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STABILIZED 2012

REAFFIRMED 2006

SMPTE STANDARD

SMPTE 168-2001
Revision of
ANSI/SMPTE 168-1996

for Motion-Picture Film (16-mm) — Perforated 8-mm Type S, (1-4)

1 Scope

This standard specifies the cutting and perforating dimensions for 16-mm motion-picture film with 8-mm type S perforations in positions 1 and 4 and a perforation pitch of either 0.1664 in or 0.1667 in. The width of the 8-mm strip after processing and slitting is also specified.

2 Dimensions

2.1 The dimensions shall be as given in figure 1 and table 1.

2.2 The dimensions pertain to a safety film as defined in SMPTE 223M.

2.3 Except for dimension A′, the dimensions apply at the time of cutting and perforating for film adjusted to a temperature of 23°C ± 1°C (nominally converted to 73°F ± 2°F) and a relative humidity of (50 ± 2)%. The manufacturer may indicate other nominal humidity conditions under which the dimensions apply.

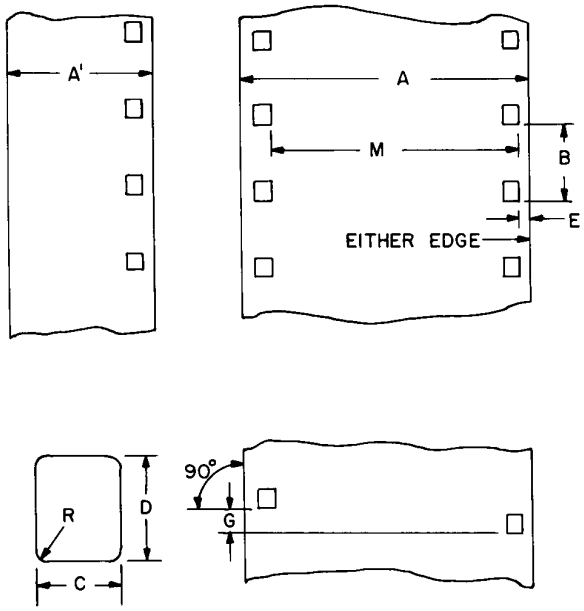

Figure 1 – Dimensions

Table 1 – Specifications

	Dimensions	Inches	Millimeters
A	Film width	0.628 ± 0.001	15.95 ± 0.03
A′	Film width after processing and slitting	0.314 ± 0.002	7.98 ± 0.05
B	Perforation pitch (long)	0.1667 ± 0.0004	4.234 ± 0.010
B′	Perforation pitch (short)	0.1664 ± 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 pitches	16.670 ± 0.017	423.42 ± 0.43
L′	100 consecutive perforation pitches	16.640 ± 0.017	422.70 ± 0.43
M	Lateral perforation displacement	0.552 ± 0.001	14.02 ± 0.03
R	Radius of perforation fillet	0.005 ± 0.001	0.13 ± 0.03

Approved
June 6, 2001

2.4 Some equipment may be used to slit 8-mm type S film that originally had been designed for the slitting of less critical conventional 8-mm film from 16-mm 2R-1500 camera originals or prints. With this procedure, a larger tolerance for dimension A′ of 0.314 in + 0.002 in – 0.003 in may be used for film that has not been prestriped with magnetic material. New slitting equipment should be designed to function within the prescribed tolerances.

NOTES

1 Although film stock with a perforation pitch of 0.1667 in (4.234 mm) may be used as a reversal camera original film, its principal use is for the production of prints. The principal use of the stock perforated 0.1664 in (4.227 mm) is as an intermediate film in the production of prints. If this film is used in a camera and slit after processing, the width of the strips so slit shall be 0.314 in ± 0.002 in (7.98 mm ± 0.05 mm).

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.

The numerals (1-4) 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 16-mm films indicates that the perforations are in row

1 – adjacent to the reference edge
2 – on the reference side of center
3 – on the nonreference side of center
4 – adjacent to the nonreference edge

when the film end is observed from the base side with the wound roll 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 (refer to ANSI/SMPTE 75M).

Annex A (informative)
Additional data

A.1 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.

A.2 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 (4.227 mm or 4.234 mm). 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 the time of printing (sprocket-type contact printer), there are three major considerations involved in choosing the pitch. These considerations are: (1) the sprocket diameter and tooth engagement, (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 in to 0.0065 in (0.140 mm to 0.165 mm) thick, the optimum pitch differential is 0.3%. 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 ± 0.1% from the ideal pitch, which is 0.3% 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 of 0.2% 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%. Accordingly, the pitch chosen for the negative or intermediate stock is 0.1664 in (4.227 mm).

Low-shrinkage negative film perforated to these dimensions should not thereafter shrink appreciably more than 0.2% 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% is maintained. (The film should be measured after equilibration with air at 70°F and 55% relative humidity or at the conditions prevailing at the time of perforating.)

A.3 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.

A.4 The width for 16-mm film is controlled by the shrinkage characteristics of the films involved. Thus, there have been standards for the width of 16-mm 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°F to 75°F, exposed, processed, and stored exposed to air for a period not to exceed 30 days at 65°F to 75°F and 50% to 60% relative humidity, shall have shrunk not more than 0.2% 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.

A.5 The tolerance for the slit width after processing was established to provide the laboratory with the maximum flexibility for the least critical application of commercial 8-mm type S prints. For some commercial applications, such as photographic sound use, it will be necessary for the laboratory to consider much tighter tolerances. For these more critical uses, film shrinkage characteristics must be taken into account, and the film slit within ± 0.001 in (0.03 mm) variability.

Annex B (informative)
Bibliography

ANSI/SMPTE 75M-1994, Motion-Picture Film — Raw Stock — Designation of A and B Windings

SMPTE 223M-2001, Motion-Picture Film — Safety Film