Proposed American National Standard

for motion-picture film – measurement of photoelectric output factor – photographic audio level test films

SMPTE 183M

1. Scope

1.1 This standard specifies the method of measurement of the photoelectric output factor of single-track photographic audio level test films in all film gauges, using a calibrating audio reproducer. It is applicable to both variable-area and variable density audio records.

1.2 The standard also specifies the intended performance of a calibrating audio reproducer.

1.3 Calibrated audio-level test films are employed to measure the precise output level of photographic audio reproducers and the photoelectric output factor of different audio records, and to establish a reference level on a standard program-level meter appropriately chosen for the installation.

2. Definitions and Symbols

2.1 Voltage Outputs (V_1, V_2, V_3, and V_4). The output voltage levels (Figs. 1 and 2) from the calibrating audio reproducer measured at a point in the circuitry where the voltage relationship to the amplitude of the audio record is essentially linear.

2.2 Maximum Photoelectric Output (M_{PO}). The voltage difference obtained between full illumination of the photoreceptor by the scanning beam and complete occlusion of the scanning beam, as defined by V_1 and V_4 in Figs. 1 and 2.

2.3 Photoelectric Output Factor (P_{OF}). When reproducing an audio level test film on a calibrating reproducer, the photoelectric output factor is the ratio of the peak-to-peak output voltage from the film to the maximum output of the reproducer as defined in 2.2.

3. Method of Measurement

3.1 Three steps shall be required to measure the photoelectric output factor:

3.1.1 Measure the maximum photoelectric output (M_{PO}) of the calibrating reproducer by one of two methods—the dc method or the ac method as specified in Sec. 5.

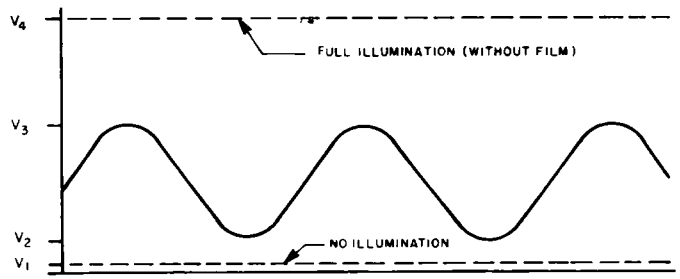


Fig. 1
Calibration Waveforms – DC Method

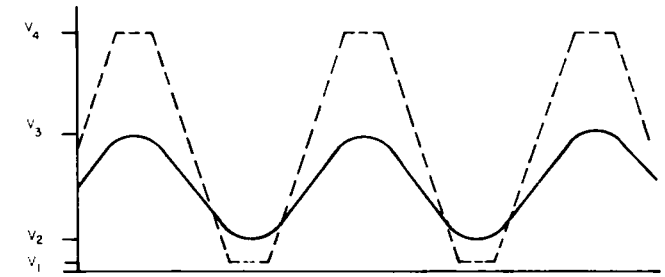


Fig. 2
Calibration Waveforms – AC Method

3.1.2 Measure the peak-to-peak output voltage of the test film as specified in 5.2.

3.1.3 Calculate the photoelectric output factor as specified in Sec. 6.

4. Measurement of Maximum Photoelectric Output

4.1 Method. Either the dc method or the ac method shall be used for measuring the maximum photoelectric output of the calibrating reproducer.

4.2 Equipment

4.2.1 For both methods, a calibrating reproducer and instrumentation arranged in accordance with Fig. 3 and aligned in accordance with the appropriate audio record format document shall be required.

4.2.2 The width of the scanning beam at the film plane shall be within 1% of the nominal value specified in the appropriate audio record format document.

4.2.3 The uniformity of illumination across the width of the scanning beam, together with the point-to-point photon efficiency of the phototransducer, shall be constant within ± 5%.

