Notes

Lead Exposure Control

Preparation

1. Read Applicable Background information and related Company Policy Chapter.
2. Make _____ Copies of this Lesson Plan for Personnel
3. Make Transparency, procure transparency pens, etc.
4. Coffee, tea, snacks

Material

1. Personal Protective Equipment the emloyee is expected to wear (see page 11)
2. Blasting Equipment the emloyee is expected to use

Objective

By the end of this session, personnel shall be able to discuss:

1. and Define “Engineering Controls”
2. and give examples of the following Engineering Controls:
   - Substitution
   - Isolation
   - Ventilation
3. Work Practice Controls to include:
   - Housekeeping
   - Personal Hygiene Practices
   - Washing and Eating Facilities
4. The Importance of Periodic Inspection and Maintenance
5. Employee Training Requirements
6. Lead Removal Operation Procedures

Background

Until the Company performs an employee-exposure assessment and determines the magnitude of the exposures actually occurring during the lead-related activity, the Company must assume that employees performing that task are exposed lead concentrations and the Company is required to provide respiratory protection appropriate to the task's presumed exposure level, protective work clothing and equipment, change areas, hand-washing facilities, training, and the initial medical surveillance prescribed by the OSHA Standard.

Lesson

Notes

Engineering Controls

Engineering controls, such as ventilation, and good work practices are the preferred methods of minimizing exposures to airborne lead at the worksite. The engineering control methods that can be used to reduce or eliminate lead exposures can be grouped into three main categories: (1) substitution, (2) isolation, and (3) ventilation. Engineering controls are the first line of defense in protecting workers from hazardous exposures.

SUBSTITUTION

Substitution includes using a material that is less hazardous than lead, changing from one type of process equipment to another, or even, in some cases, changing the process itself to reduce the potential exposure to lead. In other words, material, equipment, or an entire process can be substituted to provide effective control of a lead hazard. However, in choosing alternative methods, a hazard evaluation should be conducted to identify inherent hazards of the method and equipment.

Examples of substitution include:

@ **Use of a less hazardous material:** applying a nonleaded paint rather than a coating that contains lead.

@ **Change in process equipment:** using less dusty methods such as vacuum blast cleaning, wet abrasive blast cleaning, shrouded power tool cleaning, or chemical stripping to substitute for open abrasive blast cleaning to reduce exposure to respirable airborne particulates containing lead.

@ **Change in process:** performing demolition work using mobile hydraulic shears instead of a cutting torch to reduce exposure to lead fumes generated by heating lead compounds.

Any material that is being considered as a substitute for a lead-based paint should be evaluated to ensure that it does not contain equally or more toxic components (e.g., cadmium or chromates). Because substitute materials can also be hazardous, the Company will obtain a Material Safety Data Sheet (MSDS) before a material is used in the workplace. If the MSDS identifies the material as hazardous, as defined by OSHA's hazard communication standard (29 CFR 1926.59), an MSDS must be maintained at the job site and proper protective measures must be implemented prior to usage of the material.

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ISOLATION

Isolation is a method of limiting lead exposure to those employees who are working directly with it. A method which isolates lead contamination and thus protects nonessential workers, bystanders, and the environment is to erect a sealed containment structure around open abrasive blasting operations. However, **this method may substantially increase the lead exposures of the workers** doing the blasting inside the structure. The containment structure must therefore be provided with negative-pressure exhaust ventilation to reduce workers' exposure to lead, improve visibility, and reduce emissions from the enclosure.

VENTILATION

Ventilation, either local or dilution (general), is probably the **most important engineering control available** to the safety and health professional to maintain airborne concentrations of lead at acceptable levels. Local exhaust ventilation, which includes both portable ventilation systems and shrouded tools supplied with ventilation, is generally the preferred method. If a local exhaust system is properly designed, it will capture and control lead particles at or near the source of generation and transport these particles to a collection system before they can be dispersed into the work environment. Dilution ventilation, on the other hand, allows lead particles generated by work activities to spread throughout the work area and then dilutes the concentration of particles by circulating large quantities of air into and out from the work area. For work operations where the sources of lead dust generation are numerous and widely distributed (e.g., open abrasive blasting conducted in containment structures), dilution ventilation may be the best control.

Examples of ventilation controls include:

@ Power tools that are equipped with dust collection shrouds or other attachments for dust removal and are exhausted through a High-Efficiency Particulate Air (HEPA) vacuum system;

@ Vacuum blast nozzles (vacuum blasting is a variation on open abrasive blasting). In this type of blasting, the blast nozzle has local containment (a shroud) at its end, and containment is usually accomplished through brush-lined attachments at the outer periphery and a vacuum inlet between the blast nozzle and the outer brushes.

