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# Optics and photonics — Laser and laser-related equipment — Photothermal technique for absorption measurement and mapping of optical laser components

*Optique et photonique — Lasers et équipements associés aux lasers — Technique photothermique pour la mesure et la cartographie de l'absorption des composants laser optiques*



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# Foreword

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

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 rapid development of high-power/high-energy laser technology, laser-induced damage to optical laser components and laser-induced thermal distortion in laser components become the most important limiting factors for the operation and applications of high-power/high-energy laser systems. Normally, the laser-induced damages to optical laser components are caused by absorbing defects on the surface or within the laser components which result in thermal stress or melting of the laser components and lead to damage. The thermal distortions, which induce wavefront distortions and therefore beam quality deteriorations to the laser beam, are caused by non-uniform thermal expansion or refractive index change due to absorption irregularities (such as absorbing defects) inside the laser components. To improve the laser-induced damage threshold (LIDT) and reduce the laser-induced thermal distortion of laser components used in high-power/high-energy laser systems, there are needs not only to measure precisely the absorptance of the laser components, but also to detect various absorbing defects on/within the laser components, therefore to improve the performance of these laser components via optimizing fabrication/coating processes.

Currently, the ISO 11551 standardized testing method - laser calorimetry for absorptance measurements of optical laser components can only measure test samples with small sizes (normally less than 50 mm in diameter and 10 mm in thickness) and has almost no capability to measure the absorptance of large-sized laser components (100 mm in diameter and over) widely used in high-power/high-energy laser systems. In addition, laser calorimetry has only limited capability to map the absorptance distribution of an optical laser component.

The measurement procedures in this document have been optimized to allow the mapping of absorbing defects of optical laser components and measurement of absolute absorptance of large-sized laser optics actually used in high-power/high-energy laser systems using photothermal techniques which provide absorption measurement/mapping with high sensitivity, high spatial resolution, and high reliability.

In addition to absorption measurement/mapping of optical laser components with photothermal amplitude, the photothermal phase measurement/mapping can also find applications in thermo-physical characterization of laser optics, which will be helpful for a better understanding of defect properties of laser optics and laser-defect interaction that would lead to a better understanding of laser-induced damage mechanism of laser optics.