Standards and Recommended Practices

Approved SMPTE Engineering Guidelines

Two SMPTE Engineering Guidelines were approved by the Society's Executive Committee for Standards Approval: EG 5-1989, Projected Image Quality of 70-mm, 35-mm and 16-mm Motion-Picture Projection Systems; and EG 18-1989, Design of Effective Cine Theaters. These and other SMPTE Engineering Guidelines may be obtained from Society Headquarters for $3.00 each.

Proposed American National Standards

Parameters for ½-in Type M-2 television analog recording were approved by the Society's Working Group on ½-in Component Analog Formats, the Television Recording and Reproduction Technology Committee, and the Standards Committee. Published here for a trial period and public review are SMPTE 249M, Television Analog Recording — ½-in Type M-2 — Records; SMPTE 250M, Television Analog Recording — ½-in Type M-2 — Tapes and Cassettes; SMPTE 251M, Television Analog Recording — ½-in Type M-2 — Electrical Parameters of Video, Audio, Time and Control Code and Tracking Control; and SMPTE 252M, Television Analog Recording — ½-in Type M-2 — Pulse Code Modulation Audio.

Proposed SMPTE Recommended Practice

Also published for a trial period is a Proposed SMPTE Recommended Practice RP 158, Basic System and Transport Geometry Parameters for ½-in Type M-2 Format.

Copies of all the proposals are available from Society Headquarters for $3.00 each. Comments should be addressed to Sherwin H. Becker, Director of Engineering, at Society Headquarters. The proposals will be submitted to the Executive Committee for Standards Approval if no adverse comments are received by August 1, 1990.

Reaffirmed SMPTE Recommended Practices

The Society's Executive Committee for Standards Approval reaffirmed three SMPTE Recommended Practices: RP 50-1985, Dimensions for 8-mm Type S Motion-Picture Projector Reel Spindles; RP 58-1974, Nomenclature for Devices Enclosing 8-mm Motion-Picture Film for Projection; and RP 129-1985, Requirements for 35-mm, 16-mm and 8-mm Type S Tape Splices on Magnetic Audio Recording Motion-Picture Film. All three practices were reaffirmed in 1990. These and other SMPTE Recommended Practices are available from Society Headquarters for $3.00 each.

— Sherwin H. Becker, Director of Engineering

SMPTE ENGINEERING GUIDELINE

EG 5–1989

Projected Image Quality of 70-mm, 35-mm and 16-mm Motion-Picture Projection Systems

Introduction

The Committee on Theatrical Projection Technology decided that, with the availability of appropriate test films, a guideline should be developed to assist those interested in determining the degree of acceptability of image quality regarding the apparent sharpness of the projected image. Although factors such as image contrast, color fringing, and image steadiness are not covered, their effect on apparent sharpness should be considered.

1. *Scope*

This guideline specifies the conditions for the determination of image sharpness of 70-mm, 35-mm, and 16-mm motion-picture projection systems. It also classifies the practical limits of acceptability of image sharpness when using projector alignment test films. (See Appendix A2.)

2. *Test Conditions*

This guideline is based on the assumption that the classifications specified are those to which the projection system has been adjusted as specified in SMPTE Recommended Practice on Method for Determining the Degree of Jump and Weave in 70-, 35- and 16-mm Motion-Picture Projected Images, RP 105-1989; and that the screen luminance has been adjusted to be in accord with American National Standard for Motion-Picture Film — Screen Luminance and Viewing Conditions — Indoor Theater Projection, ANSI/SMPTE 196M-1986.

3. *Definitions*

3.1 Resolution is the apparent sharpness determined by the ability of a system to reproduce a specified number of equally spaced black lines and white spaces in groups which are at right angles to each other. (In television terminology, resolution is described by counting line pairs, a black line and a white space, as a single unit.)

3.2 The viewer's impression of resolution is related to the apparent size of the screen image. The apparent size of the screen image may be divided into three classifications:

Large: A large appearing screen image is one which is viewed from a distance of 3.7 screen heights or less (vertical field of vision is 15° or greater).

