Solar UV Radiation Risk Assessment for Outdoor Workers: Technical Guide

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Sun Safety at Work Canada
School of Occupational and Public Health
Ryerson University
350 Victoria Street
Toronto, Ontario, M5B2K3
Canada

Introduction

As part of a comprehensive Sun Safety Program, a *sun safety risk assessment* is an important element of the 'Plan' phase and builds on the elements of a *Sun Safety Policy*; descriptions of *Responsibility, Accountability and Authority* for all levels of employees; the *Role of the Health and Safety Committee* with respect to sun safety; and an understanding of the specific sun safety *legal requirements* of the jurisdiction in which the workplace is located. The sun safety risk assessment then provides a basis for implementing appropriate control measures and undertaking other management actions to reduce risk.

We recommend the following three (3) steps for undertaking a *sun safety risk assessment* which has a focus on assessing solar ultraviolet (UV) radiation exposures of outdoor workers:

1. *Operational review* – to gain an understanding of the operational environment and factors which increase the risk of adverse skin and eye conditions for outdoor workers within your workplace as a result of solar UV radiation exposure
2. *Job Safety Analysis* for specific positions identified as being at an elevated risk
3. *Daily assessment* (during season/months of elevated risk)

Before describing the above steps in detail, a discussion on measurement terminology and occupational exposure limits is provided as an introduction to the assessment approaches we recommend.

Measurement Terminology

As UV radiation is 'energy', there are specific terms used to describe the quantity of radiation at different points in its 'path' between the source (e.g. the sun) and the receiver (e.g. a person being 'struck' by the radiation). These terms include:[1]

- *Radiant Energy* – this describes the radiation when it is passing through space.
- *Radiance* – this describes the radiation as it is emitted by the 'source'
- *Irradiance* – this describes the radiation when it makes contact with a 'receiver'.

Therefore, when we are interested in measuring the amount of UV radiation a worker is exposed to, we are specifically interested in the *'irradiance'*, which has the unit *Watt per square meter (W/m^2)*. This term however relates to exposure at one time-point only. As such, when we are interested in worker exposure over a period of time (e.g. a work day), the relevant term is *'radiant exposure'*, which is often expressed as *'exposure dose'* or *'dose'*. As *radiant exposure* is the time integral of *irradiance*, its unit of measurement is the *Joule per square meter (J/m^2)*.

There is also some terminology and units of measurement which relate to specific biological effects that result from exposure to UV radiation. The main biological effects are the development of erythema (i.e. skin reddening/sunburn) and photokeratitis (i.e. burns to the outer part of the eye). Units which relate to erythema are:[2]

- *Minimal Erythema Dose (MED)* – this is defined as the UV exposure that will produce a just-perceptible erythema 8 to 24 hours after someone has been exposed. Unfortunately, the MED is not a 'standardized' measure because it relates to a specific individual. It is influenced by: (1) the spectrum of the source – all sources emit a spectrum of wavelengths of radiation with different wavelengths being more or less effective in producing erythema (this is also known as the 'erythema action spectrum'); and (2) the amount of radiation necessary to cause erythema depends on each person's skin type, with darker skin types requiring higher doses of UV radiation to cause erythema.
- *Standard Erythema Dose (SED)* – this is a 'standardized' dose, where 1 SED equals 100 J/m^2 of 'erythemal effective UV exposure' (refer to discussion following Table 1 for an explanation of this term).

Table 1 provides a description of the various skin types and the amount of UV radiation needed to produce erythema (i.e. 1 MED). When someone is exposed frequently to UV radiation, their skin 'adapts' or gets 'conditioned', which is demonstrated through both skin darkening (i.e. tanning) and skin thickening. The impact of this adaptation on the amount of UV radiation required to cause erythema is also shown in Table 1.

