



## Factsheet

# ***Material processing with lasers: laser engraving, laser welding, laser cutting, laser cleaning***

## 1 Brief information

Laser systems for material processing pose a considerable danger to users and third parties if they are used improperly. Handheld devices in particular are very dangerous as their laser beam is not enclosed and can spread freely. According to the Federal Act on Product Safety, laser systems may therefore only be placed on the market if they meet the applicable basic health and safety requirements. These requirements are specified, among other things, in the laser standards SN EN 60825-1 and SN EN ISO 11553-1, which define comprehensive safety requirements to protect involved users and uninvolved third parties. Manufacturers and importers as well as employers and operators are responsible for implementing and observing these safety standards to prevent operator accidents and injuring third parties.

Based on standard SN EN 50689, which is valid for consumer laser devices, the supply and sale of class 3B and 4 laser devices to consumers are not permitted.

### **Where can I get more information?**

You can find further information about lasers on the Federal Office of Public Health's website <https://www.bag.admin.ch/en/laser-pointers-events-involving-laser-radiation-lasertag>, and on the Suva website.

### **Please note the following tips for safely handling lasers for material processing:**

- Only use laser class 1 (fully enclosed systems, i.e. without escaping laser radiation) laser engraving devices for private purposes.
- Do not use laser cleaning or laser welding devices for private purposes.
- Follow the safety guidelines in the standards and provided by the manufacturer when using laser engraving, laser cleaning and laser welding devices for commercial purposes.
- Only purchase laser devices for material processing from reliable suppliers who have the correct technical documentation for the system (declaration of conformity, operating instructions with safety instructions).

### **Further information:**

Federal Office of Public Health FOPH  
Radiation Protection Division, Section NIS/DOS  
Schwarzenburgstrasse 157, CH-3003 Bern  
[www.bag.admin.ch](http://www.bag.admin.ch)

## 2 Dangers arising from laser systems for material processing

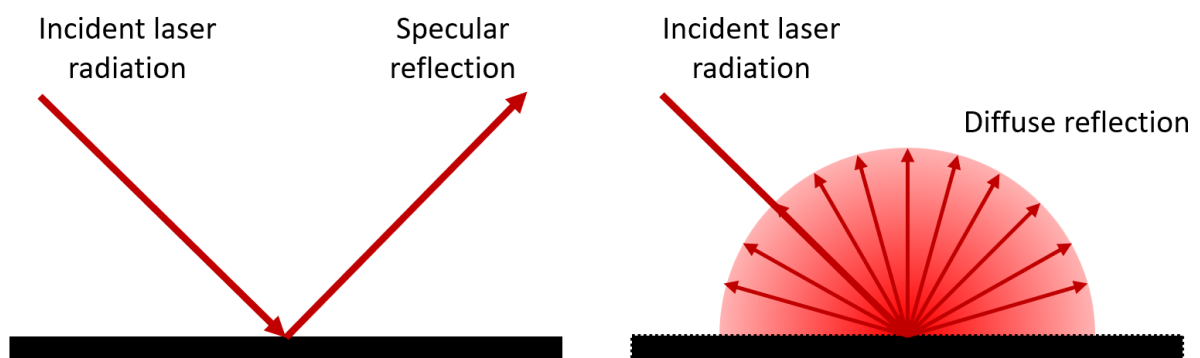
Laser systems for material processing are powerful tools that use very strong laser radiation to precisely engrave, clean or weld materials. Due to the radiation used, they harbour considerable risks if they are used incorrectly or without sufficient protective measures. Laser radiation can be dangerous to the eye even from power levels below 1 *mW*; the power of the laser radiation emitted by laser welding systems is usually more than one million times stronger. Even the scattered radiation can be harmful to the eyes, skin and hair.

### 2.1 Risk of injury from laser radiation

All laser devices are allocated to laser classes ranging from class 1 – the accessible radiation is harmless to the skin and eyes – up to class 4 – the accessible radiation is very harmful to the skin and eyes. The laser radiation used for material processing must be very powerful; the devices are therefore generally allocated to class 4, the highest class. Even diffusely scattered, i.e. indirect or reflected, radiation in this class can cause lasting injuries such as burns or blindness within in a very short time. These injuries may be caused from an exposure lasting just milliseconds (or less). This means that they can occur before an individual can react or before they even notice the radiation.

With powerful laser material processing systems, which often work in the infrared range, the laser beam is invisible. This makes handling by users and third parties even more hazardous as laser radiation can be emitted unnoticed and over large distances through the room. If the beam hits a person, this results in serious injuries and burns within a short time, even if it is indirectly reflected or diffusely reflected onto the skin or hair, due to the high energy density (see **Figure 1**). If reflections of the beam hit unprotected eyes, this results in immediate eye damage.

