
**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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 123, *Lasers and photonics*, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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

The main changes are as follows:

- [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;
- [6.3.1](#), ($\pi/4 \pm 2$) mrad was changed to $\pi/4$ rad ± 2 mrad;
- [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 $\pi/2$ 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	Term	Unit
p_L	degree of linear polarization	1
ϕ	angle of analyser	rad
a_1	amplitude of electric field in X-direction	V/m
a_2	amplitude of electric field in Y-direction	V/m
a, b	principal axes of the polarization ellipse	V/m
δ	phase difference	rad
$\Delta\delta$	phase retardation	rad
E	electric field vector amplitude	V/m
P	radiant power	W
α_X	absorptance in X-direction	1
α_Y	absorptance in Y-direction	1
ψ	angle of the principle axis of the polarization ellipse	rad

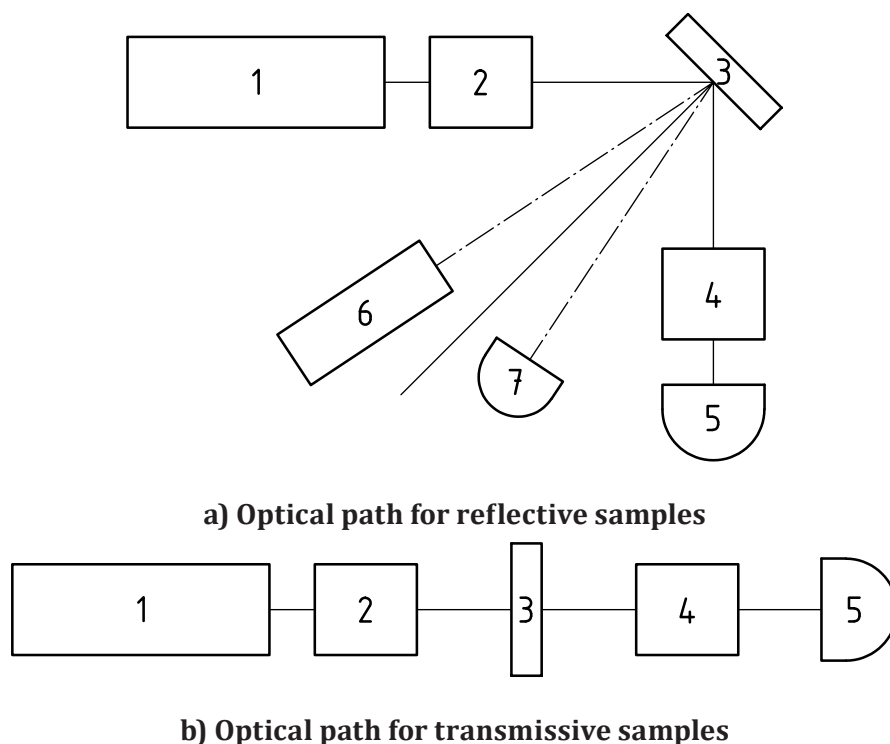
5 Measurement principle

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:

- the expected phase retardation is near zero: in this case a circularly polarized beam shall be used for the test;
- the expected phase retardation is near $\pi/2$: in this case a linearly polarized beam shall be used for the test.

Figure 1 shows the measuring set up.



Key

- radiation source
- polarizer (linear or circular)
- sample under test
- analyser
- detector
- alignment laser
- 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.