INTERNATIONAL STANDARD ISO 2969

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Cinematography — Electro-acoustic response of motion-picture control rooms and indoor theatres — Specifications and measurements

Cinématographie — Réponse électro-acoustique des salles de contrôle et des salles d'exploitation cinématographiques — Spécifications et mesurages

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2969 was developed by Technical Committee ISO/TC 36, *Cinematography*, and was circulated to the member bodies in September 1976.

It has been approved by the member bodies of the following countries :

Australia	Germany	Romania
Austria	India	South Africa, Rep. of
Belgium	Italy	Spain
Brazil	Japan	Sweden
Canada	Korea, Rep. of	United Kingdom
Czechoslovakia	Mexico	U.S.A.
France	Netherlands	U.S.S.R.

No member body expressed disapproval of the document.

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Cinematography — Electro-acoustic response of motion-picture control rooms and indoor theatres — Specifications and measurements

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the characteristics of the electro-acoustic response of motion-picture control rooms and indoor theatres. It is intended to assist in standardization of reproduction of motion-picture sound in motion-picture control rooms and indoor theaters whose volume exceeds 250 m^3. It does not apply where the recorded sound is intended for reproduction under domestic listening conditions, i.e. radio broadcasting, television broadcasting, tape, or disk. This International Standard does not cover that part of the motion-picture sound system from the transducer to the input terminals of the main fader.

2 REFERENCES

ISO 140, *Acoustics — Measurement of sound insulation in buildings and of building elements.*[1)]

ISO 266, *Acoustics — Preferred frequencies for measurements.*

ISO 1189, *Cinematography — Recorded characteristic for magnetic sound records on* 35 mm *motion-picture film — Specifications.*

IEC Publication 179, *Precision sound level meters.*

3 DEFINITIONS

3.1 complete sound reproduction system : Represented diagrammatically in figure 1 and used in studio dubbing theatres, laboratory review rooms and indoor theatres, by convention consists of an A chain and a B chain.

3.2 A chain (transducer system) : The A part of a motion-picture sound system as shown in figure 1, extending from the transducer to the input terminals of the main fader.

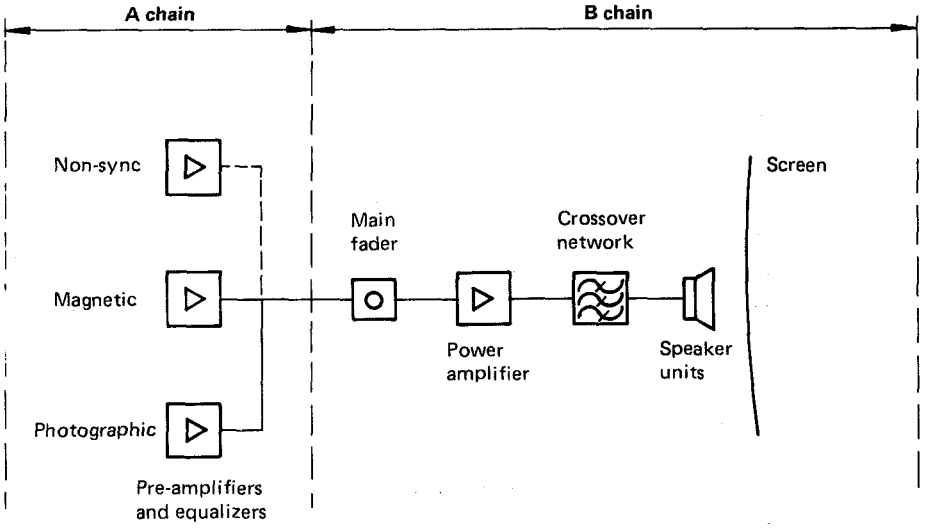

FIGURE 1 — **Complete theatrical sound reproducing system**

1) At present at the stage of draft. (Revision of ISO/R 140-1960.)

3.3 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 at any position in the listening area of the room or auditorium at which sound pressure measurements are taken.

3.4 electro-acoustic response : The electro-acoustic response of the final chain is the sound pressure level expressed in decibels with respect to an arbitrary reference pressure (see clause 5), over a given frequency range measured at a given position in the listening area when pink noise of constant electromotive force (emf) is applied to the input terminals of the main fader, preceding the power amplifier (see figure 1).

For a given area, this response is arrived at by averaging, for each frequency band, the rms sound pressures[1] at all measuring positions in the auditorium.

3.5 pink noise : A continuous spectrum noise having constant energy per constant percentage bandwith, and Gaussian probability distribution of instantaneous values.

4 METHOD OF MEASUREMENT

4.1 The electro-acoustic response shall be measured with the equipment and instruments arranged in accordance with figures 2, 3 and 4 (see annex).

