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

*Sécurité des machines — Machines à laser —
Partie 3: Méthodes de mesure et de réduction du bruit des machines
à laser, des dispositifs de traitement portatifs et des équipements
auxiliaires connexes (classe de précision 2)*

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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/IEC 11553-3 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*.

ISO/IEC 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)

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Introduction

The Machinery Safety Directive issued by the Council of the EU 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/IEC 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. The provision 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/IEC 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 3:

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

1 Scope

This part of ISO/IEC 11553 describes the requirements to deal with noise hazards and specifies all the information necessary to carry out efficiently and under standardized conditions the determination, declaration and verification of airborne noise emission from laser processing machines and hand-held laser processing devices within the scope of ISO/IEC 11553-1 and ISO/IEC 11553-2. It specifies the safety requirements relating to noise hazards. It specifies noise measurement methods, installation and operating conditions to be used for the test, together with the information to be supplied by manufacturers of such equipment.

This part of ISO/IEC 11553 applies to those laser processing machines and hand-held laser processing devices included in the scope of ISO/IEC 11553-1 and ISO/IEC 11553-2.

Noise emission characteristics include emission sound pressure levels at work stations and the sound power level. Declared noise emission values permit comparison of laser processing machines and hand-held laser processing devices on the market.

The use of this noise test code (see [Annex A](https://standards.iteh.ai/catalog/standards/sist/8897dbef-9fcb-4f61-bcef-1c0c7e701d/iso-11553-3-2013)) ensures the reproducibility of the determination of the characteristic noise emission values within specific limits. These limits are determined by the accuracy grade of the noise emission measuring method used. Noise emission measurements specified by this part of ISO/IEC 11553 meet the requirements of an engineering method (accuracy grade 2).

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 3744, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane*

ISO 3746, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*

ISO 4871, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 9614-2, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 2: Measurement by scanning*

ISO 11201, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*

ISO 11202, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections*

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ISO 11203:1995, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level*

ISO 11204, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections*

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

ISO/IEC 11553-2, *Safety of machinery — Laser processing machines — Part 2: Safety requirements for hand-held laser processing devices*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

IEC 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications*

EN 352-1, *Hearing protectors — General requirements — Part 1: Ear-Muffs*

3 Noise hazards

Noise generated by laser processing machines and hand-held laser processing devices can result in, for example:

- a) permanent hearing loss;
- b) tinnitus;
- c) tiredness, stress, headaches;
- d) other effects such as loss of balance, loss of awareness;
- e) interference with speech communication; [ISO 11553-3:2013](#)
- f) inability to hear acoustic warning signals. <https://standards.iteh.ai/catalog/standards/sist/8897dbef-9fcb-4f61-bcef-1c8cd9e08fdb/iso-11553-3-2013>

4 Safety requirements and measures

4.1 General requirements for noise reduction

Noise reduction shall be an integral part of the design process by specifically taking into account the measures at source as suggested in ISO/TR 11688-1. The success of the applied noise reduction measures is assessed on the basis of the actual noise emission values according to the noise test code specified within this part of ISO/IEC 11553 in relation to other laser processing machines of a similar application.

4.2 Noise reduction measures

Appropriate noise reduction measures shall be applied.

Particular considerations can be given to:

- a) selecting low noise level pumps rather than enclosing the pumps;
- b) releasing of pneumatic energy (To conserve energy, unnecessary releases should be avoided. Silencers or exhaust filters should be considered.);
- c) stabilizing vibrating pipelines by special fastenings to reduce noise created by such movements;
- d) the laser power generation noise source by selection of low noise components such as fans or by resilient mounting or absorber;
- e) damping measures to be applied at the cooling and fume exhaust systems;

- f) preventing vibration of panels by fitting stiffening strips or noise attenuating materials to reduce the radiation of noise;
- g) placing noise producing component parts away from the operator position whenever practicable;
- h) applying full and partial acoustic enclosures inside the guard enclosing the process zone to limit the radiation of noise generated by the laser process into the environment.

The above list is not exhaustive. Alternative technical measures (that may have identical or improved efficiency) for noise reduction can be considered.

5 Verification of safety requirements for noise emission reduction and/or protection measures

Noise emission values shall be measured by utilizing appropriate measurement method(s) and a noise emission declaration shall be given in the instructions for the user if the emission sound pressure level measured is higher than 70 dB.

An initial test can be made in order to check whether the more expensive measurement procedure described in this standard is necessary or not. The initial test is based on the application of less expensive class 2 sound pressure level meters according to IEC 61672-1. The operating conditions are as described in Clause A.9. Any environmental correction or background noise correction is not applied.

