
R Radius of perforation fillet	0.005 ± 0.001	0.13 ± 0.03

NOTE 1: The principal use of the film stock described in this standard is for the production of prints.

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).

NOTE 3: 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.

The numerals have been added to the title of this standard to specify how the rows of perforations are placed on the film. This designation is necessary only when the film stock is wider than its end use and more than one combination of perforation rows is possible. The perforation rows shall be numbered starting at the

reference edge. The reference edge is that edge of the strip nearest to the perforations which is retained on one of the slit prints that is not discarded in any subsequent slitting. The designation 1 through 4 of 16mm films indicates that the perforations are in row:

- 1—adjacent to the reference edge
- 2—on the reference side of center
- 3—on the non-reference side of center
- 4—adjacent to the non-reference edge

when the film end is observed from the base side with the spool above and away from the point of observation.

There can be two different windings for the same numbered rows of perforations. This applies, however, only when the film is perforated in the 1-3 position and the designation of the film would be 1-3, regardless of winding. Winding could be A or B depending upon the location of the reference edge (See PH22.75-1953).

### Appendix

(This Appendix is not a part of USA Standard Dimensions for 16mm Motion-Picture Film, Perforated Super 8, 2R-1667-(1-3), PH22.150-1967, 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.

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 72-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.)

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 0.1664 in. or 0.1667 in. In general, the longer pitch is for print stock and the shorter pitch is for negative or intermediate stock.

Experience has shown that the average pitch derived from Dimension L of the intermediate 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.

The choice of pitch for negative or intermediate motion-picture film depends, within certain limits, on the type of printer to be used. Where release 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 contact 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.

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 or intermediate stock is 0.1664 in.

PH22.150-1967

Low-shrinkage 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  $0.3 \pm 0.1$  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 width for 16mm film is controlled by the shrinkage characteristics of the films involved. Thus there have been standards for the width of 16mm stock of the "usual" shrinkage and for stock of "low-shrinkage"

characteristics. The purpose was to obtain films of approximately the same width regardless of the type of film base during their useful life. This standard is based on the values adapted to "low-shrinkage" 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, 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 the equipment design fail to accommodate a film of 0.630-in. width.

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# USA standard

Approved October 16, 1967

Dimensions for

## 16mm Motion-Picture Film, Perforated Super 8, 2R-1664 (1-3)

USAS  
PH22.151-1967

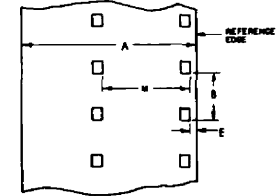
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Page 1 of 3 pages

### 1. Scope

This standard specifies the cutting and perforating dimensions for 16mm motion-picture film with super 8 perforations in positions 1-3 and a perforation pitch of 0.1664 in.



### 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 USA Standard Motion-Picture Safety Film, PH22.31-1958.



**2.3** The 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	0.628 ± 0.001	15.95 ± 0.03
B Perforation pitch	0.1644 ± 0.0004	4.227 ± 0.010
C Perforation width	0.0360 ± 0.0004	0.914 ± 0.010
D Perforation height	0.0450 ± 0.0004	1.143 ± 0.010
E Edge to perforation	0.020 ± 0.002	0.51 ± 0.05
G Perforation skewness	0.001 max	0.03 max
L 100 consecutive perforation pitch intervals	16.640 ± 0.017	422.70 ± 0.43
M Lateral perforation displacement	0.314 ± 0.001	7.98 ± 0.03
R Radius of perforation fillet	0.005 ± 0.001	0.13 ± 0.03

NOTE 1: The principal use of the film stock described in this standard is as an intermediate film in the production of prints.

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**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).

