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### **ULTRAVIOLET RADIATION AS A HAZARD IN THE WORKPLACE**

Ultraviolet (UV) radiation is a known cause of skin cancer, skin ageing, eye damage, and may affect the immune system.

People who work outdoors are the most likely of all workers to suffer health damage from exposure to UV radiation. Other people may be exposed to UV radiation at work from non-solar sources such as arc welding, the curing of paints, inks etc and the disinfection of equipment in hospitals and laboratories amongst others (See table 1).

In relation to non-solar sources of UV radiation, well designed engineering and administrative controls and in the case of arc welders, personal protective equipment can keep the risks to a minimum.

However with outdoor workers who are regularly exposed to the sun for long periods of time, a more comprehensive strategy is required to minimize risks. This is because the sun (exposure source) cannot be controlled like other workplace exposure hazards.

Factors that affect UV radiation include the following;

- Sun elevation: The higher the sun in the sky, the more intense the UV radiation. Therefore the UV radiation levels are highest around solar noon and in summer
- Latitude: The closer to equatorial regions, the higher the UV radiation levels.
- Cloud cover: Solar UVR can penetrate through light cloud cover, and on lightly overcast days the UV radiation intensity can be similar to that of a cloud-free day. Heavy cloud can reduce the intensity of UV radiation. Scattered cloud has a variable effect on UV radiation levels, which rise and fall as clouds pass in front of the sun.
- Altitude: At higher altitudes, the atmosphere is thinner and absorbs less UV radiation.
- Ozone: Ozone absorbs some of the UV radiation that would otherwise reach the Earth's surface.
- Ground reflection: Grass, soil and water reflect less than 10% of UV radiation; fresh snow reflects as much as 80%; dry beach sand about 15% and sea foam about 25%.

As UV radiation can neither be seen nor felt, it is important therefore that workers who have the potential to be exposed to intense levels of UV radiation are aware of the risks and are regularly reminded to take prompt, appropriate protective action.

## **HEALTH RISKS ASSOCIATED WITH ULTRAVIOLET RADIATION IN THE WORKPLACE**

UV radiation is known to cause adverse health effects that can manifest over both the short and long term. UV radiation is absorbed in the skin and the adverse health effects are mostly confined to the skin and eyes. In most cases it is considered that shorter wavelengths (UVB) are more harmful than longer wavelengths (UVA).

**Effects of UV radiation on the skin.** Short-term exposure to UV radiation causes reddening of the skin, sunburn and swelling, which may be very severe. In some people this sunburn is followed by increased production of melanin, and is recognised as a suntan. Tanning is a sign that damaged skin is attempting to protect itself from further harm. A suntan is not an indication of good health and offers only minimal protection against further exposure.

The most serious long-term effect of UV radiation particularly for white skinned populations, is the induction of skin cancer. The non-melanoma skin cancers (NMSCs) are basal cell carcinomas and squamous cell carcinomas. They are relatively common in white people, although they are rarely fatal. They occur most frequently on sun-exposed areas of the body such as the face and hands and show an increasing incidence with increasing age. The findings from epidemiological studies indicate that the risk of both of these skin cancers can be related to cumulative UV radiation exposure, although the evidence is stronger for squamous cell carcinomas.

Malignant melanoma is the main cause of skin cancer death, although its incidence is less than NMSC. A higher incidence is found in people with large numbers of naevi (moles), those with a fair skin, red or blond hair and those with a tendency to freckle, to sunburn and not to tan on sun exposure. Both acute burning episodes of sun exposure and chronic occupational and recreational exposure may contribute to the risk of malignant melanoma.

Chronic exposure to solar radiation also causes photoageing of the skin and actinic keratoses. Photoageing is characterised by a leathery, wrinkled appearance and loss of skin elasticity while actinic keratoses is a known precursor to squamous cell carcinomas.

**Effects of UVR on the eyes.** Responses of the human eye to acute overexposure of UV radiation include photokeratitis and photoconjunctivitis (inflammation of the cornea and the conjunctiva, respectively), more commonly known as snow blindness or welder's flash. Symptoms range from mild irritation to severe pain and possibly irreversible damage.

There is evidence that chronic exposure to intense levels of solar radiation is a contributory factor in the development of age-related macular degeneration of the retina and cortical cataracts, both a cause of blindness.

## HOW TO MANAGE RISKS IN THE WORKPLACE

There are a number of measures that can be put in place to control risks in the workplace.