@ Containment structures that are provided with negative-pressure dilution ventilation systems to reduce airborne lead concentrations within the enclosure, increase visibility, and control emissions.

Notes

WORK PRACTICE CONTROLS

Work practices involve the way a task is performed. OSHA has found that appropriate work practices can be a vital aid in lowering worker exposures to hazardous substances and in achieving compliance with the PEL (Permissable Exposure Level). Some fundamental and easily implemented work practices are: (1) good housekeeping, (2) use of appropriate personal hygiene practices, (3) periodic inspection and maintenance of process and control equipment, (4) use of proper procedures to perform a task, (5) provision of supervision to ensure that the proper procedures are followed, and (6) use of administrative controls.

Housekeeping-

A rigorous housekeeping program is necessary in many jobs to keep airborne lead levels at or below permissible exposure limits. Good housekeeping involves a regular schedule of housekeeping activities to remove accumulations of lead dust and lead-containing debris. The schedule should be adapted to exposure conditions at a particular worksite.

All workplace surfaces must be maintained as free as practicable of accumulations of lead dust. Lead dust on overhead ledges, equipment, floors, and other surfaces must be removed to prevent traffic, vibration, or random air currents from re-entraining the lead-laden dust and making it airborne again.

Regularly scheduled clean-ups are important because they minimize the release of lead dust into the air, which otherwise serves as an additional source of exposure that engineering controls are generally not designed to control. **Vacuuming** is considered the most reliable method of cleaning dusty surfaces, but any effective method that minimizes the likelihood of release may be used (for example, a wet floor scrubber). When vacuuming equipment is used, the vacuums must be equipped with high-efficiency particulate air (HEPA) filters. **Blowing with compressed air is generally *prohibited*** as a cleaning method, unless the compressed air is used in conjunction with a ventilation system that is designed to capture the airborne dust created by the compressed air (e.g., dust "blowdown" inside a negative-pressure containment structure).

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In addition, all persons doing the cleanup should be provided with suitable respiratory protection and personal protective clothing to prevent contact with lead. Where feasible, lead-containing debris and contaminated items accumulated for disposal should be wet-misted before handling. Such materials must be collected and put into sealed impermeable bags or other closed impermeable containers. Bags and containers must be labeled to indicate that they contain lead-containing waste.

Personal Hygiene Practices-

Personal hygiene is also an important element in any program to protect workers from exposure to lead dust. When employee exposure is above the PEL, the lead standard requires the Company to provide, and ensure that workers use, adequate shower facilities (where feasible), hand-washing facilities, clean change areas, and separate non-contaminated eating areas.

Employees must also wash their hands and faces prior to eating, drinking, using tobacco products, or applying cosmetics, and they must not eat, drink, use tobacco products, or apply cosmetics in any work area where the PEL is exceeded. In addition, employees must not enter lunchroom facilities or eating areas while wearing protective work clothing or equipment unless surface lead dust has first been removed from the clothing or equipment by vacuuming or another cleaning method that limits dispersion of lead dust.

Workers who do not shower and change into clean clothing before leaving the worksite may contaminate their homes and vehicles with lead dust. Other members of the household may then be exposed to harmful amounts of lead. A recent NIOSH publication points out the dangers of "take-home" lead contamination. For the same reason, vehicles driven to the worksite should be parked where they will not be contaminated with lead.

The personal hygiene measures described above will reduce worker exposure to lead and decrease the likelihood of lead absorption caused by ingestion or inhalation of lead particles. In addition, these measures will minimize employee exposure to lead after the work shift ends, significantly reduce the movement of lead from the worksite, and provide added protection to employees and their families.

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Change Areas-
When employee airborne exposures to lead are above the PEL, the Company must provide employees with a clean change area that is equipped with storage facilities for street clothes and a separate area with facilities for the removal and storage of lead-contaminated protective work clothing and equipment. Separate clean and dirty change areas are essential in preventing cross-contamination of the employees' street and work clothing. Clean change areas are used to remove street clothes, to suit up in clean work clothes (protective clothing), and to don respirators prior to beginning work, and to dress in street clothes after work. No lead-contaminated items are permitted to enter the clean change area.

Work clothing should be worn only on the job site. Under no circumstances should lead-contaminated work clothes be laundered at home or taken from the worksite, except to be laundered professionally or properly disposed of following applicable Federal, State, and local regulations.

