INTERNATIONAL STANDARD

ISO 10996

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Photography — Still-picture projectors — Determination of noise emissions

Photographie — Projecteurs de prises de vue — Détermination des émissions sonores

Reference number
ISO 10996:1999(E)

Foreword

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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.

International Standard ISO 10996 was prepared by Technical Committee ISO/TC 42, *Photography*.

Annexes A, B and the Bibliography of this International Standard are for information only.

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Introduction

Noise emission characteristics include both the sound power level and emission sound pressure level at the work station. The determination of these quantities allows

a) manufacturers to declare the noise emitted;

b) comparison of the noise emitted by equipment within the family concerned;

c) experimental verification of the noise control measures taken at the design stage.

The determination of one or both of the quantities can be required by, for example, legislation, directives, contracts or agreements.

Photography — Still-picture projectors — Determination of noise emissions

1 Scope

This International Standard specifies the means to determine, declare and verify the noise emission characteristics (sound power level and emission sound pressure level at the work station) of still-picture projectors.

It specifies noise measurement methods and the operating and mounting conditions that shall be used for the test.

The use of this International Standard ensures the reproducibility of the determination of the noise emission characteristics within specified limits determined by the grade of accuracy of the basic noise measurement method used. Noise measurement methods allowed by this International Standard are engineering methods (grade 2) and survey methods (grade 3).

The engineering grade of accuracy (grade 2) is preferred and is applicable, for example, to type tests or for declaration and comparison purposes.

The survey grade of accuracy (grade 3) is applicable, for example, to quality control purposes during manufacture. Survey methods usually enable measurements to be made in work rooms.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1755, *Photography — Projector slides — Dimensions*.

ISO 3744:1994, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane*.

ISO 3746, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*.

ISO 4871:1996, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*.

ISO 7574-4:1985, *Acoustics — Statistical methods for determining and verifying stated noise emission values of machinery and equipment — Part 4: Methods for stated values for batches of machines*.

ISO 11203, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level*.

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions – taken from the basic noise emission standards – apply. Further terms and definitions are given in the International Standards which are designated in clause 2 and the Bibliography.

3.1
sound power level
L_W
ten times the logarithm to the base 10 of the ratio of the sound power radiated by the source under test to the reference sound power; it is expressed in decibels

The frequency weighting or the width of the frequency band used shall be indicated. The reference power is 1 pW ($1\text{pW} = 10^{-12}\text{W}$).

EXAMPLE

The A-weighted sound power level is L_{WA}.

3.2
emission sound pressure level
L_p
ten times the logarithm to the base 10 of the ratio of the square of the emission sound pressure, $p^2(t)$, to the square of the reference sound pressure, p_0^2, measured with a particular time weighting and a particular frequency weighting, selected from those defined in IEC 60651; it is expressed in decibels; the reference sound pressure is 20 μPa

EXAMPLES

Maximum A-weighted emission sound pressure level with time weighting F: $L_{pAF,max}$.

C-weighted peak emission sound pressure level: $L_{pC,peak}$.

3.3
noise emission declaration
information on the noise emitted by the machine, given by the manufacturer or supplier in technical documents or other literature, concerning noise emission values

NOTE 1 The noise emission declaration may take the form of either the declared single-number noise emission value or the declared dual-number noise emission value.

NOTE 2 For this International Standard, the application of declared single-number noise emission values is required (see 12.2).

3.4
declared single-number noise emission value
L_d
the sum of a measured noise emission value L and the associated uncertainty K, rounded to the nearest decibel:

$$L_d = L + K$$

3.5
reference box
hypothetical surface which is the smallest rectangular parallelepiped that just encloses the source and terminates on the reflecting plane

4 Description of machinery family

This International Standard applies to still-picture projectors, i.e.

— slide projectors (full-automatic, half-automatic and hand-operated),

— overhead projectors,

— episcopes.

The test object is the projector as ready for use with all standard equipment, e.g. for slide projectors: cartridge with slides.

5 Sound power level determination

5.1 Basic International Standards to be used

For the determination of the sound power level, one of the following basic noise emission standards shall be preferably used:

— ISO 3744 (grade 2)

— ISO 3746 (grade 3).