Table 1 – Skin Type, sensitivity to sunburn and level of exposure to produce erythema[2]

Skin Phototype	Sun Sensitivity	Sunburn Sensitivity	Tanning Achieved	Individual MED without Adaptation	Individual MED with Adaptation
I (Celtic)	Very sensitive	Always sunburn	No tan	2 SED	5 SED
II (Celtic)	Moderately sensitive	High	Light tan	2 SED	5 SED
III (Mediterranean)	Moderately insensitive	Moderate	Medium tan	5 SED	12 SED
IV (Mediterranean)	Insensitive	Low	Dark tan	5 SED	12 SED
V (Asian)	Insensitive	Very low	Natural brown skin	10 SED	60 SED
VI (Black)	Insensitive	Extremely low	Natural black skin	15 SED	80 SED

A final consideration for units of measurement is the use of the term *'effective'*. When *'effective'* is used in conjunction with *irradiance* or *radiant exposure*, this means that the measured irradiance or radiant exposure has been *'weighted'* according to how effective the wavelengths of radiation (emitted by the source) are at producing a specified biological effect. This is often described as a *'biologically effective irradiance'* or *'biologically effective radiant exposure'*. For solar UV radiation, the common biological weightings are for the erythema action spectrum and the *'ultraviolet hazard'* action spectrum (which takes account of both erythema and photokeratitis). In these cases, the terminology is *'erythemal effective irradiance' (E_{er} in W/m^2)* and *'erythemal effective radiant exposure (H_{er} in J/m^2)* when weighted for erythema; and *'effective irradiance' (E_{eff} in W/m^2)* or *'ultraviolet hazard irradiance' (E_s in W/m^2)* and *'ultraviolet hazard radiant exposure (H_s in J/m^2)* when weighted for *'ultraviolet hazard'*.

Occupational Exposure Limits

An exposure standard/limit is usually based an understanding of the adverse health effects from exposure to the hazard and the levels of exposure required to produce these adverse effects. In the case of UV radiation, the adverse effects on which the exposure standards are based are erythema and photokeratitis. Both of these effects are 'acute' and short-term in nature, in that they tend to occur from high levels of exposure over a short period of time, and the effects last a day or so before the burn/observable effect subsides. As the values for the exposure limits are typically derived from experimental studies, an exposure limit should not be considered as separating 'safe' from 'unsafe' exposures, but as providing a guide to 'relative safety' versus 'possible adverse effects'.[3] As such, when evaluating occupational exposures of workers, an 'action limit' of one-half the exposure limit is generally applied, i.e. if exposures are more than half the exposure limit then action should be taken to reduce worker exposure.

ACGIH Threshold Limit Value (TLV)

The most widely used UV exposure limit was initially developed by the American Conference of Governmental Industrial Hygienists (ACGIH) in 1971.[4] This has changed only slightly over time and has since been adopted as an international standard by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).[5] This standard/limit is based on threshold data (i.e. the minimum exposure needed to produce the specific biological effect) for both erythema and photokeratitis, and as such is described as being a 'threshold limit value' (TLV). A curve representing a limiting value for exposure at each wavelength in the UV spectrum was developed, with the lowest radiant exposure/dose being 30 J/m^2 at 270 nm.[6] This is equivalent to approximately 1.0 to 1.3 SED, which is approximately one-half of an MED for a fair skinned person (i.e. skin type I or II).[2] In addition, time limits for exposure (t_{max}) are able to be determined based on the TLV dose.

The standard is based on protecting individuals from acute effects of UV exposure (i.e. erythema and photokeratitis), with the assumption that chronic exposure at sub-threshold levels would contribute slightly to long-term health risks.[7] A built-in safety factor also ensures that certain exposures above the exposure limit should not result in any acute effects. The exposure standard is considered to provide a limiting value for the eye, as repeated exposures do not result in increased protection, whereas conditioned (tanned) persons are able to tolerate skin exposures above the exposure limit without acute effects.[7]

Even though the exposure standard/limit is technically the same for both ACGIH and ICNIRP, these organizations differ in the way they in which they view the standard can be applied:

- The ACGIH view the standard to apply only to workers and as such it is considered to be a time-weighted-average (TWA) exposure for an 8 hour work day and 40 hour work week. Whereas, ICNIRP indicate that the standard can be applied to both workers and the general public.
- The ACGIH view the standard as applying to a range of artificial sources as well as the sun, whereas ICNIRP view it as only applying to artificial sources.
- The ACGIH apply the standard to both eye and skin exposures, but do acknowledge that the conditioned/tanned persons are able to tolerate skin exposures above the exposure limit without acute effects. The ICNIRP differ by indicating that the standard is considered to provide absolute limits for direct exposure to the eye, and is 'advisory' for skin exposures.

