Standards and Recommended Practices

Approved American National Standards

The American National Standards Institute approved two American National Standards on May 12, 1986: ANSI/SMPTE 3-1986, Video Recording — Frequency Response and Operating Level of Recorders and Reproducers — Audio 1 Record on 2-in Tape Operating at 15 and 7.5 in/s; and ANSI/SMPTE 196M-1986, Motion-Picture Film — Screen Luminance and Viewing Conditions — Indoor Theater Projection. Copies of the standards are available for a nominal fee from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

Approved SMPTE Recommended Practices

Two SMPTE Recommended Practices were approved by the Society's Executive Committee for Standards Approval: RP 49-1986, Leaders for 8-mm Type R and S Motion-Picture Release Prints Used in Continuous-Loop Cartridges; and RP 88-1986, Reference Carrier Frequencies and Pre-emphasis Characteristic for ½-in Type F Helical-Scan Video Tape Recording. These and other SMPTE Recommended Practices are available from Society Headquarters for $3.00 each.

Proposed SMPTE Engineering Guideline

A Proposed SMPTE Engineering Guideline is published here for a trial period and public review: EG 15, Recording Level for Dialog in Motion-Picture Production. Copies of the proposal are available from Society Headquarters for $3.00 each. The proposal will be submitted to the Society's Executive Committee for Standards Approval if no adverse comments are received from publication. Comments should be addressed to Sherwin H. Becker prior to December 1, 1986.

Approved International Standard

The International Organization for Standardization (ISO) approved an International Standard, the technical content of which is published here for your information. ISO 7831-1986, Cinematography — A-Chain Frequency Response for Reproduction of 35 mm Photographic Sound — Reproduction Characteristics, is in agreement with current practices. This material is reproduced with permission from the ISO and is copyrighted by the American National Standards Institute, 1430 Broadway, New York, NY 10018, from which copies are available.

Withdrawn SMPTE Recommended Practice

On July 9, 1986, the Executive Committee for Standards Approval approved withdrawal of SMPTE Recommended Practice RP 22-1966. The practice has been withdrawn since most laboratories exchange sensitometric strips not plotted curves because the differences between densitometers in any two laboratories overshadow any concern about a specific type of plotting paper. Also, laboratory surveys have confirmed a de-facto standard for the motion-picture industry that is far more useful than RP 22 could ever be.

— *Sherwin H. Becker, Manager of Engineering*

ANSI/SMPTE 3-1986
Revision and Redesignation of
ANSI V98.3-1980

American National Standard for video recording— frequency response and operating level of recorders and reproducers— audio 1 record on 2-in tape operating at 15 and 7.5 in/s

Approved May 12, 1986 Sponsor: Society of Motion Picture and Television Engineers

1. Scope

This standard specifies the frequency response and operating level for recorders and reproducers for audio 1 record for 2-in quadruplex video magnetic tape recording at 15 and 7.5 in/s (381 and 190.5 mm/s), as defined in ANSI V98.6-1981. It also specifies the field method of calibration of recorders and reproducers, utilizing the test tapes, as defined in ANSI V98.8-1982 and ANSI V98.11-1982.

2. Referenced American National Standards

This standard is intended for use in conjunction with the following American National Standards:

ANSI V98.6-1981, Dimensions of Video, Audio and Tracking Control Records on 2-in Video Magnetic Tape Quadruplex Recorded at 15 and 7.5 in/s

ANSI V98.8-1982, Specifications for an Audio Operating Level and Multifrequency Test Tape for Quadruplex Video Magnetic Tape Recorders Operating at 15 in/s

ANSI V98.11-1982, Specifications for an Audio Operating Level and Multifrequency Test Tape for Quadruplex Video Magnetic Tape Recorders Operating at 7.5 in/s

ANSI/IEEE 152-1953 (R1976), Volume Measurements of Electrical Speech and Program Waves

3. Operating Level

3.1 Recording and Reproducing Level Indicator. The audio recording and reproducing levels of a video magnetic tape recorder shall be monitored and adjusted with a standard volume indicator (vu meter), as specified in ANSI/IEEE 152-1953.