Other standards which may be used are

— ISO 3743-1, ISO 3743-2, ISO 9614-1, ISO 9614-2 for the engineering grade of accuracy (grade 2),

— ISO 3747, ISO 9614-1, ISO 9614-2 for the survey grade of accuracy (grade 3).

5.2 Additional specifications

The application of the basic methods of ISO 3744 or ISO 3746 within the framework of this International Standard requires the following.

For the survey grade of accuracy (ISO 3746), the reference box (3.5) shall include the test table used (see clause 7 and figure 1).

The measurement surface shall be a rectangular parallelepiped which covers the reference box at a distance of d = 1 m and which terminates on the reflecting plane (see figure 1).

The arrangement of the measurement positions on the measurement surface is shown in figure 1.

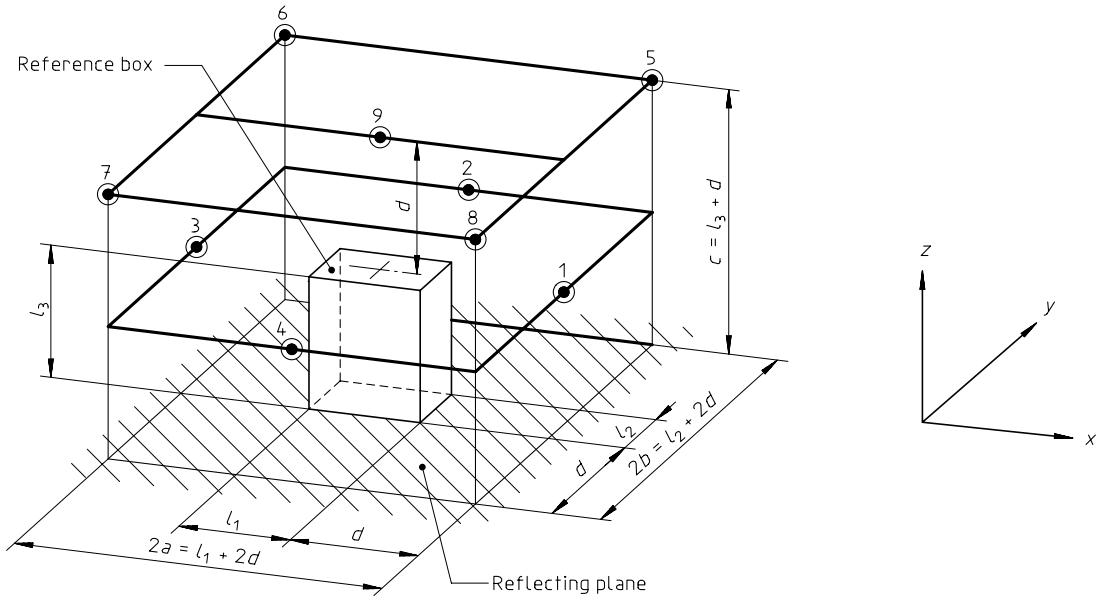
For the measurement of the A-weighted sound pressure levels, the time of observation at each measurement position shall be at least 10 s; for slide projectors, five slide changes (five cycles) shall be taken.

If the sound pressure spectrum is being determined, the time-averaged third-octave or octave sound pressure level for each frequency band within the frequency range from 100 Hz to 10 kHz shall be determined at measurement position 2 or 4 (if the operator's side is there). The direction of the projection shall be that of the x-axis (see figure 1).

For an example of a calculation for the engineering grade of accuracy (grade 2/ISO 3744), see annex A.

5.3 Measurement uncertainty

A provisional estimated value for the standard deviation of reproducibility σ_R for A-weighted sound power levels is 1,5 dB for grade 2 methods and 3 dB for grade 3 methods.



Area of the measurement surface $S = 4(ab + ac + bc)$

Figure 1 — Measurement surface with nine measurement positions for engineering grade (grade 2/ISO 3744) or with four measurement positions (1, 2, 3 and 4) for survey grade (grade 3/ISO 3746)

6 Emission sound pressure level determination

6.1 Basic International Standards to be used

If it is required to determine the emission sound pressure level at the work station, ISO 11203 (with Q calculated) shall be preferably used.

