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# Introduction to Occupational Exposure Bands (OEBs)

Guidance Document

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Version 1 | May 19, 2021

## What is an Occupational Exposure Band?

Occupational exposure banding, also called hazard banding, health hazard banding, or exposure banding, is a process of assigning chemicals into bands or categories based on a chemical's toxicological potency and the risk of adverse health effects associated with exposure. The result of this process is called an occupational exposure band, or OEB, which is a range of exposure concentrations where industrial hygienist and occupational and environmental health and safety professionals can anticipate worker health to be protected. NIOSH has developed and published the [The NIOSH Occupational Exposure Banding Process for Chemical Risk Management](#), a document that occupational health professionals can use to help protect the health of workers exposed to chemicals on the job.

An industrial hygiene and occupational and environmental health and safety (IH/OEHS) professional only creates an OEB in situations where they must make health-based risk management decisions in the absence of occupational exposure limits (OELs). While OEBs are provisional, OELs are official, authoritative standards created by recognized occupational health and worker protection bodies to protect workers' health. Examples of OELs include but are not limited to ACGIH's threshold limit values (TLVs®); OSHA's permissible exposure limits (PELs), which are enforceable by federal OSHA; NIOSH's Recommended Exposure Limits (RELs); and TERA's

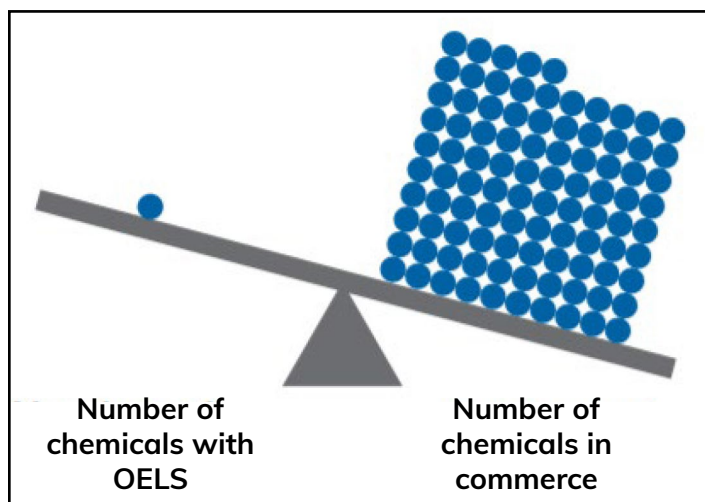


Figure 1. There are many more chemicals on the market than have OELs. Reprinted from NIOSH: *The NIOSH Occupational Exposure Banding Process for Chemical Risk Management*, page 1, [bit.ly/oebreport](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-process-for-chemical-risk-management) (July 2019).

Workplace Environmental Exposure Levels (WEELs). OELs account for many other factors in addition to a chemical's adverse health effects and take far more time and data to compile than OEBs.

However, the number of chemicals, solutions, and products on the market far exceeds available OELs. According to the EPA, the Toxic Substances Control Act (TSCA) Chemical Substance Inventory contains over 85,000 chemicals commercially available in the U.S., but only about 1,000 of those have been assigned an authoritative OEL. This means that if you are managing chemical exposures in your IH/OEHS career, it is likely that you will have to make health-

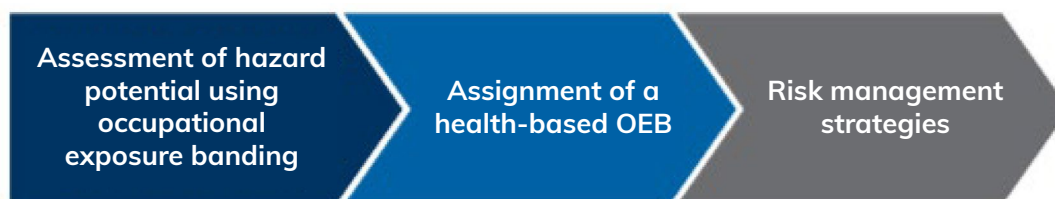


Figure 2. Through the process of creating and assigning OEBs, IH/OEHS professionals can mitigate the health effects associated with a chemical exposure. From NIOSH: *The NIOSH Occupational Exposure Banding Process for Chemical Risk Management*, page 4, [bit.ly/oebreport](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-process-for-chemical-risk-management) (July 2019).



