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Subchapter 4. Construction Safety Orders  
Article 4. Dusts, Fumes, Mists, Vapors, and Gases

Amend Section 1532.1 as follows:

§ 1532.1. Lead.

(a) Scope. This section applies to all construction work where an employee may be occupationally exposed to lead. All construction work excluded from coverage in the general industry standard for lead by section 5198(a)(2) is covered by this standard. Construction work is defined as work for construction, alteration and/or repair, including painting and decorating. It includes but is not limited to the following:

- (1) Demolition or salvage of structures where lead or materials containing lead are present;
- (2) Removal or encapsulation of materials containing lead;
- (3) New construction, alteration, repair, or renovation of structures, substrates, or portions thereof, that contain lead, or materials containing lead;
- (4) Installation of products containing lead;
- (5) Lead contamination/emergency cleanup;
- (6) Transportation, disposal, storage, or containment of lead or materials containing lead on the site or location at which construction activities are performed; and
- (7) Maintenance operations associated with the construction activities described in this subsection.

(b) Definitions.

Action level means employee exposure, without regard to the use of respirators, to an airborne concentration of lead of ~~230~~ micrograms per cubic meter of air (~~230~~  $\mu\text{g}/\text{m}^3$ ) calculated as an 8-hour time-weighted average (TWA).

Altering or disturbing means subjecting to a process that may result in the release of lead dust, lead mist, lead fume, or other lead particles. Such processes include, but are not limited to, welding, torch cutting, brazing, torch soldering, melting, pouring, spraying, cutting, shredding, crushing, baling, grinding, polishing, machining, drilling, scraping, sanding, abrading, sweeping, raking, and shoveling.

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Blood lead level means the concentration of lead measured in whole blood, expressed as micrograms per deciliter ( $\mu\text{g}/\text{dl}$ ) of whole blood.

Chief means the Chief of the Division of Occupational Safety and Health or designee.

High-efficiency particulate air (HEPA) filter means a filter that is at least 99.97 percent efficient in removing particles 0.3 micrometers in diameter.

Lead means metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.

Level 1 trigger task means a task listed in subsection (d)(2)(A), which, until an exposure assessment as required in subsection (d) is completed, is presumed to result in employee exposure above the permissible exposure limit (PEL), but not greater than 10 times the PEL.

Level 2 trigger task means a task listed in subsection (d)(2)(C), which, until an exposure assessment as required in subsection (d) is completed, is presumed to result in employee exposure above 10 times the PEL, but not greater than 50 times the PEL.

Level 3 trigger task means a task listed in subsection (d)(2)(D), which, until an exposure assessment as required in subsection (d) is completed, is presumed to result in employee exposure above 50 times the PEL.

NIOSH means the National Institute of Occupational Safety and Health (NIOSH), U.S. Department of Health and Human Services or designee.

Supervisor means one who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization to take prompt corrective measures to eliminate them. Supervisors shall be trained, as required by this section, and, when required, be certified consistent with subsection (f)(3).

Trigger task – not listed means a task described in subsection (d)(2)(B), which, until an exposure assessment as required in subsection (d) is completed, is presumed to result in employee exposure above the PEL.

(c) Permissible exposure limit (PEL).

(1) The employer shall ~~assure~~ensure that no employee is exposed to an airborne concentration of lead at concentrations greater than 10 fifty micrograms per cubic meter of air ( $10\ 50\ \mu\text{g}/\text{m}^3$ ) calculated as

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~~averaged over an 8-hour time-weighted average (TWA) period. The 8-hour TWA shall be calculated in accordance with the appendix to section 5155.~~

EXCEPTION: Until [OAL insert five years from effective date here], no employee conducting abrasive blasting shall be exposed to an airborne concentration of lead greater than 25 micrograms per cubic meter of air (25 µg/m<sup>3</sup>), calculated as an eight-hour time-weighted average (TWA).

~~(2) If an employee is exposed to lead for more than 8 hours in any work day the employees' allowable exposure, as a time-weighted average (TWA) for that day, shall be reduced according to the following formula:~~

~~Allowable employee exposure (in µg/m<sup>3</sup>) = 400 divided by hours worked in the day.~~

~~(3)~~ When respirators are used to limit employee exposure as required under subsection (c) and all the requirements of subsections (e)(1) and (f) have been met, employee exposure may be considered to be at the level provided by the protection factor of the respirator for those periods the respirator is worn. Those periods may be averaged with exposure levels during periods when respirators are not worn to determine the employee's daily TWA exposure.

(d) Exposure assessment.

(1) General.

(A) Each employer who has a workplace or operation covered by this standard shall initially determine if any employee may be exposed to lead at or above the action level.

(B) For the purposes of subsection (d), employee exposure is that exposure which would occur if the employee were not using a respirator.

(C) With the exception of monitoring under subsection (d)(3), where monitoring is required under this section, the employer shall collect personal samples representative of a full shift including at least one sample for each job classification in each work area either for each shift or for the shift with the highest exposure level.

(D) Full shift personal samples shall be representative of the monitored employee's regular, daily exposure to lead.

(2) Protection of employees ~~during~~prior to assessment of exposure.

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(A) Level 1 trigger tasks. With respect to the level 1 trigger tasks~~lead-related tasks~~ listed in subsection (d)(2)(A), where lead is present, until the employer performs an employee exposure assessment as required in subsection (d) and documents that the employee performing any of the listed tasks is not exposed above the PEL, the employer shall treat the employee as if the employee were exposed above the PEL, and not in excess of ten (10) times the PEL, and shall implement ~~employee protective measures~~interim protection as prescribed in subsection (d)(2)(E). The tasks covered by this requirement are: ~~1. Where lead-containing coatings or paint are present: manual demolition of structures (e.g., dry wall), manual scraping, manual sanding, and heat gun applications, and power tool cleaning with dust collection systems;~~

2. Spray painting with lead paint

(B) Trigger tasks – not listed. In addition, with regard to tasks not listed in subsection (d)(2)(A), where the employer has any reasons to believe that an employee performing the task may be exposed to lead in excess of the PEL, until the employer performs an employee exposure assessment as required by subsection (d) and documents that the employee's lead exposure is not above the PEL the employer shall treat the employee as if the employee were exposed above the PEL and shall implement ~~employee protective measures~~interim protection as prescribed in subsection (d)(2)(E).

(C) Level 2 trigger tasks. With respect to the level 2 trigger tasks listed in this subsection (d)(2)(C), where lead is present, until the employer performs an employee exposure assessment as required in subsection (d), and documents that the employee performing any of the listed tasks is not exposed in excess of ~~100500~~  $\mu\text{g}/\text{m}^3$  (10 x PEL), the employer shall treat the employee as if the employee were exposed to lead in excess of ~~100500~~  $\mu\text{g}/\text{m}^3$  and shall implement ~~employee protective measures~~interim protection as prescribed in subsection (d)(2)(E). Where the employer does establish that the employee is exposed to levels of lead below ~~100500~~  $\mu\text{g}/\text{m}^3$ , the employer may provide the exposed employee with the appropriate respirator prescribed for such use at such lower exposures, in accordance with section 5144(d)(3)(A)1. Table 1 of this section. The tasks covered by this requirement are:

1. Where lead-containing coatings or paint are present: manual sanding, Using lead-containing mortar; lead burning and~~2. power tool cleaning, grinding, or sanding with dust collection systems. Where lead containing coatings or paint are present: rivet busting; power tool cleaning without dust collection systems; cleanup activities where dry expendable abrasives are used; and abrasive blasting enclosure movement and removal.~~

2. Spray painting with lead paint.

(D) Level 3 trigger tasks. With respect to the level 3 trigger tasks listed in this subsection (d)(2)(D)~~of this section~~, where lead is present, until the employer performs an employee exposure assessment as required in subsection (d) and documents that the employee performing any of the listed tasks is not

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exposed to lead in excess of ~~5002,500~~  $\mu\text{g}/\text{m}^3$  (50 x PEL), the employer shall treat the employee as if the employee were exposed to lead in excess of ~~5002,500~~  $\mu\text{g}/\text{m}^3$  and shall implement ~~employee protective measures~~ interim protection as prescribed in subsection (d)(2)(E). Where the employer does establish that the employee is exposed to levels of lead below ~~5002,500~~  $\mu\text{g}/\text{m}^3$ , the employer may provide the exposed employee with the appropriate respirator prescribed for use at such lower exposures, in accordance with ~~section 5144(d)(3)(A)1. Table 1 of this section.~~ Interim protection as ~~described~~ prescribed in this subsection (d)(2)(E) is required ~~where lead-containing coatings or paint are present on structures~~ when performing any of the following tasks:

1. Using lead-containing mortar or ~~Abrasive blasting,~~ 2. lead burning ~~welding,~~

~~32.~~ Where lead-containing coatings or paint are present:

a. Rivet busting ~~Cutting and,~~

4b. Power tool cleaning, grinding or sanding without dust collection systems ~~Torch burning.~~

c. Cleanup activities where dry expendable abrasives are used.

d. Abrasive blasting enclosure movement and removal.

e. Abrasive blasting.

f. Welding.

g. Torch cutting.

h. Torch burning.

(E) Until the employer performs an employee exposure assessment as required under subsection (d) and determines actual employee exposure, the employer shall provide to employees performing the trigger tasks as described in subsections (d)(2)(A), (d)(2)(B), (d)(2)(C) and (d)(2)(D) with interim protection as follows:

1. Appropriate respiratory protection in accordance with subsection (f);<sub>i</sub>

2. Appropriate personal protective clothing and equipment in accordance with subsection (g);<sub>i</sub>

3. Change areas in accordance with subsection (i)(2);<sub>i</sub>

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4. ~~Hand washing facilities in accordance with subsection (i)(5).~~ Shower facilities in accordance with subsection (i)(3), for employees performing level 3 trigger tasks listed in subsection (d)(2)(D);

5. Eating facilities or eating areas in accordance with subsection (i)(4);

6. Regulated areas in accordance with subsection (i)(6);

7. Limiting the maximum amount of time an employee can conduct dry abrasive blasting to 5 hours per day, except that after [OAL insert five years from the effective date here] the amount of time shall be similarly limited to 2 hours per day;

85. ~~Medical surveillance~~ Biological monitoring in accordance with subsections (j)(1)(A) and (j)(1)(B) to consist of blood sampling and analysis for lead and zinc protoporphyrin levels; and

96. Training as required under subsections (l)(1)(A) and (l)(1)(B) regarding section 5194, Hazard Communication; training as required under subsection (l)(2)(C), regarding use of respirators; and training in accordance with section 1510, Safety Instructions for Employees.

(3) Basis of initial determination.

(A) Except as provided under subsections (d)(3)(C) and (d)(3)(D) the employer shall monitor employee exposures and shall base initial determinations on the employee exposure monitoring results and any of the following, relevant considerations:

1. Any information, observations, or calculations which would indicate employee exposure to lead;
2. Any previous measurements of airborne lead; and
3. Any employee complaints of symptoms which may be attributable to exposure to lead.

(B) Monitoring for the initial determination where performed may be limited to a representative sample of the exposed employees who the employer reasonably believes are exposed to the greatest airborne concentrations of lead in the workplace.

(C) Where the employer has previously monitored for lead exposures, and the data were obtained within the past 12 months during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the employer may rely on such earlier monitoring results to satisfy the requirements of subsections (d)(3)(A) and (d)(6) if the sampling and analytical methods meet the accuracy and confidence levels of subsection (d)(9).

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(D) Where the employer has objective data, demonstrating that a particular product or material containing lead or a specific process, operation or activity involving lead cannot result in employee exposure to lead at or above the action level during processing, use, or handling, the employer may rely upon such data instead of implementing initial monitoring.

1. The employer shall establish and maintain an accurate record documenting the nature and relevance of objective data as specified in subsection (n)(47), where used in assessing employee exposure in lieu of exposure monitoring.

2. Objective data, as described in subsection (d)(3)(D), is not permitted to be used for exposure assessment in connection with trigger tasks listed in subsection (d)(2).

3. Objective data for surface coatings and materials that contain lead shall meet the following methodology:

a. Lead analysis shall be performed for each unique surface coating and material that may constitute a health hazard to employees engaged in activities within the scope of this section and;

b. Analysis of surface coatings and materials shall be performed in a manner that meets the requirements of subsection (d)(9) and shall be recorded, as described in subsection (n)(47).<sub>5</sub>

(4) Positive initial determination and initial monitoring.

(A) Where a determination conducted under subsections (d)(1), (2) and (3) shows the possibility of any employee exposure at or above the action level the employer shall conduct monitoring which is representative of the exposure for each employee in the workplace who is exposed to lead.

(B) Where the employer has previously monitored for lead exposure, and the data were obtained within the past 12 months during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the employer may rely on such earlier monitoring results to satisfy the requirements of subsection (d)(4)(A) if the sampling and analytical methods meet the accuracy and confidence levels of subsection (d)(9).

(C) Objective data for an initial assessment that demonstrate surface coating or material that contain lead at concentrations equal to or exceeding 0.06% lead dry weight (600 ppm) demonstrate the presence of lead surface coatings or material that may constitute a health hazard to employees engaged in lead-related construction work. The lead concentration of paint or materials is based on the lead content in the nonvolatile components of the surface coating or material such as paint. Objective data

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as described in this subsection are not permitted to be used in lieu of exposure assessment in connection with ~~lead-related~~trigger tasks listed in subsection (d)(2).

(5) Negative initial determination.

(A) Where a determination, conducted under subsections (d)(1), (2), and (3) is made that no employee is exposed to airborne concentrations of lead at or above the action level the employer shall make a written record of such determination. The record shall include at least the information specified in subsection (d)(3)(A) and shall also include the date of determination, location within the worksite, and the name and another unique identifier (such as date of birth or employee identification numbers or social security number) of each employee monitored.

(B) Objective data that meet the requirements of subsection (n)(~~47~~) for an initial assessment that demonstrate surface coating or material that contain lead at concentrations less than 0.06% lead dry weight (600 ppm) are sufficient to establish a negative determination. The lead concentration of surface coatings or materials is based on the lead content in the nonvolatile components of the surface coating or material such as paint. Objective data as described in this subsection are not permitted to be used in lieu of exposure assessment in connection with ~~lead-related~~trigger tasks listed in subsection (d)(2).

(6) Frequency.

(A) If the initial determination reveals employee exposure to be below the action level, further exposure determination need not be repeated except as otherwise provided in subsection (d)(7).

(B) If the initial determination or subsequent determination reveals employee exposure to be at or above the action level but below 30 µg/m<sup>3</sup> as an 8-hour TWA, the employer shall perform monitoring at least every 12 months. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below the action level, at which time the employer may discontinue monitoring except as otherwise provided in subsection (d)(7).

(CB) If the initial determination or subsequent determination reveals employee exposure to be at or above 30 µg/m<sup>3</sup> as an 8-hour TWA~~the action level~~ but at or below 50 µg/m<sup>3</sup> as an 8-hour TWA~~the PEL~~, the employer shall perform monitoring in accordance with this subsection at least every 6 months. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below 30 µg/m<sup>3</sup> as an 8-hour TWA~~the action level~~, at which time Subsequent monitoring shall conform with the applicable provisions of subsection (d)(6)(B), the employer may discontinue monitoring for that employee except as otherwise provided in subsection (d)(7).



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(DC) If the initial determination or subsequent determination reveals that employee exposure is above 50 µg/m<sup>3</sup> as an 8-hour TWA~~the PEL~~, the employer shall perform monitoring quarterly. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are at or below 50 µg/m<sup>3</sup> as an 8-hour TWA~~the PEL~~ ~~but at or above the action level~~, at which time the employer shall repeat monitoring for that employee at the frequency specified in subsection (d)(6)(B) or (C), as appropriate, based on the monitoring results, except as otherwise provided in subsection (d)(7). ~~The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below the action level at which time the employer may discontinue monitoring for that employee except as otherwise provided in subsection (d)(7).~~

(7) Additional exposure assessments. Whenever there has been a change of equipment, process, control, personnel or a new task has been initiated that may result in additional employees being exposed to lead at or above the action level or may result in employees already exposed at or above the action level being exposed above the PEL, the employer shall conduct additional monitoring in accordance with this subsection.

(8) Employee notification.

(A) Within 5 working days after completion of the exposure assessment the employer shall notify each employee in writing of the results which represent that employee's exposure.

(B) Whenever the results indicate that the representative employee exposure, without regard to respirators, is at or above the PEL the employer shall include in the written notice a statement that the employees exposure was at or above that level and a description of the corrective action taken or to be taken to reduce exposure to below that level.

(9) "Accuracy of measurement". The employer shall use a method of monitoring and analysis which has an accuracy (to a confidence level of 95%) of not less than plus or minus 20~~25~~ percent for airborne concentrations of lead equal to or greater than 230 µg/m<sup>3</sup>. Methods for the determination of lead concentrations of surface coatings and material shall be determined by methods which have an accuracy (to a confidence level of 95 percent) of not less than plus or minus 20~~25~~ percent at 0.06% lead dry weight (600 ppm).

(e) Methods of compliance.

(1) Engineering and work practice controls.

(A) General. The employer shall implement engineering and work practice controls, including administrative controls, to reduce and maintain employee exposure to lead to or below the permissible

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exposure limit, to the extent that such controls are feasible. Wherever all feasible engineering and work practices controls that can be instituted are not sufficient to reduce employee exposure to or below the permissible exposure limit prescribed in subsection (c), the employer shall nonetheless use them to reduce employee exposure to the lowest feasible level and shall supplement them by the use of respiratory protection that complies with the requirements of subsection (f).

(2) Compliance program.

(A) Prior to commencement of the job, each employer shall establish and implement a written compliance program to achieve compliance with subsection (c).

(B) Written plans for these compliance programs shall include at least the following:

1. A description of each activity in which lead is emitted; e.g. equipment used, material involved, controls in place, crew size, employee job responsibilities, operating procedures and maintenance practices;
2. A description of the specific means that will be employed to achieve compliance and, where engineering controls are required, engineering plans and studies used to determine methods selected for controlling exposure to lead;
3. A report of the any engineering and work practice controls considered in meeting the PEL but not implemented due to infeasibility, that includes an explanation of how each was determined to be infeasible~~technology considered in meeting the PEL;~~
4. Air monitoring data which documents the source of lead emissions;
5. A detailed schedule for implementation of the program, including documentation such as copies of purchase orders for equipment, construction contracts, etc.;
6. A work practice program which includes items required under subsections (g), (h) and (i) and incorporates other relevant work practices such as those specified in subsection (e)(5);
7. An administrative control schedule required by subsection (e)(4), if applicable;
8. A description of arrangements made among contractors on multi-contractor sites with respect to informing affected employees of potential exposure to lead and of regulated areas;
9. Other relevant information.

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(C) The compliance program shall provide for frequent and regular inspections of job sites, regulated areas, materials, and equipment to be made by a supervisor.

(D) Written programs shall be submitted upon request to any affected employee or authorized employee representatives, to the Chief and NIOSH, and shall be available at the worksite for examination and copying by the Chief and NIOSH.

(E) Written programs shall be revised and updated at least every 6 months to reflect the current status of the program. The revisions and updates shall be documented in writing, in accordance with subsection (n)(2).

(3) Mechanical ventilation. When ventilation is used to control lead exposure, the employer shall evaluate the mechanical performance of the system in controlling exposure as necessary to maintain its effectiveness.

(4) Administrative controls. If administrative controls are used as a means of reducing employees' TWA exposure to lead, the employer shall establish and implement a written job rotation schedule ~~which~~that includes:

(A) Name and another unique identifier (such as date of birth or employee or identification number) of each affected employee;

(B) Duration and exposure levels at each job or work station where each affected employee is located; and

(C) Any other information which may be useful in assessing the reliability of administrative controls to reduce exposure to lead.

(5) The employer shall ensure that, to the extent relevant, employees follow good work practices such as described in Appendix B of this section.

(f) Respiratory protection.

(1) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(A) Periods when an employee's exposure to lead exceeds the PEL;

(B) Work operations for which engineering controls and work practices are not sufficient to reduce exposures to or below the PEL;

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(C) Periods when an employee requests a respirator; and

(D) Periods when respirators are required to provide interim protection for employees while they perform ~~the operations~~ trigger tasks specified described in subsection (d)(2).

(2) Respirator program.

(A) An employer must implement a respiratory protection program in accordance with section 5144(b) ~~(except (d)(1)(C))~~ through (m), except section 5144(d)(1)(C).

(B) If an employee exhibits breathing difficulty during fit testing or respirator use, the employer must provide the employee with a medical examination in accordance with subsection (j)(3)(A)2. to determine if the employee can use a respirator while performing the required duties.

(3) Respirator selection.

(A) The employer shall select, and provide to employees, the appropriate respirator or combination of respirators specified in Section 5144(d)(3)(A)1. Employers shall not select or use filtering facepiece respirators for protection against lead.

(B) The employer shall provide a powered, air-purifying respirator in lieu of the respirator specified in Section 5144(d)(3)(A)1, whenever:

1. An employee chooses to use this type of respirator; and
2. This respirator will provide adequate protection to the employee.

(C) The employer shall provide employees with a full facepiece respirator instead of a half mask respirator for protection against lead aerosols that may cause eye or skin irritation at the use concentrations.

(D) The employer shall provide HEPA filters for powered air-purifying respirators and N-100, R-100, or P-100 filters for non-powered air-purifying respirators.

(g) Protective work clothing and equipment.

(1) Provision and use. Where an employee is exposed to lead above the PEL without regard to the use of respirators, where employees are exposed to lead compounds which may cause skin or eye irritation (e.g. lead arsenate, lead azide), and as interim protection for employees performing trigger tasks as

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~~specified~~described in subsection (d)(2), the employer shall, in accordance with GISO Article 10, provide at no cost to the employee and ~~assure~~ensure that the employee uses appropriate protective work clothing and equipment that prevents contamination of the employee and the employee's garments such as, but not limited to:

(A) Coveralls or similar full-body work clothing;

(B) Gloves, hats, and shoes or disposable shoe coverlets; and

(C) Face shields, vented goggles, or other appropriate protective equipment ~~which complies with section 1516~~.

(2) Cleaning and replacement.

(A) The employer shall provide the protective clothing required in subsection (g)(1) in a clean and dry condition at least weekly, and daily to employees whose exposure levels without regard to a respirator are over 30 ~~200~~  $\mu\text{g}/\text{m}^3$  of lead as an 8-hour TWA.

(B) The employer shall provide for the cleaning, laundering, and disposal of protective clothing and equipment required by subsection (g)(1).

(C) The employer shall repair or replace required protective clothing and equipment as needed to maintain their effectiveness.

(D) The employer shall ~~assure~~ensure that all protective clothing is removed at the completion of a work shift, only in change areas provided for that purpose, as prescribed in subsection (i)(2).

(E) The employer shall ~~assure~~ensure that contaminated protective clothing which is to be cleaned, laundered, or disposed of, is placed in a closed container in the change area which prevents dispersion of lead outside the container.

(F) The employer shall inform in writing any person who cleans or launders protective clothing or equipment of the potentially harmful effects of exposure to lead.

(G) ~~1-~~ The employer shall ~~assure~~ensure that the containers of contaminated protective clothing and equipment required by subsection (g)(2)(E) of this section are labeled as follows:

DANGER: CLOTHING AND EQUIPMENT CONTAMINATED WITH LEAD, MAY DAMAGE FERTILITY OR THE UNBORN CHILD. CAUSES DAMAGE TO THE CENTRAL NERVOUS SYSTEM. DO NOT EAT, DRINK OR SMOKE WHEN HANDLING. DO NOT REMOVE DUST BY BLOWING OR SHAKING. DISPOSE OF LEAD

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CONTAMINATED WASH WATER IN ACCORDANCE WITH APPLICABLE LOCAL, STATE, OR FEDERAL REGULATIONS.

~~2. Prior to June 1, 2015, employers may include the following information on bags or containers of contaminated protective clothing and equipment required by subsection (g)(2)(E) in lieu of the labeling requirements in subsection (g)(2)(G)1. of this section:~~

~~Caution: Clothing contaminated with lead. Do not remove dust by blowing or shaking. Dispose of lead contaminated wash water in accordance with applicable local, state, or federal regulations.~~

(H) The employer shall prohibit the removal of lead from protective clothing or equipment by blowing, shaking, or any other means which disperses lead into the air.

(h) Housekeeping.

(1) All surfaces shall be maintained as free as practicable of accumulations of lead.

(2) Floors ~~Clean up of floors~~ and other surfaces where lead accumulates shall be cleaned, wherever possible, ~~be cleaned~~ by vacuuming or by other methods that minimize the likelihood of lead becoming airborne.

(3) Shoveling, dry or wet sweeping, and brushing ~~shall may not be used only where~~ unless the employer can demonstrate that vacuuming or other equally effective methods have been tried and found not to be effective.

(4) Where vacuuming methods are selected, the vacuums shall be equipped with HEPA filters and used and emptied in a manner which minimizes the reentry of lead into the workplace.

(5) Compressed air shall not be used to remove lead from any surface unless the compressed air is used in conjunction with a ventilation system designed to capture the airborne dust created by the compressed air.

(i) Hygiene facilities, practices and regulated areas.

(1) General hygiene.

(A) The employer shall ~~assure~~ ensure that in areas where employees are exposed to lead ~~above the PEL without regard to the use of respirators~~, food or beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied.

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(B) For all employees exposed to lead, the employer shall provide an adequate number of washing facilities, or lavatories, and special cleansing compounds, in accordance with the provisions of section 1527(a).

(C) The employer shall ensure that employees exposed to lead wash their hands, exposed arms, and face prior to entering eating areas, eating, drinking, smoking or applying cosmetics, and at the end of their shift.

(2) Change areas.

(A) The employer shall provide clean change areas for employees whose airborne exposure to lead is above the PEL without regard to the use of respirators, and as interim protection for employees performing trigger tasks as specified described in subsection (d)(2), ~~without regard to the use of respirators.~~

(B) The employers shall ~~assure~~ensure that change areas are equipped with separate storage facilities for protective work clothing and equipment, and for street clothes, which prevent cross-contamination.

(C) The employer shall ~~assure~~ensure that employees do not leave the workplace wearing any protective clothing or equipment that is required to be worn during the work shift.

(3) Showers.

(A) The employer shall provide shower facilities, ~~where feasible~~, for use by employees whose airborne exposure to lead is above the PEL, without regard to the use of respirators, and as interim protection for employees performing level 3 trigger tasks listed in subsection (d)(2)(D).

(B) The employer shall ensure that required shower facilities comply with section 3366(f).

~~(C)~~ (B) The employer shall ~~assure~~ensure, where shower facilities are ~~available~~required, that employees shower at the end of the work shift and shall provide an adequate supply of cleansing agents and towels for use by affected employees.

(4) Eating facilities.

(A) The employer shall provide readily accessible lunchroom facilities or eating areas for employees whose airborne exposure to lead is above the PEL, without regard to the use of respirators, and as interim protection for employees performing trigger tasks described in subsection (d)(2).

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~~(B) The employer shall assure that lunchroom facilities or eating areas are as free as practicable from lead contamination and are readily accessible to employees.~~

~~(C) The employer shall assure that employees whose airborne exposure to lead is above the PEL, without regard to the use of a respirator, wash their hands and face prior to eating, drinking, smoking or applying cosmetics.~~

~~(B)~~ (D) The employer shall ~~assure~~ensure that employees do not enter lunchroom facilities or eating areas with protective work clothing or equipment unless surface lead dust has been removed by HEPA vacuuming, downdraft booth, or other cleaning method that limits dispersion of lead dust.

~~(5) Hand Washing~~Cleaning of hygiene facilities. The employer shall establish, implement and maintain effective written methods and schedules to maintain the cleanliness of drinking and washing facilities, change rooms, showers, lunchrooms, and eating areas required by this subsection.

~~(A) The employer shall provide adequate handwashing facilities for use by employees exposed to lead in accordance with section 1527.~~

~~(B) Where showers are not provided the employer shall assure that employees wash their hands and face at the end of the work shift.~~

(6) Regulated ~~A~~areas.

(A) Employers shall establish regulated areas, ~~where unless the employer can demonstrate that they are not feasible, for work areas where employees are exposed to lead at or above the PEL without regard to the use of respirators, and as interim protection for employees or performing the trigger tasks described in subsection (d)(2).~~

(B) Regulated areas shall be posted with signs as described in subsection (m)(~~1~~2).

(C) Employers shall restrict access to the regulated area to employees authorized by the supervisor, to representatives of affected employees, as described in subsection (o) and to persons authorized by the Chief or NIOSH.

(D) Each employee authorized to enter the regulated area shall be provided with and be required to wear protective equipment required by subsections (f) and (g).

(j) Medical surveillance.

(1) General.



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(A) The employer shall make available initial blood lead testing~~medical surveillance~~ to employees:

1. Prior to assignment~~occupationally exposed on any day to lead work where exposure to lead is or is reasonably expected to be at or above the action level; and initial medical surveillance consists of biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin levels.~~

2. As interim protection, prior to performing trigger tasks described in subsection (d)(2), unless a negative initial determination has been made as described in subsection (d)(5).

(B) The employer shall institute a medical surveillance program in accordance with subsections (j)(2) and (j)(3)~~for all employees who are or may be exposed by the employer at or above the action level for more than 30 days in any consecutive 12 months;~~

1. For all employees who are or may be exposed to lead at or above the action level; and

EXCEPTION: Medical surveillance is not required for an employee who is not exposed to lead at or above the action level for 10 or more days in any 12 consecutive months, and who is not exposed on any day at or above 100 µg/m<sup>3</sup> as an 8-hour TWA, without regard to respirator use.

2. As interim protection, for all employees who perform trigger tasks described in subsection (d)(2).

EXCEPTION 1: Medical surveillance is not required where a negative initial determination has been made in accordance with subsection (d)(5).

EXCEPTION 2: Medical surveillance is not required for an employee who only performs level 1 trigger tasks and who does not perform these level 1 trigger tasks for 10 or more days in any 12 consecutive months.

(C) The employer shall ~~assure~~ensure that all medical examinations and procedures are performed by or under the supervision of a licensed physician.

(D) The employer shall make available the required medical surveillance including multiple physician review under subsection (j)(3)(C) without cost to employees and at a reasonable time and place.

(E) The employer shall provide complete employee identification information to the licensed healthcare provider who performs any services covered under subsections (j)(2) and (j)(3). The employer shall instruct the healthcare provider ordering blood lead tests to provide the analyzing laboratory with the employee identification information. Identification information includes:

1. Employee name, date of birth, address, and phone number; and

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2. Employer name, address, and phone number.

(2) Blood lead testing~~Biological monitoring.~~

(A) ~~Blood lead testing schedule and ZPP level sampling and analysis.~~ The employer shall make available ~~biological monitoring in the form of blood lead testing sampling and analysis for lead and zinc protoporphyrin levels~~ to each employee covered under subsections (j)(1)(A) and/or (B) on the following schedule:

1. For each employee covered under subsection (j)(1)(B), initially in accordance with subsection (j)(1)(A), and then at least every 2 months for the first 6 months after initial placement, and then every 6 months thereafter;

2. For each employee covered under subsection (j)(1)(B), at least every 2 months for the first 6 months after a change in task resulting in or likely to result in higher exposure to lead, and then every 6 months thereafter;

~~23. For~~At least every two months for each employee covered under subsections (j)(1)(A) or (B) whose last blood sampling and analysis indicated a blood lead level was at or above 1040 µg/dl but below 20 µg/dl, at least every two months. This frequency shall continue until two consecutive blood lead level~~samples and analyses, taken at least 30 days apart, are indicate a blood lead level below 1040 µg/dl; and~~

~~34. At least monthly for~~For each employee whose last blood lead level was at or above 20 µg/dl, and during the removal period of each employee who is removed from exposure to lead due to an elevated blood lead level at least monthly during the removal period;

5. At least monthly, as interim protection in accordance with subsection (d)(2)(E), for each employee performing a level 3 trigger task as listed in subsection (d)(2)(D), including a blood test taken within 3 days after discontinuing all level 3 trigger task work; and

6. At least monthly for each employee whose airborne exposure is above 500 µg/m<sup>3</sup> as an 8-hour TWA, without regard to the use of respirators, including a blood test taken within 3 days after discontinuing all work associated with airborne exposure above 500 µg/m<sup>3</sup> as an 8-hour TWA.

(B) ~~Follow-up blood sampling tests. Whenever the results of a blood lead level test indicate that an employee's blood lead level is at or above the numerical criterion for medical removal under subsection (k)(1)(A), the employer shall provide a second (follow-up) blood sampling test within two weeks after the employer receives the results of the first blood sampling test.~~

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(BC) Accuracy of blood lead ~~testing level sampling and analysis~~. Blood lead ~~testing level sampling and analysis~~ provided pursuant to this section shall ~~include analysis by a Clinical Laboratory Improvement Amendments (CLIA)-approved laboratory (under the federal CLIA regulations, 42 CFR Part 493)~~. ~~have an accuracy (to a confidence level of 95 percent) within plus or minus 15 percent or 6 µg/dl, whichever is greater, and shall be conducted by a laboratory approved by OSHA.~~

(CD) ~~Employer notification to the E~~ ~~employee notification~~. 1. Within five working days after the receipt of blood lead test~~biological monitoring~~ results, the employer shall notify each employee in writing:

1. ~~Of that employee's~~ ~~his or her~~ blood lead level; and

2. That the standard requires the employer to make medical examinations and consultations available to employees exposed at or above the action level, and as interim protection, to employees performing trigger tasks, unless an employee's exposure or work is covered by the exceptions in 1532.1(j)(1)(B). When they are required, the employer must make medical examinations and consultations available as soon as possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or past exposure to lead on the employee's ability to procreate a healthy child, or that the employee has demonstrated difficulty breathing during a respirator fit test or during use; and

~~32. The employer shall notify each employee whose blood lead level is at or above 40 µg/dl t~~ That the standard requires temporary medical removal with Medical Removal Protection benefits when an employee's blood lead level is at or above 30 µg/dl, the last two monthly blood lead levels are at or above 20 µg/dl, or the average of the results of all blood lead tests conducted in the last 6 months is at or above 20 µg/dl, as provided for in ~~is at or above the numerical criterion for medical removal under subsection (k)(1)(A).~~

(D) Physician's notification to the employee. The employer shall ensure that the physician who orders the blood test explains the findings of the blood lead test and notifies the employee of the following:

1. The results of the blood lead test;

2. Any recommended follow-up blood lead testing in accordance with subsection (j)(2)(A) and the timing of that recommended blood lead testing; and

3. If the employee's blood lead level is 20 µg/dl or greater, the recommendation that the employee undergo a medical examination by a physician if the employee has not had a lead-specific medical exam in the preceding 12 months.

(E) Elevated blood lead level response.

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1. Whenever an employee has a blood lead level at or above 10 µg/dl, the employer shall establish and implement a written elevated blood lead level response plan for that employee which describes specific means that will be used to reduce and maintain the employee's blood lead level below 10 µg/dl.

2. Training and instruction shall be provided as needed for an employee who has a blood lead level at or above 10 µg/dl, to correct any employee work practices identified in the elevated blood lead level response plan established for that employee under subsection (j)(2)(E)1.

(3) Medical examinations and consultations.

(A) Frequency. The employer shall make available medical examinations and consultations to each employee covered under subsection (j)(1)(B) on the following schedule:

1. As soon as possible for each employee for whom a blood lead test result of 20 µg/dl or greater is received, if no lead-specific medical examination was done for that employee in the preceding 12 months, and aAt least annually thereafter until the employee's blood lead level is belowfor each employee for whom a blood sampling test conducted at any time during the preceding 12 months indicated a blood lead level at or above 2040 µg/dl;

2. Prior to assignment for each employee covered by subsection (j)(1)(B);

3. As soon as possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or past exposure to lead on the employee's ability to procreate a healthy child, that the employee is pregnant, or that the employee has demonstrated difficulty in breathing during a respirator fitting-test or during use; and

34. As soon as possible, and then as medically appropriate, for each employee either removed from exposure to lead due to elevated blood lead levels in compliance with the provisions of subsection (k)(1)(A) a risk of sustaining material impairment to health, or whose exposure to lead is otherwise limited pursuant to a final medical determination in compliance with the provisions of subsection (k)(1)(B).

(B) Content. The content of medical examinations made available pursuant to subsection (j)(3)(A)2.—3. shall be determined by an examining physician and, if requested by an employee, shall include pregnancy testing or laboratory evaluation of male fertility. Medical examinations made available pursuant to subsection (j)(3)(A)1. shall include the following elements:

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1. A detailed work history and a medical history, with particular attention to past lead exposure (occupational and non-occupational), personal habits (smoking, hygiene), and past gastrointestinal, hematologic, renal, cardiovascular, reproductive and neurological problems;
  2. A thorough physical examination, with particular attention to teeth, gums, hematologic, gastrointestinal, renal, cardiovascular, and neurological systems. If requested by an employee, pregnancy testing or laboratory evaluation of male fertility shall be included. Pulmonary status should be evaluated if respiratory protection will be used;
  3. A blood pressure measurement;
  4. A blood sample and analysis which determines:
    - a. Blood lead level;
    - b. Hemoglobin and hematocrit determinations, red cell indices, and examination of peripheral smear morphology;
    - c. Zinc protoporphyrin for each employee whose last blood lead level was at or above 20 µg/dl;
    - d. Blood urea nitrogen; and,
    - e. Serum creatinine;
  5. A routine urinalysis with microscopic examination; and
  6. Any laboratory or other test relevant to lead exposure which the examining physician deems necessary by sound medical practice.
- (C) Multiple physician review mechanism.
1. If the employer selects the initial physician who conducts any medical examination or consultation provided to an employee under this section, the employee may designate a second physician:
    - a. To review any findings, determinations or recommendations of the initial physician; and
    - b. To conduct such examinations, consultations, and laboratory tests as the second physician deems necessary to facilitate this review.

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2. The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician conducts a medical examination or consultation pursuant to this section. The employer may condition its participation in, and payment for, the multiple physician review mechanism upon the employee doing the following within fifteen (15) days after receipt of the foregoing notification, or receipt of the initial physician's written opinion, whichever is later:

- a. The employee informing the employer that he or she intends to seek a second medical opinion, and
- b. The employee initiating steps to make an appointment with a second physician.

3. If the findings, determinations or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall ~~assure~~ensure that efforts are made for the two physicians to resolve any disagreement.

4. If the two physicians have been unable to quickly resolve their disagreement, then the employer and the employee through their respective physicians shall designate a third physician:

- a. To review any findings, determinations or recommendations of the prior physicians; and
- b. To conduct such examinations, consultations, laboratory tests and discussions with the prior physicians as the third physician deems necessary to resolve the disagreement of the prior physicians.

5. The employer shall act consistent with the findings, determinations and recommendations of the third physician, unless the employer and the employee reach an agreement which is otherwise consistent with the recommendations of at least one of the three physicians.

(D) Information provided to examining and consulting physicians.

1. The employer shall provide an initial physician conducting a medical examination or consultation under this section with the following information:

- a. A copy of this regulation for lead including all Appendices;
- b. A description of the affected employee's duties as they relate to the employee's exposure;
- c. The employee's exposure level or anticipated exposure level to lead and to any other toxic substance (if applicable);
- d. A description of any personal protective equipment used or to be used;

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e. Prior blood lead test results~~determinations~~; and

f. All prior written medical opinions concerning the employee in the employer's possession or control;  
and:-

g. A copy of the written elevated blood lead level response plan for that employee as required by subsection (j)(2)(E)1.

2. The employer shall provide the foregoing information to a second or third physician conducting a medical examination or consultation under this section upon request either by the second or third physician, or by the employee.

(E) ~~Written medical opinions~~ Physician's written medical report for the employee.

~~1. The employer shall obtain and furnish the employee with a copy of a written medical opinion from each examining or consulting physician which contains only the following information:~~

~~a. The physician's opinion as to whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to lead;~~

~~b. Any recommended special protective measures to be provided to the employee, or limitations to be placed upon the employee's exposure to lead;~~

~~c. Any recommended limitations upon the employee's use of respirators, including a determination of whether the employee can wear a powered air purifying respirator if an physician determines that the employee cannot wear a negative pressure respirator; and~~

~~d. The results of the blood lead determinations.~~

~~2. The employer shall instruct each examining and consulting physician to:~~

~~a. Not reveal either in the written opinion or orally, or in any other means of communication with the employer, findings, including laboratory results, or diagnoses unrelated to an employee's occupational exposure to lead; and~~

~~b. Advise the employee of any medical condition, occupational or nonoccupational, which dictates further medical examination or treatment.~~

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The employer shall ensure that the physician explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of each medical examination performed. The written report shall contain:

1. The physician's opinion as to whether the employee has any detected health-related condition that would place the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead;
2. Any recommended special protective measures to be provided to the employee, or recommended limitations to be placed upon the employee's exposure to lead;
3. Any recommended limitations upon the employee's use of respirators, including a determination of whether the employee should wear a powered air-purifying respirator instead of a non-powered air-purifying respirator;
4. The employee's blood lead test results;
5. Any recommended follow-up blood lead testing and medical examinations and the timing of each; and
6. The physician's opinion as to whether the employee has any health-related condition, occupational or non-occupational, that dictates further medical examination or treatment.

(F) Physician's written medical opinion for the employer.

1. The employer shall obtain a written medical opinion from the examining physician within 30 days of the medical examination. The written opinion shall contain the following information:
  - a. The physician's opinion as to whether the employee has any detected health-related condition that would place the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead;
  - b. Any recommended special protective measures to be provided to the employee, or limitations to be placed upon the employee's exposure to lead;
  - c. Any recommended limitation upon the employee's use of respirators, including a determination of whether the employee can wear a powered air-purifying respirator if the physician determines that the employee cannot wear a negative pressure respirator; and
  - d. The employee's blood lead test results.



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2. The employer shall instruct the examining physician to not reveal either in the written opinion to the employer, or in any other means of communication with the employer, findings, including laboratory results, or diagnoses unrelated to the employee's occupational exposure to lead.

3. The employer shall ensure that the employee receives a copy of the physician's written medical opinion described in subsection (j)(3)(F)1. within 30 days of each medical examination performed.

(F) Alternate physician determination mechanisms. The employer and an employee or authorized employee representative may agree upon the use of any alternate physician determination mechanism in lieu of the multiple physician review mechanism provided by subsection (j)(3)(C) so long as the alternate mechanism is as expeditious and protective as the requirements contained in this subsection.

(4) Chelation.

(A) The employer shall ~~assure~~ensure that any person whom ~~the employer he/she~~ retains, employs, supervises or controls does not engage in prophylactic chelation of any employee at any time.

