



Working with lead: How to protect workers' health

January 2000
Report# 60-1-2000

Introduction

Lead is a soft, bluish-gray metal that has been used almost since the beginning of civilization. This chemical element is also found in small amounts as a contaminant throughout the environment. Lead can combine with various other substances to form numerous lead compounds. Some modern day uses of lead include manufacturing ammunition, batteries, chemical compounds, explosives, glassware, and metal products. To prevent rust and corrosion, lead is also used in containers and pipes, and most steel bridges are painted with lead-based paint.

The best indicator of the extent to which an individual has been exposed to lead is their blood-lead level (BLL). The severity of symptoms associated with lead exposure generally increases as the BLL increases.

Blood-lead testing: What employers need to know

Why blood-lead testing?

Blood-lead testing is a simple, reliable, and inexpensive way to tell if workers are over-exposed to lead.

The WISHA Lead Standard requires blood-lead testing if air-lead levels are greater than the Action Level of 30 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) of air as an eight hour time-weighted average.

Lead may be present in air above this Action Level in businesses involved in the following tasks:

- ◆ Radiator repair.
- ◆ Battery handling.
- ◆ Casting or finishing of lead-containing materials or alloys.
- ◆ Gun firing (especially indoor ranges).
- ◆ Scraping, blasting, grinding, polishing, cutting, welding, or burning lead-containing paint in production or maintenance activities.

Even when air-lead concentration is kept below the Action Level, there is the risk of workers swallowing lead. Lead can easily be transferred from workers' hands to their food or tobacco.

INSIDE THIS PAMPHLET:

- *Blood-lead testing*
- *Frequently asked questions*
- *Exposure controls*
- *The lead standard*
- *Sources of information*
- *What is SHARP?*



Soldering can over-expose workers to lead

How can I provide blood-lead testing to my employees?

Any licensed health care provider can draw blood for blood-lead testing. However, the blood-lead test should be performed by an OSHA-approved laboratory. Clinics or physicians specializing in occupational medicine are preferable because they are specifically trained to recognize diseases associated with work. Look in the Yellow pages under “Physicians-Occupational Medicine.”

For your convenience, many occupational health care providers can collect blood-lead samples at your worksite. Other providers operate walk-in clinics where appointments are not required. Blood-lead testing, with analysis, costs approximately \$50 per employee.

Who should be tested?

All workers who may be exposed to lead should be offered a blood-lead test. When it is not practical to have all workers tested at once, identify those employees who are most likely to have the highest exposures and test them first.

What the numbers mean.

BLLs are expressed in micrograms of lead per deciliter (one-tenth of a liter) of blood (abbreviated mcg/dl or µg/dl). BLLs should be kept as low as possible.

10 mg/dl or less (Normal): BLLs are normal. If all employees’ BLLs stay below 10 µg/dl, lead is not a problem in your workplace.

25 mg/dl (Elevated): If any employee’s BLL is over 25 µg/dl, exposures should be reduced. Previously, it was believed that BLLs up to 40 µg/dl were not harmful, but lead's toxic effects have now been seen at BLLs even below 25 µg/dl.

40 mg/dl (Serious): If any employee’s BLL is at or above 40 µg/dl, lead exposure is a problem. Take immediate action to control workplace exposures.

60 mg/dl and above (Severe): At a blood-lead of 60 µg/dl (or three tests averaging at or above 50 µg/dl), the worker must be removed immediately from workplace exposure to lead while continuing to receive full pay. You must provide for a medical exam. Take immediate action to control exposures in the workplace.

Severity of Health Problem	Blood Lead Level	Changes in the body
Severe health effects may happen quickly and be permanent	110	Brain damage
	100	
Additional serious health effects may occur	90	Dangerous reduction in blood's ability to carry oxygen
	80	
	70	
	60	
Lead may have effects without symptoms	50	Decreased blood production
	40	Male infertility
Lead starts building up in your system	30	Nerve damage
	20	Decreased hearing
	10	Increase in blood pressure
Average level for healthy adults	3	Effects on unborn child in pregnant women
	0	

Actions to take after testing.

