

Preventing and Managing Occupational Exposure to Lead

Occupational Safety and Health Administration (OSHA) standards apply to U.S. workplaces where there is a potential for employee exposure to lead.

For regulatory purposes, OSHA defines lead as “elemental lead, all inorganic lead compounds and a class of organic lead compounds called lead soaps.” Standards do not apply to other organic lead compounds.

Inorganic lead is a naturally occurring, malleable heavy metal. In the U.S., inorganic lead is most commonly found in manufacturing and construction settings. Products containing lead include electric car batteries, ammunition, certain types of building materials, ceramic glazes and plastics.

Occupational Exposure Risk

Lead usually enters the bloodstream through inhalation of dust or fumes, or by ingestion of particles.

OSHA estimates more than 1.6 million employees in general industry and construction are potentially exposed to lead on an annual basis. Surveillance data show that 26.6 people per 100,000 employed adults had elevated blood-lead concentrations from work exposures in 2010, according to [Healthy People 2020](#), the nation’s blueprint for Americans’ health. (A Healthy People 2020 objective is to reduce the proportion of people with elevated blood-lead concentrations attributed to work-related exposures.)

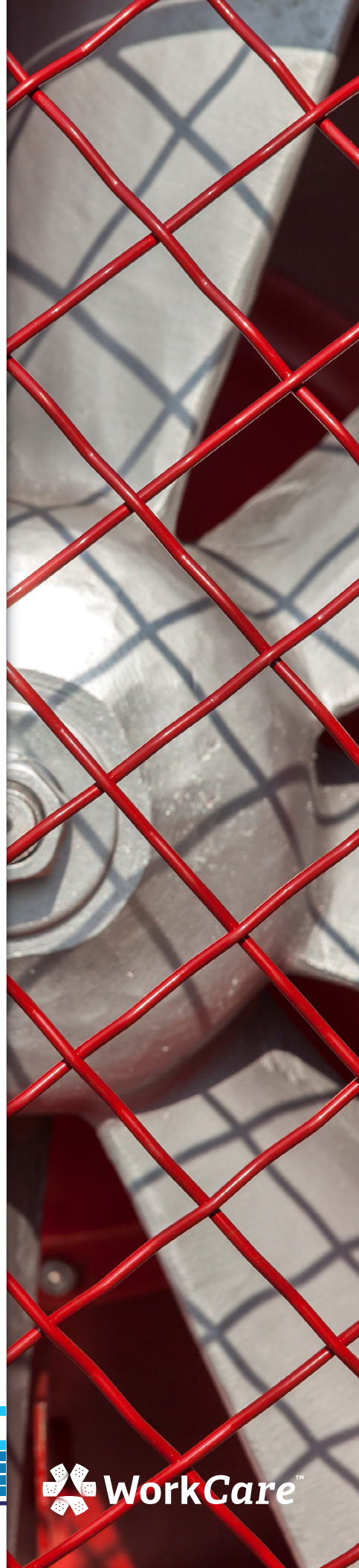
Exposure can occur at home when workers have dust containing lead on their skin, clothing or shoes.

Applicable Standards

Employers are required to protect workers from lead exposure under [OSHA standards](#) covering general industry, shipyards and construction. Engineering, administrative and work practice controls must be used to keep employee exposures at levels at or below the permissible exposure limit (PEL). Key provisions include the following:

1. The PEL is 50 µg/m³ of inorganic lead over an eight-hour time-weighted average (TWA) for covered employees.
2. When an employee is exposed to lead for more than eight hours in any work day, the PEL as a TWA must be reduced according to this formula:

Maximum permissible limit (in µg/m³) = 400 divided by hours worked in the day



3. When a respirator is worn to reduce exposure risk, exposure time may be averaged with time not wearing the respirator to determine an employee's daily TWA exposure.
4. [Medical surveillance guidelines](#) include medical removal protection for workers whose blood-lead levels (BLLs) reach or exceed 50 µg/dL (construction) or 60 µg/dL (general industry).
5. The standard calls for a program of biological monitoring and medical surveillance for all employees exposed to levels of inorganic lead above an action level of 30 µg/m(3) TWA for more than 30 days per year.

