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Optics and photonics — Lasers and laser-related equipment — Cavity ring-down method for high-reflectance and high-transmittance measurements

Optique et photonique — Lasers et équipement associé aux lasers — Méthode d'alternance de la cavité pour les mesurages du facteur de réflexion et du facteur de transmission

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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).

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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 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by ISO/TC 172, *Optics and photonics*, Subcommittee SC 9, *Lasers and electro-optical systems*.

This second edition cancels and replaces the first edition ISO 13142:2015, which has been technically revised.

The main changes compared to the previous edition are as follows:

— addition of transmittance measurements into the document.

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.

Introduction

With the development of film-deposition technology, the performance of optical thin films, especially the highly reflective (HR) and highly anti-reflective (AR) coatings which are widely used in large high-power laser systems, interferometric gravitational-wave detectors, laser gyroscopes, and cavity-enhanced and cavity ring-down spectroscopy applications, has been substantially improved in recent years. Laser-based optical systems require some optical components with extremely high reflectance or transmittance characteristic. It is necessary to be able to measure this reflectance or transmittance characteristic precisely. Up to now, the ISO standardized testing methods for reflectance/transmittance of optical laser components have the accuracy limit of approximately 0,01 % (for measurement of absolute reflectance/transmittance), which are not appropriate for measuring the reflectance /transmittance higher than 99,99 %, or in some cases measurement accuracy better than 0,01 % is required. The measurement procedures in this document have been optimized to allow the measurement of high reflectance or transmittance (larger than 99 %, theoretically up to 100 %) of optical laser components using the cavity ring-down technique which provides reflectance or transmittance data with high accuracy, high repeatability and reproducibility, and high reliability.

Optics and photonics — Lasers and laser-related equipment — Cavity ring-down method for high-reflectance and high-transmittance measurements

1 Scope

This document specifies measurement procedures for the precise determination of the high reflectance or high transmittance (>99 %) of optical laser components.

The methods given in this document are intended to be used for the testing and characterization of high reflectance of both concave and plane mirrors or high transmittance of plane windows used in laser systems and laser-based instruments. The reflectance of convex mirrors or transmittance of positive or negative lenses can also be tested by taking into consideration the radius of curvature of the mirror surface or the focal length of the lens. This document is complementary to ISO 15368 which specifies the measurement procedures for the determination of reflectance and transmittance of optical components with spectrophotometry. ISO 15368 is applicable to the measurements of reflectance and transmittance in the range from 0 % to 100 % with a typical accuracy of ±0,3 %, and is therefore not applicable to the precise measurements of reflectance and transmittance higher than 99,9 %.

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 11145, *Optics and photonics — Lasers and laser-related equipment — Vocabulary and symbols*

ISO 14644-1, *Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness by particle concentration*

ISO 80000-7, *Quantities and units — Part 7: Light and radiation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11145 and ISO 80000-7 and the following apply.

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

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

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

3.1
reflectance
<for incident radiation of given wavelength, polarization and angle of incidence> ratio of the reflected radiant or luminous flux to the incident flux in the given conditions

3.2
transmittance
<for incident radiation of given wavelength, polarization and angle of incidence> ratio of the transmitted radiant or luminous flux to the incident flux in the given conditions