The ACGIH UV Guidelines: Development, Application and Issues

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Outline

• The ACGIH
• The ACGIH UV Guidelines (TLV’s)
• Action spectra
• Relative Spectral Effectiveness
• Effective Irradiance
• Application of UV TLVs
The ACGIH

• The American Conference of Governmental Industrial Hygienists (ACGIH) is a private, not-for-profit, non-governmental corporation …dedicated to promote health and safety within the workplace.

• Publishes Threshold Limit Values (TLVs) for chemical, physical and biological agents.

• WWW.acgih.org
ACGIH UV Guidelines

• First exposure guideline for UV (1972)
• Based on UV effects on the eye (photokeratitis and cataracts) and the skin (erythema).
• Not based on skin cancer but close to levels at which DNA repair level is observed (using p53 gene)
• Adopted by NIOSH and ICNIRP
Action Spectra and Spectral Effectiveness

• UV of different wavelengths have different effects in the eye and the skin
• The “action spectrum” for each effect charts the biological response as a function of wavelength
• The reciprocal normalized envelope of relevant action spectra provides the Relative Spectral Effectiveness $S(\lambda)$
RELATIVE SPECTRAL EFFECTIVENESS: \( S (\)\)

Biological effectiveness of different wavelengths normalized to unity at 270 nm

*Threshold Limit Value at 270 nm = 3.0 mJ/cm²
Effective Irradiance $E_{	ext{eff}}$

- $E_{	ext{eff}} \ [\text{W m}^{-2}] = S \ E_? \ S(?) \ ??$
  - $E_?$ = Spectral Irradiance $[\text{W/(cm}^2 \text{ nm)}]$
  - $S(?)$ = Relative Spectral Effectiveness
  - $??$ = band width in nm
  - Summed between 100 and 400 nm
ACGIH UV Threshold Limit Value (TLV)

- UV (180 to 400 nm) exposure of the unprotected eye and skin should not exceed:
  - $T_{\text{max}} = 0.003 \frac{[\text{J/cm}^2]}{[\text{W/cm}^2]}$
  - $T_{\text{max}} = \text{maximum exposure time in secs}$
  - $E_{\text{eff}} = \text{Effective Irradiance}$
Minimal Erythemal Dose

- Biologically Effective Radiant Exposure or Dose $[\text{J m}^{-2}]_{\text{eff}}$
- Dose = $E_{\text{eff}} \times$ exposure time [Joule/m$^2$]
- Minimal Erythemal Dose
  - Minimal dose that will produce an erythema in previously unexposed skin 24 hours post-exposure
  - Varies with skin type, observations, etc.
- MED conventionally defined as 200 Joule/m$^2$
- TLV = 1/3 MED
Using the UV TLV

- TLV intended to protect nearly all healthy workers
- Does not apply when exposed to hypersensitizing agents
- Easily exceeded in sunny spring or summer day
- Easily exceeded by use of sunbeds
SUNLIGHT vs SUNBED COMPARISON

Sunlight = 0.0667/Sunbed = 0.2 MED/min
The application of UV guidelines

- Ontario Ministry of Labour adopted ACGIH guidelines for workers exposed to solar and artificial UV radiation.
- People pursuing tanning routinely expose themselves to doses significantly higher than guidelines designed to protect workers.
- Issue is voluntary exposure vs. occupational exposure.
Common sense: the best protection