INTERNATIONAL STANDARD

ISO 8687

First edition
1987-08-01

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

Cinematography — Signal-to-noise ratio of 8 mm type S, 16 mm and 35 mm variable-area photographic sound records — Method of measurement

Cinématographie — Rapport signal/bruit des enregistrements sonores photographiques à surface variable de films 8 mm *type S,* 16 mm *et* 35 mm *— Méthode de mesurage*

Reference number
ISO 8687 : 1987 (E)

Foreword

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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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8687 was prepared by Technical Committee ISO/TC 36, *Cinematography.*

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Cinematography — Signal-to-noise ratio of 8 mm type S, 16 mm and 35 mm variable-area photographic sound records — Method of measurement

1 Scope and field of application

This International Standard specifies a preferred method and an alternative method for measuring the signal-to-noise ratio of 8 mm type S, 16 mm and 35 mm variable-area photographic sound records.

2 Reference

CCIR Recommendation 468-2, *Measurement of audio-frequency noise in sound broadcasting, in sound-recording systems and on sound programme circuits.*

3 Definitions

For the purpose of this International Standard the following definitions apply.

3.1 biased, unmodulated sound record : A sound record made with no input to the photographic sound recorder, but with noise-reduction biasing used in conjunction with normal practice for the recorder being used.

3.2 fully modulated sound record : A sound record which has an amplitude equal to the maximum amplitude permitted by the applicable International Standard defining the dimensions of the photographic sound records. (See clause 7.)

3.3 system noise : The noise output of the reproducer under running conditions with lamp on, but no film.

3.4 unbiased, unmodulated sound record : A sound record made with no input to the photographic sound recorder and with no noise reduction biasing.

3.5 weighting network : A circuit which alters the frequency response of the measuring apparatus by a prescribed amount to provide agreement between the measured signal-to-noise ratio and the subjective impression of noise.

4 Apparatus

4.1 Measuring devices

Two types of measuring devices may be used (see the annex, clauses A.4 and A.5) :

a) For the preferred method, type CCIR consists of a weighting network with unity gain at 1 000 Hz and a quasi-peak response voltmeter. The system is described in 4.1.1 and is in accordance with CCIR Recommendation 468-2.

b) For the alternative method, type CCIR/ARM consists of a weighting network with unity gain at 2 000 Hz and an average responding voltmeter, calibrated to the root-mean-square response for a sine wave. The system is described in 4.1.2.

Type CCIR measurements should be made when the system to be measured contains significant amounts of impulse noise. The readings made on the two measuring systems are generally different and cannot be compared. The type of measurement used shall be stated when giving the result.

4.1.1 CCIR measuring apparatus

An acceptable signal-to-noise measuring apparatus is shown in figure 1 and consists of the following items.

4.1.1.1 Weighting network

The insertion gain of the CCIR weighting network shall vary with the frequency in accordance with the numerical values shown in the third column of table 1.

The permissible differences between the response curve of the measuring network and the nominal response of the weighting network shall be as shown in the last column of table 1.

A means shall be provided for bypassing or defeating the weighting network.

4.1.1.2 Voltmeter

4.1.1.2.1 Response to single tone bursts

The CCIR voltmeter shall provide a voltage indication proportional to the quasi-peak value of the signal, as follows.

The meter shall respond to single tone bursts as shown in table 2. The method of measurement shall be as follows : single bursts of 5 kHz tone shall be applied to the input at an amplitude so that the steady signal gives a reading of 80 % of full scale. The limits of reading corresponding to each duration of tone burst are given in table 2.

The tests shall be performed both without adjustment of the attenuators with the readings being observed directly from the instrument scale, and also with the attenuators adjusted for each burst duration to maintain the reading as nearly constant at 80 % of full scale as the attenuator steps permit.

4.1.1.2.2 Response to repetitive tone bursts

The meter shall respond to repetitive tone bursts as shown in table 3. The method of measurement shall be as follows : a series of 5 ms bursts of 5 kHz tone shall be applied to the input at an amplitude so that the steady signal gives a reading of 80 % of full scale. The limits of reading corresponding to each repetition frequency are given in table 3.

The tests shall be performed without adjustment of the attenuators but the characteristic shall be within tolerances on all ranges.

4.1.1.2.3 Overload characteristics

The overload capacity of the measuring set should be more than 20 dB with respect to the maximum indication of the scale at all settings of the attenuators. The term "overload capacity" refers to both the absence of clipping in linear stages and to retention of the law of any logarithmic or similar stage which may be incorporated. Overload capacity shall be measured as follows : isolated 5 kHz tone bursts of duration 0,5 ms shall be applied to the input at an amplitude giving full-scale reading using the most sensitive range of the instrument. The amplitude of the tone bursts shall be decreased in steps by a total of 20 dB while the readings are observed to check that they decrease by corresponding steps within an overall tolerance of ± 1 dB. The test shall be repeated for each range.