Other standards which may be used are ISO 11201 (grade 2), ISO 11204 (grades 2 and 3) and ISO 11202 (grade 3).

6.2 Selection of relevant work station

When applying ISO 11203, the work station is represented as points or paths on a surface enveloping the still-picture projector. That surface is defined in this International Standard to be the measurement surface with $d = 1$ m according to figure 1, and the emission sound pressure level is derived from the sound power level.

Using one of the other standards mentioned in 6.1 (ISO 11201, ISO 11202, ISO 11204), the emission sound pressure level shall be determined at the measurement position 2 or 4 according to figure 1, whichever yields the higher value.

6.3 Measurement uncertainty

When applying ISO 11203, the uncertainty, expressed by the standard deviation of reproducibility σ_R, is numerically equal to this associated with the method used for determining the sound power level.

Using one of the other standards mentioned in 6.1, σ_R is assumed to be 2,5 dB for grade 2 measurement methods and 5 dB for grade 3 measurement methods.

7 Installation and mounting conditions

The installation and mounting conditions shall be strictly the same for the determination of both sound power level and emission sound pressure level at the work station, if relevant.

The test environment shall be suitable for noise measurements according to the basic International Standards used. For ISO 3744 and ISO 3746, the environment is a more or less free field over a reflecting plane.

For the engineering grade of accuracy (grade 2), the projector shall be placed, if necessary, together with its fixed substructure, on the sound-reflecting floor (floor made of, for example, concrete, stone, wood, firm synthetic material) of the test room. This requirement also applies to a desk top unit.

In order to prevent the transmission of structure-borne noise, the installation of damping bases, if part of the delivery, is permissible.

For the survey grade of accuracy (grade 3), the projector shall be placed on a rigid table with a small table-top (not exceeding twice the area of the projector's base surface) and a height of 1 m maximum. The table should have rubber feet.

The projection direction shall be that of the x-axis.

8 Operating conditions

The operating conditions shall be strictly the same for the determination of both sound power level and emission sound pressure level at the work station, if relevant.

a) For slide projectors:

   The slide projectors shall be normally operated with running ventilator and cartridge filled with slides complying with ISO 1755 for automatic operation.

   While measuring the sound power level, the projector shall transport five slides with a slide stop of 5 s each.

   For manually operated slide projectors, the slide change shall be executed as steadily as possible; every change shall take about 1 s. The position of the operator shall not be between a microphone and the slide projector.

b) For overhead projectors:

   The overhead projector shall be normally operated with running ventilator but without transparencies.

c) For episcopes:

   The episcope shall be normally operated with running ventilator and closed projection stage but without opaque copy.

For operating conditions differing from the normal ones, additional measurements may be carried out (such as reverse motion for projectors or, for episcopes, projection stage which has been loosened and set to the lowest position).

The environmental air temperature shall be between 17 °C and 23 °C.

9 Measurement uncertainties

See 5.3 and 6.3 for A-weighted sound power level and emission sound pressure level determination, respectively.

10 Information to be recorded

The information to be recorded shall indicate the basic noise emission standard(s) used for the sound source under test as well as all the information required by these noise emission standards, especially those required by 10.1 to 10.5.

Any deviation from this noise test code or from the basic standard(s) used shall be recorded with the technical justifications for such deviation.

10.1 Source under test

— Manufacturer,

— type of projector,

— technical data,

— projector serial number and year of manufacture,

— additional parts: e.g. sound reproducer, type of lamphouse (power in watts), lens turret, table or stand-type projector, mounted parts.

10.2 Operating conditions of the projector

— Specification of the operating condition(s) according to clause 8,

— type of slide frame (for slide projectors).

10.3 Acoustic environment

— Description of the test environment including the physical treatment of walls, ceiling and floor,

— sketch showing the location of the projector under test and the room contents,

— employed (structure-borne sound-damping) base.

10.4 Measuring instruments

— Manufacturer, type, serial number,

— date and place of calibration.