Given the above differences in application of the standard, OHS regulatory agencies have taken different approaches to adopting the standard for occupational exposures. Some have adopted the ACGIH standard 'as is',[8] while others have adopted the ACGIH limit for artificial sources of UV only, but have indicated that it is 'advisory' for solar UV exposures. However, when regulatory agencies have adopted the standard as being advisory for solar UV exposures, they have also indicated that employers should still manage solar UV exposures of their workers within a risk management framework to ensure that exposures are as low as able to be achieved through the implementation of appropriate assessment and control measures.[9,10]

UV Index

The UV Index was initially introduced in Canada in 1992 and was then adopted internationally by the World Health Organization in 1994. The purpose of the UV Index is to provide a simple description (in a single number) of the solar UV exposure received by the public and workers, with recommended protective actions based on increasing UV Index values.[11]

The UV Index is based on the 'erythema action spectrum', in which the wavelengths of solar UV radiation reaching the Earth's surface are 'weighted' by how effective they are at producing erythema. The UV Index is calculated by multiplying the sun's 'erythemal' irradiance, in W/m^2, by 40.[11] This produces a single number to represent how effective the sun's radiation is at producing erythema. The UV Index values range from 0 to around 20, with the following categories: low (less than 2), moderate (3 to 5), high (6 and 7), very high (8 to 10), and extreme (11 and above). The WHO recommends that protection measures be used when the UV Index is 3 or above, and that additional protection be used when the UV Index is above 8.[12] In Canada, the UV Index in many locations is above 3 from 11am to 3pm daily between April and September.[13]

A comparison between UV Index, the ACGIH TLV, the time to achieve erythema, and the equivalent irradiance for solar UV radiation (in SEDs/hr) is shown in Table 2. Note that for many locations in Canada the UV Index is 6 or greater in summer, meaning that the ACGIH TLV can be exceeded in as little as 10 minutes.

Table 2 – UV Index and various exposures times and values[14]

UV Index	Time to Exceed ACGIH TLV (t_{max}) (min)	Time to achieve erythema (min)*	Ambient UV (SEDs/hr)
3	26.4	44.4	2.7
4	19.8	33.3	3.6
6	13.2	22.2	5.4
8	9.9	16.7	7.2
10	7.9	13.3	9.0
12	6.6	11.1	10.8
14	5.7	9.5	12.6

*for un-adapted sensitive skin (skin type I or II)

Solar UV Radiation Risk Assessment

The risk assessment approaches we recommend are based on characterizing both the hazard (which in our case is solar UV radiation) and worker exposure. An assessment of both environmental and operational conditions regarding solar UV radiation exposure is necessary to:

1. Determine whether outdoor workers are at an elevated risk of developing adverse skin and eye conditions; and
2. Provide a basis for taking action and managing the operational activities at the workplace to minimize the risk of adverse health effects.

To undertake a comprehensive assessment of health risks associated with solar UV radiation exposure in a work environment, we recommend the following activities (in order of action):

1. Operational Review

An *Operational Review* is the first step (and main step) in assessing solar UV radiation exposures for outdoor workers. Its purpose is to help a workplace gain an understanding of the operational environment and factors which increase the risk of adverse skin and eye conditions for their outdoor workers, as a result of solar UV radiation exposure.

The *Operational Review* can be used as an: (1) initial/baseline assessment; (2) annual review; (3) assessment of the impacts on worker exposure when major change occurs within the workplace (e.g. work tasks); or (4) assessment of changes/improvements in safety practice (particularly for the risk factor categories of 'Operation' and 'Personal Protection').