(B) If therapeutic or diagnostic chelation is to be performed by any person in subsection (j)(4)(A), the employer shall ~~assure~~ensure that it be done under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical monitoring and that the employee is notified in writing prior to its occurrence.

(k) Medical removal protection.

(1) Temporary medical removal and return of an employee.

(A) Temporary removal due to elevated blood lead level. The employer shall remove an employee from work having an exposure to lead at or above the action level, involving a trigger task as described in subsection (d)(2) and an exposure assessment as required in subsection (d) has not been completed, or altering or disturbing any material containing lead at a concentration equal to or greater than 0.5% by weight, on each occasion that:

1. The last a periodic and a follow-up blood lead sampling test conducted pursuant to this section indicates that the employee's blood lead level is at or above 3050 µg/dl;

2. Effective [OAL insert 1 year from effective date here], the last two blood lead test results are at or above 20 µg/dl; ~~or and,~~

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3. Effective [OAL insert 1 year from effective date here], the average of the results of all blood lead tests conducted in the last 6 months is at or above 20 µg/dl.

(B) Temporary removal due to a final medical determination.

1. The employer shall remove an employee from work having an exposure to lead at or above the action level, involving a trigger task as described in subsection (d)(2) and an exposure assessment as required in subsection (d) has not been completed, or altering or disturbing any material containing lead at a concentration equal to or greater than 0.5% by weight, on each occasion that a final medical determination results in a medical finding, determination, or opinion that the employee has a detected health-related medical condition which places the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment ~~to health~~ from exposure to lead.

2. For the purposes of this section, the phrase "final medical determination" means the written medical opinion on the employee's health status by the examining physician or, where relevant, the outcome of the multiple physician review mechanism or alternate medical determination mechanism used pursuant to the medical surveillance provisions of this section.

3. Where a final medical determination results in any recommended special protective measures for an employee, or limitations on an employee's exposure to lead, the employer shall implement and act consistent with the recommendation.

(C) Return of the employee to former job status.

1. The employer shall return an employee to his or her former job status:

a. For an employee removed under the provisions of subsection (k)(1)(A), due to a blood lead level at or above 50 µg/dl when two consecutive blood lead sampling tests, taken at least 30 days apart, both indicate that the employee's blood lead level is below 15 µg/dl; and

b. For an employee removed due to a final medical determination, when a subsequent final medical determination results in a medical finding, determination, or opinion that the employee no longer has a detected health-related medical condition which places the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment ~~to health~~ from exposure to lead.

2. For the purposes of this section, the requirement that an employer return an employee to his or her former job status is not intended to expand upon or restrict any rights an employee has or would have had, absent temporary medical removal, to a specific job classification or position under the terms of a collective bargaining agreement.

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(D) Removal of other employee special protective measure or limitations. The employer shall remove any limitations placed on an employee or end any special protective measures provided to an employee pursuant to a final medical determination when a subsequent final medical determination indicates that the limitations or special protective measures are no longer necessary.

(E) Employer options pending a final medical determination. Where the multiple physician review mechanism, or alternate physician medical determination mechanism used pursuant to the medical surveillance provisions of this section, has not yet resulted in a final medical determination with respect to an employee, the employer shall act as follows:

1. Removal. The employer may remove the employee from exposure to lead, provide special protective measures to the employee, or place limitations upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status.

2. Return. The employer may return the employee to his or her former job status, end any special protective measures provided to the employee, and remove any limitations placed upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status, ~~with two exceptions. If:~~

EXCEPTION 1: ~~a. If the initial removal, special protection, or limitation of the employee resulted from a final medical determination which differed from the findings, determinations, or recommendations of the initial physician; or;~~

EXCEPTION 2: ~~b. If the employee has been on removal status for the preceding eighteen months due to an elevated blood lead level, then the employer shall await a final medical determination.~~

(2) Medical removal protection benefits.

(A) Provision of medical removal protection benefits. The employer shall provide an employee up to eighteen (18) months of medical removal protection benefits on each occasion that an employee is removed from exposure to lead or otherwise limited pursuant to this section.

(B) Definition of medical removal protection benefits. For the purposes of this section, the requirement that an employer provide medical removal protection benefits means that, as long as the job the employee was removed from continues, the employer shall maintain the total normal earnings, seniority and other employment rights and benefits of an employee, including the employee's right to his or her former job status as though the employee had not been medically removed from the employee's job or otherwise medically limited.

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(C) Follow-up medical surveillance during the period of employee removal or limitation. During the period of time that an employee is medically removed from his or her job or otherwise medically limited, the employer may condition the provision of medical removal protection benefits upon the employee's participation in follow-up medical surveillance made available pursuant to this section.

(D) Workers' compensation claims. If a removed employee files a claim for workers' compensation payments for a lead-related disability, then the employer shall continue to provide medical removal protection benefits pending disposition of the claim. To the extent that an award is made to the employee for earnings lost during the period of removal, the employer's medical removal protection obligation shall be reduced by such amount. The employer shall receive no credit for workers' compensation payments received by the employee for treatment-related expenses.

(E) Other credits. The employer's obligation to provide medical removal protection benefits to a removed employee shall be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer-funded compensation program, or receives income from employment with another employer made possible by virtue of the employee's removal.

(F) Voluntary removal or restriction of an employee. Where an employer, although not required by this section to do so, removes an employee from exposure to lead or otherwise places limitations on an employee due to the effects of lead exposure on the employee's ~~medical~~ health-related condition, the employer shall provide medical removal protection benefits to the employee equal to ~~that~~ those required by subsection (k)(2)(A) and (B).

(I) Communication of hazards.

(1) General.

(A) Hazard communication. The employer shall include lead in the program established to comply with the Hazard Communication Standard (HCS) (~~s~~Section 5194). The employer shall ensure that each employee has access to labels on containers of lead and safety data sheets, and is trained in accordance with the provisions of HCS and subsection (I) of this section. The employer shall ensure that at least the following hazards are addressed:

1. Cardiovascular effects;

2~~1~~. Reproductive/developmental toxicity;

3~~2~~. Central nervous system effects;

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43. Kidney effects;

54. Blood effects; and

65. Acute toxicity effects.

~~(B) For all employees who are subject to exposure to lead at or above the action level on any day or who are subject to exposure to lead compounds which may cause skin or eye irritation (e.g. lead arsenate, lead azide),~~ The employer shall provide a training program in accordance with subsection (I)(2) and ~~assure~~ensure employee participation;

1. For employees who are exposed to lead at or above the action level on any day;

2. For employees who are exposed to lead that may cause skin or eye irritation (e.g. lead arsenate, lead azide); or

3. As interim protection, for employees who perform trigger tasks described in subsection (d)(2).

~~(C) The employer shall ensure that the training, and any training materials used, is appropriate to the educational level, literacy level, and language of employees. The employer shall provide the training program as initial training prior to the time of job assignment or prior to the start up date for this requirement, whichever comes last.~~

~~(D) The employer shall also provide the training program at least annually for each employee who is subject to lead exposure at or above the action level on any day. For each employee covered by subsection (I)(1)(B), the employer shall provide initial training covering all content in subsection (I)(2) prior to the time of initial job assignment, and at least annually thereafter.~~

~~(E) Where the certification of employee and supervisor training is required, as described in subsection (I)(3), the training shall be conducted by a training provider accredited by the California Department of Public Health Services, in accordance with Title 17, California Code of Regulations, Division 1, Chapter 8.~~

(2) Training program.

The employer shall ~~assure~~ensure that effective training on the following topics is provided for each employee covered by subsection (I)(1)(B)~~is trained in the following:~~

(A) The content of this standard and its appendices;

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(B) The specific nature of the operations which could result in exposure to lead at or above the action level;

(C) The importance of effective hygiene practices, including hand washing, and when required, showering, and how to effectively remove lead contamination from skin surfaces with the proper use of special cleansing compounds designed specifically for this purpose, in accordance with section 1527(a)(2);

(DE) The purpose, proper selection, fitting, use, and limitations of respirators;

(ED) The purpose and a description of the medical surveillance program, and the medical removal protection program;

(F) including information concerning the adverse health effects of associated with excessive exposure to lead (with particular attention to the adverse reproductive cardiovascular effects on both males and females and hazards to the fetus and additional precautions for employees who are pregnant), including low-level chronic exposure;

(G) The damage to both male and female reproductive health caused by low-level lead exposure, including damage associated with blood lead levels under 5 µg/dl;

(H) The employer's duty, as required by subsection (j)(3)(A), to make medical examinations and consultations available to each employee who notifies the employer that they desire medical advice concerning their ability to procreate a healthy child, when the employee is exposed at or above the action level, and as interim protection, to an employee who performs trigger tasks, unless the employee's exposure or work is covered by the exceptions in subsection (j)(1)(B);

(I) The routes of exposure to lead, including inhalation of airborne lead and ingestion of lead from contaminated hands and other surfaces;

(J) The possibility that lead contamination brought into personal vehicles or the home on an employee's clothes, shoes, and body will endanger the health of household members, especially that of young children and pregnant women;

(K) The recommendation to shower immediately upon returning home from work to minimize take-home lead exposure;

NOTE: When employees are exposed above the PEL, or perform level 3 trigger tasks listed in subsection (d)(2)(D), the employer must provide shower facilities and ensure that employees shower at the end of the work shift, in accordance with subsection (i)(3).

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(~~LE~~) The engineering controls and work practices associated with the employee's job assignment, and including training in of employees to following applicable relevant good work practices described in Appendix B of this section;

(~~MF~~) The contents of any compliance plan and the location of regulated areas in effect;

(~~NG~~) Instructions ~~to employees~~ that chelating agents should not routinely be used to remove lead from ~~their bodies~~ the body and should not be used at all except under the direction of a licensed physician; and

(~~QH~~) The employee's right of access to their exposure and medical records under section 3204.

(3) Certification of training for residential and public buildings.

The employer shall ensure that all employees and supervisors who are engaged in lead-related construction work as defined in Title 17, California Code of Regulations, ~~s~~Section 35040, and have been shown to be exposed to lead at or above ~~the permissible exposure limit~~ 50 µg/m<sup>3</sup> as an 8-hour TWA, meet the training requirements of this section, are trained by an accredited training provider and are certified by the California Department of Public Health (CDPH) Services. Lead-related construction work is defined in Title 17 to be any construction, alteration, painting, demolition, salvage, renovation, repair, or maintenance of any residential or public building, including preparation and cleanup, that, by using or disturbing lead containing material or soil, may result in significant exposure of adults or children to lead. As used in the definition of lead-related construction work, "public building" means a structure which is generally accessible to the public, including but not limited to, schools, daycare centers, museums, airports, hospitals, stores, convention centers, government facilities, office buildings and any other building which is not an industrial building or a residential building. Regulations for accreditation of training providers and for the certification of employees and supervisors are found in Title 17, California Code of Regulations, Division 1, Chapter 8.

(4) Access to information, training and certification materials.

(A) The employer shall make readily available to all affected employees a copy of this standard and its appendices.

(B) The employer shall provide, upon request, all materials relating to the employee information training program and certification to affected employees, their designated representatives, the Chief and NIOSH.

(m) Signs.

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(1) General.

(A) The employer shall post the following warning signs in each regulated area, and in each ~~or~~ work area where an employee's exposure to lead is at or above the action level ~~PEL~~:

DANGER  
LEAD WORK AREA  
MAY DAMAGE FERTILITY OR THE UNBORN CHILD  
CAUSES DAMAGE TO THE CENTRAL NERVOUS SYSTEM  
DO NOT EAT, DRINK OR SMOKE IN THIS AREA

(B) The employer shall ensure that no statement appears on or near any sign required by this subsection (m) that contradicts or detracts from the meaning of the required sign.

(C) The employer shall ensure that signs required by this subsection (m) are illuminated and cleaned as necessary so that the legend is readily visible.

(D) The employer may use signs required by other statutes, regulations or ordinances in addition to, or in combination with, signs required by this subsection (m).

~~(E) Prior to June 1, 2016, employers may use the following legend in lieu of that specified in subsection (m)(1)(A) of this section:~~

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

(n) Recordkeeping.

(1) Exposure assessment.

(A) The employer shall establish and maintain an accurate record of all monitoring and other data used in conducting employee exposure assessments as required in subsection (d).

(B) Exposure monitoring records shall include:

1. The date(s), number, duration, location and results of each of the samples taken if any, including a description of the sampling procedure used to determine representative employee exposure where applicable;



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2. A description of the sampling and analytical methods used and evidence of their accuracy;
3. The type of respiratory protective devices worn, if any;
4. The name, another unique identifier (such as date of birth or employee identification number or social security number), and job classification of the employee monitored and of all other employees whose exposure the measurement is intended to represent; and
5. The work operations performed by the monitored employees and the workplace conditions under which they were performed, including the processes, types of material, control methods, and work practices used, as well as the environmental conditions prevailing during the monitored operations  
environmental variables that could affect the measurement of employee exposure.

(C) The employer shall maintain monitoring and other exposure assessment records in accordance with the provisions of section 3204.

(2) Written compliance program review.

Records of the semi-annual revision and update of the employer's written compliance program, required under subsection (e)(2)(A), shall include the name of the person(s) who reviewed the program, the date the review was completed, and a summary of the revisions and updates to the program. The records shall be retained for three years.

(23) Medical surveillance.

(A) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by subsection (j).

(B) This record shall include:

1. The name, another unique identifier (such as date of birth or employee identification number or social security number), and description of the duties of the employee;
2. A copy of the physician's written opinions;
3. Results of any airborne exposure monitoring done on or for that employee and provided to the physician; and
4. Any employee medical complaints related to exposure to lead.

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(C) The employer shall keep, or ~~assure~~ensure that the examining physician keeps, the following medical records:

1. A copy of the medical examination results including medical and work history required under subsection (j);
2. A description of the laboratory procedures and a copy of any standards or guidelines used to interpret the test results or references to that information;
3. A copy of the results of blood lead testing~~biological monitoring~~.

(D) The employer shall maintain or ~~assure~~ensure that the physician maintains medical records in accordance with the provisions of section 3204.

(4) Written elevated blood lead level response plans.

Written elevated blood lead level response plans, required under subsection (j)(2)(E), shall be retained for three years.

~~(35)~~ Medical removals.

(A) The employer shall establish and maintain an accurate record for each employee removed from current exposure to lead pursuant to subsection (k).

(B) Each record shall include:

1. The name and another unique identifier (such as date of birth or employee identification number~~social security number)~~ of the employee;
2. The date of each occasion that the employee was removed from current exposure to lead as well as the corresponding date on which the employee was returned to his or her former job status;
3. A brief explanation of how each removal was or is being accomplished; and
4. A statement with respect to each removal indicating whether or not the reason for the removal was an elevated blood lead level.

(C) The employer shall maintain each medical removal record for at least the duration of an employee's employment.

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(6) Training.

(A) After conducting any training required by this section, the employer shall prepare a record that indicates the name and job classification of each employee trained, the date of the training, the name of the person(s) who conducted the training, and the topic(s) of the training.

(B) Training records shall be maintained for three years.

(47) “Objective data for exemption from requirement for initial monitoring”.

(A) For purposes of this section, objective data are information demonstrating that a particular product or material containing lead or a specific process, operation, or activity involving lead cannot release dust or fumes in concentrations at or above the action level under any expected conditions of use. Objective data can be obtained from any industry-wide study or from laboratory product test results from manufacturers of lead containing products, including surface coatings or other materials. The data the employer uses from an industry-wide survey must be obtained under workplace conditions closely resembling the processes, types of material, control methods, work practices and environmental conditions in the employer's current operations.

(B) The employer shall maintain the record of the objective data relied upon for at least 30 years.

~~(58)~~ Availability. The employer shall make available upon request all records required to be maintained by subsection (n) to affected employees, former employees, and their designated representatives, and to the Chief and NIOSH for examination and copying.

~~(69)~~ Transfer of records.

(A) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by subsection (n).

(B) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records required to be maintained by this section for the prescribed period, these records shall be transmitted to NIOSH.

(C) At the expiration of the retention period for the records required to be maintained by this section, the employer shall notify NIOSH at least 3 months prior to the disposal of such records and shall transmit those records to NIOSH if requested within the period.

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(D) The employer shall also comply with any additional requirements involving transfer of records set forth in section 3204(h).

(o) Observation of monitoring.

(1) Employee observation. The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to lead conducted pursuant to subsection (d).

(2) Observation procedures.

(A) Whenever observation of the monitoring of employee exposure to lead requires entry into an area where the use of respirators, protective clothing or equipment is required, the employer shall provide the observer with and ~~assure~~ensure the use of such respirators, clothing and equipment, and shall require the observer to comply with all other applicable safety and health procedures.

(B) Without interfering with the monitoring, observers shall be entitled to:

1. Receive an explanation of the measurement procedures;
2. Observe all steps related to the monitoring of lead performed at the place of exposure; and
3. Record the results obtained or receive copies of the results when returned by the laboratory.

(p) ~~Lead-Work Pre-Job N~~otification. The employer shall provide written notification to the nearest Division District Office in the manner prescribed by subsections (p)(1) through (p)(4) when work is planned that includes any of the tasks listed in subsection (d)(2).

EXCEPTION NO. 1: The employer is not required to notify the Division if:

- A. The amount of lead-containing materials to be disturbed is less than 100 square or 100 linear feet; or
- B. The only subsection (d)(2) task to be performed consists of torch cutting or welding, not to exceed a duration of 1 hour in any shift.

EXCEPTION NO. 2: The employer is not required to notify the Division if the percentage of lead in the material disturbed is less than 0.5%, 5,000 parts per million (weight by weight), or 1.0 mg/cm<sup>2</sup>.

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(1) The employer shall ensure that the information required by subsection (p)(2) is received by the nearest Division District Office at least 24 hours prior to the commencement of the work by any of the following means:

- (A) Letter;
- (B) Facsimile;
- (C) Electronic mail; or
- (D) Telephone call, followed by written notification sent or mailed within 24 hours of placing the call.

EXCEPTION: When an employer intends to initiate unforeseen lead-work on an urgent basis within 24 hours, the notification requirement may be met by giving telephone notice to the Division at any time prior to commencement of the work, followed by written notification sent or mailed within 24 hours of telephoning the Division.

(2) The written notification provided by the employer shall contain the following:

- (A) The name, address and phone number of the employer;
- (B) The address of the job (or common name of the site with closest streets or roadways identified);
- (C) The precise physical location of the lead related work at the job site;
- (D) The projected starting date;
- (E) The expected completion date or approximate duration of the work in days;
- (F) The approximate number of workers planned to do the lead-related work;
- (G) The type of structure(s) in which or on which the work is to be performed;
- (H) The amount of lead containing material to be disturbed in square feet or linear feet;
- (I) A description of the type of lead-related work to be performed and work practices that will be utilized;
- (J) The name of the supervisor who will be responsible for the lead-related work; and

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(K) The amount of lead in the disturbed materials (percent by weight, parts per million or milligrams per square centimeter) if known.

(3) The employer shall notify the Division, and provide the current information, if changes are made to the starting date, the surface area to be disturbed, or the type of lead-related work performed or work practices to be utilized, before or upon adoption of that change.

(4) An employer conducting ongoing, lead-related operations and maintenance work on stationary steel structures need only notify the Division once for each structure if the duration of the operations and maintenance work is less than one year. If the duration of the work is more than one year, the employer shall submit to the Division at least once per year a supplemental written notification updating all of the information required by subsection (p)(2) for each structure.

(q) Appendices. The information contained in the appendices to this section is not intended by itself, to create any additional obligations not otherwise imposed by this standard nor detract from any existing obligation.

NOTE: Authority cited: Sections 142.3 and 6717, Labor Code. Reference: Sections 142.3 and 6717, Labor Code.

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Appendix A to ~~§~~Section 1532.1 – Substance Data Sheet for Occupational Exposure to Lead

This appendix is a substance data sheet for occupational exposure to lead in construction. It includes information about how exposure to lead can affect your health.

I. Substance Identification

A. Substance: Pure lead (Pb) is a heavy metal at room temperature and pressure and is a basic chemical element. It can combine with various other substances to form numerous lead compounds.

B. Compounds covered by the standard: The word “lead” when used in this standard means elemental lead, all inorganic lead compounds and a class of organic lead compounds called lead soaps. This standard does not apply to other organic lead compounds.

C. Uses: Exposure to lead occurs in several different occupations in the construction industry, including demolition or salvage of structures where lead or lead-containing materials are present; removal or encapsulation of lead-containing materials; ~~;~~ new construction, alteration, repair, or renovation of structures that contain lead or materials containing lead; and installation of products containing lead. In addition, there are construction-related activities where exposure to lead may occur, including transportation, disposal, storage, or containment of lead or materials containing lead on construction sites, and maintenance operations associated with construction activities.

D. Permissible exposure: The permissible exposure limit (PEL) set by the standard is ~~50~~10 micrograms of lead per cubic meter of air (~~50~~10  $\mu\text{g}/\text{m}^3$ ) ~~averaged over~~calculated as an 8-hour workday time-weighted average (TWA).

As an exception, until [OAL insert five years from effective date here], no employee conducting abrasive blasting shall be exposed to lead at concentrations greater than 25  $\mu\text{g}/\text{m}^3$ , calculated as an 8-hour TWA.

E. Action level: The standard establishes an action level of ~~302~~302 micrograms of lead per cubic meter of air (~~302~~302  $\mu\text{g}/\text{m}^3$ ) ~~averaged over~~calculated as an 8-hour workday TWA. The action level refers to employee exposure, without regard to the use of respirators. The action level triggers several ancillary additional provisions of the standard such as exposure monitoring, medical surveillance, and training, and signs.

II. Health Hazard Data

A. Ways in which lead enters your body. When absorbed into your body ~~in certain doses~~, lead is a toxic substance. The object of the lead standard is to prevent absorption of harmful quantities of lead. The standard is intended to protect you not only from the immediate toxic effects of lead, but also from the serious toxic effects that may not become apparent until years of exposure have passed. Lead can be absorbed into your body by inhalation (breathing) and ingestion (eating). Lead (except for certain organic lead compounds not covered by the standard, such as tetraethyl lead) is not significantly absorbed through your skin. When lead is scattered in the air as a dust, fume or mist it can be inhaled

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and absorbed through your lungs and upper respiratory tract. Inhalation of airborne lead is generally the most important source of occupational lead absorption. You can also absorb lead through your digestive system if lead gets into your mouth and is swallowed. If you handle food, beverages, cigarettes, chewing tobacco, or make-up which have lead on them or handle them with hands contaminated with lead, this will contribute to ingestion. A significant portion of the lead that you inhale or ingest gets into your blood-stream. Once in your blood-stream, lead is circulated throughout your body and stored in various organs and body tissues. Some of this lead is quickly filtered out of your body and excreted, but some remains in the blood and other tissues. As exposure to lead continues, the amount stored in your body will increase if you are absorbing more lead than your body is excreting. Even though you may not be aware of any immediate symptoms of disease, this lead stored in your tissues can be slowly causing irreversible damage, first to individual cells, then to your organs and whole body systems.

**B. Effects of overexposure to lead.**

(1) Short-term (acute) overexposure. Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise which develops quickly to seizures, coma, and death from cardiorespiratory/pulmonary arrest. A very high, short-term dose of lead can lead to acute encephalopathy. Short-term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. The most severe, often fatal, form of encephalopathy may be preceded by vomiting, a feeling of dullness progressing to drowsiness and stupor, poor memory, restlessness, irritability, tremor, and convulsions.

There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects which take longer to acquire/develop. Lead adversely affects numerous body systems, and causes forms of health impairment and disease which arise after periods of exposure as short as days or as long as several years. For example, short-term reproductive effects may include miscarriage and reduced birth weight of children exposed to lead during pregnancy. Both high and lower level lead exposures have been associated with these outcomes. Sperm abnormalities may develop at relatively high blood lead levels (at or above 20 micrograms of lead per deciliter of whole blood (µg/dl)).

(2) Long-term (chronic) overexposure. Chronic overexposure to lead may result in severe damage to your cardiovascular, blood-forming, nervous, urinary and reproductive systems. Damage to multiple organs may occur at blood lead levels previously thought to be without recognized harm. At higher lead levels, ~~Some common~~ symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and lead colic. In lead colic there may be severe abdominal pain. Some people may not experience any symptoms even though lead is causing toxic effects in their bodies. It is important to note that permanent damage may occur even in the absence of symptoms.



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Cardiovascular system (heart and blood circulation). Long-term, low dose lead exposures may result in high blood pressure. Since high blood pressure is a significant risk factor for heart disease, stroke, and kidney (renal) disease, lead exposure may exert an important influence on death related to the effects on the heart, brain, and kidneys.

Neurologic system (brain and nervous system). Nervous system dysfunction, including declines in brain (cognitive) function and slowing of nerve conduction velocity, may occur at long-term, low blood lead levels.

High-dose exposures may ~~Damage~~ damage to the central nervous system in general and the brain (encephalopathy) in particular is in one of the most severe forms of lead poisoning. ~~The most severe, often fatal, form of encephalopathy may be preceded by vomiting, a feeling of dullness progressing to drowsiness and stupor, poor memory, restlessness, irritability, tremor, and convulsions. It may arise suddenly with the onset of seizures, followed by coma, and death.~~ There is a tendency for muscular weakness to develop at the same time. This weakness may progress to paralysis often observed as a characteristic “wrist drop” or “foot drop” and is a manifestation of a disease to the nervous system called peripheral neuropathy.

Renal system (kidneys). ~~Chronic overexposure to lead also results in kidney disease with few, if any, symptoms appearing until extensive and most likely permanent kidney damage has occurred.~~ Decreases in kidney function can start at low levels of exposure to lead. With higher levels of lead exposure, kidney disease may progress with few, if any, symptoms appearing until extensive and most likely permanent kidney damage has occurred. Routine laboratory tests reveal the presence of this kidney disease only after about two-thirds of kidney function is lost. When overt symptoms of urinary dysfunction arise, it is often too late to correct or prevent worsening conditions, and progression to kidney dialysis or death is possible.

Reproductive system. Chronic overexposure to lead impairs the reproductive systems of both ~~men~~women and ~~women~~men. ~~Overexposure to lead may result in decreased sex drive, impotence and sterility in men. Lead can alter the structure of sperm cells raising the risk of birth defects. There is evidence of miscarriage and stillbirth in women whose husbands were exposed to lead or who were exposed to lead themselves. Lead exposure also may result in decreased fertility, and abnormal menstrual cycles in women.~~ The course of pregnancy may be adversely affected by exposure to lead since lead crosses the placental barrier and poses risks to developing fetuses. Reduced birth weight of children exposed to lead during pregnancy has been documented with low-level chronic lead exposures. Children born of parents either one of whom were exposed to excess lead levels are more likely to have birth defects, mental retardation, behavioral disorders or die during the first year of childhood. Lead exposure also may result in decreased fertility and abnormal menstrual cycles in women.

Overexposure to lead may result in decreased sex drive, impotence, and sterility in men. Lead can alter the structure of sperm cells raising the risk of birth defects. There is evidence of miscarriage and stillbirth in women whose husbands were exposed to lead or who were exposed to lead themselves.

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Blood-forming system. Overexposure to lead also disrupts the blood-forming system resulting in decreased hemoglobin (the substance in the blood that carries oxygen to the cells) and ultimately anemia. Anemia is characterized by weakness, pallor and ~~fatigability~~ fatigue as a result of decreased oxygen-carrying capacity in the blood.

(3) Health protection goals of the standard. Prevention of ~~adverse health damage~~ effects for most ~~worker~~ employees from exposure to lead throughout a working lifetime requires that an ~~worker's~~ employee's blood lead level (BLL, ~~also expressed as PbB~~) be maintained ~~at or below forty~~ as low as possible. The ~~blood lead levels~~ BLL of ~~female~~ female ~~worker~~ employees (both male and female workers) who intend to have children should be maintained below ~~305~~ 40 µg/dl to minimize adverse reproductive health effects to the ~~parents~~ mother and to the developing fetus.

The measurement of your ~~blood lead level (BLL)~~ is the most useful indicator of the amount of lead being absorbed by your body. ~~Blood lead levels are most often reported in units of milligrams (mg) or micrograms (µg) of lead (1 mg=1000µg) per 100 grams (100g), 100 milliliters (100 ml) or deciliter (dl) of blood. These three units are essentially the same. Sometimes BLLs are expressed in the form of mg% or µg%. This is a shorthand notation for 100g, 100 ml, or dl. (Reference to BLL measurements in this standard are expressed in the form of µg/dl.)~~

~~BLL measurements show the amount of lead circulating in your blood stream, but do not give any information about the amount of lead stored in your various tissues. BLL measurements merely show current absorption of lead, not the effect that lead is having on your body or the effects that past lead exposure may have already caused. Your BLL is a measure of the amount of lead in your blood. This reflects both recent exposure as well as how much lead is stored in your bones. Past research into lead-related diseases, however, has focused heavily on associations between BLLs and various diseases. As a result, your BLLs over time provide is an important indicator of the likelihood that you will gradually acquire/develop a lead-related health impairment or disease.~~

~~Once your blood lead level climbs about 40µg/dl As your BLL increases, your risk of disease increases. There is a wide variability of individual response to lead, thus, it is difficult to say that a particular BLL in a given person will cause a particular effect. Health damage has been found at chronic BLLs of 5 µg/dl and greater, including high blood pressure, reduced birth weight, essential tremor, and kidney dysfunction. At the other extreme, Sstudies have associated fatal encephalopathy with BLLs as low as of 150 µg/dl, but encephalopathy may occur at BLLs of 80 µg/dl. Other studies have shown other forms of diseases in some workers with BLLs well below 80 µg/dl.~~

Your BLL is a crucial indicator of the risks to your health, but one other factor is also extremely important. This factor is the length of time you have had elevated BLLs. The longer you have an elevated BLL, the greater the risk that large quantities of lead are being gradually stored in your organs and tissues (body burden). The greater your overall body burden, the greater the chances of substantial permanent damage.

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The best way to prevent all forms of lead-related health impairments and diseases —(both short-term and long-term)— is to maintain your BLL ~~below 40 µg/dl~~ as low as possible. The ~~provisions of the standard are designed with this end in mind to detect BLL increases early and take action to control exposures.~~

Your employer has prime responsibility to ~~assure~~ensure that the provisions of the standard are complied with both by the company and by individual ~~workers~~employees. You, as an ~~employee~~worker, however, also have a responsibility to assist your employer in complying with the standard. You can play a key role in protecting your own health by learning about the lead hazards and their control, learning what the standard requires, following the standard where it governs your own actions, and seeing that your employer complies with provisions governing his or her actions.

(4) Reporting signs and symptoms of health problems. You should immediately notify your employer if you develop signs or symptoms associated with lead poisoning or if you desire medical advice concerning the effects of current or past exposure to lead or your ability to have a healthy child. You should also notify your employer if you have difficulty breathing during a respirator fit test or while wearing a respirator. In each of these cases, your employer must make available to you appropriate medical examinations or consultations. These must be provided at no cost to you and at a reasonable time and place. The standard contains a procedure whereby you can obtain a second opinion by a physician of your choice if your employer selected the initial physician.

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Appendix B to §Section 1532.1 – Employee Standard Summary

This appendix summarizes key provisions of the standard for lead in construction that you as an workeremployee should become familiar with.

I. Permissible Exposure Limit (PEL) - subsection (c)

The standard sets a permissible exposure limit (PEL) of 1050 micrograms of lead per cubic meter of air (1050  $\mu\text{g}/\text{m}^3$ ), ~~averaged over an 8-hour workday which is referred to~~ calculated as an 8-hour time-weighted average (TWA). ~~This is the highest level of lead in air to which you may be permissibly exposed over an 8-hour workday.~~ Your lead exposure over your entire workday, when calculated as an 8-hour TWA, cannot be higher than the PEL. However, since ~~this~~ the PEL is an 8-hour average TWA, short exposures above the PEL are permitted so long as for each ~~8-hour~~ work-day your average exposure does not exceed ~~this level~~ the PEL. This standard, ~~however, takes into account the fact that your daily exposure to lead can extend beyond a typical 8-hour workday as the result of overtime or other alterations in your work schedule. To deal with this situation, the standard contains a formula which reduces your permissible exposure when you are exposed more than 8 hours. For example, if you are exposed to lead for 10 hours a day, the maximum permitted average exposure would be 40~~ 40  $\mu\text{g}/\text{m}^3$ .

The standard contains an exception to the PEL described above for employees who conduct abrasive blasting. Until [OAL insert five years from the effective date here], employees conducting abrasive blasting must not be exposed to airborne lead at a concentration greater than 25  $\mu\text{g}/\text{m}^3$ , calculated as an 8-hour TWA.

II. Exposure Assessment - §subsection (d)

If lead is present in your workplace in any quantity, your employer is required to make an initial determination of whether any employee's exposure to lead exceeds the action level (230  $\mu\text{g}/\text{m}^3$  ~~averaged over~~ calculated as an 8-hour day TWA). Employee exposure, as defined here, is that exposure which would occur if the employee were not using a respirator. This initial determination requires your employer to monitor ~~workers'~~ employees' exposures unless ~~he or she has~~ they have objective data which can demonstrate conclusively that no employee will be exposed to lead in excess of the action level. Where objective data is used in lieu of actual monitoring, the employer must establish and maintain an accurate record, documenting its relevancy in assessing exposure levels for current job conditions. If such objective data is available, the employer need proceed no further on employee exposure assessment until such time that conditions have changed and the determination is no longer valid.

Objective data for surfaces and materials that is less than 0.06% lead dry weight (600 ppm) is indicative of materials that will not give lead concentrations above the action level. For this objective data to be used, lead analysis must be performed for each unique surface coating or material. Surface coating or material objective data cannot be used to replace air monitoring for exposure assessments required for the lead-related trigger tasks listed in subsection (d)(2). Objective data may be compiled from various sources, e.g., insurance companies and trade associations and information from suppliers or exposure

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data collected from similar operations. Objective data may also comprise previously-collected sampling data including area monitoring.

If it cannot be determined through using objective data that ~~worker~~employee exposure is less than the action level, your employer must conduct monitoring or must rely on relevant previous personal sampling, if available. Where monitoring is required for the initial determination, it may be limited to a representative number of employees who are reasonably expected to have the highest exposure levels. If your employer has conducted appropriate air sampling for lead in the past 12 months, ~~he or she~~they may use these results, provided they are applicable to the same employee tasks and exposure conditions and meet the requirements for accuracy as specified in the standard. As with objective data, if such results are relied upon for the initial determination, your employer must establish and maintain a record as to the relevancy of such data to current job conditions.

If there have been any employee complaints of symptoms which may be attributable to exposure to lead or if there is any other information or observations which would indicate employee exposure to lead, this must also be considered as part of the initial determination.

If this initial determination shows that a reasonable possibility exists that any employee may be exposed, without regard to respirators, over the action level, your employer must set up an air monitoring program to determine the exposure level representative of each employee exposed to lead at your workplace. In carrying out this air monitoring program, your employer is not required to monitor the exposure of every employee, but ~~he or she~~must monitor a representative number of employees and job types. Enough sampling must be done to enable each employee's exposure level to be reasonably represented by at least one full-shift exposure air sample. In addition, these air samples must be taken under conditions which represent each employee's regular, daily exposure to lead. Sampling performed in the past 12 months may be used to determine exposures above the action level if such sampling was conducted during work activities essentially similar to present work conditions.

The standard lists certain tasks which may likely result in exposures to lead in excess of the PEL and, in some cases, exposures in excess of 50 times the PEL. These tasks are known as trigger tasks, and are described in subsection (d)(2) of the lead standard. There are level 1, level 2 and level 3 trigger tasks. Performing level 3 trigger tasks is presumed to result in the highest exposures to lead. Level 1 trigger tasks include manual demolition of structures, such as dry wall, manual scraping, and heat gun applications where lead-containing coatings or paint are present. Level 2 trigger tasks include, where lead is present, manual sanding, power tool cleaning, grinding, or sanding with dust collection systems, and spray painting with lead paint. Level 3 trigger tasks include using lead-containing mortar or lead burning, and where lead is present, rivet busting, power tool cleaning, grinding or sanding without dust collection systems, cleanup activities where dry expendable abrasives are used, abrasive blasting enclosure movement and removal, abrasive blasting, welding, torch cutting, torch burning, and needle gunning.

If you are performing any of these tasks, or if your employer has any reason to believe that you may be exposed to lead over the PEL, your employer must provide you, as interim protection, with appropriate

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respiratory protection, protective clothing and equipment, change areas, shower facilities (for level 3 trigger tasks), eating areas, regulated areas, medical surveillance~~biological monitoring~~, and training until such time that an exposure assessment is conducted which demonstrates that your exposure level is below the PEL. Some of these protections (medical surveillance and training) are required even if your exposure is determined, by air monitoring, to be below the PEL. These protections are required if your exposure is determined, by air monitoring, to be at or above the action level (2  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA). In addition, the standard requires that hand washing facilities be provided, and used, whenever you are exposed to lead. Objective data cannot be used to replace air monitoring for this exposure assessment. In addition, until an exposure assessment is done, the amount of time you can conduct dry abrasive blasting is limited to 5 hours per day, except that after [OAL insert five years from the effective date] you may only conduct dry abrasive blasting for 2 hours per day, until an exposure assessment is done.

If you are exposed to lead and air sampling is performed, your employer is required to notify you in writing within 5 working days of the air monitoring results which represent your exposure. If the results indicate that your exposure exceeds the PEL (without regard to your use of a respirator), then your employer must also notify you of this in writing, and provide you with a description of the corrective action that has been taken or will be taken to reduce your exposure.

Your exposure must be rechecked by monitoring, at least every ~~12~~six months if your exposure is at or ~~over~~above the action level (2  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA) but below 30  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA ~~the PEL~~. Your employer may discontinue monitoring for you if ~~2~~two consecutive measurements, taken at least 7 days apart, are ~~at or~~ below the action level. Air monitoring must be repeated every ~~6~~3 months if you are exposed ~~at or over~~above 30  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA but at or below 50  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA ~~the PEL~~. Your employer must continue monitoring for you ~~at this frequency~~every 6 months until ~~2~~two consecutive measurements, taken at least 7 days apart, are below 30  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA ~~the PEL but above the action level, at which time your employer must repeat monitoring of your exposure every six months and may discontinue monitoring only after your exposure drops to or below the action level.~~ Air monitoring must be repeated every 3 months if you are exposed above 50  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA. Your employer must continue monitoring for you every 3 months until two consecutive measurements, taken at least 7 days apart, are at or below 50  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA.

However, whenever there is a change of equipment, process, control, or personnel or a new type of job is added at your workplace which may result in new or additional exposure to lead, your employer must perform additional monitoring.

III. Methods of Compliance - ~~S~~subsection (e)

Your employer is required to ~~assure~~ensure that no employee is exposed to lead in excess of the PEL ~~as an 8-hour TWA~~. The standard for lead in construction requires employers to institute engineering and work practice controls, including administrative controls, to the extent feasible to reduce employee exposure to lead. Where such controls are feasible but not adequate to reduce exposures below the PEL, they must be used nonetheless to reduce exposures to the lowest level that can be accomplished

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by these means, and then supplemented with appropriate respiratory protection. ~~Your employer must establish a regulated area that includes the work area where airborne exposure to lead is above the PEL, or where the lead-related tasks listed in subsection (d)(2) are performed.~~

Your employer is required to develop and implement a written compliance program prior to the commencement of any job where employee exposures may ~~reach~~exceed the PEL ~~as an 8-hour TWA~~. The standard identifies the various elements that must be included in the ~~program~~plan. For example, employers are required to include a description of operations in which lead is emitted, detailing other relevant information about the operation such as the type of equipment used, the type of material involved, crew size, employee job responsibilities, operating procedures and maintenance practices. In addition, your employer's compliance ~~program~~plan must specify the means that will be used to achieve compliance and, where engineering controls are required, include any engineering plans or studies that have been used to select the control methods. If engineering and work practice controls were considered but not put in place, the program must include a report that shows how they were demonstrated not to be feasible. Also, ~~if~~ administrative controls involving job rotation are used to reduce employee exposure to lead, the job rotation schedule must be included in the compliance ~~plan~~program. The ~~plan~~program must also detail the type of protective clothing and equipment, including respirators, housekeeping and hygiene practices that will be used to protect you from the ~~adverse~~harmful effects of exposure to lead. Finally, on sites with more than one contractor, the program must describe arrangements made among contractors to inform affected employees of potential exposure to lead and of regulated areas.

The written compliance program must be made available, upon request, to affected employees and their designated representatives, the Cal/OSHA Chief, and the National Institute for Occupational Safety and Health (NIOSH). ~~Finally, the program~~ must be reviewed and updated at least every 6 months to ~~assure~~ensure it reflects the current status in exposure control.

#### IV. Respiratory Protection - ~~S~~subsection (f)

Your employer is required to provide and ~~assure~~ensure your use of respirators when your exposure to lead is not controlled below the PEL by other means, and as interim protection if you perform trigger tasks and an exposure assessment has not been completed. The employer must pay the cost of the respirator. Whenever you request one, your employer is also required to provide you a respirator even if your airborne exposure level is not above the PEL. You might ~~desire~~want a respirator when, for example, you have received medical advice that your lead absorption should be decreased. Or, you may intend to have children in the near future, and want to reduce the level of lead in your body to minimize ~~adverse~~harmful reproductive effects. While respirators are the least satisfactory means of controlling your exposure, they are capable of providing significant protection if properly chosen, fitted, worn, cleaned, maintained, and replaced when they stop providing adequate protection.

Your employer is required to select respirators as specified in the Respiratory Protection standard, in section 5144(d)(3)(A)1 from the types listed in Table I of the Respiratory Protection section of the standard (section 1532.1(f)). However, when respirators are required, filtering facepiece respirators

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(disposable respirators or dust masks) are not to be selected by your employer and are not to be used for protection from lead. Any respirator chosen must be approved by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 42 CFR part 84. Theis respirator selection table in section 5144 will enable your employer to choose a type of respirator which will give you a proper amount of protection based on your airborne lead exposure. Your employer may select a type of respirator that provides greater protection than that required by the standard; that is, one recommended for a higher concentration of lead than is present in your workplace.

An air-purifying respirator works by removing particles, gases, or vapors from the air you breathe, if the correct type of filter, cartridge, or canister is used with the facepiece. The typical air-purifying respirator is a negative pressure respirator because it requires the force of your inhalation to draw air through the purifying element. For example, Aa powered air-purifying respirator (PAPR) is much more protective than a typical negative pressure respirator, and may also be more comfortable to wear. A PAPR has a filter, cartridge, or canister to clean the air, and a power source which continuously blows filtered air into your breathing zone. Your employer might make a PAPR available to you to may ease the burden of having to wear a negative pressure air--purifying respirator for long periods of time. The standard providesrequires that your employer must provide can obtain you with a PAPR upon request. Your employer also must provide high-efficiency particulate air (HEPA) filters for PAPRs and N-100, R-100, or P-100 filters for non-powered air-purifying respirators. In addition, if you are exposed to lead aerosols that cause eye or skin irritation at the use concentrations, your employer must provide you with a full facepiece respirator instead of a half mask respirator.

