Laser Interlocks on Access Points to Designated Laser Areas

This appendix covers the type of interlocking system connected to the entrances of a designated laser area and which is operative when the laser hazard is present, restricting access to those personnel who are trained, authorised and suitably equipped. At the University, this is appropriate for the entrances to designated laser areas where there may be harmful laser emissions; typically this includes work with open beam Class 3B and/or 4 systems. The University laser survey form highlights that this is a requirement for this type of work and such a laser system should not be put into operation until this requirement is satisfactorily met and approved by the School/Departmental Laser Safety Supervisor.

There are commercially built interlock systems available from competent manufacturers in the field however Schools/Departments may choose to develop systems in-house. This is acceptable provided that the equipment is assessed as fit for purpose and adequately maintained (Provision of Work Equipment Regulations). This appendix looks at the types of interlock that may be used and gives guidance on the type of components that should be incorporated, this is based on guidance taken from the IEC 60825-14: 2004 - Safety of Laser Products.

Note 1: This guidance covers any new laser interlock systems being put into use. For existing systems, there will only be a requirement to upgrade the system if it is felt the functionality is inappropriate for safety reasons. Proposals for new interlock systems should be overseen by the School/Departmental Laser Supervisor, with reference to Safety Office/University Laser Safety Adviser as deemed necessary.

Note 2: The main function of the laser interlock system is to prevent inadvertent access of untrained people to a designated laser area where they may be at risk of exposure to a harmful laser emission.

Interlock System Requirements

- The interlock should be of fail-safe design such that it maintains its protective function in the event of component failure. It is recommended that the design gives a high level of reliability, i.e. Safety Integrity Level 4 is inherent in commercially produced equipment.
- The laser interlock must prevent inadvertent exposure to a harmful laser beam, either by switching off the laser power supply or operating a beam shutter across the laser beam. In terms of which operation the interlock triggers, the decision must be made locally as to the most appropriate method to maintain safety and for practical operation of the laser system in question. Where a beam shutter is used, this must be capable of withstanding the incident laser beam without damage. The shutter should be a commercially brought item, must be fixed in place and system designers must consider the possibility of jamming (i.e. preference for gravity-drop as opposed to spring powered shutters).
- The interlocking system must require the resetting of the system (e.g. reset button) to control restart of the laser rather than permitting continued operation as soon as the door or other trigger point is closed.

- Interlock systems need to cover each experiment within a designated laser area, i.e. there may be multiple systems operating in segregated sections of a room and inadvertent opening of the door(s) needs to prevent any potential harmful exposure on each and every system. There must be emission warning signs on each laser "compartment" (see section below for requirements) with the room. There should be a clearly displayed status board indicating what is taking place within the room.
- Interlock systems should be routinely checked to ensure they are operating as expected.
- It is recommended that as part of the control system, there is an indication of the interlock system being operational within the room (i.e. not just relying on activation of the external emission warning sign).

Types of Interlock

There are two types of interlock: the 'non-locking' type which tends to be used at the University and the 'locking' type. The latter physically prevents unauthorised access to a laser area and therefore eliminates unwanted interruptions to the laser emission. This type is covered in 60825-14 but it is not used in any of the designated laser areas of the University. If this type were considered essential, there must be a fail-safe method of entering the room in an emergency situation. It is not acceptable to rely on key codes, swipe cards or keys. Interlock systems of this type must be discussed with the Safety Office/University Laser Safety Adviser.]

- **Non-locking type of Interlock**

The most common type of interlock used in the University is the non-locking type whereby their safety function is to shut down the laser emission/operate a shutter across the laser output, in the event of someone opening the door. These should operate as above and permit an override facility.

Override facility

This is permitted where risk assessment justifies the need for trained and authorised users of a particular laser system to access the designated laser area without affecting the laser emission.

Consideration must be given to the positioning of the laser system and hence the laser emission within the room to ensure that during the overriding of the interlock, no harmful laser emission can emerge through the open doorway.

The override itself should be fail safe and time limited, independently of the switches. Typically 10 seconds is acceptable but the time chosen should be the minimum that is practical for the particular situation.

A non-secure switch is deemed adequate for use on the inside of the room but the access method on the outside of the room should not be easily operable by non-authorised persons, i.e. a key pad, key switch or similar, is required to gain access.

Emission warning sign

In conjunction with the interlocking system, particularly the non-interlocking type, there must also be an illuminated warning sign at the entry point(s) to the designated laser area.

The aim of this is to minimise unnecessary interruptions to the laser operation. The operation of the sign should not be manual; it must be appropriately connected so that it only indicates the laser system is on when the system is being operated.

Components

- **Types of Switch**

In terms of the type of contact, the options are magnetic (or other proximity switches) or mechanical switches.

- Mechanical switches should be of a positive break design (contacts spring apart upon opening the door) to avoid the possibility of contacts sticking, particularly over time.
- Where magnetic switches are used, these should be coded (two parts designed to operate as a unique pair) to avoid casual override. Again the design should be a type that minimises the possibility of a contact weld.

