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

*Optique et photonique — Lasers et équipements associés aux lasers —  
Méthodes d'essai de la puissance et de l'énergie des faisceaux lasers  
et de leurs caractéristiques temporelles*



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 11554 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 9, *Electro-optical systems*.

This third edition cancels and replaces the second edition (ISO 11554:2003), which has been technically revised.

For the purposes of this International Standard, the CEI annex regarding fulfilment of European Council Directives has been removed.

## Introduction

The measurement of laser power (energy for pulsed lasers) is a common type of measurement performed by laser manufacturers and users. Power (energy) measurements are needed for laser safety classification, stability specifications, maximum laser output specifications, damage avoidance, specific application requirements, etc. This document provides guidance on performing laser power (energy) measurements as applied to stability characterization. The stability criteria are described for various temporal regions (e.g., short-term, medium-term and long-term) and provide methods to quantify these specifications. This International Standard also covers pulse measurements where detector response speed can be critically important when analysing pulse shape or peak power of short pulses. To standardize reporting of power (energy) measurement results, a report template is also included.

This International Standard is a Type B standard as stated in ISO 12100-1.

The provisions of this International standard may be supplemented or modified by a Type C standard.

Note that for machines which are covered by the scope of a Type C standard and which have been designed and built according to the provisions of that standard, the provisions of that Type C standard take precedence over the provisions of this Type B standard.

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

## 1 Scope

This International Standard specifies test methods for determining the power and energy of continuous-wave and pulsed laser beams, as well as their temporal characteristics of pulse shape, pulse duration and pulse repetition rate. Test and evaluation methods are also given for the power stability of cw-lasers, energy stability of pulsed lasers and pulse duration stability.

The test methods given in this International Standard are used for the testing and characterization of lasers.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the last edition of the referenced document (including any amendments) applies.

ISO 11145:2006, *Optics and optical instruments — Lasers and laser-related equipment — Vocabulary and symbols*

IEC 61040:1990, *Power and energy measuring detectors — instruments and equipment for laser radiation*

*International vocabulary of basic and general terms in metrology (VIM)*. BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML, 2nd ed. 1993

## 3 Terms and definitions

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

### 3.1 relative intensity noise

**RIN**

$R(f)$

single-sided spectral density of the power fluctuations normalized to the square of the average power as a function of the frequency  $f$

NOTE 1 The relative intensity noise  $R(f)$  or RIN as defined above is explicitly spoken of as the “relative intensity noise spectral density”, but usually simply referred to as RIN.

NOTE 2 For further details, see Annex A.

### 3.2 small signal cut-off frequency

$f_c$

frequency at which the laser power output modulation drops to half the value obtained at low frequencies when applying small, constant input power modulation and increasing the frequency