Annex C (informative)
Bibliography

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PROPOSED SMPTE RECOMMENDED PRACTICE

RP 200

Relative and Absolute Sound Pressure Levels for Motion-Picture Multichannel Sound Systems

1 Scope

This practice specifies the measurement methods and wide-band sound pressure levels for review rooms and indoor theaters. Together with SMPTE 202M, it is intended to assist in the standardization of the reproduction of motion-picture sound in such rooms.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this practice. At the time of publication, the edition indicated was 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 standard indicated below.

SMPTE 202M-1998, Motion-Pictures — Dubbing Theaters, Review Rooms, and Indoor Theaters — B-Chain Electroacoustic Response

3 Definitions

3.1 absolute sound pressure level: The sound pressure level of a single channel of a theatrical sound system in which the relative sound pressure levels have been calibrated correctly.

3.2 B-chain (final chain): That part of a motion-picture sound reproduction system, as shown in figure 1, commencing at the input terminals of the main fader and terminating in the listening area defined in figure 2 at which sound pressure measurements are taken.

3.3 electroacoustic response: The electroacoustic response of the B-chain is the spatially averaged frequency response measured in 1/3 octave bands expressed in decibels, as described in SMPTE 202M.

3.4 pink noise: A stochastic signal having a continuous spectrum with equal energy per equal logarithmic interval of frequency, and with a gaussian probability distribution of instantaneous amplitude.

3.5 reference level: The wide-band sound pressure level measured with an rms meter and a bandpass of 22 Hz to 22 kHz, when the test signal has a level equivalent to 60% modulation on an analog photographic sound track, or the equivalent level on a digital photographic sound track (typically 18 dB below 100% modulation), and the fader is at its normal setting (see annexes A.5 and A.6).

3.6 relative sound pressure level: In this context, the sound pressure level of one channel when compared with another during reproduction of the wide-band test signal of 3.7, as opposed to the sound pressure level in one frequency range when compared with another.

3.7 wide-band pink noise: Pink noise having a bandwidth exceeding the normal acoustic frequency range. A suitable test signal should have a frequency response flat to within ± 0.5 dB when measured in 1/3-octave bands with center frequencies from 25 Hz to 20 kHz with an integrating averaging technique.