In the case that the A-weighted sound pressure level at the workstation, determined under the prescribed conditions, is not exceeding 65 dB(A) no further measurements following the procedures in this standard of ISO/IEC 11553 is required. The noise emission declaration shall simply state: Emission sound pressure level $L_{pA} \leq 70$ dB.

If the emission sound pressure level measured is greater than 65 dB, the noise reduction measures, measurements, verification and documentation outlined in this part of ISO/IEC 11553 are necessary.

Table 1 summarizes verification methods of safety requirements for noise emission reduction and/or protective measures.

Table 1 — Verification method of safety requirements for noise emission reduction and/or protective measures

Clause	Verification method
4	Measurement of noise emission values according to the noise test code shown in Annex A .
6	Verification that a noise emission declaration is given in the instructions.

6 Information for the user

The information for the user shall contain the following information on airborne noise emissions, determined and declared in accordance with [Annex A](#):

- a) the A-weighted emission sound pressure level at workstations, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this fact shall be indicated;
- b) the peak C-weighted instantaneous sound pressure value at workstations, where this exceeds 63 Pa (130 dB in relation to 20 μ Pa);
- c) the A-weighted sound power level emitted by the machinery, where the A-weighted emission sound pressure level at workstations exceeds 80 dB(A).

Additionally if further protection is necessary, the information shall:

- d) recommend possible noise enclosures, screens to be fitted to the machinery, etc.;

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- e) recommend additional noise reduction measures, for example, to use sound proofing cabins, as well as necessary requirements relating to installation and assembly for reducing noise;
- f) recommend the use of low-noise operating modes or limited time of operation;
- g) recommend the wearing of personal hearing protectors (see EN 352-1).

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Annex A (normative)

Noise test code (accuracy grade 2)

A.1 Emission sound pressure level determination

The measurement positions for determining the A-weighted emission sound pressure level at work stations and other positions are specified in Clause A.9. All microphone positions are at a height of $1,55 \pm 0,075$ m above the floor or access level.

A-weighted emission sound pressure levels shall be determined in accordance with preferably ISO 11201 grade 2, or ISO 11202 grade 2 or ISO 11204 grade 2. If the environmental conditions make it impossible to reach an accuracy grade 2, ISO 11202 grade 3 or ISO 11204 grade 3 shall be applied. The test report shall state the reasons why it was not possible to apply a grade 2 method.

NOTE The advantage of applying ISO 11201 grade 2 is that for $K_2 \leq 2$ dB the environmental correction is not considered.

Emission sound pressure levels of laser processing machines with defined operator positions shall be measured as described in A.9.1.

For hand-held laser processing devices (HLDs) without remote component parts (power device, chiller, filter fan), the A-weighted emission sound pressure level shall be measured in accordance with A.9.3 Table A.5 I.

For hand-held laser processing devices (HLDs) with remote (several metres away) component parts, measurements shall be carried out separately for each machine part. The hand-held tool shall be measured according to A.9.3 Table A.5 I, and the remote component part according to A.9.3 Table A.5 II.

In those cases where the determination of the sound power level is required for HLDs, the use of ISO 11203 is permissible. However, it is necessary to distinguish between the hand-held laser tool and the remote component part. For the hand-held tool, the emission sound pressure level can be determined from the sound power level according to ISO 11203 with $Q = 11$ dB. If the associated component part also generates noise to such extent that the sound power level has to be declared, the emission sound pressure level can be determined by applying ISO 11203:1995, 6.2.3 d) with the measurement surface at a distance of about 1 m from the reference box according to ISO 3744.

A.2 Sound power level determination

A.2.1 General method

The A-weighted sound power levels shall be determined in accordance with ISO 3744 or ISO 9614-2 grade 2. If, due to inappropriate environmental conditions, these standards are not applicable ISO 3746 or ISO 9614-2 grade 3 shall be used. The test report shall state the reasons why it was not possible to apply an accuracy grade 2 method for determining the sound power level.

For hand-held laser processing devices with remote component parts, the hand-held tool and the remote component part shall be treated independently. The determination of the sound power level of the hand-held tool shall be done by defining the reference box around the test-setup described in A.9.3 Table A.5 II, see also Figure A.1. The measurement distance d of the parallelepiped measurement surface shall be 1 m. The operator shall position himself in such a way that he is not hinder the direct sound propagation from the tool to any measurement microphone.

For determining the sound power level of the component part, a parallelepiped measurement surface shall be applied.