Medium: A medium appearing screen image is one which is viewed from a distance of 3.7 to 5.7 screen heights (vertical field of vision is between 10° and 15°).

Small: A small appearing screen image is one which is viewed from a distance of greater than 5.7 screen heights (vertical field of vision is 10° or less).

4. *Method*

Project an appropriate test film containing resolution targets calibrated in line pairs per millimeter (see A2), using the projection format with the greatest horizontal magnification (usually anamorphic for 35-mm projection).

Examine the projected image closely (see A1), considering only the vertical line pairs in the resolution target, since the horizontal line pairs are affected by system unsteadiness (jump) to a degree which makes them unreliable for resolution evaluation.

A line pair is considered to be clearly recognizable when the individual lines in the pattern can be clearly distinguished and the number of lines seen in the pattern is the same as the number of lines in the original target.

5. *Classification*

For each classification of apparent size of the screen image, the practical minimum limit of acceptability in terms of clearly recognizable lines per millimeter shall be as follows:

Classification	Lines per Millimeter Center	Sides*	Corners
Large appearing screen image (Review rooms, premier theaters)	80	56	48
Medium appearing screen image (First-run theaters)	68	56	40
Small appearing screen image	56	48	40

*Assumes left and right sides equivalent at same focus setting.

Revision of EG 5-1982
Approved December 19, 1989

Appendix

(This Appendix is not part of the SMPTE Engineering Guideline, but is included for information only.)

A1. Judgment of screen image resolution must be made from areas closer to the screen than those generally considered the best for viewing and definitely not from the rear of the theater or projection room.

A2. Appropriate test films are SMPTE 35-PA, as specified in SMPTE Recommended Practice RP 40-1971 (R1989), Specifications for 35-mm Projector Alignment and Screen Image Quality Test Film; SMPTE 70-PA, as specified in SMPTE Recommended Practice RP 91-1987, Specifications for 70-mm Projector Alignment and Screen Image Quality Test Film; and SMPTE 16-PA, as specified in SMPTE Recommended Practice RP 82-1985, Specifications for 16-mm Projector Alignment and Screen Image Quality Test Film.

SMPTE ENGINEERING GUIDELINE

EG 18–1989

Design of Effective Cine Theaters

1. *Introduction*

Present-day cinema technology provides the motion-picture theater exhibitor with projection and sound equipment capable of displaying high-quality images with clean, full-frequency sound. Yet, many patrons are denied this full realization of the film producer's art because the theater designer has failed to provide the proper environment for experiencing the wonderful world of illusion that is the art of cinematography. Good design has often been compromised by "practical" solutions and the belief that effective cinemas are not economically feasible. Contrary to this belief, many effective cine theaters have been designed for museums, universities, visitor centers, and Worlds Fairs by creative teams of architects, acousticians, and motion-picture engineers at reasonable cost. Similar results could be achieved for the film exhibitor by architects and their consultants based on the parameters and criteria contained in this guideline.

The effective cine theater is a place in which everyone can see and hear well. The summary lists the architectural parameters which must be addressed by the designers and the criteria recommended here.

2. *Image Size*

Although there is validity in discussing image size in terms of visual acuity or camera lens perspective, a criterion in terms of how much of the viewer's field of vision is occupied by the image may be more responsive to the filmmaker's intent and the viewer's subjective impression.