The *Operational Review* is not deigned to be a personal risk assessment for specific employees, but is a tool to assist workplaces make an assessment of the overall risk that their workers face from exposure to solar UV radiation.

We have developed a tool, the *Solar UV Radiation Risk Assessment for Outdoor Workers – Operational Review*, which will allow a workplace to make this assessment. Key aspects of the design of this tool are:

- Three categories of risk factors are presented: Environment, Operation, and Personal Protection. For each category, a number of risk factors are listed. For each risk factor, there are a range of variables, with each variable having a point allocation.
- For the 'Environment' category of risk factors, three risk factors are presented as being the main factors which influence the amount of UV radiation workers may be exposed to from the sun. These factors are 'time of year', 'altitude' and 'surfaces'. The 'time of year' risk factor reflects UV Index (UVI) values for locations throughout Canada. Based on measured UVI for locations throughout Canada,[15] time periods where the UVI was above 3 and above 8 were identified. The following variable categories were then determined as being broadly representative of UVI and exposure/seasonality: UVI of >8 = Summer (June – Aug), UVI 3 – 7 = Fall (Sept – Oct) or Spring (March – May), and UVI <3 = Winter (Nov – Feb). As such, for the *Operational Review*, UVI is being used to provide the baseline assessment for the levels of 'environmental' exposure to solar UV radiation, prior to the application of control/protection measures. This approach aligns with a conclusion from the ICNIRP that an assessment of solar UV radiation exposure for specific outdoor work environments can only usually be semi-quantitative.[2]
- The risk ratings and point's allocation included in the risk assessment are based on key factors which are known to contribute to the risk of skin cancer for outdoor workers from occupational exposure to solar UV radiation. The point's allocation was made on the basis of expert judgement, however, the variables listed where determined through a comprehensive review and assessment of the literature. A rationale is provided in the tool for the risk factors and the variables chosen.
- Risk factors/variables which contribute more to the overall risk have a higher point allocation than risk factors which contribute less. Therefore, the more points awarded, the higher the risk.
- An assessment of three (3) positions or worker activities/tasks can be conducted simultaneously to allow for comparison.

Upon completion of the *Operational Review*, workplaces should have a good understanding of the overall risk their workers are at regarding solar UV radiation exposure, and they will also have an understanding of the variables which influence the level of risk identified. This will assist workplaces to identify and implement alternative operational procedures and/or personal protection measures which may decrease the level of risk faced by the workers.

2. Job Safety Analysis

When the *Operational Review* identifies particular positions/jobs within the workplace are at an elevated risk for adverse health conditions associated with solar UV radiation exposure, a more detailed assessment of the risk factors and potential control/prevention measures associated with these positions/jobs may be appropriate. However, the *Operational Review* does provide a detailed analysis of exposure variables and so if the level of risk identified for particular positions/job tasks is 'high', then implementing changes to current 'operational' and/or 'personal protection' practices should take place.

If a more detailed assessment of exposure is desired for particular positions/job tasks, such an assessment is most effectively undertaken by completing a Job Safety Analysis (JSA). An analysis such as this could also be undertaken if the results of the *Operational Review* were inconclusive.

Workplaces should already have a process in-place for undertaking a JSA. As such, we would recommend that you implement this process, but with a focus on solar UV radiation as a specific hazard for assessment. If you would like further information on what a JSA is and how to undertake one, please refer to the following resources:

- https://www.ccohs.ca/oshanswers/hsprograms/job-haz.html
- *Job Safety Analysis Made Simple*, CCOHS & HRSDC, 2009. Product information available at: http://www.ccohs.ca/products/publications/JSA.html

First Component of a Job Safety Analysis

The first component of a JSA for solar UV radiation is a detailed description of the environmental and operational conditions/arrangements under which the work is being undertaken. This will include:

- A detailed description of the workers exposed, based on position and work tasks, including number of workers in each category and work arrangements (e.g. length of shift, shift work)
- Where the work tasks are undertaken, including location, altitude, and reflective surfaces encountered during normal work activities

