
**Optics and optical instruments —
Preparation of drawings for optical
elements and systems —**

**Part 13:
Laser irradiation damage threshold**

*Optique et instruments d'optique — Préparation des dessins pour éléments
et systèmes optiques —*

Partie 13: Seuil de dommage au rayonnement laser



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.

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 10110-13 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 1, *Fundamental standards*.

ISO 10110 consists of the following parts, under the general title *Optics and optical instruments — Preparation of drawings for optical elements and systems*:

- Part 1: *General*
- Part 2: *Material imperfections — Stress birefringence*
- Part 3: *Material imperfections — Bubbles and inclusions*
- Part 4: *Material imperfections — Inhomogeneity and striae*
- Part 5: *Surface form tolerances*
- Part 6: *Centring tolerances*
- Part 7: *Surface imperfection tolerances*
- Part 8: *Surface texture*
- Part 9: *Surface treatment and coating*
- Part 10: *Table representing data of a lens element*

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- *Part 11: Non-toleranced data*
- *Part 12: Aspheric surfaces*
- *Part 13: Laser irradiation damage threshold*
- *Part 14: Wavefront deformation tolerance for systems containing zero-power elements only*

Annex A of this part of ISO 10110 is for information only.

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Optics and optical instruments — Preparation of drawings for optical elements and systems —

Part 13:

Laser irradiation damage threshold

1 Scope

ISO 10110 specifies the presentation of design and functional requirements for optical elements in technical drawings used for manufacturing and inspection.

This part of ISO 10110 specifies rules for the indication of the damage threshold from laser irradiation below which optical surfaces shall not exhibit any damage as defined in ISO 11254-1.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 10110. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10110 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 10110-5:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 5: Surface form tolerances.*

ISO 10110-6:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 6: Centring tolerances.*

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

ISO 10110-10:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 10: Table representing data of a lens element.*

ISO 11254-1:—¹⁾, *Optical surfaces — Test methods for laser radiation-induced damage threshold — Part 1: 1 on 1 test.*

1) To be published.

3 Definitions

For the purposes of this part of ISO 10110, the following definitions apply.

3.1

wavelength

λ
wavelength of the laser radiation

3.2

pulse repetition rate

f_p
number of pulses per second of a repetitively pulsed laser

3.3

energy density

H_{th}
<pulsed laser irradiation> energy density threshold, expressed in joules per square centimetre, above which damage occurs

3.4

power density

E_{th}
<continuous wave laser irradiation> power density threshold, expressed in watts per square centimetre, above which damage occurs

4 Other test parameters

N_{TS} is the number of test sites,

N_p is the number of pulses per test site.

Any other test parameters shall be in accordance with ISO 11254-1. For certain optical elements it may be necessary to specify the state and plane of polarization as well as the angle of incidence.

5 Specifications

Specifications of laser irradiation damage threshold apply to the finished surfaces, particularly including surface treatments and coatings.

5.1. Damage threshold for pulsed laser irradiation

The specification of a laser irradiation damage threshold H_{th} (expressed in joules per square centimetre) for an optical surface shall include the laser wavelength, the pulse duration group (pdg) according to ISO 11254-1, the pulse repetition rate, the number of required test sites, and the number of pulses per test site.

5.2. Damage threshold for continuous wave (CW) laser irradiation

The specification of a laser irradiation damage threshold E_{th} (expressed in watts per square centimetre) for an optical surface shall include the laser wavelength and the number of required test sites. The irradiation time shall be 1 s according to ISO 11254-1, laser group 6.

6 Indication

The laser irradiation damage threshold shall be indicated on the technical drawing by a code number and the parameters specified in clause 5. Additional requirements shall be covered by notes.

The code number for the laser radiation threshold is **6**.

The indication shall have the following form:

a) for pulsed laser irradiation:

$$\mathbf{6}/H_{\text{th}}; \lambda; \text{pdg}; f_p; N_{\text{TS}} \times N_p$$

where pdg is the pulse duration group according to ISO 11254-1;

b) for CW laser irradiation:

$$\mathbf{6}/E_{\text{th}}; \lambda; N_{\text{TS}}$$

The units of H_{th} , E_{th} , λ and f_p shall be given in the indication.

7 Location

The indication on the technical drawing shall be shown in connection with a leader line to the surface to which it relates and will be associated with other surface codes (3/, 4/, 5/) as specified in ISO 10110-5, ISO 10110-6 and ISO 10110-7. An example of such an indication is given in Annex A to ISO 10110-1:1996, figure A.1.

Alternatively, the indication may be listed in a table according to figure 2 of ISO 10110-10:1996.

8 Examples of indication

EXAMPLE 1: **6/25 J·cm⁻²; 1 064 nm; 2; 20 Hz; 5 × 100**

This means that no damage is permitted below an energy density of 25 J·cm⁻², for a laser wavelength of 1 064 nm (Nd:YAG), a pulse duration between 10 ns and 30 ns according to laser group 2 given in ISO 11254-1, a pulse repetition rate of 20 Hz, 5 test sites, and 100 pulses per test site.

EXAMPLE 2: **6/6 kW·cm⁻²; 10,6 μm; 10**

This means that no damage is permitted below 6 kW·cm⁻² power density of a CW laser emitting at 10,6 μm wavelength (CO₂), for an irradiation time of 1 s according to laser group 6 of ISO 11254-1, for 10 test sites.

Annex A
(informative)

Bibliography

[1] ISO 10110-1:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 1: General*.

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