INTERNATIONAL STANDARD

ISO 22234

First edition
2005-11-15

Cinematography — Relative and absolute sound pressure levels for motion-picture multi-channel sound systems — Measurement methods and levels applicable to analog photographic film audio, digital photographic film audio and D-cinema audio

Cinématographie — Niveaux de pression sonore relatifs et absolus pour les systèmes de films cinématographiques sonores multicanaux — Méthodes de mesure et niveaux applicables aux films sonores photographiques analogiques, aux films sonores photographiques numériques et à l'audio de D-cinéma

Reference number
ISO 22234:2005(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 22234 was prepared by Technical Committee ISO/TC 36, *Cinematography*.

Cinematography — Relative and absolute sound pressure levels for motion-picture multi-channel sound systems — Measurement methods and levels applicable to analog photographic film audio, digital photographic film audio and D-cinema audio

1 Scope

This International Standard specifies the measurement methods and wide-band sound pressure levels for motion-picture control rooms, review rooms, and indoor theatres. Together with ISO 2969, it is intended to assist in standardization of reproduction of motion-picture sound in such rooms.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2969:1987, *Cinematography — B-chain electro-acoustic response of motion-picture control rooms and indoor theatres — Specifications and measurements*

IEC 60268-17:1990, *Sound system equipment — Part 17: Standard volume indicators*

IEC 61672-1:2002, *Electroacoustics — Sound level meters — Part 1: Specifications*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
absolute sound pressure
spatially averaged sound pressure level of a single channel of a theatrical sound system measured with broadband pink noise at the reference electrical level as a stimulus

NOTE The 0 dB (reference) level for sound pressure is 20 μN/m^2.

3.2
average responding meter
meter which provides a voltage indication proportional to the average value of the rectified signal, with ballistics as described in IEC 60268-17

3.3
bass extension
technique of taking low-frequency information from a film sound-track, processing it, and sending it to a sub-woofer, as opposed to an LFE channel

NOTE See A.3.

3.4
B-chain
final chain
that part of a motion-picture sound reproduction system, as shown in Figure 1 for a typical film system, commencing at the input terminals of the main fader and terminating in the listening area defined in Figure 2 in which sound pressure level measurements are taken

NOTE See A.7.

3.5
electroacoustic response
⟨B-chain⟩ spatially averaged frequency response measured in one-third octave bands as described in ISO 2969

NOTE The electroacoustic response is expressed in decibels.

3.6
LFE channel
discrete low-frequency effects channel, normally having an upper bandwidth between 80 Hz and 125 Hz

3.7
pink noise
stochastic signal having a continuous spectrum with equal energy per equal logarithmic interval of frequency, and with a Gaussian probability distribution of instantaneous amplitude

3.8
reference electrical level
voltage measured by an average responding voltmeter of wide-band pink noise using a measurement band pass filter of 22 Hz to 22 kHz bandwidth when the test signal is at reference recorded level, and when the fader is at its normal setting

NOTE See A.5 and A.7.

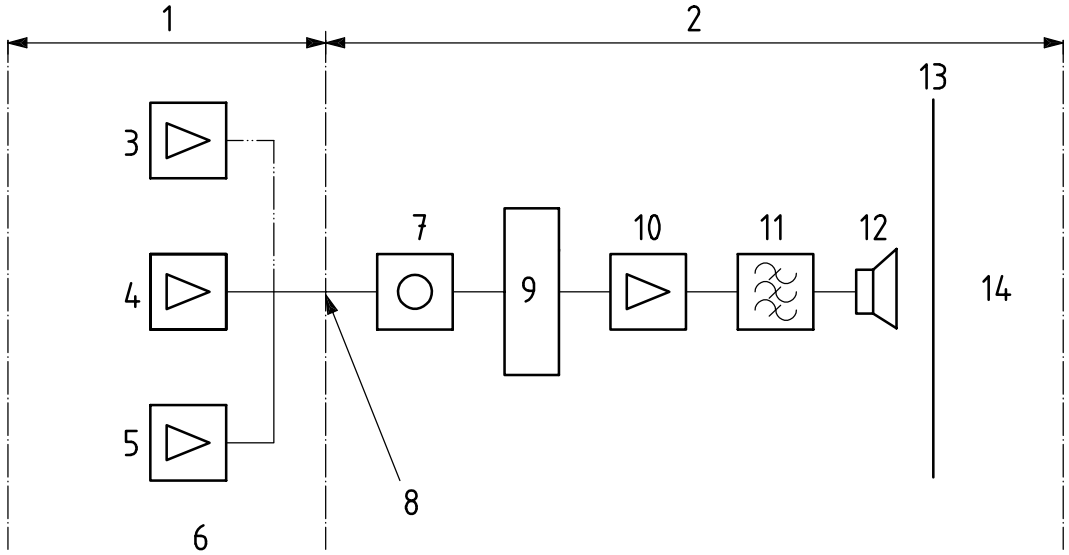
3.9
reference recorded level
level of pink noise equivalent to 50 % modulation on an analog photographic sound-track, or the equivalent level on a digital photographic sound-track or a digital cinema (D-cinema) sound-track (typically in each case 20 dB below 100 % modulation)