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Chemical Name: Chloral Hydrate CAS Number: 302-17-0				
Endpoint	Hazard code	Hazard category	H-code source	Endpoint band
Carcinogenicity	None	—	—	—
Reproductive toxicity	None	—	—	—
Specific target organ toxicity	None	—	—	—
Genotoxicity	None	—	—	—
Respiratory and skin sensitization	None	—	—	—
Acute Toxicity	—	—	—	—
Inhalation	—	—	—	—
Oral	H301	Category 3	GHS	C
Dermal	None	—	—	—
Skin corrosion/irritation	H315	Category 2	GHS	C
Eye damage/irritation	H319	Category 2	GHS	C
Most stringent band				C
Notes:				

Figure 3. A simple evaluation of the chemical chloral hydrate, according to NIOSH's process, accounts for health effects in nine toxicological categories. From NIOSH: *The NIOSH Occupational Exposure Banding Process for Chemical Risk Managements*, page 17, [bit.ly/oebreport](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-process-for-chemical-risk-managements.pdf) (July 2019).

based risk management decisions quickly and in the absence of much information about a chemical. OEBs provide a starting point and framework for making these decisions when OELs are absent.

Occupational exposure banding provides a framework to help protect worker health from potential chemical exposures, even when certain information on the chemical is lacking. Although an OEB is not

a substitute for an OEL, creating an OEB is a step towards safeguarding workers from the chemical's effects and may also help occupational health bodies prioritize the chemical in question for OEL development.

NIOSH's occupational exposure banding process uses chemical toxicity data to categorize chemicals into one of five OEBs ranging from A through E. The process has multiple phases of evaluation for determining a chemical's OEB, including the consideration of the following nine toxicological health endpoints: carcinogenicity, reproductive toxicity, specific target organ toxicity, genotoxicity, respiratory sensitization, skin sensitization, acute toxicity, skin corrosion and irritation, and eye damage and irritation. Following this process, you must consider each health effect category separately for every chemical, which helps you identify the most severe health effects associated with this chemical's use. For example, a chemical that can cause serious eye damage may not be as dangerous to other organs.

NIOSH's five exposure bands (A, B, C, D, and E) are aerosol concentration levels at which workers dealing with a chemical can expect to be protected. Band A contains the highest level of air concentrations. Chemicals assigned to Band A may cause adverse health effects at high concentrations. On the other hand, workers may be harmed if exposed to much lower concentrations of substances classified in Band E.

	A	B	C	D	E
Particulate/Dust	>10 mg/m <sup>3</sup>	>1 to 10 mg/m <sup>3</sup>	>0.1 to 1 mg/m <sup>3</sup>	>0.01 to 0.1 mg/m <sup>3</sup>	≤ 0.01 mg/m <sup>3</sup>
Gas/Vapor	>100 ppm	>10 to 100 ppm	>1 to 10 ppm	>0.1 to 1 ppm	≤ 0.1 ppm

Figure 4. NIOSH's OEB assessment framework assigns chemicals to one of five exposure bands, ranging from Band A (least harmful) to Band E (most harmful). From NIOSH: *The NIOSH Occupational Exposure Banding Process for Chemical Risk Managements*, page vii, [bit.ly/oebreport](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-process-for-chemical-risk-managements.pdf) (July 2019).



