



SANFORD UNDERGROUND RESEARCH FACILITY

SOUTH DAKOTA SCIENCE AND TECHNOLOGY AUTHORITY

Lead (Pb) Standard

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1.0 Purpose

This document outlines the guidelines and requirements for safe work with lead (Pb) and lead compounds. The information in this standard applies to general industry and construction work.

2.0 Scope

This standard applies to SDSTA employees, participating guests, users, supplemental labor workers and contractors when performing lead (Pb) work.

General industry work generally includes handling lead shielding, building experimental equipment, soldering, and machining lead or lead alloys (including brass and pewter). Construction work includes maintenance, demolition, or remodeling of buildings; new building construction; removal of lead paint from equipment or buildings; and the use of paint or other materials that contain lead.

3.0 Definitions

Action Level – An OSHA occupational exposure limit (without regard to the use of respirators) for airborne contaminants. For lead it is 30 micrograms per cubic meter of air (30 $\mu\text{g}/\text{m}^3$) for an 8-hour Time-Weighted Average (TWA). Employees whose exposure is above the Action Level for more than 30 days per year are required to be in a medical surveillance program.

HEPA – A High Efficiency Particulate Air Filter capable of filtering 0.3 micron particles with 99.97 percent efficiency.

Lead (Pb) – Metallic lead, all inorganic lead compounds (e.g., laboratory reagents, solder), and organic lead soaps. All other organic lead compounds, such as tetraethyl lead, are excluded from this definition.

Lead Paint – Paint containing greater than 0.06 % (600 ppm) lead.

Medical Surveillance – Consists of medical examinations as well as blood or urine sampling for lead and zinc protoporphyrin, if applicable. Performed by or under the supervision of a physician.

Permissible Exposure Limit (PEL) – An OSHA occupational exposure limit (without regard to the use of respirators) for airborne contaminants. For lead it is 50 micrograms per cubic meter of air (50 $\mu\text{g}/\text{m}^3$) for an 8-hour Time-Weighted Average (TWA). Exposure to airborne lead above the PEL triggers requirements such as housekeeping, engineering controls, showers, change and lunchrooms, area posting, personal protective equipment, and respiratory protection.

Personal Protective Equipment (PPE) – Safety equipment worn by employees; may include safety glasses, respirators, coveralls etc.

4.0 Responsibilities

4.1. ESH Department

- 4.1.1. Revises the lead (Pb) program as needed.
- 4.1.2. Develops and implements training.
- 4.1.3. Works with appropriate staff to identify hazards, ensure proper sampling is conducted and establishes appropriate controls.
- 4.1.4. Identifies an appropriate medical surveillance provider if medical surveillance is required.

4.2. Industrial Hygiene (IH) Designee

- 4.2.1. Performs or oversees lead (Pb) testing.
- 4.2.2. Notifies supervisors and personnel of monitoring results.
- 4.2.3. Verifies that added controls are sufficient to reduce exposure below applicable limits.
- 4.2.4. Recommends engineering or administrative controls to lead (Pb) hazards.
- 4.2.5. Recommends warning signs where appropriate.
- 4.2.6. Maintains industrial hygiene survey records, notifications of personal monitoring memos and equipment calibration logs.
- 4.2.7. Provides updated hazard information for site-specific training.
- 4.2.8. Reviews plans for new operations and significant changes to ongoing operations that may create lead (Pb) hazards.

4.3. Workers and Users

- 4.3.1. Perform work only in areas where the appropriate training and work authorization(s) have been completed.
- 4.3.2. Complete required training in lead (Pb) hazards and personal protective equipment (PPE) usage prior to exposure to lead (Pb).
- 4.3.3. Receive medical surveillance and sampling of work tasks as needed.
- 4.3.4. Use controls, including personal protective equipment.
- 4.3.5. Report suspected exposures to the supervisors and/or the ESH Department.

4.4. Project Managers and Science Collaborations

- 4.4.1. Review proposed processes involving lead (Pb) hazards with the ESH Department before installing new or moving existing equipment.
- 4.4.2. Work in conjunction with various departments and the involved working groups to ensure that engineering controls are meeting minimum performance standards and effectively preventing personnel over-exposure to lead (Pb) hazards.
- 4.4.3. Report deficient engineering controls to the proper authority for repairs.
- 4.4.4. Follow up on recommendations provided by the ESH department staff.
- 4.4.5. Ensure areas where lead (Pb) hazards are found have the proper warning signs displayed, in consultation with the ESH department.
- 4.4.6. Choose less-hazardous design options whenever possible, in consultation with the ESH department.
- 4.4.7. Include qualitative exposure assessment of lead (Pb) hazards during the development and review of work planning documents.

