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Optics and photonics — Lasers and laser-related equipment — Test methods for laser beam power (energy) density distribution

Optique et photonique — Lasers et équipements associés aux lasers — Méthodes d'essai de distribution de la densité de puissance (d'énergie) du faisceau laser

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Foreword

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

This third edition cancels and replaces the second edition (ISO 13694:2015), which has been technically revised. The main changes compared to the previous edition are as follows:

a) the definition of beam ellipticity has been harmonized with ISO 11145 and ISO 11146-1;

b) the term “second linear moments” has been replaced by “second moments”;

c) the term “field of view” has been replaced by “aperture”;

d) Clause 9 was rewritten; the paragraphs on clip-levels were corrected to reflect that they are no longer intended for noise cancelation;

e) the entries “Fitted distribution type”, “Roughness of fit R”, and “Goodness of fit G” have been removed from the Test Report;

f) the term “aspect ratio” has been removed from the test report.

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Introduction

Many applications of lasers involve using the near-field as well as the far-field power (energy) density distribution of the beam. The power (energy) density distribution of a laser beam is characterized by the spatial distribution of irradiant power (energy) density with lateral displacement in a particular plane perpendicular to the direction of propagation. In general, the power (energy) density distribution of the beam changes along the direction of propagation. Depending on the power (energy), size, wavelength, polarization, and coherence of the beam, different methods of measurement are applicable in different situations. Five methods are commonly used: camera arrays (1D and 2D), apertures, pinholes, slits, and knife edges.

According to ISO 11145, it is possible to use two different definitions for describing and measuring the laser beam diameter. One definition is based on the measurement of the encircled power (energy); the other is based on determining the spatial moments of the power (energy) density distribution of the laser beam.

The use of spatial moments is necessary for calculating the beam propagation factor, K, and the beam propagation ratio, M^2, from measurements of the beam widths at different distances along the propagation axis. ISO 11146-1 describes this measurement procedure. For other applications, other definitions for the beam diameter can be used. For some quantities used in this document the first definition (encircled power (energy)) is more appropriate and easier to use.