**NOTE 3:** 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.

The numerals have been added to the title of this standard to specify how the rows of perforations are placed on the film. This designation is necessary only when the film stock is wider than its end use and more than one combination of perforation rows is possible. The perforation rows shall be numbered starting at the

reference edge. The reference edge is that edge of the strip nearest to the perforations which is retained on one of the slit prints that is not discarded in any subsequent slitting. The designation 1 through 4 of 16mm films indicates that the perforations are in row:

- 1—adjacent to the reference edge
- 2—on the reference side of center
- 3—on the non-reference side of center
- 4—adjacent to the non-reference edge

when the film end is observed from the base side with the spool above and away from the point of observation.

There can be two different windings for the same numbered rows of perforations. This applies, however, only when the film is perforated in the 1-3 position and the designation of the film would be 1-3, regardless of winding. Winding could be A or B depending upon the location of the reference edge (See PH22.75-1953).

## Appendix

(This Appendix is not a part of USA Standard Dimensions for 16mm Motion-Picture Film, Perforated Super 8, 2R-1664 (1-3), PH22.151-1967, 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 0.1664 in. or 0.1667 in. In general, the longer pitch is for print stock and the shorter pitch is for negative or intermediate stock.

The choice of pitch for negative or intermediate motion-picture film depends, within certain limits, on the type of printer to be used. Where release 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 contact 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 72-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 derived from Dimension L of the intermediate can vary  $\pm 0.1$  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 or intermediate stock is 0.1664 in.

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characteristics. The purpose was to obtain films of approximately the same width regardless of the type of film base during their useful life. This standard is based on the values adapted to "low-shrinkage" 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, 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 the equipment design fail to accommodate a film of 0.630-in. width.

Low-shrinkage 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  $0.3 \pm 0.1$  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 width for 16mm film is controlled by the shrinkage characteristics of the films involved. Thus there have been standards for the width of 16mm stock of the "usual" shrinkage and for stock of "low-shrinkage"

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# USA standard

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PH22.155-1967

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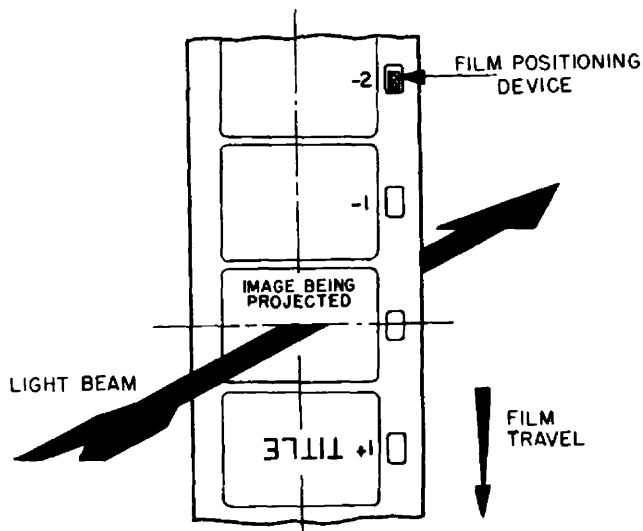
Specifications for

## Projector Usage of Super 8 Motion-Picture Film

Page 1 of 2 pages

### 1. Scope

This standard specifies the rate of projection and the orientation of the image area for super 8 film as used in a super 8 projector.



Film as seen from the light source in the projector.

### 2. Position of Film for Projection

2.1 Most 8mm films are projected with the emulsion toward the projection lens. There are, however, several processes producing prints in which the base side faces the projection lens.

2.2 The perforation used for the film-positioning device shall be two perforations above the perforation adjacent to the projected aperture when the positioning device is at the bottom of its stroke (the -2 position). This location coincides with the vertical positioning device location required for super 8 camera original films and thereby improves steadiness through cancellation.

2.3 The dimensions of the projectable image area relative to the film-positioning perforation shall be as specified in Proposed USA Standard Dimensions of Maximum Projectable Film Image Area on Super 8 Motion-Picture Film, PH22.154. It is customary to provide a framing movement

of approximately 0.015 in. (0.38mm) above and below this position.