4.5. Supervisors

- 4.5.1. Review proposed processes involving lead (Pb) hazards with the ESH Department before installing new or moving existing equipment.
- 4.5.2. Work in conjunction with various departments to ensure engineering controls are meeting minimum performance standards and effectively preventing personnel over-exposure to lead (Pb) hazards.

- 4.5.3. Report deficient engineering controls to the proper authority for repairs.
- 4.5.4. Follow up on recommendations provided by the ESH department staff.
- 4.5.5. Ensure areas where lead (Pb) hazards are found have the proper warning signs displayed, in consultation with the ESH department.
- 4.5.6. Choose less-hazardous design options whenever possible, in consultation with the ESH department.
- 4.5.7. Include qualitative exposure assessment of lead (Pb) hazards during the development and review of work planning documents.

5.0 Instructions

Use and handling of lead and lead compounds at the Sanford Underground Research Facility (SURF) follow the criteria in the Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.1025.

Primary exposure possibilities include inhaling lead particles or ingesting lead by eating or drinking without using proper hygiene. Lead is most often found onsite either as components of experiment shielding and in paint on historical buildings onsite.

5.1. Air Exposure Limits and Biological Exposure Indices

- Exposures to airborne lead and biological monitoring are evaluated against, and controlled below, the following regulatory limits:
 - Elemental and Inorganic Lead
 - ◆ 29 CFR 1910.1025, “Lead.” This standard applies to elemental lead, all inorganic lead compounds, and lead soaps, in non-construction work environments. It does not apply to other organic lead compounds. The OSHA 8-hour time-weighted permissible exposure limit (PEL) for metallic lead, any inorganic lead compound, or lead soaps is 50 ug/m³ of air averaged over an 8-hour period. The action level is 30 ug/m³ of air averaged over an 8-hour period. Employees who will be potentially exposed above the action level for 30 days or more per year must be enrolled in the Lead Medical Surveillance Program. (See HR or ESH Department for details.) Those working with lead under 30 days per year may enroll upon request.
 - ◆ 29 CFR 1926.62, “Lead.” This is the Federal OSHA construction standard that establishes the medical surveillance trigger for workers exposed on any single day to lead at or above the action level (30 ug/m³), and that is followed for any SDSTA employee (or contractor) conducting “construction”-related work.
 - ◆ ACGIH, “Biological Exposure Index (BEI)” for Lead, as established by the (ACGIH) Threshold Limit Values. The ACGIH BEI for lead in blood is 30 ug/100ml.
 - Tetramethyl and Tetraethyl Lead
 - 29 CFR 1910.1000, “Air contaminants.” The corresponding 8-hour time-weighted PEL for tetramethyl and tetraethyl lead is 75 ug/m³ of air. There is no PEL for other organic lead compounds.
 - American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values, “Air contaminants.” Exposure limits for tetraethyl lead (100 ug/m³ and tetramethyl lead 150 ug/m³). Note: Exposure to these chemicals should be limited to 75 ug/m³, the applicable OSHA Standard for general industry.

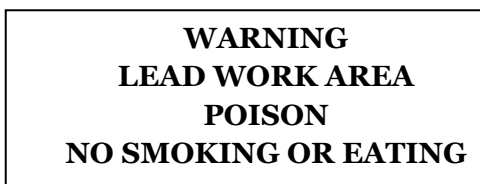
5.2. Surface Contamination Limits

- When lead-containing materials are disturbed, residual surface contamination may pose a hazard to people who subsequently occupy the area. Additionally, break areas should remain free of harmful levels of lead. In such cases, surface sampling is sometimes conducted, as determined by the ESH Department.
- Generally, the following swipe criteria would be applied:
 - <200 ug/ft² for change areas, storage facilities, and lunchrooms/eating areas.
- Similarly, a housekeeping level for established lead work areas that may be used is:
 - <1800 ug/ft² on work surfaces in a designated area.
- This latter value is a housekeeping level that defines whether a designated lead work area is in need of cleaning.
- For work and break areas at SURF, a higher or lower limit may be acceptable at the discretion of the ESH Department.