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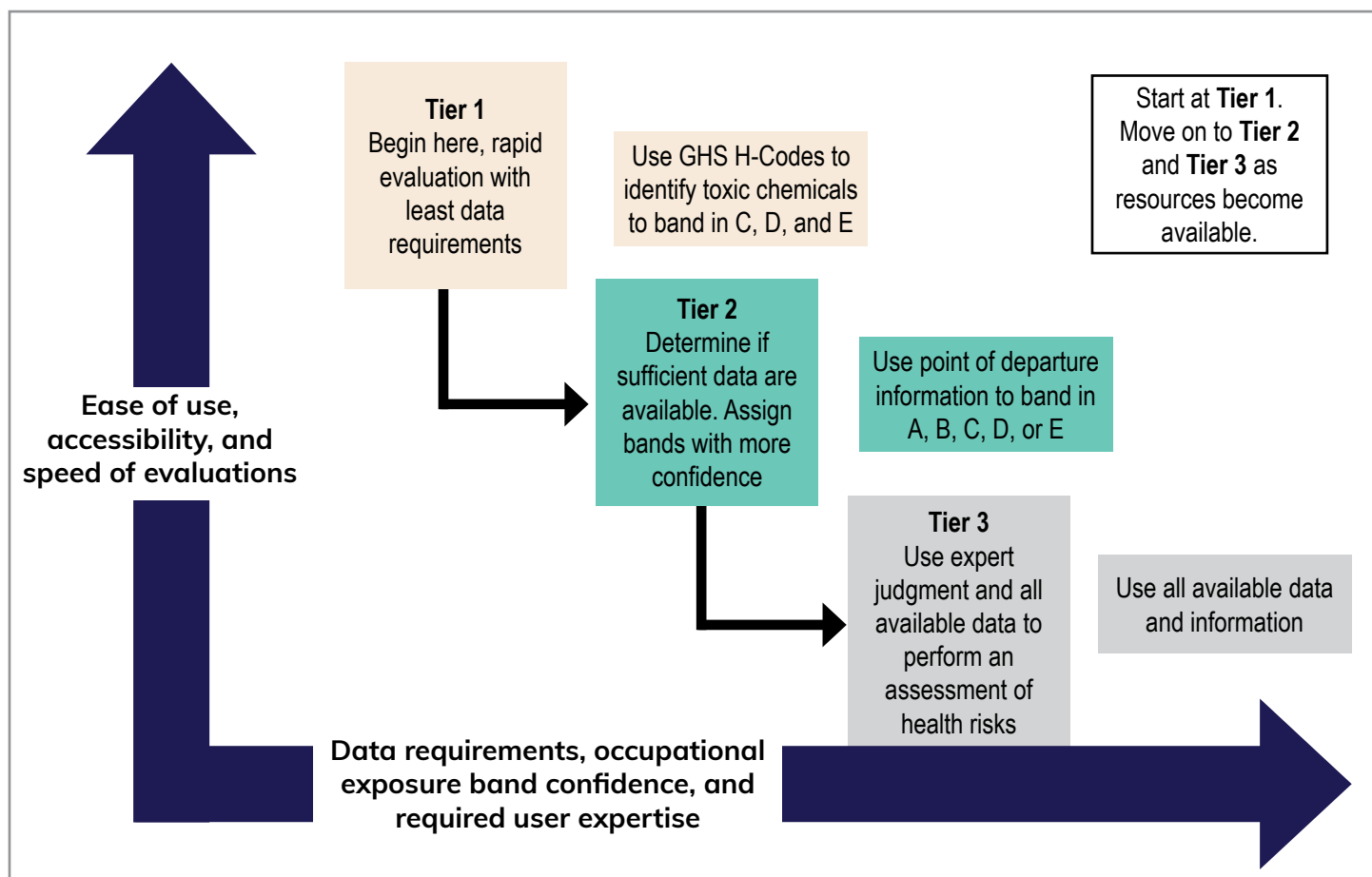


Figure 5. The tiers of NIOSH's OEB assessment framework build on each other in terms of complexity, amount of data, and required expertise. From NIOSH: *The NIOSH Occupational Exposure Banding Process for Chemical Risk Managements*, page viii, [bit.ly/oebreport](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-report.html) (July 2019).