3.2 Recorder Operating Level. When a tape record is recorded from a sinusoidal voltage having a frequency of 1000 Hz, such that the rms short circuit tape flux per unit track width on the record is 110 ± 3 nanowebers per meter of track width, the recording volume indicator shall be adjusted to deflect to its reference level (0 db) scale mark.

3.3 Reproducer Operating Level. When a tape record having an rms sinusoidal flux per width of 110 nWb/m and a frequency of 1000 Hz is reproduced, the reproducing volume indicator shall deflect to its reference level (0 dB) scale mark.

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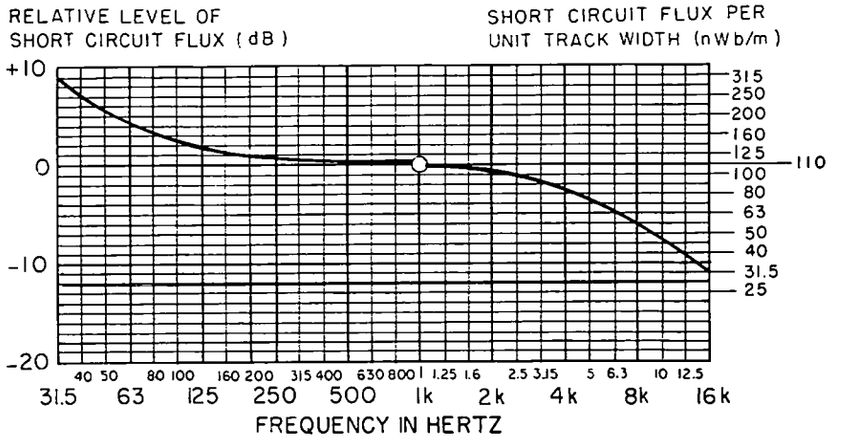

Flux and Flux Level vs Frequency

4. Frequency Response

4.1 Recorder Flux/Frequency Response. When a tape record is recorded from a constant voltage level applied to the input terminals of the recording system, the short circuit tape flux level on the record versus frequency, L_Φ (f), shall be as given by the following equation:

$$L_\Phi (f) \text{ re } 110 \text{ nWb/m} = 0.2 + 10 \log_{10} \{[1 - (F_1/f)^2]/[1 - (f/F_h)^2]\} \quad [\text{dB}]$$

where f is the frequency at which the response is being computed; F_1 is the low-frequency transition frequency, 80 Hz; and F_h is the high-frequency transition frequency, 4500 Hz. A graph of this equation is shown in the figure.

4.2 Reproducer Flux/Frequency Response. When a tape record having a short circuit tape flux level versus frequency given in 4.1 is reproduced, the output voltage level of the reproducer versus frequency shall be constant.

5. Field Method of Calibrating Recorders and Reproducers

5.1 The practical calibration of a reproducer shall be performed by reproducing the audio level and multifrequency test tape defined in ANSI V98.8-1982 or ANSI V98.11-1982. The practical calibration of a recorder shall then be performed by recording on a medium representative of that to be used, and comparing the recording so made with the recording on the test tape.

5.2 The flux/frequency response of a reproducer shall be calibrated by reproducing the frequency response test section of the specified test tape. The reproducing equalizer is adjusted so that output voltage level versus frequency of the reproducer is constant.

5.3 The operating level of a reproducer shall be calibrated by reproducing the audio operating level test section of the specified test tape. The reproducing gain control is adjusted so that the reproducing volume indicator deflects to its reference level (0 dB) scale mark.

5.4 The flux/frequency response of a recorder shall be calibrated by comparing the tape flux recorded by the recorder (with constant input voltage level), to the flux recorded on the frequency response test section of the specified test tape. The recording equalizer is adjusted so that the tape flux level versus frequency of a recorder (including the tape) is the same as that on the test tape.

5.5 The operating level of a recorder shall be calibrated by comparing the tape flux recorded by the recorder when the recording volume indicator deflects to its reference level (0 dB) scale mark, to the recording of the audio operating level test section of the specified test tape. The recording gain control is adjusted so that, when the recording volume indicator deflects to its reference level (0 dB) scale mark, the recorded tape flux is the same as that on the test tape.

Appendix

(This Appendix is not part of the American National Standard, but is included for information only.)

Previous frequency response standards for recorders and reproducers have been given in terms of a "standard reproducing system," having an "ideal" reproducing head followed by a standardized RC equalizing network whose time constant was given.