10.5 Acoustical data (if relevant)

a) A-weighted sound pressure level at each measurement position;

b) A-weighted sound pressure level of the background noise, and correction K_{1A} according to ISO 3744 or ISO 3746;

c) applied environmental correction K_{2A} according to ISO 3744 or ISO 3746;

d) A-weighted surface sound pressure level;

e) area S of the measurement surface (see figure 1);

f) A-weighted sound power level L_{WA};

g) A-weighted emission sound pressure level at the work station (together with the indication of the work station position and the method used for the determination);

h) if necessary, sound pressure spectrum;

i) place, date and person responsible for the test.

11 Test report

The test report shall include all the information required by the relevant basic noise emission standard(s) used including (if relevant):

a) reference to this noise test code and the basic noise emission standard(s) and method(s) used together with the applied grade of accuracy;

b) indication of the source under test;

c) description of installation, mounting and operating conditions;

d) A-weighted sound power level; if necessary, the maximum A-weighted sound pressure level according to 10.5 a) together with the relevant measurement position;

e) A-weighted emission sound pressure level at the work station together with the indication of the work station position and the method used for the determination;

f) date, place and person responsible for the test;

g) any deviations from the requirements of this noise test code or from the basic noise emission standard(s) used; a technical justification shall be given.

12 Declaration and verification of noise emission values

12.1 Declaration of noise emission values

The declaration of the noise emission values is the sole responsibility of the manufacturer.

The noise declaration shall be made in such a way that the values can be verified according to the procedures in ISO 4871.

For still-picture projectors, the declaration is performed for a batch of machines and includes the A-weighted sound power level and the A-weighted emission sound pressure level at the work station, if required.

Guidelines for the determination of declared noise emission values for a batch of machines are given in annex A of ISO 4871:1996.

If the determinations of the sound power levels are performed using a grade 2 accuracy method and if the total standard deviation is estimated to be equal to the given reference standard deviation σ_M of 2 dB according to 12.3, the uncertainty K for the declared single-number noise emission value (see 3.4 and 12.2) is assumed to be 3 dB so that the verification procedure (see 12.3) will pass with a probability of about 95 % (see annex B of ISO 7574-4:1985).

For grade 3 accuracy methods, the uncertainty K will be higher (about 4 dB to 6 dB).

When using ISO 11203, the uncertainty for the determination of the emission sound pressure level at the work station is numerically equal to that of the sound power level determination.

NOTE The uncertainty can be higher when applying other standards of the ISO 11200-series.

12.2 Presentation of declared values

The noise emission declaration shall take the form of the declared single-number noise emission values according to ISO 4871.

The noise declaration shall explicitly state that the noise emission values have been obtained according to this noise test code and indicate which basic standard(s) have been used.

An example of a single-number declaration is given in Annex B.

NOTE Additional noise emission quantities may also be given in the declaration.

12.3 Verification of declared values

The verification shall be performed for a batch in accordance with 6.3 of ISO 4871:1996 by using the same mounting, installation and operating conditions as those used for the initial determination of noise emission values.

For grade 2 accuracy methods, the reference standard deviation σ_M is assumed to be 2 dB.

Annex A
(informative)

Example of calculation of the sound power level using ISO 3744

Measurement results of a projector placed in a hall with acoustical ceiling (height 7 m, length 13 m, width 10 m):

Figure 1 of this International Standard and 7.5.3 of ISO 3744:1994:

L'_{pA1} = 40 dB at measurement position 1
L'_{pA2} = 41 dB at measurement position 2
L'_{pA3} = 44 dB at measurement position 3
L'_{pA4} = 41 dB at measurement position 4
L'_{pA5} = 39 dB at measurement position 5
L'_{pA6} = 40 dB at measurement position 6
L'_{pA7} = 42 dB at measurement position 7
L'_{pA8} = 40 dB at measurement position 8
L'_{pA9} = 41 dB at measurement position 9

Background noise level at all measurement positions: L''_{pA} = 30 dB

Figure 1 of this International Standard and 7.3.1 of ISO 3744:1994:

d = 1 m

l_1 = 0,30 m l_2 = 0,24 m l_3 = 0,15 m

a = 0,5 l_1 + d = 1,15 m

b = 0,5 l_2 + d = 1,12 m

c = l_3 + d = 1,15 m

S = 4(ab + ac + bc) = 15,6 m^2

$$10 \lg\left(\frac{S}{S_0}\right) \text{dB} = 11{,}9 \text{ dB with } S_0 = 1\text{m}^2$$

