NIOSH OCCUPATIONAL EXPOSURE BANDING: A NEW TOOL FOR EVALUATING CHEMICAL HAZARDS

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OBJECTIVE

To create a consistent and documented process to characterize chemical hazards so timely and well-informed risk management decisions can be made for chemicals lacking OELs.

An OEB is not meant to replace an OEL, rather it serves as a starting point to inform risk management decisions.
HIERARCHY OF OELS

- Quantitative Health-Based OELs
  - Most Extensive Data Requirements (human epidemiology studies or animal studies) greater quality, greater certainty

- Traditional OELs
  - Regulatory, Authoritative (TLVs, MAKs, WEELs, PELs, RELs)

- Working Provisional OELs
  - (internal company, trade association, vendor limits)

- Prescriptive Process Based Occupational Exposure Benchmarks and Guidance Values (OEVs)
  - (REACH DNELs/DMELs)

- Hazard Banding Strategies
  - Pharmaceutical banding
  - Occupational exposure banding

- Least Data Requirements (in vitro and animal studies)

- Moderate Data Requirements (in vitro and animal studies and anecdotal reports of human health effects) greater quality, greater certainty
CHEMICALS IN COMMERCE

• Approximately 85,000 chemicals in commerce.

OCCUPATIONAL EXPOSURE LIMITS

• Approximately 1,000 chemicals with authoritative OELs
WHAT IS OCCUPATIONAL EXPOSURE BANDING?

A mechanism to quickly and accurately assign chemicals into “categories” or “bands” based on their health outcomes and potency considerations.
### NIOSH OCCUPATIONAL EXPOSURE BANDS

<table>
<thead>
<tr>
<th>Occupational Exposure Band</th>
<th>Airborne Target Range for Particulate Concentration (mg/m³)</th>
<th>Airborne Target Range for Gas or Vapor Concentration (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&gt;10 mg/m³</td>
<td>&gt;100 ppm</td>
</tr>
<tr>
<td>B</td>
<td>&gt;1 to 10 mg/m³</td>
<td>&gt;10 to 100 ppm</td>
</tr>
<tr>
<td>C</td>
<td>&gt;0.1 to 1 mg/m³</td>
<td>&gt;1 to 10 ppm</td>
</tr>
<tr>
<td>D</td>
<td>&gt;0.01 to 0.1 mg/m³</td>
<td>&gt;0.1 to 1 ppm</td>
</tr>
<tr>
<td>E</td>
<td>≤0.01 mg/m³</td>
<td>≤0.1 ppm</td>
</tr>
</tbody>
</table>
THE PROMISE OF OCCUPATIONAL EXPOSURE BANDING

- Facilitates more rapid evaluation of health risk
- Provides guidance for materials without OELs
- Highlights areas where data are missing
- Provides a screening tool for the development of RELs
- Identifies hazards to be evaluated for elimination or substitution
- Aligned with GHS for hazard communication
- Facilitates the application of Prevention through Design principles
IS THIS THE SAME AS CONTROL BANDING?
OCCUPATIONAL EXPOSURE BANDING IS DIFFERENT!

- OEBs derived from *toxicology* and *potency*
- OEBs can be used to identify one of many control strategies
HOW IS THE PROCESS ORGANIZED?

Bands are assigned based on the findings for nine standard toxicological endpoints:

1. Carcinogenicity
2. Reproductive toxicity
3. Specific target organ toxicity resulting from repeated exposure
4. Acute toxicity
5. Genotoxicity
6. Skin corrosion and irritation
7. Respiratory sensitization
8. Skin sensitization
9. Serious eye damage and irritation
Tier 1 — GHS Hazard Codes

**User:** Health and safety generalist

A Tier 1 evaluation utilizes GHS Hazard Statements and Categories to identify chemicals that have the potential to cause irreversible health effects.

Tier 2 — Secondary Data Sources

**User:** Properly trained occupational hygienist

A Tier 2 evaluation produces a more refined OEB, based on point of departure data from reliable sources. Data availability and quality are considered.

