



SLOVENSKI STANDARD
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Lasers and laser-related equipment - Test methods of laser radiation-induced damage threshold - Part 2: Threshold determination (ISO/DIS 21254-2:2008)

Lasers and laser-related equipment - Test methods of laser radiation-induced damage threshold - Part 2: Threshold determination (ISO/DIS 21254-2:2008)

Lasers und Laseranlagen - Prüfverfahren für die laserstrahlungsinduzierte Zerstörschwelle - Teil 2: Bestimmung der Zerstörschwelle (ISO/DIS 21254-2:2008)

Lasers et équipements associés aux lasers - Méthodes d'essai pour seuil d'endommagement provoqué par laser - Partie 2: Détermination du seuil (ISO/DIS 21254-2:2008)

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Lasers and laser-related equipment - Test methods of laser radiation-induced damage threshold - Part 2: Threshold determination (ISO/DIS 21254-2:2008)

Lasers et équipements associés aux lasers - Méthodes d'essai pour seuil d'endommagement provoqué par laser - Partie 2: Détermination du seuil (ISO/DIS 21254-2:2008)

Laser und Laseranlagen - Prüfverfahren für die laserstrahlungsinduzierte Zerstörschwelle - Teil 2: Bestimmung der Zerstörschwelle (ISO/DIS 21254-2:2008)

This draft European Standard is submitted to CEN members for parallel enquiry. It has been drawn up by the Technical Committee CEN/TC 123.

If this draft becomes a European Standard, 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.

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Contents	Page
Foreword.....	3

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Foreword

This document (prEN ISO 21254-2:2008) has been prepared by Technical Committee ISO/TC 172 "Optics and optical instruments" in collaboration with Technical Committee CEN/TC 123 "Lasers and photonics" the secretariat of which is held by DIN.

This document is currently submitted to the parallel Enquiry.

This document will supersede EN ISO 11254-1:2000, EN ISO 11254-2:2001.

Endorsement notice

The text of ISO/DIS 21254-2:2008 has been approved by CEN as a prEN ISO 21254-2:2008 without any modification.

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Lasers and laser-related equipment — Test methods for laser radiation-induced damage threshold —

Part 2: Threshold determination

Lasers et équipements associés aux lasers — Méthodes d'essai pour seuil d'endommagement provoqué par laser —

Partie 2: Détermination du seuil

(Revision of ISO 11254-1:2000 and ISO 11254-2:2001)

ICS 31.260

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The CEN Secretary-General has advised the ISO Secretary-General that this ISO/DIS covers a subject of interest to European standardization. **In accordance with the ISO-lead mode of collaboration as defined in the Vienna Agreement, consultation on this ISO/DIS has the same effect for CEN members as would a CEN enquiry on a draft European Standard.** Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month FDIS vote in ISO and formal vote in CEN.

In accordance with the provisions of Council Resolution 15/1993 this document is circulated in the English language only.

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ISO/DIS 21254-2

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Contents

Page

1	Scope	1
2	Normative references	1
3	Terms and definitions	1
4	Test methods	2
4.1	Test method 1 on 1 test	2
4.1.1	Test parameters 1 on 1 test	2
4.1.2	Procedure 1 on 1 test	2
4.1.3	Evaluation 1 on 1 test	2
4.2	Test method S on 1 test	3
4.2.1	Test parameters S on 1 test	3
4.2.2	Procedure S on 1 test	3
4.2.3	Evaluation S on 1 test	4
5	Accuracy	7
6	Test report	7
6.1	1 on1 test	7
6.2	S on1 test	8
	Annex A (informative) Example of a measurement procedure	9
	Annex B (informative) Test report example	15
	Annex C (informative) Example of a measurement procedure	19
	Annex D (informative) Example of test report	23
	Annex E (informative) Extrapolation method for S-on-1 tests	27
	Annex F (informative) Conversion of damage data into defect density	29

ISO/DIS 21254-2

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 21254-2 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 9, *Electro-optical systems* and by Technical Committee CEN/TC 123, *Lasers and photonics* in collaboration.

This second edition cancels and replaces the first editions (ISO 11254-1:2000, ISO 11254-2:2001 and ISO 11254-3:2006), which have been technically revised.

ISO 21254 consists of the following parts, under the general title *Lasers and laser-related equipment — Test methods for laser radiation-induced damage threshold*:

- *Part 1: Definitions and general principles;*
- *Part 2 : Threshold determination;*
- *Part 3: Assurance of laser power (energy) handling capabilities;*
- *Part 4: Inspection, detection and measurement (Technical Report).*

Annexes A to F are for information only.