Because an adequate description of the "ideal" head and its interconnection to the following network is quite lengthy, it is simpler to specify the system responses in terms of the basic physical quantity for the recorded signal, the "short circuit tape flux." The concepts are explained in detail by J. G. McKnight in the paper "Flux and flux-frequency measurements and standardization in magnetic recording," J. SMPTE, 78: 457-472, June 1969.

Rather than specifying flux/frequency response in terms of admittances of electrical networks, the equation and graph of the response function have been specifically given. The equation does in fact describe the response of the previously specified RC equalizing network with "time constants" of 2000 and 35 microseconds.

ANSI/SMPTE 196M-1986
Revision and Redesignation of
ANSI PH22.196-1978

American National Standard for motion-picture film—screen luminance and viewing conditions—indoor theater projection

Approved May 12, 1986 Sponsor: Society of Motion Picture and Television Engineers

1. Scope

This standard specifies the screen luminance level, color quality, and viewing conditions for theatrical, review-room, and non-theatrical presentation of 16-, 35-, and 70-mm motion-picture prints intended for projection at 24 frames per second. (For review-room viewing of motion-picture prints intended for television, refer to SMPTE RP 41-1983.)

2. Purpose

The purpose of this standard is to specify screen luminance levels and viewing conditions at which tone scale, contrast, and pictorial quality of the projected print will be of the quality anticipated during its production.

3. Referenced Documents

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

ANSI/IES RP 16-1980, Nomenclature and Definitions for Illuminating Engineering

SMPTE RP 12-1983, Screen Luminance for Drive-In Theaters

SMPTE RP 41-1983, Evaluation of Color Films Intended for Television

SMPTE RP 94-1980, Gain Determination of Front Projection Screens

SMPTE RP 95-1980, Installation of Gain Screens

SMPTE RP 98-1981, Measurement of Screen Luminance in Theaters

4. Projector Operating Conditions

Measurement of screen luminance and color of projection light shall be made with the projector in complete operation with its lens set at focus position, but with no film in the aperture.

5. Photometer Type

Screen luminance shall be measured with a spot photometer having the spectral luminance response of the standard observer (photopic vision), as defined in ANSI/IES RP 16-1980. (See Appendix A3.) The acceptance angle of the photometer shall be 2° or less.

6. Luminance and Level Distribution

6.1 The distribution of projection illumination shall be symmetrical about the geometric center of the screen, and the luminance at the center of the screen shall be 55 ± 7 cd/m² (16 ± 2 fL) for

review rooms and primary theaters, and 55 = 14 cd/m² (16 = 4 fL) for other theatrical projection. Luminance shall be measured as outlined in 6.3. (See SMPTE RP 98-1981.)

6.2 The luminance measured on the horizontal centerline of the screen at a distance from the screen edges equal to 5 percent of the width of the screen shall be the same at each edge and not less than 34 cd/m² (10 fL) and not more than 85 percent of that at the center with a recommended value of 75 percent.

6.3 For typical matte white screens, screen luminance shall be measured from a position at eye level (one meter above the floor) in the center of the middle row of seats. For gain screens (lenticular, retroreflective, metallized or semi-specular), more readings are necessary to ensure proper luminance level and distribution throughout the seating area. As a minimum, the photometer readings should be taken from the center and each end of the middle row of seats. (See SMPTE RP 94-1980 and RP 95-1980.)

7. Spectral Distribution

7.1 For 35- and 70-mm prints, the light reflected from the screen in review rooms and primary theaters shall have a spectral distribution approximating that of a black-body at a color temperature of 5400 K = 200 K, the use of short-arc xenon or carbon-arc light sources being assumed. For general theaters, the color temperature shall be 5400 K = 400 K.

7.2 16-mm prints are made for projection with either arc or tungsten illuminant. When the intended illuminant cannot be specified uniquely, 16-mm prints should also be evaluated at 5400 K.

8. Multiple Projector Adjustment

8.1 Same Format. The resultant luminance from all projectors intended for use in the continuous viewing of material of the same format shall not vary by more than 7 cd/m² (2.0 fL), as measured in 6.1 above.