### 3. Rate of Projection

The usual rate of projection shall be 18 frames per second for silent use and 24 frames per second for sound use. In silent projectors having a fixed rate of projection, the rate shall be 18 frames per second with a tolerance appropriate for the intended use. Silent projectors having manually-adjustable speed shall be capable of reaching a projection rate of at least 18 frames per second.

### Appendix

(This Appendix is not a part of USA Standard Specifications for Projector Usage of Super 8 Motion-Picture Film, PH22.155-1967, but is included to facilitate its use.)

A1. Because of the increased intensity of illumination available in modern 8mm projection systems, the industry has found it desirable to extend the flicker threshold by choosing as high a projection rate (and, therefore, as high a flicker frequency) as practicable. A projection rate of 18 frames per second and a corresponding flicker frequency of 54 Hz (obtained with a three-blade shutter) has been found by experience to be an acceptable compromise.

A2. 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.

# USA standard

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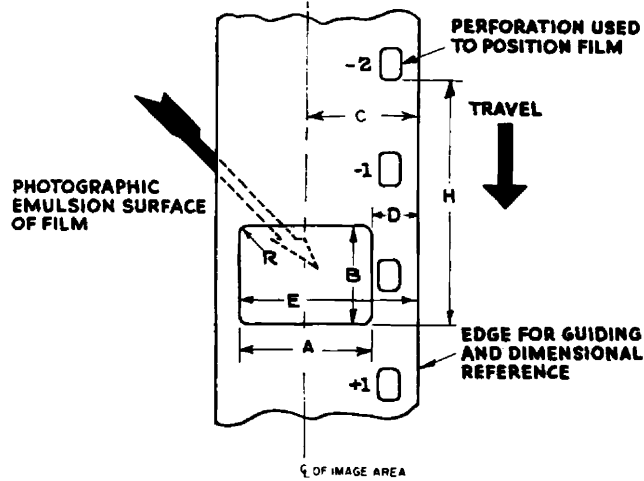
Dimensions of

## Camera Aperture Image on Super 8 Motion-Picture Film

Page 1 of 2 pages

### 1. Scope

This standard specifies the dimensions of the image area produced by the camera aperture on super 8 motion-picture film. It also specifies the position of the image relative to the reference edge of the film and the perforation used to position the film.



Film as seen from inside camera looking toward lens.

Dimensions	Inches	Millimeters
A	0.245 nom	6.22 nom
B	0.166 $\pm$ 0.000 - 0.003	4.22 $\pm$ 0.00 - 0.08
C	0.170 $\pm$ 0.002	4.32 $\pm$ 0.05
D	0.037 min 0.058 max	0.94 min 1.47 max
E	0.282 min	7.16 min
H	0.393 $\pm$ 0.005	9.98 $\pm$ 0.13
R	0.005 max	0.13 max

### 2. Dimensions

2.1 The dimensions shall be as given in the figure and table and shall apply to measurements of the image as formed on freshly exposed and processed film.

2.2 The angle between the horizontal edges of

the image and the reference edge shall be  $90^\circ \pm 1/2^\circ$ .

2.3 Dimension H is the distance from the bottom edge of the picture frame to the bottom of the perforation which is two pitches above the perforation adjacent to that picture frame.

### Appendix

(This Appendix is not a part of USA Standard Dimensions of Camera Aperture Image on Super 8 Motion-Picture Film, PH22.157-1967, but is included to facilitate its use.)

A1. If the aperture plate is not in the plane of the emulsion, the physical dimensions of the aperture in the camera will be slightly different from the dimensions given in the figure. The exact amount of this difference will depend upon the  $f/$  value and focal length of the camera lenses used and upon the distance between the emulsion and the physical aperture. This separation

should be no greater than is necessary to prevent scratching of the film.

A2. It is the intent of this standard to provide a camera image such that the exposed area will always be larger than the area of the projector aperture. Observation of the dimensions given in the standard meets this objective without causing double exposure of the area between the frames.