- How much time each position/worker category works outside and is exposed to direct solar UV radiation, including how much shade is available during work times and during breaks
- Time of the year that each position/work category works outside
- A description of any work tasks or changes in routine work practice which may lead to enhanced solar UV exposure
- A detailed description of the protective measures used by the workers, with a description for each position and/or work task
- A description of the daily operational considerations for each position and/or work tasks and how these may impact solar UV exposure, e.g. ability to reschedule particular work activities to non-peak UV periods
- A detailed description of any photosensitizing substances which workers may encounter and how exposure may be enhanced or reduced
- A description of any safe work procedures in place for specific work tasks

Second Component of a Job Safety Analysis

The second component of a JSA is a detailed evaluation to accurately quantify the level of solar UV radiation workers are exposed to so that a comparison with the occupational exposure limit (e.g. ACGIH TLV) can be made. There are a number of measurement/evaluation approaches available, with the following being the ones most likely to be considered for an occupational exposure assessment:

- **Broad-band radiometer:** these are commercially available instruments which are able to measure UV exposure and then using an in-built weighting function, provide a reading as either:
    - An 'erythemal effective irradiance' (E_{er} in W/m^2) or an 'erythemal effective radiant exposure (H_{er} in J/m^2), if the detector is weighted for the erythema action spectra; or
    - An 'effective irradiance' (E_{eff} in W/m^2), an 'ultraviolet hazard irradiance' (E_s in W/m^2), or as an 'ultraviolet hazard radiant exposure (H_s in J/m^2), when the detector is weighted for the ACGIH/ICNIRP ultraviolet hazard action spectra.

  Even though these devices are portable, they are not able to be worn by workers. As such, they are used to 'indirectly' measure worker exposure. They are generally used to determine a 'worst case exposure' and this is done by orientating the detector towards the sun, typically during short durations when the highest exposure is expected. Because solar radiation contains a large amount of visible and infrared radiation, the radiometers used should have good 'stray light suppression', otherwise large measurement errors will result.[16] Two instruments currently available* are the *PMA2100 Data Logging Radiometer* from Solar Light Company (http://solarlight.com), and the *ILT500 Research Radiometer* from International Light Technologies (http://www.int-lighttech.com).

- **Personal active dosimeter:** these are commercially available electronic dose-meters which are calibrated to measure the erythemal effective radiant exposure (H_{er} in J/m^2). They have a data-logging ability which allows for analysis of UV dose throughout the workday. They are small enough to be worn by workers (generally on either their wrist or lapel/shoulder), and as such, are able to provide measurements of individual personal UV exposure. If multiple dose-meters are used at one time on a worker, UV exposures at different parts of the body are also able to be assessed. These are relatively new devices and have been used in a number of research studies.[17-20] Two dose-meters currently available* are the *UV dosimeter* from Scienterra Ltd (http://scienterra.moonfruit.com/#/home/4567276434) and the *X-2000 Personal UV Irradiance Dosimeter* from Gigahertz-Optik (http://2010.ghzoptik.de/238-0-X-2012-10.html).

- **Personal passive dosimeter:** these have been used widely in research studies to evaluate solar UV exposure of both workers and the general public. They are generally in the form of a 'film badge' whose chemical or biological properties are altered on exposure to UV radiation, with this change able to be quantified. The most widely used film badge has been polysulphone,[14,21,22] which gets 'darker' on exposure to UV radiation and so this 'change in absorbance' is able to be measured. Due to the way in which polysulpone is 'calibrated', its measurements can be weighted for either the erythemal action spectrum or the ultraviolet hazard action spectrum. Another passive dosimeter which has been used widely is the biospore film, *VioSpor* by Biosense Laboratories* (http://www.biosense.de/v-e.htm).[23,24] The VioSpor badge has a responsivity profile which is close to that of human skin and so provides measurements which are weighted for the erythemal action spectrum. These devices provide cumulative data for the time during which the dosimeter is worn, however they do not have a data-logging ability and so are not able to provide detailed analysis of exposure at various times of the day or for various work tasks. Due to the way in which personal passive dosimeters are calibrated and used, additional lab-based and field equipment is necessary in order to undertake these measurements.

