Proposed Standards for 16-Mm and 8-Mm Picture Apertures

IN CONNECTION with the broad program of reviewing all standards at the close of the war, the Standards Committee of the Society of Motion Picture Engineers was asked to restudy the six American Standards for picture apertures in 16-mm and 8-mm cameras and projectors. Since it appeared that a thorough revision was in order, a subcommittee, with John A. Maurer as chairman, was organized for this assignment. By the end of 1947, the pattern and most of the details of the new proposals were well established. Because of other changes at that time, it became desirable to disband the special subcommittee and to transfer to the Society's standing Committee on 16-mm and 8-mm Motion Pictures the task of ironing out the remaining few, but important, controversial points. Agreement was reached in October, 1948, and the new proposals were passed along to the Standards Committee with a recommendation for favorable action. The new proposals, four in number, are shown on the following pages. This is in keeping with the policy of the Standards Committee of publishing in the JOURNAL all proposals involving new material or major revisions before taking action on the question of submitting them to the American Standards Association. Your comments are invited.

Specifically, the four proposed standards are entitled:

Z22.7	Location and Size of Picture Aperture of 16-mm Motion Picture Cameras.
Z22.8	Location and Size of Picture Aperture of 16-mm Motion Picture Projectors.
Z22.19	Location and Size of Picture Aperture of 8-mm Motion Picture Cameras.
Z22.20	Location and Size of Picture Aperture of 8-mm Motion Picture Projectors.

When these are finally approved, they will replace the same Z22 numbers that were issued in 1941. Since the two 16-mm proposals cover sound, as well as silent, equipment, it is intended that they will also supplant 1941 American Standards Z22.13 and Z22.14 which related to 16-mm sound cameras and projectors.

In the drafting of these proposed standards, an effort was made to dimension the drawings so that they will be of the most direct use to the engineer. The introduction of the "K" dimensions, showing the distance from the centerline of the aperture to the registering edge of the film perforation, is a case in point.

During the evolution of these proposals, there was a good deal of debate on the question of specifying which edge of 16-mm film should be guided. The Committee on 16-mm and 8-mm motion pictures finally concluded that this question properly should be left to the designer, but the proposal does call attention to the factors involved. A similar statement is made relative to the problem of assigning a definite value to dimension "G."

In the past, standards dealing with this type of subject matter generally have been limited to dimensioned drawings. The Standards Committee feels it is desirable to include explanatory text or notes to make the intention and application of the standard more certain. This practice is followed in these four proposals to a degree that makes any further discussion of technical points appear to be unnecessary.

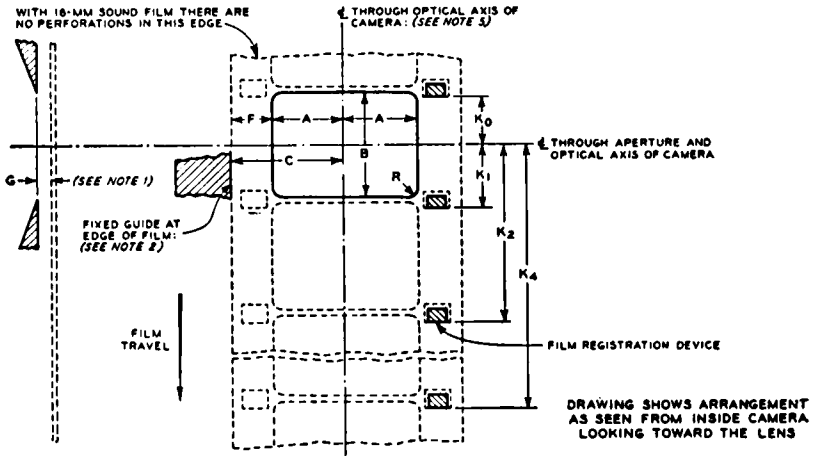
SEVERAL STANDARDS developed by subcommittees of ASA Sectional Committee Z10 listed below are available. Authors are encouraged to follow these standard symbols and abbreviations.

