HEALTH & SAFETY AT WORK

Eye Protection: A Guide To Provision And Use

2010
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Introduction

Contrary to popular myth the role of the Health and Safety advisor is not to prohibit as much work as possible. Instead we are here to advise and facilitate the safe start-up and continuation of any processes and procedures required to progress the business of the Medical Research Council.

This brochure provides an overview of some of the areas and instances where personal protective equipment, specifically in the form of eye protection, is required by law to be provided and used.

As an overview it is not an all-encompassing consideration of all the types available but is an introduction to a large and varied subject.

Health and Safety culture

In the research environment we are exposed to hazards and their associated risks often on a daily basis. Through the existence and promotion of a positive Health and Safety culture the MRC can plan to avoid, reduce or prevent exposure to specific risks.

These principles of risk prevention, reduction and avoidance should be evident throughout the MRC’s approach and attitude to all its activities, from junior to very senior level.

Whilst completely mitigating all risks is near impossible we can implement measures of risk prevention and these are recorded in the form of a written risk assessment. While removal of all risks would be the ideal, in reality scientific progress, by necessity, involves work with a variety of hazardous and unusual substances.

The Law

There are many and varied pieces of legislation, which in this case can be defined as Acts or Regulations which are Law and must be complied with. These include:

- The Health and Safety at Work Act etc Act 1974
- The Management of Health and Safety at Work Regulations 1999
- Provision and Use of Work Equipment Regulations 1998
- Personal Protective Equipment Regulations 2002
- Health and Safety (Display Screen Equipment) Regulations 1992
- Workplace (Health, Safety and Welfare) Regulations 2002

To provide aid and guidance in compliance there are also a number of standards or agreed methods of best practice available to support the legislation – these are the starting point for any safety professional in the workplace.
While this brochure does not intend to deal with risk assessment as such, the principles of risk assessment need to be recognised and understood and can be summarised as follows:

**Step 1:** Identify the hazards

**Step 2:** Decide who might be harmed and how

**Step 3:** Evaluate the risks and decide on precautions

**Step 4:** Record your findings and implement them

**Step 5:** Review your assessment and update if necessary

Regulation 3 of the Management of Health and Safety at Work Regulations 1999 covers in depth the requirements of all employers to undertake and record suitable and sufficient risk assessments. Guidance from the Health and Safety Executive breaks this requirement down into the above logical steps.

Step 3 in the HSE guidance advises that once risks have been identified, any reasonably practical measures to avoid exposure should be adopted and for the purposes of the following training information we will be looking at the selection, use, maintenance and storage of eyewear.

Eyewear is a form of Personal Protective Equipment, or PPE, and in the hierarchy of risk control all items of PPE are considered to be the final line of defence. This is mainly because they protect only the user and do not take into account negation of the risk to others in the vicinity. However, because PPE is the “last resort” after other methods of protection have been considered, it is important that users wear it all the time they are exposed to the risk.

**There should never be exemptions to this rule, even for jobs that take “just a few minutes”**
Provision of eye protection

It is imperative that users who are issued with PPE, in our case eye protection, know why it is needed, when it is to be used, repaired or replaced and most importantly its limitations.

Information, instruction and training are crucial and should always go hand-in-hand with the issue of any piece of PPE. As well as issuing protective eyewear and giving instruction as to its application, occasional audits of use should be carried out to make sure that the user continues to use the eye protection correctly.

In cases where eye protection is found not to be used, an investigation to discover the reasons why should be initiated. If the reason the user is not wearing their PPE is not simply forgetfulness or human error but because of discomfort or poor vision a comprehensive review should be carried out and alternative PPE provided.

**Maintenance of eyewear is crucial:**
wear and tear can decrease visual acuity.

All forms of safety eyewear need to provide good vision, including on the periphery of sight, should be lightweight for prolonged use, comfortable and fit for purpose. A good spectacle will have anti-scratch and anti-glare properties.

**Clean your safety eyewear regularly**
Eye injuries and their significance

Before we consider the work processes we should spend a few moments considering the eye itself and why specifically we are interested in its protection.

In 2009 there were twelve injuries relating to the eye.