A point to note is that all of the measurement approaches described above have their own inherent errors and inaccuracies, and depending on how well the devices are calibrated and the measurements undertaken, the error could be as high as 80%.[25] However, it would be usual to expect an error/inaccuracy of between +/- 20% to 30% for most field measurement situations,[26] with uncertainty in the measured values not to exceed 30% when making a comparison with the occupational exposure limit.[27]

*mention of a brand/product does not imply endorsement. Prospective purchasers should undertake their own assessment of available products.

Third Component of a Job Safety Analysis

The third component of the JSA is a comparison of the measured exposure levels to the occupational exposure standard/limit. There are three possible outcomes:

- **Acceptable** – this is where the measured values are below the 'Action Limit' (i.e. half of the occupational exposure limit). No further action is necessary as the risk of health effects is considered to be very low. However, ongoing monitoring of exposure should take place, particularly using the *Operational Review* on a regular (e.g. annual) basis.
- **Uncertain** – this is where the measured values are above the 'Action Limit' but below the Occupational Exposure Limit. Additional control measures should be considered and implemented where appropriate.
- **Unacceptable** – this is where the measured values are above the Occupational Exposure Limit. In this case, control measures appropriate to the exposure situation need to be implemented. Once additional controls are implemented, their effectiveness needs to be evaluated, particularly by undertaking further exposure measurements.

A point to note is that depending on which biological action spectrum the measurement devices are weighted/ calibrated for (i.e. whether this is the erythemal action spectrum or the ultraviolet hazard action spectrum), will determine whether the occupational exposure standard (e.g. ACGIH TLV) can be assessed/compared to directly, or whether the *erythemal effective radiant exposure* (usually expressed as SED) will have to be compared to an SED estimation of the ACGIH TLV.

When undertaking any quantitative exposure assessment a detailed evaluation/assessment plan should be developed. For an assessment of solar UV radiation, this will include:

- A description of the measurement equipment used and the reason why this measurement equipment was chosen. This will include a description of the: measurement sensitivity range with respect to the exposures able to be measured; spectral sensitivity of the detector, e.g. whether it is already 'weighted' and how this weighting compares to the relevant biological action spectrum; 'field of view' of the detector'; averaging time of the detector's response; environmental conditions which may impact the performance of the equipment; calibration history and source/methods.[27]
- Identification of 'similar exposure groups' (SEGs) of workers
- Typical positions and orientations for measurement which are representative of personal exposure within each SEG
- Number of measurements which need to be made, and if personal dosimeters are being used, which workers will be wearing the dosimeters
- Duration of measurement – it should be long enough to make an accurate measurement and for the measurement to be representative of worker exposure

- Timing of the measurement – measurements should be undertaken on days which are predicted to have high ambient UV levels. If measurements are taken over part of a day, the measurements should be taken at peak ambient UV times, so that the measurements are representative of maximum solar UV exposure of workers. In addition, the predicted and actual maximum UV Index for the days of measurement should be reported and a comparison made between this and other work days within the season.
- Whether the workers are exposed to artificial UV sources (e.g. welding) or to other radiant heat sources.
- A description of the way in which the measurement data will be aggregated
- A description of how the measurement data will be compared to the occupational exposure standard
- A description of the uncertainty/error associated with the measurement

Further detailed information on undertaking accurate measurement and assessment of UV radiation exposure in workplace settings is available from the EN 14255 series of European Standards (for the *Measurement and Assessment of Personal Exposures to Incoherent optical Radiation*).

The approaches described above can be both complex and costly and so they need to be undertaken by a properly trained/experienced OHS professional. Also, they should only be undertaken when it is deemed that the exposure estimates provided through the *Operational Review* are not sufficient to implement effective control/protection measures.

3. Daily Assessment

Based on the *Operational Review* and the JSA (when appropriate), the workplace should have a good understanding of the level of risk their workers are at regarding solar UV radiation exposure (when undertaking routine/regular work practices or tasks). However, there can be daily variations in conditions which may mean that workers may have higher solar UV exposures than those previously assessed.