3.10
relative sound pressure level
sound pressure level of one channel when compared with another during reproduction of the wide-band test signal of 3.1, as opposed to the sound pressure level in one frequency range when compared with another

3.11
wide-band pink noise
pink noise having a bandwidth exceeding the normal acoustic frequency range

NOTE A suitable test signal should have a frequency response flat to within 0,5 dB when measured in one-third octave bands with centre frequencies from 25 Hz to 20 kHz with an integrating averaging technique.

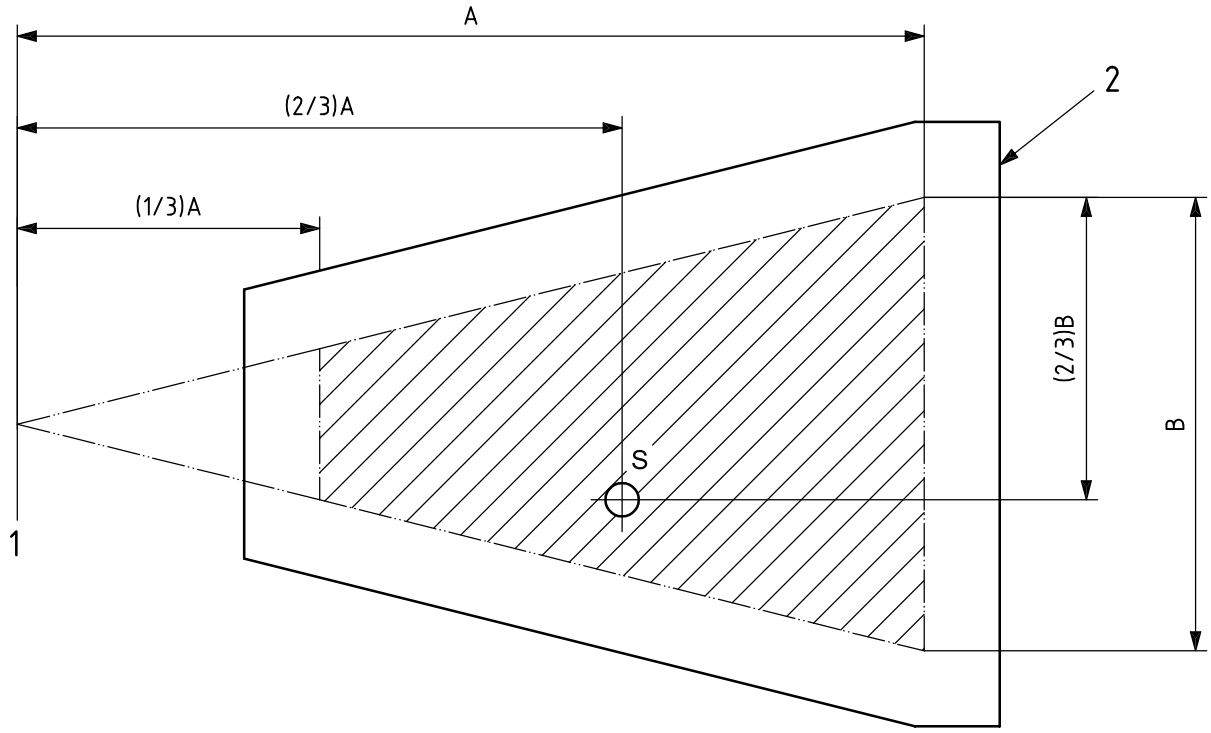
3.12
wide-band sound level meter
meter which conforms to IEC 61672-1



Key

1 A-chain
2 B-chain
3 non-sync
4 magnetic
5 photographic
6 preamplifiers and equalizers
7 main fader
8 insertion point for test signals
9 B-chain equalizer
10 power amplifier
11 crossover network
12 loudspeakers
13 screen
14 auditorium acoustics

Figure 1 — Complete film-based theatrical sound reproduction system



Key

1 screen
2 limits of seating area

Figure 2 — Plan view, theatre auditorium

4 Test methods

4.1 Electroacoustic response

The electroacoustic response of each channel should be measured and confirmed to comply with ISO 2969 before measurement of relative and absolute sound pressure levels.