Tier 3 — Expert Judgement

**User:** Toxicologist or experienced occupational hygienist

Tier 3 involves the integration of all available data and determining the degree of conviction of the outcome.
GHS hazard codes and categories provide the basis for Tier 1 criteria

- Relatively low data requirements
- Chemicals can be banded in bands C, D, and E
- Chemicals are assigned Tier 1 OEBs based on severity and reversibility of effects
- Tier 1 is useful as a screening tool, but Tier 2 is recommended if data and expertise are available
TIER 1 Process

1. Chemical of interest has no OEL
2. Locate GHS hazard codes and categories in recommended databases.
3. Compare hazard codes and categories with NIOSH criteria for each health endpoint.
4. Assign band for each relevant health endpoint based on criteria.
5. Assign a Tier 1 OEB for the chemical based on most protective endpoint band.
<table>
<thead>
<tr>
<th>TIER 1 Criteria</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OEL Ranges</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle</td>
<td>&gt; 0.1 to \leq 1 milligrams per cubic meter of air (mg/m³)</td>
<td>&gt; 0.01 to \leq 0.1 mg/m³</td>
<td>\leq 0.01 mg/m³</td>
</tr>
<tr>
<td>Vapor</td>
<td>&gt; 1 to \leq 10 parts per million (ppm)</td>
<td>&gt; 0.1 to \leq 1 ppm</td>
<td>\leq 0.1 ppm</td>
</tr>
<tr>
<td><strong>Acute Toxicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H301</td>
<td>Category 3</td>
<td></td>
<td>H300 Category 1</td>
</tr>
<tr>
<td>H302</td>
<td>Category 4</td>
<td></td>
<td>H300 Category 1</td>
</tr>
<tr>
<td>H331</td>
<td>Category 3</td>
<td></td>
<td>H330 Category 1</td>
</tr>
<tr>
<td>H332</td>
<td>Category 4</td>
<td></td>
<td>H330 Category 1</td>
</tr>
<tr>
<td>H311</td>
<td>Category 3</td>
<td></td>
<td>H310 Category 1</td>
</tr>
<tr>
<td>H312</td>
<td>Category 4</td>
<td></td>
<td>H310 Category 1</td>
</tr>
<tr>
<td><strong>Skin Corrosion/ Irritation</strong></td>
<td></td>
<td></td>
<td>H314 Category 1, 1A, 1B, or 1C</td>
</tr>
<tr>
<td>H315</td>
<td>Category 2</td>
<td></td>
<td>H318 Category 1</td>
</tr>
<tr>
<td>H319</td>
<td>Category 2, 2A or 2B</td>
<td></td>
<td>H318 Category 1</td>
</tr>
<tr>
<td><strong>Respiratory and Skin Sensitization</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H317</td>
<td>Category 1B</td>
<td>H317 Category 1 or 1A</td>
<td></td>
</tr>
<tr>
<td>H334</td>
<td>Category 1B</td>
<td>H334 Category 1 or 1A</td>
<td></td>
</tr>
<tr>
<td>H341</td>
<td>Category 2</td>
<td>H340 Category 1, 1A or 1B</td>
<td></td>
</tr>
<tr>
<td><strong>Genotoxicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H350</td>
<td>Category 2</td>
<td>H351 Category 2</td>
<td></td>
</tr>
<tr>
<td><strong>Carcinogenicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H361 (including H361f, H361d, and H361fd) Category 2</td>
<td>H360 (including H360f, H360d, and H360fd) Category 1B</td>
<td>H360 (including H360f, H360d, and H360fd) Category 1 or 1A</td>
<td></td>
</tr>
<tr>
<td><strong>Toxic to Reproduction</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H371</td>
<td>Category 2</td>
<td>H370 Category 1</td>
<td></td>
</tr>
<tr>
<td>H373</td>
<td>Category 2</td>
<td>H372 Category 1</td>
<td></td>
</tr>
<tr>
<td><strong>Specific Target Organ Toxicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tier 2 — Both Qualitative and Quantitative

- Some training in toxicology

- Based on readily available secondary data from authoritative sources (government, professional health agencies, authoritative toxicological benchmarks)

- Needs sufficient data to generate reliable OEB

- Prescriptive analytical strategy to ensure consistency

- Potential for chemicals to be moved from the Tier 1 OEB to a more or less protective OEB
Begin Tier 2 process.

Search recommended databases for toxicity information.

Compare qualitative and quantitative data to NIOSH Tier 2 banding criteria.

Assign band and EDS for each health endpoint based on NIOSH Tier 2 banding criteria.

Assign a Tier 2 OEB for the chemical based on most protective endpoint band if the TDS is above 30 or if the overall band is E.
OCCUPATIONAL EXPOSURE BANDING

Overview:

Occupational exposure banding is a process that classifies occupational hazards into bands ranging from band 1 to band 7, which correspond to a range of exposure control strategies designed to protect worker health. These bands are assigned based on a characterization of the physical/chemical hazards and their associated effects. The Center for Disease Control and Prevention (CDC) provides guidance on how to classify hazards into one of these seven bands.