5.3. Exposure Controls

- The SDSTA Lead Compliance Plans (LCPs) in ESH-(4000-WI)-204633 Lead (Pb) Compliance Plans Work Instruction (or similar documentation) outline some specific requirements for lead work at SURF for work that may cause an exposure over the PEL. These Lead Compliance Plans must be reviewed on a regular basis for lead work not associated with buildings (if the plans are still in effect). Lead Compliance Plans should be developed by the organization planning and conducting the work, and may be included in the general work-planning documents such as a Job Hazard Analysis (JHA) or a Standard Operating Process (SOP) provided that the exposure hazards are identified and suitable controls are developed. If a separate LCP is not attached to the work planning document, the exposure hazards and suitable controls are to be listed in the work planning document itself.
- A separate Lead Compliance Plan is not required for jobs with a Negative Exposure Assessment (NEA), such as those in ESH-(4000-A)-204634 Negative Exposure Assessment.
- Housekeeping and Decontamination:
 - Surfaces should be maintained as free as practicable from accumulation of lead. Shoveling, blowing, wet or dry sweeping, and/or blowing of lead-containing dusts is not allowed unless specifically approved in the Lead Compliance Plan.
 - Contaminated work surfaces should be cleaned sufficiently to reduce lead levels to less than 1800 ug/ft². A different level may be accepted for industrial or laboratory areas, at the discretion of the ESH Department. Recommended cleanup methods include vacuuming the area with a high-efficiency particulate air (HEPA)-filtered vacuum or wet-wiping with disposable cloths. Consult the ESH Department to determine the proper waste disposal practices.
- Personal Hygienic Practices:
 - The precautions below apply to areas where lead is disturbed, and where the potential for exposure is greater than the PEL:

- ◆ Designate a separate location for eating, storing, and preparing food and beverages and cosmetics to avoid the possibility of ingesting lead. No lead work shall be performed in these designated areas. Lunchrooms should be kept under positive pressure by the provision of tempered, filtered air.
 - ◆ Wash hands and face before eating, drinking, or applying cosmetics. (Workers should shower if exposed in excess of the PEL.) Do not wear protective clothing into lunchrooms.
 - ◆ Designate change rooms where workers can segregate street clothes from clothing used for work.
 - ◆ Make shower facilities available. Portable shower units are recommended for required decontamination activities. Showers located throughout the SURF facilities may be used, provided that other workers do not use these showers while they may be potentially contaminated with lead dust. All showers used by lead workers should be decontaminated before used by other workers.
 - ◆ 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. These bags should be labeled in accordance with any SDSTA environmental guidance. Consult your supervisor or the ESH Department to determine exact requirements.
- Regulated Areas:
 - Signs shall be posted at all possible entrances in “Regulated Areas” (i.e., locations where lead work or lead use is being conducted). These signs should be designed in accordance with the OSHA or ANSI design criteria and color scheme. These signs shall be easily visible to workers and visitors. Contact the ESH Department for guidance if you have any questions about signs. Refer to ESH-(4000-A)-204635 Lead (Pb) Work Area Warning Sign and Label for Contaminated Clothing for an example of the appropriate signage.



- Monitoring Program:
 - 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 depends on the results of the initial samples.
 - Initiating and collecting air samples is as follows:
 - ◆ Work supervisors shall notify the IH Designee at least 48 hours in advance of planned lead operations so that air sampling can be arranged.
 - ◆ The IH Designee or a technician working under the guidance of the IH Designee shall do the following:
 - ◇ Collect the initial air samples for uncharacterized operations that may generate airborne lead and submit them to an accredited 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 three (3) months, and a written compliance plan detailing the steps to be taken to reduce the airborne lead levels must be developed and implemented.
- ◇ If work tasks expose a person at or above the action level for more than 30 days per year, the person will need to be enrolled in a medical surveillance program consisting of biological monitoring and examinations that conform to the 29 CFR 1910.1025(j) standard.
 - ◇ The results of air sampling conducted to measure exposure during operations at the work site 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 ESH Department.
 - Laboratories that analyze lead air samples must be accredited by the American Industrial Hygiene Association.
 - For more complete details on lead exposure assessment, contact the ESH Department or refer to the appropriate OSHA lead standard.
- **Surface Contamination Sampling:**
 - Floors and other surfaces in work areas where significant lead is disturbed may be tested for residual lead contamination before workers re-occupy those areas at the discretion of the ESH Department. Specifically, this guidance applies when the work involves any of the activities listed in the Lead (Pb) Compliance Plans Work Instruction 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 usually obtained by making two S-shaped swipes with a pre-wetted wipe at a 90° angle over a 1-ft² area and submitted to an Analytical Laboratory for analysis. Details on this sampling method can be found in the HUD “Guidelines for the evaluation and control of lead-based paint hazards in housing.” Samples are generally collected by ESH Staff.
 - Clearance swipe samples, where required for work performed by contractors, shall be obtained and analyzed by the contractor in accordance with the HUD Guidelines. However, SDSTA reserves the right to request changes in the sampling and analysis procedure or to obtain parallel clearance samples.
 - The analytical laboratory must be accredited by the American Industrial Hygiene Association or another organization accredited by the EPA specifically to perform lead analyses.
 - **Application and Installation of Lead-Containing Products:**
 - With the exception of lead 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. Requests for a special allowance require prior review of the ESH Department and the Operations Department.
 - **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.
 - Lead-abatement work performed by SURF personnel or supplemental labor workers should be evaluated by the ESH Department for determination of appropriate controls. A lead compliance plan is normally required for lead-abatement work.