For the reasons above, all class 4 laser material processing devices may only be operated if fully enclosed – i.e. enclosed in housing – or, in the case of handheld laser devices, only operated in a specially enclosed and protected laser area and with use of the necessary protective equipment. It is the responsibility of the operator and the manufacturer to ensure that nobody is exposed to unauthorised radiation.



**Figure 1:**

**Left:** Specular reflection is directional reflection such as occurs with a mirror in the visible spectrum. The reflected beam is just as dangerous

as the original incident radiation. **Right:** A diffuse reflection scatters the incident laser radiation in all directions; the exact reflection depends heavily on the surface irradiated.

### 2.2 Risk of fire and explosion, health risks from smoke and fumes

The high energy density of laser radiation is not only hazardous to the eyes and skin but can also ignite inflammable materials. As laser radiation for material processing is usually invisible, this can also occur unnoticed over large distances. A class 4 laser that is not fully enclosed may therefore only be used in a specially enclosed, fire-protected area.

Smoke or fumes that contain toxic substances may be produced when engraving, cleaning, cutting or welding with lasers. Without appropriate respiratory protection and a suitable exhaust air system, this can lead to respiratory tract diseases or long-term damage to health. Effective extraction of hazardous substances is therefore mandatory.

## 2.3 Laser engraving devices

Laser engraving devices are available both for use by consumers and for professional use. In the case of devices that are not fully enclosed, strong laser radiation is freely accessible. Depending on the type and material of the workpiece as well as the direction of the laser beam, both users and third parties could be injured. These types of devices that are not fully enclosed therefore do not meet the current requirements for protection against escaping laser radiation. The protective goggles provided often offer no or insufficient protection against laser radiation. Laser engraving machines are considered to be machines according to the Machine Ordinance. Only fully enclosed laser engraving devices can be allocated to laser class 1 and therefore be considered not dangerous. Only the sale of laser class 1 laser engraving devices is permitted for private use (see section 3.1).

Mobile, self-contained laser engraving devices that are operated by hand fall under the ban on laser pointers of the [O-NIRSA](#) (see also factsheet [Laser pointer or not](#)).

## 2.4 Handheld laser systems

Laser cleaning, laser cutting and laser welding systems are considered to be machines according to the Machine Ordinance. These types of handheld devices cannot be operated while enclosed. Due to the very strong accessible radiation, these devices are allocated to laser class 4. Such systems are restricted to commercial use as they require a high level of expertise and very specific protective equipment. A laser protection officer with appropriate training ensures compliant operation during commercial use. The sale of such systems to private individuals is prohibited (see section 3.3).

# 3 Legal provisions

According to the Federal Act on Product Safety, laser systems for material processing are considered to be laser processing machines. They therefore have to comply with the basic health and safety requirements of the Machine Ordinance. For risks due to laser radiation, these requirements are specified in standards SN EN 60825-1, SN EN ISO 11553-1 and SN EN ISO 11553-2.

In addition, the requirements of standard SN EN 50689 apply to laser devices intended for consumer use ("consumer laser devices"). Suva is responsible for ensuring compliance with the standards when commercial laser systems for material processing are placed on the market; the BFU is responsible for ensuring the compliance of non-commercial devices (i.e. consumer laser devices).

## 3.1 Consumer laser devices (*for private use*)

Consumer laser devices are laser devices intended for private use by consumers or which may also be used by consumers under reasonably foreseeable conditions. To ensure the health and safety of users and third parties, this circumstance must be taken into account by the manufacturer. Due to the hazardous nature or unpredictability of laser radiation, safe handling of certain laser devices places particular demands in terms of the professional experience and specialist knowledge of the users of these devices. According to standard SN EN 50689, which sets out the above situation in more detail, "consumer laser devices" should belong to laser class 1 and only under specific conditions laser class 2 or 3R. Consumer laser devices must not belong to laser classes 1M, 2M, 3B or 4.

Laser engraving devices should only be allocated to laser class 1 if they are fully enclosed so that laser radiation cannot escape from the device either directly or indirectly and users therefore have no access to dangerous laser radiation.

Handheld laser cleaning, laser cutting and laser welding systems are not enclosed and are used open,

without protective housing. Due to the very strong accessible radiation, these devices are allocated to laser class 4. They are therefore not consumer laser devices. Based on the requirements of SN EN 50689, laser welding or laser cleaning systems therefore may not be offered or supplied to consumers.

## 3.2 Distributors' obligations

Anyone placing a laser system on the market in Switzerland must be able to prove that it meets the basic health and safety requirements. The requirements according to the Machine Ordinance apply for placement on the market. The manufacturer declares this by attaching a declaration of conformity to a full laser system or a declaration of incorporation to an incomplete system (Art. 2 para. 1 let. b Machine O and Annex II of the EU Machinery Directive).