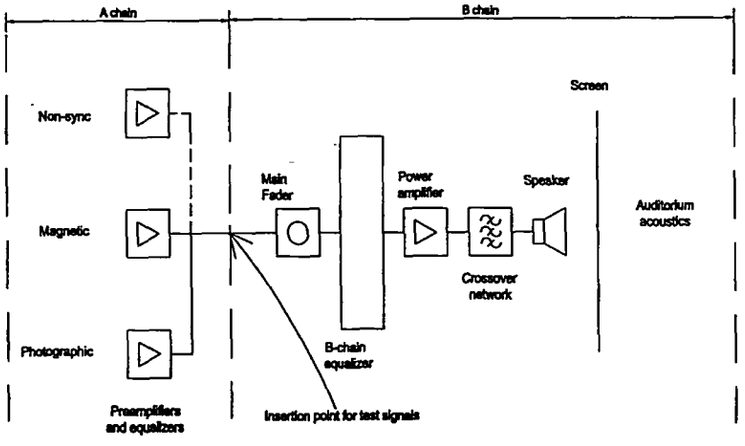


Figure 1 – Complete theatrical sound reproduction system

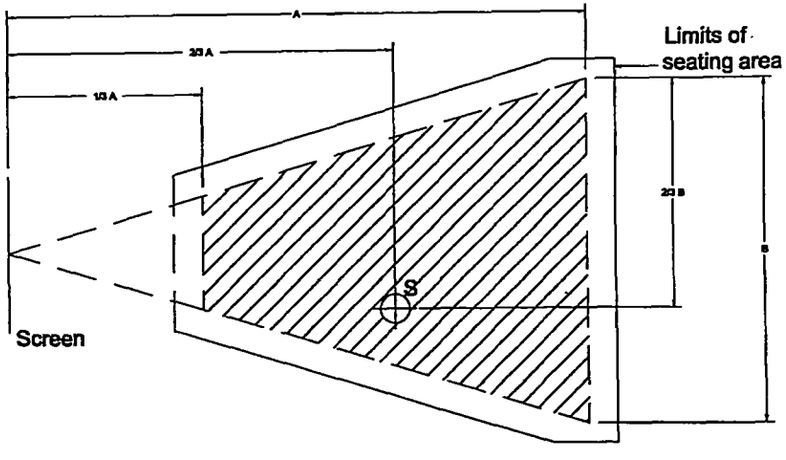


Figure 2 – Theater auditorium

4 Method of measurement

4.1 Electroacoustic response

The electroacoustic response shall be measured and confirmed to conform to SMPTE 202M before measurement of relative and absolute sound pressure levels.

4.2 Measuring equipment

The sound pressure level of screen and surround channels shall be measured using a sound level meter set to C-weighting and slow reading. The sound pressure level of the subwoofer channel shall be made using a third-octave real-time analyzer.

4.3 Test signal

The test signal shall be wide-band pink noise, measured one channel at a time. The pink noise shall be inserted into the system prior to the main fader, or at an equivalent point.

4.4 Sound pressure level

The sound pressure level should be measured in at least one position for screen and surround channels and averaged. All measurement locations should be within the normal seating area as shown in the hatched area in figure 2, and should nominally include the center of the seating area. If a single location only is selected, it shall be the equivalent to position S as shown in figure 2. If the room volume is small, and the microphone is clearly in the direct field of the surround loudspeakers, then the single location should be closer to the centerline of the theater. The subwoofer sound pressure level should be measured in at least four positions and averaged over time intervals of not less than 30 seconds.

4.5 Screen channels

The screen channels, when measured with the wide-band noise test signal of 3.7, should display an equal sound pressure level within ± 0.5 dB.

4.6 Surround channel(s)

If there are two independent surround channels, left and right, then each should display a sound pressure level 3 dB below reference level. If there is one single surround channel, then the sound pressure level should equal that of the reference level.

4.7 Subwoofer channel, playback of discrete digital photographic sound track

The subwoofer channel, when compared with a wide-band screen channel, should show 10 dB of in-band gain when viewed on a real-time analyzer (see figure 3 and annex A.1).

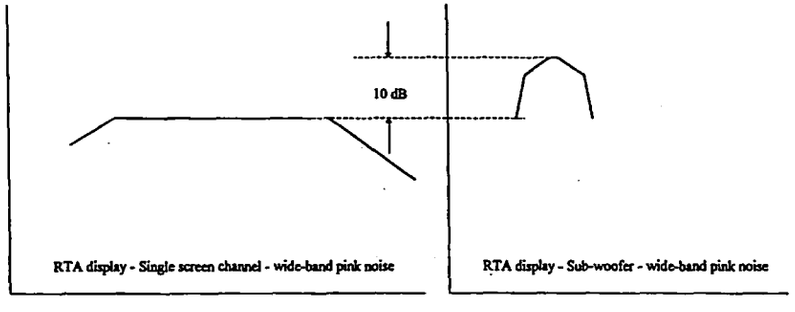


Figure 3 – Measurement of subwoofer sound-pressure level, digital sound track, using real-time analyzer

4.8 Subwoofer channel, playback of matrix-encoded analog photographic sound track

The subwoofer channel, when compared with a wide-band screen channel, should show the same level; i.e., should show no in-band gain when viewed on a real-time analyzer (see figure 4 and annex A.2). If the test signal is applied to both the center screen channel and the subwoofer channel simultaneously, the analyzer should show 3 dB of in-band gain.

5 Reference level

The recommended reference level, as defined in 3.5 and measured as specified in this practice should be 85 dBC for normal theatrical operation (see annex A.6).