4.2 Measuring equipment

The sound pressure level of screen and surround channels should be made using a wide-band sound level meter set to C-weighting and slow response. The sound pressure level of the sub-woofer channel should be made using a one-third octave real-time analyser, or a sound level meter with a one-third octave filter set.

4.3 Test signal

The test signal should be wide-band pink noise, fed into the sound system one channel at a time. The pink noise should be inserted into the system prior to the main fader, or at an equivalent point. The fader should be set to its normal setting (see A.5 and A.7).

4.4 Sound pressure level

The sound pressure level should be measured in at least one position for each screen and surround channel and the measurements for each channel then spatially averaged. If a single location only is selected, it should be position S as shown in Figure 2. All measurement locations should be within the normal seating area as shown in the hatched area in Figure 2. The sub-woofer sound pressure level should be measured in at least four positions and averaged over time intervals of no less than 30 s.

4.5 Screen channels

The relative sound pressure level of each screen channel should be within 0,5 dB of the absolute sound pressure level.

4.6 Surround channel(s)

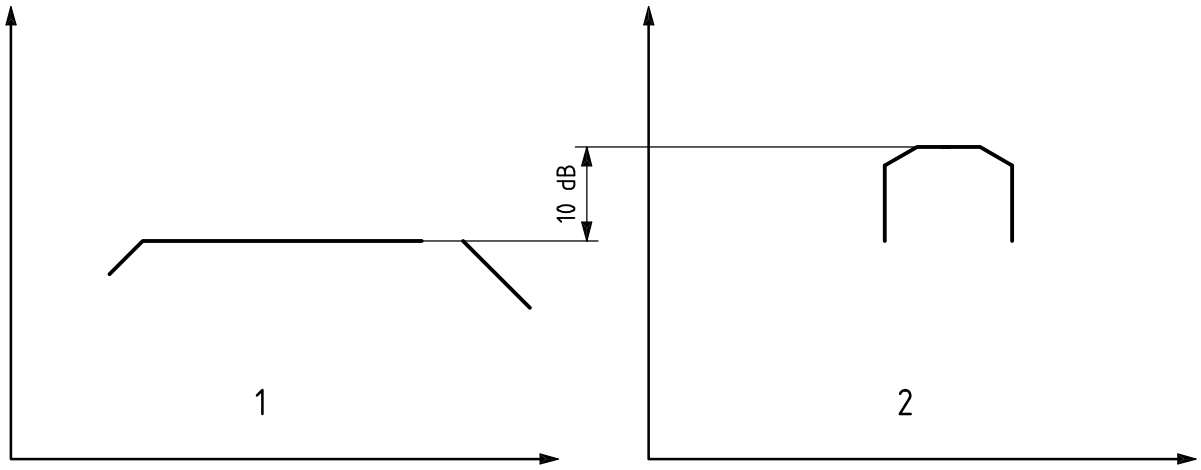
If there is one single surround channel, then the sound pressure level when playing the test signal should equal that of the absolute sound pressure level. If there are two independent surround channels, left and right, then each should display a sound pressure level such that when they are simultaneously fed the same in-phase test signal the sum should equal the absolute sound pressure level. For two surround channel systems, the individual sound pressure level for each channel will usually be 3 dB below the absolute sound pressure level. (See A.8.) This procedure will ensure compatibility for theatres with fewer surround playback channels where the surround information is combined. With three or more surround channels, the individual channel reproduction levels should be set up to be equal to one channel of a two surround channel system.

4.7 Sub-woofer LFE channel, playback of discrete digital photographic sound-track or D-cinema sound-track

The sub-woofer channel, when compared with a wide-band screen channel, should show 10 dB of “in-band” gain when viewed on a real-time analyser, i.e. a level in its pass band 10 dB higher than the level in the pass band of the screen channel. See Figures 3 and A.1.

4.8 Sub-woofer channel, for playback of matrix-encoded analog photographic sound-track with bass extension playback processing

The bass extension sub-woofer 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 analyser. See Figures 4, A.2 and A.3. If the test signal is applied to both the centre screen channel and the sub-woofer channel simultaneously, the analyser should show 3 dB of “in-band” gain in the frequency area common to both transducers.

