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ANSI/SMPTE 183M-1996
Revision of
ANSI/SMPTE 183M-1985

SMPTE STANDARD

for Motion-Picture Film — Photographic Audio Level Test Films – Measurement of Photoelectric Output Factor

1 Scope

1.1 This standard specifies the method of measurement of the photoelectric output factor of single 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 (figures 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 figures 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 clause 5.

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 clause 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

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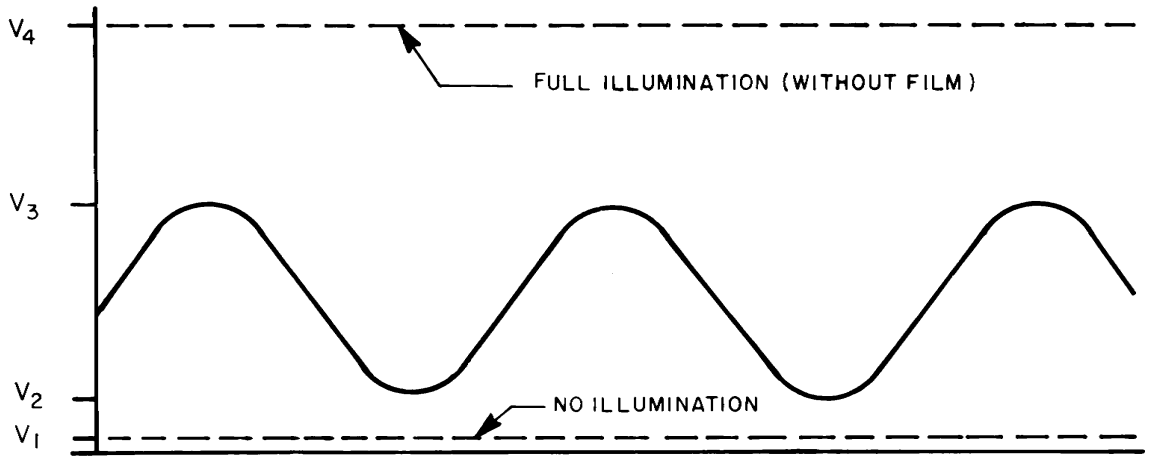

Figure 1 – Calibration waveforms — DC method

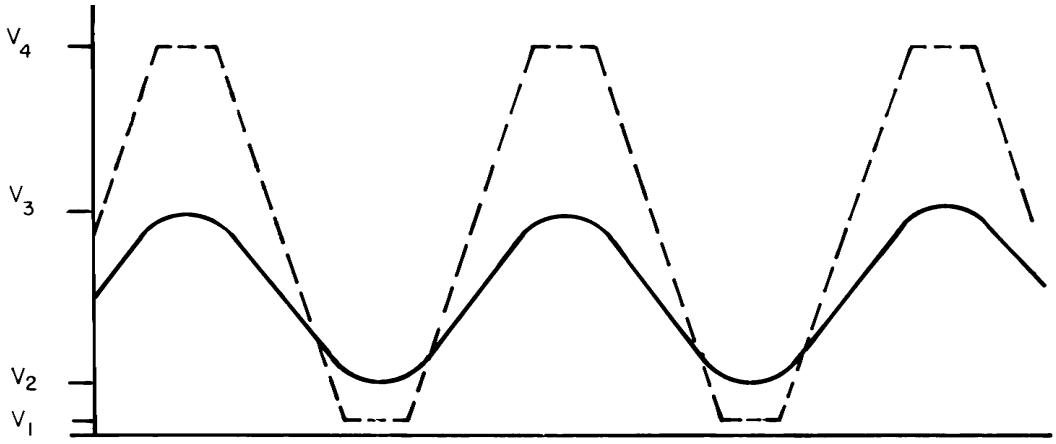

Figure 2 – Calibration waveforms — AC method

with figure 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 photo-transducer, shall be constant within ± 5%.

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 (figure 4) that gives equal on-and-off durations at a nominally constant frequency, and has a nonreflecting black surface.

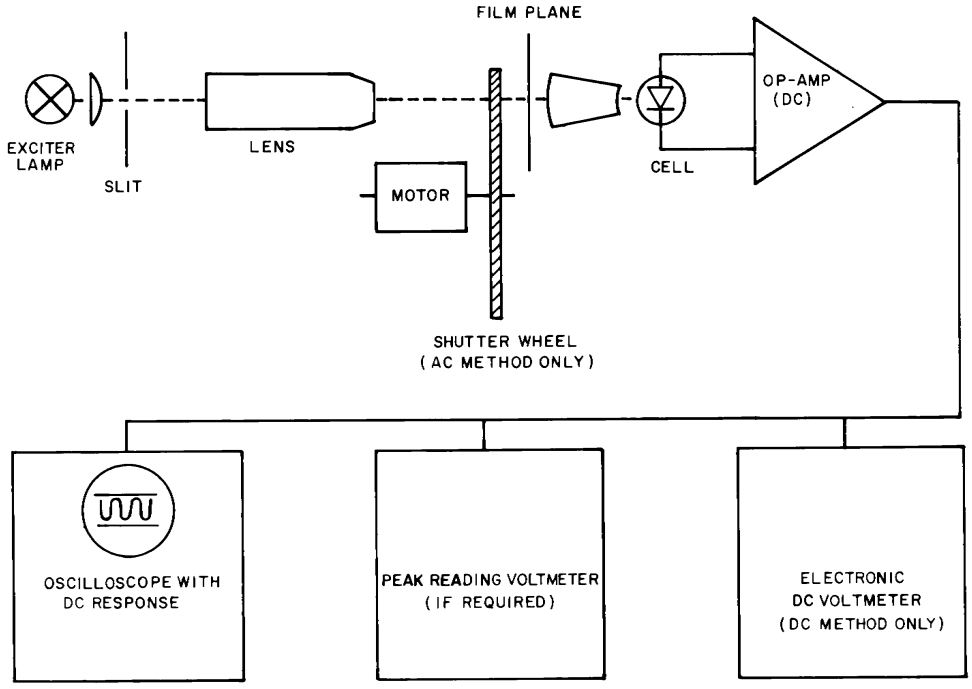

Figure 3 – Equipment required to establish photoelectric output factor

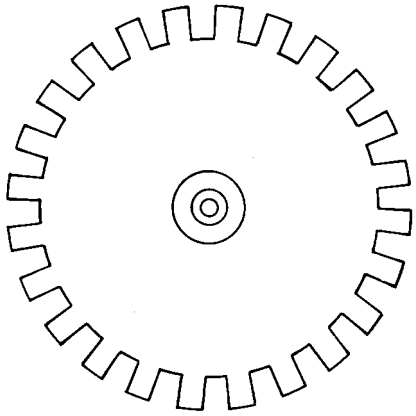

Figure 4 – Shutter wheel

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.

Annex A (informative)
Additional data

A.1 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.

A.2 Use of calculated corrections for incorrect scanning-beam width may lead to errors.

A.3 A theoretically derived photoelectric output factor can be calculated for variable-area audio records using the following equation:

$$P_{OF}\ (\text{theoretical}) = T \times R \times M$$

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.

A.4 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%.

A.5 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 $\pm$ 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.