INTERNATIONAL STANDARD

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Optics and photonics — Optical transfer function — Application

Part 1: Interchangeable lenses for 35 mm still cameras

Optique et photonique — Fonction de transfert optique — Application

Partie 1: Objectifs interchangeables pour appareils photographiques de 35 mm

Reference number
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Foreword

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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 9336-1 was prepared by Technical Committee ISO/TC 172, *Optics and photonics* Subcommittee SC 1, *Fundamental standards*.

This second edition cancels and replaces the first edition (ISO 9336-1:1994) which has been technically revised.

ISO 9336 consists of the following parts, under the general title *Optics and photonics — Optical transfer function — Application*:

— *Part 1: Interchangeable lenses for 35 mm still cameras*

— *Part 3: Telescopic systems*

Optics and photonics — Optical transfer function — Application

Part 1:
Interchangeable lenses for 35 mm still cameras

1 Scope

This part of ISO 9336 specifies a method of testing interchangeable lenses for 35 mm still cameras with a picture format of 24 mm × 36 mm in terms of imaging states aimed at making valid optical transfer function (OTF) measurements.

Special lenses for macrophotography, i.e. those designed and manufactured exclusively for obtaining a magnified image are not covered by this part of ISO 9336.

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 9334, *Optics and photonics — Optical transfer function — Definitions and mathematical relationships*

ISO 9335:1995, *Optics and photonics — Optical transfer function — Principles and procedures of measurement*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9334 apply.

4 General description of the lenses to be tested

The lenses are used in still cameras with a picture format of 24 mm × 36 mm. The typical object distance is up to several metres but sometimes more. Some lenses are capable of close focusing with a ratio of reproduction of up to 1:1.

5 Test conditions

In general, measurements shall be made with the infinite object/image conjugate and in accordance with the general principles and procedures given in ISO 9335. Measurements should be made at finite distances including the closest focusing distance.

When making measurements at a close distance, focusing shall be done by means of the lens focusing ring. Fine focusing may be done with a change in either the distance between the lens and the image analyser or that between the lens and the object, i.e. test pattern.

In order to determine the datum plane, focusing shall be done by adjusting the distance between the lens and the image analyser.

6 Specification of the imaging state

6.1 Test specimen

Table 1 specifies an imaging state for the test specimen.

6.2 Measuring equipment

Table 2 specifies an imaging state for the measuring equipment.

6.3 Measurement

Table 3 specifies an imaging state of the measurement.

7 Presentation

Table 4 specifies an imaging state for the presentation.

8 Accuracy of equipment

Overall accuracy, repeatability within one laboratory and reproducibility between several laboratories shall be assessed using known test lenses.

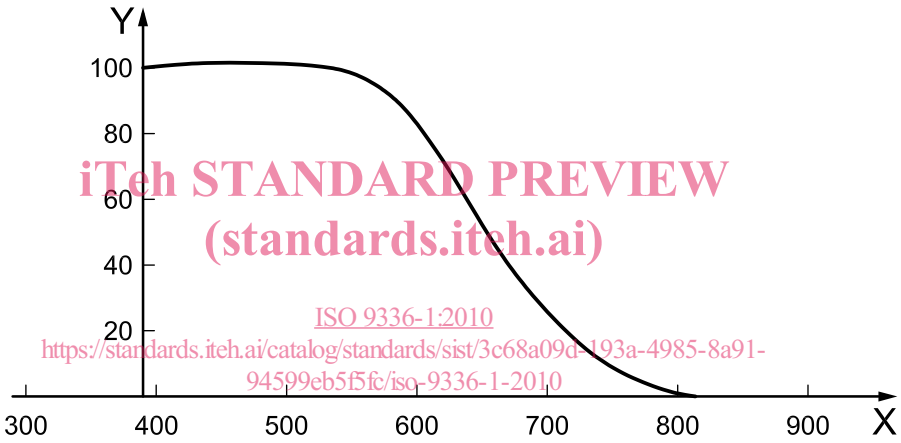
Table 1

Parameter	Value/setting	Notes
Aperture (*f*-number)	Maximum (full) and medium apertures essential Second maximum desirable	"Medium" aperture shall be *f*/5,6, if the lens full-aperture *f*-number is smaller than *f*/4. Otherwise, it shall be *f*/8. The second maximum aperture shall be the one that is one full stop smaller than the full aperture, i.e. the *f*-number is 1,4 times greater than the full-aperture *f*-number; for example, if the full-aperture *f*-number is *f*/1,8, the second maximum aperture is *f*/2,5 (1,8 × 1,4). If the second maximum aperture cannot be set for some reason, then the next possible *f*-number, which is more than half a stop greater than the full-aperture *f*-number, shall be used; in the above example, read *f*/2,8 instead of *f*/2,5.
Reference mark	Index mark for distance scale	

Table 2

Parameter	Value/setting	Notes
Bench configuration	1) Object at infinity 2) Object and image at finite conjugate (up to 1:1)	
Spectral characteristics	1) Spectral range: at least 380 nm to 670 nm 2) Light source: tungsten halogen lamp operated at a correlated colour temperature of (3 200 ± 200) K in combination with a blue filter that reduces the intensity of radiation over a wavelength range corresponding to the green to infrared region. The relative spectral transmittance of the filter[a] is shown in Figure 1. 3) Analyser: photomultiplier with S-20 photocathode.	Any light source/analyser combination may be used provided that the overall spectral characteristics are the same as those of the 3 200 K/filter/S-20 combination.

[a] The Schott BG 38, 1 mm thick, is an example of a suitable product available commercially. This information is given for the convenience of users of this part of ISO 9336 and does not constitute an endorsement by ISO of this product.



Key

X wavelength, in nanometres

Y spectral transmittance, in percent

Figure 1 — Relative spectral transmittance of the filter

Table 3

Parameter	Value/setting	Notes
MTF/PTF	MTF essential PTF desirable	
Image scale	1:∞ essential Finite distances, including the closest focusing distance, desirable	
Focusing	1) On-axis to maximum MTF at 20 mm^{-1}: at full aperture recommended 2) 30 mm^{-1} recognised	
Image height (h')	0 0,3 h'_{max} 0,5 h'_{max} 0,7 h'_{max} 0,85 h'_{max} h'_{max}	h': half diagonal of the image field (21,6 mm) This set of image heights should be used in intercomparisons of OTF results. However, a different set of image heights may be selected for special applications.
Reference angle (ϕ)	1) 0°, 90°, 180° and 270°; or alternatively 2) 56°, 124°, 236° and 304°	Two diagonal directions
Azimuth	Radial and tangential	

Table 4

Parameter	Value/setting	Notes
Reference plane	Datum plane or mounting flange	
Upper spatial frequency	50 mm^{-1}	Higher spatial frequencies may be chosen for special applications.
Selected spatial frequencies	1) 10 mm^{-1}, 20 mm^{-1} and 40 mm^{-1} recommended 2) 10 mm^{-1} and 30 mm^{-1} recognised	To be used, for example, when the OTF is given as a function of the image height.
Frequencies for numerical presentation	Ten equidistant frequencies over the range 5 mm^{-1} to 50 mm^{-1}	Higher spatial frequencies may be chosen for special applications.
Parameter list	In addition to the standard parameter list given in 7.1 of ISO 9335:1995, the following data should be listed: — position of the measurement plane relative to the datum plane; — estimated uncertainty of the measurement.	