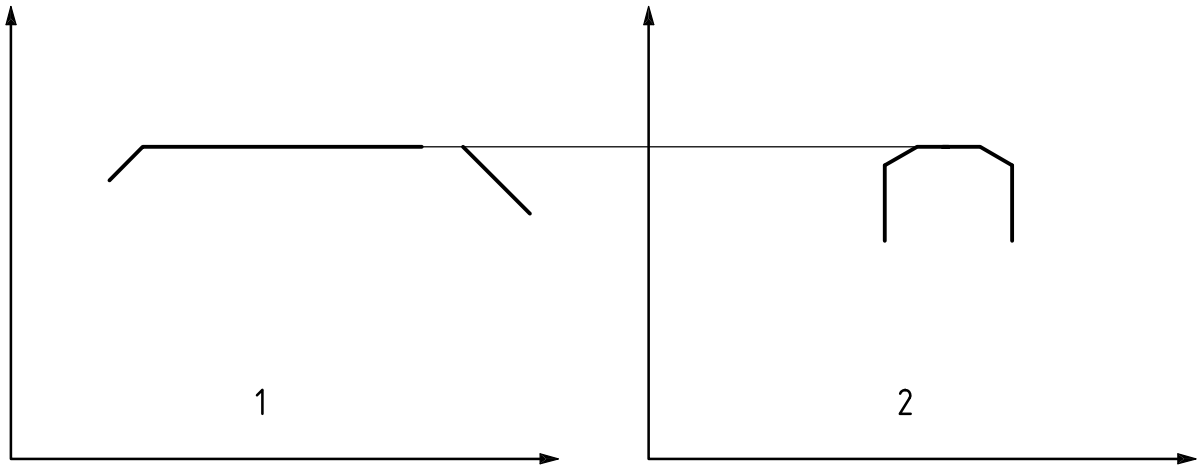


Key

1 RTA display, single screen channel, wide-band pink noise

2 RTA display, sub-woofer, wide-band pink noise

Figure 3 — Measurement of subwoofer sound-pressure level, digital LFE sound track, using real-time analyser



Key

1 RTA display, single screen channel, wide-band pink noise

2 RTA display, sub-woofer, wide-band pink noise

Figure 4 — Measurement of subwoofer sound-pressure level, analog photographic sound track with bass extension playback processing, using real-time analyser

5 Reference level

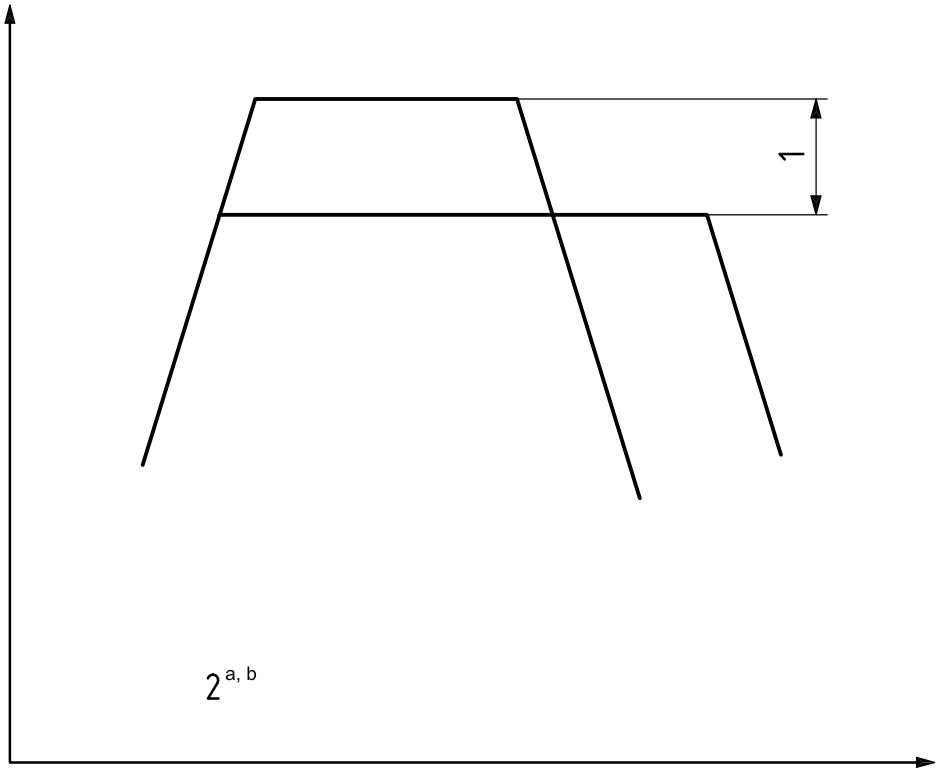
The reference level defined as in 3.1 and measured as specified in this International Standard should be 85 dB (C-weighted), for normal theatrical operation.

