SBMS Guidance note SBMS04:

Use of equipment generating Ultraviolet Radiation (UV)

Equipment emitting ultraviolet radiation is in fairly widespread use in SBMS. Examples include: microbiological safety cabinets (MSCs), transilluminator boxes and UV crosslinkers (see pictures below). The MSCs usually contain a UV lamp used to help maintain a sterile environment. Transilluminator boxes are used for DNA 'nicking' or to observe gels containing fluorescently stained nucleic acids, and UV crosslinkers are mainly used to crosslink DNA or RNA to membranes.

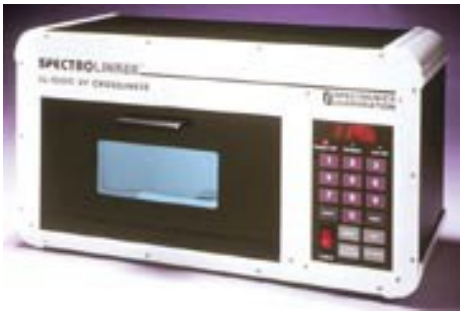
This type of work is covered by the University Safety policy part 7.2- ionising radiations use of UV equipment see http://www.safety.ed.ac.uk/policy/part7/part7_2/part7_2.shtm#3

What is UV?

UV radiation extends from the blue end of the visible spectrum to the X-ray region and is divided into three distinct bands with different properties of penetration and potential for damage.

:Region	Wavelength (nm)	Hazard Rating
UVA	315-400	Lowest
UVB	280-314	Mid to High
UVC	180-280	Highest

Sunlight falls into the UVA region. UV radiation from laboratory equipment is in a concentrated form which poses a significant threat to researchers as if no control measures are used, tissue damage may occur in only a few seconds.



UV Crosslinker

MSC containing UV germidcidal lamp

Hazards associated with UV

Hazards to health arise mainly from sources emitting radiation with wavelengths longer than 200 nm. as short wavelength radiation is strongly absorbed in the air. Effects are confined mainly to the eyes and the skin, and can result in a serious threat to both if they are exposed. Diagnosis of exposure may vary and are caused mainly by radiation of wavelength shorter than 315 nm. Further information may be found in the Safety policy part 7.2 http://www.safety.ed.ac.uk/policy/part7/part7_2/part7_2.shtm#3

Transilluminator Box

Effects on the Skin

(extracted from University Safety policy part 7.2) Two types of effect are felt by the skin. They can be acute effects which appear within a few hours of exposure or chronic, cumulative effects which may not appear for a significant period of time. Acute effects of ultraviolet are similar to sunburn The redness produced is called erythema and its severity will depend on the duration and intensity of exposure and the skin pigmentation of the individual. Symptoms are comparable of normal sunburn and include redness, swelling, pain, blisters and peeling on the burned area. Severe sunburn can lead to headache and nausea like conditions. Variables for this intensity are mostly genetic factors but can be exaggerated by photosensitization from certain foods, drugs (e.g., tetracycline) and other chemical agents.

Chronic effects could appear after repeated exposures, and include accelerated skin ageing and skin cancer. Although there is much evidence for skin cancer due to solar UV radiation, no occupational effects due to artificial sources have been observed.

Effects on the eyes

The cornea of the eye is also very susceptible to UV radiation and is extremely vulnerable because of its lack of thickness. Exposure to UV-B and UV-C can cause lesions of the cornea and ultimately cause photokeratitis(PK). Eye injury can occur due to very brief exposure or with just a flash of intense UV. The severity depends on the duration, intensity and wavelength of the exposure, the effect being a maximum at a wavelength of 270 nm. The symptoms may appear in 6 to 12 hours after exposure and subside after 24 to 36 hours with no permanent damage. Unlike the skin, the eyes do not develop a tolerance to repeated exposure to ultraviolet. The absorption of UV-A radiation in the lens of the eye is thought to produce progressive yellowing with time and may contribute to the formation of cataracts, causing partial or complete loss of transparency.

Symptoms of PK are described as a sensation of sand in the eye that may last for several days. Other symptoms of an overexposed eye may occur within a few hours and include sensitivity to light, unexplained tearing, and a burning or painful sensation in the eye

Other Hazards

UV radiation below about 250 nm can dissociate oxygen in the air to form ozone (threshold limit 0.1 part per million), thus room ventilation may also be an issue.

UV lamps often operate at pressures below or above atmospheric and may produce a risk of explosion particularly during lamp replacement or maintenance work

Use of hazardous substances such as EtBr in gels for visualisation- See also http://www.safety.ed.ac.uk/resources/General/EthBrAlt.shtm

Control Measures for reducing exposure

UV presents an external hazard that an be controlled by a combination of:

- time - *minimise your time of exposure*
- distance - *maximise your distance from the source*
- shielding - *utilise effective shielding materials*

Hazards should controlled by a the following hierarchy of control measures:.

