SLOVENSKI STANDARD
oSIST prEN ISO 24013:2022

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Optika in fotonska tehnologija - Laserji in laserska oprema - Merjenje faznega zamika optičnih komponent za polarizirano lasersko sevanje (ISO/DIS 24013:2022)

Optics and photonics - Lasers and laser-related equipment - Measurement of phase retardation of optical components for polarized laser radiation (ISO/DIS 24013:2022)

Optik und Photonik – Laser und Laseranlagen – Messung der Phasenverschiebung optischer Komponenten für polarisierte Laserstrahlung (ISO/DIS 24013:2022)

Optique et photonique - Lasers et équipements associés aux lasers - Mesurage du retard de phase des composants optiques pour le rayonnement laser polarisé (ISO/DIS 24013:2022)

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Optics and photonics — Lasers and laser-related equipment — Measurement of phase retardation of optical components for polarized laser radiation

Optique et photonique — Lasers et équipements associés aux lasers — Mesurage du retard de phase des composants optiques pour le rayonnement laser polarisé

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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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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 9, *Laser and electro-optical systems*.

This second edition cancels and replaces the first edition (ISO 24013:2006), which has been technically revised.

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

— Clause 6.3.3 was amended to add an additional step requiring that a transmitting optic be aligned so that its optical axis is horizontal.

— Clauses 2 and 6.1 were amended to reflect that ISO 14644-1:1999 does not need the year..

— Clause 6.3.1, (π/4 ± 2) mrad was changed to π/4 rad ± 2 mrad.

— Clauses 7.1 and 8.1 were updated to account for phase retardances close to π.

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

Normally it is desirable that the state of polarization be not influenced by the optical components used. For the generation or maintenance of specific states of polarization the influence of optical components on the beam polarization is crucial. For generating circularly polarized radiation from linearly polarized radiation π/2 phase retarders are used.

This document describes methods to determine the relative phase retardation of optical components with respect to the x- and y-axes of the polarization and s- and p-polarization, respectively. This document is necessary for optics manufacturers, suppliers and customers of such optics for the determination of the influence of phase retardation of optical components.

Optics and photonics — Lasers and laser-related equipment — Measurement of phase retardation of optical components for polarized laser radiation

1 Scope

This document specifies test methods for the determination of the linear optical phase retardation of optical components by polarized laser beams.

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 12005, *Lasers and laser-related equipment — Test methods for laser beam parameters — Polarization*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11145 and ISO 12005 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 https://www.electropedia.org/

4 Symbols and abbreviated terms

Table 1 — Symbols used and units of measure

Symbol	Unit	Term
p_L	1	degree of linear polarization
ϕ	rad	angle of analyser
a_1	V/m	amplitude of electric field in x-direction
a_2	V/m	amplitude of electric field in y-direction
a, b	V/m	principal axes of the polarization ellipse
δ	rad	phase difference
$\Delta\delta$	rad	phase retardation
E	V/m	electric field vector amplitude
P	W	radiant power
α_x	1	absorptance in x-direction
α_y	1	absorptance in y-direction
ψ	rad	angle of the principle axis of the polarization ellipse

5 Measurement principle

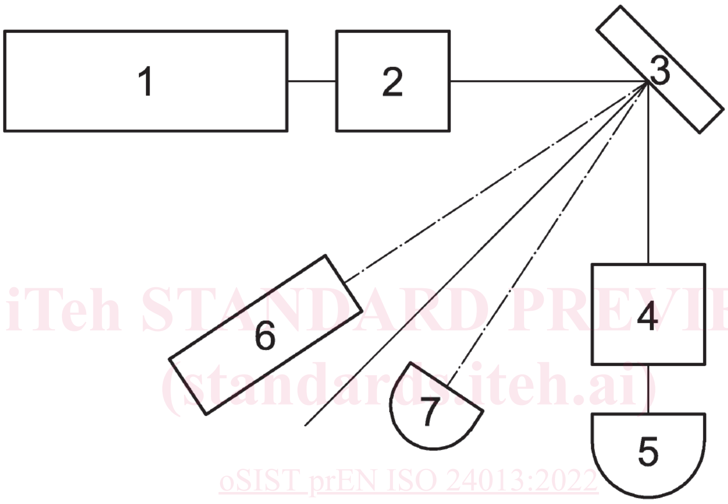
The optical component under test is irradiated by a laser beam with a defined state of polarization. After passing the component the state of polarization of the beam is determined by using an analyser. The phase retardation is then evaluated from the change of the state of polarization.

