SMPTE RECOMMENDED PRACTICE

RP 143-2004
Revision of RP 143-1999

Specifications for Type U Audio Level and Multifrequency Test Film for 35-mm Striped Four-Track Release Print Audio Reproducers, Magnetic Type

1 Scope

1.1 This practice specifies a type U audio frequency test film to be used for adjusting the mechanical and electrical parameters of 35-mm motion-picture magnetic audio reproducers intended for striped release prints perforated CS, operating at 24 frames (96 perforations) per second (approximately 90 ft [27 m] per minute [18 in or 457 mm per second]) for proper playback.

1.2 The International Organization for Standardization recognizes two reference levels for test films: Type U with a reference level of 185 nWb/m and type E with a reference level of 320 nWb/m, in order to account for differing meter types in common use in the United States and Europe.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this practice. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ANSI S4.3-1982 (R1992), Method for Measurement of Weighted Peak Flutter of Sound Recording and Reproducing Equipment

ANSI S4.6-1984 (R1992), Method of Measuring Recorded Flux of Magnetic Sound Records at Medium Wavelengths

ANSI/IEEE 152-1992, Audio Program Level Measurement Approved November 5, 1999

ANSI/SMPTE 177-1995, Motion-Picture Film (35-mm) — Four-Track Magnetic Audio Release Prints — Magnetic Striping

SMPTE 102-2002, Motion-Picture Film (35-mm) — Perforated CS-1870

SMPTE 137-2000, Motion-Picture Film (35-mm) — Release Prints — Four Magnetic Audio Records

3 Manufacturing

3.1 Film stock

Test films made to this practice shall be cut and perforated in accordance with SMPTE 102.

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3.2 Magnetic coating

3.2.1 Full-coat film

For full-coat film, the coating shall extend from edge to edge of the film. The coating shall be on the same side as the striping specified in 3.2.2.

3.2.2 Stripe-coat film

For stripe-coat film, the striping shall be in accordance with ANSI/SMPTE 177.

3.2.3 Magnetic particle orientation

The film may show a preferred direction for recording due to orientation of the magnetic particles within the coating during manufacture. The preferred direction is the direction which shows the greatest high-frequency sensitivity. If there is such a preferred direction, it shall be marked by means of an arrow faced in the preferred direction on the head and tail of the film.

3.3 Primary characteristics of test film records

3.3.1 Audio record

3.3.1.1 Full-coat film

If the audio record is recorded on full-coat film, the recording shall extend from one edge of the film to the other.

3.3.1.2 Striped-coat film

If the audio record is recorded on striped-coat film, it shall be recorded with individual head elements in accordance with SMPTE 137. The polarity of each head element shall be identical with all the other elements, and the gaps shall be in line.

3.3.2 Azimuth

The azimuth of the audio records shall be 90° ± 1' to the reference edge of the film. The reference edge is defined in ANSI/SMPTE 177.

3.3.3 Frequency response of the recorded flux

With a constant amplitude vs frequency sine-wave signal applied to the input of the recording system, the relative characteristic of the recorded flux vs frequency decreases with increasing frequency corresponding to a combination of two curves: one falling with increasing frequency in conformity with the impedance of a series combination of a capacitance and a resistance having a time constant τ_1; and one falling with increasing frequency in conformity with the impedance of parallel combination of a capacitance and a resistance having a time constant τ_2 (see annex A.4).

This characteristic is given by the following equation:

$$L_\phi = C_0 - 10 \log_{10} \left[\frac{1 + (2\pi\tau_2)^2 f^2}{1 + \frac{1}{(2\pi\tau_1)^2 f^2}} \right]$$

where L_ϕ is the flux level in dB, f is the frequency in hertz for which L_ϕ is computed, τ_1 is a time constant of 3180 μs, τ_2 is a time constant of 35 μs, and C_0 is a constant with a value of 0.19424 calculated to make $L_\phi = 0$ at the reference frequency of 1000 Hz. The approximate numerical values are given in table 1 (see annex A.6).

Table 1 – Frequency response

Frequency	Level in dB
31.5 Hz	+ 5.66
40 Hz	+ 4.29
63 Hz	+ 2.32
125 Hz	+ 0.84
250 Hz	+ 0.35
500 Hz	+ 0.19
1 kHz	0
2 kHz	– 0.57
4 kHz	– 2.29
6.3 kHz	– 4.46
8 kHz	– 5.93
10 kHz	– 7.47
12.5 kHz	– 9.13
14 kHz	–10.01
16 kHz	–11.07

3.3.4 Signal identification

Each test section and segment shall be preceded by a voice announcement identifying the content at a level whose peak value does not exceed the peak value of the frequency series.

