



NSAI
Standards

Irish Standard
I.S. EN ISO 11146-1:2021

Lasers and laser-related equipment - Test methods for laser beam widths, divergence angles and beam propagation ratios - Part 1: Stigmatic and simple astigmatic beams (ISO 11146-1:2021)

I.S. EN ISO 11146-1:2021

Incorporating amendments/corrigenda/National Annexes issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):

NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.

This document is based on:

EN ISO 11146-1:2021

Published:

2021-07-21

*This document was published
under the authority of the NSAI
and comes into effect on:*

2021-08-09

ICS number:

31.260

NOTE: If blank see CEN/CENELEC cover page

NSAI
1 Swift Square,
Northwood, Santry
Dublin 9

T +353 1 807 3800
F +353 1 807 3838
E standards@nsai.ie
W NSAI.ie

Sales:
T +353 1 857 6730
F +353 1 857 6729
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

National Foreword

I.S. EN ISO 11146-1:2021 is the adopted Irish version of the European Document EN ISO 11146-1:2021, Lasers and laser-related equipment - Test methods for laser beam widths, divergence angles and beam propagation ratios - Part 1: Stigmatic and simple astigmatic beams (ISO 11146-1:2021)

This document does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

For relationships with other publications refer to the NSAI web store.

Compliance with this document does not of itself confer immunity from legal obligations.

In line with international standards practice the decimal point is shown as a comma (,) throughout this document.

This page is intentionally left blank

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 11146-1

July 2021

ICS 31.260

Supersedes EN ISO 11146-1:2005

English Version

**Lasers and laser-related equipment - Test methods for
laser beam widths, divergence angles and beam
propagation ratios - Part 1: Stigmatic and simple
astigmatic beams (ISO 11146-1:2021)**

Lasers et équipements associés aux lasers - Méthodes
d'essai des largeurs du faisceau, angles de divergence
et facteurs de limite de diffraction - Partie 1: Faisceaux
stigmatiques et astigmatiques simples (ISO 11146-
1:2021)

Laser und Laseranlagen - Prüfverfahren für
Laserstrahlmessungen, Divergenzwinkel und
Beugungsmaßzahlen - Teil 1: Stigmatische und einfach
astigmatische Strahlen (ISO 11146-1:2021)

This European Standard was approved by CEN on 4 July 2021.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, 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: Rue de la Science 23, B-1040 Brussels

EN ISO 11146-1:2021 (E)

Contents	Page
European foreword.....	3

European foreword

This document (EN ISO 11146-1:2021) 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 January 2022, and conflicting national standards shall be withdrawn at the latest by January 2022.

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

This document supersedes EN ISO 11146-1:2005.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN websites.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 11146-1:2021 has been approved by CEN as EN ISO 11146-1:2021 without any modification.

This page is intentionally left blank

INTERNATIONAL STANDARD

ISO
11146-1

Second edition
2021-07

Lasers and laser-related equipment — Test methods for laser beam widths, divergence angles and beam propagation ratios —

Part 1: Stigmatic and simple astigmatic beams

*Lasers et équipements associés aux lasers — Méthodes d'essai des
largeurs du faisceau, angles de divergence et facteurs de limite de
diffraction —*

Partie 1: Faisceaux stigmatiques et astigmatiques simples



Reference number
ISO 11146-1:2021(E)

© ISO 2021

ISO 11146-1:2021(E)



COPYRIGHT PROTECTED DOCUMENT

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Coordinate systems	7
5 Test principles	7
5.1 Applicability.....	7
5.2 Beam widths and beam diameter.....	7
5.3 Beam divergence angles.....	8
5.4 Beam propagation ratios.....	8
5.5 Combined measurement of beam waist locations, beam widths, beam divergence angles and beam propagation ratios.....	8
6 Measurement arrangement and test equipment	8
6.1 General.....	8
6.2 Preparation.....	8
6.3 Control of environment.....	9
6.4 Detector system.....	9
6.5 Beam-forming optics and optical attenuators.....	9
6.6 Focusing system.....	10
7 Beam widths and beam diameter measurement	10
7.1 Test procedure.....	10
7.2 Evaluation.....	10
8 Measurement of divergence angles	12
8.1 Test procedure.....	12
8.2 Evaluation.....	12
9 Combined determination of beam waist locations, beam widths, divergence angles and beam propagation ratios	12
10 Test report	14
Bibliography	17

ISO 11146-1:2021(E)

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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 9, *Laser and electro-optical systems*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 123, *Lasers and photonics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 11146-1:2005), which has been technically revised. The main changes compared to the previous edition are as follows:

- The terms and definitions were harmonized with the new edition of ISO 11145.
- The "principal axes" were defined more thoroughly and named as x' and y' . Quantities related to the principal axes coordinate system refer to this definition and use x' and y' in their indices.
- The requirements for the integration range for the determination of the second order moments have been relaxed.

A list of all parts in the ISO 11146 series can be found on the ISO website.

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

The propagation properties of every laser beam can be characterized within the method of second order moments by ten independent parameters (see ISO/TR 11146-3). However, due to their higher symmetry most laser beams of practical interest need fewer parameters for a complete description. Most lasers of practical use emit beams which are stigmatic or simple astigmatic because of their resonator design.

This document describes the measurement methods for stigmatic and simple astigmatic beams while ISO 11146-2 deals with the measurement procedures for general astigmatic beams. For beams of unknown type the methods of ISO 11146-2 are applicable. Beam characterization based on the method of second order moments as described in both parts is only valid within the paraxial approximation.

The theoretical description of beam characterization and propagation as well as the classification of laser beams is given in ISO/TR 11146-3, which is a Technical Report and describes the procedures for background subtraction and offset correction.

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

In ISO/TR 11146-3, three alternative methods for beam width measurement and their correlation with the method used in this document are described. These methods are:

- variable aperture method;
- moving knife-edge method;
- moving slit method.

Lasers and laser-related equipment — Test methods for laser beam widths, divergence angles and beam propagation ratios —

Part 1: Stigmatic and simple astigmatic beams

1 Scope

This document specifies methods for measuring beam widths (diameter), divergence angles and beam propagation ratios of laser beams. This document is only applicable for stigmatic and simple astigmatic beams. If the type of the beam is unknown, and for general astigmatic beams, ISO 11146-2 is applicable.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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 — Lasers and laser-related equipment — Vocabulary and symbols*

ISO 11146-2, *Lasers and laser-related equipment — Test methods for laser beam widths, divergence angles and beam propagation ratios — Part 2: General astigmatic beams*

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

EN 61040:1992, *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, ISO 13694, EN 61040 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

NOTE The x-, y- and z-axes in these definitions refer to the laboratory system as described in [Clause 4](#). Here and throughout this document the term “power density distribution $E(x,y,z)$ ” refers to continuous wave sources. It might be replaced by “energy density distribution, $H(x,y,z)$ ” in case of pulsed sources.

This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

-
- Looking for additional Standards? Visit Intertek Inform Infostore
 - Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation
-