Finally, NIOSH employs a tiered approach to creating OEBs based on the assessor's skill and the kind of information available on the chemical. A Tier 1 assessment is based on publicly available data, while Tier 2 employs database searches of health effects and Tier 3 requires assessment of peer-reviewed reports. As your evaluation advances through the tier system, the tiers become more rigorous to complete and require more extended evaluations, more data, and greater IH/OEHS expertise.

## Tier 1

Tier 1 is the beginning point of NIOSH's process for creating an OEB. You should start at Tier 1 and progress to Tiers 2–3 as resources (i.e., additional data and technical expertise) become available. A Tier 1 evaluation is relatively quick and uses publicly available information such as the Globally Harmonized System for Classification and Labeling of Chemicals (GHS) hazard statement codes, also known as H-codes, to assign toxic chemicals only to bands C, D, and E.



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Chemicals with the potential to seriously harm workers even at low exposures are assigned to bands D and E. Chemicals that may cause reversible health effects are assigned to band C. Bands A and B are assigned at Tier 2.

A Tier 1 assessment is a screening assessment, and you may have performed one already in the course of your work. This is the process for conducting a Tier 1 assessment:

1. Choose a chemical without an OEL.
2. Select a physical state of that chemical. Different states of a chemical may be associated with different effects at different concentrations. The correct range of safe air concentrations covered under the A-E bands depends on the chemical's state.
3. Find GHS H-code and category information. Refer to the GESTIS Substance Database, Annex VI, or the chemical's safety data sheet.
4. For each health endpoint, compare H-code data to the Tier 1 criteria.

5. Assign a band for each health endpoint with data.
6. Assign the Tier 1 OEB for the chemical based on the health endpoint with the most severe health effects associated with exposure to the chemical. Continue to Tier 2 or end the assessment if you assigned Band E.

## Tier 2

Tier 2 is an intermediate stage for gathering information based on authoritative sources and prescribed literature to assign chemicals to bands more confidently than in Tier 1. Tier 2 uses point of departure data, and chemicals may be assigned to all bands A through E. A Tier 2 evaluation requires at least intermediate knowledge of toxicology concepts. The process for conducting a Tier 2 assessment is comparable to that for Tier 1.

Use NIOSH-recommended sources for Tier 2 to find toxicity and potency data for each of the nine health endpoints, then compare the available toxicological data to the Tier 2 criteria. Assign an endpoint

