INTERNATIONAL STANDARD

ISO 11316

First edition
1999-10-15

Photography — Projection of still pictures — Measuring methods for the evaluation of imaging properties

Photographie — Projection de prises de vue — Méthodes de mesure pour l'évaluation des caractéristiques d'image

Reference number
ISO 11316:1999(E)

Contents

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed 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.

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 11316 was prepared by Technical Committee ISO/TC 42, *Photography*.

Annex A of this International Standard is for information only.

Photography — Projection of still pictures — Measuring methods for the evaluation of imaging properties

1 Scope

This International Standard specifies methods for the objective determination of the imaging properties of still projection by the measurement of modulation, picture-height distortion and stray light. In particular, the modulation for two local frequencies is determined objectively by the projection of line pairs or edges.

Annex A (informative) provides an example relating to slide projectors for slides of nominal size 24 mm × 36 mm.

NOTE The test slide specified for the measurement of modulation is not suitable for use in a subjective assessment.

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 ISO and IEC maintain registers of currently valid International Standards.

ISO 5-2:1991, *Photography — Density measurements — Part 2: Geometric conditions for transmission density.*

ISO 5-3:1995, *Photography — Density measurements — Part 3: Spectral conditions.*

ISO 1755:1987, *Projector slides — Dimensions*.

ISO 9039:1994, *Optics and optical instruments — Quality evaluation of optical systems — Determination of distortion.*

CIE-Publ. No. 17.4:1987, *International Lighting Vocabulary* [*same edition by IEC-Publ. 50 (845): International Electrotechnical Vocabulary, Chapter 845: Lighting*].

CIE-Publ. No. 50:1979, *Proceedings at the 1979 CIE Session (Kyoto).*

3 Terms and definitions

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

3.1
projected-picture modulation
relationship between the illumination of test projection pattern measured in the light and the dark areas on screen

3.2
test projection pattern
pairs of lines in a rectangular position at two local frequencies on five measuring points

EXAMPLE See Figures A.1 and A.2.

3.3
projected picture-height distortion
distortion on a projected picture measured on screen

3.4
projection stray light
relationship between the illumination of test projection pattern on screen measured in the large dark field and in the light area nearby the centre in percent

4 Projection picture modulation measurement

4.1 Test projection pattern

The base of the test projection pattern shall be glass. The ISO standard visual diffuse transmission density of the material, in accordance with ISO 5-2 and ISO 5-3, shall not exceed $D = 0{,}1$. The optical density of the dark elements should exceed the optical density of the base by at least 3,0.

NOTE Since the optical density of the dark elements which have been produced on the screen by photographic means varies due to projection duration, light of the projection and rise in temperature in the picture frame, the pattern and the base material shall be made resistant, e.g. by depositing a chrome layer on it.

Size and external dimensions of the test projection pattern should, for each special purpose, conform to the image sizes defined in the relevant standards.

The test projection pattern shows an arrangement of structures with two perpendicular orientations.

4.2 Detector

The photoelectric detector shall have a colour sensitivity similar to V_λ as specified in CIE No. 50, term 845-01-22.

In front of the detector a pinhole or a slit is needed. In the case of a slit, the orientation is to be set parallel to the projected structure of the test object. The detector shall be kept on screen in two positions for each measuring.

a) In the centre of projected bright lines (I_{max}).
b) In the centre of projected dark lines (I_{min}), symbols (and abbreviated terms).

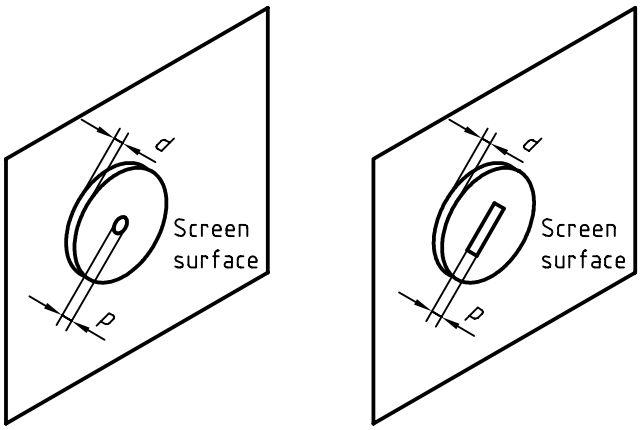


Figure 1 — Detector set-up

$$p \leqslant \frac{M}{P_{\text{freq.}} \times 8}$$

where

p is the pinhole diameter or width of the slit (mm);

$P_{\text{freq.}}$ is the high pattern frequency (mm^{-1});

M is the magnification;

d is the detector distance from screen (focus on screen surface and move back the projector for measuring the distance d).

4.3 Measuring method

Set up the projector and screen so as to ensure that the optical axis of the projector is normal to the screen (perpendicular projection).