A supplied-air respirator (SAR) can also be more protective than a typical negative pressure respirator. A SAR is supplied with breathing-quality air from a source such as an air compressor or compressed air cylinder. Three types of supplied-air respirators are demand, pressure-demand, and continuous flow. The demand-type provides protection equivalent to that of a non-powered negative pressure air-purifying respirator of the same facepiece type. Greater protection is provided by either the pressure-demand or continuous-flow types because positive air pressure exists within the respirator at all times.

Your employer must implement a respiratory protection program in accordance with section 5144. This program must include written procedures for proper respirator selection, medical evaluations, fit testing, use, cleaning, storage, and maintenance of respirators, and training, as well as procedures to ensure adequate air quality, quantity, and flow for supplied-air respirators.

Your employer must assureensure that your respirator facepiece fits properly. Proper fit of a respirator facepiece is critical. Obtaining a proper fit on each employee may require your employer to make available two or three different mask types, in various sizes. In order to assureensure that your respirator fits properly and that facepiece leakage is minimized, your employer must give you either a qualitative fit test or a quantitative fit test as specified in Appendix A of the Respiratory Protection standard, located at-section 5144.



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You must also receive from your employer proper training in the use of respirators. Your employer is required to teach you how to wear a respirator, to know why it is needed, and to understand its limitations.

The standard provides that if your respirator uses filter elements, you must be given an opportunity to change the filter elements whenever an increase in breathing resistance is detected. You also must be permitted to periodically leave your work area to wash your face and respirator facepiece whenever necessary to prevent skin irritation. ~~Before you begin using a respirator, and again if~~ you ever have difficulty in breathing during a fit test or while using a respirator, your employer must make a medical ~~examination~~evaluation available to you to determine whether you can safely wear a respirator. The result of this examination may be to give you a positive pressure respirator (which reduces breathing resistance) or to provide alternative means of protection.

V. Protective Work Clothing and Equipment - ~~S~~subsection (g)

If you are exposed to lead above the PEL ~~as an 8-hour TWA~~, without regard to your use of a respirator, ~~perform trigger tasks and an exposure assessment has not been completed~~, or if you are exposed to lead compounds such as lead arsenate or lead azide which can cause skin and eye irritation, your employer must provide you with protective work clothing and equipment appropriate for the hazard. If work clothing is provided, it must be provided in a clean and dry condition at least weekly, and daily if your airborne exposure to lead is greater than ~~30~~ 200  $\mu\text{g}/\text{m}^3$ . Appropriate protective work clothing and equipment can include coveralls or similar full-body work clothing, gloves, hats, shoes or disposable shoe coverlets, and face shields or vented goggles. Your employer is required to provide all such equipment at no cost to you. In addition, your employer is responsible for providing repairs and replacement as necessary, and also is responsible for the cleaning, laundering or disposal of protective clothing and equipment.

The standard requires that your employer ~~assure~~ensure that you follow good work practices when you are working in areas where your exposure to lead may exceed the PEL. With respect to protective clothing and equipment, where appropriate, the following procedures should be observed prior to beginning work:

1. Change into work clothing and shoe covers in the clean section of the designated changing areas;
2. ~~Use~~Put on work garments ~~of~~and appropriate protective gear, including respirators, before entering the work area; and
3. Store any clothing not worn under protective clothing in the designated changing area.

~~Workers~~Employees should follow these procedures upon leaving the work area:

1. HEPA vacuum heavily contaminated protective work clothing while it is still being worn. At no time may lead be removed from protective clothing by any means which result in uncontrolled dispersal of lead into the air;

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2. Remove shoe covers and leave them in the work area;
3. Remove protective clothing and gear in the dirty area of the designated changing area. Remove protective coveralls by carefully rolling down the garment to reduce exposure to dust.
4. Remove respirators last; and
5. Wash hands, exposed arms, and face.

~~Workers~~Employees should follow these procedures upon finishing work for the day (in addition to procedures described above):

1. Where applicable, place disposal coveralls, and shoe covers with the abatement waste;
2. Contaminated clothing which is to be cleaned, laundered or disposed of must be placed in closed containers in the change room.
3. Clean protective gear, including respirators, according to standard procedures;
4. Wash hands, exposed arms, and face again. If showers are available, take a shower and wash hair. If shower facilities are not available at the work site, shower immediately at home and wash hair.

VI. Housekeeping - ~~§~~subsection (h)

Your employer must establish a housekeeping program sufficient to maintain all surfaces as free as practicable of accumulations of lead dust. HEPA vacuuming is the preferred method of meeting this requirement, and the use of compressed air to clean floors and other surfaces is generally prohibited unless removal with compressed air is done in conjunction with ventilation systems designed to contain dispersal of the lead dust. Dry or wet sweeping, shoveling, or brushing may not be used except where vacuuming or other equally effective methods have been tried and do not work. Vacuums must be used equipped with a special filter called a ~~high efficiency particulate air (HEPA)~~ filter and be used and emptied in a manner which minimizes the reentry of lead into the workplace.

VII. Hygiene Facilities, Practices and Regulated Areas - ~~§~~subsection (i)

The standard requires that hand washing facilities be provided, and used, where occupational exposure to lead occurs. In addition, change areas, ~~showers (where feasible)~~, and lunchrooms or eating areas are to be made available to ~~worker~~employees exposed to lead above the PEL without regard to the use of respirators, and as interim protection to employees performing trigger tasks. Also, showers must be provided for employees exposed above the PEL and as interim protection for employees who perform level 3 trigger tasks. Where shower facilities are required, employees must shower at the end of their work shift.

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Your employer must ~~assure~~ensure that ~~except in these facilities,~~ food and beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied, where employees are exposed to lead~~airborne exposures are above the PEL.~~

Clean Change rooms must be provided by your employer where employees are exposed to lead above the PEL without regard to the use of respirators, and as interim protection for employees performing trigger tasks. The change area must be equipped with separate storage facilities for your protective clothing and equipment, and your street clothes to avoid cross-contamination. ~~After showering, no required protective clothing or equipment worn during the shift may be worn home.~~ It is important that contaminated clothing or equipment be removed in change areas and not be ~~worn~~brought home. ~~Bringing lead contamination home prolongs or you will extend your exposure to lead and exposes your family, as since lead from your clothing can accumulate in your house, car, house,~~ etc. Where showers are required to be provided, employees must shower at the end of their shift.

Lunchrooms or eating areas may not be entered with protective clothing or equipment unless surface dust has been removed by HEPA vacuuming, downdraft booth, or other cleaning method. ~~Finally, workers~~Employees exposed to ~~lead above the PEL~~ must wash ~~both~~ their hands, exposed arms, and faces prior to entering an eating area, eating, drinking, smoking, or applying cosmetics, and at the end of their shift.

~~All of the facilities and hygiene practices just discussed are essential to minimize additional sources of lead absorption from inhalation or ingestion of lead that may accumulate on you, your clothes, or your possessions. Therefore, e~~Employers shall~~must~~ establish regulated areas, where access is controlled by the supervisor, for work areas where employees are exposed to lead ~~at or above the PEL~~ without regard to the use of respirators, and as interim protection where employees are or performing the specific~~trigger tasks that require air monitoring,~~ as required by subsection (d)(2) of the lead standard. Employers must post signs in the regulated area and ensure that ~~Any~~ employee that enters the regulated area ~~must be~~is provided with protective work clothing and equipment.

All of the hygiene facilities, practices, and regulated areas described above are essential to minimize additional sources of lead absorption from inhalation or ingestion of lead that may accumulate on you, your clothes, or your possessions. Strict compliance with these provisions can virtually eliminate several sources of lead exposure which significantly contribute to excessive lead absorption.

#### VIII. Medical Surveillance - Ssubsection (j)

The medical surveillance program is part of the standard's comprehensive approach to the prevention of lead-related disease. Its purpose is to supplement the main thrust of the standard which is aimed at minimizing airborne concentrations of lead and sources of ingestion. Only medical surveillance can determine if the other provisions of the standard have ~~a~~effectively protected you as an individual. Compliance with the standard's provisions will protect most ~~worker~~employees from the ~~adverse~~harmful effects of lead exposure, but may not be satisfactory to protect individual ~~worker~~employees (1) who have high body burdens of lead acquired over past years, (2) who have

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additional uncontrolled sources of non-occupational lead exposure, (3) who ~~exhibit unusual variations in absorb~~ lead at an unusually high ~~absorption~~ rates, or (4) who have specific non-work related ~~medical health-related~~ conditions which could be aggravated by lead exposure (e.g., ~~renal~~ kidney disease, anemia). In addition, control systems may fail, or hygiene and respirator programs may be inadequate. Periodic medical surveillance of individual ~~worker~~ employees will help detect those failures. Medical surveillance ~~will~~ is also be important to protect your reproductive ~~ability~~ health, ~~regardless of whether you are a man or woman~~ gender.

All medical surveillance required by the standard must be performed by or under the supervision of a licensed physician. The employer must provide required medical surveillance without cost to employees and at a reasonable time and place. The standard's medical surveillance program has two parts – blood lead testing ~~periodic biological monitoring~~ and medical examinations. ~~Your employer's obligation to offer you medical surveillance is triggered by the results of the air monitoring program. Full medical surveillance must be made available to all employees who are or may be exposed to lead in excess of the action level for more than 30 days a year and whose blood lead level exceeds 40 µg/dl.~~

A. Blood Lead Testing

Initial ~~medical surveillance consisting of blood lead testing~~ sampling and analysis for lead and zinc ~~protoporphyrin~~ must be provided to all employees prior to assignment to work where exposure to lead is or is likely to be at or above the action level, and as interim protection, prior to performing trigger tasks ~~exposed at any time (1 day) above the action level.~~ Blood lead test results show your blood lead level (BLL). BLL means the concentration of lead measured in whole blood, expressed as micrograms per deciliter (µg/dl).

After the initial blood lead testing, additional blood lead testing must be made available to you. There are two exceptions to this requirement. The first exception is if you are exposed to lead at or above the action level for less than 10 days in any 12 consecutive months, and your exposure is not on any day at or above 100 µg/m<sup>3</sup> as an 8-hour TWA, without regard to respirator use, then additional blood lead testing is not required to be provided. The second exception is if you only perform level 1 trigger tasks, and perform these level 1 trigger tasks for less than 10 days in any 12 consecutive months, then additional blood lead testing is not required to be provided. Also, if your initial BLL is at or above 10 µg/dl, you must be provided with additional blood lead testing as described in the next paragraph. There are no exceptions to this.

Unless your exposure to lead or work with lead falls under one of the exceptions described above, after the initial testing, blood lead testing ~~Biological monitoring~~ under the standard must be provided on the following schedule: at least every 2 months for the first 6 months after initial placement, and also for the first 6 months after any change in task resulting in higher exposure; and at least every 6 months thereafter until your blood lead level is below 40 µg/dl. A zinc protoporphyrin (ZPP) test is a very useful blood test which measures an adverse metabolic effect of lead on your body and is therefore an indicator of lead toxicity. If your last BLL exceeds ~~is at or above 10~~ 40 µg/dl but is below 20 µg/dl, the monitoring ~~testing~~ frequency must be increased ~~from every 6 months to at least every 2 months and not~~

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reduced until two consecutive BLLs, taken at least 30 days apart, indicate a blood lead level are below 10 40µg/dl. Blood lead testing then must be provided as described in the schedule given at the start of this paragraph. If your last BLL is at or above 20 µg/dl, or you are removed from exposure to lead due to an elevated BLL, blood lead testing must be provided to you at least monthly. Monthly blood lead tests must also be provided as an interim protection if you perform level 3 trigger tasks, including a blood test taken within 3 days after discontinuing all level 3 trigger task work. Finally, blood lead tests must be provided to you at least monthly if your airborne exposure to lead is above 500 µg/m<sup>3</sup> as an 8-hour TWA, without regard to your use of a respirator, including a blood test taken within 3 days after discontinuing all work associated with airborne exposure above 500 µg/m<sup>3</sup> as an 8-hour TWA. Each time your BLL is determined to be over 40µg/dl,

Yyour employer must notify you of your BLL this in writing within five working days of his or her receipt of the test results. In addition, the physician who orders your blood test will notify you of the results of your blood lead test and recommend any follow-up blood testing and/or a medical exam, based on your blood test results. The employer must also inform you that the standard requires temporary medical removal with economic protection when your BLL is at or above exceeds 30 50µg/dl, or effective [OAL insert 1 year from effective date here], your last two monthly BLLs are at or above 20 µg/dl, or when the average of the results of all of your blood lead tests in the last 6 months are at or above 20 µg/dl. (Ssee Discussion of Medical Removal Protection, Ssubsection (k)-). Anytime your BLL exceeds 50µg/dl your employer must make available to you within two weeks of receipt of these test results a second follow-up BLL test to confirm your BLL. If the two tests both exceed 50µg/dl, and you are temporarily removed, then your employer must make successive BLL tests available to you on a monthly basis during the period of your medical removal. Finally, if you have a BLL at or above 10 µg/dl, your employer must establish and implement a written elevated blood lead level response plan designed to reduce and maintain your BLL below 10 µg/dl.

**B. Medical Examination and Consultation**

An initial medical examination and consultation must be made available to you prior to your assignment to lead work if your exposure to lead will be at or above the action level, or you will perform trigger tasks and an exposure assessment has not been completed. There are two exceptions to this requirement. The first exception is if you are exposed to lead at or above the action level for less than 10 days in any 12 consecutive months, and your exposure is not on any day at or above 100 µg/m<sup>3</sup> as an 8-hour TWA, without regard to respirator use, then a medical examination is not required to be provided. The second exception is if you only perform level 1 trigger tasks, and perform these level 1 trigger tasks for less than 10 days in any 12 consecutive months, then a medical examination is not required to be provided. The initial examination will provide information to establish a baseline for you to which subsequent data can be compared.

Medical examinations beyond the initial one must be made available on an annual basis if your blood lead levelBLL exceedsis 20 40µg/dl or greater at any time during the preceding year and you are being exposed above the airborne action level of 30µg/m<sup>3</sup> for 30 or more days per year. The initial

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~~examination will provide information to establish a baseline to which subsequent data can be compared.~~ Such a medical examination must be made available as soon as possible upon receiving a blood lead test result of 20 µg/dl or greater if you have not had a lead-specific medical examination in the last 12 months.

~~An initial medical examination to consist of blood sampling and analysis for lead and zinc protoporphyrin must also be made available (prior to assignment) for each employee being assigned for the first time to an area where the airborne concentration of lead equals or exceeds the action level at any time. In addition, a medical examination or consultation beyond the initial one must be made available as soon as possible if you notify your employer that you are experiencing signs or symptoms commonly associated with lead poisoning or that you have difficulty breathing while wearing a respirator or during a respirator fit test. You must also be provided a medical examination or consultation beyond the initial one if you notify your employer that you desire medical advice concerning the effects of current or past exposure to lead on your ability to procreate a healthy child.~~

~~Finally, after the initial medical examination or consultation is provided, you must be provided with an additional medical examination or consultation as soon as possible, and then as medically appropriate, when you appropriate follow up medical examinations or consultations may also be provided for employees who have been temporarily removed from exposure to lead, or your exposure to lead is otherwise limited under the medical removal protection provisions of the standard. (See Part IX, below.)~~

The standard specifies the minimum content of pre-assignment and annual medical examinations. The content of other types of medical examinations and consultations is left up to the sound discretion of the examining physician. Pre-assignment and annual medical examinations must include (1) a detailed work history and medical history; (2) a thorough physical examination, including an evaluation of your pulmonary status if you will be ~~required to use~~ using a respirator; (3) a blood pressure measurement; ~~and (4) a series of laboratory tests designed to check your blood chemistry and your kidney function;~~ and (5) a zinc protoporphyrin (ZPP) test if your last blood lead level was at or above 20 µg/dl. In addition, at any time upon your request, a laboratory evaluation of male fertility will be made (microscopic examination of a sperm sample), or a pregnancy test will be given.

The standard does not require that you participate in any of the medical procedures, tests, etc. which your employer is required to make available to you. Medical surveillance can, however, play a very important role in protecting your health. You are strongly encouraged, therefore, to participate in a meaningful fashion. The standard contains a multiple physician review mechanism which will give you a chance to have a physician of your choice directly participate in the medical surveillance program. If you are dissatisfied with an examination by a physician chosen by your employer, you can select a second physician to conduct an independent analysis. The two doctors would attempt to resolve any differences of opinion, and select a third physician to resolve any firm dispute. Generally your employer will choose the physician who conducts medical surveillance under the lead standard - unless you and your employer can agree on the choice of a physician or physicians. Some companies and unions have agreed in advance, for example, to use certain independent medical laboratories or panels of physicians. Any of

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these arrangements are acceptable so long as required medical surveillance is made available to workeremployees.

The standard requires your employer to provide certain information to a physician to aid in his or her examination of you. This information includes (1) the standard and its appendices, (2) a description of your duties as they relate to occupational lead exposure, (3) your exposure level or anticipated exposure level, (4) a description of any personal protective equipment you wear, (5) prior blood lead level results, ~~and~~ (6) prior written medical opinions concerning you that the employer has, and (7) a copy of your employer's written elevated blood lead level response plan (required when an employee's BLL is at or above 10 µg/dl).

After a medical examination or consultation the physician must prepare a written ~~report~~ opinion for your employer which must contain (1) the physician's opinion as to whether you have any health-related medical condition which places your health, including the ability to procreate a healthy child, at increased risk of material impairment to health from exposure to lead, (2) any recommended special protective measures to be provided to you or any limitations to be placed on your exposure to lead, (3) ~~any blood lead level test results determinations~~, and (4) any recommended limitation on your use of respirators. This last element must include a determination of whether you can wear a powered air-purifying respirator (PAPR) if you are found unable to wear a negative pressure respirator. Your employer must ensure that you also receive a copy of the physician's written medical opinion. In addition, the physician who conducts your medical examination will explain the results of your medical examination to you and provide you with a separate written medical report within 30 days of your medical exam. This report will contain the information in the physician's written medical opinion, plus additional information, including a determination of whether you should wear a PAPR instead of a non-powered (negative pressure) air-purifying respirator, any recommended follow-up blood lead testing or medical exams, and the physician's opinion as to whether you have any health-related condition, work-related or not, for which you should have a further medical examination or treatment.

C. Additional Information about Medical Surveillance

The medical surveillance program of the ~~interim~~ lead standard may at some point in time serve to notify certain workeremployees that they have acquired a disease or other adverse ~~medical~~ health-related condition as a result of occupational lead exposure. If this is true, these workeremployees might have legal rights to compensation from public agencies, their employers, firms that supply hazardous products to their employers, or other persons. Some states have laws, including workers' compensation laws, that disallow an workeremployee who learns of a job-related health impairment to sue, unless the workeremployee sues within a short period of time after learning of the impairment. (This period of time may be a matter of months or years.) An attorney can be consulted about these possibilities. It should be stressed that Cal/OSHA is in no way trying to either encourage or discourage claims or lawsuits. However, since results of the standard's medical surveillance program can significantly affect the legal remedies of an workeremployee who has acquired a job-related disease or impairment, it is proper for Cal/OSHA to make you aware of this.

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The medical surveillance section of the standard also contains provisions dealing with chelation. Chelation is the use of certain drugs (administered in pill form or injected into the body) to reduce the amount of lead absorbed in body tissues. Experience accumulated by the medical and scientific communities has largely confirmed the effectiveness of this type of therapy for the treatment of very severe lead poisoning. On the other hand, it has also been established that there can be a long list of extremely harmful side effects associated with the use of chelating agents. The medical community has balanced the advantages and disadvantages resulting from the use of chelating agents in various circumstances and has established when the use of these agents is acceptable. The standard includes these accepted limitations due to a history of abuse of chelation therapy by some lead companies. The most widely used chelating agents are succimer and calcium disodium EDTA<sub>7</sub> (Ca Na<sub>2</sub> EDTA), ~~Calcium Disodium Versenate (Versenate), and d-penicillamine (penicillamine or Cupramine).~~

The standard prohibits “prophylactic chelation” of any employee by any person the employer retains, supervises or controls. “Prophylactic chelation” is the routine use of chelating or similarly acting drugs to prevent elevated blood lead levels in ~~worker~~employees who are occupationally exposed to lead, or the use of these drugs to routinely lower blood lead levels to predesignated concentrations believed to be “safe.” It should be emphasized that where an employer takes an employee who has no symptoms of lead poisoning and has chelation carried out by a physician (either inside or outside of a hospital) solely to reduce the ~~worker’s~~employee’s blood lead level, that will generally be considered prophylactic chelation. The use of a hospital and a physician does not mean that prophylactic chelation is not being performed. Routine chelation to prevent increased or reduce current blood lead levels is unacceptable whatever the setting.

The standard allows the use of “therapeutic” or “diagnostic” chelation if administered under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical monitoring. Therapeutic chelation responds to severe lead poisoning where there are marked symptoms. Diagnostic chelation involves ~~giving~~ giving a patient a dose of the drug then collecting all urine excreted for some period of time as an aid to the diagnosis of lead poisoning.

In cases where the examining physician determines that chelation is appropriate, you must be notified in writing of this fact before such treatment. This will inform you of a potentially harmful treatment, and allow you to obtain a second opinion.

IX. Medical Removal Protection - Subsection (k)

Excessive lead absorption subjects you to increased risk of disease. Medical removal protection (MRP) is a means of protecting you when, for whatever reasons, other methods, such as engineering controls, work practices, and respirators, have failed to provide the protection you need. MRP involves the temporary removal of an employee from ~~his or her~~their regular job to a place of significantly lower exposure without any loss of earnings, seniority, or other employment rights or benefits. The purpose of this program is to cease further lead absorption and allow your body to naturally excrete lead which has previously been absorbed. Temporary medical removal can result from an elevated blood lead level, or a medical opinion. For up to 18 months, or for as long as the job the employee was



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removed from lasts, protection is provided as a result of either form of removal. The vast majority of removed ~~worker~~employees, however, will return to their former jobs long before this ~~eighteen~~18-month period expires.

Your employer must remove you from work having an exposure to lead at or above the action level of 2  $\mu\text{g}/\text{m}^3$ , from work involving a trigger task where an exposure assessment has not been completed, and from work altering or disturbing any material containing lead at a concentration at least 0.5% by weight, on each occasion that your BLL is at or above 30  $\mu\text{g}/\text{dl}$ , or effective [OAL insert 1 year from effective date here], your last two BLL results are at or above 20  $\mu\text{g}/\text{dl}$ , or the average of the results of all of your blood lead tests conducted in the last 6 months is at or above 20  $\mu\text{g}/\text{dl}$ . If you are removed from your normal job because of a high BLL, your employer must return you to your former job status when two consecutive blood lead tests, taken at least 30 days apart, both indicate that your BLL is below 15  $\mu\text{g}/\text{dl}$ .

You may also be removed from exposure even if your blood lead level is below ~~30~~50 $\mu\text{g}/\text{dl}$  or the other criteria mentioned above, if a final medical determination indicates that you temporarily need reduced lead exposure for medical reasons. If the physician who is implementing your employer's medical program makes a final written opinion recommending your removal or other special protective measures, your employer must implement the physician's recommendation. If you are removed in this manner, you ~~may~~must only be returned when the doctor indicates that it is safe for you to do so.

The standard does not give specific instructions dealing with what an employer must do with a removed ~~worker~~employee. Your job assignment upon removal is a matter for you, your employer and your union (if any) to work out consistent with existing procedures for job assignments. Each removal must be accompanied in a manner consistent with existing collective bargaining relationships. Your employer is given broad discretion to implement temporary removals so long as no attempt is made to override existing agreements. Similarly, a removed ~~worker~~employee is provided no right to veto an employer's choice which satisfies the standard.

In most cases, employers will likely transfer removed employees to other jobs with sufficiently low lead exposure. Alternately, an ~~worker's~~employee's hours may be reduced so that the time-weighted average exposure is reduced to below the action level, or ~~he or she~~they may be temporarily laid off if no other alternative is feasible.

In all of these situations, MRP benefits must be provided during the period of removal - i.e., you continue to receive the same earnings, seniority, and other rights and benefits you would have had if you had not been removed. Earnings includes more than just your base wage; it includes overtime, shift differentials, incentives, and other compensation you would have earned if you had not been removed. During the period of removal you must also be provided with appropriate follow-up medical surveillance. If you were removed because your blood lead level was too high, you must be provided with a monthly blood lead level test. If a medical opinion caused your removal, you must be provided medical tests or examinations that the doctor believes to be appropriate. If you do not participate in this follow-up medical surveillance, you may lose your eligibility for MRP benefits.

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When you are medically eligible to return to your former job, your employer must return you to your “former job status.” This means that you are entitled to the position, wages, benefits, etc., you would have had if you had not been removed. If you would still be in your old job if no removal had occurred that is where you go back. If not, you are returned consistent with whatever job assignment discretion your employer would have had if no removal had occurred. MRP only seeks to maintain your rights, not expand them or diminish them.

If you are removed under MRP and you are also eligible for workers’ compensation or other compensation for lost wages, your employer's MRP benefits obligation is reduced by the amount that you actually receive from these other sources. This is also true if you obtain other employment during the time you are laid off with MRP benefits.

The standard also covers situations where an employer voluntarily removes an ~~worker~~employee from exposure to lead due to the effects of lead on the employee's ~~medical~~health-related condition, even though the standard does not require removal. In these situations MRP benefits must still be provided as though the standard required removal. Finally, it is important to note that in all cases where removal is required, respirators cannot be used as a substitute. Respirators may be used before removal becomes necessary, but not as an alternative to a transfer to a low exposure job, or to lay-off with MRP benefits.

X. ~~Communication of Hazards~~Employee Information, Training and Certification - Ssubsection (I)

~~Your employer must include lead in their hazard communication program and training. Also, y~~Your employer is required to provide an information and training program for all employees exposed to lead above the action level ~~on any day~~ or who may ~~suffer~~experience skin or eye irritation from lead compounds such as lead arsenate or lead azide, ~~and as interim protection for employees who perform trigger tasks~~. The program must train these employees regarding the specific hazards associated with their work environment, protective measures which can be taken, including the contents of any compliance plan in effect, the danger of lead to their bodies (including their reproductive systems), and their rights under the standard. All employees must be trained prior to initial assignment to areas where there is a possibility of exposure ~~as described above~~over the action level. This training program must also be provided at least annually thereafter ~~unless further exposure above the action level will not occur~~.

The California Department of ~~Public Health Services~~(CDPH) requires the certification of employees and supervisors performing lead related construction activities in residential and public buildings, as defined in Title 17, California Code of Regulations, Division 1, Chapter 8, ~~when it has been shown that they have been exposed to lead at or above 50 µg/m<sup>3</sup> as an 8-hour TWA~~. Lead related construction work is defined in Title 17 as any construction, alteration, painting, demolition, salvage, renovation, repair, or maintenance of any residential or public building, including preparation and cleanup, that, by using or disturbing lead containing material or soil, may result in significant exposure of adults or children to lead. “Public building” means a structure which is generally accessible to the public, including but not limited to, schools, daycare centers, museums, airports, hospitals, stores, convention centers,

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government facilities, office buildings and any other building which is not an industrial building or a residential building. Where training certification is required, the training must be given by a training provider accredited by the ~~CDPH~~ California Department of Health Services.

XI. Signs - ~~S~~subsection (m)

The standard requires that the following warning sign be posted in each regulated area, or in work areas where the exposure to lead ~~exceeds~~ is at or above the action level PEL:

DANGER  
LEAD WORK AREA  
MAY DAMAGE FERTILITY OR THE UNBORN CHILD  
CAUSES DAMAGE TO THE CENTRAL NERVOUS SYSTEM  
DO NOT EAT, DRINK OR SMOKE IN THIS AREA

~~Prior to June 1, 2016, employers may use the following legend in lieu of that specified above:~~

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

These signs are to be posted and maintained in a manner which ~~assures~~ ensures that the legend is readily visible.

XII. Recordkeeping - ~~S~~subsection (n)

Your employer is required to keep all records of exposure monitoring for airborne lead. These records must include the name and job classification of employees measured, details of the sampling and analytical techniques, the results of this sampling, and the type of respiratory protection being worn by the person sampled. Such records are to be retained for at least 30 years. Your employer is also required to keep all records of blood lead testing ~~biological monitoring~~ and medical examination results. These records must include the names of the employees, the physician's written opinion, and a copy of the results of the examination. Medical records must be preserved and maintained for the duration of employment plus 30 years. However, if the employee's duration of employment is less than one year, the employer need not retain that employee's medical records beyond the period of employment if they are provided to the employee upon termination of employment.

Recordkeeping is also required if you are temporarily removed from your job under the medical removal protection program. This record must include your name and unique identifier ~~social security number~~, the date of your removal and return, how the removal was or is being accomplished, and whether or not the reason for the removal was an elevated blood lead level. Your employer is required to keep each medical removal record only for as long as the duration of an employee's employment.

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In addition, the standard requires that your employer keep records of their semi-annual review of their written compliance program, and written elevated blood lead level response plans, for three years. They are also required to keep records of any training required by this standard for three years.

The standard requires that if you request to see or copy environmental monitoring, blood lead level monitoring, or medical removal records, they must be made available to you or to a representative that you authorize. Your union also has access to these records. Medical records other than BLL's must also be provided upon request to you, to your physician or to any other person whom you may specifically designate. Your union does not have access to your personal medical records unless you authorize their access.

XIII. Observation of Monitoring - ~~§~~subsection (o)

When air monitoring for lead is performed at your workplace as required by this standard, your employer must allow you or someone you designate to act as an observer of the monitoring. Observers are entitled to an explanation of the measurement procedure, and to record the results obtained. Since results will not normally be available at the time of the monitoring, observers are entitled to record or receive the results of the monitoring when returned by the laboratory. Your employer is required to provide the observer with any personal protective devices required to be worn by employees working in the area that is being monitored. The employer must require the observer to wear all such equipment and to comply with all other applicable safety and health procedures.

~~XIV. Effective Date - Subsection (p)~~

~~The standard's effective date was November 4, 1993. Employer obligations under the standard begin as of that date with full implementation of engineering controls as soon as possible but no later than within 4 months, and all other provisions completed as soon as possible, but no later than within 2 months from the effective date.~~

XIV. For Additional Information

A. A copy of the standard for lead in construction can be obtained free of charge at [http://www.dir.ca.gov/Title8/1532\\_1.html](http://www.dir.ca.gov/Title8/1532_1.html) or by calling or writing your local Cal/OSHA Office.

B. Additional information about the standard, its enforcement, and your employer's compliance can be obtained at <http://www.dir.ca.gov/dosh/EnforcementPage.htm> or from the nearest Cal/OSHA Office listed in your telephone directory.

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Appendix C to §Section 1532.1 – Medical Surveillance Guidelines Requirements

This appendix outlines the medical surveillance provisions of the construction standard for lead and provides further information to the physician regarding the examination and evaluation of employees exposed to lead.

Introduction

The primary purpose of the Occupational Safety and Health Act of 1970 is to ~~assure~~ensure, so far as possible, safe and healthful working conditions for every working man and woman. The occupational health standard for lead in construction is designed to protect ~~worker~~employees exposed to inorganic lead including metallic lead, all inorganic lead compounds and organic lead soaps.

Under this standard occupational exposure to inorganic lead is to be limited to ~~50~~10  $\mu\text{g}/\text{m}^3$  (micrograms per cubic meter) ~~based on~~calculated as an 8-hour time-weighted average (TWA). This permissible exposure limit (PEL) must be achieved through a combination of engineering, work practice and administrative controls to the extent feasible. Where these controls are in place but are found not to reduce employee exposures to or below the PEL, they must be used nonetheless, and supplemented with respirators to meet the ~~50~~10  $\mu\text{g}/\text{m}^3$  exposure limit. As an exception, until [OAL insert five years from the effective date], the PEL for employees conducting abrasive blasting is 25  $\mu\text{g}/\text{m}^3$ , calculated as an 8-hour TWA.

The standard establishes an action level of 2  $\mu\text{g}/\text{m}^3$  calculated as an 8-hour TWA. The action level refers to employee exposure, without regard to the use of respirators. The action level triggers several ancillary provisions of the standard such as exposure monitoring, medical surveillance, training, and signs.

The standard lists certain construction tasks which, when lead is present, may likely result in exposures to lead in excess of the PEL and, in some cases, exposures in excess of 50 times the PEL. These tasks are known as trigger tasks, and are described in subsection (d)(2) of the lead standard. Trigger tasks are categorized as level 1, level 2, or level 3 trigger tasks. Performing level 3 trigger tasks is presumed to result in the highest exposures to lead. Level 1 trigger tasks include manual demolition of structures (such as dry wall), manual scraping, and heat gun applications. Level 2 trigger tasks include manual sanding, power tool cleaning, grinding, or sanding with dust collection systems, and spray painting with lead paint. Level 3 trigger tasks include using lead-containing mortar or lead burning, and rivet busting, power tool cleaning, grinding or sanding without dust collection systems, cleanup activities where dry expendable abrasives are used, abrasive blasting enclosure movement and removal, abrasive blasting, welding, torch cutting, torch burning, and needle gunning. If an employee performs any of these trigger tasks when lead is present, or if the employer has any reason to believe that the employee may be exposed to lead over the PEL, the employer must provide the employee with interim protection, until such time that an exposure assessment is conducted which demonstrates that the employee's exposure level to lead is below the PEL. Interim protections include appropriate respiratory protection, protective

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clothing and equipment, change areas, shower facilities (for level 3 trigger tasks), eating areas, regulated areas, and medical surveillance.

The standard also provides for a program of ~~biological monitoring~~ medical surveillance for employees, ~~exposed to lead above the action level at any time, and additional~~ as outlined in section I of this Appendix. This program consists of initial blood lead testing and medical evaluation, along with periodic blood lead testing and medical evaluation, to be performed on a schedule which is defined by previous laboratory results, employee complaints or concerns, and the clinical assessment of the examining physician. ~~medical surveillance for all employees exposed to levels of inorganic lead above 30 µg/m<sup>3</sup> (TWA) for more than 30 days per year and whose BLL exceeds 40 µg/dl.~~

~~The purpose of this document is to outline the medical surveillance provisions of the interim standard for inorganic lead in construction, and to provide further information to the physician regarding the examination and evaluation of workers exposed to inorganic lead.~~

Section ~~I1~~ provides a detailed description of the medical surveillance ~~monitoring~~ procedures including the required frequency of blood lead testing and medical examination and consultation for exposed ~~worker~~ employees, provisions for medical removal protection (MRP), the ~~recommended~~ right of the employee to a second medical opinion, and notification and recordkeeping requirements of the physician and the employer. A discussion of the requirements for respirator use and respirator monitoring and Cal/OSHA's position on prophylactic chelation therapy are also included in this section.

Section ~~II2~~ discusses the toxic effects and clinical manifestations of lead poisoning and effects of lead intoxication on the cardiovascular, neurologic, renal, gastrointestinal, and enzymatic pathways in heme synthesis/hematologic systems. The adverse effects on both male and female reproductive capacity and on the fetus are also discussed.

Section ~~III3~~ outlines the recommended medical evaluation of the ~~worker~~ employee exposed to inorganic lead, including details of the medical history, physical examination, and recommended laboratory tests, which are based on the toxic effects of lead as discussed in ~~Section II2~~.

Section ~~IV4~~ provides detailed information concerning the laboratory tests available for the monitoring of exposed ~~worker~~ employees. Included also is a discussion of the relative value of each test and the limitations and precautions which are necessary in the interpretation of the laboratory results.

**I. Medical Surveillance and Monitoring Requirements for ~~Workers~~ Employees Exposed to Inorganic Lead**

**A. Blood Lead Testing**

Under the standard for inorganic lead in the construction industry, initial ~~medical surveillance consisting of biological monitoring to include blood lead testing and ZPP level determination~~ shall be provided to employees prior to assignment to work where exposure to lead is or is likely to be at or above the action level, and as interim protection, prior to performing trigger tasks described in subsection (d)(2) of the

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lead standard. exposed to lead at or above the action level on any one day. In addition, a program of biological monitoring is to be made available to all employees exposed above the action level at any time and additional medical surveillance is to be made available to all employees exposed to lead above 30  $\mu\text{g}/\text{m}^3$  TWA for more than 30 days each year and whose BLL exceeds 40  $\mu\text{g}/\text{dl}$ .

After the initial blood lead testing, additional blood lead testing must be made available to employees. This program consists of periodic blood sampling and medical evaluation to be performed on a schedule which is defined by previous laboratory results, worker complaints or concerns, and the clinical assessment of the examining physician. There are two exceptions to this requirement. The first exception is if an employee is exposed to lead at or above the action level for less than 10 days in any 12 consecutive months, and their exposure is not on any day at or above 100  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA, without regard to respirator use, then additional blood lead testing is not required to be provided. The second exception is if they only perform level 1 trigger tasks, and perform these level 1 trigger tasks for less than 10 days in any 12 consecutive months, then additional blood lead testing is not required to be provided. Also, if the employee's initial blood lead level (BLL) is at or above 10  $\mu\text{g}/\text{dl}$ , they must be provided with additional blood lead testing, as described in the next paragraph. There are no exceptions to this.

Unless an employee's exposure to lead or work with lead falls under one the exceptions described above, blood lead testing under the standard must be provided on the following schedule: Under this program, the blood lead level (BLL) of all employees who are exposed to lead above 30  $\mu\text{g}/\text{m}^3$  for more than 30 days per year or whose blood lead is above 40  $\mu\text{g}/\text{dl}$  but exposed for no more than 30 days per year is to be determined at least every two months for the first six months of after initial placement, and also for the six months after any change in task resulting in higher exposure; and every six months thereafter. If an employee's last BLL is at or above 10  $\mu\text{g}/\text{dl}$  but is below 20  $\mu\text{g}/\text{dl}$ , the testing frequency is increased to must be at least every two months for employees whose last blood lead level was 40  $\mu\text{g}/\text{dl}$  or above. This frequency must continue until two consecutive BLLs, taken at least 30 days apart, are less than 10  $\mu\text{g}/\text{dl}$ . Blood lead testing then must be provided as described in the schedule given at the start of this paragraph. For employees whose last blood lead test indicated a BLL at or above 20  $\mu\text{g}/\text{dl}$  or who are removed from exposure to lead due to an elevated blood lead, a new blood lead level/BLL must be measured monthly. Monthly blood lead tests must also be provided as an interim protection for each employee who performs a level 3 trigger task as listed in subsection (d)(2)(D), including a blood test taken within 3 days after discontinuing all level 3 trigger task work. Finally, blood lead tests must be provided at least monthly to each employee whose airborne exposure to lead is above 500  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA, without regard to the use of respirators, including a blood test taken within 3 days after discontinuing all work associated with airborne exposure above 500  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA. A zinc protoporphyrin (ZPP) measurement is strongly recommended on each occasion that a blood lead level measurement is made.

B. Medical Examination and Consultation

An annual/initial medical examination and consultation performed under the guidelines discussed in Section III is to be made available to an employee prior to assignment to work where exposure to lead

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will be at or above the action level, and as interim protection prior to performing trigger tasks. There are two exceptions to this requirement. The first exception is if an employee is exposed to lead at or above the action level for less than 10 days in any 12 consecutive months, and their exposure is not on any day at or above  $100 \mu\text{g}/\text{m}^3$  as an 8-hour TWA, without regard to respirator use, then a medical evaluation is not required to be provided. The second exception is if an employee only performs level 1 trigger tasks, and they perform these level 1 trigger tasks for less than 10 days in any 12 consecutive months, then a medical evaluation is not required to be provided.

Medical examinations beyond the initial one must be made available on an annual basis if an employee's BLL is  $20 \mu\text{g}/\text{dl}$  or greater at any time during the preceding year. This medical examination must be made available as soon as possible upon receiving a blood lead test result of  $20 \mu\text{g}/\text{dl}$  or greater if the employee has not had a lead-specific medical examination in the last 12 months. ~~each employee exposed above  $30 \mu\text{g}/\text{m}^3$  for more than 30 days per year for whom a blood test conducted at any time during the preceding 12 months indicated a blood lead level at or above  $40 \mu\text{g}/\text{dl}$ . Also, an examination is to be given to all employees prior to their assignment to an area in which airborne lead concentrations each or exceed the  $30 \mu\text{g}/\text{m}^3$  for more than 30 days per year.~~ In addition, a medical examination must be provided as soon as possible after notification by an employee that the employee has developed signs and symptoms commonly associated with lead intoxication, that the employee desires medical advice regarding lead exposure and the ability to procreate a healthy child, or that the employee has demonstrated difficulty in breathing during a respirator fitting test or during respirator use. ~~A medical examination beyond the initial one is also to be made available to each employee removed from exposure to lead due to a risk of sustaining material impairment to health~~ an elevated blood lead level, as discussed in the next section, or otherwise limited or specially protected pursuant to medical recommendations.

The requirements of section 1532.1 for the medical surveillance of employees who are exposed to lead are summarized in Table 1.

Table 1. Minimum Requirements for Medical Surveillance.