8.2 Different Formats. The resultant luminance from projectors intended for use in a sequential system of viewing material of different formats shall not vary by more than 14 cd/m² (4.1 fL), as measured in 6.1 above (see Appendix A4.)

8.3 The apparent color temperature of the projection light from projectors intended for interchangeably sequential operation shall be consistent within a total range of 400 K. For 16-mm projection with sources with a color temperature of less than 3500 K, the range shall be limited to 7 percent or 200 K.

9. Review Room Viewing Conditions

All observers in a review room shall be located within a standard observing area which is

(a) within the limits of a 15° angle on either side of a perpendicular to the mid-point of the screen as a center, in both the horizontal and vertical planes, and

(b) at a distance of 3 = 1 picture heights from the screen.

10. Stray Light

10.1 No stray light or illuminated area with a luminance in excess of 3.4 cd/m² (1.0 fL) shall be visible from the standard observing area of a review room.

10.2 Luminance from stray light, as described in Appendix A5, shall be no more than 0.4 percent of the screen luminance at the center of the screen in review rooms and primary theaters and under 1 percent in general theatrical projection facilities.

Appendix

(This Appendix is not part of the American National Standard, but is included for information only.)

A1. Luminance Level Limits

Possible luminance levels are limited by a minimum value below which the visual process becomes less efficient and by a maximum value above which (assuming a shutter frequency of 48 flashes/s) flicker becomes objectionable. Permissible luminance range is limited by the criterion that a good release print must provide acceptable quality when projected at any luminance within the range. Users are reminded that screen luminance may decrease as a function of bulb age, dirt on optics, dirt on screen, etc. Projection equipment should be chosen to have more than sufficient light output to meet the specifications in this standard over a period of time. Usually, arc current is adjusted to compensate for changes in light output.

A2. Normal Print

To provide interchangeability in motion-picture projection, it is desirable that print quality conforms to that of a normal print so that theaters can operate at known projection conditions and will, thereby, be able to exhibit projected pictures of good pictorial quality. It has not been possible to specify this normal print in terms of its optical density and other objective measurements because of the difficulties of specifying artistic quality in scientific terms. Accordingly, the normal print is defined as that print which conveys the desired artistic impression when projected under review room conditions as described by this standard.

A3. Meter Acceptance Angle and Response

A photometer with a photopic spectral response allows use of a well known standard response for all photometer manufacturers. A mesopic (partially dark adapted) response might be better but no standard has been set for the mesopic observer under typical screen viewing conditions. When entering a theater from daylight, we find it difficult to see others in the audience although they see us because they are partially dark adapted. The degree of adaption varies with the film subject matter. A typical film reduces the average screen luminance from 55 to 5.5 cd/m² (16 to 1.6 fL). The rest of the theater is much darker. Because of increased blue sensitivity of the eyes (Purkinje Effect) as one becomes somewhat dark adapted, a photometer with a photopic response may give readings on a xenon illuminated screen and a carbon-arc illuminated screen that are the same, although many observers see the xenon illuminated screen as the brighter. The xenon-arc spectrum has a peak in the blue region where, because of the Purkinje shift, there is increased sensitivity. A representative mesopic curve may be developed and adopted in the future.

A4. Matching Luminance of Different Formats

It may be necessary to adjust projector light output to compensate for the different aperture sizes and magnifications used when projecting different formats. The projector light source should be capable of achieving the specified screen luminance for the format with the least light efficiency (usually nonanamorphic wide screen). Adjustment may be made by changing arc current, or the use of attenuators in the light beam to reduce the screen luminance to the recommended value when projecting more light-efficient formats.

A5. Stray Light

Stray light shall be measured by comparing the screen luminance with the luminance of the image of an opaque test object placed in the center of the projector aperture. The test object preferably should have a diameter of 5 percent of frame width, and should not exceed 10 percent. The balance of the projected beam is attenuated by any suitable neutral density film that produces through the normal projection system an average screen luminance equal to 10 percent of the luminance of the screen as defined in 6.1. All sources of illumination in the auditorium, such as exit and aisle lights, shall be used in their normal manner while stray light is being measured. Excessive stray light or flare should be corrected to ensure proper print contrast.

A6. Other Applications

Specifications for drive-in theater screen luminance are covered in SMPTE RP 12-1983.