4.1.1.2.4 Reversibility error

The difference in reading when the polarity of an asymmetric signal is reversed shall not be greater than 0,5 dB when measured as follows : isolated 1 ms rectangular pulses shall be applied to the input in the unweighted mode, at an amplitude giving an indication of 80 % of full scale. The polarity of the input signal shall be reversed and the difference in indication shall be noted.

4.1.1.2.5 Overswing

The reading device shall be free from excessive overswing when measured as follows : when a 1 kHz tone is suddenly applied to the input at an amplitude which gives a steady reading of 0,775 V (or 0 dB), the momentary excess reading shall be less than 0,3 dB.

Table 1 — Weighting curve

Frequency	CCIR/ARM insertion gain	CCIR insertion gain	Tolerance
Hz	dB	dB	dB
31,5	− 35,5	− 29,9	± 2,00
63,0	− 29,5	− 23,9	± 1,40*
100,0	− 25,4	− 19,8	± 1,00
200,0	− 19,4	− 13,8	± 0,85*
400,0	− 13,4	− 7,8	± 0,70*
800,0	− 7,5	− 1,9	± 0,55*
1 000,0	− 5,6	0,0	± 0,50
2 000,0	0,0	+ 5,6	± 0,50*
3 150,0	+ 3,4	+ 9,0	± 0,50*
4 000,0	+ 4,9	+ 10,5	± 0,50*
5 000,0	+ 6,1	+ 11,7	± 0,50
6 300,0	+ 6,6	+ 12,2	0,00
7 100,0	+ 6,4	+ 12,0	± 0,20*
8 000,0	+ 5,8	+ 11,4	± 0,40*
9 000,0	+ 4,5	+ 10,1	± 0,60*
10 000,0	+ 2,5	+ 8,1	± 0,80*
12 500,0	− 5,6	0,0	± 1,20*
14 000,0	− 10,9	− 5,3	± 1,40*
16 000,0	− 17,3	− 11,7	± 1,65*
20 000,0	− 27,8	− 22,2	± 2,00
31 500,0	− 48,3	− 42,7	+ 2,80* − ∞

* This tolerance is obtained by linear interpolation on a logarithmic graph on the basis of values specified for the frequencies used to define the mask, i.e. 31,5; 100; 1 000; 5 000; 6 300; and 20 000 Hz.

Table 2 — Single tone burst response

Burst duration (ms)*		1	2	5	10	20	50	100	200
Amplitude reference steady signal reading	(%)	17,0	26,6	40	48	52	59	68	80
	(dB)	− 15,4	− 11,5	− 8,0	− 6,4	− 5,7	− 4,6	− 3,3	− 1,9
Limiting values Lower limit	(%)	13,5	22,4	34	41	44	50	58	68
	(dB)	− 17,4	− 13,0	− 9,3	− 7,7	− 7,1	− 6,0	− 4,7	− 3,3
Upper limit	(%)	21,4	31,6	46	55	60	68	78	92
	(dB)	− 13,4	− 10,0	− 6,6	− 5,2	− 4,4	− 3,3	− 2,2	− 0,7

* The rise- and fall-time of the burst envelope should be less than 5 µs.

Table 3 — Repetitive tone-burst response

		2	10	100
Burst repetition frequency	(Hz)	2	10	100
Amplitude reference steady signal reading	(%) (dB)	48 – 6,4	77 – 2,3	97 – 0,25
Limiting values				
Lower limit	(%) (dB)	43 – 7,3	72 – 2,9	94 – 0,5
Upper limit	(%) (db)	53 – 5,5	82 – 1,7	100 – 0,0

4.1.1.2.6 Calibration

Calibrate the instrument so that a steady input signal of 1 kHz sine wave at 0,775 V root-mean-square, having less than 1 % total harmonic distortion, gives a reading of 0,775 V (or 0 dB). The scale shall have a calibrated range of at least 20 dB with the indication corresponding to 0,775 V (or 0 dB) between 2 and 10 dB below full scale.

4.1.2 CCIR/ARM measuring apparatus

An acceptable signal-to-noise measuring apparatus is shown in figure 1 and consists of the following items.

4.1.2.1 Weighting network

The insertion gain of the weighting network shall vary with the frequency in accordance with the numerical values shown in the second column of table 1.

The permissible differences between the response curve of the measuring network and the nominal response of the weighting network shall be as shown in the last column of table 1.

A means shall be provided for bypassing or defeating the weighting network.

4.1.2.2 Voltmeter

The CCIR/ARM voltmeter shall provide an indication responding to the average value of the rectified signal as calibrated to the root-mean-square response for a sine wave input. It shall have sufficient sensitivity so that the noise signals will cause a meter deflection of at least one-third of full scale.