Types of Enclosure

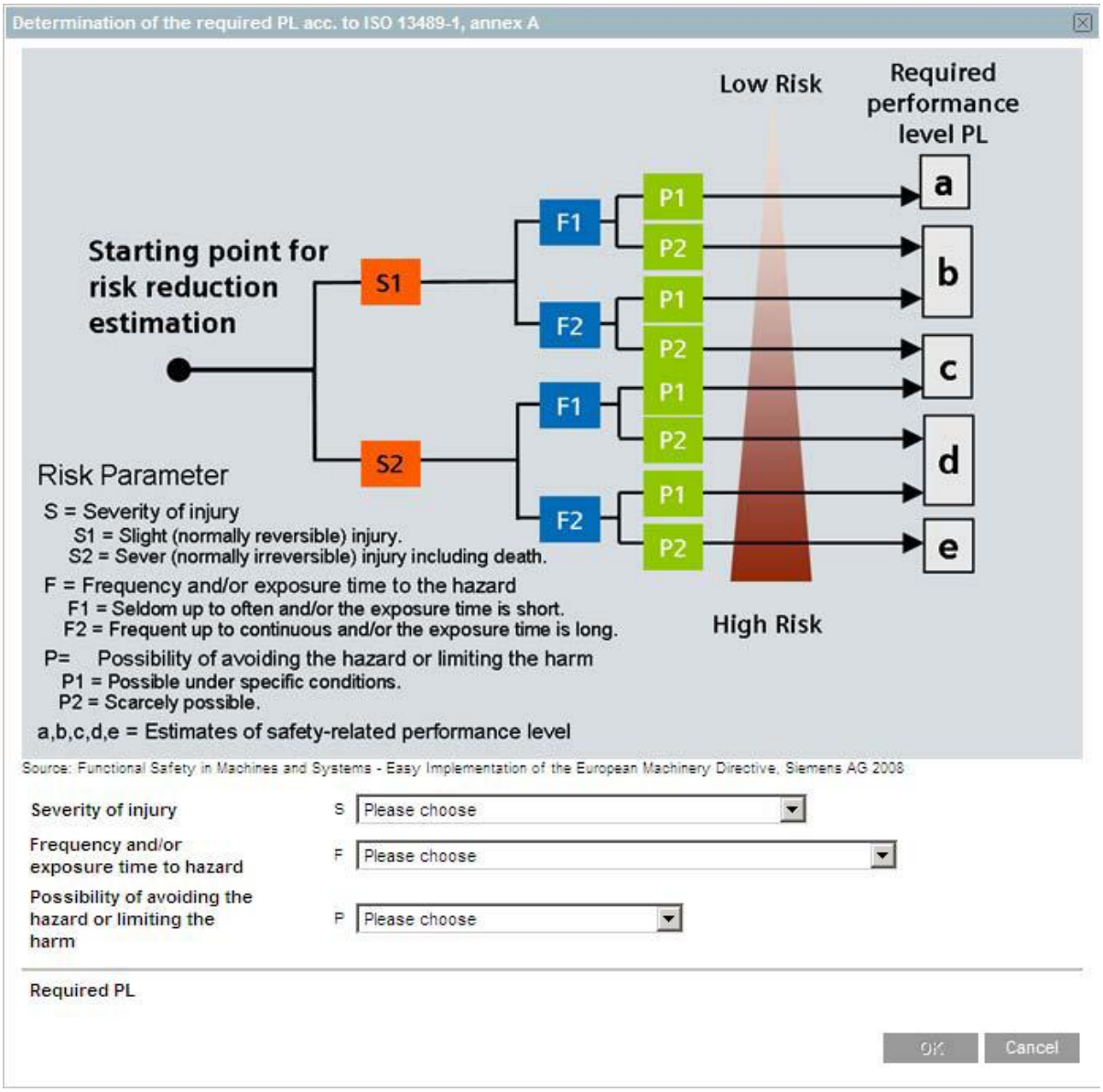
In the main, interlocks are set up on the doors into the designated laser area. However, it is sometimes more practical, particularly for set ups where the designated laser area is a section of a room, to use curtains or other types of barrier. In designing the interlock system, the above principles apply but consideration must be given to the fastening of the curtain or alternative to ensure that no inadvertent exposure is possible through any gaps and that the contacts between curtain and the adjacent surface are sufficient to ensure the interlock is triggered if a person attempts to enter the area, i.e. one contact point may not be sufficient. It may be appropriate to edge the curtain with a solid panel so that it maps to the adjacent surface more easily, thus ensuring there no gaps. The material used must also be carefully chosen to ensure it is suitable for the type of laser in use, i.e. considering unplanned laser beams striking the material must not cause it to catch fire or allow the laser beam to pass through it.

Design Specifications

Reference diagram A.2 in 60825-14:2004 – Non-locking interlock system

Example of Specification for a Non-locking Interlock System (this is included purely as an example of what is on offer, it is not mandatory to use this particular system)**:**

The University, via Electrical and Electronic Engineering, has used the Siemans Modular Safety System software, to identify the level of risk generally expected with the use of Class 3B and 4 lasers. From this assessment (see below), the safety-related performance level required is C or D and a corresponding list of equipment and relevant standards has been drawn up and is given for each level. This should be used by system designers within Schools and Departments to ensure that their design conforms to it or that there is written justification included within the design specification as to the alternatives that are being used.



In assessing the likelihood of a person entering a designated laser area, the Severity is classed as S2 (Severe), the Frequency as F1 (seldom up to often and/or exposure time is short) and the Possibility as P1 or P2, depending on the set up within the laser room. This gives a required performance level of C or D.

To comply with performance level C: Electrical Engineering can advise.

To comply with performance level D: Electrical Engineering can advise.

Reference

IEC 60825 Safety of laser products, Annex A – Examples of interlock systems for laser controlled areas.