Title of Standard		Price
Abbreviations for Scientific and Engineering Terms	Z10.1-1941	$0.45
Letter Symbols for Hydraulics	Z10.2-1942	0.45
Letter Symbols for Mechanics of Solid Bodies	Z10.3-1948	0.30
Letter Symbols for Heat and Thermodynamics	Z10.4-1943	0.65
Letter Symbols for Physics	Z10.6-1948	1.00
Letter Symbols for Chemical Engineering	Z10.12-1946	0.50

Proposed American Standard
Location and Size of Picture Aperture of
16-Millimeter Motion Picture Cameras

Z22.7-
February 1949

This standard applies to both silent and sound 16-mm. motion picture cameras. It covers the size and shape of the picture aperture and the relative positions of the aperture, the optical axis, the edge guide, and the film registration device. The notes are a part of this standard.



Dimension	Inches	Millimeters	Note
A (measured perpendicular to edge of film)	0.201 minimum	5.11 minimum	1
B (measured parallel to edge of film)	$0.292^{+0.006}_{-0.002}$	$7.42^{+0.18}_{-0.05}$	1
C	0.314 ± 0.002	7.98 ± 0.05	2
F	0.110 minimum	2.79 minimum	3
K_0	0.125 ± 0.002	3.18 ± 0.05	4
K_1	0.175 ± 0.002	4.44 ± 0.05	4
K_2	0.474 ± 0.002	12.04 ± 0.05	4
K_3	0.773 ± 0.002	19.63 ± 0.05	4
K_4	1.072 ± 0.001	27.23 ± 0.03	4
R	0.020 maximum	0.51 maximum	1

Proposed American Standard
Location and Size of Picture Aperture of
16-Millimeter Motion Picture Cameras

Z22.7-
February 1949

The angle between the vertical edges of the aperture and the edges of normally positioned film shall be 0 degrees, ± ½ degree.

The angle between the horizontal edges of the aperture and the edges of normally positioned film shall be 90 degrees, ± ½ degree.

Note 1: Dimensions A, B, and R apply to the size of the image at the plane of the emulsion; the actual picture aperture has to be slightly smaller. The exact amount of this difference depends on the lens used and on the separation (dimension G) of the emulsion and the physical aperture. G should be no larger than is necessary to preclude scratching of the film. The greatest difference between the image size and aperture size occurs with short focal-length, large diameter lenses.

Dimensions A and B are consistent with the size of the images on a 16-mm. reduction print made from a 35-mm. negative with the standard 2.15 reduction ratio.

It is desirable to hold the vertical height of the actual aperture to a value that will insure a real (unexposed) frameline. This results in less distraction when the frameline is projected on the screen than is the case when adjacent frames overlap.

Note 2: The edge guide is shown on the sound-track edge. This location for it has the advantage that the rails bearing on the face of the film along this edge and also between the sound track and picture area can be of adequate width. Disadvantages of this location for the edge guide are that, because film shrinkage and tolerances affect the lateral position of the perforations, the pulldown tooth must be comparatively narrow and will not always be centered in the perforation.

The guide can be on the other edge, adjacent to the perforated edge of sound film. With the guide at this edge, the width of the pulldown tooth does not have to be decreased to allow for shrinkage. However, because of variations introduced by shrinkage of film, this location for the edge guide has the important disadvantage that it makes extremely difficult the provision of rails of adequate width to support the sound-track edge without encroaching on, and consequently scratching, the picture or sound-track area. (See Section 3, Proposals for 16-mm. and 8-mm. Sprocket Standards, Vol. 48, No. 6, June 1947, Journal of the Society of Motion Picture Engineers).

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The film may be pressed against the fixed edge guide by a spring, by the tendency of the film to tilt in the gate, or by other means. In the second case, there is a fixed guide for each edge of the film. The important point is to have the film centered laterally on the optical axis.