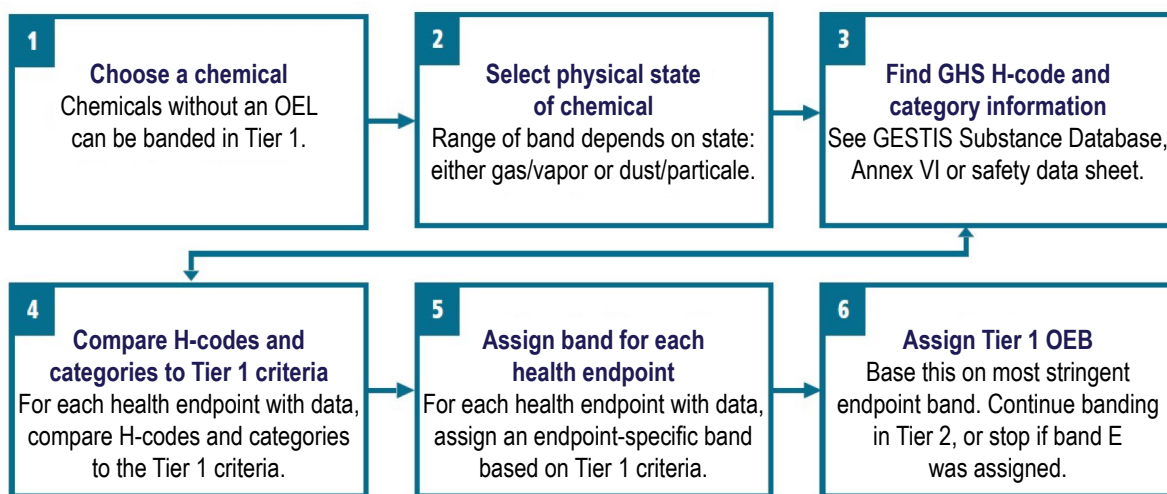


Figure 6. A Tier 1 assessment provides a basis for more thorough hazard assessment. From NIOSH: The NIOSH Occupational Exposure Banding Process for Chemical Risk Managements, page ix, [bit.ly/oebreport](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-process-for-chemical-risk-managements/) (July 2019).



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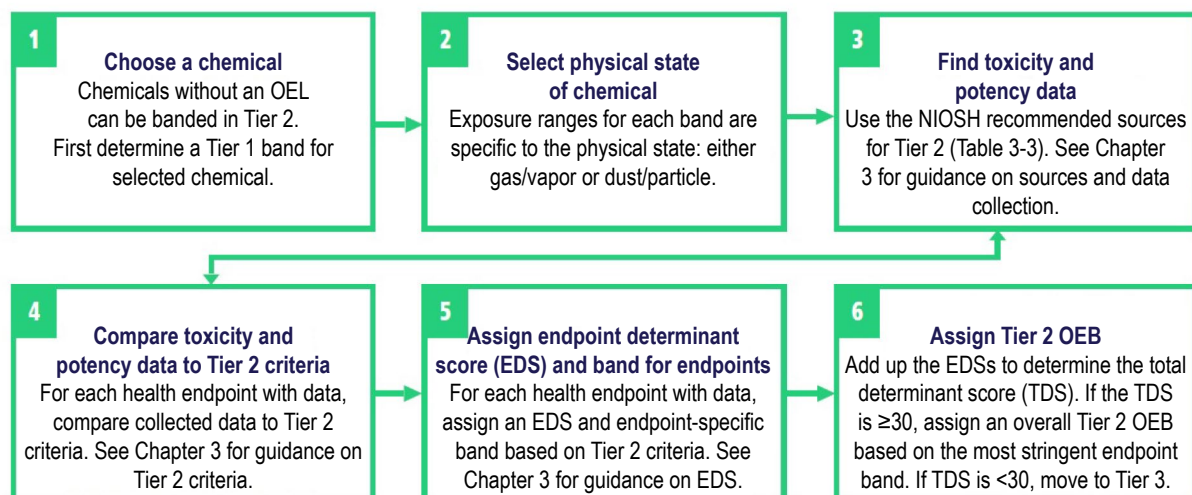


Figure 7. The Tier 2 assessment requires more toxicology data than the initial Tier 1 assessment. From NIOSH: *The NIOSH Occupational Exposure Banding Process for Chemical Risk Managements*, page x, [bit.ly/oebreport](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-process-for-chemical-risk-managements.pdf) (July 2019).

Table 3-4. Assigned scores for the presence of toxicological endpoints encountered in the Tier 2 evaluation.

Toxicological endpoint	Endpoint determinant score (EDS)
	Qualitative = 20 or 30 Quantitative = 30
<b>Carcinogenicity</b>	
Reproductive and Developmental Toxicity	30
Specific Target Organ Toxicity-Repeated Exposure	30
Genotoxicity	5
Respiratory Sensitization	10
Skin Sensitization	5
Acute Toxicity/Lethality	5
Skin Corrosion/Irritation	5
Eye Damage/Irritation	5
Data Sufficiency/Total Determinant Score (TDS)*	30/125

\*The minimum TDS criteria are waived if any of the endpoint bands are E. In that case, the chemical is assigned an overall band E, regardless of TDS.

