

ES&H manual

Environment, Safety, and Health

Volume II

Part 14: Chemical

Document 14.10

Safe Handling of Lead and Lead Compounds in General Industry and Construction Operations

Recommended for approval by the ES&H Working Group

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Approval date: June 2, 2000
Editorial update: November 13, 2003

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This work performed under the auspices of the U.S. Department of Energy by University of California Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

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Safe Handling of Lead and Lead Compounds in General Industry and Construction Operations

1.0 Introduction

This document outlines the requirements for work involving lead. The general information in this section applies to both General Industry Operations (Section 3.0) and Construction Operations (Section 5.0). General Industry Operations include research activities, the handling of lead shielding, building of experimental equipment, and machining of lead or lead alloys. Construction Operations include maintenance, the demolition or remodeling of buildings, new building construction, the removal of lead paint from equipment or buildings, and the use of paint that contains lead for road demarcation.

Appendix A contains terms and definitions used in this document; Appendix B lists medical surveillance requirements, and Appendix C is an example of a lead work permit.

All Laboratory workers (employees, participating guests, students, supplemental labor workers) and subcontractors must follow the applicable portions of the procedures outlined in this document when performing lead work. Certain workers may perform work that falls under both Sections 3.0 and 5.0. For example, an individual may be assigned to demolish a large piece of programmatic equipment coated with a lead-containing paint (Section 3.0), and the task may require the disturbance of walls coated with a leaded paint or roofing sheets made of lead-galvanized metal (Section 5.0). In many cases, there may seem to be only small differences between the two sections. But it is important for each worker to fully understand which set of requirements applies to each aspect of the particular job.

Lead, element number 82, is a gray metal with a mean atomic weight of 207.19. Lead forms many organic and inorganic compounds and a wide range of alloys. Lead has been used for thousands of years, and until recently was commonly found in a wide range of commercial and industrial products. Lead has been used as a pigment in paints, solder, surfacing for galvanized metal, as an additive in gasoline, and in alloys such as brass and pewter. At LLNL, lead has also been widely used in radiation shielding and as a reagent in laboratories.

2.0 Hazards

Exposure to lead can cause serious health hazards. Lead and most lead compounds are toxic by inhalation or ingestion of dust and fumes. A few lead compounds are

considered possible carcinogens (lead acetate, lead chromate, lead phosphate). Volatile organic lead compounds may generate vapors that are toxic when inhaled. Liquid organic lead compounds may be absorbed through the skin, and some organic and inorganic lead compounds may directly irritate the skin.

Lead is a teratogen that can cause fetal malformation, a mutagen that can affect both sperm and eggs, and a reproductive toxin that can impair fertility. Acute, high-level exposure to lead can cause encephalopathy with seizures, coma, and, in severe cases, death. In many cases, the effects of lead poisoning are irreversible (or only partially reversible) and can lead to permanent impairment of the function of the brain, kidney, nervous system, or reproductive system. Chronic exposure can lead to qualitatively similar effects, including damage to blood-forming organs, the nervous system, urinary tract, digestive tract, and reproductive system. Chronic exposure to relatively low levels of lead may cause neurological and neurobehavioral problems, especially in children. These effects may not be fully reversible if the exposure has been ongoing for a long time, or if it occurs during critical developmental phases in children.

3.0 Controls for General Industry Operations

3.1 General Information

The requirements in this section are applicable *only* to General Industry Operations (e.g., machining lead-containing materials, moving lead bricks, and soldering with lead-containing alloys in programmatic shops). These requirements are not applicable to construction activities, including building maintenance activities, or to the handling of lead compounds in chemistry research laboratories meeting the criteria in 29 CFR 1910.1450 – except for the permissible exposure limit. See Section 5.0 for the requirements for construction activities that involve the handling of lead or lead compounds. Controls for the use of lead acetate, chromate, chromate (VI) oxide, and phosphate (LLNL controlled carcinogens) are described in Document 14.12, “Safe Handling of Carcinogenic Materials,” and Document 14.2, “LLNL Chemical Hygiene Plan for Laboratories,” in the *ES&H Manual*) for other lead compounds.

The requirements for handling lead and lead compounds are based on the following:

- 29 CFR 1910.1025, “Lead.” This standard applies to elemental lead, all inorganic lead compounds, and lead soaps. It does not apply to other organic lead compounds. The OSHA permissible exposure limit (PEL) for metallic lead, any inorganic lead compound, or lead soaps is 50 $\mu\text{g}/\text{m}^3$ of air averaged over an 8-hour period.

- 29 CFR 1910.1000. "Air contaminants. The corresponding PEL for tetramethyl and tetraethyl lead is 75 $\mu\text{g}/\text{m}^3$ of air. There is no PEL for other organic lead compounds.
- 29 CFR 1926.62, "Lead," The medical surveillance trigger for workers exposed on any day to lead at or above the action level was adopted instead of that in 29 CFR 1910.1025, paragraph j(1)(i).
- The Biological Exposure Index for Lead, as established by the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values, "Air Contaminants." Exposure limits for tetraethyl lead (0.1 mg/m^3 and tetramethyl lead (0.15 mg/m^3). In addition, exposure to these chemicals should be limited to 75 mg/m^3 , the applicable OSHA Standard for general industry.

The guidelines for activities involving lead-based paint or other surface contamination are based on the following:

- Department of Housing and Urban Development (HUD), "Guidelines for the evaluation and control of lead-based paint hazards in housing." Guidelines for certain aspects of lead work are referenced from this publication.
- Limits for lead in paint established by the Stewart B. McKinney Homeless Amendments Act to the Lead-Based Paint Poisoning Prevention Act, PL-100-628. These limits are used as an administrative guideline.

3.2 Surface Contamination Limits

When lead-containing materials are disturbed such that airborne dust is generated, residual surface contamination may pose a hazard to people who subsequently occupy the area. In such cases, surface sampling is conducted periodically as determined by the ES&H Team industrial hygienist. This is intended to verify the adequacy of housekeeping (see the section entitled "Housekeeping and Decontamination" in Section 3.3.2). The following wipe sample clearance guidelines are recommended by HUD:

<100 $\mu\text{g}/\text{ft}^2$ on uncarpeted floors.

<500 $\mu\text{g}/\text{ft}^2$ on interior window sills (stools).

<800 $\mu\text{g}/\text{ft}^2$ on window troughs (the area where the sash sits when closed).

<800 $\mu\text{g}/\text{ft}^2$ on exterior concrete.

These clearance guidelines are based on hazards to children. Because a child's body easily absorbs very small particles of lead dust when ingesting or inhaling them, a small amount can create a health hazard. Therefore, these clearance guidelines are extremely low for acceptable levels of lead dust particles on surfaces. For work and areas at LLNL, a higher limit may be acceptable at the discretion of the ES&H Team industrial hygienist.

3.3 Exposure Controls

Three types of controls are used to mitigate exposure to lead: engineering controls, administrative controls, and personal protective equipment. Of these, engineering controls are the preferred method.

