DRAFT INTERNATIONAL STANDARD

ISO DIS 11553-2

ISO/TC **172**/SC **9** Secretariat: **DIN**

Voting begins on: **2016-12-06**

Voting terminates on: **2017-02-27**

Safety of machinery — Laser processing machines —

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

Sécurité des machines — Machines à laser —

Partie 2: Exigences de sécurité pour dispositifs de traitement laser portatifs

ICS: 13.110; 31.260

Member bodies are requested to consult relevant national interests in IEC/TC 76 before casting their ballot to the e-Balloting application.

This document is circulated as received from the committee secretariat.

ISO/CEN PARALLEL PROCESSING

Reference number
ISO DIS 11553-2:2016(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

ISO 11553-2 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 Draft International Standard 11553-2 is a revision of ISO 11553-2:2007 and includes the following changes:

— The document has been technically revised.

— Annex C "Examples for the design of technical safety measures for hand-held laser processing devices " and Annex D "Recommendations for the selection of personal protective clothing for use with HLD " were added.

— An Annex ZA was added.

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*

— *Part 3: Noise reduction and noise measurement methods for laser processing machines and hand-held processing devices and associated auxiliary equipment (accuracy grade 2)*

Introduction

This document is a type C standard as stated in ISO 12100:2010.

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 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 —

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 hand-held 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 dealing with noise as a hazard are covered by ISO 11553-3.

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 documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

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

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

ISO 3864-4, *Graphical symbols — Safety colours and safety signs — Part 4: Colorimetric and photometric properties of safety sign materials*

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

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

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

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

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

ISO 13850, *Safety of machinery — Emergency stop function — Principles for design*

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

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

ISO 13851, *Safety of machinery — Two-hand control devices — Functional aspects and design principles*

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

IEC 60825-1:2014, *Safety of laser products — Part 1: Equipment classification and requirements*

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

IEC 60825-4, *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, IEC 60825-4 and the following apply. ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
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

3.2
disposal unit
equipment that captures and removes effluents and by-products during laser material processing by passing these on for filtration (e.g. capture devices, pipes, filtration systems, ventilation systems)

3.3
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

3.4
supply unit
all devices that provide the process energies and operating material supply direct 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)

4 Hazards

4.1 Inherent hazards

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

a) mechanical hazards,

b) electrical hazards,

c) thermal hazards,

d) vibration hazards,

e) radiation hazards; for example:

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; for example:

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 used to assist laser target interactions; 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 can cause the hand held laser processing device to malfunction thus giving rise to hazardous conditions and/or making intervention necessary within hazard area.

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 (example given in Annex B, Figures B.1),

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 spaces

Hand-held laser processing devices can be used in confined spaces. Additional hazards may be created including

a) concentration of harmful substances in the air,

b) enrichment of process gases (nitrogen, argon, helium, oxygen) in the 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 (mechanical shock) hazard.

4.3.2 Working at heights

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

a) falling objects,

b) fall of the user.

4.3.3 Environmental effects

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

This includes the following environmental effects due to

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 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 assessment,

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:

e) each manufacturer shall comply with the safety requirements and measures stipulated in this clause,

f) 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).

NOTE 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,

b) after each modification of the hand-held laser processing device by the person or organization responsible for the modification,

c) for each use/operation not included by the intended use.

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

d) hazards listed in 4.1 and 4.3,

e) danger zones, particularly those associated with

   1) the laser system,

   2) the laser beam path/propagation, beam delivery system,

   3) the process zone, and

   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

a) hazard analysis and risk assessment,

b) integration of safety measures,

c) verification of safety measures, and

d) provision of appropriate information for the user.

5.3.2 Protection against laser radiation hazards

5.3.2.1 General

The possibility of people being exposed to levels of laser radiation exceeding the Maximum Permissible Exposure (MPE) limits for an exposure time of 3×10^4s, as defined in standards IEC 60825-1 and IEC/TR 60825-14, shall be eliminated during operation.

To satisfy this, the following requirements shall be met:

a) Risk assessment shall be performed,

b) The hand held laser processing device shall only be operated by trained and authorized persons. Unauthorized human access to a danger zone should be prevented by engineering controls as specified in IEC 60825-1.

c) If access cannot be prevented, exposure above the ocular MPE shall be eliminated by use of engineering or administrative controls, including Personal Protective Equipment, satisfying the following requirements:

   1) The design of protective devices, such as shutters, guards, beam dissipation devices, trip devices and deterring/impeding devices shall meet the requirements specified in IEC 60825-1.

   2) In cases of ambiguity or difference of interpretation between ISO 12100 and IEC 60825-1, the first two sentences of 5.3.2.1.1, 5.3.2.1.2 and 5.3.2.1.3 of ISO 11553-1 shall be definitive.

NOTE 1 The same protective device may be used to provide simultaneous protection against more than one hazard.

NOTE 2 Exposure limits for the eye and the skin of employees in the workplace and the general public are in many countries specified in national laws. These legally-binding national exposure limits might differ from the MPEs used is this standard.

5.3.2.2 Protection during operation and maintenance

The principal danger zone is usually the process zone, but the danger zone shall be defined as a result of the risk assessment.

In the danger zone, human exposure shall be limited during operation and maintenance to levels of laser radiation not exceeding the Maximum Permissible Exposure (MPE) limits for an exposure time of 3×10^4s by use of engineering or administrative controls (for example local protection using a protective enclosure), or the use of Personal Protective Equipment (for example laser protective eyewear and clothing).

5.3.2.3 Protection during service

During service procedures, human access to laser radiation exceeding the Accessible Emission limit (AEL) for Class 1 is sometimes unavoidable. During servicing it shall be ensured that only authorized persons are allowed access to zones exposed to levels of laser radiation that exceed the AEL values for Class 1. Hand-held laser-processing devices shall therefore be designed and appropriate safety measures provided, with respect to the following four situations listed in order of preference.

a) Servicing takes place outside danger zones.

b) Servicing takes place in danger zones to which access is controlled in the same manner as during production (e.g. interlocked cover).

c) Servicing takes place in a danger zone (e.g. with open guards that are normally closed during production) but accessible laser radiation does not exceed the AEL for Class 1.

d) Servicing takes place in danger zones, e.g. because opening of guards (normally closed during production) is necessary. In this case, accessible laser radiation exceeds the AEL for Class 1.

The manufacturer shall indicate the class of accessible laser radiation and recommended safety procedures for each of these situations (as applicable).

When servicing hand-held laser processing devices, the laser device should be switched off. For activities (e.g. adjustment), where this is not possible, a nominal ocular hazard area should be established.

5.4 Design requirements

5.4.1 Design

The design of the hand-held laser processing devices shall take place according to ergonomic principles.