These break down as:

- 7 chemical splashes,
- 1 chemical vapour (formaldehyde),
- 1 Ice (from freezer),
- 1 liquid nitrogen
- 1 soap
- 1 plastic fragment (freezer tray)

Thankfully all of these injuries did not require major treatment nor did they result in any lasting damage however, considering we have only 2 eyes, any injury or loss of sight is very high impact to the individual. In most cases injury could be avoided by the sensible use of safety eyewear.

The eye

Our eyes are amazing and as a single part of the human sense spectrum are used to evaluate and respond to our environment. The eye allows us to see by reacting to light particles via an arrangement of rods and cones situated in the retina.

We use them for more than just vision. Not only do they allow conscious light perception and colour differentiation they also send messages to the brain to enable us to perceive depths and distance. Any potential injury can have a high cost as permanent damage to one eye may result in loss of these combined functions.
Categories of eyewear

Eyewear covers not only general laboratory safety spectacles, goggles or visors/faceshields but also specialised, sometimes prescription based eyewear and may combine prescription lenses with the safety-based goggle or spectacle (see page 15 for summary table).

Workwear spectacles in the form of those required for close work using computers, whether in an administrative area or in a diagnostic laboratory with computer driven equipment, must also be considered.

Maintenance and facilities operatives will also have a need for reinforced safety spectacles for their day to day work.

Laboratory eyewear

The main types of laboratory eye and face protection are:

Safety spectacles:

These may take the form of separate lenses in a metal or plastic frame, similar in appearance to prescription glasses, or have a single lens/frame moulding, sometimes called eye-shields. Most designs have side-shields. Spectacles can incorporate corrective lenses, while eye-shields may fit over prescription glasses.
Goggles:

These are made with a flexible plastic frame and one or two lenses with a flexible plastic headband. They give the eyes protection from all angles as the complete rim is in contact with the face. Some goggles are ventilated and may be unsuitable for protection against gases and fine dusts.

Visors/faceshields:

These have one large lens with a frame and adjustable head harness or are mounted on a helmet. Most can be worn with prescription glasses. They protect the face BUT do not fully enclose the eyes.

We will see more specific uses and learn more about the provision, care and maintenance of variations of these later in this brochure.

However fit for purpose and effective protective eye wear is -

it will have no effect if it is not worn.

British Standards and manufacture

There are a number of British Standards which currently cover the manufacture of eye protection which should be considered where appropriate. These include:

- BS EN 166: Specification for personal eye protection
- BS EN 207: Specification for laser radiation filters
Substances hazardous to health

The Control of Substances Hazardous to Health Regulations 2002 apply to all types of workplaces and every type of work activity involving the use of substances which may be hazardous to health of people at work.

To protect the eye from all foreign objects, be they dust particles, caustic fluids, radiochemicals or metal swarf shavings, suitable eye protection should be selected and worn where applicable in the workplace.

Ideally, the work processes and engineering control measures should prevent or minimise the release of harmful substances into the workplace. As previously mentioned, PPE, in this case eye protection, should be the last line of defence.

Chemical insult

Most high risk chemicals in the laboratory are dispensed in a fume cabinet which provides ventilated protection in a fit-for-purpose secure environment (always assuming that the cabinet itself is free from excess clutter). Wearing safety spectacles for activities involving work with chemicals in a fume cabinet is mandatory in the CSC.

Users must use eye protection when dispensing chemicals in the fume cabinet. While the cabinet itself provides some protection, the cabinet is there to provide respiratory protection – 100% extract of all fumes are vented usually high on a building roof. It is not a control for protecting the eyes from splashes but will protect from irritation from fumes and aerosols.

The activities before and after dispensing are often overlooked and here eye protection is essential. Stock bottles need to be taken to the cabinet from their safe place of storage and it’s often during these “transit” movements that accidents can occur.

Once the initial aliquot is dispensed from the stock bottle, safety glasses are then needed to work with the resulting solution, which can often have more than one hazardous chemical component. Safety glasses should be worn for the whole of the experiment if stated in the risk assessment.
In some units, generic risk assessments have led to **mandatory** wearing of safety spectacles for some activities. For example, these include:

- Work with ethidium bromide stock solutions
- Work with open sources of ionising radiations
- Work with phenol/chloroform based solutions
- Work with strong acids and bases

Other hazardous substances and chemicals are assessed using the risk assessment approach.

