

INTERNATIONAL STANDARD

ISO 11553-1

First edition
2005-02-01

Safety of machinery — Laser processing machines —

Part 1: General safety requirements

*Sécurité des machines — Machines à laser —
Partie 1: Prescriptions générales de sécurité*
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Reference number
ISO 11553-1:2005(E)



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Published in Switzerland

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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 11553-1 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 9, *Electro-optical systems*, in collaboration with IEC/TC 76, *Optical radiation safety and laser equipment*.

This first edition of ISO 11553-1 cancels and replaces ISO 11553:1996, which has been technically revised.

ISO 11553 consists of the following parts, under the general title *Safety of machinery — Laser processing machines*:

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- *Part 1: General safety requirements*
 - *Part 2: Safety requirements for hand-held laser processing devices*

Introduction

The Machinery Safety Directive issued by the Council of the EEC outlines essential and mandatory requirements that must be met in order to ensure that machinery is safe. In response, CEN/CENELEC initiated a programme to produce safety standards for machines and their applications. This part of ISO 11553 is one in that series.

It has been prepared as a harmonized standard to provide a means of conforming with the essential safety requirements of the Machinery Directive and associated EFTA Regulations.

This document is a type B standard as stated in ISO 12100-1. The provisions of this document may be supplemented or modified by a type C standard.

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

It is applicable to machines using laser radiation to process materials. The purpose of this part of ISO 11553 is to prevent injuries to persons by

- listing potential hazards generated by machines containing lasers,
- specifying safety measures and verifications necessary for reducing the risk caused by specific hazardous conditions,
- providing references to pertinent standards, and
- specifying the information which is to be supplied to the users so that they can establish proper procedures and precautions.

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Safety of machinery — Laser processing machines —

Part 1: General safety requirements

1 Scope

This part of ISO 11553 describes hazards generated by laser processing machines, as defined in 3.2, and specifies the safety requirements relating to radiation hazards and hazards generated by materials and substances. It also specifies the information to be supplied by the manufacturers of such equipment.

Requirements dealing with noise as a hazard from laser processing machines are not included in this part of ISO 11553. They will be included in a subsequent amendment.

This part of ISO 11553 is not applicable to laser products, or equipment containing such products, which are manufactured solely and expressly for the following applications:

- photolithography;
- stereolithography;
- holography; <https://standards.iteh.ai/catalog/standards/sist/3205c87d-d00f-4562-821c-2193c544a835/iso-11553-1-2005>
- medical applications (per IEC 60601-2-22);
- data storage.

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 3864:1984, *Safety colours and safety signs*

ISO 11252:2004, *Lasers and laser-related equipment — Laser device — Minimum requirements for documentation*

ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*

ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles*

ISO 13849-1:1999, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 14118:2000, *Safety of machinery — Prevention of unexpected start-up*

ISO 14119:1998, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

IEC 60204-1:1997, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60825-1:2001, *Safety of laser products — Part 1: Equipment classification, requirements and user's guide*

IEC 60825-4:1997, *Safety of laser products — Part 4: Laser guards*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100-1 and IEC 60825-1 and the following apply.

3.1 machine

assembly of linked parts or components, at least one of which moves, with the appropriate actuators, control and power circuits, joined together for a specific application, in particular for the processing, treatment, moving or packaging of a material

[ISO 12100-1]

3.2 laser processing machine

machine in which (an) embedded laser(s) provide(s) sufficient energy/power to melt, evaporate, or cause a phase transition in at least a part of the workpiece, and which has the functional and safety completeness to be ready-to-use

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3.3 location with controlled access

location where the hazard is inaccessible except to authorized persons who have received adequate training in laser safety and servicing of the system involved

NOTE See Table 1.

3.4 location with restricted access

location where the hazard is inaccessible to the public but may be accessible to other observers or other untrained personnel who are kept from being exposed to the hazards of laser processing by barriers or other methods

NOTE See Table 1.

3.5 location with unrestricted and uncontrolled access

location where access is not limited or controlled

NOTE See Table 1.

Table 1 — Description of locations

Location	Controlled	Restricted	Unrestricted and uncontrolled
People	Authorized and trained in laser safety	Personnel untrained in laser safety but not the public	All, including the public

3.6**(preventive) maintenance**

performance of those adjustments or procedures specified in user information, which are intended to be performed by the user for the purpose of assuring the intended performance of the product

EXAMPLES Replenishment of consumables and cleaning.

3.7**manufacturer**

individual or organization that assembles the laser processing machine

NOTE 1 Where a laser processing machine is imported, the importer assumes the responsibilities of the manufacturer.

