Guidance on the use of personal protective equipment

Thorsten Ackemann

Dept. of Physics, University of Strathclyde

V2.1, 11/9/2015

1. Introduction

Personal protective equipment (PPE) protects individual users against health or safety risks at work. In the laser safety context, this is mainly eye-protecting PPE ("laser goggles", laser safety eyewear, laser eye-protectors) but other PPE might be appropriate in addition (e.g. gloves if working with an UV laser).

The use of PPE is the last resort from a safety management point of view and priority should be given to engineering controls (enclosures, etc.) to achieve safety. However, PPE might be still needed after implementing other controls and in a university research environment the need for PPE arises quite commonly for open beam alignment purposes. In addition, for some high power lasers even a small amount of scattered radiation can be dangerous so that wearing PPE is required even if table shielding is in place. This is identified in the MoW. The supplied PPE needs to be used in a responsible fashion.

The following text provides some guidance on the selection, use and care of laser goggles.

2. Use of laser goggles and training

The purpose of laser goggles is to attenuate the beam of a laser which is not safe (class 3R outside of 400-700 nm, 3B, 4) to a safe level below the maximum permissible exposure (MPE). In order to ensure this, the goggles not only need to be correctly selected (see section 3) but also correctly used and maintained and the user needs to take ownership of the process.

1. Check goggles for correct fitting! Be aware of and use the adjustment and fixing features provided (straps, length of temple).
2. An induction to the correct fitting and use must be part of the induction process for new laser users.
3. Goggles are to be maintained. Cleaning instructions usually come along with them. Don't use solvents like acetone on plastic goggles, but usually water and mild soap are fine, if no specialized detergent was supplied or has been used up.
4. When not in use, the goggles should be stored in their containers and instructions kept at a place easily accessible and identifiable, preferably a purpose made rack system.
5. It is a legal requirement on any PPE that their integrity is regularly checked and the checks recorded. This takes place at group level quarterly by a nominated person.
6. In addition to these formal checks, users should also inspect their goggles before wearing them and report any defect to the appropriate person.
7. Goggles with scratches or cracks in filter or frame or which show other wear and tear affecting safety must be replaced.
8. Goggles are designed against accidental exposure, not for deliberate viewing: Never play with your goggles, don't hold them into the beam and don't look into the laser on purpose.

3. Selection of laser goggles

Goggles need to have the necessary optical density OD to attenuate the incoming beam to a safe level. OD is related to transmission T by $OD = -\lg(T)$. Note that the OD is a spectroscopic specification. For safe working not only the filter but also the frame needs to be able to withstand the impining power and this should be the case for some time (10 s) as it is not of much use if the filter disintegrates after a few milliseconds even if it provides a high OD for that time.

Hence the decisive numbers for the protective effect from a laser safety management point of view are the scale numbers (LBx) provided with the CE certification (DIN certification is fine for older goggles), where x denotes the optical density. For example, LB5 for a laser with an MPE of 0.4 mW means that the goggles (filter and frame) can withstand 40 W for at least 10 s, quite a remarkable specification.

As this resilience might depend on *operating conditions*, the CE marking will specify pulse parameters for which the goggles are approved:
D =cw; I = pulsed (typ. 0.1 ms – 0.1 s); R = Q-switched (typ. 1-100 ns); M = mode-locked (< 1 ns).

For example, a pair of laser goggles might bear the inscription

> ***CE***
>
> 190-520 nm OD>9, 520-532 nm OD>7, 710-750 nm OD>3, 750-850nm OD>5, 850-1050nm OD>7
>
> D 468-514 L4, DR 532 L3, DR850-1070 L3

The CE mark witnesses the certification. The goggles can be only used in the regions of 468-514 nm, at 532 nm and 850-1070 nm, though they attenuate also for other wavelengths. At 532 nm the OD is 7, but it is only certified to an optical density of 3 or an attenuation of 0.001. All three wavelength regions are valid for cw lasers. Against a Q-switched laser the goggles can be used at 850-1070 nm and 532 nm but not at 468-514 nm.

Further information is in the British standards (accessible via the library or RPS-lasers).
1. BS EN 207:2009 Personal eye-protection — Filters and eye-protectors against laser radiation (laser eye-protectors)
2. BS EN 208:2009 Eye protectors for adjustment work on lasers and laser systems (laser adjustment eye-protectors)

In case a user operates at an unconventional wavelength or needs a combination of wavelengths which is not available (or would demand a costly custom certification), a selection based on optical density only might be discussed with the RPS-lasers after a specific risk assessment.

A further important selection criteria is “visible transmission” and potentially “colour” of a filter to enhance wearing comfort and safe working. If a combination of visible wavelengths or visible and invisible wavelengths is needed which leads to a prohibitively low visible transmission, the AUPRO guidance indicates the possibility to relax safety standards for visible wavelengths. This demands a specific risk assessment and approval by the RPS-lasers. Priority should be given to protect against the invisible wavelengths. Note: from a laser safety management point of view, VIS=400-700 nm, as there is a big discrepancy between eye sensitivity and the main damage mechanism (thermal) between 700 and 800 nm.

4. Sources for laser goggles

To my knowledge there are three major manufacturers of laser goggles, some smaller ones and many distributors.

Main manufacturers:
1. Honeywell (used to be Glendale)
2. Laservision
3. NoIR laser (they sell directly from the US but have also many distributors in the UK)

Other manufacturers
1. Kentec

2. Laser Components
3. Lasermet (in addition to distributed goggles)

Distributors:

No claim for completeness regarding suppliers or product range for a specific supplier. Local Laser Support Services used to have quite competitive pricing, in particular for NoIR products.

1. Laser 2000 (Laservision)
2. Laserlines (NoIR)
3. Lasermet (Honeywell, Laservision, own ones)
4. Laser Physics UK (Honeywell, NoIR, Kentec)
5. Laser Support Services (Honeywell, NoIR)
6. Newport (Honeywell)
7. Photonic Solutions (NoIR)
8. Photonlines (NoIR)
9. Pro-lite Technology (Laservison)
10. Thorlabs (Honeywell ??, maybe own ones?)