**Thermal insult and Ultra-Violet (UV) exposure**

Protection from sources of heat (e.g., Bunsen burners, welding equipment) should be considered where exposure may occur. This eye protection should be compatible with the source in use. Radiated heat and distance from source are also factors which should be assessed.

The wearing of face visors for the use of UV light boxes is mandatory when imaging gels.

**Cryogenic exposure**

Full face visors should be worn for dispensing liquid nitrogen and liquid helium.

Small amounts of cryogenic liquid can vaporise rapidly to produce large volumes of gas (1 litre of liquid nitrogen will produce 0.7m³ of gas). Due to this large liquid-to-gas expansion ratio, cryogenic gases can build up tremendous pressures in a closed system. For this reason, eye protection **must** be worn when biological samples are removed from liquid phase storage.
Laser eye protection

Some forms of eye protection are not so straight-forward to provide and this is true for those required for work with lasers.

The optical spectrum is part of the electromagnetic spectrum and includes those wavelengths that are visible to the naked eye. Optical radiation can be divided into three sections: ultra-violet, visible and infra-red. Outside the visible spectrum are different types of invisible light, or electromagnetic radiation. Laser light (or laser beam) is a type of electromagnetic radiation and can be of differing types, e.g. ultra-violet, infra-red or x-ray.

British Standard EN207:1999 details what eyewear should be worn for lasers and what testing should be carried out. This standard also details what markings should be used for eyewear. Eyewear for laser systems is only designed to protect the user from accidental exposure. Any defects or damage to the eyewear would reduce its capability of protecting the user.

Suspect you may have had an eye strike from your laser?
You must check your eye protection for damage.

If there is damage, replace or repair the spectacles before further use.

The extent to which laser radiation can cause damage to the eye is dependent on a number of factors including:

• Absorption of laser radiation
• Duration of exposure
• Wavelength of the incoming laser radiation
• The power of the laser source
• The size of the image that is formed on the retina

A smaller spot size will be more damaging as the energy deposited will be concentrated in a smaller area.
Laser radiation does not cause a uniform insult to the eye. Different wavelengths of laser radiation affect different parts of the eye. Not all wavelengths penetrate the eye to the same extent; some penetrate further into the eye than others.

The following illustrates the variation in wavelengths for different laser radiations and their effect on the human eye

UVC (180 – 280 nm) – absorbed by the cornea
UVB (280 – 315 nm) – absorbed by the cornea
UVA (315 – 400 nm) – absorbed by the lens
Visible (400 – 700 nm) – transmitted onto retina
IRA (700 – 1400 nm) – transmitted onto retina
IRB (1400 – 3000 nm) – absorbed by cornea but can penetrate into aqueous humour
IRC (3000 – 3,000,000 nm) – absorbed by cornea

Laser protective eyewear uses filters to absorb and hence reduce the intensity of incoming laser radiation. However, different filters are required for different wavelengths. For laser safety goggles collecting all of the information required to determine the appropriate eyewear can be complex and time consuming.

In this instance you should seek help from your local laser protection supervisor.

He/she will be able to look at your system as a whole and decide which type of protection is required – in some laboratories there may be a requirement for more than one pair of spectacles to cover different classes of laser.

Where this is the case users should be carefully trained to ensure they know the difference – spectacles should be labelled and colour coded for differentiation.

Use the correct laser eye protection!!
Health hazards – display screen equipment

Visual fatigue

Visual fatigue (eye strain) is associated with glare from the display and the continual need to focus and refocus from screen to copy material and back again. The degree of individual fatigue will vary.

Where a user experiences visual difficulties which may reasonably be considered to be caused by work using DSE, the MRC will ensure that they are provided, at their request, with an appropriate eye and eyesight test. Any such test must be carried out by a competent person as soon as practicable after the request is made.

You can have a test once every two years or more often if the optician advises this as medically necessary.

If the optician thinks that you need glasses specifically for reading a computer screen i.e. with a lens different to that used in glasses that you may need for reading or distance vision then your employer will meet this cost, within the set financial limits.
Computer Glasses

Computer glasses correct your vision in the intermediate zone - the distance you normally sit from your computer screen. Regular glasses are not always suited for computer work as these normally deal with near- and far-sight issues. Reading glasses correct for the near zone, and bifocals correct for only the near and far zones.