Figure 8. Tier 2 evaluates the same health endpoints as Tier 1 but begins with assessing a chemical's toxicity data by assigning certain scores based on the availability of data for each health endpoint. From NIOSH: *The NIOSH Occupational Exposure Banding Process for Chemical Risk Managements*, page 27, [bit.ly/oebreport](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-process-for-chemical-risk-managements.pdf) (July 2019).

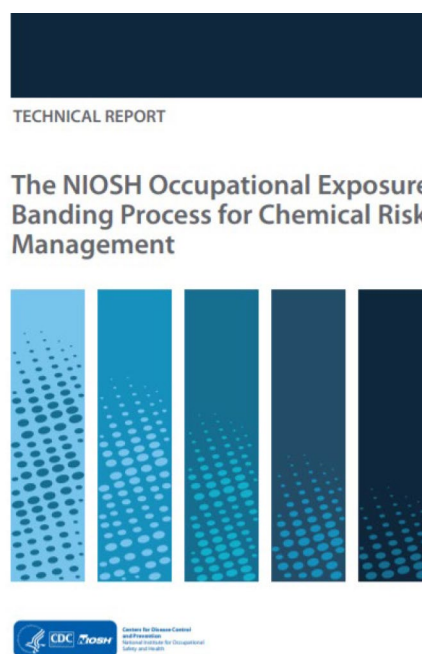


Figure 9. The NIOSH Occupational Exposure Banding Process for Chemical Risk Management is an in-depth reference for creating Tier 1-2 OEBs, downloadable in PDF form at [bit.ly/oebreport](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-process-for-chemical-risk-managements.pdf).



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determinant score (EDS) and an endpoint-specific OEB to every endpoint with data. Add up the EDSs to find the total determinant score (TDS). If the TDS is greater than or equal to 30, assign an overall Tier 2 OEB based on the most rigorous endpoint. Your Tier 2 assessment is now complete. If the TDS is less than 30, continue to Tier 3.

The Tier 2 assessment is a more detailed process than that for Tier 1. The *NIOSH Occupational Exposure Banding Process for Chemical Risk Management* document provides a comprehensive guide to the process of assigning a Tier 2 OEB.

## Tier 3

The final stage of evaluation, Tier 3, requires expert judgment, uses all available data to assess health risks, and ultimately assigns the chemical in question to any of NIOSH's five bands. However, a Tier 3 evaluation is far more stringent than this introduction can fully convey. If you wish to learn more about the Tier 3 assessment process, you can also refer NIOSH's technical report, *The NIOSH Occupational*

*Exposure Banding Process for Chemical Risk Management* ([bit.ly/oebreport](http://bit.ly/oebreport)).

Elements of the Tier 3 process include:

1. Searching bibliographic databases and journal articles for literature containing information on the chemical in question.
2. Finding critical studies of the chemical relevant to each of the health endpoints.
3. Critically reading and evaluating the studies to determine the toxicological outcome for each endpoint.
4. Using the scientific information to find the appropriate OEB for each endpoint.
5. Assigning the most stringent endpoint as the overall OEB.

## Further Information About OEBs

NIOSH has developed a web application, or e-Tool, which streamlines the occupational exposure banding process. It allows users to apply toxicology

