

Optics and optical instruments — Test methods for surface imperfections of optical elements

ICS 37.020

National foreword

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- monitor related international and European developments and promulgate them in the UK.

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Summary of pages

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Optics and optical instruments — Test methods for surface imperfections of optical elements

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



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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.

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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.

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ISO 14997 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 1, *Fundamental standards*.

Introduction

This International Standard was developed in response to worldwide demand for test methods for surface imperfections which are objective and permit fast assessment of component quality. Existing standards have been assessed [9] and found to be too variable in use to satisfy the current requirements of industry. Surface imperfections, such as digs and scratches, arise from localized damage during or after manufacture. They may be visible as a result of the light they scatter, giving rise to a false impression of poor quality. Alternatively, this light may appear as unwanted veiling glare (stray radiation) in an image plane, or it may lead to a degradation in signal quality at an image sensor. Imperfections can also provide centres of stress, eventually leading to failure of components exposed to high laser radiation power/energy densities.

Since modern methods of surface examination are capable of atomic resolution, no surface is likely to be found totally free of localized imperfections. Most surfaces produced are satisfactory for their intended purpose, but a small proportion may have suffered obvious damage and shall be reworked or regarded as unacceptable. This can leave some components which, although slightly damaged, may, when tested, still be acceptable depending on the level of acceptability of surface imperfections requested by the customer and specified on drawings in accordance with either of the two methods specified in ISO 10110-7. This International Standard describes how these methods are implemented.

In Method I, the obscuration of imperfections larger than 10 μm can be judged visually by comparison of areas with artefacts of known size on a comparison plate. The obscuration caused by imperfections equal to or less than 10 μm across and yet still visible under dark-field illumination is either too small for accurate area measurement or may transmit as well as scatter radiation. These need to be quantified by comparison of their radiometric obscuration with totally absorbing artefacts of known size. Every imperfection detected is measured and considered for summation to produce a level of grade for each surface.

In Method II, all imperfections, independently of their width, length or number or whether on or between the surfaces of a component, are observed simultaneously and the component is quickly rejected if one imperfection exceeds a pre-set level of visibility under controlled conditions of illumination and viewing.

It should be noted that other light scattering defects, which also need to be measured, can arise as digs distributed over the surface of an incompletely polished surface, and as bubbles and as striae within an optical material. The measurement of laser damage thresholds also requires sensitive means for quantifying the level of radiation scattered by damage in its early stages.

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1 Scope

This International Standard establishes the physical principles and practical means for the implementation of two methods, specified in ISO 10110-7, for measuring surface imperfections. These methods are: Method I, the surface area obscured or affected by the defects, and, Method II, the visibility of the imperfections.

Both methods are suitable for prototype, small scale or large scale production of a wide variety of optical components. Imperfection appearance or functional tolerances related to a particular component can be determined by agreement between supplier and customer.

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 10110-7:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 7: Surface imperfection tolerances*

ISO 11145:2001, *Optics and optical instruments — Lasers and laser-related equipment — Vocabulary and symbols*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10110-7 and ISO 11145 and the following apply.

3.1

fully-developed imperfection

imperfection which scatters all radiation incident upon it

3.2

partially-developed imperfection

imperfection which transmits as well as scatters radiation incident upon it

3.3

line-equivalent width

LEW

width of a fully-developed scratch or absorbing line which obscures the same amount of radiation as a partially-developed scratch

NOTE The LEW of a fully-developed scratch equals its geometrical width.