Health Effects

Blood tests are used to establish blood-lead levels during medical surveillance exams. Lead in the blood can cause serious health effects, including brain and neurological deficits. Signs and symptoms of "lead poisoning" in adults include:

- High blood pressure
- Joint, muscle or abdominal pain
- Memory or concentration lapses
- Headache
- Mood disorders
- Fatigue or sleep disturbances

[According to OSHA](#), chronic exposure in adults has been associated with impaired kidney function, nervous system effects, decreased visual-motor dexterity, slower reaction times and shorter attention span. Women of child-bearing age are advised to be particularly cautious about potential exposure because increased BLLs can affect pregnancy and fetal development. For men, chronic exposure leading to BLLs above 20 µg/dL have been shown to affect sperm quality.



Did You Know?

OSHA's Lead Standard Applies to Firing Ranges

The lead standard for general industry ([1910OS.1025](#)) applies to firing ranges, where dust and gases emitted by firearms may contain lead.

Exposure prevention methods for firing-range employees and target shooters include:

- Substituting lead with non-lead ammunition primers and projectiles
- Outdoor airflow and indoor ventilation systems (closed loop, direct exhaust)
- Bullet-trap technology to reduce bullet deformation and fragmentation
- Wet mopping, HEPA-filter vacuuming and other safe clean-up methods
- Following hand hygiene, shower and clean-clothing recommendations

For related resources, refer to:

1. [Indoor Firing Ranges](#) – NIOSH
2. [Lead Exposure at Firing Ranges – A Review](#); M Laidlaw, et al.; *Environmental Health*, Vol. 16, No. 34, 2017
3. [Lead Management & OSHA Compliance for Indoor Shooting Ranges](#), National Shooting Sports Foundation



Medical Surveillance

Under OSHA's medical surveillance guidelines, a lead exposure monitoring program consists of periodic blood sampling and medical evaluation "to be performed on a schedule which is defined by previous laboratory results, worker complaints or concerns, and the clinical assessment of the examining physician."

According to the guidelines, periodic testing is scheduled based on BLLs and whether an employee has been temporarily removed from exposure.

Controlling Exposure

Elimination or substitution of lead in work settings tops the hierarchy of exposure controls. Other methods in the hierarchy include:

- Engineering controls: Isolating the exposure source or using methods such as local exhaust ventilation.
- Administrative controls: Logistic or workforce actions such as limiting the amount of time a worker is potentially exposed.
- Personal protective equipment: This may include respiratory protection and specialized clothing.
- Good housekeeping: Cleaning methods proven to help contain airborne and surface contamination.

If respirators are used, employers must have a written respiratory protection program. As conditions warrant, employers are required to provide protective clothing, laundry service and shower facilities at no cost to employees. Clean protective clothing must be provided daily to workers in areas where airborne lead exposure levels exceed an eight-hour TWA of 200 ($\mu\text{g}/\text{m}^3$).

Recommendations for employees with exposure risk include:

- Washing hands before eating, drinking, smoking or applying makeup
- Taking a shower at the end of a shift before leaving the premises
- Not taking home soiled work clothes and shoes
- Consistently complying with workplace PPE requirements



Related Resources

1. For more information on controlling exposures to lead, refer to OSHA's Safety and Health pages:
 - [Personal Protective Equipment](#)
 - [Respiratory Protection](#)
 - [Ventilation](#)
2. For workplace lead exposures and preventive measures, refer to the:
 - National Institute for Occupational Safety and Health's [lead webpage](#)
3. For more information about possible health effects from lead exposure, visit the:
 - Agency for Toxic Substances and Disease Registry [lead toxicity webpage](#)
4. For recommendations on preventing chronic health effects from lead exposure in adults, refer to:
 - Association of Occupational and Environmental Clinics [Medical Management Guidelines for Lead-Exposed Adults](#)
 - National Institute for Occupational Safety and Health (NIOSH) [Adult Blood Lead Epidemiology and Surveillance \(ABLES\) program](#)
5. For an occupational medicine perspective on OSHA lead standards, refer to:
 - American College of Occupational and Environmental Medicine [position paper on Workplace Lead Exposure](#)
6. For a newly published study on lead exposure as a risk factor for cardiovascular disease, refer to:
 - [Low-level lead exposure and mortality in U.S. adults: a population-based cohort study](#); B Lanphear, et al.; The Lancet; published online March 12, 2018.