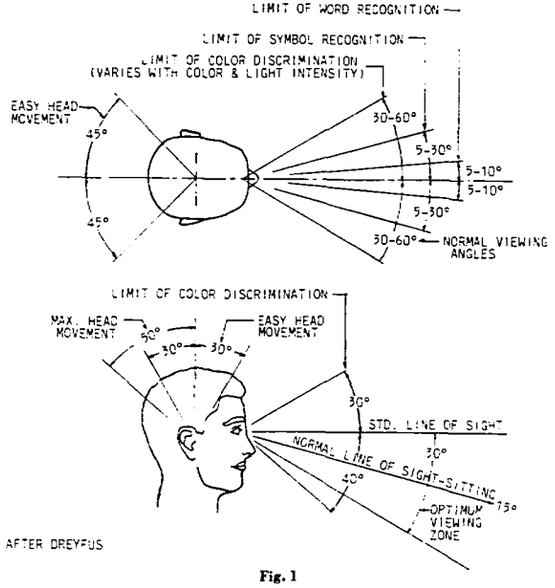


Fig. 1
Anthropometric Data — Field of Vision

Approved December 19, 1989

The anthropometric data[1] shown in Fig. 1 suggests that the screen appears large when it occupies a substantial portion of the viewer's horizontal and vertical field of vision. Experience indicates that the screen image will appear small if the image occupies less than 15° of the viewer's vertical field of vision or approximately 30° of the horizontal field of vision. Geometry for determining the viewer's field of vision is given in Fig. 2 and an analysis of some selected viewing distances are given in the Appendix.

3. *Viewing Angle Distortion*

It is evident that as the viewer's line of sight to the screen deviates from the perpendicular, circles become ellipses, squares become rhombuses, and all shapes become distorted (Fig. 3). This subject was treated in detail by Dr. Reubens Meister,[2] who concluded that *45° was the limit of tolerable viewing-angle distortion.* He provided a simple geometric construction for outlining the seating area which falls within the prescribed limits (Fig. 4), which he termed iso-deformation lines.

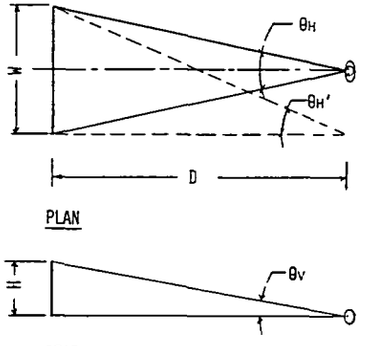
4. *Visibility*

To see well, every viewer should have an unobstructed vertical and horizontal sightline to the image on the screen (Figs. 5 and 6). If screen images are to fill 30° of the most distant viewer's field of vision and up to 80° of the nearer viewer's, it is evident that looking between the heads of the row immediately ahead, as in 2-row vision, does not permit a view of the entire screen. Thus 1-row vision is the most desirable for the effective cine theater.

Although the technique for determining the slope of the seating risers, using either drafting or analytical methods, is well known (Fig. 7), considerable confusion exists with respect to the value given (*c*), the so-called eye-to-top-of-head dimension. Whereas the actual eye-to-the-top-of-the-head distance is fairly constant at 4.5-in average (range = 3.5 in to 4.6 in), the location of a seated person's eye with respect to the top of the head of the person in front differs from the average (Fig. 8). Thus, if the riser height is to be determined by $Yn - K$, $K = 3$ ft 8 in typically, then the value of c must be obtained from $c = A - B$ (Fig. 8). It is recommended that $c = 9$ in to 10 in to be used in the analytical method. Cramer and Booth[3] have shown that when $c = 7$ in, the probability will be that 80% of the viewers will have satisfactory 1-row vision. It is suggested that $c = 7$ in as a minimum.

Since the floor slope will also be determined by the location of the aiming point (O), and the location of the front row of seats (X1), the placement of the bottom of the screen is important. Experience has shown that 4 to 6 ft above the first row of seats is satisfactory, provided a 6-ft standing person does not interrupt the projection beam. If no subtitles are to be used, the aiming point may be placed approximately 10% of the image height above the bottom of the image. This superimposes the heads in front onto the screen, which some viewers find desirable. If subtitles are to be used, the aiming point should be the bottom of the screen image.

The plot of the equation in Fig. 7 is a parabolic curve whose slope will usually exceed the aisle slopes allowed by local codes. Steps in the aisle should then be used to obtain the required seating levels with appropriate transition segments to join aisles with the seating levels.



