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Optics and photonics — Preparation of drawings for optical elements and systems —

Part 5: Surface form tolerances

Optique et photonique — Indications sur les dessins pour éléments et systèmes optiques —

Partie 5: Tolérances de forme de surface

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This fourth edition cancels and replaces the third edition (ISO 10110-5:2015), which has been technically revised.

The main changes are as follows:

— permitted units were added (waves for deviation; µrad, °, ', '' for slope);

— multiple basic forms were added (e.g. both full aperture and all subaperture indications for irregularity);

— local slope was refined: circular subpupils for 2D slope (instead of square), and downsampling of the map prior to evaluation (provided that the downsampled resolution is still finer than the indicated slope sampling interval);

— new Zernike residual indication (for a simple mid spatial frequency specification);

— new Zernike coefficient indication (tabular form only);

— new local curvature indication;

— permission added to use trimmed PV estimators (PVr and PV%) to evaluate PV irregularity and PV total deviation unless specifically disallowed by a note on the drawing;

— indication code key (glossary) added;

— sampling length and interval for Peak and RMS slope indications were consolidated;

— examples for the new indications were added, and each specification form has a relevant example;

— consistency and clarity of Zernike polynomial notation were improved;

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— delimiter within forms changed from a semicolon to either a colon or one or more spaces (e.g. AX:AY instead of AX;AY) to avoid confusion with the semicolon used as the delimiter between forms.

A list of all parts in the ISO 10110 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document refers to deviations in the form (shape) of an optical surface and provides a means of specifying tolerances for certain types of surface form deviation in terms of nanometres.

As it is common practice to measure the surface form deviation interferometrically as the wavefront deformation caused by a single reflection from the optical surface at normal (90° to surface) incidence, it is possible to describe a single definition of interferometric data reduction that can be used in both cases, i.e. in surface form deviation as well as wavefront deformation. As the analysis of most measurements is software based, the deviations are expressed in nanometres. Interferometric measurements, however, use the unit "fringe spacings". One "fringe spacing" is equal to a surface form deviation that causes a deformation of the reflected wavefront of one wavelength. A value expressed in nanometres is an indication of the actual height deviation of the surface itself (and not that of the reflected wavefront).

The surface under test, together with the test glass is, for example, such an interferometer. The surface form deviation is represented by the wavefront deformation that is the difference between the wavefront reflected by the actual surface and that reflected by the test glass surface.

Due to the potential for confusion and misinterpretation, nanometres rather than fringe spacings are to be used. Where fringe spacings are used as units, the wavelength is also to be specified.

In addition, tolerances for slope deviations of surfaces can be given in units of mrad, µrad, arcmin or arcsec.

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Optics and photonics — Preparation of drawings for optical elements and systems —

Part 5: Surface form tolerances

1 Scope

This document specifies rules for indicating the tolerance for surface form deviation, in the ISO 10110 series, which standardizes drawing indications for optical elements and systems.

NOTE The terminology of interferometry employing the unit "fringe spacings" is widely used for the specification of tolerances. However, the usage of non-interferometric methods for testing of optical parts has recently become more important. Therefore, unlike in the earlier versions of this document, nanometres are now the preferred and standard unit to express surface form deviations. The usage of fringe spacings is still permitted, provided that the base wavelength is explicitly stated.

This document applies to surfaces of plano, spherical, aspheric, cylindric, and toric form as well as to surfaces of other non-spherical shape such as generally described surfaces. It also applies to the substrates of diffractive surfaces; for transmitted or reflected wavefront specifications see ISO 10110-16 and ISO 10110-14.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 10110-1, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 1: General*

ISO 14999-4, *Optics and photonics — Interferometric measurement of optical elements and optical systems — Part 4: Interpretation and evaluation of tolerances specified in ISO 10110*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14999-4 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
surface form deviation
function representing the distances normal to the surface between a nominal optical surface form and a measured form described as a measured wavefront deformation f_{WD} or $f_{\mathrm{WD,CY}}$ as defined in ISO 14999-4

Note 1 to entry: ISO 14999-4 provides the definitions for the deformation functions.

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