Dimension C is made slightly less than half the width of unshrunk film so that the film will be laterally centered if it has a slight shrinkage at the time it is run in the camera. This is the normal condition. As indicated by the above discussion, C may be measured in either direction from the vertical centerline.

Note 3: Dimension F must be maintained only when a photographic sound record is to be made on the film that passes through the camera; otherwise F may be disregarded.

Note 4: The K dimensions are measured along the path of the film from the horizontal centerline of the aperture to the stopping position of the registration device. Both the dimensions and tolerances were computed to keep the frameline within 0.002 to 0.005 inch of the centered position for films having shrinkages of 0.0 to 0.5 per cent at the time they are exposed in the camera. For any given camera, use the value of K corresponding to the location of the registration device.

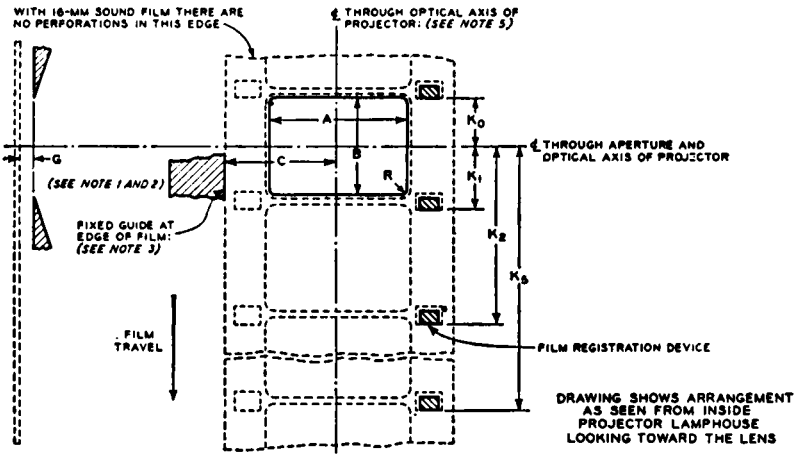
If the film does not stop exactly where the film registration device leaves it, because of coasting or some other cause, a slight adjustment of the value of K will be necessary. This will be indicated if film that has a shrinkage of 0.2 to 0.3 per cent when it is run in the camera does not show a properly centered frameline. From such a test, the amount and direction of the adjustment can be determined.

Note 5: "Optical axis of camera" is defined as the mechanical axis or centerline of the sleeve or other device for holding the picture-taking lens. Except for manufacturing tolerances, it coincides with the optical axis of the lens.

Proposed American Standard
Location and Size of Picture Aperture of
16-Millimeter Motion Picture Projectors

Z22.8-
February 1949

This standard applies to both silent and sound 16-mm. motion picture projectors. It covers the size and shape of the picture aperture and the relative positions of the aperture, the optical axis, the edge guide, and the film registration device. The notes are a part of this standard.



Dimension	Inches	Millimeters	Note
A (measured perpendicular to edge of film)	0.380 ± 0.002	9.65 ± 0.05	1
B (measured parallel to edge of film)	0.284 ± 0.002	7.21 ± 0.05	1
C	0.314 ± 0.002	7.98 ± 0.05	3
K_0	0.124 ± 0.005	3.15 ± 0.13	4
K_1	0.174 ± 0.005	4.42 ± 0.13	4
K_2	0.473 ± 0.005	12.01 ± 0.13	4
K_3	0.771 ± 0.005	19.58 ± 0.13	4
K_4	1.070 ± 0.005	27.18 ± 0.13	4
K_5	1.368 ± 0.005	34.75 ± 0.13	4
R	0.020 maximum	0.51 maximum	1

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Location and Size of Picture Aperture of
16-Millimeter Motion Picture Projectors

Z22.8-
February 1949

The angle between the vertical edges of the aperture and the edges of normally positioned film shall be 0 degrees, ± ½ degree.

The angle between the horizontal edges of the aperture and the edges of normally positioned film shall be 90 degrees, ± ½ degree.