<u>A. Initial blood lead level (BLL) test required to be made available.</u>	<u>Prior to assignment to work where exposure to lead is or reasonably expected to be <math>\geq</math> the action level (<math>2 \mu\text{g}/\text{m}^3</math> as an 8-hour TWA); and</u>  <u>Prior to performing trigger tasks, and an exposure assessment has not been completed.</u>
<u>B. Additional BLL tests required to be made available.</u>	<u>For employees:</u>  <u>whose last BLL was <math>\geq 10 \mu\text{g}/\text{dl}</math>; or</u>



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	<p><u>who are exposed <math>\geq</math> action level for <math>\geq</math> 10 days in any 12 consecutive months; or</u></p> <p><u>who are exposed on any day <math>\geq</math> 100 <math>\mu\text{g}/\text{m}^3</math> as an 8-hour TWA; or</u></p> <p><u>who perform trigger tasks, and an exposure assessment has not been completed*.</u></p> <p><u>*Note that additional blood lead tests are not required for an employee who only performs level 1 trigger tasks and who performs these level 1 trigger tasks for &lt; 10 days in any 12 consecutive months, unless their last BLL was <math>\geq</math> 10 <math>\mu\text{g}/\text{dl}</math>.</u></p>
<p><u>C. Schedule of BLL tests required to be made available for employees when their:</u></p> <p><u>1. Last BLL was &lt; 10 <math>\mu\text{g}/\text{dl}</math>, and the employee is included in B above.</u></p> <p><u>2. Last BLL was <math>\geq</math> 10 <math>\mu\text{g}/\text{dl}</math> but &lt; 20 <math>\mu\text{g}/\text{dl}</math>.</u></p> <p><u>3. Last BLL was <math>\geq</math> 20 <math>\mu\text{g}/\text{dl}</math>.</u></p>	<p><u>Every 2 months for the first 6 months after initial placement, and also for the first 6 months after a change in task resulting in higher exposure, and then every 6 months.</u></p> <p><u>Every 2 months. Continue until 2 BLLs, taken at least 30 days apart, are &lt; 10 <math>\mu\text{g}/\text{dl}</math>.</u></p> <p><u>Every 1 month.</u></p>
<p><u>D. Schedule of BLL tests required to be made available for employees whose airborne exposure is above 500 <math>\mu\text{g}/\text{m}^3</math> as an 8-hour TWA.</u></p>	<p><u>Every 1 month. Include a blood test taken within 3 days after discontinuing all work associated with airborne exposure &gt; 500 <math>\mu\text{g}/\text{m}^3</math> as an 8-hour TWA.</u></p>
<p><u>E. Schedule of BLL tests required to be made available for employees who perform a level 3 trigger task, and an exposure assessment has not been completed.</u></p>	<p><u>Every 1 month. Include a blood test taken within 3 days after discontinuing all level 3 trigger task work.</u></p>
<p><u>F. Initial medical examination and consultation required to be made available.</u></p>	<p><u>Prior to assignment for employees who will be:</u></p> <p><u>exposed <math>\geq</math> the action level for <math>\geq</math> 10 days in any 12 consecutive months; or</u></p>

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	<p><u>exposed on any day <math>\geq 100 \mu\text{g}/\text{m}^3</math> as an 8-hour TWA; or</u></p> <p><u>performing trigger tasks, and an exposure assessment has not been completed*.</u></p> <p><u>*Note that medical examinations are not required for an employee who only performs level 1 trigger tasks and who performs these level 1 trigger tasks for &lt; 10 days in any 12 consecutive months.</u></p>
<u>G. Additional medical examinations and consultations required to be made available.</u>	<p><u>For employees who are:</u></p> <p><u>exposed <math>\geq</math> the action level for <math>\geq 10</math> days in any 12 consecutive months;</u></p> <p><u>exposed on any day <math>\geq 100 \mu\text{g}/\text{m}^3</math> as an 8-hour TWA; or</u></p> <p><u>performing trigger tasks, and an exposure assessment has not been completed*.</u></p> <p><u>*Note that medical examinations are not required for an employee who only performs level 1 trigger tasks and who performs these level 1 trigger tasks for &lt; 10 days in any 12 consecutive months.</u></p>
<u>H. Schedule of additional medical examinations and consultations required to be made available, for employees included in G above.</u>	<p><u>As soon as possible when an employee's BLL is <math>\geq 20 \mu\text{g}/\text{dl}</math>, if no lead-specific medical examination was done in the preceding 12 months; and</u></p> <p><u>annually until the employee's BLL is &lt; <math>20 \mu\text{g}/\text{dl}</math>.</u></p> <p><u>As soon as possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or past exposure to lead</u></p>

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	on the employee's ability to procreate a healthy child, that the employee is pregnant, or that the employee has demonstrated difficulty in breathing during a respirator fit test or during use.
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[Note: Exposure levels in Table 1 are without regard to an employee's use of a respirator.]

C. Medical Removal Protection

Results of ~~BLL testing~~biological monitoring or the recommendations of an examining physician may necessitate removal of an employee from further lead exposure pursuant to the standard's medical removal protection (MRP) program. The object of the MRP program is to provide temporary medical removal to ~~workers~~employees either with substantially elevated ~~blood lead levels~~BLLs or otherwise at risk of sustaining material health impairment from continued substantial exposure to lead.

Under the standard's ~~ultimate worker~~employee medical removal criteria, an ~~worker~~employee is to be removed from any work having an eight hour TWA exposure to lead of  $30 \mu\text{g}/\text{m}^3$  ~~when his or her blood lead level reaches  $50 \mu\text{g}/\text{dl}$  and is confirmed by a second follow-up blood lead level performed within two weeks after the employer receives the results of the first blood sampling test.~~ Return of the employee to his or her job status depends on a worker's blood lead level declining to  $40 \mu\text{g}/\text{dl}$  an exposure to lead at or above the action level, involving a trigger task as listed in subsection (d)(2) of the lead standard, or altering or disturbing any material containing lead at a concentration equal to or greater than 0.5% by weight, on each occasion that:

1. The last blood lead test indicates that the employee's BLL is at or above  $30 \mu\text{g}/\text{dl}$ ; or
2. Effective [OAL insert 1 year from effective date here], the last two blood lead test results are at or above  $20 \mu\text{g}/\text{dl}$ ; or
3. Effective [OAL insert 1 year from effective date here], the average of the results of all blood lead tests conducted in the last 6 months is at or above  $20 \mu\text{g}/\text{dl}$ .

Medical removal is to continue until two consecutive BLLs, taken at least 30 days apart, are below  $15 \mu\text{g}/\text{dl}$ .

~~As part of the interim standard, the employer is required to notify in writing each employee whose blood lead level exceeds  $40 \mu\text{g}/\text{dl}$ . In addition each such employee is to be informed that the standard requires medical removal with MRP benefits, discussed below, when an employee's blood lead level exceeds the above defined limit.~~

In addition to the above ~~blood lead level~~BLL criteria~~en~~, temporary ~~medical worker~~ removal for employees may also take place as a result of medical determinations and recommendations. ~~A~~ Writtenwritten medical opinions must be prepared after each examination pursuant to the standard. If

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the examining physician includes a medical finding, determination or opinion that the employee has a ~~medical~~health-related condition which places the employee's health, including the ability to procreate a healthy child, at increased risk of material ~~health~~ impairment from exposure to lead, then the employee must be removed from work having an exposure to lead at or above the action level, involving a trigger task as listed in subsection (d)(2) of the lead standard, or altering or disturbing any material containing lead at a concentration equal to or greater than 0.5% by weight~~exposure to lead at or above 30 µg/m<sup>3</sup>.~~ Alternatively, if the examining physician recommends special protective measures for an employee (e.g., use of a powered air purifying respirator) or recommends limitations on an employee's exposure to lead, then the employer must implement these recommendations.

Monthly BLL tests must be made available during the medical removal period for an employee who is removed from exposure to lead due to an elevated BLL. In addition, unless an employee's exposure or work is covered by the exceptions described in subsection I.B. of this appendix, a medical examination is to be made available as soon as possible and then as medically appropriate to each employee removed from exposure to lead due to an elevated BLL or due to a risk of sustaining material impairment to health, or otherwise limited or specially protected pursuant to medical recommendations.

Recommendations may be more stringent than the specific provisions of the standard. The examining physician, therefore, is given broad flexibility to tailor special protective procedures to the needs of individual employees. This flexibility extends to the evaluation and management of pregnant ~~worker~~employees and male and female ~~worker~~employees who are planning to raise children. Based on the history, physical examination, and laboratory studies, the physician might recommend special protective measures or medical removal for an employee who is pregnant or who is planning to conceive a child when, in the physician's judgment, continued exposure to lead at the current job would pose a significant risk. The return of the employee to his or her former job status, or the removal of special protections or limitations, depends upon the examining physician determining that the employee is no longer at increased risk of material impairment or that special measures are no longer needed.

During the period of any form of special protection or removal, the employer must maintain the ~~worker's~~employee's earnings, seniority, and other employment rights and benefits (as though the ~~worker~~employee had not been removed) for a period of up to 18 months or for as long as the job the employee was removed from lasts if less than 18 months. This economic protection will maximize meaningful ~~worker~~employee participation in the medical surveillance program, and is appropriate as part of the employer's overall obligation to provide a safe and healthful workplace. The provisions of MRP benefits during the employee's removal period may, however, be conditioned upon participation in medical surveillance.

On rare occasions, an employee's BLL may not acceptably decline within 18 months of removal. This situation will arise only in unusual circumstances, thus the standard relies on an individual medical examination to determine how to protect such an employee. This medical determination is to be based on both laboratory values, including BLLs, zinc protoporphyrin levels, blood counts, and other tests felt to be warranted, as well as the physician's judgment that any symptoms or findings on physical

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examination are a result of lead toxicity. The medical determination may be that the employee is incapable of ever safely returning to their former job status. The medical determination may provide additional removal time past 18 months for some employees or specify special protective measures to be implemented.

The requirements of section 1532.1 for the temporary removal of an exposed employee and their subsequent return to work with lead are summarized in Table 2.

Table 2. Minimum Requirements During the Medical Removal Protection (MRP) Period.

<u>A. BLL requiring employee medical removal.</u>	<u>one BLL <math>\geq</math> 30 <math>\mu\text{g}/\text{dl}</math>; or</u>  <u>effective [OAL insert 1 year from effective date here], the last two BLLs are <math>\geq</math> 20 <math>\mu\text{g}/\text{dl}</math>; or</u>  <u>effective [OAL insert 1 year from effective date here], the average of all BLLs over the last 6 months is <math>\geq</math> 20 <math>\mu\text{g}/\text{dl}</math>.</u>
<u>B. MRP due to a final medical determination.</u>	<u>A written medical opinion on the employee's health status by the examining physician results in a medical finding, determination, or opinion that the employee has a detected health-related condition which places the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead.</u>
<u>C. Frequency of BLL tests required to be made available for an employee removed from exposure to lead because of an elevated BLL.</u>	<u>Every 1 month.</u>
<u>D. Medical examinations and consultations required to be made available.</u>	<u>As soon as possible, then as medically appropriate, for an employee:</u>  <u>who is exposed (without regard to respirator use) <math>\geq</math> the action level for <math>\geq</math> 10 days in any 12 consecutive months; or</u>  <u>who is exposed (without regard to respirator</u>

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	<p><u>use) on any day <math>\geq 100 \mu\text{g}/\text{m}^3</math> as an 8-hour TWA; or</u></p> <p><u>who performs trigger tasks, and an exposure assessment has not been completed*.</u></p> <p><u>*Note that medical examinations are not required for an employee who only performs level 1 trigger tasks and who performs these level 1 trigger tasks for &lt; 10 days in any 12 consecutive months.</u></p>
<u>E. Permissible working conditions for an employee on MRP.</u>	<p><u>Employee must be removed from any work:</u></p> <p><u>having an exposure to lead (without regard to respirator use) <math>\geq</math> the action level; or</u></p> <p><u>involving a trigger task; or</u></p> <p><u>altering or disturbing any material containing lead at a concentration <math>\geq 0.5\%</math> by weight.</u></p>
<u>F. When an employee has been placed on MRP due to elevated BLL, the BLL at which an employee shall be returned to their former work.</u>	<p><u>Two consecutive BLLs, taken at least 30 days apart, both indicate a BLL &lt; 15 <math>\mu\text{g}/\text{dl}</math>.</u></p>
<u>G. When an employee has been placed on MRP due to a final medical determination, the conditions under which an employee shall be returned to their former work.</u>	<p><u>A subsequent final medical determination results in a medical finding, determination, or opinion that the employee no longer has a detected health-related condition that places the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead.</u></p>

NOTE: When a medical opinion indicates that an employee is at risk of material impairment from exposure to lead, the physician can remove an employee from exposures exceeding the action level (or less) or recommend special protective measures as deemed appropriate and necessary. Medical monitoring during the medical removal period can be more stringent than noted in the table above if the physician so specifies. Return to work or removal of limitations and special protection is permitted when the physician indicates that the employee is no longer at risk of material impairment.

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The lead standard provides for a multiple physician review in cases where the employee wishes a second opinion concerning potential lead poisoning or toxicity. If an employee wishes a second opinion, he or she can make an appointment with a physician of his or her choice. This second physician will review the findings, recommendations or determinations of the first physician and conduct any examinations, consultations or tests deemed necessary in an attempt to make a final medical determination. If the first and second physicians do not agree in their assessment they must try to resolve their differences. If they cannot reach an agreement then they must designate a third physician to resolve the dispute.

D. Requirements for Providing Information to Laboratories, Employees, Employers, and Healthcare Providers

For Blood Lead Tests:

The employer must instruct the healthcare provider who orders blood lead tests to provide the analyzing laboratory with complete employee identification information. This information includes:

1. Employee name, date of birth, address, and phone number; and
2. Employer name, address, and phone number.

The employer must ensure that the ordering physician explains the findings of any blood lead test and notifies the employee of the following:

1. The results of the blood lead test;
2. Any recommended follow-up blood lead testing in accordance with subsection (j)(2)(A) and the timing of that recommended blood lead testing; and
3. If the employee's blood lead level is 20 µg/dl or greater, the recommendation that the employee undergo a medical examination by a physician if the employee has not had a lead-specific medical exam in the preceding 12 months.

In addition, the employer is required to provide a written notification to the employee within five working days after the receipt of the employee's blood lead test results. The employer must notify each employee:

1. Of that employee's BLL;
2. That the standard requires the employer to make medical examinations and consultations available to employees exposed at or above the action level, and as interim protection, to employees performing trigger tasks, unless an employee's exposure or work is covered by the exceptions in 1532.1(j)(1)(B). When they are required, the employer must make medical examinations and consultations available as soon as possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or past exposure to lead on the employee's ability to procreate a healthy child, or that the employee has demonstrated difficulty breathing during a respirator fit test or during use; and
3. That the standard requires medical removal with MRP benefits when an employee's BLL exceeds any of the limits defined for medical removal.

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For Medical Examination and Consultation:

The employer must provide examining and consulting physicians with the following specific information:

1. A copy of the lead regulations and all appendices;
2. ~~a~~ A description of the employee's duties as related to exposure;
3. ~~†~~ The exposure level or anticipated level to lead and any other toxic substances (if applicable);
4. ~~a~~ A description of personal protective equipment used;
5. Prior ~~blood lead levels~~ BLLs;
6. ~~and a~~ All prior written medical opinions regarding the employee in the employer's possession or control; and
7. A copy of the employer's written elevated blood lead level response plan (required when an employee's BLL is at or above 10 µg/dl).

The employer must ensure that the physician explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of each medical examination performed. The written report shall contain:

1. The physician's opinion as to whether the employee has any detected health-related condition that would place the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead;
2. Any recommended special protective measures to be provided to the employee, or recommended limitations to be placed upon the employee's exposure to lead;
3. Any recommended limitations upon the employee's use of respirators, including a determination of whether the employee should wear a powered air-purifying respirator (PAPR) instead of a non-powered air-purifying respirator;
4. The employee's BLL;
5. Any recommended follow-up blood lead testing and medical examinations and the timing of each; and
6. The physician's opinion as to whether the employee has any health-related condition, occupational or non-occupational, that dictates further medical examination or treatment.

The employer must also obtain from the physician and provide the employee with a written medical opinion from the examining physician within 30 days of the medical examination. The written opinion shall contain the following information:

1. The physician's opinion as to whether the employee has any detected health-related condition that would place the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead;
2. Any recommended special protective measures to be provided to the employee, or limitations to be placed upon the employee's exposure to lead;
3. Any recommended limitation upon the employee's use of respirators, including a determination of whether the employee can wear a PAPR if the physician determines that the employee cannot wear a negative pressure respirator; and
4. The employee's BLL.



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containing blood lead levels, the physician's opinion as to whether the employee is at risk of material impairment to health, any recommended protective measures for the employee if further exposure is permitted, as well as any recommended limitations upon an employee's use of respirators.

Employers must instruct each physician not to reveal to the employer in writing or in any other way his or her findings, laboratory results, or diagnoses which are felt to be unrelated to occupational lead exposure. They must also instruct each physician to advise the employee of any occupationally or non-occupationally related medical condition requiring further treatment or evaluation.

#### E. Additional Requirements

The standard provides for the use of respirators where engineering and other primary controls do not provide adequate protection are not effective. However, the use of respiratory protection shall not be used in lieu of temporary medical removal due to elevated blood lead levels BLLs or findings that an employee is at risk of material health impairment. This is based on the numerous inadequacies of respirators including skin rash where the facepiece makes contact with the skin, unacceptable stress to breathing in some ~~workers~~ employees with underlying cardiopulmonary impairment, difficulty in providing adequate fit, the tendency for respirators to create additional hazards by interfering with vision, hearing, and mobility, and the difficulties of assuring the maximum effectiveness of a complicated work practice program involving respirators. Respirators do, however, serve a useful function where engineering and work practice controls are inadequate by providing supplementary, interim, or short-term protection, provided they are properly selected for the environment in which the employee will be working, properly fitted to the employee, maintained and cleaned periodically, and worn by the employee when required. When respirators are required, filtering facepiece respirators (disposable respirators or dust masks) are not to be used for protection from lead. Also, a PAPR is much more protective than a typical negative pressure respirator, and may also be more comfortable to wear. The standard provides that an employer must provide a PAPR to an employee upon request.

~~In its standard on occupational exposure to inorganic lead in the construction industry, OSHA has prohibited prophylactic chelation is prohibited by the lead standard.~~ Diagnostic and therapeutic chelation are permitted only under the supervision of a licensed physician with appropriate medical monitoring in an acceptable clinical setting. The decision to initiate chelation therapy must be made on an individual basis and take into account the severity of symptoms felt to be a result of lead toxicity along with blood lead levels BLLs, zinc protoporphyrin (ZPP) levels, and other laboratory tests as appropriate. ~~EDTA~~ Calcium disodium EDTA (Ca Na<sub>2</sub> EDTA) and penicillamine succimer, which are the primary chelating agents used in the therapy of occupational lead poisoning, have significant potential side effects and their use must be justified on the basis of expected benefits to the ~~worker~~ employee. Unless frank and severe symptoms are ~~prevent~~ present, therapeutic chelation is not recommended, given the opportunity to remove an ~~worker~~ employee from exposure and allow the body to naturally excrete accumulated lead. As a diagnostic aid, the chelation mobilization test ~~using CA-EDTA~~ has limited applicability. It offers very limited utility as a biomarker of long-term lead exposure, and does not predict the clinical efficacy of chelation. ~~According to some investigators, the test can differentiate between lead-induced and other nephropathies. The test may also provide an estimation of the mobile fraction of the total body lead burden.~~

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Employers are required to ~~assure~~ensure that accurate records are maintained on exposure assessment, including environmental monitoring, medical surveillance, and medical removal for each employee. Exposure assessment records must be kept for at least 30 years. Medical surveillance records must be kept for the duration of employment plus 30 years except in cases where the employment was less than one year. If duration of employment is less than one year, the employer need not retain this record beyond the term of employment if the record is provided to the employee upon termination of employment. Medical removal records also must be maintained for the duration of employment. All records required under the standard must be made available upon request to the Cal/OSHA Chief, and the National Institute for Occupational Safety and Health (NIOSH). Employers must also make environmental and biological monitoring and medical removal records available to affected employees and to former employees or their authorized employee representatives. Employees or their specifically designated representatives have access to their entire medical surveillance records.

In addition, the standard requires that the employer inform all ~~worker~~employees who are exposed to lead at or above the action level  $30 \mu\text{g}/\text{m}^3$  on any one day; who are exposed to lead that may cause skin or eye irritation (e.g., lead arsenate, lead azide); or who perform trigger tasks of the provisions of the standard and all its appendices, the purpose and description of medical surveillance, and provisions for medical removal protection if temporary removal is required. An understanding of the potential health effects of lead exposure by all exposed employees along with full understanding of their rights under the lead standard is essential for an effective monitoring program.

## II. Adverse Health Effects of Inorganic Lead

Although the toxicity of lead has been known for 2,000 years, the knowledge of the complex relationship between lead exposure and human response is still being refined. Significant research into the toxic properties of lead continues throughout the world, ~~and it should be anticipated that our understanding of thresholds of effects and margins of safety will be improved in future years. The most recent scientific evidence shows multiple health effects at BLLs once thought to be without recognized harm. Prolonged exposure to these low levels of lead can result in adverse cumulative effects. These health effects may be permanent.~~

The provisions of the lead standard are founded on two prime medical judgments: ~~F~~first, the prevention of adverse health effects from exposure to lead throughout a working lifetime requires that ~~worker~~employee blood lead levels BLLs be maintained ~~at or below~~ as low as possible  $40 \mu\text{g}/\text{dl}$ , and second, the ~~blood lead levels~~ BLLs of ~~female worker~~female employees, male or female, who are trying to conceive ~~intend to parent in the near future~~ should be maintained below  $50 \mu\text{g}/\text{dl}$  to minimize adverse reproductive health effects to the ~~mother~~parents and developing fetus. The lead standard is designed to detect BLL increases early and take action to control exposures. The adverse effects of lead on reproduction are being actively researched and Cal/OSHA encourages the physician to remain abreast of recent developments in the area to best advise pregnant ~~worker~~employees or ~~worker~~employees planning to conceive children.

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The spectrum of health effects caused by lead exposure can be subdivided into ~~five~~four developmental stages: ~~Normal~~, physiological changes of uncertain significance, pathophysiological changes, overt symptoms (morbidity), and mortality. Within this process there are no sharp distinctions, but rather a continuum of effects. Boundaries between categories overlap due to the wide variation of individual responses and exposures in the working population. OSHA's development of the lead standard focused on pathophysiological changes as well as later stages of disease.

In terms of mechanisms of disease, lead interferes with cellular metabolism in tissues throughout the body. As a divalent cation, lead interferes with calcium metabolism which affects, for example, neurotransmission and vascular tone. Lead has a high affinity for negatively charged sulfhydryl groups, ultimately affecting the synthesis of heme required for production of hemoglobin, cytochromes involved in cellular respiration, and microsomal oxidases involved in biotransformation pathways. In addition, lead increases reactive oxygen species, which effects vascular tone. Lead also affects cell membranes and nucleic acids with multi-system effects. In the nervous system, lead alters the permeability of the blood brain barrier and accumulates in astroglia. Other modes of action include cell death, genotoxicity, inflammation, and endocrine disruption.

1. Cardiovascular Effects. Current evidence indicates a causal relationship between lead exposure and hypertension, and between lead exposure and coronary heart disease. Various mechanisms of action may mediate the hypertensive effect, including oxidative stress, inflammation, hormonal and blood pressure regulatory-system dysfunction, and vasomodulator imbalance. These mechanisms, and possibly subclinical atherosclerosis which has been demonstrated in some studies, likewise contribute to coronary heart disease. Since hypertension is a significant risk factor for heart disease, stroke, and renal insufficiency, lead exposure may exert an important influence on cardiovascular, cerebrovascular, and renovascular mortality. Prospective cohort studies have demonstrated an approximate 50% increase in cardiovascular mortality associated with chronic BLLs of 10 µg/dl or greater.

12. Heme Synthesis Inhibition. The earliest ~~demonstrated~~hematologic effect of lead involves lead's ability to inhibit at least two enzymes of the heme synthesis pathway at very low ~~blood levels~~BLLs. Inhibition of delta-aminolevulinic acid dehydratase (ALA-D) which catalyzes the conversion of delta-aminolevulinic acid (ALA) to protoporphyrin is observed at a ~~blood lead level~~BLL ~~below 20~~as low as 10 µg/dl. At a ~~blood lead level~~BLL of 40 µg/dl, more than 20% of the population would have 70% inhibition of ALA-D. There is an exponential increase in ALA excretion at ~~blood lead levels~~BLLs greater than 40 µg/dl.

Another enzyme, ferrochelatase, is also inhibited at low ~~blood lead levels~~BLLs. Inhibition of ferrochelatase leads to increased free erythrocyte protoporphyrin (FEP) in the blood which can then bind to zinc to yield zinc protoporphyrin (ZPP). At a ~~blood lead level~~BLL of 50 µg/dl or greater, nearly 100% of the population will have an increase in FEP. There is also an exponential relationship between ~~blood lead levels~~BLLs greater than 40 µg/dl and the associated ZPP level, which has led to the development of the ZPP screening test for lead exposure.

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While the significance of these effects is subject to debate, ~~it is Cal/OSHA's position that~~ these enzyme disturbances are early stages of a disease process which ~~may~~ eventually results in the clinical symptoms of lead poisoning. Whether or not the effects do progress to the later stages of clinical disease, disruption of these enzyme processes over a working lifetime is ~~considered to be~~ a material impairment of health.

One of the eventual results of lead-induced inhibition of enzymes in the heme synthesis pathway is anemia which can be asymptomatic if mild, but is associated with a wide array of symptoms including dizziness, fatigue, and tachycardia when more severe. Recent evidence suggests that bone lead stores may exert a subclinical effect on hematopoiesis, since bone lead levels have been found to correlate with decreased hemoglobin and hematocrit in individuals with low BLLs (mean BLL < 10 µg/dl). Studies have indicated that Once BLLs lead levels reach as low as 50 µg/dl, can be associated with a definite decreased in hemoglobin is evident, although most cases of lead-induced anemia, as well as shortened red-cell survival times, occur at BLLs lead levels exceeding 80 µg/dl. Inhibited hemoglobin synthesis is more common in chronic cases, whereas shortened erythrocyte life span is more common in acute cases.

In lead-induced anemias, there is usually a reticulocytosis along with the presence of basophilic stippling, and ringed sideroblasts, although none of the above are pathognomonic for lead-induced anemia.

23. Neurological Effects. Inorganic lead has been found to have toxic effects on both the central and peripheral nervous systems. The earliest stages of lead-induced central nervous system effects are first manifested by themselves in the form of behavioral disturbances and central nervous system symptoms including irritability, restlessness, insomnia and other sleep disturbances, fatigue, vertigo, headache, poor memory, tremor, depression, and apathy. With more severe exposure, symptoms can progress to drowsiness, stupor, hallucinations, delirium, convulsions, and coma.

The most severe and acute form of lead poisoning which usually follows ingestion or inhalation of large amounts of lead is acute encephalopathy which may arise precipitously with the onset of intractable seizures, coma, ~~cardiopulmonary respiratory~~ arrest, and death within 48 hours.

While there is disagreement about what exposure levels are needed to produce the earliest symptoms, most experts agree that symptoms and neurocognitive deficits definitely can occur at ~~blood lead levels~~ BLLs of 60 40 µg/dl whole blood. Subclinical neurocognitive deficits are possible at lower levels, and therefore ~~recommend a 40~~ 10 µg/dl maximum is recommended. The central nervous system effects frequently are not reversible following discontinued exposure or chelation therapy and when improvement does occur, it is almost always only partial.

The peripheral neuropathy resulting from lead exposure characteristically involves only motor function with minimal sensory damage and has a marked predilection for the extensor muscles of the most active extremity. The peripheral neuropathy can occur with varying degrees of severity. The earliest and mildest form which can be detected in ~~workers~~ employees with ~~blood lead levels~~ BLLs as low as 50 30

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µg/dl is manifested by slowing of motor nerve conduction velocity often without clinical symptoms. With progression of the neuropathy there is development of painless extensor muscle weakness usually involving the extensor muscles of the fingers and hand in the most active upper extremity, followed in severe cases by wrist drop or, much less commonly, foot drop.

In addition to slowing of nerve conduction, electromyographical studies in patients with ~~blood lead levels~~ BLLs greater than 50 µg/dl have demonstrated a decrease in the number of acting motor unit potentials, an increase in the duration of motor unit potentials, and spontaneous pathological activity including fibrillations and fasciculations. Essential tremor in some studies has been shown to occur at BLLs less than 10 µg/dl. ~~Whether these effects occur at levels of 40 µg/dl is undetermined.~~

While the peripheral neuropathies can occasionally be reversed with therapy, again such recovery is not ~~assured~~ ensured particularly in the more severe neuropathies and often improvement is only partial. The lack of reversibility is felt to be due in part to segmental demyelination.

~~34.~~ Gastrointestinal. Lead may also affect the gastrointestinal system producing abdominal colic or diffuse abdominal pain, constipation, obstipation, diarrhea, anorexia, nausea, and vomiting. Lead colic may develop at chronic BLLs of 40 µg/dl and greater, or at acutely elevated BLLs of 80 µg/dl or greater rarely develops at blood lead levels below 80 µg/dl.

~~45.~~ Renal. Renal toxicity represents one of the most serious health effects of lead poisoning. Kidney dysfunction is thought to occur at chronic BLLs of 5-10 µg/dl or greater but also may arise after acute high-dose lead exposures. In the early stages of disease nuclear inclusion bodies can frequently be identified in proximal renal tubular cells. Renal function remains normal and the changes in this stage are probably reversible. With more advanced disease there is progressive interstitial fibrosis and impaired renal function. Eventually extensive interstitial fibrosis ensues with sclerotic glomeruli and dilated and atrophied proximal tubules; all represent end stage kidney disease. Azotemia can be progressive, eventually resulting in frank uremia necessitating dialysis. There is occasionally associated hypertension and hyperuricemia with or without gout.

Early kidney disease is difficult to detect. The urinalysis is normal in early lead nephropathy and the blood urea nitrogen and serum creatinine increase only when two-thirds of kidney function is lost. Measurement of creatinine clearance can often detect earlier disease as can other methods of measurement of glomerular filtration rate. An abnormal Ca-EDTA-chelation mobilization test has been used to differentiate between lead-induced and other nephropathies, but this procedure is not widely accepted. ~~A form of Fanconi syndrome with aminoaciduria, glycosuria, and hyperphosphaturia indicating severe injury to the proximal renal tubules is occasionally seen in children.~~

~~56.~~ Reproductive eEffects. Exposure to lead can have serious effects on reproductive function in both males and females. In male ~~workersemployees~~ exposed to lead there can be a decrease in sexual drive, impotence, decreased ability to produce healthy sperm, and sterility. Malformed sperm (teratospermia), decreased number of sperm (hypospermia), and sperm with decreased motility (asthenospermia) can all occur. ~~Teratospermia has been noted at mean blood lead levels of 53 µg/dl and hypospermia and~~

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~~asthenospermia at 41 µg/dl. These adverse effects may occur at BLLs of 20 µg/dl or greater.~~  
Furthermore, there appears to be a dose-response relationship for teratospermia in lead-exposed ~~worker~~employees.

Women exposed to lead may experience menstrual disturbances including dysmenorrhea, menorrhagia, and amenorrhea. Following exposure to lead, women have a higher frequency of sterility, premature births, ~~spontaneous~~-miscarriages, and stillbirths.

Germ cells can be affected by lead and lead can cause genetic damage in the egg or sperm cells before conception and result in failure to implant, miscarriage, stillbirth, or birth defects.

Infants of mothers with lead poisoning have a higher mortality during the first year and suffer from lowered birth weights, slower growth, and nervous system disorders.

Lead can pass through the placental barrier and lead levels in the mother's blood are comparable to concentrations of lead in the umbilical cord at birth. Transplacental passage becomes detectable at 12-14 weeks of gestation and increases until birth.

There is little direct data on damage to the fetus from exposure to lead but it is generally assumed that the fetus and newborn would be at least as susceptible to neurological damage as young children. Current evidence indicates that there is no known lower limit of toxicity at any age. Blood lead levels of 50-60 µg/dl ~~Lead exposure~~ in children can cause significant neurobehavioral impairments including cognitive dysfunction and ~~there is evidence of hyperactivity at blood levels as low as 25 µg/dl. Given the overall body of literature concerning the adverse health effects of lead in children, Cal/OSHA feels that the blood lead level in children should be maintained below 30 µg/dl with a population mean of 15 µg/dl. Blood lead levels in the fetus and newborn likewise should not exceed 30 µg/dl. Therefore, women planning to conceive should maintain BLLs less than 5 µg/dl.~~

~~Because of lead's ability to pass through the placental barrier and also because of the demonstrated adverse effects of lead on reproductive function in both the male and female as well as the risk of genetic damage of lead on both the ovum and sperm, Cal/OSHA recommends a 30 µg/dl maximum permissible blood lead level in both males and females who wish to bear children.~~

67. Other Toxic Effects. Debate and research continue on the effects of lead on the human body. Lead may impair the immune and endocrine systems, including thyroid function and the pituitary-adrenal axis, but these effects have not been well defined. Also, although the epidemiologic data is limited and inconsistent, based on toxicologic data and animal studies, lead is considered a probable human carcinogen by several authoritative sources. ~~Hypertension has frequently been noted in occupationally exposed individuals although it is difficult to assess whether this is due to lead's adverse effects on the kidney or if some other mechanism is involved. Vascular and electrocardiographic changes have been detected but have not been well characterized. Lead is thought to impair thyroid function and interfere with the pituitary-adrenal axis, but again these effects have not been well defined.~~

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## III. Medical Evaluation

The most important principle in evaluating an ~~worker~~employee for any occupational disease including lead poisoning is a high index of suspicion on the part of the examining physician. As discussed in ~~Section 211~~, lead can affect numerous organ systems and produce a wide array of signs and symptoms, most of which are non-specific and subtle in nature at least in the early stages of disease. Unless serious concern for lead toxicity is present, many of the early clues to diagnosis may easily be overlooked.

The crucial initial step in the medical evaluation is recognizing that an ~~worker's~~employee's employment can result in exposure to lead. The ~~worker~~employee will frequently be able to define exposures to lead and lead containing materials but often will not volunteer this information unless specifically asked. In other situations the ~~worker~~employee may not know of any exposures to lead but the suspicion might be raised on the part of the physician because of the industry or occupation of the ~~worker~~employee. Potential occupational exposure to lead and its compounds occur in many occupations in the construction industry, including demolition and salvaging operations, painting, removal or encapsulation of materials containing lead, construction, alteration, repair or renovation of structures containing lead, transportation, disposal, storage or containment of lead or lead-containing materials on construction sites, and maintenance operations associated with construction activities.

Once the possibility for lead exposure is raised, the focus can then be directed toward eliciting information from the medical history, physical exam, and finally from laboratory data to evaluate the ~~worker~~employee for potential lead toxicity.

A complete and detailed work history is important in the initial evaluation. A listing of all previous employment with information on job description, exposure to fumes or dust, known exposures to lead or other toxic substances, a description of any personal protective equipment used, and previous medical surveillance should all be included in the ~~worker's~~employee's record. Where exposure to lead is suspected, information concerning on-the-job personal hygiene, smoking, ~~or eating~~ and drinking habits in work areas, laundry procedures, and use of any protective clothing or respiratory protection equipment should be noted. A complete work history is essential in the medical evaluation of an ~~worker~~employee with suspected lead toxicity, especially when long term effects such as neurotoxicity and nephrotoxicity are considered.

The medical history is also of fundamental importance and should include a listing of all past and current ~~medical~~health-related conditions, current medications including proprietary drug intake and ethnic remedies, previous surgeries and hospitalizations, allergies, smoking history, alcohol consumption, and also non-occupational lead exposures such as hobbies (hunting, riflery). Also known childhood exposures should be elicited. Any previous history of cardiovascular, hematological, neurological, gastrointestinal, renal, psychological, gynecological, genetic, or reproductive problems should be specifically noted.

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A careful and complete review of systems must be performed to assess both recognized complaints and subtle or slowly acquired symptoms which the ~~worker~~employee might not appreciate as being significant. The review of symptoms should include the following:

1. General - weight loss, fatigue, decreased appetite.
2. Head, Eyes, Ears, Nose, Throat (HEENT) - headaches, visual disturbances or decreased visual acuity, hearing deficits or tinnitus, pigmentation of the oral mucosa, or metallic taste in mouth.
3. Cardio-pulmonary - shortness of breath, cough, chest pains, palpitations, or orthopnea.
4. Gastrointestinal - nausea, vomiting, heartburn, abdominal pain, constipation, or diarrhea.
5. Neurologic - irritability, insomnia, weakness (fatigue), dizziness, loss of memory, confusion, hallucinations, incoordination, ataxia, decreased strength in hands or feet, disturbances in gait, difficulty in climbing stairs, or seizures.
6. Hematologic - pallor, easy fatigability, abnormal blood loss, or melena.
7. Reproductive (male and female, and spouse where relevant) - history of infertility, impotence, loss of libido, abnormal menstrual periods, history of miscarriages, stillbirths, or children with birth defects.
8. Musculo-skeletal - muscle and joint pains.

The physical examination should emphasize the neurological, gastrointestinal, and cardiovascular systems. The ~~worker's~~employee's weight and blood pressure should be recorded. Historically, and the oral mucosa was checked for pigmentation characteristic of a possible Burtonian or lead line on the gingiva. ~~It should be noted, however,~~However, that the lead line may not be present even in severe lead poisoning if good oral hygiene is practiced.

The presence of pallor on skin examination may indicate an anemia which, if severe, might also be associated with a tachycardia. If an anemia is suspected, an active search for blood loss should be undertaken including potential blood loss through the gastrointestinal tract.

A complete neurological examination should include an adequate mental status evaluation including a search for behavioral and psychological disturbances, memory testing, evaluation for irritability, insomnia, hallucinations, and mental clouding. Gait and coordination should be examined along with close observation for tremor. A detailed evaluation of peripheral nerve function including careful sensory and motor function testing is warranted. Strength testing particularly of extensor muscle groups of all extremities is of fundamental importance.

Cranial nerve evaluation should also be included in the routine examination.



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The abdominal examination should include auscultation for bowel sounds and abdominal bruits and palpation for organomegaly, masses, and diffuse abdominal tenderness.

Cardiovascular examination should evaluate possible early signs of ischemic heart disease and congestive heart failure. Pulmonary status should be addressed particularly if respiratory protection is contemplated.

As part of the medical evaluation, the ~~interim~~ lead standard requires the following laboratory studies:

1. Blood lead level;
2. Hemoglobin and hematocrit determinations, red cell indices, and examination of the peripheral blood smear to evaluate red blood cell morphology;
3. Blood urea nitrogen;
4. Serum creatinine;
5. Routine urinalysis with microscopic examination;
6. A zinc protoporphyrin (ZPP) level for each employee whose last BLL was at or above 20 µg/dl.

In addition~~al~~ to the above, the physician is authorized to order any further laboratory or other tests which he or she deems necessary in accordance with sound medical practice. The evaluation must also include pregnancy testing or laboratory evaluation of male fertility if requested by the employee. Additional tests which are probably not warranted on a routine basis but may be appropriate when blood lead and ZPP levels are equivocal include delta-aminolevulinic acid and coproporphyrin concentrations in the urine, and dark-field illumination for detection of basophilic stippling in red blood cells.

If an anemia is detected further studies including a careful examination of the peripheral smear, reticulocyte count, stool for occult blood, serum iron, total iron binding capacity, bilirubin, and, if appropriate, vitamin B12 and folate may be of value in attempting to identify the cause of the anemia.

If a peripheral neuropathy is suspected, nerve conduction studies are warranted both for diagnosis and as a basis to monitor any therapy.

If renal disease is questioned, a 24-hour urine collection for creatinine clearance, protein, and electrolytes may be indicated. Elevated uric acid levels may result from lead-induced renal disease and a serum uric acid level might be performed.

An electrocardiogram and chest x-ray may be obtained as deemed appropriate.

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Sophisticated and highly specialized testing should not be done routinely and where indicated should be under the direction of a specialist.

#### IV. Laboratory Evaluation

The ~~blood lead level~~BLL at present remains the single most important test to monitor lead exposure and is the test used in the medical surveillance program under the lead standard to guide employee medical removal. ~~The ZPP has several advantages over the blood lead level. Because of its relatively recent development and the lack of extensive data concerning its interpretation, the~~The ZPP currently remains an ancillary test due to its lack of sensitivity.

This section will discuss the ~~blood lead level~~BLL and ZPP in detail and will outline their relative advantages and disadvantages. Other blood tests currently available to evaluate lead exposure will also be reviewed.

~~The blood lead level is a good index of current or recent lead absorption when there is no anemia present and when the worker has not taken any chelating agents. However, blood lead levels along with urinary lead levels do not necessarily indicate the total body burden of lead and are not adequate measures of past exposure.~~ BLL, a measure of the amount of lead currently found in the blood, reflects both recent exogenous exposure as well as endogenous redistribution of lead stored in bone. BLL does not reflect the total body burden. One reason for this is that lead has a high affinity for bone and up to 90% of the body's total lead is deposited there. A very important component of the total lead body burden is lead in soft tissue (liver, kidney, and brain). This fraction of the lead body burden, the biologically active lead, is not entirely reflected by ~~blood lead levels~~BLLs since it is a function of the dynamics of lead absorption, distribution, deposition in bone and excretion. Following discontinuation of exposure to lead, the excess body burden is only slowly mobilized from bone and other relatively stable body stores and excreted.

When interpreting a person's BLL, three key questions to keep in mind are whether the exposure history has been acute or chronic; recent or remote; high or low. For instance, ~~Consequently,~~ a high ~~blood lead level~~BLL may only represent recent heavy exposure to lead without a significant total body excess and likewise a low ~~blood lead level~~BLL does not exclude an elevated total body burden of lead.

Also due to its correlation with recent exposures, the ~~blood lead level~~BLL may vary considerably over short time intervals.

To minimize laboratory error and erroneous results due to contamination, blood specimens must be carefully collected after thorough cleaning of the skin with appropriate methods using lead-free blood containers and analyzed by a reliable laboratory. Under the standard, samples must be analyzed in laboratories that are CLIA-approved (under the federal Clinical Laboratory Improvement Amendments (CLIA) regulations), which are approved by OSHA. Analysis is to be made using atomic absorption spectrophotometry, anodic stripping voltammetry or any method which meets the accuracy requirements set forth by the standard.

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The determination of lead in urine is generally considered a less reliable monitoring technique than analysis of whole blood primarily due to individual variability in urinary excretion capacity as well as the technical difficulty of obtaining accurate 24-hour urine collections. In addition, ~~workers~~employees with renal insufficiency, whether due to lead or some other cause, may have decreased lead clearance and consequently urine lead levels may underestimate the true lead burden. Therefore, urine lead levels should not be used as a routine test.