8.1 of ISO 3744:1994:

$$\overline{L'_{pA}} = 10 \lg\left(\frac{1}{9}\sum_{i=1}^{9} 10^{0{,}1 L'_{pAi}}\right) \text{dB}$$

$$= 10 \lg\left[\frac{1}{9}\left(10^{4{,}0} + 10^{4{,}1} + 10^{4{,}4} + 10^{4{,}1} + 10^{3{,}9} + 10^{4{,}0} + 10^{4{,}2} + 10^{4{,}0} + 10^{4{,}1}\right)\right] \text{dB} = 41{,}1 \text{dB}$$

$$\overline{L''_{pA}} = 30 \text{ dB}$$

8.3 of ISO 3744:1994:

$$K_{1A} = -10\lg\left(1-10^{-0,1\Delta L}\right)\ \text{dB}$$

with $\Delta L = \overline{L'_{pA}} - \overline{L''_{pA}} = 41{,}1\text{dB} - 30\ \text{dB} = 11{,}1\text{dB}$

$K_{1A} \approx 0{,}4$ dB

A.4.1 of ISO 3744:1994:

α is assumed to be 0,3

S_V = 2 (7 m · 13 m) + 2 (7 m · 10 m) + 2 (10 m · 13 m) = 582 m^2

$A = \alpha \cdot S_V$ = 175 m^2

$$\frac{A}{S} = 11{,}2$$

Clause A.4 of ISO 3744:1994:

K_{2A} = 10 lg[1 + 4 (S/A)] dB = 10 lg[1 + (4 × 0,089)] dB

= 1,3 dB

8.5 of ISO 3744:1994:

$$\overline{L_{pfA}} = \overline{L'_{pA}} - K_{1A} - K_{2A}$$

= 41,1 dB – 0,4 dB – 1,3 dB

= 39,4 dB

8.6 of ISO 3744:1994:

$$L_{WA} = \overline{L_{pfA}} + 10\lg\left(\frac{S}{S_0}\right)\ \text{dB}$$

L_{WA} = 39,4 dB + 11,9 dB = 51,3 dB

Clause 12 of this International Standard:

If the total standard deviation is assumed to be as high as the reference standard deviation, the integer-declared noise emission value results in $L_{WAd} = L_{WA} + K$ = 51,3 dB + 3 dB ≈ 54 dB

Annex B
(informative)

Example of a single-number noise emission declaration for still-picture projectors

Projector model number, operating conditions, and other identifying information: Type 990, Model 11-TC, 50 Hz, 230 V, standardized operating conditions	
DECLARED SINGLE-NUMBER NOISE EMISSION VALUES in accordance with ISO 4871	
A-weighted sound power level, L_{WAd} (ref. 1 pW), in decibels	54[a]
A-weighted emission sound pressure level, L_{pAd} (ref. 20 μPa) at the operator's position, in decibels	42[a]
Values determined according to noise test code given in ISO 10996, using the basic standards ISO 3744 and ISO 11203. NOTE Declared single-number noise emission values are the sum of measured values and the associated uncertainty, and they represent upper boundaries of the range of values which is likely to occur in measurements.	
[a] Typical values, only for illustration.	

Bibliography

[1] ISO 3743-1:1994, *Acoustics — Determination of sound power levels of noise sources — Engineering methods for small, movable sources in reverberant fields — Part 1: Comparison method for hard-walled test rooms*.

[2] ISO 3743-2:1994, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering methods for small movable sources in reverberant fields — Part 2: Methods for special reverberation test rooms*.

[3] ISO 3747: — [1)], *Acoustics — Determination of sound power levels of noise sources using sound pressure — Comparison method for use in situ*.

[4] ISO 9614-1:1993, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 1: Measurement at discrete points*.

[5] ISO 9614-2:1996, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 2: Measurement by scanning*.

[6] ISO 11201:1995, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Engineering method in an essentially free field over a reflecting plane*.

[7] ISO 11202:1995, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Survey method in situ*.

[8] ISO 11204:1995, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Method requiring environmental corrections*.

[9] IEC 60651:1979, *Sound level meters*.

1) To be published. (Revision of ISO 3747:1987)

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