Where workers are exposed to lead above the PEL for 30 days or more a year, both engineering and administrative controls shall be used to reduce exposure to or below the PEL. If these controls are not adequate, respiratory protection shall be used in addition to engineering and administrative controls. Where workers are exposed above the PEL for more than 30 days a year, engineering controls must be used to reduce exposure to levels close to the PEL but at least to $200 \mu\text{g}/\text{m}^3$. In addition, any combination of controls can be used to further reduce exposure to the PEL ($50 \mu\text{g}/\text{m}^3$).

3.3.1 Engineering Controls

Ventilation systems used to control lead particulates shall be evaluated qualitatively or quantitatively every 3 months. These systems shall be re-evaluated within 5 days of a process or ventilation change that may alter worker exposure. Ventilation systems used for unique, temporary, or infrequent lead operations shall be evaluated before use. The nature of these evaluations shall be determined by the ES&H Team industrial hygienist. At a minimum, a quantitative evaluation shall be conducted annually.

Note: This requirement applies only to elemental lead, inorganic lead compounds, and lead soaps.

Where they will not interfere with their shielding properties, lead items used for shielding or weighting should be encapsulated in a suitable coating to protect the lead from corrosion and to reduce worker contact. Corroded lead materials may be particularly hazardous and should be encapsulated or replaced if feasible. Newly purchased shielding bricks should be encapsulated to prevent corrosion.

3.3.2 Administrative Controls

Integration Work Sheet: An approved integration Work Sheet (IWS) is required (at a minimum).

Hazard Assessment. A negative exposure assessment (NEA) or negative initial determination (NID) is a statement written by an LLNL industrial hygienist indicating that a specific lead-disturbing job (or a class of very similar lead-disturbing jobs) does not result in worker exposure above the action level. Work conducted pursuant to an NEA/NID can proceed without subsequent review, provided that the controls specified in the NEA /NID are adhered to.

Handling of <25 lead bricks is designated as “minuscule lead work” as a negative initial determination has been made for this task. It has been determined by air sampling that this type of work will not result in exposure above the PEL. A Lead Work Permit is not required for minuscule lead work; however, lead awareness training is required for personnel performing the work.

Lead Work Permits. Permits are used for short-term operations and must be developed for any operation that will (or may) result in exposure above the PEL – unless the operation and its controls are fully described on the Integration Work Sheet, in a current safety plan, or in a current NEA. Permits must specify the manner in which the work will be altered to reduce exposure level to the PEL using both engineering and administrative controls.

The work supervisor/Responsible Individual shall develop a Lead Work Permit for the following activities:

- Machining of lead or alloys with lead.
- Sanding of lead, lead coatings, or lead alloys.
- Burning, welding, or torch brazing of any material containing or coated with any amount of lead.
- Abrasive blasting of any material containing or coated with any amount of lead.
- Handling of 25 or more lead bricks, unless the bricks are encapsulated.
- Handling of more than 25 lb of lead shot or beads, unless they are fully encapsulated.
- Spray paints or coatings containing lead.
- Volatile organic lead compounds used other than as a reagent in chemistry laboratories.
- All operations that may result in exposure over the PEL.
- Use of any lead compound identified as a potential carcinogen. The supervisor shall submit the permit to the ES&H Team industrial hygienist for approval at least 48 hours in advance of beginning the scheduled work.

It should be noted that the exemption for minuscule lead work is based on best industrial hygiene judgment, and that there may be unusual circumstances under which the work may result in hazardous levels of airborne lead.

Safety Plans. OSPs may be used in lieu of Lead Work Permits. An OSP is appropriate where lead work is ongoing or repetitive and may be reasonably expected to result in exposure above the PEL. Operations adequately covered in an OSP do not require a Lead Work Permit. Lead OSPs shall be reviewed *every* 6 months.

Housekeeping and Decontamination. These are important elements in the control of lead exposure. Dry sweeping and blowing of lead-containing dusts are prohibited. Contaminated work surfaces should be cleaned sufficiently to reduce lead levels to less than 100 µg/ft². A higher level may be accepted for industrial or laboratory areas, at the discretion of the ES&H Team industrial hygienist. Recommended clean-up methods include vacuuming the area with a high-efficiency particulate air (HEPA)-filtered vacuum or wet-wiping with disposable cloths. Consult the ES&H Team environmental analyst for guidance on the proper waste disposal practices.

Personal Hygienic Practices. The precautions below apply to areas where lead is disturbed, and where the potential for exposure can be greater than the PEL unless the work is covered by an NEA/NID or is minuscule work.

- Designate a separate location for eating, storing, and preparing food and beverages, and for using tobacco products and cosmetics to avoid the possibility of ingesting lead. *No lead work shall be performed in these designated areas.* Lunchrooms shall be kept under positive pressure by the provision of tempered, filtered air.
- Wash your hands and face before eating, drinking, using tobacco products, or applying cosmetics. Do not wear protective clothing into lunchrooms.
- Designate change rooms where workers can segregate street clothes from clothing used for work.
- Provide shower facilities. Showers located throughout the Laboratory may be used, provided that other workers do not use these showers while they may be potentially contaminated with lead dust. Showers used by lead workers must be decontaminated before use by other workers. Portable shower units may be used for required decontamination activities.

Signs. Signs with the wording below shall be posted at all possible entrances to areas where lead work (other than lead work performed pursuant to an NEA/NID) is being conducted. These signs shall be well illuminated so that they are easily visible to workers and visitors. Contact your ES&H Team for guidance if you have any questions about signs.

**WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING**

Personal Monitoring Program. Personal air sampling shall be conducted to assess an individual's (or group's) exposure to airborne lead during work that disturbs lead-containing materials. Initial samples are required for all operations where exposure above the action level may occur. The frequency of subsequent sampling is dependent upon the results of the initial samples.

The process for initiating and collecting air samples is as follows:

- Work supervisors shall notify the ES&H Team industrial hygienist at least 48 hours in advance of planned lead operations so that air sampling can be arranged.
- The ES&H Team industrial hygienist or a health and safety technician working under the guidance of an industrial hygienist shall do the following:
 - Collect the initial personal air samples for uncharacterized operations that may generate airborne lead and submit them to the Hazards Control Department Analytical Laboratory for analysis. If the results of the representative samples are below the action level, no further sampling is required as long as the operation continues unchanged. If the results are above the action level but below the PEL, air sampling must be repeated at least every 6 months. For results greater than the PEL, air sampling must be repeated every 3 months and a written compliance plan (e.g., an operational safety plan [OSP]) detailing the steps to be taken to reduce the airborne lead levels must be developed and implemented.
 - Inform the payroll and work supervisors of affected workers in writing within 5 work days of receipt of results if the samples show that exposure exceeds the PEL. Supervisors are then responsible for notifying each affected worker. Exposure results are reported without any consideration of respiratory protection worn during the operation. Provide these supervisors with a description of the corrective actions to be taken to reduce exposure, and provide the Health Services Department with a copy of the notification.

The results of air sampling conducted to measure exposure during operations at the Laboratory may be used to represent the level of exposure for other similar operations. The decision to accept these results, however, is at the discretion of the ES&H Team industrial hygienist.