- ✓ **Report:** Promptly inform employees of their BLLs (in writing).
- ✓ **Remove:** Any employees whose BLLs are at or above 60 µg/dl (or have three consecutive tests averaging at or above 50 µg/dl) must be removed into non-exposed jobs, while maintaining pay, until their BLLs drop below 40 µg/dl.
- ✓ **Remedy:** If anyone has a BLL above 25 µg/dl, take steps to reduce exposures. Develop and implement an exposure reduction plan, including installing engineering controls (exhaust ventilation, etc.). Make and enforce rules for work practices, including prohibiting eating, drinking and tobacco use in work areas where lead is present. Improve processes and ventilation to reduce exposure. Evaluate your respiratory protection program, making improvements where needed.
- ✓ **Re-test:** Test employees every six months. If the BLL is at or above 40 µg/dl, re-test at least every two months. If the BLL is over 60 µg/dl (or averaging at or above 50 µg/dl), test at least every month.



Frequently asked questions

Q. No one seems sick. Why should we do blood-lead testing?

- A. Early detection is the key to preventing lead poisoning. By the time lead-exposed workers are obviously sick, the damage to their nerves, brain, and kidneys may be permanent.

Q. Most of our employees' BLLs have been under 40 mg/dl for years. Why should they now be kept below 25 mg/dl?

- A. The old benchmark of 40 µg/dl is no longer considered safe by public health officials, even though the current WISHA lead

standard allows workers to continue working with BLLs of 40 µg/dl. The U.S. Public Health Service goal is to eliminate BLLs over 25 µg/dl. The average adult BLL in the general population is below 5 µg/dl.

Q. How does a person get lead in their blood?

- A. By breathing it as a dust, mist, or metal fume. By swallowing lead-contaminated material from hands (including fingernails) on food, or tobacco products. Lead is toxic in extremely tiny amounts, which are measured in millionths of an ounce. However, inorganic lead is not absorbed through the skin.

Q. Is blood-lead testing better than air-lead testing?

- A. Blood-lead testing has several advantages: it is often much less expensive; it is less variable from one day to the next; and it shows *actual lead absorbed by the body*. Air-lead testing, however, can sometimes reveal an over-exposure risk before blood-lead testing can and helps find the sources of lead that need control.

Q. If an employee was lead poisoned as a child, will this show up in the blood-lead test?

- A. Lead poisoning from childhood will not show up in the adult's BLL. Lead typically builds up slowly in the blood, during weeks and months of exposure. Meanwhile, lead is constantly removed from the blood; the BLL normally drops by half in about one month if the person is free from exposure.

Q. What exposures show up in the BLL?

- A. The BLL reflects lead exposure from the most recent several weeks.

Q. What is a ZPP level?

- A. ZPP (zinc protoporphyrin) is a blood enzyme that is usually measured along with blood-lead. When ZPP is high (over 70), this suggests that the BLL has been high for some time.

Q. What should be done if some workers refuse the test?

- A.** Encourage employees to get their blood tested for lead. Remind them that its purpose is to protect their health. Reassure them that it is free of charge to them, and that it is not a drug test or HIV/AIDS test and that they cannot catch a disease from the test.

If an employee still refuses to have a blood test, have them sign a release. This release should state that the test was offered because of lead exposures at work and that the employee understands that the results will only be used for lead monitoring. The form should be witnessed by someone other than the employee's supervisor. Finally, the release form should contain a statement that if the employee changes their mind, they may arrange for a blood test by contacting the appropriate person in the company.

Q. What does lead do to your health?

- A.** Lead is very toxic to the nerves in the brain and body, and it damages the kidneys and reproductive organs of both men and women. The early signs of lead poisoning include fatigue and moodiness. Unfortunately, lead is often not recognized as the cause. Lead poisoning is usually a slow process, often taking place over months or years. However, with a very high exposure, lead poisoning can rapidly create a life-threatening emergency.

