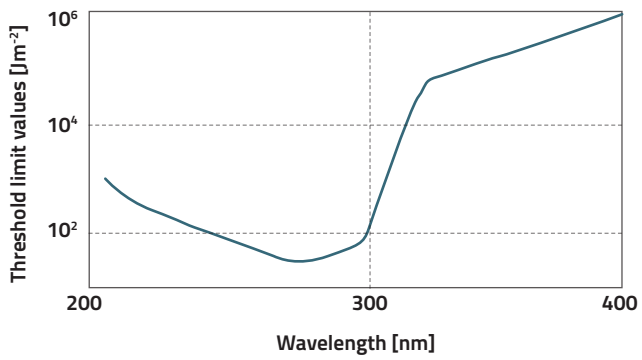
Ultraviolet safety considerations



UV radiation
Electromagnetic radiation with a wavelength between 10 and 400 nm is called ultraviolet radiation. Radiation below 180 nm is referred to as vacuum UV. Normally we use the term UVC for wavelengths to 290 nm, UVB for 290 - 320 nm, and UVA for 320 - 400 nm, although there is no agreement on the exact boundaries. Radiation below 320 nm is called 'deep UV' in photolithography.

UV and light sources
Arc lamp and deuterium sources produce UV with wavelengths down to 180 nm and below, depending on the lamp and the envelope material of the lamp. Most tungsten halogen lamps have UV stop envelope materials. But there are models which emit some radiation down to 220 nm. The UV intensity levels from some of these sources may be higher than those from the sun and shorter wavelengths may be present.

This high-intensity UV and VIS radiation can permanently damage the cornea, lens, and retina of the eye, and even cause blindness. This damage may not be immediately apparent. The deep UV is absorbed in the cornea or eye fluids; focused VIS and UV can damage the retina. A normal blink reaction to visible light may not be adequate protection, and a beam of invisible UV (produced by spectral filtering) can be most dangerous, as the blink response is not induced. UV radiation can also cause painful sunburn, and with prolonged exposure, serious burns.

Guidelines
It is recommended by the U.S. National Institute for Occupational Safety and Health (NIOSH) that the total intensity from 315 to 400 nm hitting unprotected skin should not exceed 10 W/m^2 for periods longer than 1000 seconds. For shorter exposure times, the energy density should not exceed 10^4 J/m^2.

See the figure for wavelengths below 320 nm, which shows threshold limit values for occupational exposure to ultraviolet radiation in an 8-hour period. These values for exposure of the eye or the skin apply to UV radiation from arcs, gas and vapor discharges, fluorescent and incandescent sources, and solar radiation, but they do not apply to UV lasers. (ACGIH ISBN: 0-9367-12-99-6).

Recommendations:
The simplest thing to do if you do not need the ultraviolet is to get rid of it at the source. Contact us for lenses or filters to accomplish this. If you require the UV then there are several precautions you should take to minimise exposure and reduce the hazards.

- Never look directly into the output beam even with safety glasses.
- Do not look at the specular (mirror) reflection of the beam.
- Always wear UV protective eyewear and gloves.
- Do not view UV images without safety glasses. Looking at the big image of high-wattage lamps on a distant wall or the small image of low-wattage lamps on a probe requires welding goggles!
- Use a manual or electronic shutter to close the beam when the source is not in use.

Ozone
Shortwave ultraviolet light photolyses molecular oxygen to produce ozone, O_3. Lamps with an output below about 240 nm (cw or pulsed) produce ozone. It is emitted into the cooling air stream of the lamp housing. Most ozone is produced in the 175 - 200 nm range. Ozone formation can be eliminated by using ozone-free lamps.

Relatively low concentrations of ozone can cause nasal dryness and a burning sensation in the throat, headaches, nausea, and irritation of the mucous membranes.

The concentration of ozone (or its effect on you) is highly dependent on the environment. Operating in a small enclosed space may result in high concentrations, whereas operating the same system in a large, well-ventilated laboratory may not be a problem. Recommended maximum exposures typically are:

- 0.1 ppm for an 8-hour exposure
- 2 ppm for a 2-hour exposure

A 150 W Xe UV arc lamp can contribute more than 1 ppm ozone to the convective air stream. This may be of little consequence in a well-ventilated area but some people are very sensitive to ozone and the long-term effects are not well documented. Noticeable symptoms for most people appear at 0.3 - 0.5 ppm.

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A very sensitive nose can detect 0.015 ppm. 1 ppm produces a strong and obnoxious odor. As a rule of thumb, if you can easily smell ozone, the level is too high for prolonged exposure.

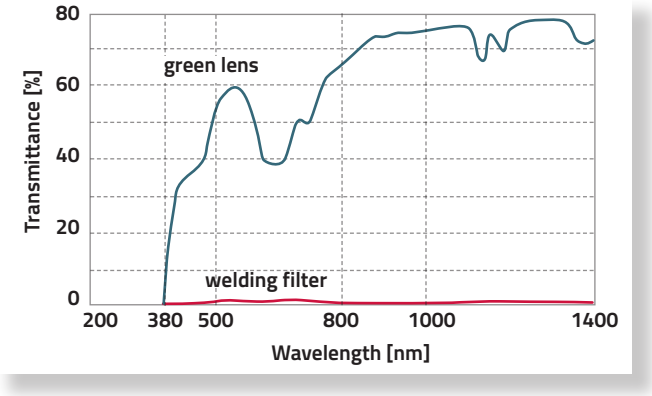
Recommendations

- Use an ozone-free lamp unless you need the short-wave UV.
- If used indoors, the ozone produced by the ozone producing lamps can be effectively eliminated by exhausting the air from the cooling system to outside of the building. Exhausting the air is not dangerous, as the hot gas is unstable and rapidly breaking down to oxygen in the ducting.

Note: Ozone has an absorption in the UV. If ozone is created and built up in the optical path, particularly a long enclosed optical path, then the observed UV radiation level may change accordingly and lead to misinterpretation of the lamp or sample performance.

UV safety glasses

Our UV protective eyewear is inexpensive and comfortable to wear. Both are made of green tinted plastic with UV blocking, polycarbonate lenses which offer high-impact protection (see fig. for transmittance curve).



We offer spectacle and "over-the-glass" frame styles. Both are comfortable and lightweight. The "over-the-glass" model fits directly over prescription eyeglasses with no compromise in protection. Both models are made of hard, durable plastic with close-fitting side shields to prevent UV radiation from reaching the eyes. The sides are adjustable in length.

Adjustment of the image of an arc or filament on a small probe or target is normally done by viewing the image. This requires welding goggles because of the glare.

Protective gloves

When working with fixtures in the beam the hands are particularly prone to UV exposure. Even minimal exposure may cause burning of the skin. Protect your hands with gloves. There are probably no special UV gloves available. Any clothing type (cotton) with or without coating will help.

Ordering information	
LSZ025	UV safety spectacles
LSZ026	UV safety spectacles "over the glass" (may be worn over prescription glasses)
LSZ027	UV welding goggles

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