Surface Monitoring. Samples should be obtained at least semiannually from areas where activities (e.g., those described in Section 3.3.2, "Administrative Controls, Lead Work Permits") are conducted or where exposure above the action level may occur. The health and safety technician or industrial hygienist shall obtain these samples by making two S-shaped swipes with a prewetted wipe at a 90° angle over a 1-ft² area and submit the swipes to the Hazards Control Department Analytical Laboratory for analysis. Details on this sampling method can be found in the HUD guidelines cited in Section 3.1.

Laboratories that analyze lead swipes or bulk samples must be accredited by the American Industrial Hygiene Association or another organization accredited by the Environmental Protection Agency (EPA) specifically to perform lead analysis.

Medical Surveillance and Removal

Applicability. The biological monitoring, medical surveillance, and removal provisions in this document are applicable to all LLNL and non-LLNL workers who are exposed to the limits described in this document. The LLNL Health Services Department performs medical surveillance for LLNL workers only. The employers of non-LLNL workers provide medical surveillance for their workers.

The requirements below, and the general requirements detailed in Appendix B, apply to biological monitoring and medical surveillance.

1. For every worker who is (or may be) exposed to lead above the action level for 1 day or more a year, the work supervisor will provide the Health Services Department with the number of days of exposure.
2. 29 CFR 1926.62 expresses the blood lead concentration in terms of micrograms of lead per deciliter ($\mu\text{g}/\text{dL}$) of blood, whereas 29 CFR 1910.1025 uses the roughly equivalent unit of micrograms of lead per 100 grams ($\mu\text{g}/100\text{ g}$) of whole blood. For the sake of consistency, this document uses micrograms of lead per deciliter of whole blood.
3. Biological monitoring includes the measurement of blood of zinc protoporphyrin (ZPP). The interpretation of ZPP results is within the discretion of the examining clinician.
4. A comprehensive medical exam must comply with the requirements of 29 CFR 1926.62(j)(3)(ii)(A-F).

5. Workers may request a second examination per applicable OSHA guidelines of the lead standard. Generally, the workers' program or department will cover the expenses of this examination, provided that these workers notify the Health Services Department and their supervisors within 15 days of making an appointment with a physician of their choice. Any differences between the findings of two examining physicians shall be resolved in accordance with 29 CFR 1910.1025(j)(iii). Additional requirements relating to the temporary removal of workers from lead work areas can be found in 29 CFR 1910.1025(k).
6. Pregnant women, and women and men who are actively trying to conceive a child are urged to contact the Health Services Department for a medical review. If the worker has been exposed to lead above the action level, the Health Services Department will follow the requirements in Table B-1 and Fig. B-1 of Appendix B. If the worker has not been exposed above the action level, the Health Services Department will provide appropriate counseling and take the necessary action based upon the individual circumstances of the case.
7. **Note:** Women of child-bearing potential, whose blood lead exceeds 10 µg/dl, are at risk of delivering a child with a blood lead over the current Centers for Disease Control guideline of 10 µg/dl. If the blood lead of such children remains elevated, they may be at increased risk of cognitive deficits. The blood lead of these children should be closely monitored and appropriate steps should be taken to minimize the child's exposure to environmental lead.

Training

OSHA-Required Training when working with lead are found in 29 CFR 1910.1025, "Lead," 29 CFR 1910.1200, "Hazard Communication," and 29 CFR 1910.1450, "Occupational Exposure to Chemicals in Laboratories."

29 CFR 1910.1025 stipulates two levels of training:

Level 1. 29 CFR 1910.1025 states that workers who are occupationally exposed to lead at *any* level above background must be informed of the content of the standard and its appendices. A short lead awareness training (HS4261-W) fulfills part of this requirement. An onsite meeting completes the necessary training with specific job-related issues. In this training, workers should be provided a copy of the standard and its appendices, and the task-specific aspects of the operation should be addressed (e.g., expected degree of hazard, health effects, good practices, personal hygiene, and sources of additional information). Lead awareness training class also fulfills part of the requirements in Document 10.2, "LLNL Health Hazard Communication Program," in the *ES&H Manual*).

Level 2. Lead worker training is required annually for workers who may be reasonably expected to be exposed at or above the action level or for whom the possibility of skin irritation exists. Lead worker training consists of a review the elements of the standard, including:

- The content of this document and its appendices. Copies of this document must be given to workers.
- The specific nature of the operation that could result in exposure above the action level.
- Respirator-use training, as outlined in 29 CFR 1910.134.
- A description of the Medical Surveillance Program, the procedure for removing affected workers from work involving lead, and information on the adverse health effects of lead. Particular emphasis is placed on the male and female reproductive systems.
- A description of engineering and administrative controls and personal protective equipment.
- The content of any compliance plans, including information on the proper uses of chelating agents.

Lead worker training is best obtained from an accredited provider. The state of California has an accreditation program that consists of specific training for lead workers and their supervisors. Alternatively, the Hazards Control Department can design a custom class for lead workers.

All completed training shall be submitted to the Laboratory Training and Information Network (LTRAIN).

3.3.3 Personal Protective Equipment

Personal protective equipment such as coveralls, shoe covers, head covers, gloves, and respirators is required for operations that may generate airborne lead levels above the PEL ($50 \mu\text{g}/\text{m}^3$) and operations for which there is no NEA/NID. Refer to Document 11.1, "Personal Protective Equipment," in the *ES&H Manual* for additional information. Safety shoes will be required for many operations. Leather gloves (or equivalent) shall be used when handling unencapsulated lead bricks or shielding. Additional requirements may be applicable if the exposure is known or expected to exceed $200 \mu\text{g}/\text{m}^3$. When required, such equipment shall be specified in an OSP or Lead Work Permit that has been reviewed by the ES&H Team industrial hygienist.

The ES&H Team industrial hygienist shall select respirators, except those for subcontractors other than labor only, in conformance with LLNL and OSHA requirements. No worker shall be required to wear a negative pressure respirator for more than 4.4 hours a day during the installation of feasible engineering controls. Fit-testing of respirators, where required, must be conducted within 12 months prior to lead work. If requested by the worker and sufficient for the exposure, a tight-fitting powered air-purifying respirator must be provided in lieu of a negative pressure respirator.

4.0 Responsibilities

All workers and organizations responsible for safe handling of lead and lead compounds shall refer to Document 2.1, "Laboratory and ES&H Policies, General Worker Responsibilities, and Integrated Safety Management," in the *ES&H Manual* for a list of general responsibilities. Specific responsibilities are listed below each title. See Section 6 for construction specific responsibilities.

4.1 Workers

- Follow the requirements outlined in this document for work involving lead.
- Notify the Health Services Department if you are pregnant or actively trying to conceive a child.

4.2 Responsible Individual

- Verify that all controls are in place prior to starting work.
- Verify that workers have read the FSP, OSP IWS and/or Lead work permit.
- Verify that workers are trained before starting work.

4.3 Hazards Control Department

- When possible, establish NEAs/NIDs for consistent types of lead work.
- Perform required air monitoring.
- Notify work/payroll supervisors of air sample results.
- Notify work supervisors of the need for medical surveillance when sampling so indicates.
- Assist in the design and implementation of engineering control systems.

- Develop and provide the necessary training or assist in identifying an alternative source of training.
- Provide exposure information to the Health Services Department.
- Review Integration Work Sheets (IWSs), OSPs, and Lead Work Permits to ensure they incorporate adequate controls.
- Select the most appropriate type of respirator for workers involved in lead work.
- Provide respirators to qualified personnel.
- Assist work supervisors in identifying potential lead-disturbing activities.
- Perform surface swipe testing as required.

4.4 Health Services Department

- Perform required medical surveillance exams and blood tests.
- Determine when workers must be removed from exposure because of abnormalities detected during medical surveillance.
- Determine when workers who have been removed from work involving lead because of medical abnormalities can return.
- Notify workers of any medical findings, as required.
- Notify work and payroll supervisors of any work restriction related to lead work.
- Request the ES&H Team to perform a worksite evaluation for any worker found to have a blood-lead level above that specified in Appendix B.
- Determine if measured elevations in blood lead are occupational.

4.5 Safeguards and Security

- Ensure that all firing-range instructors have a blood lead test annually.
- Provide engineering and administrative controls that maintain exposure below the action level for firing range instructors and other persons on the firing line or in the immediate area.

4.6 Supervisors

4.6.1 Work Supervisors

- Identify all workers who may be reasonably expected to be exposed to lead.
- Request that the ES&H Team evaluates the workplaces of all workers who may be exposed to lead above established limits.
- Schedule workers who have been exposed above the medical surveillance action level for medical exams.
- Ensure that all available and specified engineered and administrative controls and personal protective equipment are used appropriately.
- Ensure that individuals who may be potentially exposed to lead receive appropriate training.
- Initiate Lead Work Permits or OSPs when required.
- Notify workers of the results of personal air samples.
- Conduct job-specific lead awareness training.
- Provide an alternate workplace and job for workers whom the Health Services Department has removed from work involving lead exposure.
- Notify the industrial hygienist at least 48 hours prior to lead work, as required.

4.6.2 Payroll Supervisors

- Schedule workers who are exposed above the medical surveillance action level for medical exams.
- Ensure that individuals who may be potentially exposed to lead receive appropriate training.
- Arrange for lead awareness training.
- Provide an alternate workplace and job for workers whom the Health Services Department has removed from work involving lead exposure.

5.0 Controls for Construction Operations

This section is applicable to construction-type activities that involve the handling of lead or lead compounds, including demolition, renovation, alteration, repair, painting, new construction, lead abatement, and maintenance activities. Non-construction activities are addressed in Section 3 of this document. Research laboratory activities involving lead acetate, lead chromate, and lead phosphate are addressed in

Document 14.12, while the handling of other lead compounds in chemistry laboratories is addressed in Document 14.2.

The requirements in this section are based on the following:

- 29 CFR 1926.62, "Lead." This standard applies to elemental lead, inorganic lead compounds, and lead soaps. It does not apply to other organic lead compounds. The permissible exposure limit (PEL) for metallic lead, any inorganic lead compound, or lead soaps is $50 \mu\text{g}/\text{m}^3$ of air averaged over an 8-hour period.

The medical surveillance action level for metallic lead, any inorganic lead compounds, or lead soaps is $30 \mu\text{g}/\text{m}^3$ of air averaged over an 8-hour period for any one day.

A biological monitoring program limits blood lead levels. See Appendix B, "Medical Surveillance Requirements," for details.

- ACGIH Threshold Limit Values. "Air Contaminants." Exposure limits for tetraethyl lead ($0.1 \text{ mg}/\text{m}^3$) and tetramethyl lead ($0.15 \text{ mg}/\text{m}^3$). In addition, exposure to these chemicals should be limited to $75 \text{ mg}/\text{m}^3$, the applicable OSHA Standard for general industry.
- The Biological Exposure Index for Lead, as established by the ACGIH.

Guidelines for lead-based paint is based on the Department of Housing and Urban Development (HUD), "Guidelines for the evaluation and control of lead-based paint hazards in housing." Guidelines for certain aspects of lead work are referenced from this publication.

Limits for lead in paint established by the Stewart B. McKinney Homeless Amendments Act to the Lead-Based Paint Poisoning Prevention Act, PL-100-628. These limits are used as an administrative guideline.

17 CCR, Division 1, Chapter 8, "Accreditation of Training Providers and Interim Certification of Individuals Engaged in Lead-related Construction Work." Accreditation requirements are referenced from this publication. The California licensing requirements current and in effect are applicable.

5.1 Surface Contamination Limits

When lead-containing materials are disturbed such that an aerosol is generated, residual surface contamination may pose a hazard to people who subsequently occupy that area. In such cases, surface sampling is conducted at the end of the lead activity. This is intended to verify the adequacy of decontamination procedures. The following wipe sample clearance standards are recommended by HUD:

100 $\mu\text{g}/\text{ft}^2$ on floors.

500 $\mu\text{g}/\text{ft}^2$ on interior window sills (stools).

800 $\mu\text{g}/\text{ft}^2$ on window troughs (the area where the sash sits when closed).

800 $\mu\text{g}/\text{ft}^2$ on exterior concrete.

These clearance standards are based on lead dust hazards to children. Because a child's body easily absorbs very small particles of leaded dust when ingested or inhaled, a small amount can create a health hazard. Therefore, these clearance standards are extremely low for acceptable levels of leaded dust particles on surfaces. Higher values may be acceptable for industrial areas, at the discretion of the industrial hygienist.

5.2 Exposure Controls

Three types of controls are used to mitigate exposure to lead: engineering controls, administrative controls, and personal protective equipment. Of these, engineering controls are the preferred method. Both engineering and administrative controls shall be used to reduce worker exposure to or below the PEL, or as close to the PEL as is feasible, before personal protective equipment is used. Personal protective equipment shall be used when feasible engineering controls have not been fully successful in reducing exposure to levels below the PEL, or pending the installation of engineering controls.

5.2.1 Engineering Controls

Lead work that is known to result in exposure above the PEL, or activities such as those that require a Lead Work Permit or safety procedure (see the section below entitled "Administrative Controls"), will typically require the following engineering and administrative controls, as determined on a case by case basis by the cognizant industrial hygienist:

- Use of HEPA-filtered exhaust systems at the source of particulate generation or, if this is not feasible, within the general work area.
- Establishment of a regulated area that will keep unprotected workers out and prevent the spread of lead dust beyond the boundaries of the area. For work

inside buildings, this may involve erection of critical barriers over ventilation system vents, doors, open areas, and other penetrations. Further, it may be necessary to arrange the ventilation system to place the work area under negative pressure relative to the surrounding areas. The ES&H Team industrial hygienist shall specify the necessary controls.

- Use of exhausted power tools with HEPA filters.
- Use of wet methods.

5.2.2 Administrative Controls

Hazard Assessment. Complete an IWS before initiating any work with potential for lead exposure.

A negative exposure assessment (NEA) or NID is a statement written and approved by an LLNL industrial hygienist indicating that a specific lead-disturbing job (or a class of very similar lead-disturbing jobs) does not result in worker exposure above the action level. Work conducted pursuant to an NEA can proceed without subsequent review, provided that the controls specified in the NEA are adhered to. If changes in process, equipment, material, personnel, or task result in a different lead exposure, the NEA may not be applicable.

No Lead Work Permit is required where an NEA/NID has been established or if work is covered by an OSP.

Lead Work Permits (LWP). Permits are used for short-term operations and must be developed for any operation that may result in exposure above the PEL, unless the operation is described in a current safety plan or a current NEA/NID. Permits must specify the manner in which the work will be altered to reduce exposure level to the PEL using both engineering and administrative controls, if possible.

A Lead Work Permit (Appendix C) is required for the following activities where lead-containing paint or other lead sources can be disturbed. These are “presumptive tasks” where exposure above the PEL must be assumed until air sampling proves to the contrary.

- Demolishing buildings; scraping and sanding paint; using a heat gun; spray-painting; cleaning power tools with a HEPA-filtered dust-collection system; roof repair or other similar processes where the material contains lead. (Exposure of ≤ 10 times the PEL for these operations shall be assumed unless data indicate otherwise.)
- Using leaded mortar; lead burning; rivet busting; cleaning power tools without a HEPA-filtered, dust-collection system; using dry expendable abrasives for clean-up activities; and moving or removing abrasive blasting

enclosures where lead is present. (Exposure of >10 times the PEL shall be assumed for these operations unless data indicate otherwise.)

- Performing activities where leaded paints, leaded coatings, or lead-containing alloys are disturbed by abrasive blasting, welding, cutting, and torch burning where the material contains lead. (Exposure of >50 times the PEL shall be assumed for these operations unless other data indicate otherwise.)
- Performing other operations that may result in exposure above the PEL.
- Performing lead abatement work.

Until an NEA is developed for each of these tasks, workers shall be provided with suitable respiratory protection, protective clothing, change areas, hand-washing facilities, biological monitoring, and training.

The need for a LWP is negotiable with the ES&H Team industrial hygienist for tasks not listed in Section 5.2.2.

Safety Plans. Activities involving more than 40-person hours should be described in a safety plan, rather than on a Lead Work Permit, unless the ES&H Team industrial hygienist determines that a Lead Work Permit would be adequate and waives the safety plan requirement. Operations adequately covered in a safety plan are not required to be described in a Lead Work Permit. Lead OSPs shall be reviewed every 6 months.

Subcontract Work. Lead work conducted by subcontractors (other than supplemental labor) requires prior submission of either an NEA/NID pursuant to the OSHA standard's basis of initial determination for exposure assessment that is satisfactory to the ES&H Team industrial hygienist or the subcontractors Lead Compliance Program that incorporates all the elements specified in the standard before the operation begins. Contractors also are required to work in accordance with Plant Engineering specifications and the guidance given in this document if lead is disturbed. Use of a LLNL Lead Work Permit will not meet this requirement.

Personal Hygienic Practices. The precautions below apply to areas where lead and lead compounds are used and there is no NEA/NID.

- Designate separate lunchrooms, food storage and preparation areas, and eating areas to avoid the possibility of ingesting lead. *No lead work shall be performed in these designated areas.* Lunchrooms shall be kept as free of lead contamination as practical.
- Wash your hands and face before eating, drinking, using tobacco products, or applying cosmetics. Do not wear protective clothing into lunchrooms.

- Designate change rooms where workers can segregate street clothes from clothing used for lead work operations that generate airborne lead levels exceeding the PEL.
- Shower facilities are available in the area if the airborne levels are greater than the PEL and for operations in the section above entitled “Lead Work Permits” for which there is no NEA/NID. Showers located throughout the Laboratory may be used for these purposes, provided that other workers do not use the showers while they are potentially contaminated with lead dust. Showers used by lead workers must be decontaminated before they can be used by other Laboratory workers. Portable shower units may be used for required decontamination activities.
- Surfaces are kept free of any accumulation of lead dust. Use HEPA-filtered vacuum cleaners to remove dust and debris. Dry shoveling and sweeping are prohibited.
- Promptly place lead-coated or lead-containing demolition or renovation debris (e.g., sheet rock) in plastic bags or other sealable containers. Do not allow them to accumulate in the workspace.

Signs. Signs with the wording below shall be posted at all possible entrances to areas where lead work is being conducted and for which there is no NEA. These signs shall be well illuminated so that they are easily visible to workers and visitors. Contact your ES&H Team for guidance if you have any questions about signs.

**WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING**

Application and Installation of Lead-Containing Products. With the exception of the use of leaded solder in electrical work, materials containing more than 0.06% lead should not be used, specified, or allowed in the construction of buildings or infrastructure. In addition, paint should not contain more than 0.06% lead, and solder used in potable water distribution systems shall not contain lead. An exception to this requirement (other than for drinking water) is allowed where the user (or specifier) can demonstrate that no adequate non-leaded replacement product is available. The use of leaded construction materials in such cases requires prior review of the ES&H Team industrial hygienist and the facility point of contact.

Lead Paint Abatement. Lead abatement refers to construction activities undertaken specifically to remediate an imminent or potential hazard to humans or the environment from lead paint. This may include the removal, enclosure, or encapsulation of paint.

All lead abatement work involving less than 40-person hours that is performed by LLNL personnel or supplemental labor only workers shall be described in a Lead Work Permit. An OSP may be required by the ES&H Team industrial hygienist for lead abatement work involving more than 40-person hours.

All subcontracted lead abatement work shall be conducted by a contractor licensed by the California Department of Health Services and in accordance with the HUD “Guidelines for the evaluation and control of lead based paint hazards in housing.”

All indoor lead abatement areas should be subjected to a final visual inspection and final surface sampling in accordance with the HUD Guidelines.

Preconstruction Paint Sampling. Lead is present in paint on the surfaces of many LLNL buildings. Thus, it is necessary to identify activities such as maintenance, renovation, remodeling, and demolition that will disturb lead-coated surfaces so that the appropriate controls can be implemented before work begins. It will be necessary to test the interior and exterior of most building surfaces before beginning activities that disturb potential lead-containing material. Or it may be assumed that the material disturbed includes lead.

Specifically, painted surfaces must be tested before beginning construction activities that involve

- Scraping, abrasive blasting, or sanding.
- Demolishing buildings.
- Cutting, sawing, or otherwise penetrating a wall or other painted surface — except for installing a few screws into a wall.
- Burning, torch cutting, arc cutting, welding, brazing.
- Using a heat gun to remove paint.
- Performing other activities that generate lead-containing dust.

Testing also must be conducted on other potential lead-containing construction materials if a lead aerosol may be generated, including but not limited to

- Galvanized metal that is to be cut with a torch, burned, power sawn, or otherwise heated to the melting point of lead (>320°C).

- Brass, bronze, and pewter that is to be sanded or heated to the melting point of lead (>320°C).
- Solders that are to be sanded.

Testing and Analysis Techniques. OSHA regards any level of lead in the material as “lead containing.” Analysis of bulk samples can be conducted using atomic absorption or inductively coupled plasma emission spectroscopy (ICPES). Alternative techniques (e.g., laboratory or field x-ray fluorescence) may be approved by the ES&H Team industrial hygienist.

Laboratories that analyze lead swipe or bulk samples must be accredited by the American Industrial Hygiene Association or another organization accredited by the EPA specifically to perform lead analysis.

Work Performed by Plant Engineering Personnel. Preconstruction testing is conducted by Plant Engineering personnel who should (1) complete the State Accreditation Program for Lead Inspectors or be certified by the American Board of Industrial Hygiene in Industrial Hygiene, or (2) work under the direct supervision of a Certified Industrial Hygienist or an accredited inspector.

Work Performed by Subcontractors. Plant Engineering personnel shall either (1) test all potentially lead-containing surfaces before releasing a construction proposal for work that may disrupt lead, or (2) require the contractor to perform the test(s) before disrupting any potential lead-containing materials. Contractors who make lead determinations must be accredited by the State of California as lead building inspectors or the work must be conducted *directly* by a Certified Industrial Hygienist.

Work Performed by Other LLNL Organizations. Authorizing Organizations shall ensure that testing is performed by or under the supervision of the ES&H Team.

Personal Air Sampling. Personal air samples are collected to characterize an individual’s (or group’s) exposure to lead. Initial and periodic sampling may be required, depending on the nature of the work and the exposure level. Every construction-related procedure (other than minuscule lead work) that will disturb lead should have personal sampling until an NEA/NID is established.

The following is the general procedure for personal air sampling:

- Work supervisors shall notify the ES&H Team industrial hygienist at least 48 hours in advance of planned lead operations so that air sampling can be arranged.

- The ES&H Team industrial hygienist or a health and safety technician working under the guidance of an industrial hygienist shall then do the following:
 - Collect the initial air samples for uncharacterized operations that may generate airborne lead and submit them to the Hazards Control Department Analytical Laboratory (or another laboratory) for analysis. If the results of these representative samples are below the action level, no further sampling is required if the operation continues unchanged. A change in equipment, process, personnel, or task must be evaluated by the ES&H Team industrial hygienist to determine if further sampling is required. If the results are above the action level but below the PEL, air sampling must be repeated at least every 6 months. For results greater than the PEL, air sampling must be repeated every 3 months. In addition, a written compliance plan (e.g., Lead Work Permit or an OSP) detailing the steps to be taken to reduce airborne lead levels must be developed and implemented.
 - Inform the work and payroll supervisors of affected workers in writing within 5 work days of receipt of results if exposure exceeds the PEL. Supervisors are then responsible for notifying each affected worker. Exposure results are reported without any consideration of respiratory protection worn during the operation. Provide these supervisors with a description of the corrective actions to be taken to reduce exposure, and the Health Services Department with a copy of the notification.

The results of air sampling conducted to measure exposure during operations at the Laboratory may be used to represent the level of exposure for other similar operations. The decision to accept these results, however, is at the discretion of the ES&H Team industrial hygienist.

Surface Contamination Sampling. The floors and other surfaces in construction work areas where lead is disturbed should be tested for residual lead contamination before LLNL workers can re-occupy those areas. Specifically, this requirement applies when the work involves any of the activities listed in the section entitled “Lead Work Permits” (in Section 3.3.2) for which there is no NEA/NID, when the work is lead hazard abatement or involves exposure above the action level, and when the work area is inside and will subsequently be re-occupied on a regular basis.

These samples are obtained by making two S-shaped swipes with a prewetted wipe at a 90° angle over a 1-ft² area and submitting the swipes to the Hazards Control Department Analytical Laboratory for analysis. Details on this sampling method can be found in Section 10 (Requirements/Regulatory Summary) of the HUD Guidelines.

Clearance swipe samples, where required for work performed by subcontractors, shall be obtained and analyzed by the subcontractor in accordance with the HUD Guidelines.

However, LLNL reserves the right to request changes in the sampling and analysis procedure or to obtain parallel clearance samples.

The analytical laboratory the subcontractor uses must be accredited by the American Industrial Hygiene Association or another organization accredited by the EPA specifically to perform lead analyses.

Medical Surveillance and Removal

Applicability. The biological monitoring, medical surveillance, and removal provisions in this document are applicable to all LLNL workers, participating guests, students, supplemental labor workers, and subcontractors who are exposed above the limits specified in this document.

The LLNL Health Services Department performs medical surveillance for LLNL workers only; the employers of non-LLNL workers provide medical surveillance to their workers.

The requirements below, and the general requirements detailed in Appendix B, apply to biological monitoring and medical surveillance.

1. For every worker who is (or may be) reasonably expected to be exposed to lead above the action level for one or more days, or who performs tasks that require a Lead Work Permit or lead OSP, the supervisor will provide the Health Services Department with the number of days of exposure.
2. 29 CFR 1926.62 expresses the blood lead concentration in terms of micrograms of lead per deciliter ($\mu\text{g}/\text{dL}$) of blood, whereas 29 CFR 1910.1025 uses the roughly equivalent unit of micrograms of lead per 100 grams ($\mu\text{g}/100\text{ g}$) of whole blood. For the sake of consistency, this document uses micrograms of lead per deciliter of whole blood.
3. Biological monitoring includes the measurement of blood levels of zinc protoporphyrin (ZPP). The interpretation of ZPP results is within the discretion of the examining clinician.
4. A comprehensive medical exam must comply with the requirements of 29 CFR 1926.62(j)(3)(ii)(A-F).
5. Workers may request a second examination per applicable OSHA guidelines of the lead standard. Generally, the workers' program or department will cover the expenses of this examination, provided that these workers notify the Health Services Department and their supervisors within 15 days of making an appointment with a physician of their choice. Any differences between the findings of two examining physicians shall be resolved in accordance with 29 CFR 1926.62.

Additional requirements relating to the temporary removal of workers from lead work areas can be found in 29 CFR 1926.62(k).

6. Pregnant women, and women and men who are actively trying to conceive a child are urged to contact the Health Services Department for a medical review. If the worker has been exposed to lead above the action level, the Health Services Department will follow the requirements in Table B-1 and Fig. B-1 of Appendix B. If the worker has not been exposed to lead above the action level, the Health Services Department will provide appropriate counseling and take the necessary action based upon the individual circumstances of the case.
7. **Note:** Women of child-bearing potential, whose blood lead exceeds 10 µg/dl, are at risk of delivering a child with a blood lead over the current Centers for Disease Control guideline of 10 µg/dl. If the blood lead of such children remains elevated, they may be at increased risk of cognitive deficits. The blood lead of these children should be closely monitored and appropriate steps should be taken to minimize the child's exposure to environmental lead. All LLNL construction subcontracts, including labor only, supplemental labor, and job-specific contracts, must have a provision excluding the use of prophylactic chelation therapy at any time where there is a possibility that workers may be exposed to lead above the action level.

Training

OSHA-Required Training. Two OSHA regulations require training for personnel potentially exposed to lead: "Construction Industry Hazard Communication Standard" and "Construction Lead Standard," Level 1 and level 2, respectively:

Level 1. Lead awareness training (Course HS 4261-W) shall be provided to all workers who perform construction work that generates lead aerosols at levels below the action level and to workers who perform the activities listed in the section entitled "Lead Work Permits" for which the exposure level has not been determined. This includes plumbers and electricians who use leaded solders and carpenters who disturb small amounts of lead paint.

Level 2. Lead worker training is required annually for workers who are exposed to lead at levels exceeding the action limit specified in this document and for those who are subject to exposure to lead compounds that cause skin irritation

Lead worker training is best obtained from an accredited provider. The State of California has an accreditation program that consists of specific training for lead workers and their supervisors. Alternatively, the Hazards Control Department can design a custom class for lead workers.

Inspector Training. The State of California offers a course for lead inspectors. Workers who conduct surveys to determine the lead content in materials should complete this course, unless they are Certified Industrial Hygienists or work directly under the supervision of a Certified Industrial Hygienist or trained inspector. Subcontractors who perform lead surveys shall meet either the training or the certification requirement.

5.2.3 Personal Protective Equipment

Personal protective equipment includes disposable coveralls, gloves, head covers, work shoes with disposable covers, respirators, and other necessary equipment. Such equipment is required for operations that generate airborne lead levels above the PEL (50 $\mu\text{g}/\text{m}^3$) or for activities for which there is no NEA/NID and a Lead Work Permit or safety procedure is required. See Document 11.1 for additional information. Workers may be issued reusable work coveralls in lieu of disposable coveralls. These coveralls shall not be worn home. Coveralls shall be laundered by LLNL (or the subcontractor for subcontracted work) and provided to workers at least weekly, or daily, if exposure levels exceed 200 $\mu\text{g}/\text{m}^3$. Reusable clothing must comply with the cleaning and replacement requirements in the standards.

The ES&H Team industrial hygienist shall select respirators, except those for subcontractors other than labor only, in accordance with LLNL and OSHA requirements. Fit-testing for respirators must be conducted within 12 months prior to lead work. If requested by the worker and sufficient for the exposure, a powered air-purifying respirator must be provided in lieu of a negative pressure respirator.

6.0 Construction Specific Responsibilities

General requirements for safe handling of lead and lead compounds can be found in Document 2.1. Specific responsibilities are listed below each title.

See Section 4.0 for the responsibilities of workers, Hazards Control Department, Health Services Department and supervisors.

6.1 Facility Point of Contact

The Facility Point of Contact shall test programmatic equipment surfaces and materials to determine if lead is present before construction work is started that will disturb materials that may contain lead (e.g., paint, galvanized metal, caulking, flashing) or potentially result in airborne lead exposure.

6.2 Plant Engineering

- Ensure that personnel who disturb or use leaded products receive the required training.
- Test surfaces and material to determine if lead is present before beginning construction work that will disturb materials that may contain lead (e.g., paint, galvanized metal, caulking, flashing) or potentially result in airborne lead exposure.
- Where required, develop IWSs, and Lead Work Permits or OSPs and have them reviewed by the ES&H Team industrial hygienist.
- Obtain the necessary equipment to conduct work on leaded materials.
- Ensure that persons working on leaded products receive the required medical examinations and biological monitoring.
- Prohibit its personnel, supplemental labor personnel, and construction contractors from using construction products containing more than 0.06% lead or any lead on drinking-water lines (this does not apply to electrical solder).
- Specify in construction contracts if and where lead will be disturbed; Alternatively, require that subcontractors determine the presence of lead before disturbing materials that may contain lead.
- Develop and maintain a "Bidding Specification" that implements the LLNL Lead Safety Program in construction, renovation, and demolition contracts where lead material may be encountered.

6.3 Procurement Department

The Procurement Department shall ensure that a clause requiring the use of the Plant Engineering bidding specification is inserted into all procurement service construction subcontracts that may involve exposure to lead.

7.0 Work Standards

29 CFR 1910, Subpart Z, "Toxic and Hazardous Substances."

29 CFR 1910.1000, "Air Contaminants."

29 CFR 1910.1025, "Lead."

29 CFR 1910.1200, "Hazard Communication."

29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories."

29 CFR 1926, Subpart D, "Occupational Health and Environmental Controls."

29 CFR 1926.62, "Lead."

ACGIH, TLVs and BEIs: Threshold Limit Values for Chemical Substances and Physical Agents, 2002 (excluding Biological Exposure Indices, TLVs for Physical Agents, and Biologically Derived Airborne Contaminants).

DOE Order 440.1A, "Worker Protection Management for DOE Federal and Contractor Employees," Attachment 2, "Contractor Requirement Document," Section 1-11, 13-18, (delete item 18.a), 19 (delete item 19.d.3) and 22.

8.0 Other References

17 CCR, Division 1, Chapter 8, "Accreditation of Training Providers and Interim Certification of Individuals Engaged in Lead-related Construction Work."

29 CFR 1926.59, "Hazard Communication."

CDC: *Preventing Lead Poisoning in Young Children*, October 1991.

Department of Housing and Urban Development, "Guidelines for the evaluation and control of lead-based paint hazards in housing," HUD (February 1995).

Stewart B. McKinney Homeless Amendments Act to the Lead-Based Paint Poisoning Prevention Act, PL-100-628. These limits are used as an administrative guideline.

Appendix A

Terms and Definitions

Action level	The Medical Surveillance Action Level for lead is 30 $\mu\text{g}/\text{m}^3$. This is the level of airborne lead to which a worker is exposed that may trigger the need for testing the blood for lead levels. Exposure above this level on a single day in a year will trigger blood testing for construction work; exposure must exceed this level for more than 30 days per year during general industry work to trigger blood testing.
Certified industrial hygienist (CIH)	An industrial hygienist certified by the American Board of Industrial Hygiene in the Practice of Industrial Hygiene.
Construction industry work	All work involving lead other than general industry work or chemical laboratory research. This includes all building and building-related equipment maintenance and repair activities, demolition, remodeling, and new construction.
General industry lead work	All work involving lead other than construction activities or chemical laboratory research. This includes work such as moving lead shielding bricks; using lead solder in electronics assembly shops; and machining leaded alloys in machine shops.
Lead alloys	Metals made up of a mixture of metallic elements. For example, brass consists mostly of copper, but it usually contains 2–10% lead as well.
Lead compounds	Chemical compounds that include lead. These may be inorganic (e.g., lead oxide) or organic (e.g., tetramethyllead).
Lead-containing material	Any material with any lead content. Certain limited exemptions apply for materials containing less than 0.06% lead.
Lead soap	A lead salt of a long chain, naturally occurring carboxylic acid.
Lead work area	Any area where lead-containing materials are disturbed such that exposure to airborne lead above 30 $\mu\text{g}/\text{m}^3$ may occur. Also, any area where a presumptive task of lead-disturbing activity occurs for which there is no NEA/NID.

Minuscule lead work

Work involving lead that is not likely to result in exposure approaching the action level based on initial sampling or permissible exposure limit and not a “presumptive task.” This includes handling fewer than 25 lead bricks (general industry and construction).

Appendix B

Medical Surveillance Requirements

Table B-1 and Fig. B-1 in this appendix list requirements and procedures for biological monitoring and medical surveillance.

Table B-1. Biological monitoring and medical surveillance requirements.

Blood lead level (µg/dl)	Frequency of retest	Medical exam	Administrative action
Less than 30	Perform the test every 6 months as long as the worker continues to work with lead and is exposed at or above the action level 30 days or more per year. If the exposure is less than 30 days per year, retest every year.	Repeat exam is not required. (Refer to Fig. B-1 to determine whether an initial exam is required.)	None
30-39.9	Repeat the test within 60 days, then every 6 months.	Do a comprehensive medical if none has been done within the last 12 months and if the clinician determines that the elevated blood lead level is work related.	<ol style="list-style-type: none"> 1. Interview the worker to determine if there is a nonoccupational exposure. 2. Notify the Hazards Control Department and request a worksite evaluation.
40-49.9	Test every 2 months until two consecutive tests show that the level is less than 40 µg/dL.	Do a comprehensive medical if none has been done within the last 12 months.	<ol style="list-style-type: none"> 1. Notify the worker in writing within 5 days about test results and the possible consequences. 2. Notify the Hazards Control Department and request a worksite evaluation.
Equal to or greater than 50	Repeat the test in 2 weeks, then perform the test every month until 2 consecutive tests show that the level is less than 40 µg/dL.	Do a comprehensive medical if none has been done within the last 12 months.	<ol style="list-style-type: none"> 1. Remove the worker from work. 2. Notify the worker in writing within 5 days about test results. 3. Notify the Hazards Control Department and request a worksite evaluation. 4. Do not have the worker return to work until two consecutive tests indicate that the level is less than 40 µg/dL.

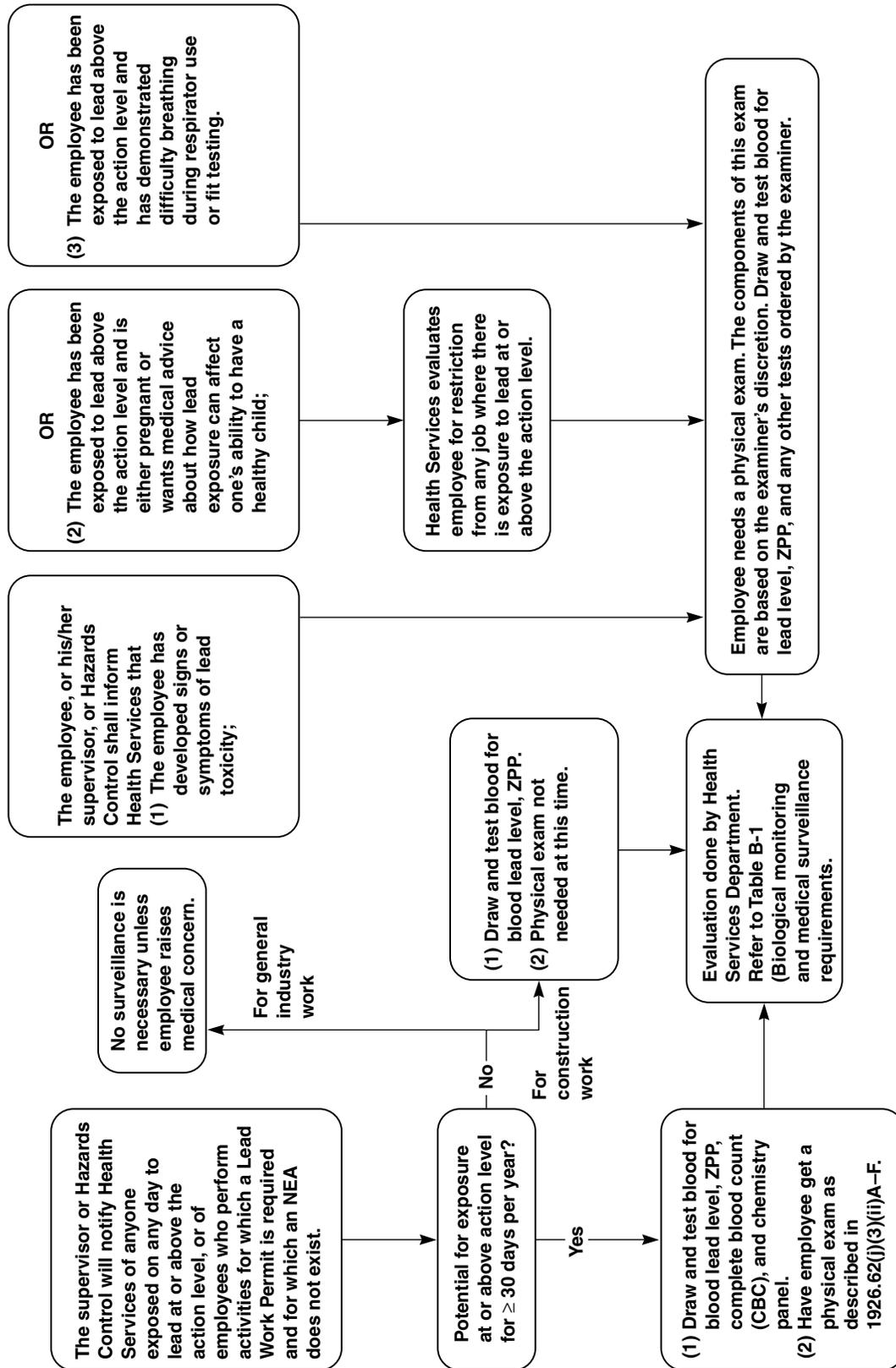


Figure B-1. Medical surveillance process.

Appendix C

Example of Lead Work Permit

GENERAL INFORMATION				
Building _____	Room/Area _____	Subarea _____		
Leaded material _____	Concentration _____	Condition _____		
Area to be reoccupied _____		Clearance sample by _____		
General work description _____				
Lead/particulate-generating operations _____				
Expected duration _____		Dates _____		
ENGINEERING CONTROLS				
Local exhaust _____	General ventilation _____			
Wetting _____	HEPA vacuum _____			
Enclosure _____	Drop sheets _____			
Critical barriers _____	Glove bag _____			
Other Engineering Controls _____				
Other Technology Considered _____				
Personal Protective Equipment				
Respirator (type) _____				
Coveralls _____	Shoe covers _____			
Gloves _____	Safety shoes _____			
Safety eyewear _____	Hard hats _____			
HYGIENIC CONTROLS				
Change area _____		Shower facility _____	Hand-wash facility _____	
WORKER TRAINING				
Name	ID No.	Training	Notes	Expiration
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
Supervisor's signature _____		Date _____		
Industrial hygienist _____		Date _____		

This Lead Work Permit is good only for the work described. Any change in scope, procedures, or personnel requires re-approval of the permit. If necessary, attach the names of additional workers on a separate piece of paper (see Document 14.10, "Safe Handling of Lead and Lead Compounds in General Industry and Construction Operations," in the *ES&H Manual* for further details). Keep a copy of the permit at the job site. The ES&H Team industrial hygienist and the FPOC should also keep a copy.