Note 1: Dimensions A, B, and R apply to the portion of the image on the film that is to be projected; the actual opening in the aperture plate has to be slightly smaller. The exact amount of this difference depends on the lens used and on the separation (dimension G) of the emulsion and the physical aperture. To minimize the difference in size and make the image of the aperture as sharp as practicable on the screen, G should be no larger than is necessary to preclude scratching of the film. When the reduction in size from the image to the actual aperture is being computed, it is suggested a 2-inch f/1.6 lens be assumed unless there is reason for doing otherwise.

Note 2: The limiting aperture is shown as being between the film and the light source so that it will give the maximum protection from heat. If other factors are more important, it may be on the other side of the film.

Note 3: The edge guide is shown on the sound-track edge. This location for it has the advantage that the rails bearing on the face of the film along this edge and also between the sound track and picture area can be of adequate width. Disadvantages of this location for the edge guide are that, because film shrinkage and tolerances affect the lateral position of the perforations, the pulldown tooth must be comparatively narrow and will not always be centered in the perforation. Also, in some prints the sound-track edge is slit after processing, in which case there is likely to be some lateral weave between this edge and the pictures.

The guide can be on the other edge, adjacent to the perforated edge of sound film. With the guide at this edge, the width of the pulldown tooth does not have to be decreased to allow for shrinkage. Also, slitting the sound-track edge after processing will not introduce lateral unsteadiness. However, because of variations introduced by shrinkage of film, this location for the edge guide has the important disadvantage that it makes extremely difficult the provision of rails of adequate width to support the

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sound-track edge without encroaching on, and consequently scratching, the picture or sound-track area. (See Section 3, Proposals for 16-mm. and 8-mm. Sproket Standards, Vol. 48, No. 6, June 1947, Journal of the Society of Motion Picture Engineers).

The film may be pressed against the fixed edge guide by a spring, by the tendency of the film to tilt in the gate, or by other means. In the second case, there is a fixed guide for each edge of the film. The important point is to have the film centered laterally on the optical axis.

Dimension C is made slightly less than half the width of unshrunk film so that the film will be laterally centered if it has a slight shrinkage at the time it is run in the projector. This is the normal condition. As indicated by the above discussion, C may be measured in either direction from the vertical centerline.

Note 4: The K dimensions are measured along the path of the film from the horizontal centerline of the aperture to the stopping position of the registration device. It is customary to provide a framing movement of 0.025 inch above and below this nominal position. For any given projector, use the value of K corresponding to the location of the registration device.

If the film does not stop exactly where the film registration device leaves it, because of coasting or some other cause, a slight adjustment of the value of K will be necessary.

Note 5: "Optical axis of projector" is defined as the mechanical axis or centerline of the sleeve for holding the projection lens. Except for manufacturing tolerances it coincides with the lens axis.

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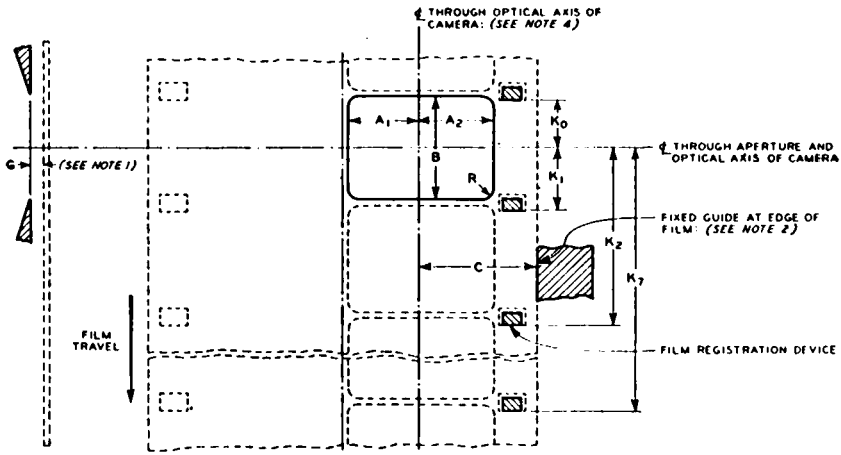
Location and Size of Picture Aperture of
8-Millimeter Motion Picture Cameras

Z22.19-
February 1949

This standard applies to 8-mm. motion picture cameras. It covers the size and shape of the picture aperture and the relative positions of the aperture, the optical axis, the edge guide, and the film registration device. The notes are a part of this standard.