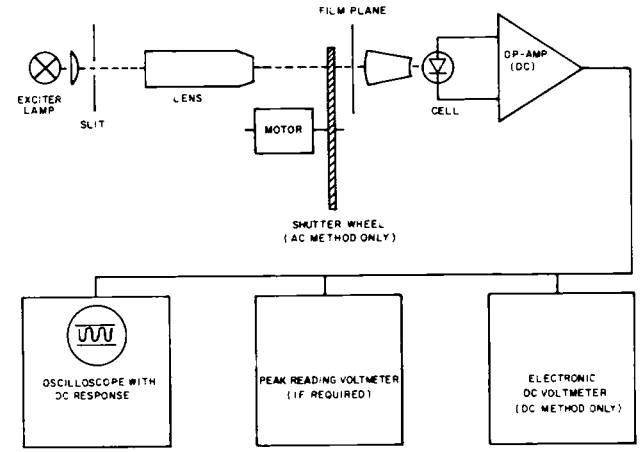


Fig. 3
Equipment Required to Establish Photoelectric Output Factor

4.3 Additional Specifications for DC Method. The combination of phototransducer and amplifier shall have a constant electrical peak output for all frequencies from the measuring frequency down to 0 Hz or dc ± 1% or 0.1 dB.

4.4 Additional Specifications for AC Method

4.4.1 The scanning beam shall be interrupted by a mechanical shutter (Fig. 4) that gives equal on-and-off durations at a nominally constant frequency, and has a nonreflecting black surface.

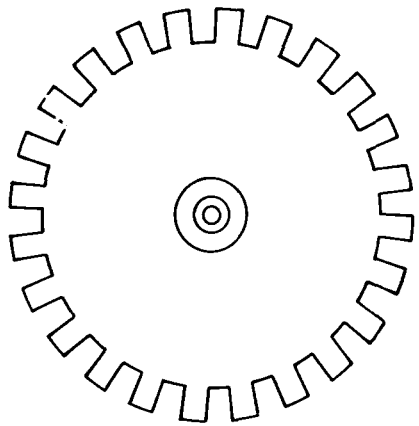


Fig. 4
Shutter Wheel

4.4.2 The frequency of interruption of the scanning beam shall match the frequency of the audio record on the audio-level test film (± 5%).

4.4.3 When the output of the test film is measured (5.2), the shutter shall be locked open (in the full-illumination position producing voltage V_4 when operating).

4.4.4 The combination of phototransducer and amplifier shall have an electrical peak output that shall not vary by more than ± 5% or 0.5 dB.

5. Method of Measurement

5.1 DC Method. With no film in the reproducer, measure the output voltage with the phototransducer directly illuminated by the scanning beam and also measure the output voltage with the scanning beam completely occluded. Compute the maximum photoelectric output (M_{PO}) by taking the difference between these two voltages.

5.2 AC Method. With no film in the reproducer and with the shutter operating, measure the peak-to-peak amplitude of the output signal voltage using the peak reading ac voltmeter. This reading is the maximum photoelectric output (M_{PO}) and is compared to the measurement of the peak-to-peak output of the test film as measured using the peak reading ac voltmeter.

6. Calculation of the Photoelectric Output Factor (P_{OF})

Compute the photoelectric output factor of the test film by dividing the peak-to-peak amplitude of the test film as measured in 5.2 by the maximum photoelectric output of the reproducer.

Appendix

(The Appendix is not a part of this American National Standard, but is included for information purposes only.)

A1. An ideal test film should have a photoelectric output factor of 1.0. This is a theoretical value that cannot be obtained in photographic audio recording because of audio track image density, fog density, base density, and track configuration limitations.

A2. Use of calculated corrections for incorrect scanning-beam width may lead to errors.

A3. A theoretically derived photoelectric output factor can be calculated for variable-area audio records using the following equation:

$$P_{OF}\text{ (theoretical)} = TxRxM$$

where T (transmission factor) is the difference in transmittance between the clear and dark areas of the audio track image, R (reduction factor) is the ratio between the maximum modulated width of a variable-area audio track and the width of the reproducer scanning beam, as defined by the appropriate standards, and M (film modulation factor) is the ratio of the modulation height of the test film to the maximum modulated width of a variable-area audio track for that format.