Summary:

The National Institute for Occupational Safety and Health (NIOSH) has developed a method to classify hazards into seven bands based on their physical and chemical properties. This method helps employers to prioritize exposure control strategies to protect workers from these hazards.

Related Topics:

- Control Technologies
- Personal Protective Equipment
- Training
- Surveillance
- Research
- Standards
- Legislation

References:


Content:

- Toxic Substances
- Exposure Limit Values
- Control Measures
- Personal Protective Equipment
- Medical Surveillance
- Training
- Surveillance
- Research
- Standards
- Legislation
OCCUPATIONAL EXPOSURE BANDING E-TOOL

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Overview

Occupational exposure banding is a process of assigning chemicals into specific categories or bands based on a chemical's potency and the adverse health outcomes associated with exposure. The output of this process is an occupational exposure band (OEB), which corresponds to a range of exposure concentrations that is expected to protect worker health. For more information on occupational exposure banding please refer to the NIOSH occupational exposure banding step guide: occupational exposure bands.

The occupational exposure banding e-Tool is a supplementary online application that incorporates the occupational exposure banding process and allows users to apply toxicity and potency information to generate quantitative exposure guidance for chemicals. The Occupational Exposure Banding e-Tool should be used in concert with the Current Intelligence Bulletin (CIB). The CIB contains detailed instructions for searching for and choosing appropriate data for banding. This e-Tool is a supplementary tool meant to assist with Tier 1 and Tier 2 banding. To learn more click here: e-Tool.
Register

Create a new account.

Email  
(Please use a business email)

Password

Confirm password

- Must be 6 or more characters.
- Must contain one uppercase character (A through Z)
- Must contain one lowercase character (a through z)
- Must contain one number (0 through 9)
- Must contain one symbol (such as $, !, #, %)

☐ By checking this box, you have read the Disclaimer.
Overview

Tier 1 produces a qualitative occupational exposure band (OEB) assignment based on Globally Harmonized System of Classification and Labeling of Chemicals (GHS). Tier 1 involves assigning the OEB based on criteria aligned with specific GHS hazard codes and categories. Chemicals with potential to cause serious or irreversible health effects at relatively low doses warrant assigning band D or band E. Chemicals that are likely to cause reversible health effects at higher concentrations are categorized in band C. Bands A and B are not assigned in Tier 1. Tier 1 is intended to be used by individuals with basic toxicology knowledge.

Please note that the following hazard codes will not be used for Tier 1 Banding: H200’s (physical hazards), H300, H305, H313, H316, H320, H332, H335, H336, H362, and H400’s (environmental hazards). If a chemical has been assigned any of these codes, they will not contribute to the Tier 1 band assignment.

Basic instructions to use the Occupational Exposure Banding e-Tool for Tier 1.

1. **Step 1:** Enter chemical name and/or CAS number.
   - If the chemical has an OEL listed in the NIOSH Pocket Guide, you will be redirected to the Pocket Guide entry.

2. **Step 2:** Select the physical state of the chemical.
   - This allows the tool to display the appropriate units for the exposure range that corresponds to the OEB.

3. **Step 3:** Choose to auto-fill data from GESTIS Substance Database or enter your own data.
   - The e-Tool has been linked to the GESTIS Substance Database and the data can be auto-filled for chemicals found in the GESTIS database. Users can also use Annex VI or safety data sheets (SDS) to find and enter H-codes and categories manually. Links are provided in the resources tab on the left navigation pane.

4. **Step 4:** If data is auto-filled move to Step 5. Otherwise enter GHS information into the e-Tool.
   - If the data was not auto-filled use Annex VI or SDS to enter data by clicking through the health endpoint tabs across the page to select the appropriate hazard code/category combination for each endpoint.

5. **Step 5:** Click "Submit Tier One."
   - A recommendation page will display the information that was submitted, the Tier 1 OEB, and the corresponding exposure range.

6. **Step 6:** Review results and edit entry if necessary.
   - If everything is correct, the OEB can be applied. If not, select "Edit This Entry" in the yellow highlighted section on the bottom of the screen.
NIOSH Occupational Exposure Banding e-Tool (version 1.0)

Chemical Information

Please note that the following hazard codes will not be used for Tier 1 Banding: H200's (physical hazards), H303, H305, H313, H316, H320, H333, H335, H336, H362, and H400's (environmental hazards). If a chemical has been assigned any of these codes, they will not contribute to the Tier 1 band assignment.