There are two cases to distinguish:

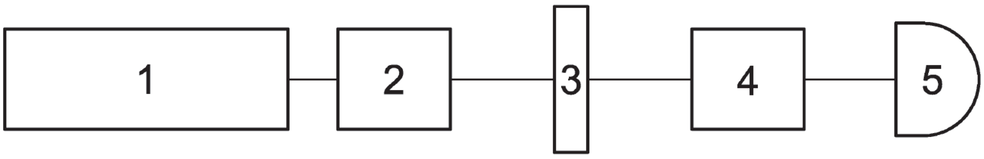
a) the expected phase retardation is near zero: in this case a circularly polarized beam shall be used for the test;

b) the expected phase retardation is near π/2: in this case a linearly polarized beam shall be used for the test.

Figure 1 shows the measuring set up.



a) Optical path for reflective samples



b) Optical path for transmissive samples

Key

1 radiation source
2 polarizer (linear or circular)
3 sample under test
4 analyser
5 detector
6 alignment laser
7 positional sensitive detector

Figure 1 — Schematic drawing of the measuring set up

A laser and a polarizer generating linearly or circularly polarized radiation shall be used in combination with an analyser and a power detector. For measuring reflective samples an alignment laser in combination with a positional sensitive detector ensures a reproducible angle alignment of the sample under test.

6 Preparation of test sample and measuring arrangement

6.1 General

Storage, cleaning and the preparation of the test samples are carried out in accordance with the manufacturer's instructions for normal use.

The environment of the testing place consists of dust-free filtered air with between 40 % and 60 % relative humidity. It is recommended that the residual dust be reduced in accordance with, for example, the clean-room ISO class 7 as defined in ISO 14644-1.

A linearly polarized and monochromatic source, such as a laser, shall be used as the radiation source. To keep errors as low as possible, the beam power stability should be as high as possible.

Wavelength, angle of incidence and state of polarization of the laser radiation used for the measurement shall correspond to the values specified by the manufacturer for the use of the test sample. If ranges are accepted for these three quantities, any combination of wavelength, angle of incidence and state of polarization may be chosen from these ranges.

6.2 Laser beam preparation

The accuracy of the measurement is strongly influenced by a clear definition of the state of polarization of the laser beam. Therefore it is necessary to prepare the polarization state of the probe beam (linearly or circularly) carefully.

If the expected phase retardation is near π/2, a linearly polarized beam shall be used. The quantity $(1 - p_L)$, where p_L is the degree of linear polarization, shall be less than 10^{-3}. This shall be verified by using the analyser without the sample in the beam path.

NOTE 1 Such a state of polarization can be achieved by using a linearly polarized laser beam in combination with additional polarizing elements.

If the expected phase retardation is near zero, a circularly polarized beam shall be used. The degree of linear polarization p_L shall be less than 10^{-3}. This shall be verified by using the analyser without the sample in the beam path.

NOTE 2 Such a state of polarization can be achieved by using a linearly polarized laser beam in combination with additional linearly polarizing elements and a π/2 phase retarding element.

All optical elements shall not increase the quantity $(1 - p_L)$ in the case of a linearly polarized beam and p_L in the case of a circularly polarized beam, by more than 10^{-3}. For this reason the use of folding mirrors in the test setup is discouraged and all other optical elements shall be used under normal incidence.

6.3 Sample adjustment and system calibration

6.3.1 Reflective samples

The sample shall be mounted very accurately at the angle of incidence according to the manufacturer's specification. The deviation from the intended angle of use shall be less than 2 mrad. For this purpose the component shall be mounted on a precision rotary stage. Back reflecting the laser beam into the laser cavity defines the normal incidence.

Additionally, in the case of a linearly polarized probe beam, the angle between the direction of polarization of the incoming laser beam and the plane of incidence shall be π/4 rad ± 2 mrad.