~~The zinc protoporphyrin test, unlike the blood lead determination, measures an adverse metabolic effect of lead and as such is a better indicator of lead toxicity than the level of blood lead itself. The level of ZPP reflects lead absorption over the preceding 3 to 4 months, and therefore is a better indicator of lead body burden. The ZPP requires more time than the blood lead to reach significantly elevated levels; the return to normal after discontinuing lead exposure is also slower. Furthermore, the ZPP test is simpler, faster, and less expensive to perform and no contamination is possible. Many investigators believe it is the most reliable means of monitoring chronic lead absorption.~~

The ZPP test, unlike the blood lead determination, is an indirect and relatively insensitive biomarker of lead absorption. Zinc protoporphyrin results from the inhibition of the enzyme ferrochelatase which catalyzes the insertion of an iron molecule into the protoporphyrin molecule, which then becomes heme. If iron is not inserted into the molecule, then zinc, having a greater affinity for protoporphyrin, takes the place of the iron, forming ZPP. The level of circulating ZPP may not rise until a BLL of 20 µg/dl in some adults and is not greater than 90% sensitive until the BLL exceeds 50 µg/dl. An elevation in the level of circulating ZPP may occur at blood lead levels as low as 20-30 µg/dl in some workers. Once the blood lead level has reached 40 µg/dl there is more marked rise in the ZPP value from its normal range of less than 100 µg/dl/100 ml. Increases in blood lead levels/BLLs beyond 40 µg/dl/100 g are associated with exponential increases in ZPP. The upper limit of normal for ZPP varies some between labs but is usually between 35 and 40 µg/dl.

Whereas blood lead levels/BLLs fluctuate over short time spans, ZPP levels remain relatively stable. ZPP is measured directly in red blood cells and is present for the cell's entire 120 day life-span. Therefore, the ZPP level in blood reflects the average ZPP production over the previous 3-4 months and consequently the average lead exposure during that time interval. The ZPP requires more time than the blood lead to reach significantly elevated levels; the return to normal after discontinuing lead exposure is also slower, lagging the BLL by about 2-6 weeks. Therefore, the ZPP may be useful to assess chronicity of exposure. For example, an elevated BLL and normal ZPP suggest recent exposure, while an elevated BLL and elevated ZPP suggest chronic/ongoing exposure.

It is recommended that a hematocrit be determined whenever a confirmed ZPP of 50 µg/dl/100 ml whole blood is obtained to rule out a significant underlying iron deficiency anemia. If the ZPP is in excess of 100 µg/dl/100 ml and not associated with abnormal elevations in blood lead levels/BLLs, the laboratory should be checked to be sure that blood leads were determined using a laboratory that is CLIA-approved atomic absorption spectrophotometry anodic stripping voltammetry, or any method which meets the accuracy requirements set forth by the standard by an OSHA approved laboratory

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~~which is experienced in lead level determinations.~~ Repeat periodic blood lead studies should be obtained in all individuals with elevated ZPP levels to be certain that an associated elevated ~~blood lead level~~ BLL has not been missed due to transient fluctuations in blood leads.

ZPP has a characteristic fluorescence spectrum with a peak at 594 ~~nanometers~~nm which is detectable with a hematofluorimeter. The hematofluorimeter is accurate and portable and can provide on-site, instantaneous results for ~~worker~~employees who can be frequently tested via a finger prick.

However, careful attention must be given to calibration and quality control procedures. Limited data on blood lead-ZPP correlations and the ZPP levels which are associated with the adverse health effects discussed in ~~Section 2II~~ are the major limitations of the test. Also it is difficult to correlate ZPP levels with environmental exposure and there is some variation of response with age and sex. ~~Nevertheless, the ZPP promises to be an important diagnostic test for the early detection of lead toxicity and its value will increase as more data is collected regarding its relationship to other manifestations of lead poisoning.~~

Levels of delta-aminolevulinic acid (ALA) in the urine are also used as a measure of lead exposure. Increasing concentrations of ALA are believed to result from the inhibition of the enzyme delta-aminolevulinic acid dehydratase (ALA-D). Although the test is relatively easy to perform, inexpensive, and rapid, the disadvantages include variability in results, the necessity to collect a complete 24 hour urine sample which has a specific gravity greater than 1.010, and also the fact that ALA decomposes in the presence of light.

The pattern of porphyrin excretion in the urine can also be helpful in identifying lead intoxication. With lead poisoning, the urine concentrations of coproporphyrins I and II, porphobilinogen and uroporphyrin I rise. The most important increase, however, is that of coproporphyrin III; ~~levels may exceed 5,000 µg/L in the urine in lead poisoned individuals,~~ but its correlations with ~~blood lead levels~~BLLs and ZPP are not as good as those of ALA. Increases in urinary porphyrins are not diagnostic of lead toxicity and may be seen in porphyria, some liver diseases, and in patients with high reticulocyte counts.

V. Summary. The standard for inorganic lead in the construction industry places significant emphasis on the medical surveillance of all ~~worker~~employees exposed to levels of inorganic lead at or above the action level of 2.30µg/m<sup>3</sup> TWA, and as interim protection for employees performing trigger tasks. The physician has a fundamental role in this surveillance program, and in the operation of the medical removal protection program.

Even with adequate ~~worker~~employee education on the adverse health effects of lead and appropriate training in work practices, personal hygiene and other control measures, the physician has a primary responsibility for evaluating potential lead toxicity in the ~~worker~~employee. It is only through a careful and detailed medical and work history, a complete physical examination, and appropriate laboratory testing that an accurate assessment can be made. Many of the adverse health effects of lead toxicity are either irreversible or only partially reversible and therefore early detection of disease is very important.

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This document outlines the medical monitoring program as defined by the occupational safety and health standard for inorganic lead. It reviews the adverse health effects of lead poisoning and describes the important elements of the history and physical examinations as they relate to these adverse effects. Finally, the appropriate laboratory testing for evaluating lead exposure and toxicity is presented.

It is hoped that this review and discussion will give ~~the~~ physicians a better understanding of the Cal/OSHA lead standard, with the ultimate goal of protecting the health and well-being of ~~the worker~~ employees exposed to lead who are under ~~his or her~~ their care.

~~Appendix D to § 1532.1 – Qualitative and Quantitative Fit Test Protocols~~

~~[See Section 5144, Appendix A]~~

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Subchapter 7. General Industry Safety Orders  
Group 16. Control of Hazardous Substances  
Article 107. Dusts, Fumes, Mists, Vapors and Gasses

Amend Section 5155 as follows:

§5155. Airborne Contaminants.

(a) Scope and Application.

(1) This section establishes requirements for controlling employee exposure to airborne contaminants and skin contact with those substances which are readily absorbed through the skin and are designated by the "S" notation in Table AC-1 at all places of employment in the state.

\* \* \* \* \*

Table AC-1  
PERMISSIBLE EXPOSURE LIMITS FOR CHEMICAL CONTAMINANTS

<i>Chemical Abstracts Registry</i>			<i>PEL<sup>(d)</sup></i>		<i>STEL<sup>(o)</sup></i>	
<i>Number<sup>(a)</sup></i>	<i>Skin<sup>(b)</sup></i>	<i>Name<sup>(c)</sup></i>	<i>ppm<sup>(e)</sup></i>	<i>mg/M<sup>3(f)</sup></i>	<i>Ceiling<sup>(g)</sup></i>	<i>ppm<sup>(e)</sup> mg/M<sup>3(f)</sup></i>

\* \* \* \* \*

7758976		Lead chromate, as Pb	--	<u>0.020.01</u>		
		as Cr	--	0.005		
		(see also Sections 5198, 1532.1, 1532.2, 5206 & 8359)				
<u>7439921</u>		Lead (metallic) and inorganic compounds, dust and fume, as Pb	--	<u>0.050.01</u>		
		(see also Sections 5198 & 1532.1)				

\* \* \* \* \*

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Sections 142.3 and 144.6, Labor Code.

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Subchapter 7. General Industry Safety Orders  
Group 16. Control of Hazardous Substances  
Article 109. Hazardous Substances and Processes

Amend Section 5198 as follows:

§5198. Lead.

(a) Scope and Application.

(1) This section applies to all occupational exposure to lead, except as provided in ~~paragraph~~subsection (a)(2).

(2) This section does not apply to the construction industry or to agricultural operations.

(b) Definitions.

For purposes of this section, the definitions in section 5161 do not apply to the terms used throughout this section.

Action Level. Employee exposure, without regard to the use of respirators, to an airborne concentration of lead at an 8-hour time-weighted average concentration of 230 micrograms per cubic meter of air ( $230 \mu\text{g}/\text{m}^3$ ), calculated as an 8-hour time-weighted average (TWA).

Altering or disturbing. Subjecting to a process that may result in the release of lead dust, lead mist, lead fume, or other lead particles. Such processes include, but are not limited to, welding, torch cutting, brazing, torch soldering, melting, pouring, spraying, cutting, shredding, crushing, baling, grinding, polishing, machining, drilling, scraping, sanding, abrading, sweeping, raking, and shoveling.

Blood lead level. The concentration of lead measured in whole blood, expressed as micrograms per deciliter ( $\mu\text{g}/\text{dl}$ ) of whole blood.

Chief. The Chief of the Division of Occupational Safety and Health, P.O. Box 420603, San Francisco, California 94142 or designee.

Director. The Director, National Institute for Occupational Safety and Health (NIOSH), U. S. Department of Health and Human Services, or designee.

High-efficiency particulate air (HEPA) filter. A filter that is at least 99.97 percent efficient in removing particles 0.3 micrometers in diameter.

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Lead. Metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.

Presumed hazardous lead work (PHLW).

(1) Altering or disturbing material that is:

(A) known to contain lead at a concentration equal to or greater than 0.5% by weight, as a result of material testing or as content listed in a safety data sheet or similar specification sheet; or

(B) reasonably anticipated to contain lead at a concentration equal to or greater than 0.5% by weight. Such materials include, but are not limited to, scrap lead, lead solder, lead bullet fragments and dust, lead sheeting, lead cable housing, and lead billets.

(2) Torch cutting any scrap metal.

EXCEPTION: Altering or disturbing material, as specified in this subsection, or torch cutting any scrap metal, does not constitute PHLW when the total combined duration of lead exposure resulting from altering, disturbing, and torch cutting is less than 8 hours during any 30-day period.

(c) Permissible Exposure Limit (PEL).

(1) The employer shall assure that no employee is exposed to an airborne concentration of lead at an 8-hour time-weighted average concentration greater than 1050 micrograms per cubic meter of air (1050 µg/M<sup>3</sup>), calculated as an 8-hour time-weighted average (TWA). The 8-hour TWA shall be calculated in accordance with the appendix to section 5155.

(2) If an employee is exposed to lead for more than 8 hours in any work day, the permissible exposure limit for that day, as a time-weighted average concentration (TWA), shall be reduced according to the following formula:

Maximum permissible limit (in µg/M<sup>3</sup>) = 400 ÷ hours worked in the day.

(3) When respirators are used to supplement engineering and work practice controls to comply with the PEL, and all the requirements of subsections (e)(1) and (f) have been met, employee exposure, for the purpose of determining whether the employer has complied with the PEL, may be considered to be at the level provided by the protection factor of the respirator for those periods the respirator is worn.



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Those periods may be averaged with exposure levels during periods when respirators are not worn to determine the employee's daily TWA exposure.

(d) Exposure Monitoring.

(1) General.

(A) For the purposes of subsection (d), employee exposure is that exposure which would occur if the employee were not using a respirator.

(B) With the exception of monitoring under subsection (d)(34), the employer shall collect full shift ~~(for at least 7 continuous hours)~~ personal samples including at least one sample for each shift for each job classification in each work area.

(C) Full shift personal samples shall be representative of the monitored employee's regular, daily exposure to lead.

(2) Protection of Employees Prior to Assessment of Exposure.

Until the employer performs an employee exposure assessment as required under subsection (d) and determines actual employee exposure, the employer shall provide employees performing PHLW with interim protection as follows:

(A) Appropriate respiratory protection consisting of, at a minimum, a half-mask respirator with N-100, R-100, or P-100 filters, in accordance with subsection (f). Employers shall not select or use filtering facepiece respirators.

NOTE: A respirator that provides greater protection, such as a full-face respirator, may be appropriate when employees perform tasks such as welding, grinding, torch burning, torch cutting, and cleaning or emptying bullet traps.

(B) Appropriate protective work clothing and equipment, in a clean and dry condition at least weekly, in accordance with subsection (g).

(C) Medical surveillance in accordance with subsection (j).

(D) Training in accordance with subsection (l).

(E) Posted signs in accordance with subsection (m)(2).

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~~(23)~~ Initial Determination. Each employer who has a workplace or work operation covered by this standard shall determine if any employee may be exposed to lead at or above the action level.

~~(34)~~ Basis of Initial Determination.

(A) The employer shall monitor employee exposures and shall base initial determinations on the employee exposure monitoring results and any of the following, relevant considerations:

1. Any information, observations, or calculations which would indicate employee exposure to lead;
2. Any previous measurements of airborne lead; and
3. Any employee complaints of symptoms which may be attributable to exposure to lead.

(B) Monitoring for the initial determination may be limited to a representative sample of the exposed employees who the employer reasonably believes are exposed to the greatest concentrations of airborne lead in the workplace.

(C) Measurements of airborne lead made in the preceding 12 months may be used to satisfy the requirement to monitor under subsection (d)~~(34)~~(A) if sampling and analytical methods used meet the accuracy and confidence levels of subsection (d)~~(910)~~.

~~(45)~~ Positive Initial Determination and Initial Monitoring.

(A) Where a determination conducted under subsections (d)~~(23)~~ and (d)~~(34)~~ shows the possibility of any employee exposure at or above the action level, the employer shall conduct monitoring which is representative of the exposure for each employee in the workplace who is exposed to lead.

(B) Measurements of airborne lead made in the preceding 12 months may be used to satisfy this requirement if the sampling and analytical methods used meet the accuracy and confidence levels of subsection (d)~~(910)~~.

~~(56)~~ Negative Initial Determination. Where a determination conducted under subsections (d)~~(23)~~ and (d)~~(34)~~ is made that no employee is exposed to concentrations of airborne lead at or above the action level, the employer shall make a written record of such determination. The record shall include at least the information specified in subsection (d)~~(34)~~ and shall also include the date of determination, location

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within the worksite, and the name and another unique employee identifier (such as date of birth or employee identification numbers, social security number) of each employee monitored.

~~(67)~~ Frequency.

(A) If ~~initial~~ monitoring reveals an employee's exposure to be above 50 µg/m<sup>3</sup> as an 8-hour TWA ~~the permissible exposure limit~~, the employer shall repeat monitoring quarterly until at least two consecutive measurements, taken at least 7 days apart, are at or below 50 µg/m<sup>3</sup> as an 8-hour TWA ~~the permissible exposure limit~~. Subsequent monitoring for that employee shall conform with the applicable provisions of subsections (d)(~~67~~)(B) or (C), as appropriate, based on the monitoring results.

(B) If ~~initial monitoring or monitoring conducted in accordance with subsection (d)(6)(A)~~ reveals an employee's exposure to be at or above 30 µg/m<sup>3</sup> as an 8-hour TWA ~~the action level~~ but no greater than 50 µg/m<sup>3</sup> as an 8-hour TWA ~~the permissible exposure limit~~, the employer shall repeat monitoring at least every 6 months. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below 30 µg/m<sup>3</sup> as an 8-hour TWA ~~the action level~~ at which time Subsequent monitoring shall conform with the applicable provisions of subsection (d)(7)(C) the employer may discontinue monitoring for that employee except as otherwise provided by subsection (d)(7).

(C) If monitoring reveals employee exposure to be at or above the action level but below 30 µg/m<sup>3</sup> as an 8-hour TWA, the employer shall repeat monitoring at least every 12 months. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below the action level, at which time the employer may discontinue monitoring except as otherwise provided by subsection (d)(8).

(~~DE~~) Whenever ~~initial monitoring or monitoring conducted in accordance with subsection (d)(6)(A)~~ reveals an employee's exposure to be below the action level, further measurements are not required except as otherwise provided by subsection (d)(~~78~~).

(~~78~~) Additional Monitoring. Whenever there has been a production, process, control, or personnel change which may result in new or additional exposure to lead, or whenever the employer has any other reason to suspect a change which may result in new or additional exposures to lead, additional monitoring in accordance with this subsection shall be conducted.

(~~89~~) Employee Notification.

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(A) Within 5 working days after the receipt of monitoring results, the employer shall notify each employee in writing of the results which represent that employee's exposure.

(B) Whenever the results indicate that the representative employee exposure, without regard to respirators, exceeds the permissible exposure limit, the employer shall include in the written notice a statement that the permissible exposure limit was exceeded and a description of the corrective action taken or to be taken to reduce exposure to or below the permissible exposure limit.

(910) Accuracy of Measurement. The employer shall use a method of monitoring and analysis which has an accuracy (to a confidence level of 95%) within plus or minus 20 percent at concentrations of airborne lead equal to or greater than 230  $\mu\text{g}/\text{m}^3$ .

(e) Compliance.

(1) Methods.

(A) ~~Except as specified in subsection (e)(1)(B), where any employee is exposed to lead above the permissible exposure limit (PEL) for more than 30 days per year, the employer shall implement engineering, and work practice controls, including, and administrative controls, to reduce and maintain employee exposure to lead at or below the PEL, except to the extent that the employer can demonstrate that such controls are not feasible. Where engineering, work practice, and administrative controls which can be instituted are not sufficient to reduce employee exposure to or below the permissible exposure limit, they shall nonetheless be used by the employer to reduce exposures to the lowest feasible level. Small non-ferrous foundries (fewer than 20 employees), however, are only required to achieve 75  $\mu\text{g}/\text{M}^3$  by such controls.~~

(B) Where a separate engineering control air limit (SECAL) has been specified for particular processes (see Table 1), the employer shall implement engineering and work practice controls to reduce and maintain employee exposure at or below the SECAL, except to the extent that the employer can demonstrate that such controls are not feasible.

Table 1 -- Separate Engineering Control Airborne Limits (SECALs) for Selected Processes; Implementation Schedule

<u>Industry</u>	<u>Process</u>	<u>SECAL** and Implementation Dates</u>
<u>Lead acid battery manufacturing*</u>	<u>Oxide production; paste mixing; grid pasting and parting; and battery assembly.</u>	<u>50 <math>\mu\text{g}/\text{m}^3</math> on [OAL insert effective date here], then 40 <math>\mu\text{g}/\text{m}^3</math> on [OAL insert five years from the effective date here].</u>

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<p><u>Grid production and small parts casting; and plate formation.</u></p>	<p><u>50 µg/m<sup>3</sup> on [OAL insert effective date here], then</u>  <u>30 µg/m<sup>3</sup> on [OAL insert five years from the effective date here].</u></p>
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\* Processes in this industry that are not specified in this table must achieve the PEL as specified in subsection (e)(1)(A).

\*\* A SECAL is an airborne concentration of lead calculated as an 8-hour TWA.

(CB) Where engineering and work practice controls ~~Where controls which can be instituted in accordance with subsection (e)(1)(A) are not sufficient to reduce and maintain employee exposure to or below the permissible exposure limit~~ PEL or, where applicable, the SECAL, the employer shall implement such controls to reduce exposure to the lowest level feasible. The employer shall supplement these controls with respiratory protection, in conformance with subsection (f), to control employee exposure ~~within to or below the permissible exposure limit~~ PEL.

~~(C) Where any employee is exposed to lead above the permissible exposure limit, but for 30 days or less per year, the employer shall implement feasible engineering controls to reduce exposure to 150 µg/M<sup>3</sup>; but thereafter may implement any combination of engineering, work practice, administrative and respiratory controls to reduce and maintain exposure to lead to or below the permissible exposure limit.~~

(2) Compliance Program.

~~(A) Where applicable, Each employer shall establish and implement a written compliance program to reduce exposures to or below the permissible exposure limit~~ PEL or, where applicable, the SECAL, and interim levels solely by means of engineering and work practice controls in accordance with subsection (e)(1)(C) ~~in accordance with the implementation schedule in subsection (e)(1).~~

(B) Written plans for these compliance programs shall include at least the following:

1. A description of each operation in which lead is emitted; e.g. machinery used, material processed, controls in place, crew size, employee job responsibilities, operating procedures and maintenance practices;
2. A description of the specific means that will be employed to achieve compliance, including engineering plans and studies used to determine methods selected for controlling exposure to lead;

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3. A report of ~~the~~any engineering and work practice controls considered in meeting the PEL but not implemented due to infeasibility, that includes an explanation of how each was determined to be infeasible~~technology considered in meeting the permissible exposure limit;~~

4. Air monitoring data which documents the source of lead emissions;

5. A detailed schedule for implementation of the program, including documentation such as copies of purchase orders for equipment, construction contracts, etc.;

6. A work practice program which includes items required under subsections (g), (h), and (i);

7. An administrative control schedule required by subsection (e)(~~45~~), if applicable; and

8. Other relevant information.

(C) Written programs shall be submitted upon request to the Chief and the Director, and shall be available at the worksite for examination and copying by the Chief, the Director, and any affected employee or authorized employee representatives.

(D) Written programs shall be revised and updated at least every 6 months to reflect the current status of the program. The revisions and updates shall be documented in writing, in accordance with subsection (n)(2).

~~(3) [Reserved.]~~

~~(34)~~ Mechanical Ventilation.

(A) When ventilation is used to control exposure, measurements which demonstrate the effectiveness of the system in controlling exposure, such as capture velocity, duct velocity, or static pressure shall be made at least every 3 months. Measurements of the system's effectiveness in controlling exposure shall be made within 5 days of any change in production, process, or control which might result in a change in employee exposure to lead.

(B) Recirculation of Air. If air from exhaust ventilation is recirculated into the workplace, the employer shall ~~assure~~ensure that:

1. The exhaust has a high efficiency filter with a reliable back-up filter; and

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2. Controls are installed, operating, and maintained which monitor the concentration of lead in the return air and which, in case of failure, automatically prevent the recirculation of exhaust air.

(45) Administrative Controls. If administrative controls are used as a means of reducing employees' TWA exposure to lead, the employer shall establish and implement a written job rotation schedule that ~~which~~ includes:

(A) The name and another unique identifier (such as date of birth or employee identification number) of each affected employee;

(B) Duration and exposure levels at each job or work station where such affected employee is located; and

(C) Any other information which may be useful in assessing the reliability of administrative controls to reduce exposure to lead.

(f) Respiratory Protection.

(1) General. For employees who are required to use respirators by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(A) Work operations for which engineering and work practice controls are not sufficient to reduce exposures to or below the ~~permissible exposure limit~~ PEL;

(B) Periods necessary to implement engineering or work practice controls;

(C) Periods when an employee requests a respirator; and

(D) Periods when an employee performs PHLW, as interim protection in accordance with subsection (d)(2).

(2) Respirator program.

(A) The employer must implement a respiratory protection program in accordance with section 5144 ~~(be)~~ (except (d)(1)(C)) through (m) (except subsection (d)(1)(C)).

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(B) If an employee exhibits breathing difficulty during fit testing or respirator use, the employer must provide the employee with a medical examination in accordance with subsection (j)(3)(A)3. to determine whether or not the employee can use a respirator while performing the required duty.

(3) Respirator Selection.

(A) The employer shall select, and provide to employees, the appropriate respirators specified in Section 5144(d)(3)(A)1. Employers shall not select or use filtering facepiece respirators for protection against lead.

(B) The employer shall provide a powered, air-purifying respirator in lieu of the respirator specified in subsection (f)(3)(A) whenever:

1. An employee chooses to use this type of respirator; and
2. This respirator will provide adequate protection to the employee.

(C) The employer shall provide employees with full facepiece respirators instead of half mask respirators for protection against lead aerosols that cause eye or skin irritation at the use concentrations.

(D) The employer shall provide HEPA filters for powered air-purifying respirators and N-100, R-100, or P-100 filters for non-powered air-purifying respirators.

(g) Protective Work Clothing and Equipment.

(1) Provisions and Use.

~~(A) If an employee is exposed to lead above the PEL, without regard to the use of respirators, or where the possibility of skin or eye irritation exists, the employer shall, in accordance with Article 10, provide at no cost to the employee and assure that the employee uses appropriate protective work clothing and equipment such as, but not limited to:~~

1. To employees exposed to lead above the PEL without regard to the use of respirators;
2. As interim protection, in accordance with subsection (d)(2), to employees who perform PHLW; and



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3. To employees for whom the possibility exists of skin or eye irritation from exposure to lead (e.g. lead arsenate, lead azide).

(B) The employer shall provide protective work clothing and equipment at no cost to the employee, and shall ensure its use.

(C) Appropriate protective work clothing and equipment includes, but is not limited to:

~~(A1.)~~ Coveralls or similar full-body work clothing;

~~(B2.)~~ Gloves, hats, and shoes or disposable shoe coverlets; and

~~(C3.)~~ Face shields, vented goggles, or other appropriate protective equipment ~~which complies with Article 10.~~

(2) Cleaning and Replacement.

(A) The employer shall provide the protective clothing required in subsection (g)(1), in a clean and dry condition at least weekly, and daily to employees whose exposure levels without regard to respirator use are over 30150  $\mu\text{g}/\text{m}^3$  of lead ~~on an 8-hour time-weighted average basis~~ TWA.

(B) The employer shall provide for the cleaning, laundering, or disposal of protective clothing and equipment required by subsection (g)(1).

(C) The employer shall repair or replace required protective clothing and equipment as needed to maintain their effectiveness.

(D) The employer shall ~~assure~~ ensure that all protective clothing is removed at the completion of a work shift and only in change rooms provided for that purpose as prescribed in subsection (i)(2).

(E) The employer shall ~~assure~~ ensure that contaminated protective clothing which is to be cleaned, laundered, or disposed of, is placed in a closed container in the change room which prevents dispersion of lead outside the container.

(F) The employer shall inform in writing any person who cleans or launders protective clothing or equipment of the potentially harmful effects of exposure to lead.

(G) Labeling of ~~e~~Contaminated ~~p~~Protective ~~e~~Clothing and ~~e~~Equipment.

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~~1.~~The employer shall ensure that labels of bags or containers of contaminated protective clothing and equipment include the following information:

DANGER: CLOTHING AND EQUIPMENT CONTAMINATED WITH LEAD. MAY DAMAGE FERTILITY OR THE UNBORN CHILD. CAUSES DAMAGE TO THE CENTRAL NERVOUS SYSTEM. DO NOT EAT, DRINK OR SMOKE WHEN HANDLING. DO NOT REMOVE DUST BY BLOWING OR SHAKING. DISPOSE OF LEAD CONTAMINATED WASH WATER IN ACCORDANCE WITH APPLICABLE LOCAL, STATE, OR FEDERAL REGULATIONS.

~~2. Prior to June 1, 2015, employers may include the following information on bags or containers of contaminated protective clothing and equipment in lieu of the labeling requirements in subsections (g)(2)(G)1. of this section:~~

~~CAUTION: CLOTHING CONTAMINATED WITH LEAD. DO NOT REMOVE DUST BY BLOWING OR SHAKING. DISPOSE OF LEAD CONTAMINATED WASH WATER IN ACCORDANCE WITH APPLICABLE LOCAL, STATE OR FEDERAL REGULATIONS.~~

(H) The employer shall prohibit the removal of lead from protective clothing or equipment by blowing, shaking, or any other means which disperses lead into the air.

Note: A downdraft booth, "air shower," or other appropriate means for the removal of lead dust may be used provided employee exposure to airborne lead dust is prevented during such use.

(h) Housekeeping.

(1) Surfaces. All surfaces shall be maintained as free as practicable of accumulations of lead.

(2) Cleaning Methods~~Floors~~.

(A) Floors and other surfaces where lead accumulates ~~may~~shall not be cleaned by the use of compressed air.

(B) Floors and other surfaces where lead accumulates shall be cleaned, wherever possible, by vacuuming or by other methods that minimize the likelihood of lead becoming airborne.

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(CB) Shoveling, dry or wet sweeping, and brushing ~~shall may not~~ be used ~~only where~~ unless the employer can demonstrate that vacuuming or other equally effective methods have been tried and found not to be effective.

(3) Vacuuming. Where vacuuming methods are selected, the vacuums shall be used and emptied in a manner which minimizes the re-entry of lead into the workplace. Those vacuum systems which exhaust air into the workplace shall be equipped with air filters at least as effective as ~~high efficiency particulate air~~ HEPA filters. ~~High efficiency particulate air filter means 99.97% efficient against 0.3 micrometer size particles.~~

(i) Hygiene Facilities and Practices.

(1) General Hygiene.

(A) The employer shall assure ensure that in areas where employees are exposed to lead above the PEL, without regard to the use of respirators, food or beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied, except in change rooms, lunchrooms, and showers required under subsections (i)(2)-(i)(4).

(B) The employer shall provide an adequate number of washing facilities, or lavatories, in compliance with the provisions of section 3366.

(C) Where necessary to effect lead removal, the employer shall make available special cleansing compounds designed specifically for the removal of lead from skin surfaces.

(D) The employer shall ensure that employees exposed to lead wash their hands, exposed arms, and face prior to entering eating areas, eating, drinking, smoking or applying cosmetics, and at the end of their shift.

(2) Change Rooms.

(A) The employer shall provide clean change rooms for employees who work in areas where their airborne exposure to lead is above the PEL, without regard to the use of respirators.

(B) The employer shall ~~assure ensure~~ that change rooms are equipped with separate storage facilities for protective work clothing and equipment and for street clothes which prevent cross contamination.

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EXCEPTION: Separate storage facilities are not required where clean protective clothing and equipment are provided on a daily basis.

(3) Showers.

(A) The employer shall ~~assure~~ensure that employees who work in areas where their exposure to airborne lead is above the PEL, without regard to the use of respirators, shower at the end of the work shift.

(B) The employer shall ~~provide~~ensure that required shower facilities ~~in accordance~~comply with ~~§~~Section 3366(f).

(C) The employer shall ~~assure~~ensure that employees who are required to shower pursuant to subsection (i)(3)(A) do not leave the work place wearing any clothing or equipment worn during the work shift.

(4) Lunchrooms.

(A) The employer shall provide readily accessible lunchroom facilities, in accordance with ~~§~~Section 3368, for employees who work in areas where their exposure to airborne lead is above the PEL, without regard to the use of respirators.

(B) Lunchroom facilities shall have a temperature controlled, positive pressure, filtered air supply except that such facilities need not be under positive pressure if workplace operations produce no contamination by airborne lead.

~~(Title 24, Part 2 1724(c)(1)(D)(2).)~~

~~(C) The employer shall assure that employees who work in areas where their exposure to airborne lead is above the PEL, without regard to respirator use, wash their hands and face prior to eating, drinking, smoking or applying cosmetics.~~

~~(C)~~ The employer shall ~~assure~~ensure that employees do not enter lunchroom facilities with protective work clothing or equipment unless surface lead dust has been removed by vacuuming, downdraft booth, or other cleaning method.

(5) Cleaning of Hygiene Facilities. The employer shall establish, implement, and maintain written methods and schedules to maintain the cleanliness of drinking and washing facilities, change rooms,

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~~showers, and lunchrooms required by this subsection. Lavatories. The employer shall provide an adequate number of lavatory facilities which comply with Section 3366.~~

(j) Medical Surveillance.

(1) General.

(A) The employer shall institute a medical surveillance program ~~for all employees;~~

1. For all employees who are or may be exposed at or above the action level for more than 30 days per year; and

2. As interim protection, in accordance with subsection (d)(2), for all employees who perform PHLW.

EXCEPTION: Medical surveillance is not required for an employee who is not exposed to lead at or above the action level for 10 or more days in any 12 consecutive months, and who is not exposed on any day at or above 100 µg/m<sup>3</sup> as an 8-hour TWA, without regard to respirator use.

(B) The employer shall ~~assure~~ ensure that all medical examinations and procedures are performed by or under the supervision of a licensed physician.

(C) The employer shall provide the required medical surveillance including multiple physician review under subsection (j)(3)(C) without cost to employees and at a reasonable time and place.

(D) The employer shall provide complete employee identification information to the licensed healthcare provider who performs any services covered under subsections (j)(2) and (j)(3). The employer shall instruct the healthcare provider ordering blood lead tests to provide the analyzing laboratory with the employee identification information. Identification information includes:

1. Employee name, date of birth, address, and phone number; and

2. Employer name, address, and phone number.

(2) Blood Lead Testing~~Biological Monitoring~~.

~~(A) Blood Lead Testing Schedule and Zinc Protoporphyrin Sampling and Analysis.~~ The employer shall make available ~~biological monitoring in the form of blood lead testingsampling and analysis for lead and zinc protoporphyrin (ZPP) levels~~ to each employee covered under subsection (j)(1)(A) on the following schedule:

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~~1. At least every 6 months to each employee~~Prior to assignment for work covered under by subsection (j)(1)(A); or as soon as possible when work is first determined to be covered by subsection (j)(1)(A);

~~2. At least every 2 months for the first 6 months and every 6 months thereafter;~~

~~3. At least every 2 months for the first 6 months and every 6 months thereafter, following a change in work task or process resulting in or likely to result in higher exposure to lead;~~

~~24. At least every two months for each employee whose last blood sampling and analysis indicated a blood lead level was at or above 1040 µg/dl100 g but below 20 µg/dl of whole blood. This frequency shall continue until two consecutive blood lead levels samples and analysis, taken at least 30 days apart, are indicate a blood lead level below 1040 µg/dl100 g of whole blood; and~~

~~35. At least monthly for each employee whose last blood lead level was at or above 20 µg/dl, and during the removal period of each employee removed from exposure to lead due to an elevated blood lead level.~~

~~4. ZPP determinations shall be made available as soon as possible but no later than the first biological monitoring scheduled for an employee.~~

~~(B) Follow-Up Blood Sampling Tests. Whenever the results of a blood lead level test indicate that an employee's blood lead level is at or above the numerical criterion for medical removal under subsection (k)(1), the employer shall provide a second (follow-up) blood sampling test within two weeks after the employer receives the results of the first blood sampling test.~~

~~(CB) Accuracy of Blood Lead TestingLevel Sampling and Analysis. Blood lead testinglevel sampling and analysis provided pursuant to this section shall include analysis by a Clinical Laboratory Improvement Amendments (CLIA)-approved laboratory (under the federal CLIA regulations, 42 CFR Part 493). have an accuracy (to a confidence level of 95 percent) within plus or minus 15 percent or 6 µg/100ml, whichever is greater, and shall be conducted by a laboratory licensed by the Center for Disease Control (CDC), U.S. Department of Health and Human Services, or which has received a satisfactory grade in blood lead proficiency testing from CDC in the prior 12 months.~~

~~(DC) Employer Notification to the Employee Notification. Within five working days after the receipt of blood lead test biological monitoring results, the employer shall notify in writing each employee whose blood lead level is at or above 40 µg/100 g:~~

~~1. Of that employee's blood lead level; and~~

~~2. That the standard requires the employer to make medical examinations and consultations available to employees exposed at or above the action level, and as interim protection, to employees performing PHLW, unless an employee's exposure or work is covered by the exception in subsection (j)(1)(A). When they are required, the employer must make medical examinations and consultations available as soon as~~

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possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or past exposure to lead on the employee's ability to procreate a healthy child, or that the employee has demonstrated difficulty breathing during a respirator fit test or during use; and

32. That the standard requires temporary medical removal with Medical Removal Protection benefits when an employee's blood lead level is at or above 30 µg/dl, the last two monthly blood lead levels are at or above 20 µg/dl, or the average of the results of all blood lead tests conducted in the last 6 months is at or above 20 µg/dl, as provided for in ~~is at or above the numerical criterion for medical removal under subsection (k)(1).~~

(D) Physician's Notification to the Employee. The employer shall ensure that the physician who orders the blood test explains the findings of the blood lead test and notifies the employee of the following:

1. The results of the blood lead test;

2. Any recommended follow-up blood lead testing in accordance with subsection (j)(2)(A) and the timing of that recommended blood lead testing; and

3. If the employee's blood lead level is 20 µg/dl or greater, the recommendation that the employee undergo a medical examination by a physician if the employee has not had a lead-specific medical exam in the preceding 12 months.

(E) Elevated Blood Lead Level Response.

1. Whenever an employee has a blood lead level at or above 10 µg/dl, the employer shall establish and implement a written elevated blood lead level response plan for that employee which describes specific means that will be used to reduce and maintain the employee's blood lead level below 10 µg/dl.

2. Training and instruction shall be provided as needed for an employee who has a blood lead level at or above 10 µg/dl, to correct any employee work practices identified in the elevated blood lead level response plan established for that employee under subsection (j)(2)(E)1.

(3) Medical Examinations and Consultations.

(A) Frequency. The employer shall make available medical examinations and consultations to each employee covered under ~~sub~~Section 5198(j)(1)(A) on the following schedule:

1. As soon as possible for each employee for whom a blood lead test result of 20 µg/dl or greater is received, if no lead-specific medical examination was done for that employee in the preceding 12 months, and At least annually thereafter, until the employee's blood lead level is below for each employee for whom a blood sampling test conducted at any time during the preceding 12 months indicated a blood lead level at or above 2040 µg/dl100-g;

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2. Prior to assignment for each employee being assigned for the first time to an area in which 8-hour time-weighted average concentrations of airborne lead are at or above the action level;

3. As soon as possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or past exposure to lead on the employee's ability to procreate a healthy child, or that the employee has demonstrated difficulty in breathing during a respirator fitting test or during use; and

4. As soon as possible, and then as medically appropriate for each employee removed from exposure to lead due to elevated blood lead levels in compliance with the provisions of subsection (k)(1), a risk of sustaining material impairment to health, or whose exposure to lead is otherwise limited pursuant to a final medical determination in compliance with the provisions of subsection (k)(2).

(B) Content. Medical examinations made available pursuant to subsections (j)(3)(A)1–2 shall include the following elements:

1. A detailed work history and a medical history, with particular attention to past lead exposure (occupational and non-occupational), personal habits (smoking, hygiene), and past gastrointestinal, hematologic, renal, cardiovascular, reproductive and neurological problems;

2. A thorough physical examination, with particular attention to teeth, gums, hematologic, gastrointestinal, renal, cardiovascular, and neurological systems. If requested by an employee, pregnancy testing or laboratory evaluation of male fertility shall be included. Pulmonary status should be evaluated if respiratory protection will be used;

3. A blood pressure measurement;

4. A blood sample and analysis which determines:

a. Blood lead level;

b. Hemoglobin and hematocrit determinations, red cell indices, and examination of peripheral smear morphology;

c. Zinc protoporphyrin for each employee whose last blood lead level was at or above 20 µg/dl;

d. Blood urea nitrogen; and

e. Serum creatinine.

5. A routine urinalysis with microscopic examination; and



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6. Any laboratory or other test relevant to lead exposure ~~which that~~ the examining physician deems necessary by sound medical practice.

~~The content of medical examinations made available pursuant to subsections (j)(3)(A)3-4 shall be determined by an examining physician and, if requested by an employee, shall include pregnancy testing or laboratory evaluation of male fertility.~~

(C) Multiple Physician Review Mechanism.

1. If the employer selects the initial physician who conducts any medical examination or consultation provided to an employee under this section, the employee may designate a second physician to review any findings, determinations or recommendations of the initial physician and to conduct such examinations, consultations, and laboratory tests as the second physician deems necessary to facilitate this review.

2. The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician conducts a medical examination or consultation pursuant to this section. The employer may condition participation in, and payment for, the multiple physician review mechanism upon ~~by requiring the employee (within 15 days from the date of the foregoing notice or receipt of the initial physician's written opinion, whichever is later) informing to inform~~ the employer that the employee intends to seek a second medical opinion and initiating to initiate steps to make an appointment with a second physician within 15 days after receipt of the foregoing notification or receipt of the initial physician's written medical opinion, whichever is later.

3. If the findings, determinations or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall ~~assure~~ ensure that efforts are made for the two physicians to resolve any disagreement.

4. If the two physicians are unable to resolve their disagreement quickly, the employer and employee through their respective physicians shall designate a third physician to review any findings, determinations, or recommendations of the prior physicians and to conduct such examinations, consultations, laboratory tests, and discussions with the prior physicians ~~which that~~ the third physician deems necessary to resolve the disagreement of the prior physicians.

5. The employer shall act consistent with the findings, determinations and recommendations of the third physician, unless the employer and the employee reach an agreement which is otherwise consistent with the recommendations of at least one of the three physicians.

(D) Alternate Physician Determination Mechanisms. The employer and an employee or authorized employee representative may agree upon the use of any expeditious alternate physician determination mechanism in lieu of the multiple physician review mechanism provided by this section so long as the alternate mechanism otherwise satisfies the requirements contained in this section.

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~~(4) Information Provided to Examining and Consulting Physicians:~~

(A) The employer shall provide the following information to an initial physician conducting a medical examination or consultation under the provisions of this section:

1. A copy of this regulation and its appendices;
2. A description of the affected employee's duties as they relate to the employee's exposure;
3. The employee's exposure level or anticipated exposure level to lead and to any other toxic substance (if applicable);
4. A description of any personal protective equipment used or to be used;
5. Prior blood lead test results~~determinations~~; and
6. All prior written medical opinions concerning the employee in the employer's possession or control.

7. A copy of the written elevated blood lead level response plan for that employee as required by subsection (j)(2)(E)1.

(B) The employer shall provide the foregoing information to a second or third physician conducting a medical examination or consultation under this section upon request either by the second or third physician, or by the employee.

~~(5) Written Medical Opinions.~~

~~(A) The employer shall obtain and furnish the employee with a copy of a written medical report from each examining or consulting physician which contains the following information:~~

- ~~1. The physician's opinion as to whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to lead.~~
- ~~2. Any recommended special protective measures to be provided to the employee, or limitations to be placed upon the employee's exposure to lead.~~
- ~~3. Any recommended limitation upon the employee's use of respirators, including a determination of whether the employee can wear a powered air-purifying respirator if the physician determines that the employee cannot wear a negative pressure respirator; and~~
- ~~4. The results of the blood lead determinations.~~

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~~(B) The employer shall instruct the examining physician to:~~

~~1. Not reveal either in the written opinion, or in any other means of communication with the employer, findings, including laboratory results, or diagnoses unrelated to the employee's occupational exposure to lead; and~~

~~2. Advise the employee of any medical condition, occupational or non-occupational, which dictates further medical examination or treatment.~~

(5) Physician's Written Medical Report for the Employee.

The employer shall ensure that the examining physician explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of each medical examination performed. The written report shall contain:

(A) The physician's opinion as to whether the employee has any detected health-related condition that would place the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead;

(B) Any recommended special protective measures to be provided to the employee, or recommended limitations to be placed upon the employee's exposure to lead;

(C) Any recommended limitations upon the employee's use of respirators, including a determination of whether the employee should wear a powered air-purifying respirator instead of a non-powered air-purifying respirator;

(D) The employee's blood lead test results;

(E) Any recommended follow-up blood lead testing and medical examinations and the timing of each; and

(F) The physician's opinion as to whether the employee has any health-related condition, occupational or non-occupational, that dictates further medical examination or treatment.

(6) Physician's Written Medical Opinion for the Employer.