D = Most distant viewer
H = Image height (screen height)
W = Image width (screen width)
= K x H
K = Aspect ratio (format)
θ_H = Horizontal field of vision, degrees
= 2 x ARCTAN (½ W ÷ D)
θ_V = Vertical field of vision, degrees
= ARCTAN (H ÷ D)

Fig. 2
Geometry for Determining Viewer's Field of Vision Subtended by the Image

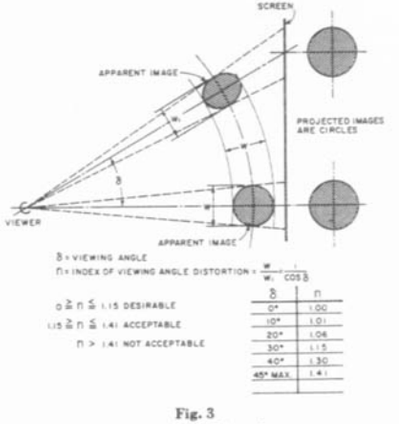


Fig. 3
Viewing Angle Distortion

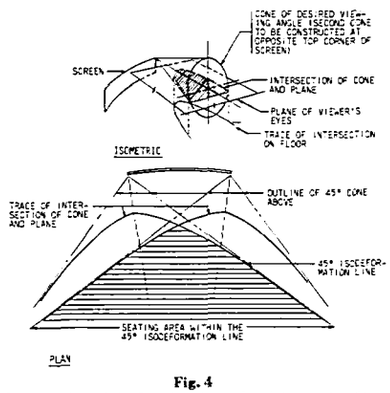


Fig. 4
Construction of the Viewing Angle Iso-deformation Line

Row spacing (*d*) should be not less than 30 in back-to-back with 36 to 40 in providing greater comfort. The width of seats should be not less than 19 in with 20 to 21 in providing greater comfort.

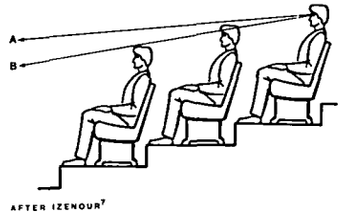
When 1-row vision is not feasible, seats should be offset as determined by a careful sightline study to the screen vertical centerline. The total number of seats in a row will be determined by local codes, nominally 14 or 15, unless wider continental seating is used. If seating layouts are done by the supplier, as is the usual case, the architect should ensure that the work meets these criteria.

5. *Comfort*

Although it is usually assumed that ventilation, heating, and cooling will provide for human comfort, frequently these conditions are compromised for reasons of economy. Thus operating costs must be considered during the design phase of the effective cine theater and accepted by the owner as an essential part of the theater's design.

In addition to ensuring that everyone will see well, seating in the effective cine theater must avoid physical discomfort, which occurs when the vertical viewing angle to the top of the screen image is excessive or the lateral viewing angle to the centerline of the screen requires uncomfortable head and/or body position.

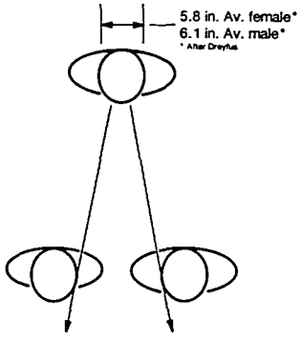
Since the normal line of sight is 12 to 15° below the horizontal, seat backs should be tilted to elevate the normal line of sight approximately the same amount. For most viewers, physical discomfort occurs when the vertical viewing angle to the top of the screen exceeds 35°, and when the horizontal line of sight measured between a perpendicular to his seat and the centerline of the screen exceeds 15°. To compensate for excessive lateral viewing angles, the seat rows should be angled or curved as shown in Fig. 9.



A: 1-row vision = single-row vision = every-row vision. Vertical sightline passes over the heads of the persons in the first row ahead.

B: 2-row vision = double-row vision = every-other-row vision.
Vertical sightline passes between the heads of the persons in the first row ahead and over the heads of the persons in the second row ahead.

Fig. 5
Vertical Sightlines



Row Spacing	Seat Width 19 in	20 in	21 in
30 in	24.4	26.3	28.1
32 in	23.0	24.7	26.4
34 in	21.6	23.3	24.9
36 in	20.5	22.0	23.5
40 in	18.4	19.9	21.2
42 in	17.5	18.9	20.2

Fig. 6
Horizontal Viewing Angles in Degrees for 2-Row Spacing for Selected Seat Widths and Row Spacings

6. *Projection Angle Distortion*

When the projector is placed in a position other than normal in relation to the screen, shapes are distorted as shown in Figs. 10 and 11. Note that the equation shows distortion to be a function of screen size, projection distance, and the projection angle. Experience suggests that 5% is a tolerable maximum limit for projection angle distortion, with 3% preferred.

7. *Architectural Distractions*

In 1947, Ben Schlanger, an eminent cinema architect, said, "What we need is a theater in which a person can sit down and look at a picture and not be conscious of the physical shelter in which he is enjoying the picture."[4] That dictum is valid today.

When the picture illuminates the screen, the light from the screen illuminates the walls and ceiling as well as the seating area. Nothing in the room's decor should distract the viewer's attention from the projected image. This does not say that the interior cannot be made to appear attractive and inviting. However, interior finishes should be non-reflective and of low chrominance. Varying the intensity of colors so that the darkest hues are in the vicinity of the screen has proved effective.

The question whether the screen should be masked in black or be "free floating" is a matter of preference. In theaters using more than one film format, the need for variable masking would lead to the choice of black masking all around. Aisle lights and exit signs required by safety codes can be a serious source of distraction, and circulation patterns for patrons entering and leaving may cause undue distractions. These architectural elements must be carefully evaluated in the design of the effective cine theater.

8. *Acoustical Environment*

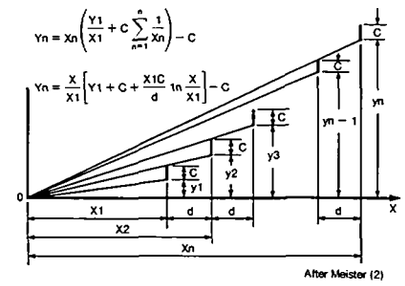
Technical advances in film sound recording and reproduction make it increasingly apparent that the acoustical environment of the cine theater is critical to the patron's full enjoyment of modern films. Recent research indicates that special consideration must be given to the following:

Freedom from flutter echo, spurious room resonances, and focusing.

Special absorptive treatment of the wall behind the screen loudspeakers and the rear wall of the theater to avoid undesirable reflections and phase cancellations.

Elimination of those elements considered desirable in the live theater, which preferentially support the loudness and "color" the sound of live music.

Background noise: The noise level in the theater due to air conditioning and other mechanical sources must be equal to or less than the Noise Criteria Curve NC30 of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) for each octave band. Details of measurement methods and maximum noise levels are given in SMPTE Recommended Practice RP 141-1986, Background Acoustic Noise Levels in Theaters and Review Rooms.



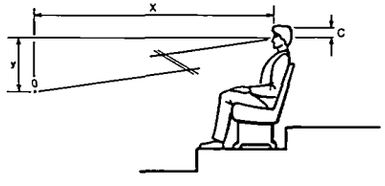
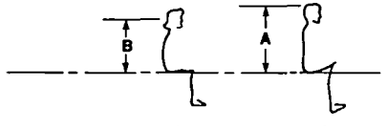


Fig. 7
Analytical Method for Sightline Study



	A* Seat to Top of Head (Inches)		B* Seat to Eye Level (Inches)	
	Female	Male	Female	Male
Large	34.9	38.5	30.2	33.9
Average	32.9	36.0	28.8	31.5
Small	29.7	33.4	26.3	29.0

A-B	A = Large male B = Small female	12.2 in Without slump 14.2 in With slump
A-B	A = Average male B = Average female	7.2 in Without slump 9.2 in With slump
A-B	Per classic texts on theater design	4-5 in (10—12.8 cm)

*After Dreyfus[6] and Jones[8]

Fig. 8
Anthropometric Data for Sightline Study

Acoustical isolation: To eliminate objectionable noise from adjacent theaters (in the case of multiples), the projection booth and outside sources, walls, ceilings, floors, and doors must be designed with suitable noise reduction based on industry standard sound transmission class (STC) ratings in the mid-60s and 70s. A table summarizing published information[5] is reproduced in Table 1 to guide the acoustician. A local survey of ambient street and overflight noise should also be available.