1. Engineering controls

This includes effective screening - preferably in an interlocked enclosure.

- If the Transilluminator lid or shielding is damaged in any way the equipment should not be used until it is repaired.
- Crosslinkers are not to be used if the door safety interlocking mechanism is not working properly
- Microbiological Safety Cabinets (MSCs) are never to be occupied while the UV lamp is activated (interlocks should be fitted to prevent this).

Other engineering control measures include screens or filters used to contain the radiation. Reflective surfaces should be avoided and surfaces surrounding the equipment painted in a dark, matt colour.

2. Administrative controls

- limitation of access - *Access should be limited to authorised users in areas where UV is used without enclosures.*
- training - *It is essential that all potential users of UV equipment are made aware of the hazards associated with this type of work.*
- warning signs (see opposite) - *must be displayed warning users and others of the potential hazards and the protective measures that need to be taken.*

3. PPE

- protect skin and eyes - *If screen not practical, all persons present must have adequate UV opaque PPE with all exposed areas of skin and the eyes protected.*
- *When using a transilluminator often forgotten areas are: the neck/upper chest below a face visor; and, underneath the wrist area of the forearms.*
- Wear disposable **nitrile** gloves to protect exposed skin on the hands

Howie Laboratory coats i.e. with fitted cuffs, are a requirement for work with this type of equipment, as there have been incidents where researchers have received burns to the wrists whilst manipulating samples on a transilluminator.

In another reported incident a demonstrator was burnt under his chin when using a UV transilluminator even though he was wearing full protective clothing and face visor. The exposure occurred whilst he was looking up to talk to students while standing over the equipment without adequate shielding.

EXAMPLE OF HAZARD WARNING SIGN (for transiluminator)
CAUTION ULTRAVIOLET RADIATION

1. Work must always be carried out behind a screen or a full face visor must be worn

2. Operators should also ensure that their hands and forearms are always covered.

3. To protect other people in the vicinity there should be screens to the rear and sides of the transilluminator.

NB UVB from transilluminator is hazardous up to 2m away

Table 1: Simple explanation of terms likely to appear on suitable PPE for protection against UV radiation

Mark or symbol which must appear on the frame, in this order	**Explanation**
Maker's mark	
BS EN 166	Indicates compliance with all the general specifications in BS EN 166 : 2002
9	Field of strength. 9 =molten metals
B	Mechanical strength, B = medium energy impact
Mark or symbol which must appear on the visor, in this order	Explanation
Scale No 2-# (or 3-# if good colour recognition is required)	For UV protection, the scales are defined in BS EN 170, and # varies depending on the UV sources and applications. For low pressure mercury lamps in transilluminators and germicidal lamps, the scale will need to be 2-1.2, 2-.4 or 2-1.7. For photochemical lamps, with medium pressure mercury lamps, it would be 2-2 or 2-2.5.
Optical class e.g. 1-3	Class 1 is the best quality ocular.
Mechanical strength (S, F, B or A)	F = high speed particles, low energy impact, and is satisfactory for normal laboratory work.
Fields of use (3,4,5,9,or G for frames, 8,9 for oculars)	3 = resistant to liquid droplets (goggles) or liquid splashes (face shields) and it probably the most relevant field for our purposes. 9 = resistant to molten metals and hot solids

Risk assessment summary: Use of UV Transilluminators

Activity	Hazard	Person(s) in danger	Existing measures to control risk	Risk rating
Use of UV transilluminator to visualise DNA bands or nick DNA.	Damage to eyes and tissue if exposed to UV radiation.	Users of unit. People working in vicinity.	1) Ensure appropriate shielding is always in place prior to use. 2) Switch off transilluminator when not in use. 3) Hazard warning signs. 4) Use transilluminator in designated area only with restricted access to other persons. 5) Interlocks on systems must not be overridden. 6) Full UV face protection **LABELLED 'SUITABLE FOR UV PROTECTION'** CE marked to the following specification: - **(**See Table 1). **British Standards EN170/ EN 166** **American Satnandard: ANZI Z87.1 1986** 7) Store PPE appropriately so doesn't get damaged. 8) As well as eye/face protection, use protection for skin (hands, arms, and chin.) 9) **Transilluminator MUST NOT BE USED by anyone who has not received appropriate instruction.** 10) See safety circular on Ethidium bromide. http://www.safety.ed.ac.uk/resources/General/EthBrHazards.shtm 11) Report any incidents via accident reporting system. 12) Report any damage to equipment or PPE to local manager and take items out of use until repaired.	**Medium**