Q. What is the effect of smoking on BLLs?

- A.** Smokers often have higher BLLs than non-smokers because workplace dust on hands and face gets onto cigarettes. Smokers both swallow and breathe the lead on the cigarettes. Ban tobacco products in lead work areas, set aside a "smoking area" away from the work area, and insist that employees wash their hands before smoking or chewing tobacco.

Q. What if my workers are exposed "off the job"?

- A.** Many hobbies such as shooting (firing ranges – reloading shells) and fishing (pouring lead sinkers) can have lead exposures. While you are responsible for monitoring and controlling their exposures at work, you can make your employees aware of other non-work exposures and encourage them to take the appropriate precautions.

Q. I understand that the "Lead Standard" requires blood-lead testing if my workers are exposed at certain air-lead levels. Just how much lead are we talking about?

- A.** Imagine a typical high school football field. If a box was placed over the field that went from sideline to sideline and from end zone to end zone with a lid at the top of the goal posts, then the amount of lead needed to be dispersed in the air to reach the "Action Level" (the level where you have to start blood tests) would weigh about 1/3 of a penny. To reach the "Permissible Exposure Limit" (the maximum average lead level in air to which employees may be exposed to without respiratory protection) it would only take an amount of lead that weighs the same as 1/2 a penny.



Exposure Controls

When discussing exposure controls, we can think of three levels of controls:

- at the source,
- along the exposure path, and
- at the employee.

The most effective control is to eliminate the hazard at the source. In the case of lead, this could mean substituting another compound for one containing lead, local exhaust ventilation, or enclosing the process.

The next level of exposure controls, controlling along the exposure path, includes contaminant removal before the contaminant reaches the employee (e.g., dilution ventilation).

The final level includes those controls implemented at the employee. These controls include employee education and personal protective equipment (PPE). Included in employee education would be training on the policies covering work practices and the selection and use of PPE. PPE includes protective clothing and respirators. PPE should be thought of as the "last resort" and selected after other types of controls have been considered and shown to be infeasible. Employees must understand why PPE is necessary and how to use it. The company must set and enforce policies on its use. This requires supervisors to constantly monitor and correct inappropriate PPE use.

Ventilation

Local exhaust ventilation can be very effective at removing contaminants from the air. The system must be carefully designed to ensure that it will operate correctly, capturing contaminants. A ventilation engineer with experience in designing and installing local exhaust ventilation would be your best choice. When selecting a ventilation contractor, be sure to ask about their experience with designing and installing industrial exhaust ventilation.



As with all mechanical systems, the most carefully designed and installed ventilation system must be maintained. Because filters clog, belts wear out, ducts corrode, and other components fail, exhaust ventilation must be checked on a regular basis to ensure it is operating properly. A gauge can be installed that indicates the operating condition of the whole system at a glance. Additional air velocity measurements should be taken at the opening of the exhaust hood to ensure the air is moving enough to capture contaminants as they are generated. Keeping a record of the measurements will allow you to determine if the system needs attention before a major failure.

Personal Protective Equipment



Respirators are the last line of defense against lead poisoning by inhalation. If care is not taken to ensure both the proper fit and adequate employee training,

wearing respirators may be as bad as no protection at all.

Respirators must be sized and fitted to the individual worker, and they must be selected for the concentration and type of contaminant encountered in the workplace. Because respirator use requires some knowledge on the part of the wearer, workers must be trained on the selection, use, care, and cleaning of respirators and how to check the fit to ensure a good seal. Workers wearing respirators must also be able to check the respirator for damage or wear each time it is put on. The use of respirators is covered by WISHA regulation WAC 296-62-071. If air exposures are greater than 50 micrograms of lead per cubic meter of air, there are further requirements in the "Lead Standard" (WAC 296-62-07521(7)).

Coveralls can protect the workers clothing from gross contamination with lead dust. If these coveralls are not disposable, they must be stored and laundered separately to prevent cross contamination of the other clothing.

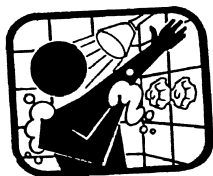
Gloves generally protect a worker in much the same way as coveralls.

Boots worn at work should not be worn home. Boots and work shoes can be easily contaminated with lead dust and can contaminate the worker's car and home. Workers should change work shoes before leaving for the day. An alternative is to provide disposable protective boot covers.

Removing PPE takes some thought. Coveralls, shoes, and gloves may be highly contaminated with lead dust that can be released into the air. Because of this potential for contamination, **respirators should be removed last**. When removing contaminated coveralls, you can control the dust somewhat by rolling them down. Rolling coveralls while removing keeps the dusty side in. Start by rolling the coveralls to the waist and then down the legs do not shake out coveralls once removed, place them directly into a covered laundry container (a clean garbage can work well for this purpose). Remove shoes and any other contaminated article of clothing and finally remove the respirator. Never use compressed air to blow excess dust off PPE - use a HEPA vacuum.

Laundering contaminated clothing may present another lead exposure hazard. If contaminated work clothing is laundered on site, the worker loading the wash machine should also wear a respirator and coveralls. Commercial laundry services may take lead-contaminated clothing. Check with the individual laundry to see if they have any special handling requirements in addition to those found in the "Lead Standard".

Hygiene Facilities



Workers must be provided with facilities where they can wash up. Simple personal hygiene practices can protect workers from lead over-exposures. Diligent hand washing can protect workers from ingesting lead and contaminating "clean areas" of the facility. If exposures are

greater than the regulated limit, showers and changing rooms are required (see WAC 296-62-07521(10)).

Tobacco and Eating

Workers should not use tobacco or eat while working around or with lead-containing materials. Lead dust from the worker's hands can contaminate tobacco products and food. Smoking poses an additional hazard in that the burning of the cigarette can vaporize lead on its surface. The vaporized lead is inhaled deeply along with the tobacco smoke, effectively delivering the lead to the area of the lungs where it is quickly absorbed by the body. Workers should always thoroughly wash their hands and face whenever they stop to eat, smoke, or use other forms of tobacco.

Surface Cleaning

When surfaces in the workplace are free from lead, exposures from hand to mouth contact are reduced, and dispersion of leaded dust into the air is minimized. The first step in cleaning a contaminated, dusty surface is to use a HEPA



vacuum, which is a specialized piece of equipment that uses a very efficient filter on its exhaust. The HEPA filter captures the smallest

particles of lead dust. A regular shop-vac is unacceptable because it cannot trap small particles of dust; this fine material is blown into the air via the vacuum's exhaust. Care must be used whenever emptying or maintaining HEPA vacuums because they become contaminated with lead. Following the HEPA-vacuuming, the contaminated surface should be wet-washed with warm water and a detergent (detergents specifically designed for cleaning lead contamination are available). After the area has dried, the surface should be HEPA-vacuumed once more. Workers performing these tasks should wear appropriate PPE.

Take Home Exposures

“Take home” exposures occur when a worker carries home lead contamination in their clothing or on their bodies. Family members may inhale or ingest this dust. Regardless of the potential severe health effects to the worker and their family members, this type of secondary exposure can be very costly to employers because it may open a business to “third party liability”. Under the workers’ compensation regulations, workers are barred from suing their employers for over-exposures at work. However, if the workers carry this lead contamination home and spouses or children are poisoned, the employer may be held liable for damages.

A good source of information on “take home” exposure is the document “*Protect Your Family: Reduce Contamination at Home*” published by NIOSH. To obtain a copy call 1-800-35-NIOSH, ask for NIOSH publication 97-125 or via the web at www.cdc.gov/niosh/homepage.html.



The “Lead Standard” WAC 296-62-07521

The following is a very brief overview of the “Lead Standard for General Industry”. The “Lead in Construction Standard” (WAC 296-155-176) is not addressed here and is substantially different than the “General Industry” standard. Please contact L&I for more information on the specific requirements of either standard.

If lead is used in the workplace, you must collect full shift air samples from the workers’ breathing zone. All workers likely to be exposed must be trained on the hazards and controls of lead in the workplace.

If the results of the air monitoring are over the “Action Level” of 30 micrograms per cubic meter of air ($\mu\text{g}/\text{m}^3$), you must re-test the air every 6 months until the results are less than the

Action Level, and institute a medical monitoring program.

In a medical monitoring program, you must offer employees a blood-lead test. If an employee’s BLL is over 40 $\mu\text{g}/\text{dl}$ (micrograms per deciliter), you must offer a physical examination to that employee. If a BLL is high enough (60 $\mu\text{g}/\text{dl}$ or more, or three tests that average 50 $\mu\text{g}/\text{dl}$ or more), the employee must be removed from further lead exposures until the employee’s BLL drops below 40 $\mu\text{g}/\text{dl}$.

If the results of the air monitoring are over the Permissible Exposure Limit (PEL) of 50 $\mu\text{g}/\text{m}^3$ as an eight hour time-weighted average (TWA), then in addition to the requirements above you must re-test the air every three months, and provide employees with respirators. **Note:** if respirators are required, you must have a “Respiratory Protection Program” that meets both the “Lead Standard” (WAC 296-62-07521) and the “Respiratory Protection Standard” (WAC 296-62-071).

Other requirements that apply if employees are exposed over the PEL for airborne lead include:

- ✓ Implement engineering and work practice controls (ventilation, etc.).
- ✓ Provide and clean personal protective equipment (PPE), including work clothing and shoes or shoe coverlets, at no cost to employees.
- ✓ Maintain surfaces free as practicable of accumulations of lead.
- ✓ Have a separate lead-free lunch/break area.
- ✓ Have a shower facility and change room for workers.
- ✓ Post warning signs.

The above summary outlines the major provisions of the lead standard. The standard is quite extensive and we strongly urge any employer with the potential for lead exposures to contact L&I’s WISHA Consultation services.

Sources of information

Free of Charge, State-funded Safety & Health Consultation:

Labor & Industries Regional Offices

Everett (Region 1, northwest Washington),
(425) 290-1431.

Seattle (Region 2, King County),
(206) 281-5533.

Tacoma (Region 3, Pierce, Kitsap, Clallam, and
Jefferson Counties), (253) 596-3917.

Olympia (Region 4, southwest Washington),
(360) 902-5472.

Wenatchee (Region 5, central and southeastern
Washington), (509) 886-6570.

Spokane (Region 6, eastern Washington),
(509) 324-2543.

Safety & Health consultants can provide an on-site assessment of your facility, including air-testing capabilities.

Industrial ventilation questions can be addressed to consultants or to Dan Locke, Policy & Technical Services, Department of Labor & Industries, (360) 902-5162.

University of Washington

The Department of Environmental Health provides on-site consultation services through:

University of Washington,
Field Research & Consultation Group,
4225 Roosevelt Way,
Seattle, WA 98105.
(206) 543-9711

Yellow Page Headings

Industrial Hygiene Consultants

Safety Equipment and Clothing
(respirators, coveralls, etc.)

What is SHARP?

SHARP stands for Safety & Health Assessment & Research for Prevention. SHARP is a multidisciplinary research program within the Washington State Department of Labor and Industries, whose mission is to conduct research, monitoring, and demonstration projects that promote healthy work environments and the prevention of workplace injuries and illnesses. SHARP was created by the Washington State Legislature in 1990.

SHARP has addressed a diverse range of occupational health concerns in response to requests from employers, labor, health care professionals, and agency staff. SHARP's research specialists offer expertise in computer systems, economics, epidemiology, ergonomics, industrial hygiene, occupational medicine, nursing, and toxicology.

SHARP maintains the Occupational Lead Exposure Registry and can provide further information to interested employers on work-related lead poisoning and methods of prevention.

You can contact us at:

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PO Box 44330
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Check out SHARP on the World Wide Web:

www.lni.wa.gov/sharp

SHARP's web site provides more information about the SHARP program, describes SHARP's research interests, lists our publications (many are available on-line), introduces the SHARP team, and provides links to other sites of occupational and environmental interest.