DRAWING SHOWS ARRANGEMENT AS SEEN FROM INSIDE CAMERA LOOKING TOWARD THE LENS

Dimension	Inches	Millimeters	Note
A_1 (measured perpendicular to edge of film)	0.094 min., 0.104 max.	2.39 min., 2.64 max.	1
A_2	0.094 min.	2.39 min.	1
B (measured parallel to edge of film)	$0.138\ ^{+\ 0.008}_{-\ 0.001}$	$3.51\ ^{+\ 0.20}_{-\ 0.03}$	1
C	0.205 ± 0.002	5.21 ± 0.05	2
K_0	0.050 ± 0.002	1.27 ± 0.05	3
K_1	0.100 ± 0.002	2.54 ± 0.05	3
K_2	0.249 ± 0.002	6.32 ± 0.05	3
K_3	0.399 ± 0.002	10.13 ± 0.05	3
K_4	0.549 ± 0.002	13.94 ± 0.05	3
K_5	0.698 ± 0.002	17.73 ± 0.05	3
K_6	0.848 ± 0.002	21.54 ± 0.05	3
K_7	0.998 ± 0.002	25.35 ± 0.05	3
R	0.010 maximum	0.25 maximum	1

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Z22.19-
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The angle between the vertical edges of the aperture and the edges of normally positioned film shall be 0 degrees, ± ½ degree.

The angles between the horizontal edges of the aperture and the edges of normally positioned film shall be 90 degrees, ± ½ degree.

Note 1: Dimensions A, B, and R apply to the size of the image at the plane of the emulsion; the actual picture aperture has to be slightly smaller. The exact amount of this difference depends on the lens used and on the separation (dimension G) of the emulsion and the physical aperture. G should be no larger than is necessary to preclude scratching of the film. The greatest difference between the image size and aperture size occurs with short focal-length, large diameter lenses.

It is desirable to hold the vertical height of the actual aperture to a value that will insure a real (unexposed) frameline. This results in less distraction when the frameline is projected on the screen than is the case when adjacent frames overlap.

Note 2: The film may be pressed against the fixed edge guide by a spring, by the tendency of the film to tilt in the gate, or by other means. In the second case (generally used in pre-loaded magazines), there is a fixed guide for each edge of the film. The important point is to have the film located in the correct lateral position with respect to the optical axis.

The value of dimension C has been chosen on the assumption that the film will have a slight shrinkage when it is run through the camera. This is the normal condition.

Note 3: The K dimensions are measured along the path of the film from the horizontal centerline of the aperture to the effective stopping position of the registration device. Both the dimensions and tolerances were computed to keep the frameline within 0.002 to 0.005 inch of the centered position for films having shrinkages between 0.0 and 0.5 per cent at the time they are exposed in the camera. For any given camera, use the value of K corresponding to the location of the registering device.

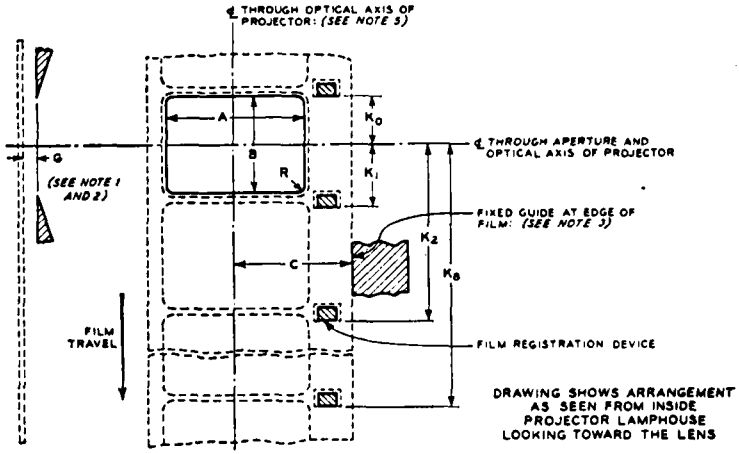
If the film does not stop exactly where the film registration device leaves it, because of coasting or some other cause, a slight adjustment of the value of K will be necessary. This will be indicated if film that has a shrinkage of 0.2 to 0.3 per cent when it is run in the camera does not show a properly centered frameline. From such a test, the amount and direction of the adjustment can be determined.

