Health and safety for Laser marking

Considerations and best practice in CO^2 Laser Health & Safety

Introduction

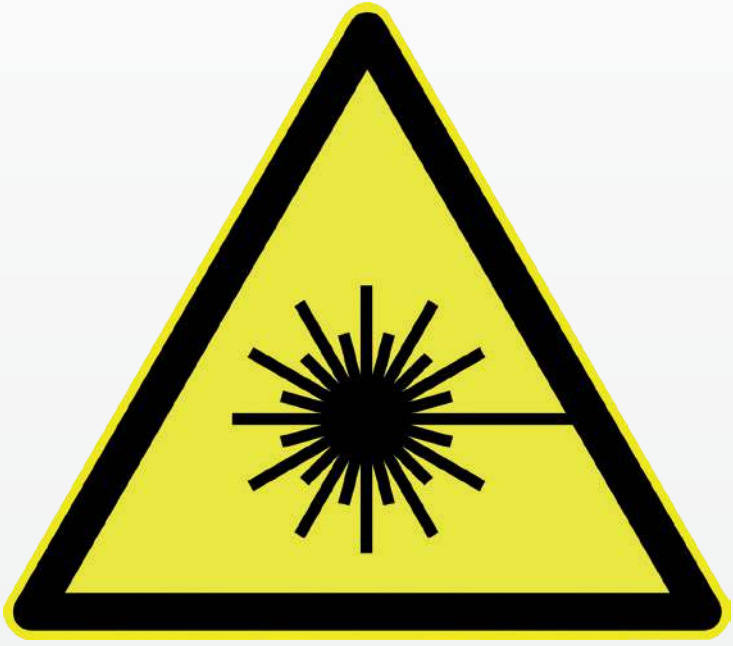
When purchasing coding and marking technology, important areas need consideration beyond the primary function of the technology. For example, when purchasing a laser marking device, the principle purpose of the equipment will be to mark certain information on a product or packaging. However, the safe operation of the equipment is of paramount importance – for the wellbeing of the employees in the vicinity, and as a result, the overall successful operation of the manufacturing business in question. This whitepaper looks at the background to, and key considerations for, laser coding health and safety. Domino is committed to the welfare our customers, ensuring our laser products and guarding meets the highest levels of health and safety.

The Background

A number of laser classifications exist, however the most important laser class that is relevant to Domino's CO^2 laser products is Class 1. A complete overview of the laser classifications are shown in Appendix A of this guide.

The difference between the various laser classes lies in the actual hazard, based on the laser output levels and its wavelength. Lasers in Class 1 actually bear no risks for humans and their environment (caused by optical radiation) because the laser radiation remains well below 25 microwatts.

However ***there are still other risks present*** like electrical shock, airborne contamination or fire. Lasers in Class 4 meanwhile, create the **highest level of danger** for humans and their environment. These can result in serious injuries to the eyes and burns to the skin.



Appendix A

Laser Class	Description
Class 1	The accessible laser radiation may be visible or invisible but is harmless
Class 1 M	The accessible laser radiation may be visible or invisible but is harmless, provided additional optical instruments are not used
Class 2	The accessible laser radiation may be visible and is harmless for accidental exposure to the eyes for periods less than 0.25 secs
Class 2 M	The accessible laser radiation may be visible and is harmless for accidental exposure to the eyes for periods less than 0.25 secs provided additional optical instruments are not used
Class 3 R	The accessible laser radiation may be visible or invisible, and potentially harmful to eyes
Class 3 B	The accessible laser radiation may be visible or invisible. Direct radiation is harmful to the eyes and skin although diffused, (reflected from a matt surface), radiation is harmless
Class 4	The accessible laser radiation may be visible or invisible. Direct and diffuse radiation is extremely harmful to eyes and skin and can pose a fire risk if projected onto combustible materials

Note: As supplied out of the box CO^2 Lasers are Class 4

Laser Guarding

All laser guard materials must be opaque - between 9 to 11 micron wavelength laser light produced by the CO2 laser. Guards may be metallic. However, if a see-through guard is necessary, this must be accompanied by the use of acrylic, (Perspex or flexiglass), or polycarbonate materials.

If the guarding chosen is metallic, a low reflectivity is required. The housing must be orientated in a manner that results in no laser light being reflected back to the laser. Reflected light can cause damage o the laser. The thickness of the guard material depends on the mechanical strength required

for stable housings, and the amount of 'burn through' anticipated. For the purposes of adequate mechanical rigidity and laser safety, a thickness of at least six millimetres is required for 10W and 30W laser systems. A thickness of at least eight millimetres is recommended for 60W laser systems.

To ensure laser safety, even greater thickness of the guarding material may be recommended.

Housings made from acrylic or polycarbonate must be installed within a minimum distance of the laser lens of

- '4' times the focal distance for 10W and 30W systems
- '5' times the focal distance for 60W systems.

Example of a Domino laser installed in a beverage production environment, including class 1 laser guarding.

These distances are important to eliminate mirror reflection from any surrounding parts. In a faulty condition, these materials withstand the laser beam for only a limited time before the beam eventually burns through. The laser must therefore be monitored to avoid a fire risk. A ceramic or metal plate may be used as a beam stop. A greater thickness is required to achieve an 'eight hour burn through' requirement.