If the manufacturer is based abroad, the importer is responsible for proof that the system meets the requirements. If the operator purchases an incomplete system, they are responsible for the assembly of the full system, for the system complying with the basic health and safety requirements and for being able to prove this with a declaration of conformity. In addition to correct classification and labelling and regular maintenance of the system, this also includes alarms (e.g. visible or audible signals for invisible lasers in use) and protection of the system against access by unauthorised parties by means of e.g. a key switch. In addition, other safety requirements e.g. for electrical safety, must also be implemented. Details can be found in the relevant standards.

Anyone purchasing a laser system from a foreign supplier is therefore responsible as the distributor for compliance with the above safety requirements, incl. correct classification, regular maintenance and appropriate protective equipment (see section 3.3).

Laser systems for material processing that are not placed on the market as consumer laser products for commercial use (see section 3.1) pose a high potential hazard. This concerns both the users themselves and uninvolved third parties, primarily through use by inexperienced and untrained users. For this reason, based on the legal bases listed above, offering laser products for sale or advertising them for commercial purposes is not permitted in areas that address both professional customers and private consumers. This applies to online trading as well as bricks-and-mortar retail. All economic operators involved (manufacturers, importers, distributors, etc.) are responsible.

## 3.3 Protective measures in commercial use

Manufacturers and operators of laser systems must ensure that their systems do not pose a risk to either users or uninvolved third parties. The principles of safety integration must be taken into account by the manufacturer when designing the full system (Annex 1 No. 1.1.2 of the EU Machinery Directive). SN EN 60825-1 stipulates the minimum protective measures necessary when operating any laser system.

Engraving lasers have strong lasers. Sale to consumers is therefore restricted to enclosed devices from which no laser radiation can escape. Handheld laser cleaning, laser cutting and laser welding systems have very strong lasers. Their use therefore requires a high level of expertise and very specific protective equipment. The sale of such systems to consumers is therefore prohibited (see section 3.1). To ensure that no uninvolved third parties can be harmed from a great distance (laser beams are often invisible and, in some cases, pose a safety hazard over several 100 m metres), commercial use requires comprehensive protective measures:

*(Non-exhaustive list)*

- Laser monitoring area with monitored access which prevents the escape of laser radiation; incl. warning light before entering the laser monitoring area, which indicates the operating status of the laser;
- The laser monitoring area must be equipped with certified laser safety screens or curtains.
- Labelling of and restriction of access to the laser monitoring area;
- The trigger button of the handheld laser gun must not be activated unintentionally (e.g. only by a two-button trigger);

- Compliant and certified personal protective equipment for staff, such as laser protection helmet, laser protection glasses and protective clothing;
- Correct technical documentation for the system (declaration of conformity; operating instructions with safety instructions);
- Appointment and training of laser protection officers at the company;

Suva supervises industrial companies that use laser systems or place them on the market. More detailed information on the requirements for operating laser systems can be found in the Suva leaflet "[Caution: laser beam!](#)" or on the website [www.suva.ch/laserschweissen](http://www.suva.ch/laserschweissen) (not available in English).

## 4 Bibliography

SN EN 60825-1:2014 «Safety of laser products – Part 1: Equipment classification and requirements»<sup>1</sup>

SN EN ISO 11553-1:2020 «Safety of machinery - Laser processing machines - Part 1: Laser safety requirements»<sup>1</sup>

SN EN ISO 11553-2:2010 «Safety of machinery -- Laser processing machines -- Part 2: Safety requirements for hand-held laser processing devices»<sup>1</sup>

SN EN 50689:2021 «Safety of laser products - Particular Requirements for Consumer Laser Products»<sup>1</sup>

Federal Law on Product Safety (not available in English): Bundesgesetz über die Produktesicherheit (PrSG) [SR 930.11](#)

Ordinance to the Federal Act on Product Safety (not available in English): Verordnung über die Produktesicherheit (PrSV) [SR 930.111](#)

Machine Ordinance (not available in English): Verordnung über die Sicherheit von Maschinen (MaschV) [SR 819.14](#)

Ordinance to the Federal Act on Protection against the Risks associated with Non-Ionising Radiation and with Sound (O-NIRSA) [SR 814.711](#)

Suva leaflet «*Caution : laser beam!*» <https://www.suva.ch/de-ch/download/dokument/achtung--laserstrahl--sicherer-umgang-mit-lasereinrichtungen/standard-variante--66049.E>

Factsheet: Laser pointer or not? <https://backend.bag.admin.ch/fileservice/sdweb-docs-prod-bagadminch-files/files/2025/03/18/ced7c6da-3487-4a72-a480-e01b6e9923b0.pdf>

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<sup>1</sup> The standard may be viewed free of charge and obtained for a fee from the Swiss Association for Standardization (SNV), Sulzerallee 70, 8404 Winterthur; [www.snv.ch](http://www.snv.ch).