Note 4: "Optical axis of camera" is defined as the mechanical axis or centerline of the sleeve or other device for holding the picture-taking lens. Except for manufacturing tolerances, it coincides with the optical axis of the lens.

Proposed American Standard
Location and Size of Picture Aperture of
8-Millimeter Motion Picture Projectors

Z22.20-
February 1949

This standard applies to 8-mm. motion picture projectors. It covers the size and shape of the picture aperture and the relative positions of the aperture, the optical axis, the edge guide, and the film registration device. The notes are a part of this standard.



Dimension	Inches	Millimeters	Note
A (measured perpendicular to edge of film)	0.172 ± 0.001	4.37 ± 0.03	1
B (measured parallel to edge of film)	0.129 ± 0.001	3.28 ± 0.03	1
C	0.205 ± 0.002	5.21 ± 0.05	3
K_0	0.050 ± 0.005	1.27 ± 0.13	4
K_1	0.100 ± 0.005	2.54 ± 0.13	4
K_2	0.249 ± 0.005	6.32 ± 0.13	4
K_3	0.398 ± 0.005	10.11 ± 0.13	4
K_4	0.547 ± 0.005	13.89 ± 0.13	4
K_5	0.696 ± 0.005	17.68 ± 0.13	4
K_6	0.846 ± 0.005	21.49 ± 0.13	4
K_7	0.995 ± 0.005	25.27 ± 0.13	4
K_8	1.144 ± 0.005	29.06 ± 0.13	4
R	0.010 maximum	0.25 maximum	1

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The angle between the vertical edges of the aperture and the edges of normally positioned film shall be 0 degrees, ± ½ degree.

The angle between the horizontal edges of the aperture and the edges of normally positioned film shall be 90 degrees, ± ½ degree.

Note 1: Dimensions A, B, and R apply to the portion of the image on the film that is to be projected; the actual opening in the aperture plate has to be slightly smaller. The exact amount of this difference depends on the lens used and on the separation (dimension G) of the emulsion and the physical aperture. To minimize the difference in size and make the image of the aperture as sharp as practicable on the screen, G should be no larger than is necessary to preclude scratching of the film. When the reduction in size from the image to the actual aperture is being computed, it is suggested a 1-inch f/1.6 lens be assumed unless there is reason for doing otherwise.

Note 2: The limiting aperture is shown as being between the film and the light source so that it will give the maximum protection from heat. If other factors are more important, it may be on the other side of the film.

Note 3: In 8-mm. projectors the edge guide should bear on the edge of the film adjacent to the perforations. The other edge of the film usually is slit after processing and so is more likely to weave laterally with respect to the pictures.

The value of dimension C has been chosen so that film having a slight shrinkage when it is projected will be properly centered. This is the normal condition.

Note 4: The K dimensions are measured along the path of the film from the horizontal centerline of the aperture to the stopping position of the registration device. It is customary to provide a framing movement of approximately 0.025 inch above and below this nominal position. For any given projector, use the value of K corresponding to the location of the registration device.

If the film does not stop exactly where the film registration device leaves it, because of coasting or some other cause, a slight adjustment of the value of K will be necessary.

Note 5: "Optical axis of projector" is defined as the mechanical axis or centerline of the sleeve for holding the projection lens. Except for manufacturing tolerances, it coincides with the lens axis.