SLOVENSKI STANDARD
SIST EN ISO 11146:2000

01-januar-2000

Laserji in laserska oprema – Preskusne metode za parametre laserskega žarka – Širina žarka, kot divergence kota in faktor širjenja žarkov (ISO 11146:1999)

Laser and laser-related equipment - Test methods for laser beam parameters - Beam widths, divergence angle and beam propagation factor (ISO 11146:1999)

Laser und Laseranlagen - Prüfverfahren für Laserstrahlparameter - Strahlabmessungen, Divergenzwinkel und Strahlpropagationsfaktor (ISO 11146:1999)

Lasers et équipements associés aux lasers - Méthodes d'essai des parametres des faisceaux laser - Largeurs du faisceau, angle de divergence et facteur de propagation du faisceau (ISO 11146:1999)

Ta slovenski standard je istoveten z: **EN ISO 11146:1999**

ICS:

31.260	Optoelektronika, laserska oprema	Optoelectronics. Laser equipment

SIST EN ISO 11146:2000 **en**

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 11146

June 1999

ICS 31.260

English version

Lasers and laser-related equipment - Test methods for laser beam parameters - Beam widths, divergence angle and beam propagation factor (ISO 11146:1999)

Lasers et équipements associés aux lasers - Méthodes d'essai des paramètres des faisceaux laser - Largeurs du faisceau, angle de divergence et facteur de propagation du faisceau (ISO 11146:1999)

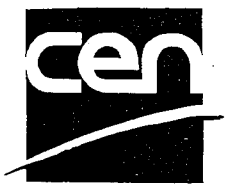
Laser und Laseranlagen - Prüfverfahren für Laserstrahlparameter - Strahlabmessungen, Divergenzwinkel und Strahlpropagationsfaktor (ISO 11146:1999)

This European Standard was approved by CEN on 19 May 1999.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Foreword

The text of the International Standard ISO 11146:1999 has been prepared by Technical Committee ISO/TC 172 "Optics and optical instruments" in collaboration with Technical Committee CEN/TC 123 "Lasers and laser related equipment", 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 December 1999, and conflicting national standards shall be withdrawn at the latest by December 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 11146:1999 was approved by CEN as a European Standard without any modification.

NOTE: Normative references to International Standards are listed in annex ZA (normative).

Annex ZA (normative)
Normative references to international publications with their relevant European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

Publication	Year	Title	EN	Year
ISO 11145	1994	Optics and optical instruments - Lasers and laser related equipment - Vocabulary and symbols	EN ISO 11145	1994

INTERNATIONAL STANDARD

ISO 11146

First edition
1999-06-01

Lasers and laser-related equipment — Test methods for laser beam parameters — Beam widths, divergence angle and beam propagation factor

Lasers et équipements associés aux lasers — Méthodes d'essai des paramètres des faisceaux laser — Largeurs du faisceau, angle de divergence et facteur de propagation du faisceau

Reference number
ISO 11146:1999(E)

Contents

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 11146 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 9, *Electro-optical systems*.

Annexes A and B form a normative part of this International Standard. Annex C is for information only.

Introduction

Any radially symmetric laser beam requires three parameters for characterization:

a) location of the beam waist z_0;

b) waist diameter $d_{\sigma 0}$; and

c) the far-field divergence angle Θ_σ for the beam under test.

With these three values, one can predict the beam diameter at any plane along the propagation axis. To a first approximation (for divergence angles less than 0,8 rad), the beam propagates as

$$d_\sigma{}^2(z) = d_{\sigma 0}{}^2 + (z - z_0)^2 \cdot \Theta_\sigma{}^2 \tag{1}$$

The beam propagates according to equation (1) provided the second moments of the power (energy) density distribution function are used for the definition of beam widths and divergences. The propagation is described by a beam propagation factor K or a times-diffraction-limit factor M^2 which can be derived from the above basic data. The relationship between K and M^2, respectively, the actual waist diameter $d_{\sigma 0}$ and the divergence angle Θ_σ, is:

$$K = \frac{1}{M^2} = \frac{4\lambda_0}{\pi} \cdot \frac{1}{n \cdot d_{\sigma 0} \cdot \Theta_\sigma} = \frac{4\lambda}{\pi} \cdot \frac{1}{d_{\sigma 0} \cdot \Theta_\sigma} \tag{2}$$

where

K is the beam propagation factor;

M^2 is the times-diffraction-limit factor;

λ_0 is the wavelength in vacuum ;

λ is the wavelength in medium with index of refraction n,

Θ_σ is the divergence angle,

$d_{\sigma 0}$ is the waist diameter,

n is the index of refraction.

NOTE 1 The accuracy of measurement of beam propagation factors is expected to be in the region of 10 %. It is not consistent with divergence angles (full angle according to ISO 11145) above 0,8 rad.

The product

$$n \cdot d_{\sigma 0} \cdot \Theta_\sigma = \frac{4\lambda_0}{K\pi} = \frac{M^2 4\lambda_0}{\pi} \tag{3}$$

describes the propagation of laser beams and is invariant throughout the propagation of the beam as long as aberration-free and non-aperturing optical systems are used.

For non-radially symmetric beams, the values of seven parameters are required for characterization:

— locations of the beam waists z_{0x} and z_{0y}

— waist widths $d_{\sigma 0x}$ and $d_{\sigma 0y}$;

— far-field divergence angles $\Theta_{\sigma x}$ and $\Theta_{\sigma y}$; and

— azimuth angle φ between the x-axis of the beam axes system and the x'-axis of the laboratory system. The x-axis of the beam axes system coincides with the principal axis of the laser beam closest (within ±45°) to the arbitrary x' coordinate.

In analogy to equation (3), the propagation of non-radially symmetric beams, which are however still characterizable using two principal axes orthogonal to each other, can be described independently for the x- and y-axes using K_x and K_y as beam propagation factors, or M_x^2 and M_y^2 as times-diffraction-limit factors, respectively.

NOTE 2 Beams that suffer from general astigmatism (twisted beams) require three additional parameters for their characterization. The propagation in the x-z plane is not necessarily independent of the propagation characteristics in the y-z plane and not necessarily along the propagation path will a generally astigmatic beam exhibit a circular power density distribution. The measurement of generally astigmatic beams is outside the scope of this International Standard.

In this International Standard, the second moments of the power (energy) density distribution function are used for the determination of beam widths. However, there may be problems experienced in the direct measurement of this property in the beams from some laser sources. In this case, other indirect methods of measurement of second moment may be used as long as comparable results are achievable.

In annex A, three alternative methods for beam width measurement and their correlation with the method used in this International Standard are described. These methods are:

- Variable aperture method
- Moving knife-edge method
- Moving slit method

The problem of the dependence of the measuring result on the truncation limits of the integration has been investigated and evaluated by an international round robin carried out in 1997. The results of this round robin testing were taken into consideration in this document.