Lens design
There are several types of computer lenses available. They range from occupational progressive lenses and trifocals with larger than normal intermediate zones, to single-vision (intermediate) lenses. Specially designed bifocals or computer prescriptions that clip-on to your regular eyeglasses are also available. Your optician can help you decide which lens design you need.

Tints and coatings
Computer lenses can be tinted to help with reducing eyestrain from excessive glare from windows or fluorescent overhead lights. Anti-reflective coating or ultraviolet coatings and amber tints can all help relieve eyestrain. All of these considerations should be addressed via a formal DSE assessment – this can be arranged through your local DSE safety representative or through the safety team.
Voucher scheme

The MRC will meet the cost of prescription spectacles where required for work, either through reimbursement up to the set limit or the provision of vouchers. Further information is available from the local safety team.

Accidents and first aid

While protective glasses are provided in all our laboratories, for all types of work, accidents do happen.

We have eyewash facilities available and first aid and lifesaver personnel who can deal with eye injuries.

All eye injuries are potentially serious.

If there is something splashed in the eye, wash the eye with clean running water; to flush a chemical from the eye irrigate for at least 10 minutes. If possible, gently hold the eyelid open to allow thorough irrigation.

All casualties who have had a major chemical insult to the eye should be guided to hospital for further checks.

Any casualties who have foreign objects lodged in their eye that cannot be removed by local first aid should be guided to hospital for further medical assistance.

All suspected laser strikes should be reported and casualties should attend an eye clinic as soon as possible.
Further reading and information

**MRC Policy and Guidance**
Standards for liquid nitrogen supply 2008 - hard copy available to MRC units form the MRC Corporate Heath, Safety and Security Section.

Working with Display Screen equipment
www.mrc.ac.uk/Utilities/Documentrecord/index.htm?d=MRC005587

Eye Protection
www.mrc.ac.uk/Utilities/Documentrecord/index.htm?d=MRC005593

Links to voucher schemes
www.mrc.ac.uk/About/WorkingfortheMRC/Healthsafetyandsecurity/Policiesguidance/Workingenvironment/index.htm#P21_430

**DSE**
Working with visual display units, HSE guidance leaflet
www.hse.gov.uk/pubns/indg36.pdf

**First Aid**
Basic advice on first aid at work, HSE guidance leaflet
www.hse.gov.uk/pubns/indg347.pdf

**British Standards**
Personal eye protection. Specifications
BS EN 166:2002. ISBN 0 580 38916 2

Personal eye-protection. Filters and eye-protectors against laser radiation (laser eye-protectors).
BS EN 207:1999. ISBN 0 580 30718 2

**MRC Safety Team contact details:**
Corporate Health, Safety and Security
Medical Research Council
20 Park Crescent
London. W1B 1AL

Tel: (0) 20 7670 5266
Please visit our website: www.mrc.ac.uk/hss
Quick-view eyewear selection guide

As an example of a local eye protection policy implementation, this table is an at-a-glance guide to the areas where eyewear is recommended for use within the Clinical Sciences Centre. It can be adapted or adopted for use in any laboratory based MRC unit.

| NOTE: There are areas where eye protection is mandatory as indicated by the coloured ticks. |

<table>
<thead>
<tr>
<th>General lab areas</th>
<th>Non prescription based</th>
<th>Prescription based</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Safety Glasses</td>
<td>Goggles</td>
</tr>
<tr>
<td>Biological agents</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Chemical agents</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dust particles and vapours</td>
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<td>x</td>
</tr>
<tr>
<td>Strong acids/bases</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cryogenic</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Thermal</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Close screen work - laboratory</td>
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<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specialist areas</th>
<th>Non prescription based</th>
<th>Prescription based</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Safety Glasses</td>
<td>Goggles</td>
</tr>
<tr>
<td>Ionising radiations</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Optical - UV</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Optical - laser</td>
<td>✓*</td>
<td></td>
</tr>
<tr>
<td>Close screen work - office</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Maintenance/ workshop</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Voucher scheme is available for help with the purchase of these specialist forms of eyewear

✓ = recommended
✓✓ = highly recommended
x = unsuitable

* Laser eyewear is based on calculations dependent on the beam characteristics – specialist advice is required.