4.2 Sound pressure level measurements shall be taken as follows (see annex) :

a) in dubbing theatres, at each of the principal listening areas;

b) in review rooms and review theatres, at a sufficient number of positions to cover the listening area;

c) in indoor theatres, at position X as shown in figure 3, and R as shown in figure 4, and other representative positions within the shaded area.

4.3 It is recommended that measurements be made at a height of between 1 m (3.3 ft) and 1,5 m (4.9 ft), and not closer than

a) 1,5 m (4.9 ft) to any wall;

b) 5 m (16.4 ft) to the loudspeakers.

5 CHARACTERISTICS

The electro-acoustic response of the B chain shall be within the tolerance of the curve given in the table and figure 5. This response represents current practice. The curve x and its tolerance, shown with stars in figure 5, within 4 to 10 kHz represents the characteristic for future development.

NOTE — To assist in achieving compliance, the arbitrary reference pressure may be chosen to bring as many frequencies as possible within tolerance; i.e. any arbitrary constant may be subtracted from the set of band sound pressure levels measured as in clause 4.

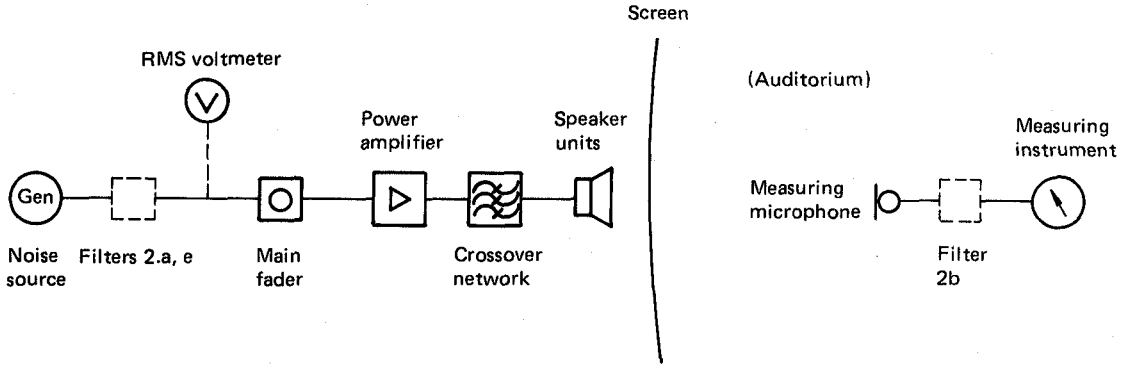

FIGURE 2 — **Method of measurement of B chain**

(See clause A.3 of the annex)

1) If the variations among the sound pressure levels at the different measuring positions are small, not exceeding 4 dB, the arithmetic mean of these individual sound pressure levels in decibels can be used. If the variations exceed 4 dB, the procedures for averaging described in ISO 140 must be followed.

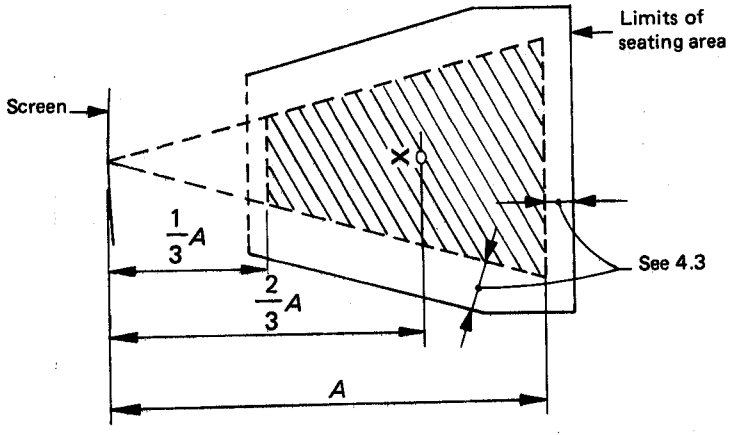

FIGURE 3 – **Theatre auditorium**

NOTE – See annex for measurement procedures

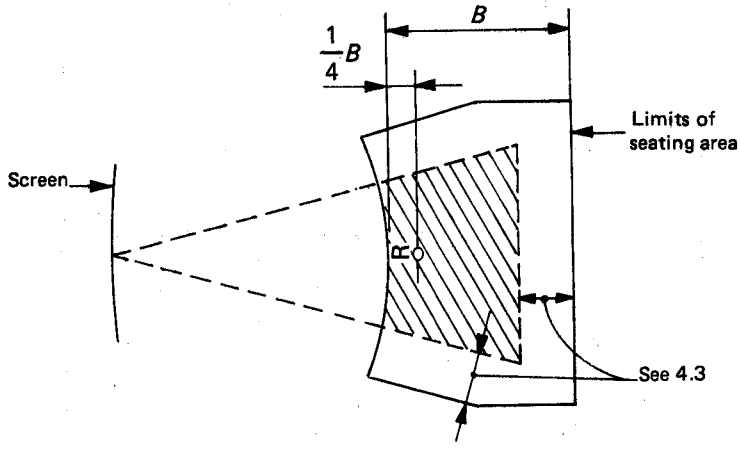

FIGURE 4 – **Theatre balcony**

NOTE – See annex for measurement procedures.