Reverberation: Fig. 12 shows preferred reverberation time for the 500 Hz octave band.[5] Ideally, the reverberation time would be equal for all frequencies. Although this is not realizable in most motion-picture theaters, the acoustician should strive to achieve a smooth decay for all frequencies with an absence of bass "overhang."

Loudspeaker position: For reproduction of multitrack sound records in theaters showing 35-mm 1.85:1 and 2.35:1 formats, it is recommended that when three behind-the-screen speakers are used they be positioned as required for the 2.35:1 format and that acoustically transparent material be used on the trailing edges of the 1.85:1 masking.[5] Alternately, five loudspeakers may be used behind the screen, two of which are positioned for the 2.35 format, and two for the 1.85, with one pair switched off, depending on the format being used.

Equalization: Whether ⅓-octave band equalization will be required in the film sound B chain is a decision to be made by the motion-picture engineer or acoustician. When equalization is required, the house curve characteristic shall be as described by Curve X in American National Standard for Motion-Pictures—B Chain Electro-Acoustic Response—Control Rooms and Indoor Theaters, ANSI PH22.202M-1984, or as specified by the equipment manufacturer.

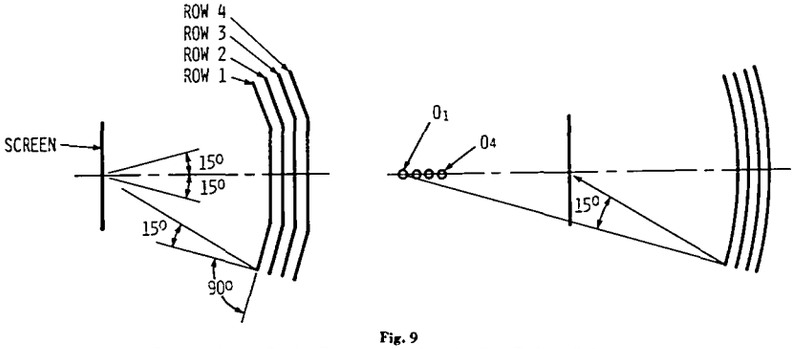


Fig. 9
Construction for Seating Row Angle and Seating Row Radius of Curvature

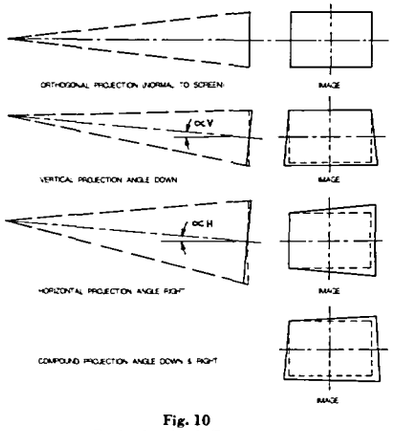


Fig. 10
Projection Angle Distortion

Summary

A. The effective cine theater is a place where everyone can see and hear well.

1. *Image Size.* How large should the screen image be?

The image on the screen should subtend not less than 15° of the most distant viewer's vertical field of vision, and approximately 30° of his horizontal field of vision.

2. *Viewing Angle Distortion.* What is the tolerable limit of distortion due to the position of the viewer with respect to the projected image?

All seats should be contained within a 45° iso-deformation line.

3. *Visibility (Seating Risers and Sightlines).* Does every viewer have an unobstructed horizontal and vertical sightline to the projected image?

Seating slopes and/or seating risers should be designed for 1-row (single-row) vision. If 2-row vision is used, seats should be staggered.

When using the analytical method, the value of c, the so-called eye-to-top-of-head dimension, should be 9 to

10 in and not less than 7 in; the aiming point should be the bottom of the screen when subtitles are to be used, or 10% of the image height above that point when no subtitles will be used.

Rows should be spaced not less than 30 in back-to-back *with 36 to 40 in preferred unless otherwise required* by code (for continental seating).

Seats should be not less than 19 in side-to-side, with 20 in preferred. (For pseudo-staggered seating, use 19, 20, and 21 in.)