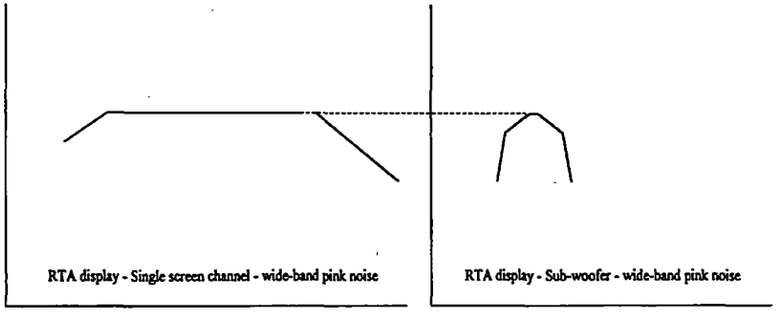


Figure 4 – Measurement of subwoofer sound-pressure level, analog photographic sound track using real-time analyzer

Annex A (informative) General information

A.1 Subwoofers and sound-level meters

Although a sound-level meter is suitable for measuring sound pressure levels of screen and surround channels, its use for measurement of subwoofer levels can lead to significant errors. The first reason for this is the differing low-pass cut-off of different subwoofers. For example, if pink noise and a sound-level meter were used to set equal levels between one speaker extending to 120 Hz and another extending to 250 Hz, the actual levels would then be significantly different, as shown in figure A.1.

A second reason to avoid use of sound-level meters for subwoofer measurement is the inaccuracy at low frequencies associated with all but the very expensive pieces of equipment, and deviation in some cases from true C-weighting.

A.2 In-band gain

Using a real-time analyzer is the only accurate method of measuring band-limited signal levels. In-band gain is the relative level within the bandpass of interest.

A.3 Bass extension

With analog photographic sound tracks, unwanted noise can occur at very low frequencies, below approximately 50 Hz. Two main causes of this noise are ground noise reduction timing errors and low frequency streaking noise caused by bad print washing. For this reason, some analog processors strip out low-frequency information, and process it to remove low-level unwanted components. This processed output is then sent to a dedicated subwoofer. This technique is known as bass extension. The method of measurement of a bass extension subwoofer signal does not differ from that of a linear crossover device, as described in 4.8.

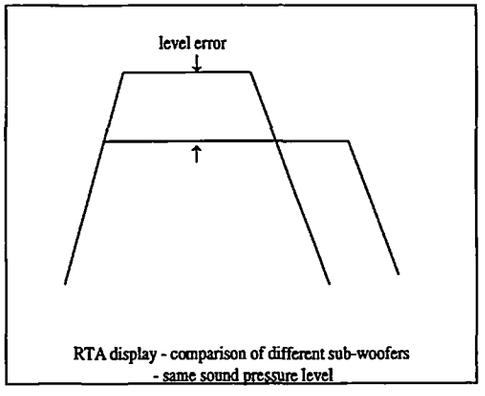


Figure A.1 – Ambiguity caused by setting sound-pressure levels of subwoofers with sound-level meters

A.4 Subwoofer polarity

It is frequently very difficult to determine the best polarity of a subwoofer by conventional methods of checking the speaker cone polarity. The effective phase may change with frequency, especially with a discrete digital subwoofer channel where filter slopes may cause changing phase with frequency. For this reason, it is recommended that subwoofer polarity is evaluated with pink noise sent to center and subwoofer channels simultaneously. The best result should be selected of the two polarities by looking at the resultant combination signal measured with a real-time analyzer. In some cases, there may be no apparent signal level change regardless of selected polarity of subwoofer with respect to center front with discrete signals, and in this case, optimum polarity should be selected from evaluation of a composite signal through the analog photographic B-chain.