NOTE 2 An individual or organization that is responsible for modification of a machine is regarded as a manufacturer.

3.8**modification**

change to the machine which makes it capable of processing materials in a manner which differs from the original design, or which makes it capable of processing materials different from what was envisaged in the original design, or which affects the safety characteristics of a machine

3.9**process zone**

area where the laser beam interacts with the material of the workpiece

3.10**production**

phase during which the machine is used as intended, including the following operations:

- loading and unloading of parts and/or materials to be processed;
- processing during which the laser beam works alone or in conjunction with other tools

NOTE The loading/unloading can be fully or partly automated or manual.

3.11**service****corrective maintenance**

performance of those procedures or adjustments described in the manufacturer's service instructions which may affect any aspect of a product's performance

EXAMPLES Fault diagnosis, equipment strip-down and repairing.

3.12**subassembly**

constituent part needed for proper performance of the laser processing machine

NOTE A laser processing subassembly can be of any laser class in accordance with IEC 60825-1.

3.13**workpiece**

material intended to be processed, i.e. the target of the laser beam

4 Hazards**4.1 General**

The following subclauses outline areas of concern associated with materials processing with lasers.

4.2 Inherent hazards

The following hazards (see ISO 12100-1 and ISO 12100-2) may be generated by a laser processing machine:

- mechanical hazards;
- electrical hazards;
- thermal hazards;
- vibration hazards;
- radiation hazards, such as
 - hazards generated by direct or reflected laser beam,
 - hazards generated by ionizing radiation,
 - hazards generated by collateral (UV, microwave, etc.) radiation produced, for example, by flash lamps, discharge tubes or RF-power sources, and
 - hazards generated by secondary radiation due to beam effect (the wavelength of the secondary radiation may be different from that of the beam);
- hazards generated by materials and substances, such as
 - hazards due to products which are used in the machine (e.g. laser gases, laser dyes, lasing gases, solvents),
 - hazards resulting from interaction between the beam and the material (e.g. fumes, particles, vapours, debris), fire or explosion,
 - hazards from associated gases (see for example 5.3.4) used to assist laser target interactions and from any fumes that are produced; these hazards include explosion, fire, toxic effects and oxygen depletion;
- hazards generated by neglecting ergonomic principles in machine design.

4.3 Hazards created by external effects (interferences)

Power conditions and the environment in which the machine operates may cause the machine to malfunction, thus giving rise to hazardous conditions and/or making it necessary for someone to intervene within hazard zones.

Additional environmental interferences include

- temperature,
- humidity,
- external shock/vibration,
- vapours, dust or gases from the environment,
- electromagnetic/radio frequency interference,
- source voltage interruption/fluctuation, and
- insufficient hardware/software compatibility and integrity.

4.4 Hazards covered by this part of ISO 11553

Only radiation hazards and hazards generated by the laser interaction with materials and substances are dealt with in this part of ISO 11553. Other potential hazards are listed in Annex A.

5 Safety requirements and measures

5.1 General requirements

The extent to which hazards are covered is indicated in the Scope. Machinery shall comply as appropriate with ISO 12100-1 and ISO 12100-2 for hazards which are not covered by this part of ISO 11553.

Manufacturers shall ensure the safety of laser processing machines by

- hazard identification and analysis,
- implementation of safety measures,
- certification and verification of the safety measures, and
- provision of appropriate information for the user.

Based on the hazard identification (see 5.2), appropriate safety measures shall be incorporated into the laser processing machine by design and manufacture.

The following requirements shall be satisfied:

- each manufacturer shall comply with the safety requirements and measures stipulated in this clause;
- the manufacturer of an installed machine shall be responsible for the compliance of the whole machine, including subassemblies.

NOTE These requirements apply even if the manufacturer and the customer/user are the same legal entity.

These measures shall take into account each hazard listed in Clause 4, and the results of the hazard analysis, and should take into account information in Annexes A and B.

5.2 Risk assessment

A risk assessment shall be performed

- for all phases of machine “life” (as applicable); for examples see ISO 12100-1;
- after each modification of the machine by the person or organization responsible for the modification.

A risk assessment includes but is not limited to

- a) hazards listed in 4.2 and 4.3;
- b) danger zones, particularly those associated with
 - the laser system,
 - the laser beam path/beam delivery system, and
 - the process zone;
- c) “interferences” listed in 4.3.

The results of the risk assessment shall be duly documented. Concerning principles for risk assessment, see also EN 1050.