Showers-
When employee exposures exceed the PEL, the Company must provide employees with suitable shower facilities, where feasible, so that exposed employees can remove accumulated lead dust from their skin and hair prior to leaving the worksite. Where shower facilities are available, employees must shower at the end of the work shift before changing into their street clothes and leaving the worksite. Showers must be equipped with hot and cold water.

Washing Facilities
Washing facilities must be provided to employees in accordance with the requirements of 29 CFR 1926.51(f). Water, soap, and clean towels are to be provided for this purpose. Where showers are not provided, the Company must ensure that employees wash their hands and faces at the end of the work shift.

Eating Facilities
The Company must provide employees who are exposed to lead at levels exceeding the PEL with eating facilities or designated areas that are readily accessible to employees and must ensure that the eating area is free from lead contamination

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To further minimize the possibility of food contamination and reduce the likelihood of additional lead absorption from contaminated food, beverages, tobacco, and cosmetic products, the Company must prohibit the storage, use, or consumption of these products in any area where lead dust or fumes may be present.

PERIODIC INSPECTION AND MAINTENANCE

Periodic inspection and maintenance of process equipment and control equipment, such as ventilation systems, is another important work practice control. At worksites where full containment is used as an environmental control, the failure of the ventilation system for the containment area can result in hazardous exposures to workers within the enclosure. Equipment that is near failure or in disrepair will not perform as intended. Regular inspections can detect abnormal conditions so that timely maintenance can be performed. If process and control equipment is routinely inspected, maintained, and repaired, or is replaced before failure occurs, there is less chance that hazardous employee exposures will occur.

EMPLOYEE TRAINING REQUIREMENTS

The Company must provide training and information to employees as required by OSHA's lead in construction (29CFR 1926.62), hazard communication (29 CFR 1926.59), and safety training and education (29 CFR 1926.21) standards. One important element of this program is training workers to follow the proper work practices and procedures for their jobs.

Workers must know the proper way to perform job tasks to minimize their exposure to lead and to maximize the effectiveness of engineering controls. For example, if a worker performs a task away from (rather than close to) an exhaust hood, the control measure will be unable to capture the particulates generated by the task and will thus be ineffective. In certain applications such as abatement in buildings, wet methods can significantly reduce the generation of lead-containing dust in the work area. Wetting of surfaces with water mist prior to sanding, scraping, or sawing, and wetting lead-containing building components prior to removal will minimize airborne dust generation during these activities. Failure to operate engineering controls properly may also contaminate the work area.

Notes

LEAD REMOVAL OPERATION PROCEDURES

This section describes the job operations that take place in construction worksites and involve worker exposures to lead. Although this list of operations is extensive, it is not necessarily inclusive (i.e., other construction activities not mentioned here may also involve lead exposure). OSHA's lead standard for construction applies to any construction activity that potentially exposes workers to airborne concentrations of lead.

Open Abrasive Blast Cleaning-

The most common method of removing lead-based paints is open abrasive blast cleaning. The abrasive medium, generally steel shot/grit, sand, or slag is propelled through a hose by compressed air. The abrasive material abrades the surface of the structure, exposing the steel substrate underneath. The abrasive also conditions the substrate, forming a "profile" of the metal, which improves the adherence of the new paint.

Work is generally organized so that blasting proceeds for approximately one-half day, followed by compressed air cleaning of the steel and application of the prime coat of paint. Prime coat painting must follow blasting immediately to prevent surface rust from forming. Intermediate or finish coats of paint are applied later.

Structures that are typically cleaned by open abrasive blasting are bridges, tanks and towers, locks and dams, pipe racks, pressure vessels and process equipment, supporting steel, and metal buildings. Until recently, abrasive blasting work was conducted in unobstructed air. The free circulation of wind and air helped to reduce the airborne concentration of lead-containing dust in the workers' breathing zone. Tarpaulins were generally used only to protect neighboring homes and automobiles from a damaging blast of abrasive or to reduce residents' complaints about overspray, dust, and dirt.

Currently, some State and local regulations require the use of enclosures or containment structures to prevent the uncontrolled dispersal of lead dust and debris into the environment. Although containment structures are designed to reduce the dispersion of lead into the environment, they usually increase worker exposure to airborne lead, reduce visibility, and increase the risk of slip and fall injuries due to waste material build-up on the footing surface of the enclosure.

Notes

Containment structures vary in their design and in their effectiveness in containing debris. **Some containment structures consist of tarpaulins** made of open mesh fabrics (screens) that are loosely fitted around the blasting area; **some use rigid materials** such as wood, metal, or plastic to enclose the blasting area; **and some use a combination** of flexible and rigid materials. Large air-moving devices may be connected to the enclosed containment structure to exhaust dust-laden air and create a negative pressure with respect to the ambient atmosphere.