(A) The employer shall obtain a written medical opinion from the examining physician within 30 days of the medical examination. The written opinion shall contain the following information:

1. The physician's opinion as to whether the employee has any detected health-related condition that would place the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead;

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2. Any recommended special protective measures to be provided to the employee, or limitations to be placed upon the employee's exposure to lead;

3. Any recommended limitation upon the employee's use of respirators, including a determination of whether the employee can wear a powered air-purifying respirator if the physician determines that the employee cannot wear a negative pressure respirator; and

4. The employee's blood lead test results.

(B) The employer shall instruct the examining physician to not reveal either in the written opinion to the employer, or in any other means of communication with the employer, findings, including laboratory results, or diagnoses unrelated to the employee's occupational exposure to lead.

(C) The employer shall ensure that the employee receives a copy of the physician's written medical opinion described in subsection (j)(6)(A) within 30 days of each medical examination performed.

(67) Chelation.

(A) The employer shall assure ensure that any person whom the employer he retains, employs, supervises, or controls does not engage in prophylactic chelation of any employee at any time.

(B) If therapeutic or diagnostic chelation is to be performed by any person in subsection (j)(67)(A), the employer shall assure ensure that it be done under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical monitoring and that the employee is notified in writing prior to its occurrence.

(k) Medical Removal Protection.

(1) Temporary Removal Due to Elevated Blood Lead Levels.

The employer shall remove an employee from work having an exposure to lead at or above the action level, altering or disturbing any material containing lead at a concentration equal to or greater than 0.5% by weight, or torch cutting any scrap metal, on each occasion that: the average of the last three

(A) The last blood lead test sampling tests conducted pursuant to this section (or the average of all blood sampling tests conducted over the previous six (6) months, whichever is longer) indicates that the employee's blood lead level is at or above 3050 µg/dl 100 g of whole blood; provided, however, that an employee need not be removed if the last blood sampling test indicates a blood lead level below 40 µg/100 g of whole blood.

(B) Effective [OAL insert 1 year from effective date here], the employee's last two blood lead test results are at or above 20 µg/dl; or

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(C) Effective [OAL insert 1 year from effective date here], the average of the results of all blood lead tests conducted for the employee in the last 6 months is at or above 20 µg/dl.

(2) Temporary Removal Due to a Final Medical Determination.

(A) The employer shall remove an employee from work having an exposure to lead at or above the action level, altering or disturbing any material containing lead at a concentration equal to or greater than 0.5% by weight, or torch cutting any scrap metal, on each occasion that a final medical determination results in a medical finding, determination, or opinion that the employee has a detected health-related medical condition which places the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment to health from exposure to lead.

(B) Note: For the purposes of this section, the phrase "final medical determination" shall mean the written medical opinion on the employee's health status by the examining physician or, where relevant, the outcome of the multiple physician review mechanism or alternate physician determination mechanism used pursuant to the medical surveillance provisions of this section.

(CB) Where a final medical determination results in any recommended special protective measures for an employee, or limitations on an employee's exposure to lead, the employer shall implement and act consistent with the recommendation.

(3) Return of the Employee to Former Job Status.

(A) The employer shall return an employee to his or her former job status:

1. For an employee removed under subsection (k)(1), due to a blood lead level at or above 50 µg/100 g when two consecutive blood lead sampling tests, taken at least 30 days apart, both indicate that the employee's blood lead level is below 1540 µg/dl 100 g of whole blood; and

2. For an employee removed due to a final medical determination, when a subsequent final medical determination results in a medical finding, determination, or opinion that the employee no longer has a detected health-related medical condition which places the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment to health from exposure to lead.

(B) For the purposes of this section, the requirement that an employer return an employee to his or her former job status is not intended to expand upon or restrict any rights an employee has or would have had, absent temporary medical removal, to a specific job classification or position under the terms of a collective bargaining agreement.

(4) Removal of Other Employee Special Protective Measures or Limitations. The employer shall remove any limitations placed on an employee or end any special protective measures provided to an employee

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pursuant to a final medical determination when a subsequent final medical determination indicates that the limitations or special protective measures are no longer necessary.

(5) Employer Options Pending a Final Medical Determination. Where the multiple physician review mechanism, or alternate ~~physician~~ medical determination mechanism used pursuant to the medical surveillance provisions of this section, has not yet resulted in a final medical determination with respect to an employee, the employer shall act as follows:

(A) Removal. The employer may remove the employee from exposure to lead, provide special protective measures to the employee, or place limitations upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status.

(B) Return. The employer may return the employee to his or her former job status, end any special protective measures provided to the employee, and remove any limitations placed upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status.

**EXCEPTIONS:**

EXCEPTION 1: If the initial removal, special protection, or limitation of the employee resulted from a final medical determination which differed from the findings, determinations, or recommendations of the initial physician.

EXCEPTION 2: If the employee has been on removal status for the preceding eighteen months due to an elevated blood lead level, the employer shall await a final medical determination.

**(6) Medical Removal Protection Benefits.**

(A) Provision of Medical Removal Protection Benefits. The employer shall provide to an employee up to eighteen (18) months of medical removal protection benefits on each occasion that an employee is removed from exposure to lead or otherwise limited pursuant to this section.

(B) Definition of Medical Removal Protection Benefits. For the purposes of this section, the requirement that an employer provide medical removal protection benefits means that the employer shall maintain the earnings, seniority and other employment rights and benefits of an employee, including the employee's right to their former job status, as though the employee had not been medically removed from the employee's job ~~normal exposure to lead~~ or otherwise medically limited.

(C) Follow-Up Medical Surveillance During the Period of Employee Removal or Limitation. During the period of time that an employee is medically removed from the employee's job ~~normal exposure to lead~~ or otherwise medically limited, the employer may condition the provision of medical removal protection

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benefits upon the employee's participation in follow-up medical surveillance made available pursuant to this section.

(D) Worker's' Compensation Claims. If a removed employee files a claim for worker's' compensation payments for a lead-related disability, then the employer shall continue to provide medical removal protection benefits pending disposition of the claim. To the extent that an award is made to the employee for earnings lost during the period of removal, the employer's medical removal protection obligation shall be reduced by such amount. The employer shall receive no credit for worker's' compensation payments received by the employee for treatment related expenses.

(E) Other Credits. The employer's obligation to provide medical removal protection benefits to a removed employee shall be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer-funded compensation program, or receives income from employment with another employer made possible by virtue of the employee's removal.

(F) Employees Whose Blood Lead Levels Do Not Adequately Decline Within 18 Months of Removal. The employer shall take the following measures with respect to any employee removed from exposure to lead due to an elevated blood lead level whose blood lead level has not declined within the past eighteen (18) months of removal so that the employee has been returned to his or her former job status.

1. The employer shall make available to the employee a medical examination pursuant to this section to obtain a final medical determination with respect to the employee.
2. The employer shall ~~assure~~ensure that the final medical determination obtained indicates whether or not the employee may be returned to his or her former job status, and if not, what steps should be taken to protect the employee's health.
3. Where the final medical determination has not yet been obtained, or once obtained indicates that the employee may not yet be returned to his or her former job status, the employer shall continue to provide medical removal protection benefits to the employee until either the employee is returned to former job status, or a final medical determination is made that the employee is incapable of ever safely returning to his or her former job status.
4. Where the employer acts pursuant to a final medical determination which permits the return of the employee to his or her former job status despite what would otherwise be an unacceptable blood lead level, later questions concerning removing the employee again shall be decided by a final medical determination. The employer need not automatically remove such an employee pursuant to the blood lead level removal criteria provided by this section.

(G) Voluntary Removal or Restriction of an Employee. Where an employer, although not required by this section to do so, removes an employee from exposure to lead or otherwise places limitations on an

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employee due to the effects of lead exposure on the employee's ~~medical~~ health-related condition, the employer shall provide medical removal protection benefits to the employee equal to ~~that~~ those required by subsection (k)(65)(A) and (B).

(I) Employee Information and Training.

(1) Training Program.

(A) Each employer who has a workplace which falls within the scope of this section in which there is a potential exposure to airborne lead at any level shall inform employees with occupational exposure to lead of the content of Appendices A and B of this regulation.

(B) The employer shall institute a training program; ~~for and assure the participation of all employees who are subject to exposure to lead at or above the action level or for whom the possibility exists of skin or eye irritation from exposure to lead.~~

1. For employees who are exposed to lead at or above the action level on any day;

2. For employees for whom the possibility exists of skin or eye irritation from exposure to lead (e.g. lead arsenate, lead azide); and

3. As interim protection, in accordance with subsection (d)(2), for employees who perform PHLW.

(C) The employer shall ensure that all employees covered under subsection (I)(1)(B) participate in the training program, and that the training, and any training materials used, are appropriate to the educational level, literacy level, and language of these employees.

~~(C)(D)~~ For each employee covered by subsection (I)(1)(B), the employer shall provide initial training covering all content in subsection (I)(1)(E) prior to the time of initial job assignment, for those employees subsequently covered by this paragraph and at least annually thereafter.

~~(D) The training program shall be repeated at least annually for each employee covered by subsection (I)(1)(C).~~

(E) The employer shall ~~assure~~ ensure that effective training on the following topics is provided for each employee covered by subsection (I)(1)(B) ~~is informed of the following:~~

1. The content of this standard and its appendices;

2. The specific nature of the operations ~~which that~~ could result in exposure to lead at or above the action level, or that constitute PHLW;



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3. The importance of effective hygiene practices, including hand washing, and when required, showering, and how to effectively remove lead contamination from skin surfaces with the proper use of special cleansing compounds designed specifically for this purpose, in accordance with subsection (i)(1)(C);

43. The purpose, proper selection, fitting, use, and limitations of respirators;

54. The purpose and a description of the medical surveillance program, and the medical removal protection program;

6. The including information concerning the adverse health effects of associated with excessive exposure to lead (with particular attention to the adverse reproduction cardiovascular effects on both males and females), including low-level chronic exposure;

7. The damage caused to both male and female reproductive health by low-level lead exposure, including damage associated with blood lead levels under 5 µg/dl;

8. The employer's duty, as required by subsection (j)(3)(A), to make medical examinations and consultations available to each employee who notifies the employer that they desire medical advice concerning their ability to procreate a healthy child, when the employee is exposed at or above the action level, and as interim protection, to an employee who performs PHLW, unless the employee's exposure or work is covered by the exception in subsection (j)(1)(A);

9. The routes of exposure to lead, including inhalation of airborne lead and ingestion of lead from contaminated hands and other surfaces;

10. The possibility that lead contamination brought into personal vehicles or the home on an employee's clothes, shoes, and body will endanger the health of household members, especially that of young children and pregnant women;

11. The recommendation to shower immediately upon returning home from work to minimize take-home lead exposure;

NOTE: When employees are exposed above the PEL, the employer must provide shower facilities and ensure that employees shower at the end of the work shift, in accordance with subsection (i)(3).

125. The engineering controls and work practices associated with the employee's job assignment;

136. The contents of any compliance plan in effect; and

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~~147. Instructions to employees that chelating agents should not routinely be used to remove lead from their bodies~~the body and should not be used at all except under the direction of a licensed physician; and-

15. The employee's right of access to their exposure and medical records under section 3204.

(2) Access to Information and Training Materials.

(A) The employer shall make a copy of this standard and its appendices readily available to all affected employees including employees exposed below the action level.

(B) The employer shall provide, upon request, all materials relating to the employee information and training program to the Chief.

(m) Communication of Hazards.

(1) Hazard Communication - General.

(A) Chemical manufacturers, importers, distributors and employers shall comply with all requirements of the Hazard Communication Standard (HCS) (Section 5194) for lead.

(B) In classifying the hazards of lead at least the following hazards are to be addressed: cardiovascular effects; ~~reproductive/developmental toxicity~~; central nervous system effects; kidney effects; blood effects; and acute toxicity effects.

(C) Employers shall include lead in the hazard communication program established to comply with the HCS (Section 5194). Employers shall ensure that each employee has access to labels on containers of lead and to safety data sheets, and is trained in accordance with the requirements of HCS and subsection (l) of this section.

(2) Signs.

(A) The employer shall post ~~the following~~a warning signs ~~in each work area where:~~

1. in each work area where employee exposures are at or above the action level~~PEL is exceeded;~~ and

2. as interim protection, in accordance with subsection (d)(2), in each work area where PHLW is performed.

(B) The sign shall bear the following legend:

DANGER  
LEAD WORK AREA

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MAY DAMAGE FERTILITY OR THE UNBORN CHILD  
CAUSES DAMAGE TO THE CENTRAL NERVOUS SYSTEM  
DO NOT EAT, DRINK OR SMOKE IN THIS AREA

~~(B)(C)~~ The employer shall ensure that no statement appears on or near any sign required by this subsection (m)(2) which contradicts or detracts from the meaning of the required sign.

~~(C)(D)~~ The employer shall ensure that signs required by this subsection (m)(2) are illuminated and cleaned as necessary so that the legend is readily visible.

~~(D)(E)~~ The employer may use signs required by other statutes, regulations, or ordinances in addition to, or in combination with, signs required by this subsection (m)(2).

~~(E)~~ Prior to June 1, 2016, employers may use the following legend in lieu of that specified in subsection (m)(2)(B) of this section:

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

(n) Recordkeeping.

(1) Exposure Monitoring.

(A) The employer shall establish and maintain an accurate record of all monitoring required in subsection (d).

(B) This record shall include:

1. The date(s), number, duration, location and results of each of the samples taken, including a description of the sampling procedure used to determine representative employee exposure where applicable;
2. A description of the sampling and analytical methods used and evidence of their accuracy;
3. The type of respiratory protective devices worn, if any;
4. ~~The name, another unique identifier (such as date of birth or employee identification number or social security number), and job classification of the employee monitored and of all other employees whose exposure the measurement is intended to represent; and~~

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5. The work operations performed by the monitored employees and the workplace conditions under which they were performed, including the processes, types of material, control methods, and work practices used, as well as the environmental conditions prevailing during the monitored operations ~~environmental variables that could affect the measurement of employee exposure.~~

(C) The employer shall maintain these monitoring records for at least 40 years or for the duration of employment plus 20 years, whichever is longer.

(2) Written Compliance Program Review.

Records of the semi-annual revision and update of the employer's written compliance program, required under subsection (e)(2)(A), shall include the name of the person(s) who reviewed the program, the date the review was completed, and a summary of the revisions and updates to the program. The records shall be retained for three years.

(23) Medical Surveillance.

(A) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by subsection (j).

(B) This record shall include:

1. The name, another unique identifier (such as date of birth or employee identification numbers) ~~social security number~~, and description of the duties of the employee;
2. A copy of the physician's written opinions;
3. Results of any monitoring of exposure to airborne lead done for that employee and the representative exposure level supplied to the physician; and
4. Any employee medical complaints related to exposure to lead.

(C) The employer shall keep, or ~~assure~~ ensure that the examining physician keeps, the following medical records:

1. A copy of the medical examination results including medical and work history required under subsection (j).
2. A description of the laboratory procedures and a copy of any standards or guidelines used to interpret the test results or references to that information.
3. A copy of the results of blood lead testing ~~biological monitoring~~.

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(D) The employer shall maintain or ~~assure~~ensure that the physician maintains those medical records for at least 40 years, or for the duration of employment plus 20 years, whichever is longer.

(4) Written Elevated Blood Lead Level Response Plans.

Written elevated blood lead level response plans, required under subsection (j)(2)(E), shall be retained for three years.

(35) Medical Removals.

(A) The employer shall establish and maintain an accurate record for each employee removed from current exposure to lead pursuant to subsection (k).

(B) Each record shall include:

1. The name and another unique identifier (such as date of birth or employee identification number ~~social security number~~) of the employee;
2. The date on each occasion that the employee was removed from current exposure to lead as well as the corresponding date on which the employee was returned to his or her former job status;
3. A brief explanation of how each removal was or is being accomplished; and
4. A statement with respect to each removal indicating whether or not the reason for the removal was an elevated blood lead level.

(C) The employer shall maintain each medical removal record for at least the duration of an employee's employment.

(6) Training.

(A) After conducting any training required by this section, the employer shall prepare a record that indicates the name and job classification of each employee trained, the date of the training, the name of the person(s) who conducted the training, and the topic(s) of the training.

(B) Training records shall be maintained for three years.

(47) Availability.

(A) The employer shall make available upon request all records required to be maintained by this subsection to the Chief and the Director for examination and copying.

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(B) Environmental monitoring, medical removal, and medical records required by this section shall be provided upon request to employees, designated representatives, and authorized representatives of the Chief in accordance with sSection 3204. Medical removal records shall be provided as prescribed by sSection 3204 for monitoring records.

(~~58~~) Transfer of Records.

(A) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by subsection (n).

(B) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records required to be maintained by this section for the prescribed period, these records shall be transmitted to the Director.

(C) At the expiration of the retention period for the records required to be maintained by this section, the employer shall notify the Director at least 3 months prior to the disposal of such records and shall transmit those records to the Director if requested within the period.

(D) The employer shall also comply with any additional requirements involving the transfer of records set forth in sSection 3204.

(o) Observation of Monitoring.

During any observation of monitoring under subsection (d) by an affected employee or employees or their representative (pursuant to sSection 340.1) in an area where the use of respirators, protective clothing or equipment is required, the employer shall provide the observer with, and ~~assure~~ensure the use of, such respirators, clothing and equipment and shall require the observer to comply with all other applicable safety and health procedures. Without interfering with the monitoring, the observer shall be entitled to receive an explanation of the measurement procedures used.

(p) Appendices.

The information contained in the appendices to this section is not intended to create any additional obligations not otherwise imposed by this standard nor detract from any existing obligation.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Federal Register Volume 77, Number 58 (Monday, March 26, 2012) Pages 17574-17896.

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Appendix A to Section 5198 – Substance Data Sheet for Occupational Exposure to Lead

Substance Data Sheet for Occupational Exposure to Lead

This appendix is a substance data sheet for occupational exposure to lead. It includes information about how exposure to lead can affect your health.

I. Substance Identification

A. Substance: Pure lead (Pb) is a heavy metal at room temperature and pressure and is a basic chemical element. It can combine with various other substances to form numerous lead compounds.

B. Compounds Covered by the Standard: The word “lead” when used in this standard means elemental lead, all inorganic lead compounds and a class of organic lead compounds called lead soaps. This standard does not apply to other organic lead compounds.

C. Uses: Exposure to lead occurs in at least 120 different occupations, including primary and secondary lead smelting, lead storage battery manufacturing, lead pigment manufacturing and use, solder manufacturing and use, shipbuilding and ship repairing, auto manufacturing and repair, painting, and printing, working with scrap metal, and working with firearms or ammunition.

D. Permissible Exposure: The Permissible Exposure Limit (PEL) set by the standard is ~~50~~10 micrograms of lead per cubic meter of air (~~50~~10  $\mu\text{g}/\text{Mm}^3$ ), ~~averaged over~~calculated as an 8-hour ~~workday time-weighted average (TWA).~~

E. Action Level: The standard establishes an action level of ~~302~~ micrograms per cubic meter of air (~~302~~  $\mu\text{g}/\text{Mm}^3$ ), ~~calculated as an 8-hour TWA time-weighted average, based on an 8-hour workday.~~ The action level refers to employee exposure, without regard to the use of respirators. The action level initiates several requirements of the standard, such as exposure monitoring, medical surveillance, ~~and training and education, and signs.~~

II. Health Hazard Data

A. Ways in which lead enters your body.

When absorbed into your body ~~in certain doses~~, lead is a toxic substance. The object of the lead standard is to prevent absorption of harmful quantities of lead. The standard is intended to protect you not only from the immediate toxic effects of lead but also from the serious toxic effects that may not become apparent until years of exposure have passed.

Lead can be absorbed into your body by inhalation (breathing) and ingestion (eating). Lead (except for certain organic lead compounds not covered by the standard, such as tetraethyl lead) is not significantly absorbed through your skin. When lead is scattered in the air as a dust, fume or mist it can be inhaled and absorbed through your lungs and upper respiratory tract. Inhalation of airborne lead is generally the

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most important source of occupational lead absorption. You can also absorb lead through your digestive system if lead gets into your mouth and is swallowed. If you handle food, beverages, cigarettes, chewing tobacco, or make-up which have lead on them or handle them with hands contaminated with lead, this will contribute to ingestion.

A significant portion of the lead that you inhale or ingest gets into your blood-stream. Once in your ~~blood-system~~blood stream, lead is circulated throughout your body and stored in various organs and body tissues. Some of this lead is quickly filtered out of your body and excreted, but some remains in the blood and other tissues. As exposure to lead continues, the amount stored in your body will increase if you are absorbing more lead than your body is excreting. Even though you may not be aware of any immediate symptoms of disease, this lead stored in your tissues can be slowly causing irreversible damage, first to individual cells, then to your organs and whole body systems.

**B. Effects of overexposure to lead—**

(1) Short-term (acute) overexposure. Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise which develops quickly to seizures, coma, and death from ~~cardiopulmonary~~respiratory arrest. A very high, short-term dose of lead can lead to acute encephalopathy. Short-term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. The most severe, often fatal, form of encephalopathy may be preceded by vomiting, a feeling of dullness progressing to drowsiness and stupor, poor memory, restlessness, irritability, tremor, and convulsions.

There is no sharp dividing line between rapidly developing acute effects of lead and chronic effects which take longer to ~~acquire~~develop. Lead adversely affects numerous body systems and causes forms of health impairment and disease which arise after periods of exposure as short as days or as long as several years. For example, short-term reproductive effects may include miscarriage and reduced birth weight of children exposed to lead during pregnancy. Both high and lower level lead exposures have been associated with these outcomes. Sperm abnormalities may develop at relatively high blood lead levels (at or above 20 micrograms of lead per deciliter of whole blood (µg/dl)).

(2) Long-term (chronic) overexposure. Chronic overexposure to lead may result in severe damage to your cardiovascular, blood-forming, nervous, urinary and reproductive systems. Damage to multiple organs may occur at blood lead levels previously thought to be without recognized harm. At higher lead levels, ~~Some common~~ symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and lead colic. In lead colic there may be severe abdominal pain. Some people may not experience any symptoms even though lead is causing toxic effects in their bodies. It is important to note that permanent damage may occur even in the absence of symptoms.

Cardiovascular system (heart and blood circulation). Long-term, low dose lead exposures may result in high blood pressure. Since high blood pressure is a significant risk factor for heart disease, stroke, and



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kidney (renal) disease, lead exposure may exert an important influence on death related to the effects on the heart, brain, and kidneys.

*Neurologic system (brain and nervous system).* Nervous system dysfunction, including declines in brain (cognitive) function and slowing of nerve conduction velocity, likewise may occur at chronic, low blood lead levels.

~~High-dose exposures may damage to the central nervous system in general and the brain (encephalopathy) in particular is in one of the most severe forms of lead poisoning. The most severe, often fatal, form of encephalopathy may be preceded by vomiting, a feeling of dullness progressing to drowsiness and stupor, poor memory, restlessness, irritability, tremor, and convulsions. It may arise suddenly with the onset of seizures, followed by coma, and death. There is a tendency for muscular weakness to develop at the same time. This weakness may progress to paralysis often observed as a characteristic "wrist drop" or "foot drop" and is a manifestation of a disease to the nervous system called peripheral neuropathy.~~

*Renal system (kidneys).* Decreases in kidney function can start at low levels of exposure to lead. With higher levels of lead exposure, chronic overexposure to lead also results in kidney disease may progress with few, if any, symptoms appearing until extensive and most likely permanent kidney damage has occurred. Routine laboratory tests reveal the presence of this kidney disease only after about two-thirds of kidney function is lost. When overt symptoms of urinary dysfunction arise, it is often too late to correct or prevent worsening conditions, and progression to kidney dialysis or death is possible.

*Reproductive system.* Chronic overexposure to lead impairs the reproductive systems of both women and men. Overexposure to lead may result in decreased sex drive, impotence and sterility in men. Lead can alter the structure of sperm cells raising the risk of birth defects. There is evidence of miscarriage and stillbirth in women whose husbands were exposed to lead or who were exposed to lead themselves. Lead exposure also may result in decreased fertility and abnormal menstrual cycles in women. The course of pregnancy may be adversely affected by exposure to lead since lead crosses the placental barrier and poses risks to developing fetuses. Reduced birth weight of children exposed to lead during pregnancy has been documented with low-level chronic lead exposures. Children born of parents either one of whom were exposed to excess lead levels are more likely to have birth defects, mental retardation, or behavioral disorders or to die during the first year of childhood. Lead exposure also may result in decreased fertility and abnormal menstrual cycles in women.

Overexposure to lead may result in decreased sex drive, impotence, and sterility in men. Lead can alter the structure of sperm cells raising the risk of birth defects. There is evidence of miscarriage and stillbirth in women whose husbands were exposed to lead or who were exposed to lead themselves.

*Blood-forming system.* Overexposure to lead also disrupts the blood-forming system resulting in decreased hemoglobin (the substance in the blood that carries oxygen to the cells) and ultimately anemia. Anemia is characterized by weakness, pallor and fatigue as a result of decreased oxygen-carrying capacity in the blood.

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(3) Health protection goals of the standard. Prevention of ~~adverse health effects~~damage for most ~~worker~~employees from exposure to lead throughout a working lifetime requires that ~~worker~~employee blood lead levels (PbBLL) be maintained ~~at or below forty micrograms per one hundred grams of whole blood (40 µg/100g)~~ as low as possible. The ~~blood lead levels~~BLLs of ~~female worker~~female employees (both male and female ~~workers~~) who intend to have children should be maintained below ~~5 30 µg/dl~~100g to minimize adverse reproductive health effects to the ~~mother~~parents and the developing fetus.

The measurement of your ~~BLL~~blood lead level is the most useful indicator of the amount of lead being absorbed by your body. Your BLL is a measure of the amount of lead in your blood. This reflects both recent exposure as well as how much lead is stored in your bones. ~~Blood lead levels (PbB) are most often reported in units of milligrams (mg) or micrograms (µg) of lead (1 mg = 1000 µg) per 100 grams (100g), 100 milliliters (100ml) or deciliter (dl) of blood. These three units are essentially the same. Sometime PbB's are expressed in form of mg% or µg%. This is a shorthand notation for 100g, 100ml, or dl. PbB measurements show the amount of lead circulating in your blood stream but do not give any information about the amount of lead stored in your various tissues. PbB measurements merely show current absorption of lead, not the effect that lead is having on your body or the effects that past lead exposure may have already caused. Past research into lead-related diseases, however, has focused heavily on associations between PbBLLs and various diseases. As a result, the relative level of your PbB is an important indicator of the probability of your acquiring your BLLs over time provide an important indicator of the likelihood that you will gradually develop a lead-related health impairment or disease.~~

Once ~~As your blood lead level~~BLL increases ~~climbs above 40 µg/100g~~, your risk of disease increases. There is a wide variability of individual response to lead; thus, it is difficult to say that a particular ~~PbB~~BLL in a given person will cause a particular effect. ~~Health damage has been found at chronic BLLs of 5 µg/dl and greater, including high blood pressure, reduced birth weight, essential tremor, and kidney dysfunction. At the other extreme, studies have associated fatal encephalopathy with PbBLLs as low as of 150 µg/dl~~100g, but encephalopathy may occur at BLLs of 80 µg/dl. ~~Other studies have shown other forms of disease in some workers with PbBs well below 80 µg/100g.~~ Your ~~PbB~~BLL is a crucial indicator of the risks to your health, but one other factor is also extremely important. This factor is the length of time you have had elevated ~~PbB~~BLLs. The longer you have an elevated ~~PbB~~BLL, the greater the risk that large quantities of lead are being gradually stored in your organs and tissues (body burden). The greater your overall body burden, the greater the chances of substantial permanent damage.

The best way to prevent all forms of lead-related ~~health~~ impairments and diseases (both short-term and long-term) is to maintain your ~~PbB~~BLL below 40 µg/100g ~~as low as possible~~. The ~~provisions of the standard are~~ designed with this end in mind ~~to detect BLL increases early and take action to control exposures.~~

Your employer has prime responsibility to ~~assure~~ensure that the provisions of the standard are complied with both by the company and by individual ~~worker~~employees. You as an ~~an worker~~employee, however, also have a responsibility to assist your employer in complying with the standard. You can play a key role in protecting your own health by learning about the lead hazards and their control, learning what the standard requires, following the standard where it governs your own actions, and seeing that your employer complies with provisions governing ~~his~~their actions.

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(4) Reporting signs and symptoms of health problems. You should immediately notify your employer if you develop signs or symptoms associated with lead poisoning or if you desire medical advice concerning the effects of current or past exposure to lead on your ability to have a healthy child. You should also notify your employer if you have difficulty breathing during a respirator fit test or while wearing a respirator. In each of these cases your employer must make available to you appropriate medical examinations or consultations. These must be provided at no cost to you and at a reasonable time and place. The standard contains a procedure whereby you can obtain a second opinion by a physician of your choice if the employer selected the initial physician.

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Appendix B to Section 5198 – Employee Standard Summary

Section 5198 Summary

This appendix summarizes key provisions of the standard that you as an employee should become familiar with.

I. Permissible Exposure Limit (PEL) - subsection (c)

The standard sets a permissible exposure limit (PEL) of 100 micrograms of lead per cubic meter of air ( $100 \mu\text{g}/\text{M}^3$ ), averaged over an 8-hour workday as a time-weighted average (TWA). ~~This is the highest level of lead in air to which you may be permissibly exposed over an 8-hour workday.~~ Your lead exposure over your entire workday, when calculated as an 8-hour TWA, cannot be higher than the PEL. ~~However, since the PEL is an 8-hour average TWA, it permits short exposures above the PEL are permitted so long as for each 8-hour workday your average exposure does not exceed the PEL.~~

~~This standard recognizes that your daily exposure to lead can extend beyond a typical 8-hour workday as the result of overtime or other alterations in your work schedule. To deal with this, the standard contains a formula which reduces your permissible exposure when you are exposed more than 8 hours. For example, if you are exposed to lead for 10 hours a day, the maximum permitted average exposure would be  $40 \mu\text{g}/\text{M}^3$ .~~

II. Exposure Monitoring - subsection (d)

If lead is present in any quantity in the workplace where you work, your employer is required to make an initial determination of whether the action level ( $2 \mu\text{g}/\text{m}^3$  calculated as an 8-hour TWA) is exceeded for any employee. This initial determination must include instrument monitoring of the air for the presence of lead and must cover the exposure of a representative number of employees who are reasonably believed to have the highest exposure levels. If your employer has conducted appropriate air sampling for lead in the past year, ~~he~~ they may use these results. If there have been any employee complaints of symptoms which may be attributable to exposure to lead or if there is any other information or observations which would indicate employee exposure to lead, this must also be considered as part of the initial determination. ~~This determination must have been completed within 30 days of the effective date of the standard.~~ If this initial determination shows that a reasonable possibility exists that any employee may be exposed, without regard to the use of respirators, over the action level ~~( $30 \mu\text{g}/\text{M}^3$ )~~, your employer must set up an air monitoring program to determine the exposure level of every employee exposed to lead at your workplace.

In carrying out this air monitoring program, your employer is not required to monitor the exposure of every employee but must monitor a representative number of employees and job types. Enough sampling must be done to enable each employee's exposure level to be reasonably represented by at least one full-shift ~~(at least 7 hours)~~ air sample. In addition, these air samples must be taken under

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conditions which represent each employee's regular, daily exposure to lead. ~~All initial exposure monitoring must have been completed within 90 days of the effective date of the standard.~~

The standard includes a classification for work with lead that may result in significant employee exposure to airborne lead. In the standard, this work is referred to as presumed hazardous lead work (PHLW). PHLW includes altering or disturbing material that contains or is likely to contain at least 0.5% lead by weight; and torch cutting any scrap metal. In the standard, "altering or disturbing" means "subjecting to a process that may result in the release of lead dust, lead mist, lead fume, or other lead particles. Such processes include, but are not limited to, welding, torch cutting, brazing, torch soldering, melting, pouring, spraying, cutting, shredding, crushing, baling, grinding, polishing, machining, drilling, scraping, sanding, abrading, sweeping, raking, and shoveling." Examples of materials that are likely to contain at least 0.5% lead include scrap lead, lead solder, lead bullet fragments and dust, lead sheeting, lead cable housing, and lead billets. Because scrap metal is likely to contain lead, and it is not easy to tell if there is lead in a piece of scrap metal, all torch cutting of scrap metal is classified as PHLW.

There is an exception to what counts as PHLW. Altering or disturbing material, or torch cutting any scrap metal, is not PHLW when the total combined duration of lead exposure resulting from altering, disturbing, and torch cutting is less than 8 hours during any 30-day period.

If you are performing PHLW, your employer must provide you, as interim protection, with appropriate respiratory protection, protective clothing and equipment, medical surveillance, training and posted signs, until your employer conducts an exposure assessment and determines actual employee exposure, as required under subsection (d) of the lead standard. Once an exposure assessment has been completed, your employer must provide you with the appropriate protections, based on your level of exposure to lead, as required by the standard.

If you are exposed to lead and air sampling is performed, your employer is required to ~~quickly~~ notify you in writing within 5 working days of the air monitoring results which represent your exposure. If the results indicate your exposure exceeds the PEL (without regard to your use of respirators), then your employer must notify you of this in writing and also provide you with a description of the corrective action that has been or will be taken to reduce your exposure.

Your exposure must be rechecked by monitoring, at least every 12~~six~~ months if your exposure is at or above~~over~~ the action level (2  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA) but below 30  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA~~the PEL~~. ~~Air monitoring must be repeated every three months, if you are exposed over the PEL.~~ Your employer may discontinue monitoring for you if two~~two~~ consecutive measurements, taken at least two weeks 7 days apart, are below the action level. Air monitoring must be repeated every 6 months if you are exposed at or above 30  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA but at or below 50  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA. Your employer must continue monitoring for you every 6 months until two consecutive measurements, taken at least 7 days apart, are below 30  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA. Air monitoring must be repeated every 3 months if you are exposed above 50  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA. Your employer must continue monitoring for you every 3 months until two consecutive measurements, taken at least 7 days apart, are at or below 50  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA.

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However, whenever there is a production, process, control, or personnel change at your workplace which may result in new or additional exposure to lead, or whenever there is any other reason to suspect a change which may result in new or additional exposure to lead, your employer must perform additional monitoring.

III. Compliance - subsection (e)

~~Except for certain industries, the regulation requires employers to reduce and maintain employee exposure to lead at or below the permissible exposure limit by means of engineering, work practice, and administrative controls to the extent that such controls are feasible. Even though such controls may not be sufficient to effect compliance with the PEL, they must be instituted to achieve the lowest feasible exposure level and the employer must provide supplemental protection in the form of respirators.~~

Your employer is required to ensure that no employee is exposed to lead above the PEL. The lead standard requires employers to institute engineering and work practice controls, including administrative controls, to the extent feasible to reduce employee exposure to lead. Where such controls are feasible but not adequate to reduce exposures to at or below the PEL, they must be used to reduce exposures to the lowest level that can be accomplished by these means, and then supplemented with appropriate respiratory protection.

Certain processes used in the lead acid battery manufacturing industry have Separate Engineering Control Airborne Limits (SECALs), which will have a phase-in period. Table 1 shows the specific processes, SECALs, and implementation dates:

Table 1 -- Separate Engineering Control Airborne Limits (SECALs) for Selected Processes; Implementation Schedule

<u>Industry</u>	<u>Process</u>	<u>SECAL (as an 8-hour TWA) and Implementation Dates</u>
<u>Lead acid battery manufacturing*</u>	<u>Oxide production; paste mixing; grid pasting and parting; and battery assembly.</u>	<u>50 µg/m<sup>3</sup> on [OAL insert effective date here], then</u> <u>40 µg/m<sup>3</sup> on [OAL insert five years from effective date here].</u>
	<u>Grid production and small parts casting; and plate formation.</u>	<u>50 µg/m<sup>3</sup> on [OAL insert effective date here], then</u> <u>30 µg/m<sup>3</sup> on [OAL insert five years from effective date here].</u>

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\* Processes in this industry that are not specified in this table must achieve the PEL as specified in subsection (e)(1)(A).

Where a SECAL has been specified for particular processes, your employer must implement engineering and work practice controls to reduce and maintain employee exposures to or below the SECAL, except to the extent that your employer can demonstrate that such controls are not feasible. Note that even when there is a SECAL for a particular process, your employer must ensure that your exposure to lead is not above the PEL. Respirators may be used to supplement engineering and work practice controls to reduce employee exposure to or below the PEL.

~~Where employee exposure above the PEL occurs intermittently for no more than 30 days per year, feasible engineering controls must be implemented to achieve compliance with an exposure limit of 150 µg/M<sup>3</sup> but compliance with the PEL may be accomplished by any combination of engineering, work practice, and administrative controls and respiratory protection.~~

Your employer must also develop and implement a written compliance program to reduce exposures to or below the PEL or, where applicable, the SECAL, using only engineering and work practice controls. The standard identifies the various elements that must be included in the program. For example, employers are required to include a description of operations in which lead is emitted, detailing other relevant information about the operation such as the type of equipment used, the type of material involved, crew size, employee job responsibilities, operating procedures and maintenance practices. In addition, your employer's compliance program must specify the means that will be used to achieve compliance and, where engineering controls are required, include any engineering plans or studies that have been used to select the control methods. If engineering and work practice controls were considered but not put in place, the program must include a report that shows how they were demonstrated not to be feasible. Also, if administrative controls involving job rotation are used to reduce employee exposure to lead, the job rotation schedule must be included in the compliance program. The program must also detail the type of protective clothing and equipment, including respirators, housekeeping, and hygiene practices that will be used to protect you from the adverse effects of exposure to lead.

The written compliance program must be made available, upon request, to affected employees and their designated representatives, the Cal/OSHA Chief, and the National Institute for Occupational Safety and Health (NIOSH). The program must be reviewed and updated at least every 6 months to ensure it reflects the current status of exposure control.

**IV. Respiratory Protection - subsection (f)**

Your employer is required to provide and assure your use of respirators when your exposure to lead is not controlled below the PEL by other means, and as interim protection if you perform PHLW and an exposure assessment has not been completed. The employer must pay the cost of the respirator.

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Whenever you request one, your employer is also required to provide you a respirator even if ~~they~~your air exposure level ~~does not exceed~~is not above the PEL. You might ~~desire~~want a respirator when, for example, you intend to have children in the near future, and want to reduce the level of lead in your body to minimize adverse reproductive effects. While respirators are the least satisfactory means of controlling your exposure, they are capable of providing significant protection when properly chosen, fitted, worn, cleaned, and maintained and are replaced when they stop providing adequate protection.

Your employer is required to select respirators as specified in the Respiratory Protection standard, in section 5144(d)(3)(A)(1) from the types listed in the respiratory protection subsection of the standard. However, when respirators are required, filtering facepiece respirators (disposable respirators or dust masks) are not to be selected by your employer and are not to be used for protection from lead. Any respirator chosen must be approved by ~~the National Institute for Occupational Safety and Health~~ (NIOSH) under the provisions of 42 CFR part 84. The respirator selection table in section 5144 will enable your employer to choose a type of respirator which will give you proper protection based on your airborne lead exposure. Your employer may select a type of respirator that provides greater protection than that required by the standard; that is, one recommended for a higher concentration of lead than that to which you are exposed.

An air-purifying respirator works by removing particles, gases, or vapors from the air you breathe,~~is any respirator which has a~~ if the correct type of filter, cartridge, or canister ~~which cleans the work room air as you breathe~~it is used with the facepiece. The typical air-purifying respirator is a negative pressure respirator because it requires the force of your inhalation to draw air through the ~~filtering~~purifying element. It is less protective than a powered air-purifying respirator (PAPR) is much more protective than a typical negative pressure respirator, and may also be more comfortable to wear. A PAPR~~which~~ also has a filter, cartridge, or canister to clean the air, ~~but~~and a power source which continuously blows filtered air into your breathing zone. ~~Your employer might make a~~A PAPR available to you to may ease the burden of having to wear a negative pressure air-purifying respirator for long periods of time. The standard ~~provides~~requires that your employer must provide ~~can obtain you with~~ a PAPR upon request. Your employer also must provide high-efficiency particulate air (HEPA) filters for PAPRs and N-100, R-100, or P-100 filters for non-powered air-purifying respirators. In addition, if you are exposed to lead aerosols that cause eye or skin irritation at the use concentrations, your employer must provide you with a full facepiece respirator instead of a half mask respirator.

A ~~S~~supplied-air respirators (SAR) can also be more protective than a typical negative pressure respirator. A SAR is supplied with breathing-quality air from a source such as an air compressor or compressed air cylinder. Three types of supplied-air respirators are demand, pressure-demand, and continuous flow. The demand-type provides protection equivalent to that of a non-powered negative pressure air-purifying respirator of the same facepiece type.~~are also available which, as the name implies, are respirators to which breathing quality air is supplied from a source such as an air compressor, blower or compressed air cylinder. Three types of supplied-air respirators are available~~demand, pressure demand, and continuous flow. The demand-type requires the force of inhalation to open a diaphragm valve thus



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~~admitting air from the supply source. As any leakage around the facepiece will permit the concurrent admission of contaminated air, the demand-type only provides protection generally equivalent to that of the typical negative pressure air purifying respirator of the same facepiece type. Greater protection is provided by either the pressure-demand or continuous-flow types as~~because positive air pressure exists within the respirator at all times.

Your employer must ~~implement~~also start a Respiratory Protection Program in accordance with ~~General Industry Safety Orders~~ section 5144. This program must include written procedures for ~~the proper~~ respirator selection, medical evaluations, fit testing, use, cleaning, storage, and maintenance of respirators, and training, as well as procedures to ensure adequate air quality, quantity and flow for supplied-air respirators.

Your employer must ~~assure~~ensure that your respirator facepiece fits properly. Proper fit of a respirator facepiece is critical and no single facepiece fits all facial configurations equally well. Obtaining a proper fit thus may require your employer to make available two or three different mask types, in various sizes, in order that facepiece leakage is minimized for each employee. In order to ~~assure~~ensure that your respirator fits properly and that facepiece leakage is minimized, your employer must give you either a “quantitative or qualitative fit test” as specified in Appendix A of ~~Section~~ 5144, Respiratory Protection.

You must also receive from your employer proper training in the use of respirators. Your employer is required to teach you how to wear a respirator, to know why it is needed, and to understand its limitations.

The standard provides that if your respirator uses filter elements, you must be given an opportunity to change the filter elements whenever an increase in breathing resistance is detected. You also must be permitted to periodically leave your work area to wash your face and respirator facepiece whenever necessary to prevent skin irritation. Before you begin using a respirator, and again if you ever have difficulty in breathing during a fit test or while using a respirator, your employer must make a medical examination available to you to determine whether you can safely wear a respirator. The result of this examination may be to give you a positive pressure respirator (which reduces breathing resistance) or to provide alternative means of protection.

