Applying Physical Agent TLVs® as Guidelines for A Safe Workplace

- Often perceived to pose some special problems for practicing hygienists
- The TLVs® may appear highly complex with too many different units
- Highly specialized instrumentation may be required to measure each physical agent
Easy to apply??

\[
\sum_{305}^{700} E_\lambda \cdot t \cdot B(\lambda) \cdot \Delta \lambda \leq 10 \text{ mJ/cm}^2 \quad (t \leq 10^4 \text{ s})
\]

\[
\sum_{305}^{700} E_\lambda \cdot B(\lambda) \cdot \Delta \lambda \leq 1.0 \mu\text{W/cm}^2 \quad (t > 10^4 \text{ s})
\]
The Electromagnetic Spectrum

Wavelength (m)

Size of a wavelength

Common name of wave

Sources

Frequency (Hz)

Energy of one Photon (eV)
The Optical Spectrum: Several TLVs®

<table>
<thead>
<tr>
<th>UV-C</th>
<th>UV-B</th>
<th>UV-A</th>
<th>VISIBLE</th>
<th>IR-A</th>
<th>IR-B</th>
<th>IR-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>200-280</td>
<td>280-315</td>
<td>315-400</td>
<td>400-760</td>
<td>760-1400</td>
<td>1400-3000</td>
<td>3000-1E6</td>
</tr>
</tbody>
</table>

- **CORNEA**
  - Photokeratitis (Snow Blindness or Welder’s Flash)
- **LENS**
  - Cataract
  - Cataract?
- **EPIDERMIS**
  - (Photochemical Effects) Erythema
  - Skin Cancer

- **RETINA**
  - Retinal Burns
  - Color Vision
  - Night Vision

- **CORNEA**
  - Thermal Injury

- **DERMIS**
  -
  -
  -

**Note:** Spectral regions listed in units of nanometers.
Multiple Exposures

- Noise
- Heat Stress
- Ultraviolet Radiation
- Airborne Contaminants
The UV TLV® Plotted as Exposures
Ultraviolet (UV) TLV® as an Action Spectrum

The same function – two different views (linear and logarithmic)
Can We Always Achieve Total Protection?
Heat Stress versus UV Protection

- Ultraviolet Radiation TLVs® competing?
- Loose clothing with air movement that covers the skin is the effective solution.
Measurement of Physical Agent TLVs®

- In some cases, special instruments are designed to follow a complex TLV® expression
  - Noise: A-weighted sound pressure level meters
  - Radio-frequency hazards: RF survey meters
  - Ultraviolet radiation: UV hazard meters
  - Heat: WBGT heat stress monitors
  - High-intensity light: blue light hazard meters
- Personal dosimeters; e.g., noise, UV, EMF, ionizing
UV Hazard Meter
Controlling Emissions and Exposures

- Enclosure
  - Equipment
  - Emission control
- Personal protection or shield
- Exposure control
Controlling Emissions

- Some physical agent hazards are routinely controlled through source controls
- Emission limits can provide the expected protection
- Product safety standards—Examples:
  - Laser accessible emission limits (AELs) ANSI, FDA, IEC
  - Vibrating hand tools (ISO)
  - Ultraviolet photocuring devices
  - Cell-phone emission guidance (FDA, IEEE, ICNIRP, IEC)
  - Lamp-safety standards (ANSI, CIE)
- The emission limits should be in consonance with the TLVs®
- Some technical standards committees derived emission limits from occupational exposure limits
Hand-Arm (Segmental) Vibration - Used in Equipment Evaluation
PAC Scope of Activities

- Analyzing physical characteristics and reports of biological effects
- Recommending appropriate terminology, quantities and units
- Assessing new workplace exposure situations
- Developing exposure guidelines – the TLVs® – for Physical Agents
Physical-Agent TLV® Development

- TLVs® are based upon critical evaluation of relevant scientific studies with emphasis on their effects upon human health.
- The evaluation must be based on clear, quality criteria for evaluating human health (epidemiological) and laboratory (human, animal and in vitro) studies.
- Clear, consistent dosimetry of physical agents.
• A judgment must be made whether the available evidence allows the identification of an exposure hazard (i.e., adverse health effect)

• Further risk assessment should provide quantitative data, such as exposure-effect relationships and identification of a threshold, if any

• The dose response relationship should be established

• Plausible mechanisms underlying the interaction should be understood
Fundamental Dose Limitations And Derived TLV® Guidance

- A basic limit in terms of the biologically effective quantity may first be defined and the TLV® derived
- TLVs® may then be expressed in terms of a directly measurable exposure rather than the basic dose
- Using the derived TLVs® assures internal exposures are below the basic limits, since the relationships between them are reasonably worst-case
- RF TLVs® have been developed for situations of maximum coupling conditions between the fields and the exposed person