Containment or enclosure structures can be broadly classified as either partial or full. Partial containment refers to those that inherently allow some level of emission to the atmosphere outside of the containment. An example of a partial containment is a structure with loosely hung permeable tarps and partially sealed joints and entryways. Full containment refers to a relatively tight enclosure (with tarps that are generally impermeable and fully sealed joints and entryways) where minimal or no fugitive emissions are expected to reach the outside environment. Partial or full containment can be used to contain entire structures or portions thereof. Examples of the kinds of engineering controls and work practices that can be implemented to protect blasting workers are presented below.

Engineering Controls

@ Containment/ventilation systems should be designed and operated so as to:

1. Create a negative pressure within the structure, which reduces the dispersion of lead into the environment.
2. Optimize the flow of ventilation air past the worker(s), thereby reducing the airborne concentration of lead and increasing visibility. This can be accomplished by employing either a downdraft or crossdraft ventilation system that is properly balanced by a make-up air supply.
3. Be specific to each task, because conditions can vary substantially from one worksite to another. The dust-laden air must be filtered prior to its release into the atmosphere.

Notes

@ Mini-enclosures, which have smaller cross-sectional areas than conventional enclosures, can be erected. Mini-enclosures have advantages over larger conventional enclosures because the same size fan and dust collector can achieve much higher velocities past the helmets of the workers. Mini-enclosure containment structures are usually lightweight, low wind-loading structures that isolate that area where blasting and surface priming is taking place on a given day.

@ The risk of silicosis is high among workers exposed to abrasive blasting with silica-containing media, and this hazard is difficult to control. The Company prohibits the use silica as an abrasive blasting material. A variety of materials such as slag and steel grit are available as alternative blasting media. Because some substitute materials may have their own unique hazards, **the MSDS for the substitute material shall be consulted before it is used.**

@ Blast cleaning with recyclable abrasive such as steel grit or aluminum oxide requires specialized equipment for vacuuming or collecting the abrasive for reuse, separating the lead dust and fines from the reusable abrasive, and, in the case of steel grit, maintaining clean, dry air to avoid rusting of the abrasive. In addition, the abrasive classifier must be extremely efficient in removing lead dust, to prevent it from being reintroduced into the containment and combining with the paint to increase worker exposures. Recycling equipment must be well maintained and regularly monitored to ensure it is removing lead effectively.

@ When site conditions warrant, less dusty methods should be used in place of open abrasive blast cleaning. These include:

-- Vacuum-blast cleaning,
-- Wet abrasive blast cleaning,
-- High-pressure water jetting,
-- High-pressure water jetting with abrasive injection,
-- Ultrahigh-pressure water jetting,
-- Sponge jetting,
-- Carbon-dioxide (dry-ice) blasting,
-- Chemical stripping, and
-- Power-tool cleaning.

Notes

WORK PRACTICE CONTROLS

Notes

The Company, when engaged in open abrasive blast cleaning operations shall implement the following control measures:

@ Develop and implement a good respiratory protection program in accordance with OSHA requirements in 29 CFR 1926.103 and OAR 437-03-037.

@ Provide workers with Type CE abrasive-blast respirators; these are the only respirators suitable for use in abrasive-blasting operations. Currently there are only three models of Type CE abrasive blast respirators certified by MSHA/ NIOSH:
-- A continuous-flow respirator with a loose-fitting hood that has a protection factor of 25,
-- A continuous-flow respirator with a tight-fitting face-piece that has a protection factor of 50, and
-- A pressure-demand respirator with a tight-fitting face-piece that has a protection factor of 2000.

The first two models (i.e., the continuous-flow respirators) should be used only for abrasive blast operations where the abrasive materials do not include silica sand and the level of contaminant in the ambient air does not exceed 25 or 50 times the recommended exposure limit, respectively. The third model, which is a pressure-demand respirator, must be worn whenever silica sand is used as an abrasive material (NIOSH 1993).

@ Ensure to the extent possible that workers are upstream from the blasting operation to reduce their exposure to lead dust entrained in the ventilation air.

Vacuum Blast Cleaning

Vacuum blasting is a variation of open abrasive blasting. In this configuration, the blast nozzle has local containment (a shroud) at its end and containment is usually accomplished by brush-lined attachments at the outer periphery and a vacuum inlet between the blast nozzle and the outer brushes. The brushes prevent dispersion of the abrasive and debris as they rebound from the steel surface. These particles are removed from the work area by the built-in vacuum system. The abrasive itself can either be disposed of or cleaned and recycled. If used properly, vacuum blast cleaning can achieve cleaning of good quality with minimal dust generation except in areas where access is difficult because of configuration (such as between back-to-back angles).