The voltmeter shall be free from excessive overswing when measured as follows : when a 1 kHz signal is suddenly applied to the input at an amplitude which gives a steady reading of approximately two-thirds of full scale, the momentary excess reading shall be less than 0,3 dB.

4.2 Test reproducer

The area of the film scanned by the test reproducer shall be as described in the applicable International Standard (see clause 7) defining the dimensions of the photographic sound records. The test reproducer shall be capable of reproducing all frequencies of a multifrequency test film, as described by the applicable International Standard (see clause 7), at a uniform level ± 2 dB. If the test reproducer does not meet this criterion, the frequency response of the test reproducer shall be reported along with the signal-to-noise ratios. The meter used for measuring the frequency response of the reproducer shall have no weighting network and shall have either an average response or a true root-mean-square meter response. The correct method of quoting signal-to-noise ratio is to state the measurement bandwidth and the response of the reproducer within this bandwidth.

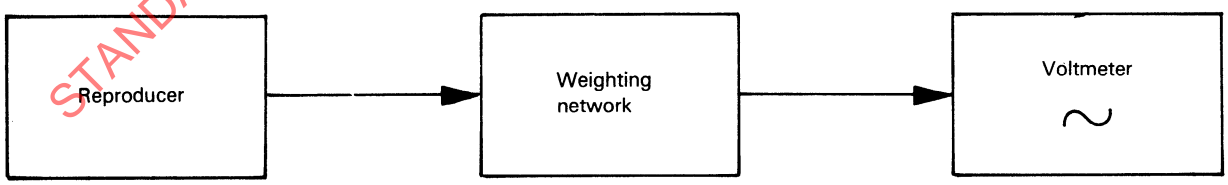

Figure 1 — Measuring apparatus for signal-to-noise ratio

5 Test track

The test track shall consist of three sections, recorded in sequence at the same lamp-current setting and printed at the same light step.

5.1 Section one shall consist of a sound record of 1 000 Hz recorded at 80 % of full modulation and shall serve as the reference signal. The length of this section shall provide a running time of approximately 10 s. When reproduced, this section shall have a harmonic distortion of less than 5 %.

5.2 Section two shall be recorded with an unbiased, unmodulated sound record. The length of this section shall provide a running time of approximately 15 s.

5.3 Section three shall be recorded with a biased, unmodulated sound record. The length of this section shall provide a running time of approximately 15 s.

6 Test measurements

6.1 Record and develop the test track described in clause 5 under the standard conditions for the system being checked. Provide sufficient unspliced film ahead of the test track to permit stabilization of the printer speed.

6.2 Reproduce the test track and measure the output of the reproducer preamplifier with the required test apparatus (see clause 4). Measure the signal level of section one (the reference signal) (see the annex, clause A.1), without the weighting network, then measure the signal level of sections two and three with the weighting network. Calculate the unbiased, unmodulated signal-to-noise ratio (A), in decibels, using the formula

$$A = 20 \lg \frac{V_1}{V_2} + 2$$

where

V_1 is the signal level, in volts, of section one;

V_2 is the signal level, in volts, of section two.

Calculate the biased, unmodulated signal-to-noise ratio (B), in decibels, using the formula

$$B = 20 \lg \frac{V_1}{V_3} + 2$$

where

V_1 is the signal level, in volts, of section one;

V_3 is the signal level, in volts, of section three.

6.3 After carrying out the measurements specified in 6.2 measure the system noise with the required test apparatus with the exciter lamp, preamplifier, and all driving and take-up motors on, and a 0,4 neutral-density filter placed at or near the film plane. Calculate the signal-to-system-noise ratio (C), in decibels, using the formula

$$C = 20 \lg \frac{V_1}{V_n} + 2$$

where

V_1 is the signal level, in volts, of section one;

V_n is the signal level, in volts, of system noise.

If the signal-to-system-noise ratio is not at least 10 dB greater than the unbiased, unmodulated signal-to-noise ratio or the biased, unmodulated signal-to-noise ratio, whichever is greater, report the system signal-to-noise ratio measurement with the audio track signal-to-noise ratios.

7 Bibliography

ISO 70, *Cinematography — Monophonic* 35 mm *negative photographic sound record on* 35 mm *motion-picture film — Position and maximum width dimensions.*

ISO 71, *Cinematography —* 16 mm *negative photographic sound record on* 16 mm, 35/16 mm *and* 35/32 mm *motion picture film — Positions and dimensions.*

ISO 2939, *Cinematography — Picture image area and photographic sound record on* 35 mm *motion-picture release prints — Position and dimensions.*

ISO 4243, *Cinematography — Picture image area and photographic sound record on* 16 mm *motion-picture release prints — Position and dimensions.*

ISO 4244, *Cinematography — Photographic-monophonic sound test films — Specifications.*