A4. Accuracy in measuring the photoelectric output factor of an audio level test film is not significantly affected by harmonic distortion contained within the test film, providing the total harmonic distortion as measured at the output of the reproducer is not greater than 3%.

A5. A true peak-measuring voltmeter should be used for the peak-to-peak voltage measurements. Measurements made with an average or an rms-responding voltmeter corrected to give pseudo-peak values will be in error. The meter should have an accuracy of ± 0.1 dB over the bandwidth from 31.5 Hz to 16 kHz. Alternately, a calibrated oscilloscope can be used to measure the true peak-to-peak voltage. It should have the same accuracy.

Proposed American National Standard

for motion-picture film (16-mm) – 200-mil center-position magnetic audio record

SMPTE 218M

1. Scope

This standard specifies the position, dimensions, and reproducing speed of the nominal 5.08-mm (0.200-in) center-position magnetic audio record on 16-mm motion-picture film.

2. Reference Documents

The following documents are intended to be used in conjunction with this standard:

ANSI PH22.109-1980, Dimensions for 16-mm Motion-Picture Film Perforated 1R

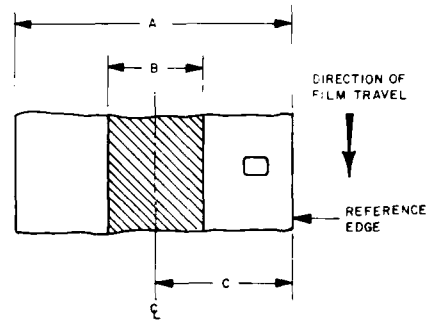
SMPTE RP 25-1984, Audio and Picture Synchronization on Motion-Picture Film Relative to the Universal Leader for Magnetic and Photographic Records

3. Audio Record

3.1 The lateral location and width of the center-position magnetic audio record shall be as specified in the figure and table.

3.2 The recording shall be made so that the azimuth of the record is at an angle of 90° ± 3′ to the reference edge of the film.

3.3 With the direction of travel as shown in the figure, the magnetic coating is on the surface toward the observer.



Dimensions	Millimeters	Inches
A	15.95 ref	0.628 ref
B	5.08 $+\,^{0.05}_{0.00}$	0.200 $+\,^{0.002}_{0.000}$
C	7.98 ± 0.05	0.314 ± 0.002

4. Reproducing Speed

The recording shall be made so that the audio record will reproduce properly at 24 perforations per second (approximately 11 m [36 ft] per minute or 183 mm [7.2 in] per second) which is 24 frames per second. An alternate reproducing speed may be 25 frames per second.

Appendix

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A1. Record Width

The width of the recorded area must be measured with great care as it enters directly into the calculation of flux per unit track width.

When the recording head gap is narrower than the width of the coating or stripe, as is normal for all motion-picture test films, there is a measurement complication involving both the uncertainties in seeing the track and in determining the recording fringing.

If the recording head is available, the track width is best measured indirectly by measuring the gap width and adding to this dimension twice the thickness of the test record magnetic coating. This correction will usually be 0.0003 to 0.0006 in (8 to 15 μm).

If the recording head is unavailable, the recorded record may be made visible by the use of a carbonyl iron suspension. Care should be taken to apply the minimum quantity that makes the recording visible, so that the developed image is not wider than the actual recorded area.

A2. Reproducing Head Gap Width

If precision measurements or calibrations are to be made on magnetic audio records made in accordance with this standard, reproducing head gaps of the same width dimension or wider than the recorded track must be used to prevent edge effects or fringing.

A3. Erase Heads

Erasing head gaps used to erase the records specified in this standard should be substantially wider than the record specified.

A4. Film Base

The film base used for the audio records conforming to this standard is usually made in accordance with ANSI PH22.109-1980.

A5. Picture-Audio Synchronization

The film is used for audio records only. Any accompanying picture is on a separate photographic film. When audio records are intended to be used in synchronization with pictorial material found on a separate film, the picture-audio relationship should be in accordance with SMPTE RP 25-1984.

A6. Magnetic Coating

The dimensions of the magnetic coating are not specified, but it is assumed to be wide enough to permit placement of the audio records in accordance with this standard.