#### V. Protective Work Clothing and Equipment - subsection (g)

If you are exposed to lead above the PEL or perform PHLW and an exposure assessment has not been completed, or if you are exposed to lead compounds such as lead arsenate or lead azide which can cause skin and eye irritation, your employer must provide you with protective work clothing and equipment appropriate for the hazard. If work clothing is provided, it must be provided in a clean and dry condition at least weekly, and daily if your exposure to airborne lead without regard to respirator use is greater than ~~30~~150  $\mu\text{g}/\text{M}^3$ . Appropriate protective work clothing and equipment can include coveralls or similar full-body work clothing, gloves, hats, shoes or disposable shoe coverlets, and face shields or vented goggles. Your employer is required to provide all such equipment at no cost to you.

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~~He~~Your employer is responsible for providing repairs and replacement as necessary, and also is responsible for the cleaning, laundering or disposal of protective clothing and equipment. Contaminated work clothing or equipment must be removed in change rooms and not worn home or you will extend your exposure and expose your family since lead from your clothing can accumulate in your house, car, etc. Contaminated clothing which is to be cleaned, laundered or disposed of must be placed in closed containers in the change room. At no time may lead be removed from protective clothing or equipment by any means which disperses lead into the workroom air.

VI. Housekeeping - subsection (h)

Your employer must establish a housekeeping program sufficient to maintain all surfaces as free as practicable of accumulations of lead dust. HEPA ~~V~~vacuuming is the preferred method of meeting this requirement, and the use of compressed air to clean floors and other surfaces is absolutely prohibited. Dry or wet sweeping, shoveling, or brushing may not be used except where vacuuming or other equally effective methods have been tried and do not work. Vacuums must be equipped with a special filter called a HEPA filter and be used and emptied in a manner which minimizes the reentry of lead into the workplace.

VII. Hygiene Facilities and Practices - subsection (i)

The standard requires that hand washing facilities be provided, and used, where occupational exposure to lead occurs. In addition, clean change rooms, showers, and lunchrooms must be made available to ~~worker~~employees ~~exposed to lead above the PEL without regard to the use of respirators. When employees are exposed to lead the PEL is exceeded, the employer must assure~~ensure that food and beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied, except in these facilities. Change rooms, showers, and lunchrooms, ~~if available,~~ must be used by ~~worker~~employees ~~exposed in excess of the PEL. After showering, no clothing or equipment worn during the shift may be worn home, and this includes shoes and underwear. Your own clothing worn during the shift should be carried home and cleaned carefully so that it does not contaminate your home. Lunchrooms may not be entered with protective clothing or equipment unless surface dust has been removed by HEPA vacuuming, downdraft booth, or other cleaning method. Finally, worker~~employees ~~exposed to lead above the PEL must wash their hands, exposed arms, and faces prior to entering eating areas, to eating, drinking, smoking or applying cosmetics, and at the end of their shift.~~

All of the facilities and hygiene practices just discussed are essential to minimize additional sources of lead absorption from inhalation or ingestion of lead that may accumulate on you, your clothes, or your possessions. Strict compliance with these provisions can virtually eliminate several sources of lead exposure which significantly contribute to excessive lead absorption.

VIII. Medical Surveillance - subsection (j)

The medical surveillance program is part of the standard's comprehensive approach to the prevention of lead-related disease. Its purpose is to supplement the main thrust of the standard which is aimed at

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minimizing airborne concentrations of lead and sources of ingestion. Only medical surveillance can determine if the other provisions of the standard have effectively protected you as an individual. Compliance with the standard's provisions will protect most ~~worker~~employees from the ~~adverse~~harmful effects of lead exposure, but may not be satisfactory to protect individual ~~worker~~employees (1) who have high body burdens of lead acquired over past years, (2) who have additional uncontrolled sources of non-occupational lead exposure, (3) who ~~exhibit unusual variations in~~absorb lead ~~absorption at an unusually high~~ rates, or (4) who have specific non-work related ~~medical~~health-related conditions which could be aggravated by lead exposure (e.g., ~~renal~~kidney disease, anemia). In addition, control systems may fail, or hygiene and respirator programs may be inadequate. Periodic medical surveillance of individual ~~worker~~employees will help detect those failures. Medical surveillance ~~will~~is also be important to protect your reproductive ~~ability~~health, regardless of whether you are a man or woman.

All medical surveillance required by the standard must be performed by or under the supervision of a licensed physician. The employer must provide required medical surveillance without cost to the employees and at a reasonable time and place. The standard's medical surveillance program has two parts, blood lead testing ~~periodic biological monitoring~~ and medical examinations.

~~Your employer's obligation to offer medical surveillance is triggered by the results of the air monitoring program. Medical surveillance must be made available to all employees who are exposed in excess of the action level (without regard to the use of respirators) for more than 30 days a year. The initial phase of the medical surveillance program, which includes blood lead level tests and medical examinations, must be completed for all covered employees within 150 days of the effective date of the lead standard. Priority within this first round of medical surveillance must be given to employees whom the employer believes to be at greatest risk from continued exposure (for example, those with the longest prior exposure to lead, or those with the highest current exposure). Thereafter, the employer must periodically make medical surveillance both biological monitoring and medical examinations available to all covered employees.~~

A. Blood Lead Testing

Blood lead testing must be made available to you prior to assignment, or as soon as possible thereafter, when you are assigned to work in which you may be exposed to lead at or above the action level, and as interim protection, if you perform PHLW. There is an exception to this requirement. If you are exposed to lead at or above the action level for less than 10 days in any 12 consecutive months, and your exposure is not on any day at or above 100 µg/m<sup>3</sup> as an 8-hour TWA, without regard to respirator use, then blood lead testing is not required to be provided. Blood lead test results show your blood lead level (BLL). BLL means the concentration of lead measured in whole blood, expressed as micrograms per deciliter (µg/dl).

Unless your exposure to lead falls under the exception described above, additional blood lead testing under the standard must be provided on the following schedule: at least every two months for the first 6

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months after initial placement, and also for the 6 months after any change in task resulting in higher exposure; and at least every 6 months thereafter. Biological monitoring under the standard consists of blood lead level (PbB) and zinc protoporphyrin tests at least every 6 months after the initial PbB test. If a worker's your last BLL PbB is at or above 10 exceeds 40 µg/dl 100g but below 20 µg/dl, the monitoring testing frequency must be increased from every 6 months to at least every 2 months and not reduced until two consecutive tests, taken at least 30 days apart, PbBs indicate a blood lead level below 10 40 µg/dl 100g. Blood lead testing then must be provided as described in the schedule given at the start of this paragraph. If your last BLL is at or above 20 µg/dl, or you are removed from exposure to lead due to an elevated BLL, blood lead testing must be provided to you at least monthly.

Each time your BLL is tested PbB is determined to be over 40 µg/100g, your employer must notify you of the results this in writing within five working days of their his receipt of the test results. The employer must also inform you that the standard requires temporary medical removal with economic protection when your BLL PbB exceeds certain criteria (See Part IX below, Discussion of Medical Removal Protection). During the first year of the standard, this removal criterion is 80 µg/100g. Anytime your PbB exceeds 80 µg/100g your employer must make available to you a prompt follow-up PbB test to ascertain your PbB. If the two tests both exceed 80 µg/100g and you are temporarily removed, then your employer must make successive PbB tests available to you on a monthly basis during the period of your removal. Finally, if you have a BLL at or above 10 µg/dl, your employer must establish and implement a written elevated blood lead level response plan designed to reduce and maintain your BLL below 10 µg/dl.

B. Medical Examination and Consultation

An initial medical examination and consultation must be made available to you prior to assignment for the first time to an area where the concentration of airborne lead may be at or above the action level. There is an exception to this requirement. If you are exposed to lead at or above the action level for less than 10 days in any 12 consecutive months, and your exposure is not on any day at or above 100 µg/m<sup>3</sup> as an 8-hour TWA, without regard to respirator use, then a medical examination is not required to be provided. The initial examination will provide information to establish a baseline with which subsequent data can be compared.

A M medical examinations and consultation beyond the initial one must be made available on an annual basis if your blood lead level exceeds is 20 40 µg/dl 100g or greater at any time during the preceding year. This medical examination must be made available as soon as possible upon receiving a blood lead test result of 20 µg/dl or greater if you have not had a lead-specific medical examination in the last 12 months. The initial examination will provide information to establish a baseline with which subsequent data can be compared. An initial medical examination must also be made available (prior to assignment) for each employee being assigned for the first time to an area where the concentration of airborne lead equals or exceeds the action level.

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In addition, a medical examination or consultation beyond the initial one must be made available as soon as possible if you notify your employer that you are experiencing signs or symptoms commonly associated with lead poisoning or that you have difficulty breathing while wearing a respirator or during a respirator fit test. You must also be provided a medical examination or consultation beyond the initial one if you notify your employer that you desire medical advice concerning the effects of current or past exposure to lead on your ability to procreate a healthy child.

Finally, beyond the initial medical examination or consultation, appropriate follow-up medical examinations or consultations ~~may~~must also be provided for employees who have been temporarily removed from exposure under the medical removal protection provisions of the standard (§see Part IX, below, Medical Removal Protection).

The standard specifies the minimum content of pre-assignment and annual medical examinations. The content of other types of medical examinations and consultations is left up to the sound discretion of the examining physician. Pre-assignment and annual medical examinations must include (1) a detailed work history, and medical history; (2) a thorough physical examination, ~~and~~including an evaluation of your pulmonary status if you will be using a respirator; (3) a blood pressure measurement; (4) a series of laboratory tests designed to check your blood chemistry and your kidney function; and (5) a zinc protoporphyrin level if your last blood lead level was at or above 20 µg/dl. In addition, at any time upon your request, a laboratory evaluation of male fertility will be made (microscopic examination of a sperm sample), or a pregnancy test will be given.

The standard does not require that you participate in any of the medical procedures, tests, etc. which your employer is required to make available to you. Medical surveillance can, however, play a very important role in protecting your health. You are strongly encouraged, therefore, to participate in a meaningful fashion. The standard contains a multiple physician review mechanism which provides you with the right to a second medical opinion from a physician of your choice if you are dissatisfied with an examination by a physician chosen by your employer. The standard requires the two physicians to attempt a resolution of any difference in their opinions. If any dispute remains unresolved, the standard provides that a third physician, selected by you and your employer, shall make a final, binding medical determination unless you and your employer reach an agreement which is otherwise consistent with the recommendations of one of the physicians. Generally, your employer will choose the physician who conducts medical surveillance under the lead standard, unless you and your employer otherwise agree on the choice of a physician or physicians. Some companies and unions have agreed in advance, for example, to use certain independent medical laboratories or panels of physicians. Any of these arrangements are acceptable so long as required medical surveillance is made available to ~~worker~~employees.

The standard requires your employer to provide certain information to a physician to aid in his or her examination of you. This information includes (1) the standard and these appendices, (2) a description of your duties as they relate to lead exposure, (3) your exposure level, (4) a description of personal

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protective equipment you wear, (5) prior blood lead level results, ~~and~~ (6) prior written medical opinions concerning you that the employer may have, and (7) a copy of your employer's written elevated blood lead level response plan (required when an employee's BLL is at or above 10 µg/dl).

After a medical examination or consultation the physician must prepare a written ~~report~~ opinion for your employer which must contain (1) the physician's opinion as to whether you have any health-related medical condition which places your health, including the ability to procreate a healthy child, at increased risk of material impairment ~~to health~~ from exposure to lead, (2) any recommended special protective measures to be provided to you, (3) ~~any blood lead test results level determinations~~, and (4) any recommended limitation on your use of respirators. This last element must include a determination of whether you can wear a powered air-purifying respirator (PAPR) if you are found unable to wear a negative pressure respirator. Your employer must ensure that you also receive a copy of the physician's written medical opinion. In addition, the physician who conducts your medical examination will explain the results of your medical examination to you and provide you with a separate written medical report within 30 days of your medical exam. This report will contain the information in the physician's written medical opinion, plus additional information, including a determination of whether you should wear a PAPR instead of a non-powered (negative pressure) air-purifying respirator, any recommended follow-up blood lead testing or medical exams, and the physician's opinion as to whether you have any health-related condition, work-related or not for which you should have a further medical examination or treatment.

C. Additional Information about Medical Surveillance

The medical surveillance program of the lead standard may at some point in time serve to notify certain ~~worker~~ employees that they have acquired a disease or other adverse ~~medical~~ health-related condition as a result of occupational lead exposure. If this is true, ~~worker~~ employees may have legal rights to compensation from public agencies, their employers, firms that supply hazardous products to their employers, or other persons. The results of the medical surveillance program can significantly affect the legal remedies of an ~~an worker~~ employee who has acquired a job-related disease or impairment. Some states have laws, including workers' compensation laws, that disallow an employee who learns of a job-related health impairment to sue, unless the employee sues within a short period of time after learning of the impairment (this period of time may be a matter of months or years). An attorney can be consulted about these possibilities. It should be stressed that Cal/OSHA is in no way trying to either encourage or discourage claims or lawsuits. However, since results of the standard's medical surveillance program can significantly affect the legal remedies of an employee who has acquired a job-related disease or impairment, it is proper for Cal/OSHA to make you aware of this.

The medical surveillance subsection of the standard also contains provisions dealing with chelation. Chelation is the use of certain drugs (administered in pill form or injected into the body) to reduce the amount of lead absorbed in body tissues. Experience accumulated by the medical and scientific communities has largely confirmed the effectiveness of this type of therapy for the treatment of very

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severe lead poisoning. On the other hand, it has also been established that there can be a long list of extremely harmful side effects associated with the use of chelating agents. The medical community has balanced the advantages and disadvantages resulting from the use of chelating agents in various circumstances and has established when the use of these agents is acceptable. The standard includes these accepted limitations due to a history of abuse of chelation therapy by some lead companies. The most widely used chelating agents are succimer and calcium disodium EDTA, ( $\text{Ca Na}_2 \text{ EDTA}$ ), ~~calcium disodium versenate (Versenate), and d-penicillamine (penicillamine or Cupramine).~~

The standard prohibits “prophylactic chelation” of any employee by any person the employer retains, supervises or controls. “Prophylactic chelation” is the routine use of chelating or similarly acting drugs to prevent elevated blood lead levels in ~~worker~~employees who are occupationally exposed to lead, or the use of these drugs to routinely lower blood lead levels to predesignated concentrations believed to be ‘safe.’ It should be emphasized that where an employer takes an worker~~employee~~ who has no symptoms of lead poisoning and has chelation carried out by a physician (either inside or outside of a hospital) solely to reduce the ~~worker’s~~employee’s blood lead level, such practice is generally considered prophylactic chelation. The use of a hospital and a physician does not mean that prophylactic chelation is not being performed. Routine chelation to prevent increased or reduce current blood lead levels is unacceptable whatever the setting.

The standard allows the use of “therapeutic” or “diagnostic” chelation if administered under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical monitoring. Therapeutic chelation responds to severe lead poisoning where there are marked symptoms. Diagnostic chelation involves giving a patient a dose of the drug then collecting all urine excreted for some period of time as an aid to the diagnosis of lead poisoning.

In cases where the examining physician determines that chelation is appropriate, you must be notified in writing of this fact before such treatment. This will inform you of a potentially harmful treatment and allow you to obtain a second medical opinion if you choose to do so.

**IX. Medical Removal Protection - subsection (k)**

Excessive lead absorption subjects you to increased risk of disease. Medical removal protection (MRP) is a means of protecting you when, for whatever reasons, other methods such as engineering and administrative controls, work practices, and respirators have failed to provide the protection you need. MRP involves the temporary removal of an worker~~employee~~ from his or her regular job to a place of significantly lower exposure without any loss of earnings, seniority, or other employment rights or benefits. The purpose of this program is to cease further lead absorption and allow your body to naturally excrete lead which has previously been absorbed. Temporary medical removal can result from an elevated blood lead level, or a medical opinion. Up to ~~eighteen~~18 months of protection is provided as a result of either form of removal. The vast majority of removed ~~worker~~employees, however, will return to their former jobs long before this ~~eighteen~~18-month period expires. The standard contains

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special provisions to deal with the extraordinary but possible case where an ~~an worker's~~ employee's blood lead level does not adequately decline during ~~eighteen~~ 18 months of removal.

If your last blood lead level is ~~3050~~ 50  $\mu\text{g}/\text{dl}$  ~~100g~~ or above, or effective [OAL insert 1 year from effective date here], your last 2 blood lead results are at or above 20  $\mu\text{g}/\text{dl}$  or the average of the results of all blood lead tests in the last 6 months is at or above 20  $\mu\text{g}/\text{dl}$ , you must be removed from any exposure where your air lead level without a respirator would be at or above 230  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA or above, from work altering or disturbing any material containing lead at a concentration greater than or equal to 0.5% by weight, and from torch cutting any scrap metal. If you are removed from your normal job because of a high BLL, your employer ~~may not~~ must be returned ~~until you~~ to your former job status when your blood lead level BLL declines to at least below 15 40- $\mu\text{g}/\text{dl}$  100g, and two consecutive blood lead tests, taken at least 30 days apart, both indicate this level.

You may also be removed from exposure even if your blood lead levels are below ~~these~~ 30  $\mu\text{g}/\text{dl}$  or the other criteria described above if a medical determination indicates that you temporarily need reduced lead exposure for medical reasons. If the physician who is implementing your employer's medical program makes a written opinion recommending your removal or other special protective measures, your employer must implement the physician's recommendation. If you are removed in this manner, you ~~may only~~ must be returned when the doctor indicates that it is safe for you to do so.

The standard does not give specific instructions dealing with what an employer must do with a removed ~~worker~~ employee. Your job assignment upon removal is a matter for you, your employer and your union (if any) to work out consistent with procedures or agreements for job assignments which may exist in your place of employment. Each removal must be accomplished in a manner consistent with existing collective bargaining relationships. Your employer is given broad discretion to implement temporary removals so long as no attempt is made to override existing agreements. Similarly, a removed ~~worker~~ employee is provided no right to veto an employer's choice which satisfies the standard.

In most cases, employers will likely transfer removed employees to other jobs with sufficiently low lead exposure. Alternatively, an ~~an worker's~~ employee's hours may be reduced so that the time-weighted average exposure is reduced to below the action level, or he or she may be temporarily laid off if no other alternative is feasible.

In all of these situations, MRP benefits must be provided during the period of removal that is, you continue to receive the same earnings, seniority, and other rights and benefits you would have had if you had not been removed. Earnings include more than just your base wage; they include overtime, shift differentials, incentives, and other compensation you would have earned if you had not been removed. During the period of removal you must also be provided with appropriate follow-up medical surveillance. If you were removed because your blood lead level was too high, you must be provided with a monthly blood lead test. If a medical opinion caused your removal, you must be provided medical tests or examinations that the doctor believes to be appropriate. If you do not participate in this follow up medical surveillance, you may lose your eligibility for MRP benefits.



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When you are medically eligible to return to your former job, your employer must return you to your “former job status.” This means that you are entitled to the position, wages, benefits, etc., you would have if you had not been removed. If you would still be in your old job if no removal had occurred, you are to be returned to this job. If you would not be in your old job, the job assignment to which you return must be consistent with the decision which your employer would have been obliged to make had no removal occurred. MRP only seeks to maintain your rights, not expand them or diminish them.

If you are removed under MRP and you are also eligible for workers’ compensation or other compensation for lost wages, your employer’s MRP benefits obligation is reduced by the amount that you actually receive from these other sources. Similarly, if you obtain other employment during the time you are laid off, the benefits you receive under MRP are reduced by the amount you earn in such other employment.

The standard also covers situations where an employer voluntarily removes an ~~an worker~~employee from exposure to lead due to the effects of lead on the employee’s ~~medical~~health-related condition, even though the standard does not require removal. In these situations MRP benefits must also be provided as though the standard required removal. Finally, it is important to note that in all cases where removal is required, respirators cannot be used as a substitute. Respirators may be used before removal becomes necessary, but not as an alternative to a transfer to a low exposure job or to a lay-off with MRP benefits.

**X. Employee Information and Training - subsection (l)**

Your employer is required to provide an information and training program for all employees exposed to lead at or above the action level on any day, or who may ~~suffer~~experience skin or eye irritation from lead compounds such as lead arsenate or lead azide, and as interim protection for employees who perform PHLW. This program must inform these employees of the specific hazards associated with their work environment, protective measures which can be taken, the danger of lead to their bodies (including their reproductive ~~health~~systems), and their rights under the standard. In addition your employer must make readily available to all employees, including those exposed below the action level, a copy of the standard and these appendices.

Your employer is required to complete this training program for all ~~new~~employees described above ~~(who may be exposed to lead at or above the action level or for whom the possibility exists of eye or skin irritation from lead exposure)~~ prior to initial job assignment. This training program must also be provided at least annually thereafter.

**XI. Communication of Hazards~~Signs~~ - subsection (m)**

Your employer must include lead in their hazard communication program and training.

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The standard requires that the following warning sign must be posted in work areas where the exposure to lead is at or above the action level, and as interim protection in each work area where PHLW is performed exceeds the PEL:

DANGER

LEAD WORK AREA

MAY DAMAGE FERTILITY OR THE UNBORN CHILD

CAUSES DAMAGE TO THE CENTRAL NERVOUS SYSTEM

DO NOT EAT, DRINK OR SMOKE IN THIS AREA

However, prior to June 1, 2016, employers may use the following legend in lieu of that specified above:

WARNING

LEAD WORK AREA

POISON

NO SMOKING OR EATING

XII. Recordkeeping - subsection (n)

Your employer is required to keep all records of exposure monitoring for airborne lead. These records must include the name and job classification of employees measured, details of the sampling and analytic techniques, the result of this sampling, and the type of respiratory protection being worn by the person sampled. Your employer is also required to keep all records of biological monitoring blood lead testing and medical examination results. These must include the names of the employee, the physician's written opinion, and a copy of the results of the examination. All of the above kinds of records must be kept for 40 years or for at least 20 years after your termination of employment, whichever is longer.

Recordkeeping is also required if you are temporarily removed from your job under the medical removal protection program. This record must include your name and unique identifiers social security number, the date of your removal and return, how the removal was or is being accomplished, and whether or not the reason for the removal was an elevated blood lead level. Your employer is required to keep each medical removal record only for the duration of an employee's employment.

In addition, the standard requires that your employer keep records of their semi-annual review of their written compliance program, and written elevated blood lead level response plans, for three years. They are also required to keep records of any training required by this standard for three years.

The standard requires that if you request to see or copy environmental monitoring, blood lead level (PbBLL) monitoring testing, or medical removal records, they must be made available to you or to a

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representative that you authorize. Your union also has access to these records. Upon your request, your complete medical records must also be provided to you, to your physician or to any other person whom you may specifically designate. Your union does not have access to your personal medical records unless you authorize such access.

**XIII. Observation of Monitoring - subsection (o)**

When air monitoring for lead is performed at your workplace as required by the standard, your employer must allow you or someone you designate to observe the monitoring. The observer is entitled to an explanation of the measurement procedure and to record the results obtained. Since results will not normally be available at the time of the monitoring, the observer is entitled to record or receive the results of the monitoring when returned by the laboratory. Your employer is required to provide the observer with any personal protective devices required to be worn by employees working in the area that is being monitored. The employer must require the observer to wear all such equipment and to comply with all other applicable safety and health procedures.

**XIV. Effective Date**

~~The standard's effective date is September 8, 1979, and the employer obligations under the standard begin to come into effect as of that date.~~

**XV. For Additional Information**

A. A copy of the standard for lead in general industry can be obtained free of charge at <http://www.dir.ca.gov/Title8/5198.html>, or by calling or writing your local Cal/OSHA office. ~~Copies of the Federal lead standard and explanatory materials can be obtained free of charge by calling or writing the OSHA Office of Publications, Room S-1212, United States Department of Labor, Washington, D.C. 20210; Telephone, (202) 523-6138. The following publications are available:~~

- ~~1. The Federal lead standard and summary of the statement of reasons (preamble), Federal Register, Volume 43, pp. 52952-53014, November 14, 1978.~~
- ~~2. The full statement of reasons (preamble), Federal Register, Volume 43, pp. 54354-54509, November 21, 1978.~~
- ~~3. Partial Administrative Stay and Corrections to the Federal lead standard, Federal Register, Volume 44, pp. 5446-5448, January 26, 1979.~~
- ~~4. Notice of the Partial Judicial Stay, Federal Register, Volume 44, pp. 14554-14555, March 13, 1979.~~
- ~~5. Corrections to the preamble, Federal Register, Volume 44, pp. 20680-20681, April 6, 1979.~~
- ~~6. Additional correction to the preamble concerning the construction industry, Federal Register, Volume 44, p. 50338, August 28, 1979.~~

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~~7. Appendices A, B and C to the Federal lead standard, Federal Register, Volume 44, pp. 60980-60994, October 23, 1979. Corrections to the appendices, Federal Register, Volume 44, p. 68828, November 30, 1979.~~

~~8. Notice of Limited Reopening of Rulemaking Record (and summary of U.S. Court of Appeals decision), Federal Register, Volume 45, pp. 63881-3, September 26, 1980.~~

~~9. Supplemental feasibility statement (in response to U.S. Court of Appeal's remand order), Federal Register, Volume 46, pp. 6134-6228, January 21, 1981.~~

~~10. Revised supplemental feasibility statement, Federal Register, Volume 46, pp. 60758-60776, December 11, 1981.~~

~~11. Revisions of the Federal standard and appendices and new Appendix D. Federal Register, Volume 47, pp. 51110-51119, November 12, 1982.~~

B. Additional information about the California-lead standard for general industry, its enforcement, and your employer's compliance can be obtained at <http://www.dir.ca.gov/dosh/EnforcementPage.htm> or from the nearest CalAL/OSHA Consulting Service District Office in Downey, Fresno, Panorama City, Sacramento, San Diego, and San Francisco. The CAL/OSHA Consulting Service is listed in your telephone directory ies under California State Government/Industrial Relations Department.

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Appendix C to Section 5198 – Medical Surveillance Requirements

This appendix outlines the medical surveillance provisions of the general industry standard for lead and provides further information to the physician regarding the examination and evaluation of employees exposed to lead.

Medical Surveillance Guidelines

Introduction

The occupational health standard for lead was promulgated to protect workers exposed to lead which, as defined by the standard, includes metallic lead, all inorganic lead compounds and organic lead soaps but excludes all other organic lead compounds. The term “inorganic lead” used throughout this appendix is meant to be synonymous with the definition of lead set forth in the standard.

The primary purpose of the Occupational Safety and Health Act of 1970 is to ensure, so far as possible, safe and healthful working conditions for every working man and woman. The occupational health standard for lead is designed to protect employees exposed to inorganic lead including metallic lead, all inorganic lead compounds and organic lead soaps.

Under this final standard in effect as of September 8, 1979, occupational exposure to inorganic lead is to be limited to an airborne concentration of 1050  $\mu\text{g}/\text{Mm}^3$  (micrograms per cubic meter) based on calculated as an 8-hour time-weighted average (TWA). This permissible level of exposure limit (PEL) must be achieved through a combination of engineering, work practice, and administrative controls to the extent feasible (in periods of time ranging from 1 to 10 years) in primary lead smelting, secondary lead smelting, electronics, gray iron foundries, ink manufacture, paints and coatings manufacture, can manufacture, and printing. In these industries, respirators may be used to meet the 50  $\mu\text{g}/\text{M}^3$  exposure limit pending the implementation of the prescribed controls. For all other industries, there is no prescribed period during which compliance with the PEL must be achieved by controls other than respiratory protection. Where these controls are in place but are found not to reduce employee exposures to or below the PEL, they must be used nonetheless, and supplemented with respirators to meet the 10  $\mu\text{g}/\text{m}^3$  exposure limit. Where a separate engineering control air limit (SECAL) has been specified for particular processes in lead acid battery manufacturing (see section 5198, Table 1 in subsection (e) Compliance), the employer shall implement engineering and work practice controls to reduce and maintain employee exposure at or below the SECAL, except to the extent that the employer can demonstrate that such controls are not feasible. Where these controls are in place but are found not to reduce employee exposures to or below the PEL, they must be used nonetheless, and supplemented with respirators to meet the 10  $\mu\text{g}/\text{m}^3$  PEL.

The standard establishes an action level of 2  $\mu\text{g}/\text{m}^3$  calculated as an 8-hour TWA. The action level refers to employee exposure, without regard to the use of respirators. The action level triggers several ancillary provisions of the standard such as exposure monitoring, medical surveillance, training, and signs.

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The standard includes a classification for work with lead that may result in significant employee exposure to airborne lead. In the standard, this work is referred to as presumed hazardous lead work (PHLW). PHLW includes altering or disturbing material that contains or is likely to contain at least 0.5% lead by weight; and torch cutting any scrap metal. In the standard, "altering or disturbing" means "subjecting to a process that may result in the release of lead dust, lead mist, lead fume, or other lead particles. Such processes include, but are not limited to, welding, torch cutting, brazing, torch soldering, melting, pouring, spraying, cutting, shredding, crushing, baling, grinding, polishing, machining, drilling, scraping, sanding, abrading, sweeping, raking, and shoveling." Examples of materials that are likely to contain at least 0.5% lead include scrap lead, lead solder, lead bullet fragments and dust, lead sheeting, lead cable housing, and lead billets. Because scrap metal is likely to contain lead, and it is not easy to tell if there is lead in a piece of scrap metal, all torch cutting of scrap metal is classified as PHLW.

There is an exception to what counts as PHLW. Altering or disturbing material, or torch cutting any scrap metal, is not PHLW when the total combined duration of lead exposure resulting from altering, disturbing, and torch cutting is less than 8 hours during any 30-day period.

If the employee performs PHLW, the employer must provide the employee with interim protection, until the employer conducts an exposure assessment and determines actual employee exposure, as required under subsection (d) of the lead standard. Interim protections include appropriate respiratory protection, protective clothing and equipment, medical surveillance, training and posted signs. Once an exposure assessment has been completed, the employer must provide the employee with appropriate protections based on their level of exposure to lead, as required by the standard.

The standard also provides for a program of ~~biological monitoring and~~ medical surveillance for all employees ~~exposed to levels of inorganic lead above the action level of 30 µg/M<sup>3</sup> (TWA) for more than 30 days per year as outlined in section I. This program consists of initial blood lead testing and medical evaluation, along with periodic blood lead testing and medical evaluation, to be performed on a schedule which is defined by previous laboratory results, employee complaints or concerns, and the clinical assessment of the examining physician.~~

~~The purpose of this document is to outline the medical surveillance provisions of the standard for inorganic lead and to provide further information to the physician regarding the examination and evaluation of workers exposed to inorganic lead.~~

Section I ~~of this appendix~~ provides a detailed description of the ~~medical surveillance monitoring procedures~~ including the required frequency of blood ~~lead~~ testing and medical examination and consultation for exposed ~~workers~~ employees, provisions for medical removal protection (MRP), ~~the right of the employee to a second medical opinion~~, and notification and recordkeeping requirements of the physician and the employer. Discussions of respirator use, respirator monitoring, and ~~Cal/OSHA's position on prophylactic~~ chelation therapy are also included ~~in this section~~.

Section II discusses the toxic effects and clinical manifestations of lead poisoning and effects of lead intoxication on ~~the cardiovascular, neurologic, renal, gastrointestinal, and hematologic systems~~

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enzymatic pathways in heme synthesis. The adverse effects on both male and female reproductive capacity and on the fetus are also discussed.

Section III outlines the recommended medical evaluation of the ~~worker~~employee exposed to inorganic lead including details of the medical history, physical examination, and recommended laboratory tests, which are based on the toxic effects of lead as discussed in ~~Section II~~.

Section IV provides detailed information concerning the laboratory tests available for the monitoring of exposed ~~worker~~employees. Also discussed are the relative value of each test and the limitations and precautions which are necessary in the interpretation of laboratory results.

I. Medical surveillance ~~and monitoring~~ requirements for ~~worker~~employees exposed to inorganic lead.

A. Blood Lead Testing

Under the occupational health standard for inorganic lead, ~~a program of biological monitoring and medical surveillance~~ blood lead testing is to be made available to all employees prior to assignment, or as soon as possible thereafter, when they are assigned to work in which they may be exposed to lead at or above the action level, and as interim protection, if they perform PHLW. There is an exception to this requirement. If the employee is exposed to lead at or above the action level for less than 10 days in any 12 consecutive months, and their exposure is not on any day at or above  $100 \mu\text{g}/\text{m}^3$  as an 8-hour TWA, without regard to respirator use, then blood lead testing is not required to be provided. ~~exposed to lead above the action level of  $30 \mu\text{g}/\text{M}^3$  TWA for more than 30 days each year. This program consists of periodic blood sampling and medical evaluation to be performed on a schedule which is defined by previous laboratory results, worker complaints or concerns, and the clinical assessment of the examining physician.~~

Unless the employee's exposure to lead falls under the exception described above, additional blood lead testing under the standard must be provided on the following schedule: at least every two months for the first 6 months after initial placement, and also for the 6 months after any change in task resulting in higher exposure; and at least every 6 months thereafter. If an employee's last blood lead level (BLL) was at or above  $10 \mu\text{g}/\text{dl}$  but below  $20 \mu\text{g}/\text{dl}$ , the testing frequency must be at least every 2 months and not reduced until two consecutive tests, taken at least 30 days apart, indicate a BLL below  $10 \mu\text{g}/\text{dl}$ . Blood lead testing then must be provided as described in the schedule given at the start of this paragraph. Under this program, the blood lead level of all employees who are exposed to lead above the action level of  $30 \mu\text{g}/\text{M}^3$  is to be determined at least every six months. The frequency is increased to every two months for employees whose last blood lead level was between  $40 \mu\text{g}/100\text{g}$  whole blood and the level requiring employee medical removal to be discussed below. For employees whose last BLL was at or above  $20 \mu\text{g}/\text{dl}$  or who are removed from exposure to lead due to an elevated blood lead, a new blood lead level-BLL must be measured monthly. A zinc protoporphyrin (ZPP) measurement is required on each occasion that a blood lead level measurement is made.

B. Medical Examination and Consultation

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An annual initial medical examination and consultation performed under the guidelines discussed in Section III is to be made available to employees prior to assignment for the first time to an area where the concentration of airborne lead may be at or above the action level. There is an exception to this requirement. If the employee is exposed to lead at or above the action level for less than 10 days in any 12 consecutive months, and their exposure is not on any day at or above 100  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA, without regard to respirator use, then an initial medical examination is not required to be provided.

Medical examinations and consultations must be made available to employees in some additional situations. When employees are exposed at or above the action level for 10 or more days in any 12 consecutive months, or are exposed on any day at or above 100  $\mu\text{g}/\text{m}^3$  as an 8-hour TWA, or perform PHLW and an exposure assessment has not been completed, medical examinations and consultations must be made available. These medical examinations and consultations must be made on an annual basis to each if an employee's for whom a blood test conducted at any time during the preceding 12 months indicated a blood lead level (BLL) is at or above 20  $\mu\text{g}/100\text{ gdl}$  or greater at any time during the preceding 12 months. This medical examination must be made available as soon as possible upon receiving a blood lead test result of 20  $\mu\text{g}/\text{dl}$  or greater if the employee has not had a lead-specific medical examination in the last 12 months. Also, an examination is to be given to all employees prior to their assignment to an area in which airborne lead concentrations reach or exceed the action level. In addition, a medical examination must be provided as soon as possible after notification by an employee that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice regarding lead exposure and the ability to procreate a healthy child, or that the employee has demonstrated difficulty in breathing during a respirator fitting test or during respirator use. A medical examination is also to be made available as soon as possible and then as medically appropriate to each employee removed from exposure to lead due to elevated BLLs, as discussed in the next section, due to a risk of sustaining material impairment to health, or whose exposure to lead is otherwise limited or specially protected pursuant to medical recommendations.

The requirements of section 5198 for the medical surveillance of employees who are exposed to lead are summarized in Table 1.

Table 1. Minimum Requirements for Medical Surveillance.

<u>A. Blood lead level (BLL) tests required to be made available.</u>	<u>For employees:</u>  <u>who are exposed <math>\geq</math> the action level (2 <math>\mu\text{g}/\text{m}^3</math> as an 8-hour TWA) for <math>\geq</math> 10 days in any 12 consecutive months; or</u>  <u>who are exposed on any day <math>\geq</math> 100 <math>\mu\text{g}/\text{m}^3</math> as an 8-hour TWA; or</u>
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	<u>who perform presumed hazardous lead work (PHLW), and an exposure assessment has not been completed.</u>
<u>B. Schedule of BLL tests required to be made available for employees when:</u>  <u>1. Assigned to work where exposure will be <math>\geq</math> the action level for <math>\geq 10</math> days in any 12 consecutive months.</u>  <u>2. Assigned to work where exposure on any day will be <math>\geq 100 \mu\text{g}/\text{m}^3</math> as an 8-hour TWA.</u>  <u>3. Assigned to perform PHLW, and an exposure assessment has not been completed.</u>  <u>4. Last BLL was <math>&lt; 10 \mu\text{g}/\text{dl}</math>.</u>  <u>5. Last BLL was <math>\geq 10 \mu\text{g}/\text{dl}</math> but <math>&lt; 20 \mu\text{g}/\text{dl}</math>.</u>  <u>6. Last BLL was <math>\geq 20 \mu\text{g}/\text{dl}</math>.</u>	<u>Prior to assignment to such work.</u>  <u>Prior to assignment to such work.</u>  <u>Prior to assignment to such work.</u>  <u>Every 2 months for the first 6 months after initial placement, and also for the first 6 months after a change in work task or process resulting in higher exposure, and then every 6 months.</u>  <u>Every 2 months. Continue until 2 BLLs, taken at least 30 days apart, are <math>&lt; 10 \mu\text{g}/\text{dl}</math>.</u>  <u>Every 1 month.</u>
<u>C. Initial medical examination and consultation required to be made available.</u>	<u>Prior to assignment for employees who will be:</u>  <u>exposed <math>\geq</math> action level for <math>\geq 10</math> days in any 12 consecutive months; or</u>  <u>exposed on any day <math>\geq 100 \mu\text{g}/\text{m}^3</math> as an 8-hour TWA.</u>
<u>D. Medical examinations and consultations required to be made available.</u>	<u>For employees:</u>  <u>who are exposed at or above the action level for <math>\geq 10</math> days in any 12 consecutive months; or</u>

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	<p><u>who are exposed on any day <math>\geq 100 \mu\text{g}/\text{m}^3</math> as an 8-hour TWA; or</u></p> <p><u>who perform PHLW and an exposure assessment has not been completed.</u></p>
<p><u>E. Schedule of medical examinations and consultations required to be made available, for employees included in D above.</u></p>	<p><u>As soon as possible when an employee's BLL is <math>\geq 20 \mu\text{g}/\text{dl}</math>, if no lead-specific medical examination was done in the preceding 12 months; and</u></p> <p><u>annually until the employee's BLL is <math>&lt; 20 \mu\text{g}/\text{dl}</math>.</u></p> <p><u>As soon as possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or past exposure to lead on the employee's ability to procreate a healthy child, that the employee is pregnant, or that the employee has demonstrated difficulty in breathing during a respirator fit test or during use.</u></p>

NOTE: Exposure levels in Table 1 are without regard to an employee's use of a respirator.

C. Medical Removal Protection

Results of ~~biological monitoring~~BLL testing or the recommendations of an examining physician may necessitate removal of an employee from further lead exposure pursuant to the standard's medical removal protection (MRP) program. The objective of the MRP program is to provide temporary medical removal to ~~workers~~employees either with substantially elevated ~~blood lead levels~~BLLs or otherwise at risk of sustaining material health impairment from continued substantial exposure to lead. ~~The guidelines which are summarized in the following table were created under the standard for the temporary removal of an exposed employee and his or her subsequent return to work in an exposure area.~~

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A. Blood lead level requiring employee medical removal. (Level must be confirmed with second follow-up blood lead level within two weeks of first report.)	$\geq 60 \mu\text{g}/100 \text{ g}$ or average of last three blood samples over previous 6 months (whichever is over a longer time period) is $50 \mu\text{g}/100\text{g}$ or greater unless last blood sample is $40 \mu\text{g}/100\text{g}$ or less.
<p>B. Frequency which employees exposed to action level of lead (<math>30 \mu\text{g}/\text{m}^3/\text{TWA}</math>) must have blood level checked (ZPP is also strongly recommended in each occasion that a blood lead is obtained):</p> <p>1. Last blood lead level less than <math>40 \mu\text{g}/100\text{g}</math></p> <p>2. Last blood lead level between <math>40 \mu\text{g}/100\text{g}</math> and level requiring medical removal (see A above)</p> <p>3. Employees removed from exposure to lead because of an elevated blood lead level.</p>	<p>Every 6 months.</p> <p>Every 2 months.</p> <p>Every 1 month.</p>
C. Permissible airborne exposure limit for workers removed from work due to an elevated blood lead level (without regard to respirator protection).	$< 30 \mu\text{g}/\text{m}^3$ -8 hr. TWA.
D. Blood lead level confirmed with a second blood analysis at which employee may return to work.	$\leq 40 \mu\text{g}/100 \text{ g}$ .

Note: When medical opinion indicates that an employee is at risk of material impairment from exposure to lead, the physician can remove an employee from exposures exceeding the action level (or less) or recommend special protective measures as deemed appropriate and necessary. Medical monitoring during the medical removal period can be more stringent than noted in the table above if the physician so specifies. Return to work or removal of limitations and special protection is permitted when the physician indicates that the worker is no longer at risk of material impairment.

Under the standard's ultimate ~~worker~~employee medical removal criteria, an ~~worker~~employee is to be removed from any work having any eight-hour TWA exposure to lead of  $30 \mu\text{g}/\text{M}^3$  or more (without regard to the use of respirators) whenever either of the following circumstances apply: (1) a blood lead level of  $60 \mu\text{g}/100\text{g}$  or greater is obtained and confirmed by a second follow-up blood lead level performed within two weeks after the employer receives the results of the first blood sampling test, or

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~~(2) the average of the previous three blood lead determinations or the average of all blood lead determinations conducted during the previous six months, whichever encompasses the longest time period, equals or exceeds 50 µg/100g, unless the last blood sample indicates a blood lead level at or below 40 µg/100g in which case the employee need not be removed.~~ an exposure to lead at or above the action level, altering or disturbing any material containing lead at a concentration equal to or greater than 0.5% by weight, or torch cutting any scrap metal, on each occasion that either:

1. The last blood lead test indicates that the employee's BLL is at or above 30 µg/dl; or
2. Effective [OAL insert 1 year from effective date here], the last two blood lead test results are at or above 20 µg/dl; or
3. Effective [OAL insert 1 year from effective date here], the average of the results of all blood lead tests conducted in the last 6 months is at or above 20 µg/dl.