TABLE — Characteristics of the B chain

Central frequencies of one-third octave bands	Characteristics	Tolerances	
Hz	dB	+ dB	−
50	−6	6	6
63	−3	5	5
80	−1	4	4
100	0	3	3
125	0	3	3
160	0	3	3
200	0	3	3
250	0	3	3
315	0	3	3
400	0	3	3
500	0	3	3
630	0	3	3
800	0	3	3
1 000	0	3	3
1 250	0	3	3
1 600	0	3	3
2 000	0	3	3
2 500	−1	3	3
3 150	−2	3	3
4 000	−3	3	3
	Characteristics		Tolerances	
		x[1)]		x[1)]
5 000	−5	−4	±3	±3
6 300	−8	−5	±3	±3
8 000	−11	−6	±3	±3
10 000	−14	−7	±3	±3

1) See clause 5.

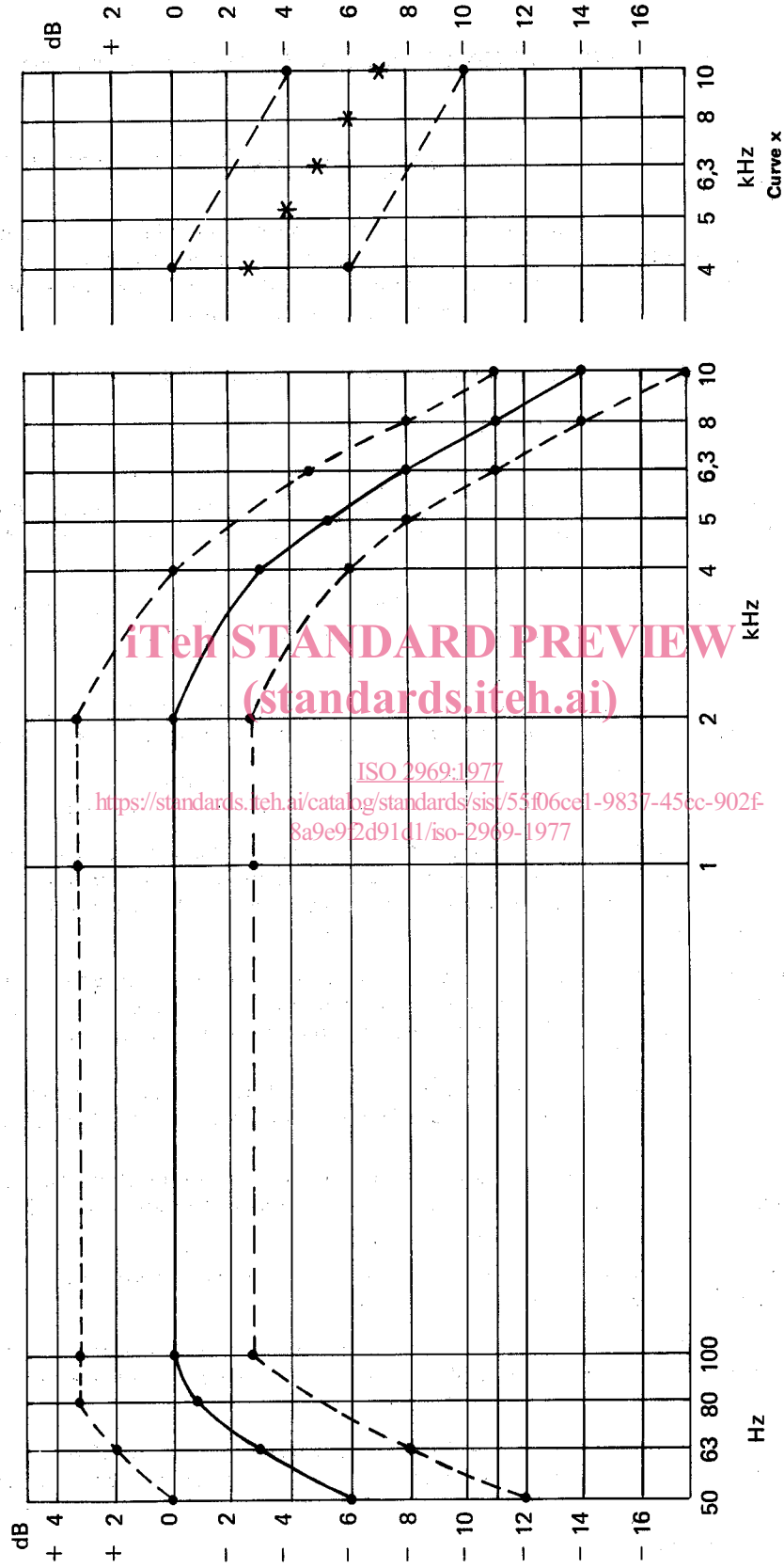

FIGURE 5 – **Curve of B chain characteristic**

NOTE – Tolerances are based upon 1/3 octave measurements. If 1/1 octave measurements are used, reduce tolerance by 1 dB.

