TECHNICAL REPORT

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# Optics and photonics — Test methods for surface imperfections of optical elements —

## Part 2: Machine vision

*Optique et photonique — Méthodes d'essai applicables aux imperfections de surface des éléments optiques —*

*Partie 2: Visionique*

Reference number
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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 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).

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).

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

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*.

A list of all parts in the ISO 14997 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.

This corrected version of ISO/TR 14997-2:2022 incorporates the following corrections:

— editorial corrections added in Introduction, Clause 2, 3.4, Figure 1 and Annex A;

— ISO 9802:2022 was added in Bibliography, the cross-references and the Bibliography were renumbered.


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# Introduction

This document was developed to account for the increased use of machine vision for surface quality inspections. The visual assessment of grades of surface imperfections of optical elements and systems is described in ISO 10110-7, and ISO 14997-1[1)]. The latter gives methods to obtain subjective results using the human eye, reference comparison standards, and in some cases optical magnification tools.

Utilizing machine vision opens the door for the objective evaluation of imperfections as well as electronic data storage of detailed and precise test reports along with statistical data handling. It offers an opportunity for better repeatability of the characterisation of surfaces and a potential method of arbitration in supplier/customer discussions about surface imperfections.

Inspection results of optics obtained by manual inspection and from already existing machine vision systems have shown good correlation. Minor deviations arise, but are largely due to the differences of subjective and objective evaluation.

Of particular concern can be long scratches such as sleeks. Such imperfections often are more visible when tilting and rotating the sample to the optimum position which, in machine vision devices, is often accomplished by covering an amount of incident illumination angles, which are limited due to practical reasons.

1) ISO 14997-1 is at the time of publication of this document published as ISO 14997:2017. The change in numbering of the International Standard is intended at the next revision of ISO 14997.

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# Optics and photonics — Test methods for surface imperfections of optical elements —

# Part 2: Machine vision

## 1 Scope

This document provides guidance for the use of machine vision to objectively assess grades of surface imperfections as defined on a drawing using ISO 10110-7 with equivalent results as those obtained by applying the inspector-based methods described in ISO 14997-1.

This document also gives guidelines on how to setup a machine vision device regarding fidelity, repeatability and reproducibility, based on the dark field detection principles of ISO 14997-1.

## 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 10110-7, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 7: Surface imperfections*

ISO 14997-1, *Optics and photonics — Test methods for surface imperfections of optical elements*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10110-7 and ISO 14997-1 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**
**machine vision**
application of computer vision to machine, robot, process or quality control

Note 1 to entry: This definition is also applicable for use in optical elements and components.

[SOURCE: ISO 2382:2015, 2123788, modified — Notes to entry omitted and new Note 1 to entry added.]

**3.2**
**machine vision grading**
application of a machine vision system and a computer algorithm to determine the grades of imperfections

Note 1 to entry: Machine vision grading reports the grade of a particular scratch or dig, which has usually been presented to the machine vision system by an operator.

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