Guide to Guard Safety Circuits

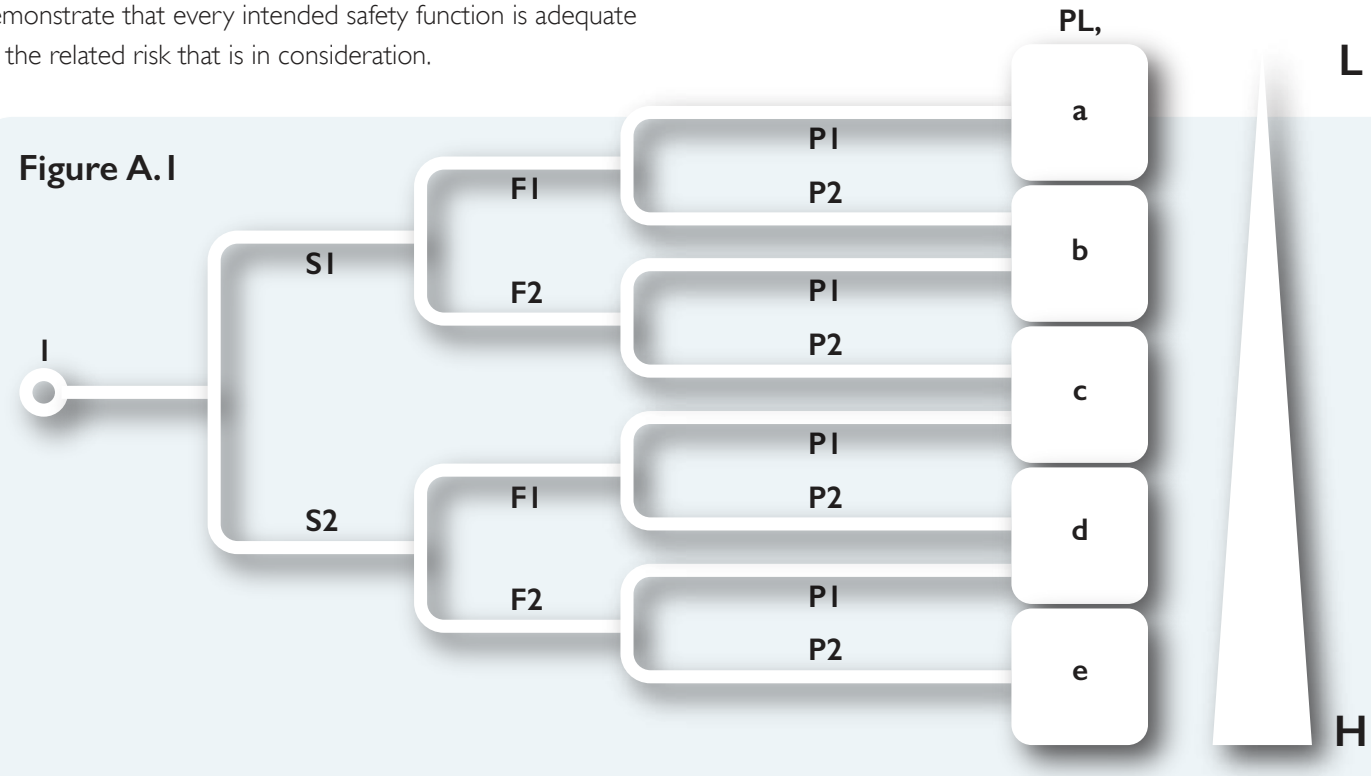
EN ISO 13849 provides the manufacturer with an iterative method to assess if a machine risk can be limited to an acceptable residual risk,via adequate safety functions. The adopted method - an hypothesis-analysis-validation – is conducted for each risk cycle. At the end of which it must demonstrate that every intended safety function is adequate to the related risk that is in consideration.

The first step consists in the evaluation of the "Performance Level" required by each safety function. Similar to EN 954-1, the EN 13849 uses a graph to display a machine function risk analysis (figure A.1). This determines, instead of a required safety category, a Required Performance Level or PLr for the safety function which protects that machine part.

The machinery manufacturer, starting from the graph point 1 and answering to S, F and P questions, will identify the PLr for the intended safety function. The manufacturer then shall produce a system to protect the machinery operator with a PL performance level equal or greater than required.

A risk analysis according to this standard indicates the result that performance level 'PLd' needs to reach.

Figure A.1



Key

1 starting point for evaluation of safety function's contribution to risk reduction
L low contribution to risk reduction
H high contribution to risk reduction
PL, required performance level

Risk parameters

S severity of injury
S1 slight (normally reversible injury)
S2 serious (normally reversible injury or death)
F frequency and/or exposure to hazard
F1 seldom-to-less-often and/or exposure time is short
F2 frequent-to-continuous and/or exposure time is long
P possibility of avoiding hazard or limiting harm
P1 possible under specific conditions
P2 scarcely possible

"At Domino we are committed to the welfare of our customers ensuring our laser products and guarding meet the highest levels of health and safety. All our installations comply with Class 1 standards"

Interlock Switches

Interlock switches must be fitted to access panels. This prevents access to the laser output lens and marking area that could be opened without the use of access tools.

Interlock switches must be wired into the laser control circuit so that the laser beam is disabled when the access is opened.

Image shows example of a laser marked carton packaging

Summary

When considering the purchase of coding and marking equipment, buyers must be sensitive to and comply with the health and safety requirements specific to the technology. Laser marking systems in particular have specific classifications and requirements, including guarding and interlock switches. These need due care and attention. Employee well-being is ensured and more efficient manufacturing operations (removal of incidents that may lead to downtime, for example low team morale, fines or damaged equipment) can place a business at a competitive advantage. Domino's laser products offer best in class technology – however the additional knowledge and expertise, especially the understanding and provision of safest installation, is an area that stakeholders must be aware of.

The D-Series lasers offer a power range of 10W, 30W and 60W lasers to code a wide variety of materials.