Introduction

This part of ISO 21254 specifies test methods for determining single-shot and multiple-shot laser radiation-induced damage thresholds (LIDT) of optical components, both coated and uncoated. The procedures have been promulgated in order to provide a method for obtaining consistent measurement results, which may be rapidly and accurately compared among different testing laboratories.

In the single-shot test, which is assigned to the term 1 on 1 test within this standard, each unexposed site of the sample surface is subjected to only one pulse of laser radiation. Repetitive laser radiation may deteriorate and damage optical components at irradiation levels below those measured for single shot damage. Besides reversible mechanisms induced by thermal heating and distortion, irreversible damage mechanisms due to ageing, microdamage and generation or migration of defects are observed. The degradation of the optical quality is a function of the laser operating parameters and the optical system in which the component is placed. The multiple-shot test, S on 1 test, is based on a protocol that uses a series of pulses with constant energy density on each unexposed test site.

Besides an evaluation technique based on the survival curve for 1 on 1 tests, this standard also describes two evaluation methods for the reduction of raw data of S on 1 damage tests: the characteristic damage curve and the extrapolation method. The characteristic damage curve method is based on a large number of S on 1 test sites on the optical surface of the specimen and comprises a set of three graphs indicating energy density values with damage probability values of 10 %, 50 % and 90 % for a selected number of pulses. The characteristic damage curve represents the results of a complete and extended laser induced damage test, and it is recommended for basic investigations in newly developed or critical laser optics. The second evaluation technique for S on 1 tests, the extrapolation method, is created from a considerably smaller number of test sites. This method generates a distribution diagram of damage and non-damage regions for the behaviour of the damage threshold as a function of the number of pulses per site. This diagram is of limited reliability and may be employed for the quality control of optical laser components, which are already qualified by a complete damage test, or for the preparation of extended damage testing.

Realistic laser damage tests adapted to industrial applications are dependent on a large number of pulses (10^9 to 10^{11} pulses) and require a disproportionate experimental expense. This standard therefore outlines also a procedure for an extrapolation of the S on 1 threshold from the characteristic damage curve to estimate the real lifetime of an optical component.

NOTE It must be realised that the laser induced damage threshold of an optical component which is subjected to repetitive radiation can be affected by a variety of different degradation mechanisms including contamination, thermal heating, migration or generation of internal defects and structural changes. These mechanisms are influenced by the laser operating parameters, the environment and the mounting conditions of the component under test. For these reasons it is necessary to record all parameters and to realise that the damage behaviour may differ in systems with altered operating conditions.

The test procedures described in this standard are applicable to all combinations of different laser wavelengths and pulse lengths. However comparison of laser damage threshold data may be misleading unless the measurements have been carried out at identical wavelengths, pulse lengths and beam diameters. Definitions and the general principle of laser induced damage threshold measurements are described in ISO/DIS 21254-1:2008.

Safety Warning: The extrapolation of damage data may lead to bad or erroneous calculated results and to an overestimation of the LIDT. This may in the cases of toxic materials (e.g. ZnSe, GaAs, CdTe, ThF₄, chalcogenides, Be, Cr, Ni) lead to severe health hazards. See ISO/DIS 21254-1:2008, Annex A for further comments.

Lasers and laser-related equipment — Test methods for laser radiation-induced damage threshold —

Part 2: Threshold determination

1 Scope

This standard is part of ISO 21254 and defines the determination of 1 on 1 and S on 1 laser radiation induced damage thresholds of optical laser components. The standard is applicable to all types of lasers and operation conditions.

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 latest edition of the referenced document (including any amendments) applies.

ISO 10110-7:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 7: Surface imperfection tolerances.*

ISO 11145, *Optics and photonics — Lasers and laser-related equipment — Vocabulary and symbols.*

ISO 15367-1, *Lasers and laser-related equipment — Test methods for determination of the shape of a laser beam wavefront — Part 1: Terminology and fundamental aspects*

ISO 15367-2, *Lasers and laser-related equipment — Test methods for determination of the shape of a laser beam wavefront — Part 2: Shack-Hartmann sensors*

ISO/DIS 21254-1:2008, *Lasers and laser-related equipment — Test method for laser radiation-induced damage threshold — Part 1: Definitions and general principles.*

ISO/TR 21254-4:¹⁾, *Lasers and laser-related equipment — Test method for laser radiation-induced damage threshold — Part 4: Inspection, detection and measurement.*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11145 and ISO/DIS 21254-1:2008 apply.

1) To be published.