- Contracted lead-abatement work should be conducted by a licensed contractor and in accordance with the Housing and Urban Development (HUD) Guidelines.
- 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 may be present in paint on the surfaces of many SURF 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 should 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 or brazing.
 - ◆ Using a heat gun to remove paint.
 - ◆ Performing other activities that generate lead-containing dust.
 - Testing should also be conducted on other potentially 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.
 - ◆ Brass, bronze, and pewter to be sanded or heated to the melting point of lead.
 - ◆ Solders to be sanded.
 - 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. Bulk samples can be analyzed 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 ESH Department.
 - Work Performed by Laboratory Personnel. Preconstruction testing is conducted by either SDSTA personnel or consultants who (1) complete the State Accreditation Program for Lead Inspectors or are certified by the American Board of Industrial Hygiene in industrial hygiene, or (2) work under the supervision of a Certified Industrial Hygienist or an accredited inspector.
 - Work Performed by Contractors. SURF 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 potentially lead-containing materials. Contractors who make lead determinations must be accredited as lead building inspectors, or the work must be conducted directly by a Certified Industrial Hygienist.
- **Lead (Pb) Shielding:**
 - Where it 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 oxidation. Any lead (Pb) shielding should be inspected for quality and approved by SDSTA prior to arrival onsite.

5.4. Training

- All personnel with possible exposure to lead (Pb) onsite are to receive awareness training as part of initial training. In addition, all SDSTA operations employees are provided with refresher training for health hazards, including lead, on an annual basis.
- Personnel who perform work under an established Negative Exposure Assessment (see Negative Exposure Assessment (NEAs) Attachment) task will only be required to review the applicable NEA and perform the task accordingly.
- The SURF training program elements for personnel handling lead (Pb) materials is based on the type(s) of tasks conducted according to the information provided in the work planning documents to be used. Expectations of exposure and the training elements required vary depending on these work tasks.
- Elements required for all tasks include at a minimum:
 - The potential route(s) of exposure.
 - The acceptable hazard controls to use.
 - The disposal or decontamination of equipment & materials, if necessary.
- Work in laboratories with lead (Pb) or lead-containing compounds, but with no direct exposure to the lead will be trained at an awareness level only. If extensive lead work may be performed (such as experiments with lead batteries or extensive handling of lead bricks or other shielding) additional training may be required.
- For construction or demolition projects involving lead (Pb) materials, extensive training or certification may be necessary to provide for both supervisors, workers, and/or subcontractors based on the risks of the activity. Documentation of off-site lead (Pb) training courses or abatement certification may be used to meet the requirements subject to SURF ESH Department approval. Please contact the ESH Department for any more details on training.

5.5. Personal Protective Equipment (PPE)

- Personal protective equipment (in addition to normal work requirements) may include coveralls, shoe covers, head covers, gloves and respirators and is required for operations that may generate airborne lead levels above the PEL (50 µg/m³). Safety shoes with metatarsal guards may be required for some 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 µg/m³. When required, special equipment may be defined by the Hazard Analysis or Lead Compliance Plan that is reviewed and approved by the ESH Department or an Industrial Hygienist.

- Protective Garments:
 - Workers are usually issued disposable work coveralls in lieu of reusable coveralls. These coveralls shall not be worn home. Reusable clothing must comply with the cleaning and replacement requirements in the standards, including having the following label:



5.6. Respiratory Protection

The ESH Department shall approve respirator use in conformance with the ESH-(4000-S)-73394 Respiratory Protection Standard. Fit testing of respirators, where required, must be conducted within twelve (12) months prior to lead (Pb) work.

6.0 Documented Information/Related Documents

- 6.1. ESH-(4000-S)-73394 Respiratory Protection Standard
- 6.2. ESH-(4000-A)-204634 Negative Exposure Assessments
- 6.3. ESH-(4000-WI)-204633 Lead (Pb) Compliance Plans Work Instruction
- 6.4. ESH-(4000-A)-204635 Lead (Pb) Work Area Warning Sign and Label for Contaminated Clothing
- 6.5. 29 CFR 1910.1025 - Lead
- 6.6. 29 CFR 1910.1000, Air contaminants
- 6.7. 29 CFR 1926.62 - Lead
- 6.8. ACGIH, Biological Exposure Index (BEI) for Lead