4. *Comfort.* Is the ventilation, heating, and cooling capacity adequate for continuous human comfort? Does the design of seats provide a natural posture for viewing the projected image? *Does the vertical viewing angle to the* top of the projected image require an uncomfortable head position? Does the lateral viewing angle to the centerline of the screen require an uncomfortable head and/or body position?

HVAC systems should be designed and operated for patrons' comfort whenever the theater is occupied.

Seat backs should be tilted approximately 12° to raise the normal downward line of sight to the horizontal.

The nearest viewer's vertical line of sight should not exceed 35° from the horizontal to the top of the projected image, and preferably should be 15° to the horizontal centerline of the screen image.

For the side seats, the lateral line of sight to the screen centerline, measured from a perpendicular to the seat row, should not exceed 15°.

5. *Projection Angle Distortion.* How much is the image distorted due to the position of the projector (projection angle)? What are the tolerable limits of distortion?

Image distortion due to the horizontal or vertical projection angle should not exceed 5%, and 3% maximum is preferred.

6. *Architectural Distraction.* Do any of the theater's interior architectural features distract the viewer's attention from the projected image?

Interior finishes, lighting required for safety, and patron traffic should be designed to minimize distractions for the patrons viewing the screen.

7. *Acoustical Environment.* Do the theater's acoustics ensure that everyone will hear well?

The theater should be free of flutter echo, spurious resonances, focusing, and all elements which will preferentially support loudness or color the sound.

Background noise from all sources should be equal to or less than NC30 in all octave bands.

Acoustical isolation from sound sources in adjacent spaces must be adequate to preserve the noise criteria (NC30) requirements.

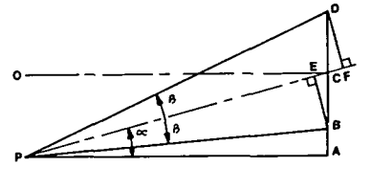
Reverberation time at 500 Hz should be optimized for the room volume, with smooth decay at all frequencies and absence of bass "overhang."

Loudspeakers for multi-channel sound should optimize the stereo aspects of the sound records.

Equalization, when used, should provide a "house curve" conforming to ANSI PH22.202M-1984.

B. The effective cine theater is a place in which state-of-the-art projection technology is employed.

1. *Screen Design.* Are the screen shape (flat or curved) and material (matte or gain) appropriate for the viewing environment?



H = Image height H′ = Aperture height
W = Image width W′ = Aperture width
FL = Lens focal length
L = PA = Projection distance
T = PC = Throw distance
CB + CD = H or W CE + CF = ΔT
∝ = Projection angle, vertical or horizontal
= ARCTAN (PO ÷ PA)
β = Projection beam half angle, vertical or horizontal
= ARCTAN (½ H′ ÷ FL), or
= ARCTAN (½ W′ ÷ FL)
% distortion = (ΔT ÷ T) x 100
For horizontal projection angle:
% distortion = [(W x sin∝ x cos∝) ÷ L] x 100
= [(W x sin∝) ÷ T] x 100
For vertical projection angle:
% distortion = [(H x sin∝ x cos∝) ÷ L] x 100
= [(H x sin∝) ÷ T] x 100

Fig. 11
Formulas for Determining Projection Angle Distortion

Table 1
Recommended Noise Reduction Between Adjacent Theaters (dB)[5]

31.5 Hz	63 Hz	125 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
38	48	52	66	66	66	66	66

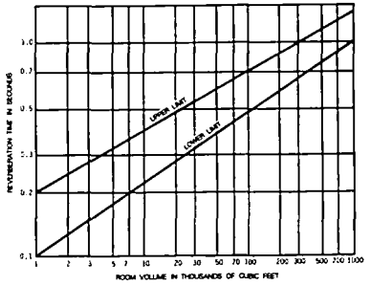


Fig. 12
Recommended Reverberation Time for Motion-Picture Theaters

2. *Screen Brightness.* Is the picture brightness (screen luminance), contrast ratio, and color balance according to SMPTE Standards?

3. *Picture Steadiness.* Do the projectors provide picture steadiness (jump and weave) and freedom from "breathing" and "ghosting" in accordance with SMPTE Standards?