Chemical Information

- Chemical Name
- CAS Number

Physical State:
- Vapor
- Particles
- Vapor & Particles

Auto Fill Genetic Data?
- Yes
- No

Submit Chemical
Chemical Information

Please note that the following hazard codes will not be used for Tier 1 Banding: H200's (physical hazards), H303, H305, H013, H316, H320, H333, H335, H336, H362, and H400's (environmental hazards). If a chemical has been assigned any of these codes, they will not contribute to the Tier 1 band assignment.

Chemical Information

[Table with columns: Chemical Name, CAS Number, Physical State, NIOSH Pocket Guide.
- Chemical Name: formaldehyde
- CAS Number: 50-00-0
- Physical State: Vapor
- NIOSH Pocket Guide: lists an OEL for this chemical. Tier 1 Banding is not recommended]
Tier One

Please note that the following hazard codes will not be used for Tier 1 Banding: H200’s (physical hazards), H303, H365, H313, H316, H320, H333, H355, H336, H362, and H400’s (environmental hazards). If a chemical has been assigned any of these codes, they will not contribute to the Tier 1 band assignment.

Carcinogenicity

<table>
<thead>
<tr>
<th>Select</th>
<th>Hazard Category</th>
<th>Hazard Code</th>
<th>Hazard Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>1</td>
<td>350</td>
<td>May cause cancer</td>
</tr>
<tr>
<td>○</td>
<td>1a</td>
<td>350</td>
<td>May cause cancer</td>
</tr>
<tr>
<td>○</td>
<td>1b</td>
<td>350</td>
<td>May cause cancer</td>
</tr>
<tr>
<td>○</td>
<td>2</td>
<td>355</td>
<td>Suspected of causing cancer</td>
</tr>
</tbody>
</table>
Tier One Recommendation

Overall Recommended Band

D

Vapor Range: >0.1 and < 1 ppm
Particle Range: >0.001 and < 0.1 mg/m³

Chemical Name: Ethylene glycol monomethyl ether
CAS#: 68-77-9

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>Hazard Code</th>
<th>Hazard Category</th>
<th>Endpoint Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Toxicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dermal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin Corrosion/Irritation</td>
<td>315</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td>Serious Eye Damage/Eye Irritation</td>
<td>319</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td>Respiratory and Skin Sensitization</td>
<td>317</td>
<td>16(kill)</td>
<td>D</td>
</tr>
<tr>
<td>Germ Cell Mutagenicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carcinogenicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reproductive Toxicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific Target Organ Toxicity</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please do not use the back button. Using the back button will result in multiple entries. Click the button below to make changes to data inputs.

Edit this Entry

- Grey Box - No Data Entered
## Tier One Edit

### List of Existing Tier One Entries

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS Number</th>
<th>Vapor Range</th>
<th>Particles Range</th>
<th>Recommended Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>testrane 1</td>
<td>testrane 1</td>
<td>&lt;= 0.1 ppm</td>
<td>&lt;= 0.01 mg/m³</td>
<td>E</td>
</tr>
<tr>
<td>testrane 1</td>
<td>testrane 1</td>
<td>&lt;= 0.1 ppm</td>
<td>&lt;= 0.01 mg/m³</td>
<td>E</td>
</tr>
<tr>
<td>testrane</td>
<td>all hands</td>
<td>&lt;= 0.1 ppm</td>
<td>&lt;= 0.01 mg/m³</td>
<td>E</td>
</tr>
<tr>
<td>test 45</td>
<td>test 45</td>
<td>&lt;= 0.1 ppm</td>
<td>&lt;= 0.01 mg/m³</td>
<td>E</td>
</tr>
<tr>
<td>test 24</td>
<td></td>
<td>&gt; 1 and &lt; 10 ppm</td>
<td>&gt; 0.1 and &lt; 1 mg/m³</td>
<td>C</td>
</tr>
<tr>
<td>test 111</td>
<td>106-94-5</td>
<td>&gt; 1 and &lt; 10 ppm</td>
<td>&gt; 0.1 and &lt; 1 mg/m³</td>
<td>C</td>
</tr>
<tr>
<td>test 1 rane</td>
<td>test 1 rane</td>
<td>&lt;= 0.1 ppm</td>
<td></td>
<td>E</td>
</tr>
</tbody>
</table>
OEB E-TOOL LINK

https://wwwn.cdc.gov/niosh-oeb
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