This would involve;

1. Engineering controls – for outdoor workers this would include the provision of shade cover or canopies. In the context of non-solar sources of UV radiation, suitable engineering controls measures would include opaque barriers, UV radiation blocking filters and door interlocking power supplies.
2. Administrative controls – for outdoor workers this would include rescheduling outdoor work programs where possible to be performed outside the peak UV radiation period (2 hours either side of solar noon), moving where possible the jobs indoors or to shady areas or rotating workers between indoor and outdoor tasks to lessen each employee's total UV exposure. In the context of non-solar sources of UV radiation, administrative controls would include warning signs, keeping staff at a safe distance and limiting the time during which UV radiation sources are switched on. Training of supervisors and employees should be undertaken for workers exposed to solar and non-solar sources of radiation.
3. Personal protective equipment (PPE) – if necessary, outdoor workers should be provided with protective clothing that is loose fitting, made of close weave fabric and provides protection to the neck and preferably to the lower arms and legs. Hats should shade the face, neck and ears and have a wide brim (8-10cm). If hard hats have to be worn, they should have attached neck flaps. Sunscreen should be a minimum SPF 15, and be broad-spectrum, that is block UVA and UVB, and be applied regularly and liberally to exposed skin. Sunglasses should be close fitting, of a wrap-round design and block at least 99% UV radiation. In the context of non-solar sources of UV radiation, arc welders in particular need to be provided with purpose-specific protective equipment.
4. Training should be offered to all employees exposed to medium to very high levels (see table 1) of UV radiation at work so that they understand the risks and what is expected of them while at the workplace.

## EXPOSURE LIMITS

Exposure limits for UV radiation for the avoidance of acute health effects have been published by bodies such as the International Commission on Non-Ionizing Radiation Protection ([www.icnirp.de/documents/uv.pdf](http://www.icnirp.de/documents/uv.pdf)) and the American Conference of Governmental Industrial Hygienists (<http://www.acgih.org/home.htm>). These limits are based on the concept of thresholds below which acute effects will not be observed in a normally sensitive lightly pigmented adult population. It is believed that there is no lower threshold for induction of chronic effects such as skin cancer: the published limits will limit the additional risk of these effects from occupational exposure by virtue of an overall reduction in exposure.

## WHAT TO DO IF WORKERS HAVE BEEN OVEREXPOSED

Acute overexposure to the sun can result in sunburn, skin blistering, headaches, nausea, vomiting, or dizziness. The latter 4 symptoms are those of sunstroke which is caused by dehydration and overheating and is not necessarily a direct effect of the UV radiation. If such cases occur, protect the worker's skin from further direct sun exposure and apply cold water to the affected areas and then seek medical attention. For UV radiation overexposure to the eye, place a sterile dressing over the eye and seek medical attention. When such incidents of overexposure occurs, it is important to identify the causes and adjust work practices or controls to prevent future incidents.

## FOR FURTHER INFORMATION

For further information on UV radiation, visit the WHO's Intersun website at <http://www.who.int/peh-uv/Intersunprogr.htm>.

**Table 1: Common UV Sources in the Workplace**

Source	Potential for Overexposure	Hazard Description	For Safety Advice Refer to:
<b>The Sun</b>	Very high	UV from the sun is highest in summer, and 2 hours either side of solar noon. Clouds may do little to reduce UV levels.	Engineering & Administrative Controls, PPE and Training
<b>Electric Welding Arcs</b>	Very high	Welding arcs can exceed the UV radiation guidelines in seconds within a few meters of the arc. Workers, bystanders and passers-by can be overexposed to UV from the arcs if engineering controls are inadequate.	Engineering & Administrative Controls, PPE and Training
<b>Tanning Lamps</b>	High	These emit mostly UV-A radiation. Tanning lamps generally must exceed occupational guidelines in order to cause tanning.	PPE and Training
<b>Germicidal Lamps</b>	High	UVB and UVC emitting lamps used to sterilize work areas in hospitals and laboratories.	Engineering Controls, PPE and Training
<b>UV Lasers</b>	High	Source of intense UV radiation at a single wavelength, with no visible light.	Engineering, Administrative Controls and Training
<b>UV Curing Lamps</b>	Medium	Lamps are usually inside cabinets, but substantial hazardous UV radiation emitted through openings can exceed the UV guidelines in seconds.	Engineering Controls, Administrative Controls & Training
<b>Black Lights</b>	Medium to Low	Low-power UV-A lamps used in non-destructive testing (NDT), insect control, and entertainment.	Engineering Controls, Personal Protection
<b>Lighting</b>	Low	Most lamps used for lighting are made to emit little or no UV radiation.	No precautions needed under normal conditions

*This table was adapted from the Ontario Ministry of Labour Canada. Please note that this table is intended as guidance only and is not comprehensive.*