A.5 Fader setting

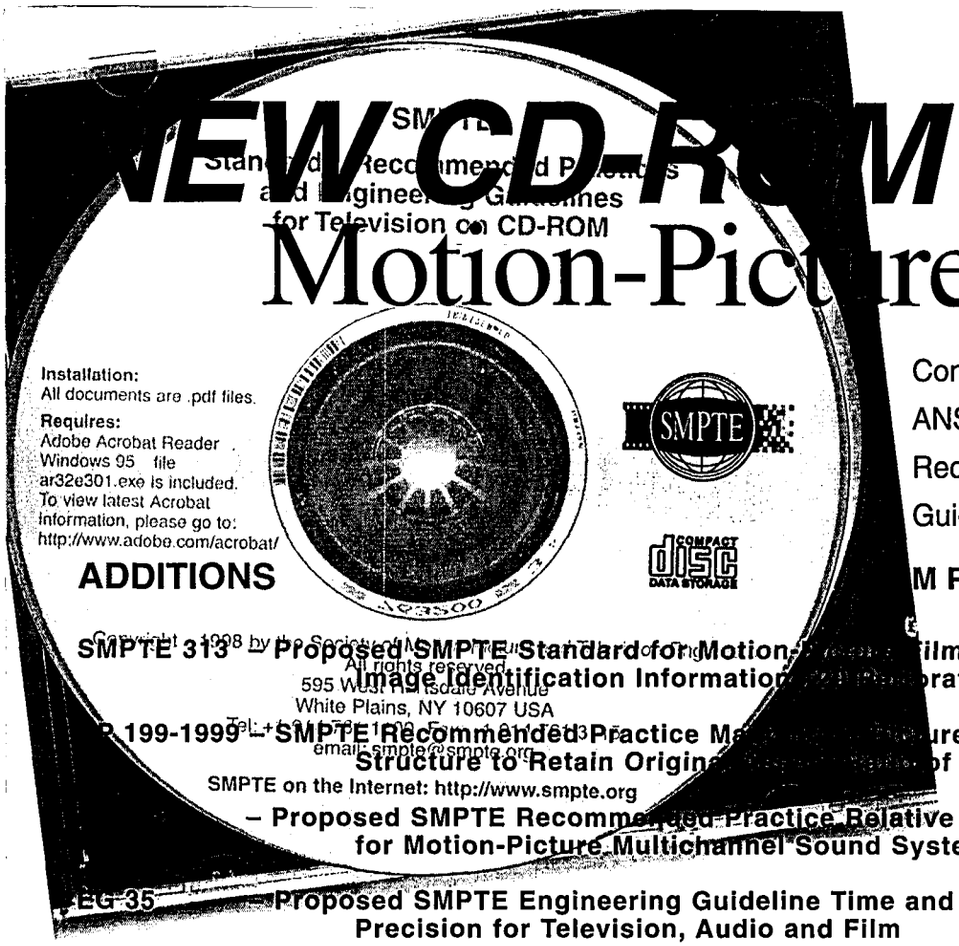
The vast majority of theater B-chains have a calibrated fader, which allows the operator to return to a known mark. In many cases, there is a scale ranging from 0 to 10, and fader point 7 is the calibrated setting. This 70% of full-scale allows for a fade to silence, and has some gain in hand for the playback of unusual modulation level program. In some theater equipment, fader setting 0 is the calibrated setting, with permissible variations to both plus and minus. For all normal film program, the playback level should be at the calibration point, which in turn should result in the reference level as described in clause 5.

A.6 Alternative test signal levels

If the test signal has a level different from that described in 3.5, then the reference level stated in clause 5 should be adjusted accordingly. For example, a reference equivalent to 50% on an analog photographic track is 1.6 dB below the 60% signal described in 3.5. The reference in clause 5 would then be reduced to 85.0 dB – 1.6 dB; i.e., 83.4 dB.

Annex B (informative) Bibliography

ANSI S1.13-1995, Measurement of Sound Pressure Levels in Air



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