A variety of heads are available to achieve a tight seal for inside corners, outside corners, and flat surfaces. The advantages of vacuum blasting are that most of the waste material and abrasive is collected at the site of generation and is therefore not transported to the breathing zone of the worker, and that there may be little or no need for containment.

Vacuum blasting has several disadvantages:

- It is more time-consuming than conventional open abrasive blasting because the abrasive blast nozzle must be smaller to capture the ricocheting abrasive and dust. This restricts the dispersion of the abrasive and thus the size of the area that can be cleaned.
- Abrasive also may escape the vacuum head if the brush attachments do not seal completely around the substrate; operator fatigue, poor work practices or irregular surfaces and edges may cause poor seals.
- Small areas and areas with gross irregularities cannot be effectively sealed by the shroud.
- The vacuum system and brushes obscure the blast surface, and some areas may therefore need to be blasted repeatedly because they are missed on the first or second pass.
- In addition, some vacuum heads are so heavy that mechanical suspension systems are needed to support them, and even then, the blasters may need to take frequent breaks.

Wet Abrasive Blast Cleaning

Wet abrasive blast cleaning is a modification of traditional open abrasive blast cleaning. This system uses compressed air to propel the abrasive medium to the surface being cleaned; however, water (which reduces dusting) is injected into the abrasive stream either before or after the abrasive exits the nozzle.

The disadvantages of using water are that inhibitors may be necessary to avoid flash rusting, the containment must be designed to capture the water and debris generated by the cleaning process, wet abrasive/paint debris is more difficult to handle and transport than dry debris, and, unless the water can be filtered, it may add to the volume of debris generated. Because many corrosion inhibitors (e.g., nitrates, nitrites, and amines) raise industrial hygiene concerns, their use must be considered carefully.

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High-Pressure Water Jetting
High-pressure water jetting (6,000 to 25,000 psi) utilizes a pressure pump, a large volume of water, a specialized lance and nozzle assembly and, in some cases, supplies of inhibitor to prevent flash rusting. High-pressure water can remove loose paint and rust, but will not efficiently remove tight paint or tight rust, or mill scale.

This technique does not create a profile (mechanically induced toothing pattern to enhance the adhesion of high-performance coatings) on its own, but if the original surface was blast cleaned, high-pressure water jetting can be used to remove the old paint and restore the original profile.

Because of the water, this kind of jetting generates little dust. The containment must be constructed to collect water rather than to control dust emissions. The debris generated is comprised of the removed paint and rust, along with the water. If the lead debris can be adequately filtered from the water, the volume of debris is low. If not, the volume of debris can be high. Typically, 5 to 10 gallons of water per minute are used. Productivity can be high with this method if the objective is to remove only loose, flaky paint. If the objective is to remove tight paint, productivity may be low. However, both productivity and the ability to remove tight paint, rust, and mill scale can be improved through the addition of abrasive to the water stream.

High-Pressure Water Jetting with Abrasive Injection
This system uses an expendable abrasive that is metered into a pressurized water jet (6,000 to 25,000 psi) for surface preparation. Although airborne lead exposures are virtually eliminated with this approach, wet abrasive is more difficult to handle and move than dry abrasive, and the volume of debris also increases. Because the abrasive exposes the bare substrate, inhibitors such as sodium nitrate or amines are often added to the water to prevent flash rusting. Abrasives used for injection include sand and slag materials, as well as soluble abrasives such as sodium bicarbonate. The sodium bicarbonate will not remove paint, rust, and mill scale as efficiently as sand or slag abrasives. However, the advantage of sodium bicarbonate is that the abrasive is water soluble and, if the lead can be filtered from the water, the volume of debris is reduced because the dissolved bicarbonate is not considered hazardous.

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ULTRAHIGH-PRESSURE WATER JETTING

Ultrahigh-pressure water jetting utilizes pressurized water at pressures in excess of 25,000 psi. Ultrahigh-pressure water jetting is similar to high pressure water jetting except that the ultrahigh variant uses even higher pressures. This means that it cleans more efficiently and removes tight paint and rust more effectively. In addition, the volume of water required is reduced, with less than 5 gallons per minute typically used.

Closure

Personal protective equipment can only be effective if the equipment is selected based on its intended use, employees are trained in its use, and the equipment is properly tested and maintained, and worn. The best protection comes from an interested management and work force committed to sound work practices.

What questions do you have?

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