Project the test pattern (3.2) onto the screen, with defined magnification.

Measure the modulation on the screen, at five defined measuring points E_x using a photoelectric detector for two local frequencies, each in tangential and radial orientation.

Determine the uniformity by arithmetic averaging of the tangential and radial modulation for both frequencies and at each of the five measuring points, the uniformity of the modulation in percent (g_2) being shown by the relation of lowest mean value of the modulation to the averaged modulation value at measuring point E_5 in the centre of the picture.

4.4 Conditions for the measurement

The magnification of the projection is to be defined according to the projection system. Best focus is set in the centre by adjusting on the highest contrast for the lower of the two local frequencies. All further measurements shall be carried out by means of this focusing.

Application for 35 mm slide projectors, see clause A.1.

5 Measuring the projected picture-height distortion, radial

The method specified in this International Standard for measuring the picture-height distortion is a simplified procedure to determine the scale of the distortion caused by perpendicular projection.

NOTE The picture-height distortion specified in this International Standard is not identical with the distortion of the objective.

Set-up of projector and screen, see 4.3.

The rectangle or square test projection pattern shall be projected onto the screen and evaluated. At perpendicular projection on the screen free of distortion, the horizontal lines of the rectangle or square are at a constant perpendicular distance from one another.

If the vertical distance at the edges is larger than in the centre of the projected picture (as shown in Figure 2), this picture-height distortion shall be given as a positive amount of Δh (called pincushion). In the other case, i.e. if the vertical distance at the edges is smaller than in the centre of the picture, this picture-height distortion shall be given as a negative amount of Δh (called barrel).

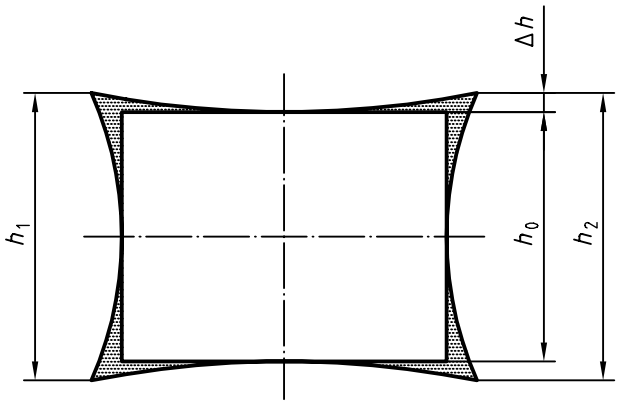


Figure 2 — Picture-height distortion, radial

The vertical distance shall be measured in the centre and at both edges and calculated according to the formulae:

$$V = \frac{\Delta h}{h_0} \times 100(\%) \quad (1)$$

$$\Delta h = \frac{h_1 + h_2 - 2h_0}{4} \quad (2)$$

where V is the picture-height distortion, radial in percent.

Application for 35 mm slide projectors, see clause A.2.

6 Projection stray light

A simple practical determination of the stray light is the measurement of the illumination I_s on the screen in the centre of the projected dark square field at measuring point E_5. The stray light s in percent is found after subtraction of the dark current I_d (covered detector) and relation to the illumination I_w in the bright field:

$$s = 100 \times \frac{I_s - I_d}{I_w} \% \quad (3)$$

The influence resulting from the geometry of the surroundings is to be kept as small as possible.

Annex A
(informative)

Application for 35 mm slide projectors

A.1 Measuring of the modulation (clause 4)

In a slide frame according to ISO 1755 there is a glass showing at five measuring points the test pattern consisting of bright ($D \leqslant 0{,}1$) and dark ($D \geqslant 3{,}0$) elements in tangential and radial orientation. The modulation shall be evaluated for the two local frequencies 5 mm^{-1} and 20 mm^{-1}.

If the test object is an edge, computations are needed to calculate the line spread function and thereafter per Fourier transformation the modulation for the defined local frequencies.

If the test pattern consists already of these two frequencies — according to Figure A.1 — the modulation M shall be calculated as follows:

$$M = \frac{I_{max} - I_{min}}{I_{max} + I_{min}} \quad \text{(A.1)}$$

I_{max} = Illumination in the centre of bright lines

I_{min} = Illumination in the centre of dark lines

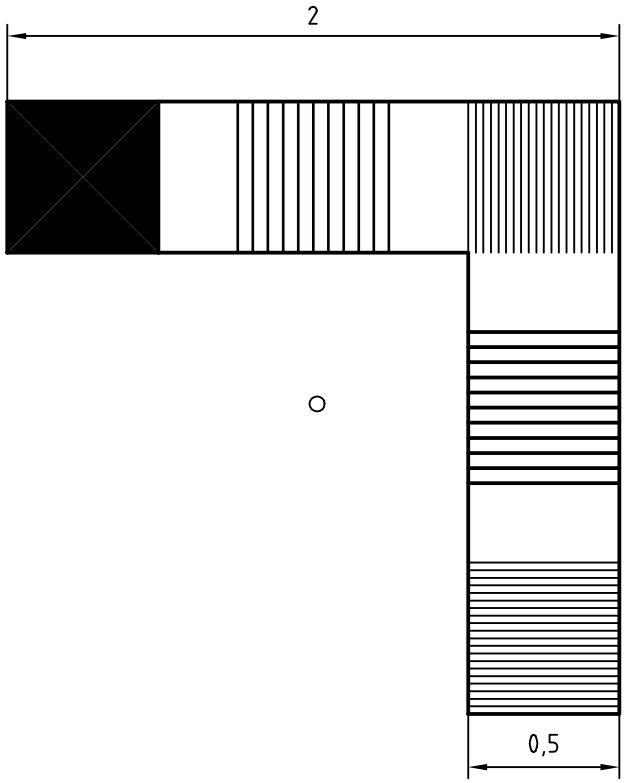
For each of the five measuring points, adjustment of the photoelectric detector shall be made by setting zero in the centre of the dark field.

According to the higher local frequency of 20 mm^{-1} and the projection magnification of 50:1 the dimension p of the detector shall be $\leqslant$ 0,3 mm (pinhole diameter or width in a rectangular slit and a length of $\leqslant$ 2/3 of the length of the lines).

$$p \leqslant \frac{M}{P_{freq.} \times 8}$$

$$p \leqslant \frac{50}{20 \times 6}$$

$$p \leqslant 0{,}3\ mm$$



NOTE Local frequencies 5 mm^{-1} and 20 mm^{-1} are not shown in correct proportion.

Figure A.1 — Test structure E_X (dimensions in mm)

In order to compensate for fluctuation of the measuring results which occurs when putting up the slide projector or when focusing, the measuring method is executed five times and each arithmetic average is recorded in a table. These average values will serve as a basis for further calculations.

Before executing each of the five measurements it is necessary to repeat the focusing every time in order to obtain meaningful results.

The projection magnification 50:1 is given when the square test structure E_5 with 2 mm length (Figure A.2) shows 100 mm in projection.

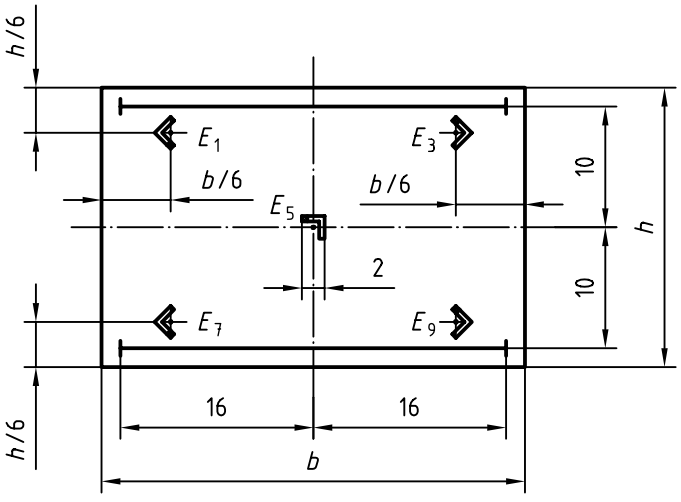


Figure A.2 — Test-slide projection

The results of an example modulation test according to this International Standard are shown in Table A.1.

Measuring point	**Local frequency**					
	5 mm^{-1}			20 mm^{-1}		
	Radially	Tangentially	Mean value	Radially	Tangentially	Mean value
	Measuring values for modulation					
1	0,824	0,822	0,823	0,399	0,370	0,384 5
3	0,857	0,680	0,768 5	0,348	0,232	0,290
5	0,859	0,865	0,862	0,518	0,481	0,499 5
7	0,783	0,809	0,796	0,107	0,180	0,143 5
9	0,777	0,745	0,761	0,111	0,136	0,123 5
Arithmetical mean values			0,8			0,29
Uniformity of modulation g_5			88,3 %	g_{20}		24,7 %

A.2 Measuring of the picture-height distortion, radial (clause 5)

On the test pattern (Figure A.2), the two horizontal lines have a distance of 20 mm. When projecting these lines with a magnification of 50, the distance on screen of these lines should be 1 000 mm. Due to distortion, this distance is not constant over the whole length of the lines.

The evaluation of picture-height distortion V shall be made according to the formulae (1) and (2) in clause 5.

A.3 Measuring of projection stray light

The evaluation of projection stray light shall be made according to clause 6.

Bibliography

EBU Tech. 3249 Measurement and analysis of the performance of film and television camera lenses.

ICS 37.040.10

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