Optics and photonics - Lasers and laser-related equipment - Test methods for laser beam power (energy) density distribution (ISO 13694:2015)

EESTI STANDARDIKESKUS
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NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 13694:2015 sisaldab Euroopa standardi EN ISO 13694:2015 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 13694:2015 consists of the English text of the European standard EN ISO 13694:2015.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 16.12.2015.	Date of Availability of the European standard is 16.12.2015.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 31.260

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 13694

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Supersedes EN ISO 13694:2000

English Version

Optics and photonics - Lasers and laser-related equipment - Test methods for laser beam power (energy) density distribution (ISO 13694:2015)

Optique et photonique - Lasers et équipements associés aux lasers - Méthodes d'essai de distribution de la densité de puissance (d'énergie) du faisceau laser (ISO 13694:2015)

Optik und Photonik - Laser und Laseranlagen - Prüfverfahren für die Leistungs-(Energie-)dichteverteilung von Laserstrahlen (ISO 13694:2015)

This European Standard was approved by CEN on 19 September 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN ISO 13694:2015 E

European foreword

This document (EN ISO 13694:2015) has been prepared by Technical Committee ISO/TC 172 "Optics and photonics" in collaboration with Technical Committee CEN/TC 123 “Lasers and photonics” the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2016, and conflicting national standards shall be withdrawn at the latest by June 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 13694:2000.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 13694:2015 has been approved by CEN as EN ISO 13694:2015 without any modification.

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 172, *Optics and photonics*, Subcommittee SC 9, *Electro-optical systems*.

This second edition cancels and replaces the first edition (ISO 13694:2000), which has been technically revised with the following changes:

a) the definition of power density distribution E (x, y, z) has been revised, a definition of the power density E (x_0, y_0, z) has been added;

b) the definition of energy density distribution H (x, y, z) has been revised, a definition of the energy density H (x_0, y_0, z) has been added;

c) the term "threshold power [energy] density" has been replaced by "clip-level power [energy] density". The index "T" indicating "threshold" has been replaced by "CL" accordingly;

d) the term "effective power [energy]" has been replaced by "clip-level power [energy]";

e) in 3.2.5, the formula for beam ellipticity has been revised;

f) the term "effective irradiation area" has been replaced by "clip-level irradiation area";

g) the notation $E_{\eta}(z)$ [$H_{\eta}(z)$] indicating the clip-level average power [energy] density has been replaced by $E_{\eta\text{ave}}(z)$, [$H_{\eta\text{ave}}(z)$];

h) Figure 1 has been revised taking into account the items a) and g) of this list.

It also incorporates the corrigendum ISO 13694:2000/Cor 1:2005.

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.

This International Standard provides definitions of terms and symbols to be used in referring to power density distribution, as well as requirements for its measurement. For pulsed lasers, the distribution of time-integrated power density (i.e. energy density) is the quantity most often measured.

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 describes this measurement procedure. For other applications, other definitions for the beam diameter can be used. For some quantities used in this International Standard, the first definition (encircled power [energy]) is more appropriate and easier to use.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document can involve the use of patents concerning the inclusion of negative noise values in background evaluation of CCD camera images as described in 8.3.2.

ISO takes no position concerning the evidence, validity, and scope of this patent right.

The holder of this patent right (U.S. No. 5,418,562 and 5,440,562, and PCT WO 94/27401) has assured ISO that they are willing to negotiate licenses under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. Information can be obtained from:

Spiricon Inc.

Laser Beam Diagnostics

2600 North Main

Logan, UT 84341

USA

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

1 Scope

This International Standard specifies methods by which the measurement of power [energy] density distribution is made and defines parameters for the characterization of the spatial properties of laser power [energy] density distribution functions at a given plane.

The methods given in this International Standard are intended to be used for the testing and characterization of both continuous wave (cw) and pulsed laser beams used in optics and optical instruments.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 — Laser and laser-related equipment — Vocabulary and symbols*

ISO 11146 (all parts), *Lasers and laser-related equipment — Test methods for laser beam widths, divergence angles and beam propagation ratios*

ISO 11554, *Optics and photonics — Lasers and laser-related equipment — Test methods for laser beam power, energy and temporal characteristics*

IEC 61040, *Power and energy measuring detectors, instruments and equipment for laser radiation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11145 and IEC 61040 and the following apply.

3.1 Measured quantities

3.1.1
power density distribution
$E(x, y, z)$
set of all power densities at location z of a certain CW beam with non-negative values for all transverse coordinates *(x,y)*

3.1.1.1
power density
$E(x_0, y_0, z)$
part of the beam power at location z which impinges on the area δA at the location (x_0, y_0) divided by the area δA $(\delta A \to 0)$