

# Chemical Hazards and Toxic Substances

## Overview

### What are chemical hazards and toxic substances?

Chemical hazards and toxic substances pose a wide range of health hazards (such as irritation, sensitization, and carcinogenicity) and physical hazards (such as flammability, corrosion, and explosibility).

This page provides basic information about chemical hazards and toxic substances in the workplace. While not all hazards associated with every chemical and toxic substance are addressed here, we do provide relevant links to other pages with additional information about hazards and methods to control exposure in the workplace.

### How does OSHA regulate worker exposure to chemicals?

#### **Worker education and training (Hazard Communication Standard)**

29 CFR 1910.1200, 1915.1200, 1917.28, 1918.90, and 1926.59

OSHA's Hazard Communication Standard (HCS) is designed to ensure that information about chemical and toxic substance hazards in the workplace and associated protective measures is disseminated to workers.

**In order to ensure chemical safety in the workplace, information about the identities and hazards of the chemicals must be available and understandable to workers. OSHA's Hazard Communication Standard (HCS) requires the development and dissemination of such information:**

- Chemical manufacturers and importers are required to evaluate the hazards of the chemicals they produce or import, and prepare labels and safety data sheets to convey the hazard information to their downstream customers;
- All employers with hazardous chemicals in their workplaces must have labels and safety data sheets for their exposed workers, and train them to handle the chemicals appropriately. The training for employees must also include information on the hazards of the chemicals in their work area and the measures to be used to protect themselves.

For more information see OSHA's Hazard Communication page.

### Allowable airborne concentrations

Employers are required to identify and evaluate the respiratory hazard(s) in their workplaces. Various types of Occupational Exposure Limits (OELs) have been established by a number of organizations, and are listed on many of OSHA's Safety and Health webpages on chemical hazards and toxic substances. Here is an explanation of some of the different levels.

- **OSHA Permissible Exposure Limits (PELs).**  
29 CFR 1910 Subpart Z, 1915 Subpart Z, 1926 Subparts D and Z

OSHA sets enforceable permissible exposure limits (PELs) to protect workers against the health effects of exposure to hazardous substances, including limits on the airborne concentrations of hazardous chemicals in the air. Most OSHA PELs are 8-hour time-weighted averages (TWA), although there are also Ceiling and Peak limits, and many chemicals include a skin designation to warn against skin contact. Approximately 500 PELs have been established.

Most of OSHA's PELs for General Industry are contained in 1910.1000 – Air Contaminants, and are listed by chemical name in Tables Z-1, Z-2, and Z-3. The standards for Marine Terminals and Longshoring both incorporate the General Industry standards (1910 Subpart Z).

Most of OSHA's PELs for Shipyard Employment are contained in 1915.1000 – Toxic and Hazardous Substances, and are listed by chemical name.

Most of OSHA's PELs for Construction are contained in 1926.55 – Gases, Vapors, Fumes, Dusts, and Mists, and are listed by chemical name.

However, many of these limits are outdated. Also, there are many substances for which OSHA does not have workplace exposure limits.

To provide employers, workers, and other interested parties with a list of alternate occupational exposure limits that may serve to better protect workers, OSHA has annotated the existing Z-Tables with additional selected occupational exposure limits. OSHA has chosen to present a side-by-side table with the California/OSHA PELs, the NIOSH Recommended Exposure Limits (RELs) and the ACGIH® TLVs®. The tables list air concentration limits, but do not include notations for skin injury, absorption or sensitization.

- **California Division of Occupational Safety and Health (Cal/OSHA) Permissible Exposure Limits (PELs).**

Cal/OSHA has established an extensive list of PELs (Cal/OSHA AC-1 Table ) that are enforced in workplaces under its jurisdiction. Cal/OSHA PELs are promulgated under statutory requirements for risk and feasibility that are no less protective than the OSH Act. Though not enforceable in establishments outside of Cal/OSHA's jurisdiction, these PELs can provide information on acceptable levels of chemicals in the workplace. Of all the states that have OSHA-approved State Plans, California has the most extensive list of PELs.

- **National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (RELs).**

NIOSH RELs are Federal agency recommendations established according to the legislative mandate for NIOSH to recommend standards to OSHA. RELs are recommended exposure limits for hazardous substances in the workplace to protect worker health. In developing RELs and other recommendations to protect worker health, NIOSH evaluates all available medical, biological, engineering, chemical, and trade information relevant to the hazard. NIOSH transmits its recommendations to OSHA for use in developing legally enforceable standards. NIOSH also publishes its recommendations in publicly available sources such as the NIOSH Pocket Guide to Chemical Hazards, Criteria Documents, Current Intelligence Bulletins, Alerts, Special Hazard Reviews, Occupational Hazard Assessments, and Technical Guidelines.

- **ACGIH® Threshold Limit Values (TLVs®) and Biological Exposure Indices (BEIs®).**

ACGIH® is a private, not-for-profit, nongovernmental corporation. It is not a standards setting body. ACGIH® is a scientific association that develops recommendations or guidelines to assist in the control of occupational health hazards. TLVs® and BEIs® are health-based values and are not intended to be used as legal standards.