3.4 Test sections

3.4.1 Reference level

A 1000 Hz ± 2% sine-wave tone shall be recorded at a flux level of 185 nWb/m ± 11 nWb/m (± 0.5 dB) for a duration of approximately 30 seconds.

3.4.2 Azimuth

A 12.5 kHz ± 2% sine-wave tone shall be recorded at a relative flux level equal to the reference level with the frequency response specified in 3.3.3 applied for a duration of approximately 30 seconds.

3.4.3 Pink noise

Pink noise shall be recorded for a duration of approximately 30 seconds. The pink noise test signal shall be recorded at such a level that there is a low statistical probability of peaks exceeding the peak-to-peak amplitude of the reference level. This condition can be verified by observing the pink noise signal on an oscilloscope connected to a playback preamplifier when compared with the peak-to-peak signal indicated by the reference level. The pink noise shall be recorded with the frequency response specified in 3.3.3.

3.4.4 Frequency response

The 1000-Hz sine-wave tones for this section shall be recorded at the reference level (185 nWb/m ± 11 nWb/m absolute). The other sine-wave tones shall be recorded according to the frequency response specified

in 3.3.3 at the flux levels in table 1 with a tolerance on level according to 4.3. The following test-segment tones shall be recorded for a duration of approximately 10 seconds at the given frequencies ± 2%:

1000, 31.5, 40, 63, 125, 500, 1000, 2000, 4000, 6300, 8000, 10 000, 12 500, 14 000, 16 000, 1000

4 Calibration and quality control

4.1 Flux level

The reference level shall be determined by means of the calibrated short-gap ferromagnetic core reproducer technique described in ANSI S4.6.

4.2 Method

The test film shall be calibrated for frequency response using a reproducing head with gap widths made in accordance with SMPTE 137.

4.3 Flux level variation with frequency

The film flux level at each frequency from 31.5 Hz through 12.5 kHz shall be within ± 0.5 dB of the value specified in 3.3.3 when measured with an instrument specified in 4.8. (Flux level variation is defined for the purposes of this clause as the average reading within each tone segment since variation with time is specified in 4.4.)

4.4 Flux level variation with time

The flux levels shall not vary more than ± 0.5 dB within the length of each test segment when measured with a standard volume indicator conforming to ANSI/IEEE 152.

4.5 Pink noise

The level in each one-third octave band from 31.5 Hz to 12.5 kHz shall be the same within the limits given in 4.3.

4.6 Distortion

The total harmonic distortion of the recorded reference level tone (3.4.1) and the frequency response tones (3.4.4) shall not exceed 0.5%.

4.7 Flutter

The weighted peak flutter of the audio record shall not exceed ± 0.1%. Verification of this section shall be made with the film stock to be used for making these test films, and measured in accordance with ANSI S4.3.

4.8 Level measurements

Level measurements shall be made with an average-responding, rms-calibrated or a true-rms ac voltmeter having a frequency response of ± 0.1 dB over a minimum frequency range of 31.5 Hz to 16 kHz.

Annex A (informative)
Additional data

A.1 Test films specified by this practice could be made in many variations: triacetate or polyester base, full- or stripe-coating, and combinations thereof. Use of test material with substantial physical differences from other material to be run can lead to high-frequency errors.

A.2 The difference in compliance between triacetate and polyester bases will establish different head wear patterns as film is run. A change from one base to the other may cause a temporary loss of high-frequency response until a new wear pattern is established. Therefore, it is recommended that users employ test films having the same film base as that used for the release prints to be run.

A.3 SMPTE RP 45 specifies precautions on this subject. Methods of using this film are found in SMPTE EG 13.

A.4 The use of an electrical circuit analogy is provided as a useful means of notation only. Each specified RC circuit should be considered separately, without interaction, and the numerical effect added.

A.5 Note that release prints are not supplied wound according to the convention in SMPTE EG 12, so the test film is pulled from the supply reel of a conventional projector clockwise, rather than the more common release-print convention of counter-clockwise winding.

A.6 This practice calls for 3180 μs low-frequency equalization. Equalization with no low-frequency record boost (a time constant of infinity) has been shown to better use the overload characteristic vs. frequency of the magnetic medium when recording typical program material. However, there is some theater equipment in the field which reproduces a flat response only when low-frequency record boost has been applied to recorded material. The use of the 3180 μs time constant is seen as a transitional compromise between the best practice that can be obtained currently and the desired future practice with an infinity time constant. In addition, some older prints may exist which were recorded to a 1590 μs time constant which must, on occasion, be accommodated.

Annex B (informative)
Bibliography

SMPTE RP 45-1972 (R1987), Use and Care of Sound Test Films

SMPTE EG 12-1994 (R1999), Control of Basic Parameters in the Manufacture of SMPTE Photographic and Magnetic Audio Test Films

SMPTE EG 13-1986 (R2002), Use of Audio Magnetic Test Films