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**Safety of machinery — Laser processing  
machines —**

Part 2:

**Safety requirements for hand-held laser  
processing devices**

iTeh STANDARD PREVIEW

*Sécurité des machines — Machines à laser —*

*(Partie 2) Exigences de sécurité pour dispositifs de traitement laser  
portatifs*

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# Contents

Page

Foreword.....	iv
Introduction .....	v
1 Scope .....	1
2 Normative references .....	1
3 Terms and definitions .....	2
4 Hazards .....	2
4.1 Inherent hazards .....	2
4.2 Hazards induced by external effects (interferences) .....	3
4.3 Further hazards related to the use of hand-held laser processing devices .....	4
5 Safety requirements and measures .....	4
5.1 General requirements .....	4
5.2 Risk assessment .....	5
5.3 Implementation of corrective measures .....	5
5.4 Design requirements .....	7
6 Verification of safety requirements and measures .....	11
6.1 General conformance .....	11
6.2 Control category classification .....	11
6.3 Laser classification .....	12
7 Information for the user .....	12
7.1 Additional requirements .....	12
7.2 Recommended inclusions .....	13
8 Labelling .....	14
Annex A (informative) Risk assessment examples .....	15
Annex B (informative) Types of hand-held laser processing machines .....	17
Bibliography .....	19

## 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 11553-2 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 9, *Electro-optical systems*.

This first edition, together with 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*:

— *Part 1: General safety requirements*

— *Part 2: Safety requirements for hand-held laser processing devices*

This corrected version of ISO 11553-2:2007 now carries the logo of the International Electrotechnical Commission (IEC) as well as that of ISO.

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## Introduction

This document is a type C standard as stated in ISO 12100-1:2003.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this document. When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C 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;
- 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.

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# Safety of machinery — Laser processing machines —

## Part 2: Safety requirements for hand-held laser processing devices

### 1 Scope

This part of ISO 11553 specifies the requirements for laser processing devices, as defined in ISO 11553-1, which are hand-held or hand-operated.

The purpose of this part of ISO 11553 is to draw attention to the particular hazards related to the use of hand-held laser and hand-operated laser processing devices and to prevent personal injury. This includes both the areas of hazard analysis and risk assessment as well as protective measures.

Requirements concerning noise as a hazard are not included in this part of ISO 11553. These requirements are to be included in a subsequent amendment.

This part of ISO 11553 does not apply to laser products or equipment manufactured solely or expressly for applications which are excluded from the scope of ISO 11553-1.

### 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 3864-1:2002, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs in workplaces and public areas*

ISO 3864-2:2004, *Graphical symbols — Safety colours and safety signs — Part 2: Design principles for product safety labels*

ISO 3864-3:2006, *Graphical symbols — Safety colours and safety signs — Part 3: Design principles for graphical symbols used in safety signs*

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

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

ISO 11553-1:2005, *Safety of machinery — Laser processing machines — Part 1: General safety requirements*

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 11553-2:2007(E)

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

ISO 13850:1996, *Safety of machinery — Emergency stop — 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 60204-1:2005, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60825-1 ed. 1.2:2001, *Safety of laser products — Part 1: Equipment classification, requirements and user's guide*

IEC/TR 60825-14:2004; *Safety of laser products — Part 14: A user's guide*

IEC 60825-4-am1:2002, *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 11145, ISO 11553-1, ISO 12100-1, IEC 60825-4 and the following apply.

#### 3.1 hand-held laser processing device

device in which a laser provides sufficient energy/power to melt, evaporate or cause a phase transition in a part of the workpiece and where the laser output or workpiece to be processed is guided manually or hand-held during the laser process

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NOTE For the purposes of this document, the terms "hand-held" and "hand-operated" have the same meaning.

#### 3.2 confined spaces

working areas surrounded on all sides, or for the most part, by solid walls where they, on account of their confinement or containment of materials, preparation or equipment, augment or can augment particular hazards that considerably exceed the hazard potential normally prevailing at workplaces

#### 3.3 supply unit

all devices that provide the process energies and operating material supply, direct these energies to the point of action and are absolutely necessary for the operation of the hand-held laser processing device (e.g. cooling system, power and gas supply)

#### 3.4 disposal units

equipment that captures and removes effluents and by-products during laser material processing passing these on for filtration (e.g. capture devices, pipes, filtration systems, ventilation systems)

## 4 Hazards

### 4.1 Inherent hazards

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

- a) mechanical hazards;