Threshold Limit Values (TLVs®) refer to airborne concentrations of chemical substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse effects.

Biological Exposure Indices (BEIs®) are guidance values for assessing biological monitoring results – concentrations of chemicals in biological media (e.g., blood, urine). BEIs® represent the levels of determinants that are most likely to be observed in specimens collected from healthy workers who have been exposed to chemicals in the same extent as workers with inhalation exposure at the TLV®.

Since ACGIH® TLVs® and BEIs® are based solely on health factors, there is no consideration given to economic or technical feasibility. ACGIH® does not believe that TLVs® and BEIs® should be adopted as standards without an analysis of other factors necessary to make appropriate risk management decisions (e.g., control options, technical and economic factors).

For more information on TLVs®, please go to the TLVs® and BEIs® Guidelines page. The TLVs® and BEIs® are copyrighted by ACGIH® and are reprinted on OSHA's Annotated PELs page with ACGIH's permission. The TLVs can be purchased in their entirety on the ACGIH® website. Permission must be requested from ACGIH® to reproduce the TLVs® and BEIs®. A link for a permission request form appears on OSHA's Annotated PELs page.

The ACGIH® TLVs® are widely recognized as authoritative, and are required to be included on safety data sheets by the OSHA Hazard Communication Standard.

## What other common terms are used when discussing chemical hazards or toxic substances?

### Action level

An airborne level, typically one-half of the PEL designated in OSHA's substance-specific standards, 29 CFR 1910, Subpart Z, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

### Ceiling Limit

The exposure limit a worker's exposure may never exceed.

### Sampling and Analytical Error

A statistical estimate of the uncertainty associated with a given exposure measurement.

### Short-Term Exposure Limit (STEL)

The average exposure to a contaminant to which a worker may be exposed during a short time period (typically 15 – 30 minutes).

### Time-Weighted Average (TWA)

The average exposure to a contaminant over a given period of time, typically 8-hours. For examples of how a TWA is calculated, see the OSHA Technical Manual.

## How do I control chemical hazards and toxic substances?

It is OSHA's long standing policy that engineering and work practice controls must be the primary means to reduce employee exposure to toxic chemicals, where feasible. Respiratory protection is required to be used if engineering or work practice controls are infeasible or while engineering controls are being implemented. For more information on engineering controls/administrative controls see the Controlling Exposures page.

## What are the requirements for respirator use?

When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used. Employers must provide appropriate respiratory protection at no cost to workers, provide appropriate training and education regarding its use, and ensure that workers use it properly. (See 29 CFR 1910.134 or OSHA's Respiratory Protection Safety and Health Topics Page)

## Where can I find other information relating to specific chemicals?

First, explore this Safety and Health Topic webpage that includes links to much of the related information available from OSHA, in addition, near the top of this page is a list of other Safety and Health Topic pages which address specific chemicals. Other sections contain information or links on subjects such as laboratory safety, and Hazard Communication or Process Safety. The OSHA Occupational Chemical Database compiles information from several government agencies and organizations. Information available on the pages includes chemical identification and physical properties, exposure limits, sampling information, and additional resources.

The NIOSH Pocket Guide to Chemical Hazards contains information on several hundred chemicals commonly found in the workplace; The Environmental Protection Agency's (EPA's) Toxic Substance Control Act (TSCA) Chemical Substances Inventory lists information on more than 62,000 chemicals or chemical substances; EPA's ChemView provides information on test data and assessments; some libraries maintain files of material safety data sheets (MSDS) for more than 100,000 substances.

### Standards

Chemical hazards and toxic substances are addressed in specific OSHA standards for general industry, maritime, and construction.

[More »](#)

### Hazard Recognition

Provides references that aid in recognizing hazards associated with chemical hazards and toxic substances.

[More »](#)

### Controlling Exposure

Provides information that may aid in controlling workplace hazards associated with chemical hazards and toxic substances.

[More »](#)

### Additional Resources

Provides links and references to additional resources related to chemical hazards and toxic substances.

[More »](#)

### Transitioning to Safer Chemicals: A Toolkit for Employers and Workers

American workers use tens of thousands of chemicals every day. Businesses can improve worker well-being through eliminating or reducing hazardous chemicals, consider using the OSHA Toolkit: Transitioning to Safer Chemicals.

### OSHA's Chemical Related Safety and Health Topics Pages

#### Arsenic

Asbestos

Asphalt fumes

Benzene

#### Beryllium

1-Bromopropane

1,3-Butadiene

Cadmium

#### Chromium

Diacetyl

Diesel exhaust

Ethylene oxide

Formaldehyde

Hexavalent chromium

Hydrogen sulfide

#### Isocyanates

#### Lead

#### Mercury

#### Metals, toxic

Metalworking fluids

Methylene chloride

Silica, crystalline

Solvents

Synthetic mineral fibers

Toluene

Occupational Safety & Health Administration  
200 Constitution Ave NW  
Washington, DC 20210  
☎ 800-321-6742 (OSHA)  
TTY  
[www.OSHA.gov](http://www.OSHA.gov)

#### **FEDERAL GOVERNMENT**

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