

INTERNATIONAL STANDARD

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Safety of machinery — Laser processing machines — Safety requirements

Sécurité des machines — Machines à laser — Prescriptions de sécurité



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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.

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 11553 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 9, *Electro-optical systems*, in collaboration with CEN/TC 123, *Lasers and laser related equipment*, and was correlated with IEC/TC 76.

Annex A forms an integral part of this International Standard. Annexes B, C and D are for information only.

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 International Standard 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.

The extent to which hazards are covered is indicated in the scope. Machinery should comply as appropriate with ISO/TR 12100 for hazards which are not covered by this International Standard.

It is applicable to machines using laser radiation to process materials. The purpose of this International Standard is to prevent injuries to persons

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

Safety of machinery — Laser processing machines — Safety requirements

1 Scope

This International Standard 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 manufacturers of such equipment.

It is not applicable to laser products, or equipment containing such products, which are manufactured solely and expressly for the following applications:

- photolithography;
- stereolithography;
- holography;
- medical applications (per IEC 601-2-22);
- data storage.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 3864:1984, *Safety colours and safety signs*.

ISO 11252:1993, *Lasers and laser-related equipment — Laser device — Minimum requirements for documentation*.

ISO/TR 12100-1:1992, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*.

ISO/TR 12100-2:1992, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles and specifications*.

IEC 204-1:1992, *Electrical equipment of industrial machines — Part 1: General requirements*.

IEC 825-1:1993, *Safety of laser products — Part 1: Equipment classification, requirements and user's guide*.

3 Definitions

For the purposes of this International Standard, the definitions given in ISO/TR 12100-1 and IEC 825-1 and the following definitions apply.

3.1 machine: Assembly of linked parts or components, at least one of which moves, with the appropriate actuators, control and power circuits, etc., joined together for a specific application, in particular for the processing, treatment, moving or packaging of material. [ISO/TR 12100]

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 machine has the functional and safety completeness to be ready-to-use.

3.3 (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.

NOTE 1 Examples include replenishment of consumables and cleaning.

3.4 manufacturer: Individual or organization that assembles the laser processing machine. Where a laser processing machine is imported, the importer assumes the duties of the manufacturer. An individual or organization that is responsible for modification of a machine is regarded as a manufacturer.

3.5 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.

3.6 process zone: Area where the laser beam interacts with the material of the workpiece.

3.7 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; this loading/unloading can be fully or partly automated or manual;
- processing during which the laser beam works alone or in conjunction with other tools.

3.8 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.

NOTE 2 Examples include fault diagnosis, equipment strip-down and repairing.

3.9 subassembly: Constituent part needed for proper performance of the laser processing machine. A laser processing subassembly can be of any laser class in accordance with IEC 825-1.

3.10 workpiece: The material intended to be processed; the target of the laser beam.

4 Hazards

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

4.1 Inherent hazards

The following hazards (see ISO/TR 12100) may be generated by a laser processing machine:

- mechanical hazards;
- electrical hazards;
- noise hazards;
- thermal hazards;
- vibration hazards;
- radiation hazards; examples include
 - 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,
 - hazards generated by secondary radiation re-emitted by targets due to beam effect (the wavelength of the re-emitted radiation may be different from that of the beam);
- hazards generated by materials and substances; examples include
 - hazards due to products which are used in the machine (for example laser gases, laser dyes, lasing gases, solvents),
 - hazards resulting from interaction between the beam and the material (for example fumes, particles, vapours, debris),
 - fire or explosion,
 - hazards from associated gases (see for example 5.3.3) 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.