Annex A
(informative)

General information

A.1 Subwoofers and sound-level meters

While a wide-band sound level meter is suitable for measuring sound pressure levels of screen and surround channels, it is not suitable for measurement of sub-woofer levels. The first reason for this is the differing low-pass cut-off of different sub-woofers. For example, if pink noise and a sound level meter were used to set equal levels between one loudspeaker extending to 125 Hz and another extending to 250 Hz, the sound pressure levels in the pass band of each loudspeaker would be significantly different, as shown in Figure A.1.



Key

1 level error

2 RTA display

a Comparison of different sub-woofers.

b Same sound pressure level.

Figure A.1 — Setting sound pressure levels of sub-woofers with sound level meters can create level ambiguity

A second reason to avoid use of wide-band sound level meters for sub-woofer measurement is the loose tolerance at low frequencies associated with the inexpensive meters typically used.

A sound level meter incorporating a one-third-octave filter set may provide acceptable results.

A.2 In-band gain

Using a real-time analyser is the only accurate method of measuring band-limited signal levels. In-band gain is the relative level within the band pass of interest, as seen on a real-time analyser display.

A.3 Bass extension

With analog photographic sound-tracks, unwanted noises can occur at very low frequencies, below approximately 50 Hz. Two main causes of these noises are ground noise reduction timing errors causing "thumping", 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 sub-woofer. This technique is known as bass extension.

A.4 Subwoofer polarity

It is frequently very difficult to determine the best polarity of a sub-woofer by conventional methods of checking the speaker cone polarity. The effective phase may change with frequency, especially with a discrete digital sub-woofer channel where filter slopes may cause changing phase with frequency. For this reason, it is recommended that sub-woofer polarity be evaluated with pink noise sent to centre and sub-woofer channels simultaneously. The best result should be selected of the two polarities by looking at the resultant combination signal measured with a real-time analyser. In some cases, there may be no apparent signal level change regardless of selected polarity of sub-woofer with respect to centre 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 theatre 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 theatre equipment, fader setting "0" is the calibrated setting, with permissible variations to both "+" and "–". For all normal film program, the playback level should be at the calibration point, which in turn should result in the reference level as defined in Clause 5.

A.6 Historical note

Previous versions of this practice were technically correct in describing the test signal level as being equivalent to 60 % modulation on an analog photographic sound-track, and 18 dB below 100 % modulation on a digital sound-track, when measured with a true rms meter. However, field experience shows that practically all users employ average responding meters for measuring level of noise in day-to-day work, including VU meters as specified in IEC 60268-17. This recommended practice recognizes the widely used conventional practice rather than the more technically accurate use of rms derived metering, due to the ready availability of VU and other average meters. These changes represent an effective level difference of approximately 0,6 dB; motion-picture theatres set up according to older versions of this practice will play 0,6 dB quieter than theatres set up according to procedures described in this document.

A.7 Noise insertion point

While Figure 1 shows a typical film system playback layout, in some cases the fader will follow the B-chain equalizer. With a D-cinema playback, the pink noise should be inserted at an equivalent position prior to the B-chain equalizer, and any non-linear signal processing or decryption after the noise insertion point should be disabled. The fader should always be set at its normal setting (see A.5).

A.8 Sum of multiple surround arrays

Theoretically, two surround channels carrying the same in-phase signal each at 3 dB below reference level, will generate a sum equal to the reference level. In rare cases, however, the required individual levels might be only 2 dB or even 1 dB below reference, or occasionally 4 dB below reference, depending on the number of speakers in each array, the geometry and spacing of the array, and the reverberation time of the theatre.

A.9 Surround level during playback of matrix encoded sound-tracks

Crosstalk in the optical pick-up assembly may reduce the subjective amplitude of surround signals with phase encoded material. For this reason, a subjective test film is sometimes used to make slight subjective adjustments to the analog surround output, after initial alignment according to the procedures described in this International Standard.

Bibliography

[1] ANSI S1.13-1995 (R1999), *Measurement of Sound Pressure Levels in Air*

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

[3] SMPTE RP 200-2002, *Relative and Absolute Sound Pressure Levels for Motion-Picture Multichannel Sound Systems — Applicable for Analog Photographic Film Audio, Digital Photographic Film Audio and D-Cinema*

ICS 37.060.99

Price based on 9 pages