Medical removal is to continue until two consecutive ~~blood lead levels~~ BLLs at least 30 days apart are ~~below 15 40-µg/dl/100g or less.~~

~~As part of the standard, the employer is required to notify in writing each employee whose blood lead level exceeds 40 µg/100g. In addition each such employee is to be informed that the standard requires medical removal with MRP benefits, discussed below, when an employee's blood lead level exceeds the above defined limits.~~

In addition to the above ~~blood lead level~~ BLL criteria, temporary ~~medical worker~~ removal for employees may also take place as a result of medical determinations and recommendations. A written medical opinion must be prepared after each examination pursuant to the standard. If the examining physician includes a medical finding, determination or opinion that the employee has a health-related condition which places the employee's health, including the ability to procreate a healthy child, ~~medical condition which places the employee at increased risk of material health impairment~~ from exposure to lead, then the employee must be removed from any work having an exposure to lead at or above the action level, altering or disturbing any material containing lead at a concentration equal to or greater than 0.5% by weight or torch cutting any scrap metal. Alternatively, if the examining physician recommends special protective measures for an employee (e.g., use of a powered air-purifying respirator) or recommends limitations on an employee's exposure to lead, then the employer must implement these recommendations.

Monthly BLL tests must be made available during the medical removal period for an employee who is removed from exposure to lead due to an elevated BLL. In addition, a medical examination is to be made available as soon as possible and then as medically appropriate to each employee removed from exposure to lead due to an elevated BLL or due to a risk of sustaining material impairment to health, or otherwise limited or specially protected pursuant to medical recommendations.

Recommendations may be more stringent than the specific provisions of the standard. The examining physician, therefore, is given broad flexibility to tailor special protective procedures to the needs of

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individual employees. This flexibility extends to the evaluation and management of pregnant ~~worker~~employees and male and female ~~worker~~employees who are planning to raise children. Based on the history, physical examination, and laboratory studies, the physician might recommend special protective measures or medical removal for an employee who is pregnant or who is planning to conceive a child when, in the physician's judgement, continued exposure to lead at the current job would pose a significant risk. The return of the employee to his or her former job status, or the removal of special protections or limitations, depends upon the examining physician determining that the employee is no longer at increased risk of material impairment or that special measures are no longer needed.

During the period of any form of special protection or removal, the employer must maintain the ~~worker's~~employee's earnings, seniority, and other employment rights and benefits (as though the ~~worker~~employee had not been removed) for a period of up to 18 months. This economic protection will maximize meaningful ~~worker~~employee participation in the medical surveillance program, and is appropriate as part of the employer's overall obligation to provide a safe and healthful workplace. The provisions of MRP benefits during the employee's removal period may, however, be conditioned upon participation in medical surveillance.

On rare occasions, an employee's ~~blood lead level~~BLL may not acceptably decline within 18 months of removal. This situation will arise only in unusual circumstances, thus the standard relies on an individual medical examination to determine how to protect such an employee. This medical determination is to be based on both laboratory values, including ~~BLLs~~lead levels, zinc protoporphyrin levels, blood counts, and other tests felt to be warranted, as well as the physician's judgment that any symptoms or findings on physical examination are a result of lead toxicity. The medical determination may be that the employee is incapable of ever safely returning to his or her former job status. The medical determination may provide additional removal time past 18 months for some employees or specify special protective measures to be implemented.

The requirements of section 5198 for the temporary removal of an exposed employee and their subsequent return to work with lead are summarized in Table 2.

Table 2. Minimum Requirements During the Medical Removal Protection (MRP) Period.

<p><u>A. BLL requiring employee medical removal.</u></p>	<p><u>one BLL <math>\geq</math> 30 <math>\mu</math>g/dl; or</u></p> <p><u>effective [OAL insert 1 year from effective date here], the last two BLLs are <math>\geq</math> 20 <math>\mu</math>g/dl; or</u></p> <p><u>effective [OAL insert 1 year from effective date here], the average of all BLLs over the last 6 months is <math>\geq</math> 20 <math>\mu</math>g/dl.</u></p>
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<u>B. MRP due to a final medical determination.</u>	<u>A written medical opinion on the employee's health status by the examining physician results in a medical finding, determination, or opinion that the employee has a detected health-related condition which places the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead.</u>
<u>C. Frequency of BLL tests required to be made available for an employee removed from exposure to lead because of an elevated BLL.</u>	<u>Every 1 month.</u>
<u>D. Medical examinations and consultations required to be made available.</u>	<u>As soon as possible, then as medically appropriate, for an employee:</u>  <u>who is exposed (without regard to respirator use) <math>\geq</math> the action level (<math>2 \mu\text{g}/\text{m}^3</math> 8-hour TWA) for <math>\geq 10</math> days in any 12 consecutive months; or</u>  <u>who is exposed (without regard to respirator use) on any day <math>\geq 100 \mu\text{g}/\text{m}^3</math> as an 8-hour TWA; or</u>  <u>who performs PHLW and an exposure assessment has not been completed.</u>
<u>E. Permissible working conditions for an employee on MRP.</u>	<u>Employee must be removed from any work:</u>  <u>having an exposure to lead (without regard to respirator use) <math>\geq</math> the action level; or</u>  <u>altering or disturbing any material containing lead at a concentration <math>\geq 0.5\%</math> by weight; or</u>  <u>torch cutting any scrap metal.</u>
<u>F. When an employee has been placed on MRP due to elevated BLL, the BLL at which an employee can return to their former work.</u>	<u>Two consecutive BLLs, taken at least 30 days apart, both indicate a <math>\text{BLL} &lt; 15 \mu\text{g}/\text{dl}</math>.</u>

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G. When an employee has been placed on MRP due to a final medical determination, the conditions under which an employee shall be returned to their former work.

A subsequent final medical determination results in a medical finding, determination, or opinion that the employee no longer has a detected health-related condition that places the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead.

NOTE: When a medical opinion indicates that an employee is at risk of material impairment from exposure to lead, the physician can remove an employee from exposures exceeding the action level (or less) or recommend special protective measures as deemed appropriate and necessary. Medical monitoring during the medical removal period can be more stringent than noted in the table above if the physician so specifies. Return to work or removal of limitations and special protection is permitted when the physician indicates that the employee is no longer at risk of material impairment.

The lead standard provides for a multiple physician review in cases where the employee wishes a second opinion concerning potential lead poisoning or toxicity. If an employee wishes a second opinion, he or she can make an appointment with a physician of his or her choice. This second physician will review the findings, recommendations or determinations of the first physician and conduct any examinations, consultations or tests deemed necessary in an attempt to make a final medical determination. If the first and second physicians do not agree in their assessment they must try to resolve their differences. If they cannot reach an agreement then they must designate a third physician to resolve the dispute.

D. Requirements for Providing Information to Laboratories, Employees, Employers, and Healthcare Providers

For Blood Lead Tests:

The employer must instruct the healthcare provider who orders blood lead tests to provide the analyzing laboratory with complete employee identification information. This information includes:

1. Employee name, date of birth, address, and phone number; and
2. Employer name, address, and phone number.

The employer must ensure that the ordering physician explains the findings of any blood lead test and notifies the employee of the following:

1. The results of the blood lead test;
2. Any recommended follow-up blood lead testing in accordance with subsection (j)(2)(A) and the timing of that recommended blood lead testing; and
3. If the employee's blood lead level is 20 µg/dl or greater, the recommendation that the employee undergo a medical examination by a physician if the employee has not had a lead-specific medical exam in the preceding 12 months.

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In addition, the employer is required to provide a written notification to the employee within five working days after the receipt of the employee's blood lead test results. The employer must notify each employee:

1. Of that employee's BLL;
2. That the standard requires the employer to make medical examinations and consultations available to employees exposed at or above the action level, and as interim protection, to employees performing PHLW, unless an employee's exposure or work is covered by the exception in subsection (j)(1)(A). When they are required, the employer must make medical examinations and consultations available as soon as possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or past exposure to lead on the employee's ability to procreate a healthy child, or that the employee has demonstrated difficulty breathing during a respirator fit test or during use; and
3. That the standard requires medical removal with MRP benefits when an employee's BLL exceeds any of the limits defined for medical removal.

For Medical Examination and Consultation:

The employer must provide examining and consulting physicians with the following specific information:

1. ~~a~~A copy of the lead standard and all appendices;
2. ~~a~~A description of the employee's duties as related to exposure;
3. ~~†~~The exposure level or anticipated level to lead and any other toxic substances (if applicable);
4. ~~a~~A description of personal protective equipment used;
5. ~~Prior blood lead levels~~BLLs;
6. ~~and a~~All prior written medical opinions regarding the employee in the employer's possession or control; and
7. A copy of the employer's written elevated blood lead level response plan for that employee (required when an employee's BLL is at or above 10 µg/dl).

~~The employer must also obtain from the physician and provide the employee with a written medical opinion containing blood lead levels, the physician's opinion as to whether the employee is at risk of material impairment to health, any recommended protective measures for the employee if further exposure is permitted, as well as any recommended limitations upon an employee's use of respirators.~~

The employer must ensure that the physician explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of each medical examination performed. The written report shall contain:

1. The physician's opinion as to whether the employee has any detected health-related condition that would place the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead;
2. Any recommended special protective measures to be provided to the employee, or recommended limitations to be placed upon the employee's exposure to lead;
3. Any recommended limitations upon the employee's use of respirators, including a determination of whether the employee should wear a powered air-purifying respirator (PAPR) instead of a non-powered air-purifying respirator;



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- 4. The employee's BLL;
- 5. Any recommended follow-up blood lead testing and medical examinations and the timing of each;  
and
- 6. The physician's opinion as to whether the employee has any health-related condition, occupational or non-occupational, that dictates further medical examination or treatment.

The employer must also obtain a written medical opinion from the examining physician within 30 days of the medical examination. The written opinion shall contain the following information:

- 1. The physician's opinion as to whether the employee has any detected health-related condition that would place the employee's health, including the ability to procreate a healthy child, at increased risk of material impairment from exposure to lead;
- 2. Any recommended special protective measures to be provided to the employee, or limitations to be placed upon the employee's exposure to lead;
- 3. Any recommended limitation upon the employee's use of respirators, including a determination of whether the employee can wear a PAPR if the physician determines that the employee cannot wear a negative pressure respirator; and
- 4. The employee's BLL.

Employers must instruct each physician not to reveal to the employer in writing or in any other way his or her findings, laboratory results, or diagnoses which are felt to be unrelated to occupational lead exposure.

~~They must also instruct each physician to advise the employee of any occupationally or non-occupationally related medical condition requiring further treatment or evaluation.~~

E. Additional Requirements

The standard provides for the use of respirators where engineering and other primary controls ~~have not been fully implemented~~ do not provide adequate protection. However, the use of respiratory protection shall not be used in lieu of temporary medical removal due to elevated ~~blood lead levels~~ BLLs or findings that an employee is at risk of material health impairment. This is based on the numerous inadequacies of respirators including skin rash where the facepiece makes contact with the skin, unacceptable stress to breathing in some ~~workers~~ employees with underlying cardiopulmonary impairment, difficulty in providing adequate fit, the tendency for respirators to create additional hazards by interfering with vision, hearing, and mobility, and the difficulties of assuring the maximum effectiveness of a complicated work practice program involving respirators. Respirators do, however, serve a useful function where engineering and work practice controls are inadequate by providing supplementary, interim, or short-term protection, provided they are properly selected for the environment in which the employee will be working, properly fitted to the employee, maintained and cleaned periodically, and worn by the employee when required. When respirators are required, filtering facepiece respirators (disposable respirators or dust masks) are not to be used for protection from lead. Also, a PAPR is much more protective than a typical negative pressure respirator, and may also be more comfortable to wear. The standard provides that an employer must provide a PAPR to an employee upon request.

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Prophylactic chelation is prohibited by the lead standard. Diagnostic and therapeutic chelation are permitted only under the supervision of a licensed physician with appropriate medical monitoring in an acceptable clinical setting. The decision to initiate chelation therapy must be made on an individual basis and must take into account the severity of symptoms felt to be a result of lead toxicity along with ~~blood lead levels~~ BLLs, zinc protoporphyrin (ZPP) levels, and other laboratory tests as appropriate. Calcium disodium EDTA (Ca Na<sub>2</sub> EDTA) and penicillamine/succimer, which are the primary chelating agents used in the therapy of occupational lead poisoning, have significant potential side effects and their use must be justified on the basis of expected benefits to the ~~worker~~ employee. Unless frank and severe symptoms are present, therapeutic chelation is not recommended, given the opportunity to remove an ~~worker~~ employee from exposure and allow the body to naturally excrete accumulated lead. As a diagnostic aid, the chelation mobilization test ~~using Ca-EDTA~~ has limited applicability. ~~According to some investigators, the test can differentiate between lead-induced and other nephropathies. The test may also provide an estimation of the mobile fraction of the total body lead burden. It offers very limited utility as a biomarker of long-term lead exposure, and does not predict the clinical efficacy of chelation.~~

Employers are required to ~~assure~~ ensure that accurate records are maintained on exposure monitoring, medical surveillance, and medical removal for each employee. Exposure monitoring and medical surveillance records must be kept for 40 years or the duration of employment plus 20 years, whichever is longer, while medical removal records must be maintained for the duration of employment. All records required under the standard must be available upon request to the ~~Cal/OSHA Chief of the Division of Occupational Safety and Health~~ and the Director of the National Institute for Occupational Safety and Health (NIOSH). ~~Employees~~ Employers must also make environmental and biological monitoring and medical removal records available to affected employees and to former employees or their authorized employee representatives. Employees or their specifically designated representatives have access to their entire medical surveillance records.

In addition, the standard requires that the employer inform all ~~workers~~ employees who are exposed to lead at or above the action level on any one day; for whom the possibility exists of skin or eye irritation from exposure to lead; or who perform PHLW and an exposure assessment has not been completed, of the provisions of the standard and all its appendices, the purpose and description of medical surveillance, and provisions for medical removal protection if temporary removal is required. An understanding of the potential health effects of lead exposure by all exposed employees along with full understanding of their rights under the lead standard is essential for an effective monitoring program.

## II. Adverse health effects of inorganic lead.

Although the toxicity of lead has been known for 2,000 years, the knowledge of the complex relationship between lead exposure and human response is still being refined. Significant research into the toxic properties of lead continues throughout the world, ~~and it should be anticipated that our understanding of thresholds of effects and margin of safety will be improved in future years. The most recent scientific evidence shows multiple health effects at BLLs once thought to be without recognized harm. Prolonged exposure to these low levels of lead can result in adverse cumulative effects. These~~

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health effects may be permanent.

The provisions of the lead standard are founded on two prime medical judgments: first, the prevention of adverse health effects from exposure to lead throughout a working lifetime requires that ~~worker~~employee blood lead levels~~BLLs~~ be maintained ~~at or below 40 µg/100g~~ as low as possible; and second, the ~~blood lead levels~~BLLs of ~~female worker~~female employees, ~~male or female, who intend to parent in the near future are trying to conceive~~ should be maintained below ~~5 µg/dl~~30 µg/100g to minimize adverse reproductive health effects to the ~~parents~~mother and developing fetus. The lead standard is designed to detect BLL increases early and take action to control exposures. The adverse effects of lead on reproduction are being actively researched and the physician is encouraged to remain abreast of recent developments in the area to best advise pregnant ~~worker~~employees or ~~worker~~employees planning to conceive children.

The spectrum of health effects caused by lead exposure can be subdivided into ~~five~~four developmental stages: ~~normal~~, physiological changes of uncertain significance, pathophysiological changes, overt symptoms (morbidity), and mortality. Within this process there are no sharp distinctions, but rather a continuum of effects. Boundaries between categories overlap due to the wide variation of individual responses and exposures in the working population. The development of the lead standard focused on pathophysiological changes as well as later stages of disease.

In terms of mechanisms of disease, lead interferes with cellular metabolism in tissues throughout the body. As a divalent cation, lead interferes with calcium metabolism which affects, for example, neurotransmission and vascular tone. Lead has a high affinity for negatively charged sulfhydryl groups, ultimately affecting synthesis of heme required for production of hemoglobin; cytochromes involved in cellular respiration; and microsomal oxidases involved in biotransformation pathways. In addition, lead increases reactive oxygen species, which affects vascular tone. Lead also affects cell membranes and nucleic acids with multi-system effects. In the nervous system, lead alters the permeability of the blood brain barrier and accumulates in astroglia. Other modes of action include cell death, genotoxicity, inflammation, and endocrine disruption.

1. Cardiovascular Effects. Current evidence indicates a causal relationship between lead exposure and hypertension, and between lead exposure and coronary heart disease. Various mechanisms of action may mediate the hypertensive effect, including oxidative stress, inflammation, hormonal and blood pressure regulatory system dysfunction, and vasomodulator imbalance. These mechanisms, and possibly subclinical atherosclerosis which has been demonstrated in some studies, likewise contribute to coronary heart disease. Since hypertension is a significant risk factor for heart disease, stroke, and renal insufficiency, lead exposure may exert an important influence on cardiovascular, cerebrovascular, and renovascular mortality. Prospective cohort studies have demonstrated an approximate 50% increase in cardiovascular mortality associated with chronic BLLs of 10 µg/dl or greater.

12. Heme Synthesis Inhibition. The earliest ~~demonstrated~~ hematologic effect of lead involves its lead's ability to inhibit at least two enzymes of the heme synthesis pathway at very low ~~blood lead levels~~BLLs. Inhibition of delta aminolevulinic acid ~~dehydrase~~dehydratase (ALA-D) which catalyzes the conversion of delta-aminolevulinic acid (ALA) to protoporphyrin is observed at a ~~blood lead level~~BLL as low as 10 µg/dl

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~~below 20 µg/100g of whole blood.~~ At a ~~blood lead level~~BLL of 40 µg/~~100gd~~, more than 20% of the population would have 70% inhibition of ALA-D. There is an exponential increase in ALA excretion at ~~blood lead levels~~BLLs greater than 40 µg/~~100gd~~.

Another enzyme, ferrochelatase, is also inhibited at low ~~blood lead levels~~BLLs. Inhibition of ferrochelatase leads to increase free erythrocyte protoporphyrin (FEP) in the blood which can then bind to zinc to yield zinc protoporphyrin (ZPP). At a ~~blood lead level~~BLL of 50 µg/~~dl~~100g or greater, nearly 100% of the population will have an increase in FEP. There is also an exponential relationship between ~~blood lead levels~~BLLs greater than 40 µg/~~dl~~100g and the associated ZPP level, which has led to the development of the ZPP screening test for lead exposure.

While the significance of these effects is subject to debate, these enzymatic disturbances ~~may be~~are early stages of a disease process which eventually results in the clinical symptoms of lead poisoning. Whether or not the effects do progress to the later stages of clinical disease, disruption of these enzymatic processes over a working lifetime is ~~considered to be~~ a material impairment of health.

One of the eventual results of lead-induced inhibition of enzymes in the heme synthesis pathway is anemia which can be asymptomatic if mild, but is associated with a wide array of symptoms including dizziness, fatigue, and tachycardia when more severe. Recent evidence suggests that bone lead stores may exert a subclinical effect on hematopoiesis, since bone lead levels have been found to correlate with decreased hemoglobin and hematocrit in individuals with low BLLs (mean BLL<10 µg/dl). Studies have indicated that~~Once lead levels~~BLLs reach as low as 50 µg/dl~~100g, can be associated with a definite decreased in hemoglobin is evident,~~ although most cases of lead-induced anemia, as well as shortened red-cell survival times, occur at ~~lead levels~~BLLs exceeding 80 µg/~~100gd~~. Inhibited hemoglobin synthesis is more common in chronic cases, whereas shortened erythrocyte life span is more common in acute cases.

In lead-induced anemias, there is usually a reticulocytosis along with the presence of basophilic stippling, and ringed sideroblasts, although none of the above are pathognomonic for lead-induced anemia.

23. Neurological Effects. Inorganic lead has been found to have toxic effects on both the central and peripheral nervous systems. The earliest stages of lead-induced central nervous system effects are manifested by behavioral disturbances and central nervous system symptoms including irritability, restlessness, insomnia and other sleep disturbances, fatigue, vertigo, headache, poor memory, tremor, depression, and apathy. With more severe exposure, symptoms can progress to drowsiness, stupor, hallucinations, delirium, convulsions, and coma.

The most severe and acute form of lead poisoning which usually follows ingestion or inhalation of large amounts of lead is acute encephalopathy which may arise precipitously with the onset of intractable seizures, coma, ~~cardiorespiratory~~pulmonary arrest, and death within 48 hours.

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While there is disagreement about what exposure levels are needed to produce the earliest symptoms, most experts agree that symptoms and neurocognitive deficits definitely can occur at ~~blood lead level~~ BLLs of 60~~40~~ µg/100gdl. Subclinical neurocognitive deficits are possible at lower levels, ~~whole blood~~ and therefore a recommend a 40~~10~~ µg/100gdl maximum is recommended. The central nervous system effects frequently are not reversible following discontinued exposure or chelation therapy and when improvement does occur, it is almost always only partial.

The peripheral neuropathy resulting from lead exposure characteristically involves only motor function with minimal sensory damage and has a marked predilection for the extensor muscles of the most active extremity. The peripheral neuropathy can occur with varying degrees of severity. The earliest and mildest form which can be detected in ~~worker/employees~~ with ~~blood lead levels~~ BLLs as low as ~~50~~30 µg/100gdl is manifested by slowing of motor nerve conduction velocity often without clinical symptoms. With progression of the neuropathy there is development of painless extensor muscle weakness usually involving the extensor muscles of the fingers and hand in the most active upper extremity, followed in severe cases by wrist drop or, much less commonly, foot drop.

In addition to slowing of nerve conduction, electromyographical studies in patients with ~~blood lead levels~~ BLLs greater than 50 µg/100gdl have demonstrated a decrease in the number of acting motor unit potentials, an increase in the duration of motor unit potentials, and spontaneous pathological activity including fibrillations and fasciculations. ~~Whether these effects occur at levels of 40 µg/100g is undetermined.~~ Essential tremor in some studies has been shown to occur at BLLs less than 10 µg/dl.

While the peripheral neuropathies can occasionally be reversed with therapy, again such recovery is not assured particularly in the more severe neuropathies and often improvement is only partial. The lack of reversibility is felt to be due in part to segmental demyelination.

34. Gastrointestinal. Lead may also affect the gastrointestinal system producing abdominal colic or diffuse abdominal pain, constipation, obstipation, diarrhea, anorexia, nausea and vomiting. Lead colic may develop at chronic BLLs of 40 µg/dl and greater, or at acutely elevated BLLs of 80 µg/dl or greater ~~rarely develops at blood lead levels below 80 µg/100g.~~

45. Renal. Renal toxicity represents one of the most serious health effects of lead poisoning. Kidney dysfunction is thought to occur at chronic BLLs of 5-10 µg/dl or greater but also may arise after acute high-dose lead exposures. In the early stages of disease nuclear inclusion bodies can frequently be identified in proximal renal tubular cells. Renal function remains normal and the changes in this stage are probably reversible. With more advanced disease there is progressive interstitial fibrosis and impaired renal function. Eventually extensive interstitial fibrosis ensues with sclerotic glomeruli and dilated and atrophied proximal tubules; all represent end stage kidney disease. Azotemia can be progressive, eventually resulting in frank uremia necessitating dialysis. There is occasionally associated hypertension and hyperuricemia with or without gout.

Early kidney disease is difficult to detect. The urinalysis is normal in early lead nephropathy and the blood urea nitrogen and serum creatinine increase only when two-thirds of kidney function is lost.

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Measurement of creatinine clearance can often detect earlier disease as can other methods of measurement of glomerular filtration rate. An abnormal ~~Ca-EDTA~~chelation mobilization test has been used to differentiate between lead-induced and other nephropathies, but this procedure is not widely accepted. ~~A form of Fanconi syndrome with aminoaciduria, glycosuria, and hyperphosphaturia indicating severe injury to the proximal renal tubules is occasionally seen in children.~~

~~56. Reproductive effects~~Effects. Exposure to lead can have serious effects on reproductive function in both males and females. In male ~~worker~~employees exposed to lead there can be a decrease in sexual drive, impotence, decreased ability to produce healthy sperm, and sterility. Malformed sperm (teratospermia), decreased number of sperm (hypospermia), and sperm with decreased motility (asthenospermia) can all occur. ~~Teratospermia has been noted at mean blood lead levels of 53 µg/100g and hypospermia and asthenospermia at 41 µg/100g. These adverse effects may occur at BLLs of 20 µg/dl or greater.~~ Furthermore, there appears to be a dose-response relationship for teratospermia in lead-exposed ~~worker~~employees.

Women exposed to lead may experience menstrual disturbances including dysmenorrhea, menorrhagia, and amenorrhea. Following exposure to lead, women have a higher frequency of sterility, premature births, spontaneous miscarriages, and stillbirths.

Germ cells can be affected by lead and lead can cause genetic damage in the egg or sperm cells before conception and result in failure to implant, miscarriage, stillbirth, or birth defects.

Infants of mothers with lead poisoning have a higher mortality during the first year and suffer from lowered birth weights, slower growth, and nervous system disorders.

Lead can pass through the placental barrier and lead levels in the mother's blood are comparable to concentrations of lead in the umbilical cord at birth. Transplacental passage becomes detectable at 12-14 weeks of gestation and increases until birth.

There is little direct data on damage to the fetus from exposure to lead but it is generally assumed that the fetus and newborn would be at least as susceptible to neurological damage as young children. Current evidence indicates that there is no known lower limit of toxicity at any age. Blood lead levels of 50-60 µg/100g~~Lead exposure~~ in children can cause significant neurobehavioral impairments including cognitive dysfunction and there is evidence of hyperactivity at blood lead levels as low as 25 µg/100g. Therefore, women planning to conceive should maintain BLLs less than 5 µg/dl. ~~Given the overall body of literature concerning the adverse health effects of lead in children, it is recommended that the blood lead level in children should be maintained below 30 µg/100g with a population mean of 15 µg/100g. Blood lead levels in the fetus and newborn likewise should not exceed 30 µg/100g.~~

~~Because of lead's ability to pass through the placental barrier and also because of the demonstrated adverse effects of lead on reproductive function in both the male and female as well as the risk of genetic damage of lead on both the ovum and sperm, a 30 µg/100g maximum permissible blood lead level is recommended for both males and females who wish to bear children.~~

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67. Other ~~†~~Toxic ~~e~~Effects. Debate and research continue on the effects of lead on the human body. Hypertension has frequently been noted in occupationally exposed individuals although it is difficult to assess whether this is due to lead's adverse effects on the kidney or if some other mechanism is involved. Vascular and electrocardiographic changes have been detected but have not been well characterized. Lead is thought to ~~impair~~ may impair the immune and endocrine systems, including thyroid function and ~~interfere with~~ the pituitary-adrenal axis, but ~~again~~ these effects have not been well defined. Also, although the epidemiologic data is limited and inconsistent, based on toxicologic data and animal studies, lead is considered a probable human carcinogen by several authoritative sources.

## III. Medical Evaluation

The most important principle in evaluating an ~~worker~~employee for any occupational disease, including lead poisoning, is a high index of suspicion on the part of the examining physician. As discussed in ~~S~~section II, lead can affect numerous organ systems and produce a wide array of signs and symptoms, most of which are non-specific and subtle in nature at least in the early stages of disease. Unless serious concern for lead toxicity is present, many of the early clues to diagnosis may easily be overlooked.

The crucial initial step in the medical evaluation is recognizing that an ~~worker's~~employee's employment can result in exposure to lead. The ~~worker~~employee will frequently be able to define exposures to lead and lead-containing materials but often will not volunteer this information unless specifically asked. In other situations the ~~worker~~employee may not know of any exposures to lead but the suspicion might be raised on the part of the physician because of the industry or occupation of the ~~worker~~employee. Potential occupational exposure to lead and its compounds occur in at least 120 occupations, including lead smelting, the manufacture of lead storage batteries, the manufacture of lead pigments and products containing pigments, solder manufacture, shipbuilding and ship repair, auto manufacturing and repair, scrap yard work, construction, and painting, and work with firearms and ammunition.

Once the possibility for lead exposure is known, the focus can then be directed toward eliciting information from the medical history, physical examination, and finally from laboratory data to evaluate the ~~worker~~employee for potential lead toxicity.

A complete and detailed work history is important in the initial evaluation. A listing of all previous employment with information on work processes, exposure to fumes or dust, known exposures to lead or other toxic substances, respiratory protection used, and previous medical surveillance should all be included in the ~~worker's~~employee's record. Where exposure to lead is suspected, information concerning on-the-job personal hygiene, smoking or eating habits in work areas, laundry procedures, and use of any protective clothing or respiratory protection equipment should be noted. A complete work history is essential in the medical evaluation of an ~~worker~~employee with suspected lead toxicity, especially when long term effects such as neurotoxicity and nephrotoxicity are considered.

The medical history is also of fundamental importance and should include a listing of all past and current ~~medical~~health-related conditions, current medications including proprietary drug intake and ethnic

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remedies, previous surgeries and hospitalizations, allergies, smoking history, alcohol consumption, and also non-occupational lead exposures such as hobbies (hunting, riflery). Also, known childhood exposures should be elicited. Any previous history of cardiovascular, hematological, neurological, gastrointestinal, renal, psychological, gynecological, genetic, or reproductive problems should be specifically noted.

A careful and complete review of systems must be performed to assess both recognized complaints and subtle or slowly acquired symptoms which the ~~worker~~employee might not appreciate as being significant. The review of symptoms should include the following:

1. General weight loss, fatigue, decreased appetite.
2. Head, Eyes, Ears, Nose, Throat (HEENT) - headaches, visual disturbances or decreased visual acuity, hearing deficits or tinnitus, pigmentation of the oral mucosa, or metallic taste in mouth.
3. Cardiopulmonary - shortness of breath, cough, chest pains, palpitations, or orthopnea.
4. Gastrointestinal - nausea, vomiting, heartburn, abdominal pain, constipation or diarrhea.
5. Neurologic - irritability, insomnia, weakness (fatigue), dizziness, loss of memory, confusion, hallucinations, incoordination, ataxia, decreased strength in hands or feet, disturbances in gait, difficulty in climbing stairs, or seizures.
6. Hematologic - pallor, easily fatigued, abnormal blood loss, melena.
7. Reproductive - (male and female and spouse where relevant) history of infertility, impotence, loss of libido, abnormal menstrual periods, history of miscarriages, stillbirths, or children with birth defects.
8. Musculo-skeletal - muscle and joint pains.

The physical examination should emphasize the neurological, gastrointestinal, and cardiovascular systems. The ~~worker's~~employee's weight and blood pressure should be recorded. ~~Historically, and~~ the oral mucosa was checked for pigmentation characteristic of a possible Burtonian or lead line on the gingiva. ~~It should be noted, however, that~~However, the lead line may not be present even in severe lead poisoning if good oral hygiene is practiced.

The presence of pallor on skin examination may indicate an anemia, which if severe might also be associated with a tachycardia. If an anemia is suspected, an active search for blood loss should be undertaken including potential blood loss through the gastrointestinal tract.

A complete neurological examination should include an adequate mental status evaluation including a search for behavioral and psychological disturbances, memory testing, evaluation for irritability, insomnia, hallucinations, and mental clouding. Gait and coordination should be examined along with



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close observation for tremor. A detailed evaluation of peripheral nerve function including careful sensory and motor function testing is warranted. Strength testing particularly of extensor muscle groups of all extremities is of fundamental importance.

Cranial nerve evaluation should also be included in the routine examination.

The abdominal examination should include auscultation for bowel sounds and abdominal bruits and palpation for organomegaly, masses, and diffuse abdominal tenderness.

Cardiovascular examination should evaluate possible early signs of ischemic heart disease and congestive heart failure. Pulmonary status should be addressed particularly if respiratory protection is contemplated.

As part of the medical evaluation, the lead standard requires the following laboratory studies:

1. Blood lead level.
2. Hemoglobin and hematocrit determinations, red cell indices, and examination of the peripheral blood smear to evaluate red blood cell morphology.
3. Blood urea nitrogen.
4. Serum creatinine.
5. Routine urinalysis with microscopic examination.
6. A zinc protoporphyrin (ZPP) level for each employee whose last blood lead level was at or above 20  $\mu\text{g}/\text{dl}$ .

In addition to the above, the physician is authorized to order any further laboratory or other tests which ~~he or she~~they deems necessary in accordance with sound medical practice. The evaluation must also include pregnancy testing or laboratory evaluation of male fertility if requested by the employee.

Additional tests which are probably not warranted on a routine basis but may be appropriate when blood lead and ZPP levels are equivocal include delta-aminolevulinic acid and coproporphyrin concentrations in the urine, and dark-field illumination for detection of basophilic stippling in red blood cells.

If an anemia is detected further studies including a careful examination of the peripheral smear, reticulocyte count, stool for occult blood, serum iron, total iron binding capacity, bilirubin, and, if appropriate, vitamin B12 and folate may be of value in attempting to identify the cause of the anemia.

If a peripheral neuropathy is suspected, nerve conduction studies are warranted both for diagnosis and as a basis to monitor any therapy.

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If renal disease is questioned, a 24-hour urine collection for creatinine clearance, protein, and electrolytes may be indicated. Elevated uric acid levels may result from lead-induced renal disease and a serum uric acid level might be performed.

An electrocardiogram and chest X-ray may be obtained as deemed appropriate.

Sophisticated and highly specialized testing should not be done routinely and where indicated should be under the direction of a specialist.

#### IV. Laboratory Evaluation

The ~~blood lead level~~BLL at present remains the single most important test to monitor lead exposure and is the test used in the medical surveillance program under the lead standard to guide employee medical removal. ~~The ZPP has several advantages over the blood lead level, but because of its relatively recent development and the lack of extensive data concerning its interpretation, the~~The ZPP currently remains an ancillary test due to its lack of sensitivity.

This section will discuss the ~~blood lead level~~BLL and ZPP in detail and will outline their relative advantages and disadvantages. Other blood tests currently available to evaluate lead exposure will also be reviewed.

~~The blood lead level is a good index of current or recent lead absorption when there is no anemia present and when the worker has not taken any chelating agents. However, blood lead levels along with urinary lead levels do not necessarily indicate the total body burden of lead and are not adequate measures of past exposure.~~BLL, a measure of the amount of lead currently found in the blood, reflects both recent exogenous exposure as well as endogenous redistribution of lead stored in bone. BLL does not reflect the body burden. One reason for this is that lead has a high affinity for bone and up to 90% of the body's total lead is deposited there. A very important component of the total lead body burden is lead in soft tissue (liver, kidney, and brain). This fraction of the lead body burden, the biologically active lead, is not entirely reflected by ~~blood lead levels~~BLLs since it is a function of the dynamics of lead absorption, distribution, deposition in bone and excretion. Following discontinuation of exposure to lead, the excess body burden is only slowly mobilized from bone and other relatively stable body stores and excreted.

When interpreting a person's BLL, three key questions to keep in mind are whether the exposure history has been acute or chronic; recent or remote; high or low. Consequently~~For instance, a high blood lead level-BLL may only represent recent heavy exposure to lead without a significant total body excess and likewise a low blood lead level-BLL does not exclude an elevated total body burden of lead.~~

Also, due to its correlation with recent exposures, the ~~blood lead level~~BLL may vary considerably over short time intervals.

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To minimize laboratory error and erroneous results due to contamination, blood specimens must be carefully collected (after thorough cleaning of the skin with appropriate methods) using lead-free blood containers and analyzed by a reliable laboratory. Under the standard, samples must be analyzed in laboratories that are CLIA-approved (under the federal Clinical Laboratory Improvement Amendments (CLIA) regulations), which are approved by the Center of Disease Control (CDC) or which have received satisfactory grades in proficiency testing by the CDC in the previous year. Analysis is to be made using atomic absorption spectrophotometry, anodic stripping voltammetry or any method which meets the accuracy requirements set forth by the standard.

The determination of lead in urine is generally considered a less reliable monitoring technique than analysis of whole blood primarily due to individual variability in urinary excretion capacity as well as the technical difficulty of obtaining accurate 24-hour urine collections. In addition, ~~worker~~employees with renal insufficiency, ~~whether~~ due to lead or some other cause, may have decreased lead clearances and consequently urine lead levels may underestimate the true lead burden. Therefore, urine lead levels should not be used as a routine test.

~~The zinc protoporphyrin test, unlike the blood lead determination, measures an adverse metabolic effect of lead and as such is a better indicator of lead toxicity than the level of blood lead itself. The level of ZPP reflects lead absorption over the preceding 3 to 4 months, and therefore is a better indicator of lead body burden. The ZPP requires more time than the blood lead to reach significantly elevated levels; the return to normal after discontinuing lead exposure is also slower. Furthermore, the ZPP test is simpler, faster, and less expensive to perform and no contamination is possible. Many investigators believe it is the most reliable means of monitoring chronic lead absorption.~~

The ZPP test, unlike the blood lead determination, is an indirect and relatively insensitive biomarker of lead absorption. Zinc protoporphyrin results from the inhibition of the enzyme ferrochelatase which catalyzes the insertion of an iron molecule into the protoporphyrin molecule, which then becomes heme. If iron is not inserted into the molecule, then zinc, having a greater affinity for protoporphyrin, takes the place of the iron, forming ZPP.

An evaluation in the level of circulating ZPP may occur at blood lead levels as low as 20-30 µg/100g in some workers. Once the blood lead level has reached 40 µg/100g there is more marked rise in the ZPP value from its normal range of less than 100 g/100ml. The level of circulating ZPP may not rise until a BLL of 20 µg/dl in some adults and is not greater than 90% sensitive until the BLL exceeds 50 µg/dl. Increases in blood lead levels BLLs beyond 40 µg/100gdl are associated with exponential increases in ZPP. The upper limit of normal for ZPP varies some between labs but is usually between 35 and 40 µg/dl.

Whereas blood lead levels BLLs fluctuate over short time spans, ZPP levels remain relatively stable. ZPP is measured directly in red blood cells and is present for the cell's entire 120-day life span. Therefore, the ZPP level in blood reflects the average ZPP production over the previous 3-4 months and consequently the average lead exposure during that time interval. The ZPP requires more time than the blood lead to reach significantly elevated levels; the return to normal after discontinuing lead exposure is also slower, lagging the BLL by about 2-6 weeks. Therefore, the ZPP may be useful to assess chronicity of exposure.

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For example, an elevated BLL and normal ZPP suggest recent exposure, while an elevated BLL and elevated ZPP suggest chronic/ongoing exposure.

It is recommended that a hematocrit be determined whenever a confirmed ZPP of 50  $\mu\text{g/dl}$  ~~100ml whole blood~~ is obtained to rule out a significant underlying iron deficiency anemia. If the ZPP is in excess of 100  $\mu\text{g/dl}$  ~~100ml~~ and not associated with abnormal elevations in ~~blood lead levels~~ BLLs, the laboratory should be checked to be sure that blood leads were determined using a laboratory that is CLIA-approved atomic absorption spectrophotometry, anodic stripping voltammetry or other method meeting the accuracy requirements set forth by the standard and by a CDC-approved laboratory which is experienced in lead level determinations. Repeat periodic blood lead studies should be obtained in all individuals with elevated ZPP levels to be certain that an associated elevated ~~blood lead level~~ BLL has not been missed due to transient fluctuations in blood leads.

ZPP has a characteristic fluorescence spectrum with a peak at 594 ~~nanometers~~ nm which is detectable with a hematofluorimeter. The hematofluorimeter is accurate and portable and can provide on-site, instantaneous results for ~~worker~~ employees who can be frequently tested via a finger prick.

However, careful attention must be given to calibration and quality control procedures. Limited data on blood lead-ZPP correlations and the ZPP levels which are associated with the adverse health effects discussed in ~~Section II~~ are the major limitations of the test. Also it is difficult to correlate ZPP levels with environmental exposure and there is some variation of response with age and sex. ~~Nevertheless, the ZPP promises to be an important diagnostic test for the early detection of lead toxicity and its value will increase as more data are collected regarding its relationship to other manifestations of lead poisoning.~~

Levels of delta-aminolevulinic acid (ALA) in the urine are also used as a measure of lead exposure. Increasing concentrations of ALA are believed to result from the inhibition of the enzyme delta-aminolevulinic acid ~~dehydrase~~ dehydratase (ALA-D). Although the test is relatively easy to perform, inexpensive, and rapid, the disadvantages include variability in results, the necessity to collect a complete 24-hour urine sample which has a specific gravity greater than 1.010, and also the fact that ALA decomposes in the presence of light.

The pattern of porphyrin excretion in the urine can also be helpful in identifying lead intoxication. With lead poisoning, the urine concentrations of coproporphyrins I and II, porphobilinogen and uroporphyrin I rise. The most important increase, however, is that of coproporphyrin III; ~~levels may exceed 5,000  $\mu\text{g/l}$  in the urine in lead poisoned individuals~~, but its correlations with ~~blood lead levels~~ BLLs and ZPP are not as good as those of ALA. Increases in urinary porphyrins are not diagnostic of lead toxicity and may be seen in porphyria, some liver diseases, and in patients with high reticulocyte counts.

V. Summary. The standard for inorganic lead places significant emphasis on the medical surveillance of all ~~worker~~ employees exposed to levels of inorganic lead at or above the action level of 2  $30\mu\text{g}/\text{Mm}^3$  TWA for 10 or more days per year, and as interim protection for those who perform PHLW as defined in the standard. The physician has a fundamental role in this surveillance program, and in the operation of the medical removal protection program.

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Even with adequate ~~worker~~employee education on the adverse health effects of lead and appropriate training in work practices, personal hygiene and other control measures, the physician has a primary responsibility for evaluating potential lead toxicity in the ~~worker~~employee. It is only through a careful and detailed medical and work history, a complete physical examination, and appropriate laboratory testing that an accurate assessment can be made. Many of the adverse health effects of lead toxicity are either irreversible or only partially reversible and therefore early detection of disease is very important.

This document outlines the medical monitoring program as defined by the occupational safety and health standard for inorganic lead. It reviews the adverse health effects of lead poisoning and describes the important elements of the history and physical examinations as they relate to these adverse effects. Finally, the appropriate laboratory testing for evaluating lead exposure and toxicity is presented.

It is hoped that this review and discussion will give physicians a better understanding of the Cal/OSHA lead standard, with the ultimate goal of protecting the health and well-being of employees exposed to lead who are under their care.

**Appendix D**

Qualitative Fit Test (QLFT) Protocols

[See Section 5144, Appendix A]