4. *Picture Sharpness.* Are lenses and lamphouses of modern design, and have they been properly matched to provide optimum image sharpness (acutance) according to SMPTE Standards?

5. *Sound System Characteristics.* Is the "B chain" of the sound system optimized for frequency response, wow and flutter, and distortion according to SMPTE Standards?

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Appendix

(This Appendix is not part of the SMPTE Engineering Guideline, but is included for information only.)

Some Representative Fields of Vision for Selected Viewing Distances Normalized for 2.35, 1.85, and 1.37 Aspect Ratios

Format	θ_H	θ_V	D		Remarks
2.35	37.6	16.1	3.45H	1.46W	Szabo, 1984
1.85	30.0	16.1	3.45H	1.86W	
1.37	22.5	16.1	3.45H	2.50W	
2.35	35.9	15.0	3.73H	1.59W	NIKFI, 1961[9]
1.85	27.8	15.0	3.73H	2.01W	
1.37	20.8	15.0	3.73H	2.72W	
2.35	28.0	12.0	4.70H	2.00W	Meister[2] and
1.85	22.3	12.0	4.70H	3.43W	Philips[10]
1.37	16.5	12.0	4.70H	3.43W	
2.35	26.4	11.3	5.00H	2.12W	Vivié, 1965[11]
1.85	21.0	11.3	5.00H	2.70W	
1.37	15.6	11.3	5.00H	3.65W	
2.35	19.5	8.35	6.81H	2.90W	Soulé, 1980[12]
1.85	15.5	8.35	6.81H	3.70W	
1.37	11.5	8.35	6.81H	5.00W	

Proposed American National Standard

for television analog recording —

½-in type M-2 — records

SMPTE 249M

1. Scope

This standard specifies the dimensions and locations of the video, audio, time code, and tracking-control records, as recorded by ½-in type M-2 helical-scan video tape recorders operating with video signals having a typical scanning structure of 525 lines, 59.94 fields/sec, 2:1 interlace, and utilizing the video cassettes specified in SMPTE 250M. This standard also specifies the records for two different audio recording modes — common audio mode and pulse code modulation (PCM) audio mode.

2. Referenced Documents

This standard is intended for use in conjunction with the following documents:

SMPTE 250M, Television Analog Recording — ½-in Type M-2 — Tapes and Cassettes

SMPTE 251M, Television Analog Recording — ½-in Type M-2 — Electrical Parameters of Video, Audio, Time and Control Code and Tracking Control

SMPTE 252M, Television Analog Recording — ½-in Type M-2 — Pulse Code Modulation Audio

SMPTE RP 158, Basic System and Transport Geometry Parameters for ½-in Type M-2 Format

3. General Specifications

3.1 All dimensions are in the metric system.

3.2 A basic dimension is a fundamental dimension to which no tolerance is applicable.

3.3 Tests and measurements made on the tape record to check the requirements of this standard shall be made under the following conditions unless otherwise specified:

Temperature	20°C ± 1°C
Relative humidity	50% ± 2%
Barometric pressure	86 to 106 kPa
Tape tension	0.31 N ± 0.05 N

3.4 Conditioning of the tape stock before recording and testing shall be as follows:

Environment	Established to the conditions specified in 3.3.
Tape tension	Wound on a reel at a tension of 0.4 N ± 0.1 N.
Condition time	24 hours.

3.5 The reference edge of the tape for dimensions specified in this standard shall be the lower edge as shown in Figs. 1 to 4. The magnetic coating, with the direction of tape travel as shown in Figs. 1 to 4, is on the side facing the observer.

4. Tape Speed

The tape speed shall be 67.693 mm/s, basic.

5. Record Locations and Dimensions

5.1 The locations and dimensions of the video and common audio mode records shall be as specified in Figs. 1 and 2 and Table 1.

5.2 The locations and dimensions of the video and PCM audio mode records shall be as specified in Figs. 3 and 4 and Table 2. The PCM records are recorded by the luminance and chrominance heads and only a single longitudinal audio record shall be available.