- b) electrical hazards;
- c) thermal hazards;
- d) vibration hazards;
- e) radiation hazards; examples include:
  - 1) hazards generated by direct or reflected laser beams, (also take into account that radiation can occur on the back of the workpiece, e.g. when cutting or due to transparency of the workpiece),
  - 2) hazards generated by ionizing radiation,
  - 3) hazards generated by collateral (UV, microwave, etc.) radiation produced, for example, by flash lamps, discharge tubes or RF-power sources,
  - 4) hazards generated by secondary radiation re-emitted by targets due to beam effects (the wavelength of the re-emitted radiation may be different from that of the beam);
- f) hazards generated by materials and substances; examples include:
  - 1) hazards due to products which are used in the laser-processing device (e.g. laser gases, laser dyes, solvents),
  - 2) hazards resulting from interaction between the beam and the material (e.g. fumes, particles, vapours, debris), fire or explosion,
  - 3) hazards from associated gases (see for example 5.4.10) used to assist laser target interactions and from any fumes that are produced; these hazards include explosion, fire, toxic effects and oxygen depletion,
  - 4) hazards due to the leakage of liquids (e.g. coolant);
- g) hazards generated by neglecting ergonomic principles in the design of the laser-processing device.

#### 4.2 Hazards induced by external effects (interferences)

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

Additional environmental interferences include:

- a) temperature;
- b) humidity;
- c) external shock/vibration;
- d) vapours, dust or gases from the environment;
- e) electromagnetic-interference;
- f) lightning strike;
- g) source voltage interruption/fluctuation;
- h) insufficient hardware/software compatibility and integrity;

- i) hand-held laser processing devices capable of being separated from the radiation source (see also Annex B);
- j) non-observance of interface specification (including power limits, control signals).

### 4.3 Further hazards related to the use of hand-held laser processing devices

#### 4.3.1 Confined rooms

Hand-held laser processing devices could be used in confined rooms. Hazards can be constituted by:

- a) concentration of harmful substances in the room air;
- b) enrichment of process gases (nitrogen, argon, helium, oxygen) in the room air;
- c) oxygen depletion;
- d) electrical current;
- e) increased radiation hazard through direct as well as directly or diffusely reflected laser radiation;
- f) increased tripping and impact (shock) hazard.

#### 4.3.2 Working at heights

Hand-held laser processing devices may be used at heights above the ground or other load bearing surfaces. Hazards are:

- a) falling objects;
- b) fall of the user.

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#### 4.3.3 Environmental effects

Hazards that can directly affect the user due to the prevailing environmental conditions. This applies in particular when hand-held laser processing machines are used outdoors.

This includes the following environmental effects:

- a) temperature (cold, heat);
- b) humidity (rain, fog, hail);
- c) mechanical effects (vibration, wind pressure);
- d) electromagnetic effects (lightning strike);
- e) visibility (sunlight, lighting).

## 5 Safety requirements and measures

### 5.1 General requirements

Machinery shall comply, as appropriate, with ISO 12100-1 or ISO 12100-2 for hazards that are not covered by this part of ISO 11553.

Manufacturers shall ensure the safety of hand-held laser processing devices by:

- a) hazard identification and risk analysis;
- b) implementation of safety measures;
- c) verification of the implemented safety measures;
- d) provision of appropriate information for the user.

Based on the hazard identification (see 5.2), appropriate safety measures shall be incorporated into the hand-held laser processing device 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 a hand-held laser processing device is responsible for compliance of the complete hand-held laser processing device with the requirements, including associated components (e.g. handling unit, laser assembly).

These measures apply to all hazards specified in Clause 4 and reflect the results of hazard analysis and risk assessment. The information given in Annexes A and B should be taken into account.

## 5.2 Risk assessment

A risk assessment shall be performed:

- a) for all phases of hand-held laser processing device "life" (as applicable); for examples see ISO 12100-1;
- b) after each modification of the hand-held laser processing device by the person or organization responsible for the modification.

A risk assessment involves a hazard identification, which includes but is not limited to:

- c) hazards listed in 4.1 and 4.3;
- d) danger zones, particularly those associated with
  - 1) the laser system,
  - 2) the laser beam path/propagation, beam delivery system,
  - 3) the process zone,
  - 4) interferences listed in 4.2.

The results of the risk assessment shall be duly documented.

## 5.3 Implementation of corrective measures

### 5.3.1 General requirements

Manufacturers shall ensure the safety of hand-held laser processing devices by:

- hazard analysis and risk assessment;
- integration of safety measures;