ANNEX

GUIDE TO THE PRACTICAL APPLICATION OF THIS INTERNATIONAL STANDARD

A.1 This International Standard refers to the B chain (final chain) which embraces the reproduction equipment as shown in figure 1 and the listening area or auditorium.

It must be emphasized that in practice, the satisfactory reproduction of sound in a listening room or auditorium is also dependent upon the alignment and performance of the A chain (see figure 1) of the installation. It is therefore essential that the A chain is correctly aligned within the tolerances of existing or proposed standards by the use of the appropriate optical or magnetic test film, and, in the case of the optical part, the relevant de-emphasis is applied.

A.2 If a theatre wishes to change to characteristic x, it may be necessary to make suitable adjustments to the A chain in order to play conventional product.

A.3 Method of measurement

A.3.1 At least five methods of measurement are recognized as providing appropriate data for the evaluation of the electro-acoustic response of the B chain. These methods depend upon the generation of pink noise from 31,5 Hz to 10 kHz or beyond, and are as follows :

a) Generate pink noise in 1/3 octave bandwidths within preferred central frequencies conforming to ISO 266. Measure the signal input and the sound level meter output with an rms voltmeter and sound level meter complying with IEC Publication 179.

b) Generate pink noise in full bandwidth. Measure the acoustic output with an rms voltmeter and sound level meter complying with IEC Publication 179, reading acoustic output through a series of 1/3 octave bandpass filters.

c) Generate pink noise in full bandwidth. Measure the acoustic output with a calibrated microphone intended for use in the diffuse field and an audio-frequency spectrum analyser, covering the spectrum in 1/3 octave bands.

d) Generate pink noise in one of the methods described in a), b) or c), and with a calibrated microphone intended for use in the diffuse field, and a precision tape recorder, record the microphone output level as a function of both frequency sweep and position analysis in the theatre. Reproduce and analyse the results by one of the methods described in a), b) or c) at a subsequent time in an appropriate laboratory.

e) Generate pink noise in octave bands, the centre frequencies of which shall be altered in either 1/1 or 1/3 octave steps. Measure the acoustic output with a sound level meter as described in a). This procedure using full octave bands requires that tolerances on the B chain electro-acoustic response curve be reduced as noted in figure 5.

A.3.2 To obtain a valid representation of the acoustic response throughout the listening area, it is suggested that at least five positions be averaged when employing whole octave bands, and at least nine positions when employing 1/3 octave bands.

A.4 It is recommended that not only should the response averaged over all measurement positions fall within tolerances specified in clause 5, but also that the response at each of the individual measurement positions should fall within these tolerances.

Provided that the final chain meets the tolerances specified, the electro-acoustic frequency response for sound reproduction should be satisfactory for both optical and magnetic recordings.

Care should be taken that deviations from the required curve, though within the tolerance area, do not cause a tonal imbalance. For example, a situation where bass responses were all positive and treble responses negative, or vice versa, should be avoided.

Where in any situation it is found that there is a departure in the electro-acoustic response of the listening room or auditorium specified in the table, it will be necessary to determine the reason. This departure may be caused by one or more of the following faults :

a) incorrect frequency response of the amplifier;

b) unsatisfactory loudspeaker performance;

c) incorrect location, orientation and directivity of the loudspeakers;

d) acoustic defects of the room;

e) incorrect adjustment of the crossover network.

Suitable corrective action must first be taken in relation to such faults.

If the electro-acoustic response remains unacceptable, then suitable active or passive corrections should be made to the B part of the installation.

Because the measurements deal only with the steady-state properties of the auditorium, acoustical defects such as backstage overhang, harmful echoes and so on, do not show up. Attempts to use measurement results as a basis for major equipment redesign in a theatre found defective have to be preceded by ascertaining that no grave acoustical faults are present. Methods for finding or eliminating such faults are not covered in this International Standard.

As the sound pressure level of band-limited random noise in rooms fluctuates strongly with time, it is recommended that measurements should be time-averaged over a period of not less than 60 s for the lowest frequency band and not less than 5 s in the highest frequency band; for intermediate bands, averaging times may be approximately interpolated between these extremes.