International

ISO 13694

Optics and photonics — Lasers and laser-related equipment — Test methods for laser beam irradiance (fluence) distribution

Optique et photonique — Lasers et équipements associés aux lasers — Méthodes d'essai de distribution de l'éclairement énergétique (exposition énergétique) du faisceau laser

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This fourth edition cancels and replaces the third edition (ISO 13694:2018), which has been technically revised.

The main changes are as follows:

— Terminologies “power”, “energy”, “power density”, and “energy density” were replaced by “radiant power”, “radiant energy”, “irradiance”, and “fluence”, respectively, in order to be consistent with ISO 80000-7 and IEC Electropedia (https://www.electropedia.org/).

— The terminologies “beam width” and “beam diameter” were restricted to be used only for those given by the second order moment which is defined in ISO 11146-1, and new terminologies “encircled-power beam width”, “encircled-power beam diameter”, “clip-level beam width”, and “clip-level beam diameter” were introduced, in order to avoid confusion of plural definitions.

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Many applications of lasers involve using the near-field as well as the far-field irradiance (fluence) distribution of the beam. The irradiance (fluence) distribution of a laser beam is characterized by the spatial distribution of radiant power density (radiant energy fluence) with lateral displacement in a particular plane perpendicular to the direction of propagation. In general, the irradiance (fluence) distribution of the beam changes along the direction of propagation. Depending on the radiant 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 radiant power (energy); the other is based on determining the spatial moments of the irradiance (fluence) 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 and ISO 11146-2 describe this measurement procedure. For other applications, other definitions for the beam diameter can be used. For some quantities used in this document the beam width based on the encircled radiant power (energy) is more appropriate and easier to use.