As such, on a daily basis, supervisors are encouraged to consider the following variables (linked to the Risk Factors in the *Operational Review*) which may have changed since the initial/*Operational Review* assessment:

- Is work scheduled to occur at higher altitudes than normal?
- Are some work tasks going to occur around surfaces which are more reflective than normal? Examples include: has there been a snow fall overnight, is work scheduled to occur at a beach-side setting where there will be added reflection from sea/water and beach sand?
- Will the location/s provide additional (or less) shade for work tasks or for breaks/lunch?

- Are work tasks likely to bring workers into contact with photosensitizing chemicals (e.g. certain drugs, plant materials, dyes, wood preservatives, or coal tars)?
- Will work tasks require a change in the normally used personal protection? Examples include: will additional clothing/PPE be needed and so this may increase heat stress; certain work tasks may make the reapplication of sunscreen more difficult; or certain tasks may require different head protection which may be less sun protective?

If the answer is 'yes' to any of the above questions, additional protection/control measures should be considered for the work tasks scheduled for that day.

In addition to the above review of scheduled work tasks/activities, supervisors should also check the projected UV Index for the day and take the following actions:

UV Index 1-2:
- Minimal sun protection required

UV Index 3-7: Protection Required:
- Workers should seek shade during breaks (this may be under trees, in vehicles, or under portable shade structures provided by the workplace)
- Between 11:00am and 3:00pm, where possible, work tasks/activities should be undertaken in shade
- Protective clothing appropriate to the work tasks/activities should be worn. This includes: protective clothing (e.g. long sleeved shirts and long pants), UV protective eyewear (e.g. sunglasses, or tinted safety glasses), wide brimmed hat or hard hat with an additional brim and neck flap, and sunscreen and lip balm (minimum 30 SPF)

UV Index 8-11: Extra Protection Required:
- Where possible, work activities should be rescheduled to avoid workers being outdoors between 11:00am and 3:00pm. If rescheduling is not possible, work tasks/activities should be undertaken in shade
- Workers should take breaks in shade (this may be under trees, in vehicles, or under portable shade structures provided by the workplace)
- Protective clothing appropriate to the work tasks/activities should be worn. This includes: protective clothing (e.g. long sleeved shirts and long pants), UV protective eyewear (e.g. sunglasses, or tinted safety glasses), wide brimmed hat or hard hat with an additional brim and neck flap, and sunscreen and lip balm (minimum 30 SPF)

The action of providing shade or rescheduling work activities during peak UV periods (i.e. between 11am and 3pm) is particularly effective in reducing a workers solar UV exposure. An Australian study showed that taking a one hour lunch break indoors or adequately protected from the sun (e.g. using shade) reduced the daily exposure of workers by 20%, with two hours of protection between 11am and 1pm reducing daily exposure by 40%.[28] As the solar UV irradiance in Canada has a more pronounced peak in the middle of the day as compared with that in Australia, for Canadian employers, providing shade or rescheduling outdoor work activities to indoors during the middle of the day is even more effective than that found in Australia.

A *UV Index Poster* is available for use by supervisors to advise their workers of the daily UV Index and the protection measures which are appropriate. Also available is a *Solar UV Radiation Response Procedure* which outlines the steps to follow as part of the Daily Assessment.

A Fact Sheet on *Solar UV Radiation Control Measures* is also available and provides a summary of the measures available to protect workers from over-exposure. Fact sheets on specific topics/controls are also available.

Sun Safety at Work Canada Resources

A range of solar UV radiation safety training, education, policy and assessment resources are available from sunsafetyatwork.ca. These include the following risk assessment related resources:

- *Solar UV Radiation Risk Assessment for Outdoor Workers: Operational Review*
- *UV Index Poster*
- Training resources including posters, fact sheets, presentations and safety talks
- *Solar UV* and *Sun Safety* policy examples
- *Personal Risk Assessment: Sun and Skin Cancer for Outdoor Workers*
- *Daily Procedures for Solar UV*

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