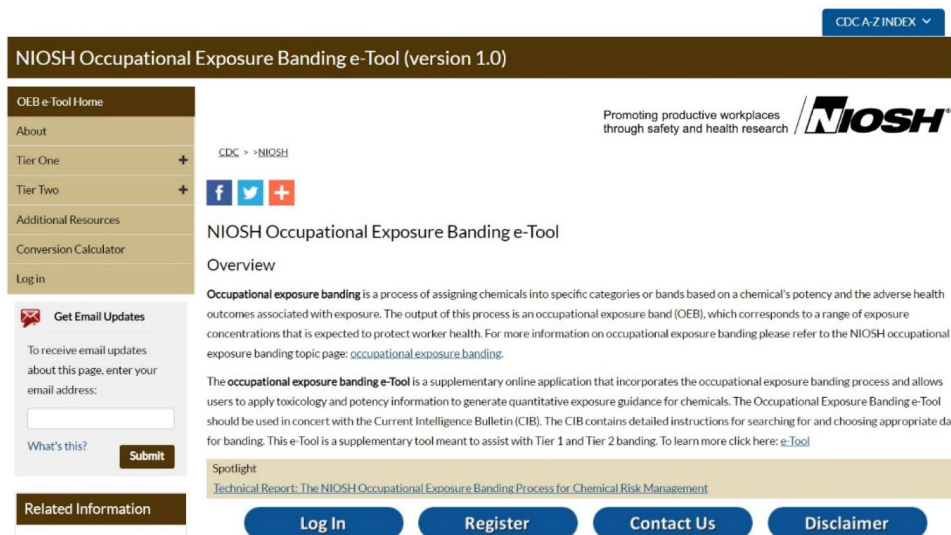


Figure 10. NIOSH has created an e-Tool which greatly simplifies the Tier 1 and Tier 2 assessment processes, available at [bit.ly/oeb-etoool](http://bit.ly/oeb-etoool).



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information for a given chemical to generate an OEB through an automated Tier 1 process and provides resources for a simplified manual Tier 2 process. The e-Tool can automatically generate a Tier 1 band for chemicals in its database. The Tier 2 process, which requires users to find relevant data in recommended sources, can still require several hours.

A full Tier 3 OEB assessment may take months or years as necessary data are collected and is still only an unofficial guideline. However, even a Tier 1 or 2 assessment is still a valuable resource for making critical risk management decisions and helping you be more aware of health risks to workers at your facility or organization. Other IH/OEHS professionals may find your work useful as well. Any data you gather or conclusions you reach are valuable contributions to the conversation of scientific progress.

## Resources

- NIOSH: “Occupational Exposure Banding: Overview,” [bit.ly/oebtopic](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-overview.html).
- NIOSH: *The NIOSH Occupational Exposure Banding Process for Chemical Risk Managements*, [bit.ly/oebreport](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-process-for-chemical-risk-managements.html) (July 2019).
- NIOSH: “NIOSH Occupational Exposure Banding e-Tool: Overview,” [bit.ly/oeb-etool](https://www.cdc.gov/niosh/publications/occupational-exposure-banding-e-tool-overview.html).
- The Synergist: “The ‘Bandits’ Speak: NIOSH Considers Feedback from Users of its Proposed Occupational Exposure Banding Process,” [bit.ly/banditsspeak](https://www.synergistmag.com/2015/05/the-bandits-speak-niosh-considers-feedback-from-users-of-its-proposed-occupational-exposure-banding-process/) (May 2015).
- The Synergist: “The NIOSH Decision Logic for OEBs: Applying Occupational Exposure Bands,” [bit.ly/synergist-1603-oeb](https://www.synergistmag.com/2016/03/the-niosh-decision-logic-for-oeb-applying-occupational-exposure-bands/) (March 2016).
- SynergistNOW: “Occupational Exposure Bands: A Reintroduction,” [bit.ly/aihablog-oeb](https://www.synergistmag.com/2020/03/occupational-exposure-bands-a-reintroduction/) (March 2020).

## AIHA®

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## About Occupational and Environmental Health and Safety Professionals

Occupational and environmental health and safety (OEHS) professionals (also known as industrial hygienists) practice the science of anticipating, recognizing, evaluating, controlling, and confirming workplace conditions that may cause workers' injury or illness. Through a continually improving cycle of planning, doing, checking and acting, OEHS professionals make sure workplaces are healthy and safe.

- Get additional resources at AIHA's [Coronavirus Outbreak Resource Center](https://www.aiha.org/coronavirus).
- Find a qualified industrial hygiene and OEHS professionals near you in our [Consultants Listing](https://www.aiha.org/consultants).



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