

BS ISO 14999-4:2015



BSI Standards Publication

# Optics and photonics — Interferometric measurement of optical elements and optical systems

Part 4: Interpretation and evaluation of  
tolerances specified in ISO 10110

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**National foreword**

This British Standard is the UK implementation of ISO 14999-4:2015. It supersedes BS ISO 14999-4:2007 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CPW/172, Optics and Photonics.

A list of organizations represented on this committee can be obtained on request to its secretary.

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**Optics and photonics —  
Interferometric measurement of  
optical elements and optical systems —**

**Part 4:  
Interpretation and evaluation of  
tolerances specified in ISO 10110**

*Optique et photonique — Mesurage interférométrique de composants  
et de systèmes optiques —*

*Partie 4: Directives pour l'évaluation des tolérances spécifiées dans  
l'ISO 10110*



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ISO copyright office  
Ch. de Blandonnet 8 • CP 401  
CH-1214 Vernier, Geneva, Switzerland  
Tel. +41 22 749 01 11  
Fax +41 22 749 09 47  
copyright@iso.org  
www.iso.org

# Contents

Page

<b>Foreword</b> .....	<b>iv</b>
<b>Introduction</b> .....	<b>v</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
3.1 Mathematical definitions .....	1
3.2 Definition of optical functions .....	2
3.3 Definition of values related to the optical functions defined in <a href="#">3.2</a> .....	4
3.4 Definition of Zernike polynomials.....	7
3.5 Definitions of functions and terms for tolerancing the slope deviation.....	7
3.6 Definitions of values for tolerancing the slope deviation.....	8
<b>4 Relating interferometric measurements to surface form deviation or transmitted wavefront deformation</b> .....	<b>11</b>
4.1 Test areas .....	11
4.2 Quantities .....	11
4.3 Single-pass transmitted wavefront deformation.....	11
4.4 Double-pass transmitted wavefront deformation.....	11
4.5 Surface form deviation.....	11
4.6 Conversion to other wavelengths .....	11
<b>5 Representation of the measured wavefront deviation as Zernike coefficients</b> .....	<b>12</b>
<b>6 Tolerancing of the slope deviation</b> .....	<b>12</b>
6.1 One-dimensional measurement of the slope deviation.....	12
6.2 Two-dimensional measurement of the slope deviation.....	15
<b>Annex A (normative) Visual interferogram analysis</b> .....	<b>16</b>
<b>Annex B (normative) Zernike polynomials</b> .....	<b>24</b>
<b>Bibliography</b> .....	<b>27</b>

## 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 documents 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](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#).

The committee responsible for this document is ISO/TC 172, *Optics and photonics*, Subcommittee SC 1, *Fundamental standards*.

This second edition cancels and replaces the first edition (ISO 14999-4:2007), which constitutes the following changes:

- a) clauses for tolerancing cylindrical and torical wavefronts, the representation of the measured wavefront deformation in terms of Zernike coefficients, and for tolerancing of the slope deviation have been added;
- b) the name of quantity A has been changed to power deviation. For further details, see [3.3.1](#), Note 2 to entry.

ISO 14999 consists of the following parts, under the general title *Optics and photonics — Interferometric measurement of optical elements and optical systems*:

- *Part 1: Terms, definitions and fundamental relationships* [Technical Report]
- *Part 2: Measurement and evaluation techniques* [Technical Report]
- *Part 3: Calibration and validation of interferometric test equipment and measurements* [Technical Report]
- *Part 4: Interpretation and evaluation of tolerances specified in ISO 10110*

## Introduction

This part of ISO 14999 provides a theoretical frame upon which are based indications from ISO 10110-5 and/or ISO 10110-14.

A table listing the corresponding nomenclature, functions, and values used in ISO 10110-5 and ISO 14999-4 is given in ISO 10110-5, Annex B.

ISO 10110-5 refers to deformations in the form of an optical surface and provides a means for specifying tolerances for certain types of surface deformations in terms of “nanometers”.

ISO 10110-14 refers to deformations of a wavefront transmitted once through an optical system and provides a means of specifying similar deformation types in terms of optical “wavelengths”.

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. One “fringe spacing” (as defined in ISO 10110-5) is equal to a surface deformation that causes a deformation of the reflected wavefront of one wavelength.

Certain scaling factors apply depending on the type of interferometric arrangement, e.g. whether the test object is being measured in single pass or double pass.

Due to the potential for confusion and misinterpretation, units of nanometres rather than units of “fringe spacings” or “wavelengths” are to be used for the value of surface form deviation or the value of wavefront deformation, where possible. Where “fringe spacings” or “wavelengths” are used as units, the wavelength is also to be specified.





# Optics and photonics — Interferometric measurement of optical elements and optical systems —

## Part 4:

# Interpretation and evaluation of tolerances specified in ISO 10110

## 1 Scope

This part of ISO 14999 applies to the interpretation of interferometric data relating to the measurement of optical elements.

This part of ISO 14999 gives definitions of the optical functions and values specified in the preparation of drawings for optical elements and systems, made in accordance with ISO 10110-5 and/or ISO 10110-14 for which the corresponding nomenclature, functions, and values are listed in ISO 10110-5, Annex B. It also provides guidance for their interferometric evaluation by visual analysis.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10110-5, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 5: Surface form tolerances*

ISO 10110-14, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 14: Wavefront deformation tolerance*

ISO/TR 14999-2, *Optics and photonics — Interferometric measurement of optical elements and optical systems — Part 2: Measurement and evaluation techniques*

## 3 Terms and definitions

### 3.1 Mathematical definitions

#### 3.1.1 function

mathematical description of the measured wavefront deformation and its decomposition into components

Note 1 to entry: The functions used in this part of ISO 14999 are scalar functions.

#### 3.1.2 peak-to-valley value

PV ( $f$ )

<of a function  $f$ > maximum value of the function within the region of interest minus the minimum value of the function within the region of interest

#### 3.1.3 root mean square value

rms ( $f$ )

<of a function  $f$  over a given area  $A$ > value given by either of the following integral expressions: