LEAD ABATEMENT WORKER
RE-ACCREDITATION TRAINING PROGRAM

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SECTION 1
BACKGROUND INFORMATION ON LEAD

INTRODUCTION

Lead is defined as "a heavy soft malleable ductile plastic but inelastic bluish white metallic element found mostly in combination and used especially in pipes, cable sheaths, batteries, solder, type metal, and shields against radioactivity" (Websters Dictionary, 1987). While the whole population is (and has been) exposed to lead at some level, some subgroups are at a very high risk. Lead poisoning is and has been a serious problem for children and some adults.

HISTORICAL USE OF LEAD

Since ancient times, man has used lead for making pipe, paint pigments, and ceramics. Industrial growth resulted in the utilization of lead in literally thousands of products. Because of its plasticity and softness, lead can be rolled into sheets and foil. It can be made into rods, pipes and tube containers. Lead is used in building construction for roofing, cornices, tank linings, electrical conduits, water pipes and sewer pipes. It is used for yacht keels, plumb-bobs and sinkers in diving suits. Lead alloys are used for accumulation plates, cable coverings, ornamental coatings and the fillings for bullets for small arms. Soft solder, used for soldering tin plates, lead pipes and copper pipes, is an alloy of lead.

Ancient man used lead without understanding its toxic properties. He mined and reduced lead from ores by smelting. The first known lead object dates from 6500 B.C. and was a statue found in Turkey. Leaden objects have been found in Egyptian tombs. In Greece and Rome, lead had a variety of uses, including as a component of water pipes, solder and in pottery glazes. Lead ore was a source of silver by the process called cupellation as early as 4000 B.C.

EARLY EVIDENCE OF LEAD POISONING

Lead poisoning may well have played a role in the decline and fall of the Roman Empire due to lowered birth rates and increased mental disturbances among the ruling class. The ruling class most likely suffered lead poisoning from storing wine and water in lead-lined vessels.

Hippocrates in 370 B.C. described a severe attack of colic in a man who extracted metals and recognized lead as a cause of the symptoms, but in general, the disease received little attention in ancient times. When occupational lead poisoning occurred, it was ignored because most workers were slaves.

In other eras, lead poisoning was referred to as *plumbism, saturnisum, colic, dry gripes, dry bellyache and potter's palsy.* Until recently, we recognized only the *acute* and some of the *chronic* manifestations of lead poisoning. Only in the past 25 years has research on more subtle *sub-clinical effects* of lead started to gain acceptance.

During the middle ages, lead was used for cistern pipes, roofing, extraction of silver and gold from copper, glazing pottery and making clear glass. The economic and technological development of this period is reflected in the fact that lead poisoning then affected miners and metal workers.

Bernardio Ramazzini, the "father of occupational medicine", wrote in 1700 A.D. of fifty-four different occupations associated with lead poisoning. In describing some of them in a section on potters and printers, he said "during this process (potting) or again when they use tongs to daub the pots with molten lead before putting them into the furnace, their mouths , nostrils and the whole body take in the lead poison that has been melted and dissolved in water: hence, they are soon attacked by grievous maladies. First their hands become palsied, they then become paralytic, splenetic, lethargic cachelic and toothless so that one rarely sees a potter whose face is not cadaverous and the color of lead". With regard to treatment of workers, Ramazzini noted, "it is hardly ever possible to give them any remedies that would completely restore their health for they do not ask for a helping hand from the doctor until their feet and hands have become very hard and they suffer from another drawback. I mean they are very poor". Today's victims often suffer from the same drawback.

Benjamin Franklin also described the toxic effects of lead in the 1700s. He indicated that the adverse effects had been known for at least 60 years and questioned whey they had not been made public knowledge.

Lead poisoning was associated with one of colonial America's early industries, rum distillation. Distillation in lead worms and still heads contaminated large quantities of rum. Pewter, and alloy of tin and lead, was commonly used in the seventeenth and eighteenth centuries. Pewter utensils such as teapots, mugs, creamers, tankards, platters, basins and pitchers, under some circumstances can add lead to food and drink. Physicians historically have used a variety of food preparations for therapeutic purposes. Some claimed that lead therapy could cure consumption, diabetes, dysentery and epilepsy.

Lead crystal is still purchased by those seeking high quality glassware. Some lead glazes are still used for dishes, although not in those dishes produced in the United States. Until recent years, lead was used in some pesticides and was a common component in solder used for copper water lines and as an alloy in brass and bronze faucets, fittings, fixtures valves, water meters and some well pumps. Older water lines from the street (service lines) often are of lead pipe.

Lead containing pigments are still found in putty, caulking, furniture, toys, food containers and dishes, pencils, and certain cosmetic and medicine containers. In 1995, several cases of lead poisoning among children in the United States were connected to the importation of crayons from China which contained lead pigments.

Exterior paints and coatings applied to structures such as bridges, water towers, highways, etc., are not covered by the ban on sales of lead containing paint to consumers.

In summary, lead is widespread in the environment, with traces found in most soils, occurring in concentrated deposits either naturally or due to human activities. It is one of the few naturally occurring substances that appears to have no use within the human body, and for which toxic effects can be detected at the *lowest measurable levels*. Lead has been, and continues to be is used in a wide variety of industrial processes and products. As a result, this century has seen a dramatic increase in the amount of lead in air, rain and snowfall, thus distributing lead widely over the planet in low concentrations, and in urban areas, in sometimes very high concentrations.

Today, lead is widespread in the environment. Traces are found in most soils, and it can occur in concentrated deposits either naturally or due to human activities. It is one of the few naturally occurring substances that appears to have no use within the human body, and for which toxic effects can be detected at the lowest measurable levels. Lead has been and continues to be is used in a wide variety of industrial processes and products. This and other non-recyclable uses in this century have increased the amount of lead in air, rain and snowfall, thus distributing lead widely over the planet, usually in low concentrations.

Much uncertainty exists in the quantitative or relative contributions of different lead sources to human exposure. Research indicates that a large number of variables, both environmental and personal can influence the levels of lead found in blood and other tissues.

Lead Paint

Today, high lead paint is well established as the most common cause of lead poisoning. One flake of paint weighing 10 milligrams (mg), about the size of a match head, can easily contain 1 mg of lead, which is over ten times a child's daily intake of lead from food. A child who regularly eats such paint flakes intentionally or inadvertently is likely to be poisoned in a few months,

Lead paint in dilapidated housing is the major source of severe lead poisoning in children. It is estimated that there are 19 million housing units in the United States today built and painted prior to 1960, which are potential sources of lead paint exposure. Five to seven million are considered immediate hazards because of the poor state of their maintenance. Houses constructed after 1960 are not necessarily free of lead paint since the voluntary standard of limiting lead content of interior paint to less than one percent was only adopted in 1966, and until very recently, exterior paint contained significant amounts of lead. Current federal regulations have, since 1977, limited the lead content of most paints to 0.06%. The paint in most homes built during the first half of this century contains up to 20-30 percent lead. Expensive older homes are also potential sources of poisoning. Many of these homes were painted with layers of heavily leaded paint. Renovation and remodeling have caused lead poisoning through the lead fumes and dust produced. The dust in homes after burning or sanding lead paint can contain so much lead that one expert compares it to "living inside a lead smelter". Lead based paint is also a source of contamination of house dust and garden soil.

Large scale screening studies of children without symptoms have demonstrated that the number of children found with undue lead absorption is greater than previously thought. It was once considered to be a problem of the inner cities in the so-called "lead belt" of the Northeast. However, when children under the age of six who live in an environment containing lead paint are tested, 3 to 20 percent will be identified with elevated blood lead

levels. This is true whether those children live in the East or West, North or South, or in a rural or urban setting. Thus, the magnitude of the problem is greater and the consequences more severe, than previously thought.

During energy crises or in areas of poverty, the burning of painted wood for fuel may release lead fumes and lead poisoning may result. Household ashes are commonly disposed of in garden soil creating yet another reservoir for future exposure.

Other Lead Containing Products

Lead containing pigments are also found in putty, caulking, furniture, toys, food containers and dishes, pencils, and certain cosmetic and medicine containers. In 1995, several cases of lead poisoning among children were connected to the importation of crayons from China which contained lead pigments.

Exterior paints and coatings applied to structures such as bridges, water towers, highways, etc., are not covered by the ban on sales of lead containing paint to consumers. It was also pointed out that proper disposal of lead painted materials is crucial to avoid further distribution of lead throughout the environment. Burial in a properly regulated hazardous waste landfill should be a safe method of disposal. The recognition of lead paint as a major source of sever lead poisoning in children does not, however, minimize the contribution from other sources such as dust, dirt, food, water and air.

Airborne Lead

Lead in the atmosphere has traditionally come mainly from the use of lead additives in fuel and from industrial processes. While leaded gasoline was in use in the United States, the concentration of lead in the air could be closely correlated with traffic density, though traffic speed and weather conditions were factors. Lead in gasoline was considered a major factor in child and adult blood lead levels in studies performed in the 1970's, which showed a close correlation between leaded gasoline use and blood lead levels. National data from the second National Health and Nutrition Examination Survey (NHANES II) conducted between 1976 and 1980, indicated a 37% decline in blood lead levels. During this same period, leaded gasoline consumption in the United States declined by over 50%.

Leaded Gasoline

Since 1973, the U.S. Environmental Protection Agency (EPA) has regulated the use of lead as an additive to gasoline. Section 211 of the Clean Air Act gives the Administrator authority to control or prohibit any fuel or fuel additive that cause or contributes to air pollution, which may endanger the public health or that impairs to a significant degree the performance of any emission control device.

Lead in Soil and Dust

Over the past decade, lead in dust and soil have drawn increasing attention as important sources of exposure to lead. Lead levels in soil and dust are generally much higher in urban areas, particularly in inner cities, near roadways and near lead industries.

Urban soils may be contaminated from a variety of atmospheric and non-atmospheric sources. The major sources of soil lead seem to be paint dust and chips from older houses and the historic particulate deposition from gasoline combustion by cars on nearby roadways. Lead in soil adjacent to a house decreases with distance. This may be due to paint and/or dust of atmospheric origin washing from the rooftop.

Lead in Water

Lead in water has been an important source of exposure in some parts of the country. Lead occasionally enters raw water through contamination of the source from mining or industrial discharges, but more commonly through use of lead piping and use of lead solder in the distribution system. Lead in drinking water generally arises from the combination of a corrosive water supply and lead pipes or lead soldered copper pipes. The current EPA standard for lead in drinking water is 15 micrograms (μg) per liter. The correlation of lead in water and the amount of water consumed as well as other environmental and host factors.

Lead in Food

Lead in food comes from a variety of sources. The majority of food exposure is through environmental pollution and the processing of food products. Lead from the air or water used in processing contributes very little. Lead is contained in some pesticides and in the solder that is used to seal the seams of some tin cans, although the use of vinyl liners have reduced this risk considerably.

The Federal Food and Drug Administration (FDA) expressed its concern to the food industry about the lead content of canned foods in 1971-1972. The greatest emphasis has been on the reduction of levels of lead in food for infants. Since 1972, the FDA, industry, and other organizations have measured levels of lead in a wide variety of foods. Most measurements were among canned foods because the lead solder used in the side seam in the three piece tin can is the single greatest controllable source of lead in foods.

Other Sources of Lead Exposure

Other specific sources of exposure have been occasional causes of elevated blood lead levels. Gasoline sniffing among adolescents has resulted in lead toxicity. Use of folk

medicines, cosmetics and health aids have been reported to cause lead poisoning in a number of states. For example, one such remedy, generally referred to as "pay-looah" consists of red and orange powders and is fed to children as a cure for fever or rash. Azardon is used among Mexican-Americans and may contain as much as 93.5 percent lead.

Another reported exposure hazard is "moonshine" which is sometimes made in lead soldered copper pipes or old automobile radiators.

Improperly glazed earthenware, lead decals on dinnerware and glasses, lead paint on toys and furniture, ingestion of colored pigments from newspapers, magazines and children's books, lead paint coating pencils, toothpaste tubes, cosmetic products, lead craft materials, fishing weights, lead cores in candle wicks, lead in gift wrapping and the wrappers of specialty food, certain health food supplements (bone meal) and silver hollow-ware all have been identified as sources of potential lead exposure.

A common misconception is that the "lead" in pencils is made of the metal. The common pencil "lead" is made of graphite, a non-toxic material.

SECTION 2
HEALTH EFFECTS ASSOCIATED WITH LEAD EXPOSURE

INTRODUCTION

Lead enters the body through two methods:

- Inhalation.
- Ingestion.

Unlike other metals such as zinc and iron, the body has no use for lead, even in trace amounts. The body can only excrete a certain amount of lead, so when too much is present, poisoning can occur. Lead accumulates in the body, so poisoning can occur from a continuation of low-level sources (*chronic exposure*), or from a single high-level source (*acute exposure*). The U.S. has made a great deal of progress in reducing lead poisoning. However, a 1988 study by the Public Health Service reported that 17% of children under 6 year old are *at risk* of lead poisoning. *Although various agencies have set standards for blood lead levels, there is no truly "safe level".*

LEAD POISONING

Lead poisoning is children is a common and serious problem in that many of the effects on growing children are irreversible, that is, they may not return to normal after treatment or removal from exposure.

Children are at greater risk of lead absorption and toxicity than adults. There are several contributing factors to the greater sensitivity of children to lead. First, the developing nervous system is more likely to be damaged by lead. Secondly, children have a number of exposure sources that exceed those affecting adults.

Adults are though to be less susceptible to lead poisoning and less likely to have irreversible changes in mental status in the lead contaminated workplace, however, lead poisoning in adults can reach serious proportions.

LEAD EXPOSURE AND ABSORPTION

The most important exposure source for children is the normal mouthing activity that occurs as part of development. Children investigate objects by tasting and biting on them, partly to aid teething discomfort, but also to discover foods or satisfy the sucking instinct. Children are less likely to reject foods which have fallen onto dirty or dusty surfaces and simultaneously, are less likely to have clean hands. Since utensils are not manageable to

young children, much of their feeding of solid foods is a hand-to-mouth activity. Children have high caloric requirements per body weight, thus consume a greater quantity of food (and any lead content it may have) per body weight. The same would apply to lead in water and lead in air. In addition, while adults absorb only about 10% of ingested (swallowed) lead, children are believed to absorb approximately 50% of ingested lead. Lead retention in adults is very low, but in children, retention is up to 30%.

Nutritional Factors

Children are at greater risk of certain nutritional deficiencies which are believed to enhance the absorption and/or toxicity of lead. Children with *pica*, an abnormal tendency to eat non-food materials, are particularly prone to lead poisoning which is often related to paint chips or flakes, toys, metal toothpaste tubes, paper or dust and, on occasion, the dust from parents clothes or gardening soil. However, as discussed, even normal activity can lead to sufficient lead absorption to cause poisoning in a contaminated environment. It is important to recognize that these children do not necessarily have pre-existing abnormal behavior patterns nor will parental supervision eliminate all the activities that contribute to the exposure.

The Elderly

The elderly may also deserve special attention. The absorption of lead by elderly people has not been studies, but age-related changes in the gastro-intestinal track and kidney may alter their ability to absorb and excrete various substances. Low income, poor dentition, or loss of appetite may lead them to have a nutritionally inadequate diet. As we have seen, diet has been shown to be of significance in lead absorption in children.

HEALTH EFFECTS

Children, particularly those under the age of two, are most seriously threatened by lead because it can permanently damage the developing nervous system leading to mental retardation. At lower levels it causes more subtle learning, behavioral or psychological problems (Ruffer 1983). Lead also affects the blood forming organs causing anemia. Affected children almost always have evidence of disturbed *heme synthesis*, that is, formation in the bone marrow of the oxygen carrying pigment of red blood cells. The now rare *acute encephalopathy* is the most severe form of the disease. This is a severe poisoning of the brain which causes vomiting, disturbances of consciousness and seizures. Lead encephalopathy (with blood lead concentrations over 100µg/dl.) can develop rapidly in cases of unrecognized chronic lead poisoning. In animals with encephalopathy, destruction of nerve cells occurs at low doses only in the very young. Biochemical and

functional changes can be induced by doses too low to cause microscopic pathological changes in the brain. Most survivors of encephalopathy, even when treated, have sustained severe and permanent brain damage.

Prolonged exposure to lead, particularly when there are symptoms, may cause kidney damage known as lead nephropathy and be related to gout and hypertension. Abnormalities in the function of the heart muscle and thyroid have also been reported in severe cases. Serious untreated lead poisoning can damage peripheral nerves in adults leading to a now rare condition called *"wrist drop"* and, at lower levels, symptoms similar to *carpal tunnel syndrome* (cf M. Beleecker).

The developing fetus is especially sensitive to the effects of lead on metabolism. The transfer of lead from mother to unborn child through the fetal blood has been demonstrated.

Chronic Lead Poisoning Symptoms

Chronic, unrecognized lead poisoning is characterized by repeated intermittent illness. Lead poisoning symptoms tend to be more severe during the summer months. The reasons for this are unclear. In children, the occurrence and severity of symptoms seems to depend upon the exposure. The earliest symptoms are irritability, loss of appetite and decreased play activity. Vomiting, intermittent abdominal pain and constipation can be signs of *lead colic*. Symptoms like these may occur at blood levels as low as 60 µg/dl., but sometimes children with levels up to 250 µg/dl. may appear clinically well. Loss of recently acquired developmental skills may occur and anemia is usually present. If not recognized, these children can rapidly deteriorate and go on to lead encephalopathy. Behavioral and learning problems impeding progress in school have been reported among some groups of children which had chronical increases in blood lead levels even without symptoms during the pre-school years.

Symptoms in adults include loss of appetite, weight loss, insomnia, headache, irritability, abdominal, muscle and joint pains. There is usually constipation, but occasionally other bowel symptoms may be present. Males and females exposed to lead may also suffer sterility and other reproductive dysfunctions. This includes impotence in the male, and miscarriage, stillbirth and menstrual problems in the female.

Symptoms of lead poisoning are often subtle and non-specific, and a physical examination generally reveals little or nothing unless there is encephalopathy. Lead poisoning should be suspected when doctors consider the diagnosis of anemia, seizure disorders, mental retardation and severe behavioral disorders.

The microscopic (small celled), hypochromatic (pale celled) anemia of lead poisoning is usually indistinguishable from that of iron deficiency in appearance even using common laboratory procedures. The FEP (free erythrocyte protoporphrin) test is abnormal in both disorders. A blood lead level or iron binding test should be used to distinguish lead exposure from iron deficiency anemia.

Contributing Factors

A number of factors have been found in association with lead exposures. These factors include race and socio-economic status, number of children in the home, age and state of repair of the home, marital status of the parents, nutritional status and use of child care facilities. Lead poisoned children often come from disadvantaged families with multiple social, medical and economic problems. Among adults, occupational exposure, participation in hobbies such as stained glass or certain arts and crafts and the use of folk remedies can cause significant exposures. Smoking, personal hygiene, eating habits and laundry of contaminated clothes are all important the differential absorption of lead among adults. Lead is rapidly and efficiently absorbed from lead fumes through the respiratory tract, often through lead dust contaminated cigarettes. Lead can be ingested with food eaten at the worksite or carried home to family members on work clothing and shoes. Industrial exposure is not the only source. In the construction industry, burning, sanding, and otherwise removing old lead paint from surfaces or cutting into bridges and other lead containing or painted metal structures can cause significant exposures. For this reason, Maryland and other states, followed by the Federal Government, passed laws extending the lead standard to cover the construction industry.

SCREENING

As mentioned previously, symptoms are usually subtle, sometimes even non-existent. Therefore, children should be tested once between the ages of 9 and 12 months, and annually thereafter. High risk children should be screened more often. Blood is tested using a finger-prick test. If the results indicate possible lead poisoning, further tests are required. Adults should also be tested if they area at a high risk of exposure due to occupation or other factors.

TREATMENT

Upon diagnosing lead poisoning, the source of the exposure should be eliminated immediately. Family education, general pediatric care and nutritional guidance should be provided. *Chelation therapy* may be required, involving drug intake to reduce lead levels. This therapy is usually painful and may cause side effects.

SECTION 3
MEDICAL SURVEILLANCE

INTRODUCTION

A medical surveillance program must be implemented for all employees in any operations that may result in exposure above the Permissible Exposure Limit (PEL) of 50 $\mu g/m^3$, for 30 days or more per calendar year.

Some of the employees that should be provided medical surveillance include:

- Custodial and maintenance workers who may regularly disturb lead-containing materials while performing their normal duties.
- Lead abatement workers.
- Lead abatement air monitoring personnel.
- Building inspectors.
- Pipe fitters, welders and demolition workers.
- Lead product manufacturing personnel.
- Other allied trades that may work with or disturb lead-containing materials.
- Abrasive-blasters and bridge painters.

Additionally, any employee who must wear a negative pressure respirator as a routine part of their job must be medically evaluated on a regular basis. This is to ensure that the use of the respirator does not adversely affect his or her health.

Through implementation of a sound medical surveillance program, a company will be able to verify every employee's medical status at time of employment, comply with OSHA standards on medical surveillance of workers exposed to lead, and reduce other associated liability risks.

OSHA STANDARDS - MEDICAL SURVEILLANCE

According to the OSHA Lead Standard, medical examinations must be provided or made available by the employer, at their expense, for all employees who are or will be exposed to airborne concentrations of lead at or above the Action Level of 30 $\mu g/m^3$ during an 8 hour time-weighted average (TWA) time-weighted average, for 30 or more days per year. This exposure is without regard to respirator use. An acceptable medical surveillance program must include pre-placement, periodic, and termination examinations.

Unlike most toxic substances in the workplace, well-standardized tests exist for the surveillance of lead absorption and biological effects. Two key tests are performed to measure an employee's exposure to lead. These are:

- *Blood Lead Level* is a direct measure of absorption. Levels reflect a balance between recent exposure and chronic storage of lead which occurs mostly in the bones.

- *Zinc Protoporphyrin Level* is a measure of lead's effect on enzyme systems. This test is relatively sensitive but non-specific. Levels reflect sub-acute exposure and may be elevated for several months after lead level has returned to normal.

Both tests must be performed by laboratories certified by NIOSH, OSHA, or CDC.

Other Responsibilities of Employers

Examinations are to be done during working hours, at no cost to the employee. Other responsibilities of the employer include:

- Providing the examining physician a copy of the standard.

- Instruct the physician to reveal only the findings related to the occupational exposure to lead.

- Advise the employee of reproductive hazards.

- Provide the employee the physician's report plus a copy of the blood lead level results within two working days after receipt.

Pre-Placement Exams

A pre-placement examination must take place prior to an employee's assignment to an occupation where lead exposure is a potential. A comprehensive medical evaluation must be performed and should include as a minimum:

- A detailed medical and work history.
- A complete physical examination of all systems with particular emphasis on teeth, gums, hematologic, gastro-intestinal, renal, cardiovascular and neurological systems.
- Pulmonary function testing and pulmonary system evaluation if respiratory protection will be worn.
- Blood sample collection and analysis which includes:

- Hemoglobin and Hematocrit determinations, red cell indices, and examination of peripheral smear morphology.
- Blood Lead Level.
- Zinc Protoporphyrin.
- Blood Urea Nitrogen.
- Serum Creatinine
- Routine urinalysis with microscopic examination.
- Any other laboratory tests deemed necessary by the examining physician.

The results of this examination will be used to determine the employee's baseline health status, as well as to evaluate whether or not they should be allowed to wear negative pressure respirators. The findings of the examination (Physician's Report) are reviewed with the employee and furnished to the employer for their files.

Only those items of the examination pertinent to potential lead exposure or respirator usage are reported to the employer. The employer must furnish a copy of the report to the employee upon request.

Individual test results are normally kept by the physician or clinic to maintain confidentiality. To assure the proper steps are taken, a copy of the medical monitoring and record keeping requirements of the OSHA Standard should be provided to the physician. It is very important for the employer to be sure the clinic maintains the results of all examinations as required by the Standard. In the event that an employee develops a health related problem, the employer will be able to check their records and confirm whether or not the condition could have occurred as a result of employment with their company.

In addition to the medical reports, the employer should request that the physician provide a signed statement indicating the following:

- Whether or not an employee is capable of wearing a negative pressure respirator.
- Any limitations associated with respirator use.
- Indicate any other workplace limitations, (intense heat, extreme cold, etc.).
- Any detectable medical conditions that would place the employee at an increased risk of material health impairment from exposure to lead.
- The physician has reviewed the results of the exam with the employee.
- The physician has informed him/her of any medical conditions that may result from exposure to lead.

Information beyond this, such as medical history and contents of the medical questionnaire must be kept confidential and must not be transmitted to the employer or others without written consent by the employee. Naturally, results of other tests done as part of *routine* employment physicals, such as hearing or vision tests would be supplied to the employer.

Periodic Blood Lead and ZPP Monitoring

As an ongoing surveillance mechanism, periodic monitoring must be made. An employee must have blood lead monitoring every two months for an initial employment of six months, and at least every three months thereafter.

If changing employers, an employee must resume the same schedule as above.

An employee whose blood lead level is at or above 40 μg/dl., must be tested every two months until two blood lead levels indicate a level below 40 μg/dl.

An employee removed from lead exposure due to an elevated blood lead level (above 50 μg/dl.), shall immediately have a medical examination, and have blood lead monitored on a monthly basis.

Inspectors must have blood lead level monitored every twelve months along with a yearly physical.

Medical Removal

An employee must be removed from lead exposure when blood level is at or above 50 μg/dl. A second blood test must be taken within two weeks. The employee must be removed from any lead exposure immediately after the first test. The employee may return to work when two consecutive blood tests indicate that the blood level is at or below 40 μg/dl.

OVERVIEW OF MEDICAL PROGRAM

Examinations and Treatment

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A. Blood lead and ZPP sampling and analysis.
B. Follow-up blood sampling tests.
C. Accuracy of blood lead level sampling and analysis.
D. Employee notification.

II. Medical Exams

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Medial Removal Protection

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A. Temporary removal due to elevated blood lead levels.
B. Temporary removal due to a final medical determination.
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D. Removal of other employees, special protective measures or limitations.
E. Employer options pending final medial determination.

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B. Definition of medical removal protection benefits.
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Health & Safety Requirements for the Abatement Area.

I. Protective Clothing

A. Full body overalls.
B. Head covering.
C. Protective eyewear.
D. Boot or shoe covers.
E. Gloves.

II. Respirators

SECTION 5
OTHER SAFETY HAZARDS

INTRODUCTION

Many other safety hazards may be present on lead abatement projects. Often, these hazards present serious and immediate treats to life and health. The use of personal protective equipment and the abatement techniques used often increase the risk of accident and injury from common work place hazards.

ELECTRICAL HAZARDS

Electrocution and electric shocks are among the most common hazards and provides the least warning. Use of wet methods increases the potential for electrical shock, from working around panels, conduit, light fixtures, alarm systems, junction boxes and computers.

Incorrect wiring, improper grounding and lack of proper insulation result in over 1,000 people being electrocuted each year, many from contact with only 120 VAC.

Three factors determine the severity of electrical shock. These are:

- The amount of current flowing through the body.
- The path of the current flowing through the body.
- The time the current flows through the body.

These factors can vary greatly. The path of the current depends upon the points of contact. Most often the path is from the hands, through the body and out the feet. The amount of electrical resistance determines in part the amount of current flow through this path. Moist skin or damp conditions greatly reduce the electrical resistance and significantly increase a person's risk of serious injury if he/she comes in contact with a current source. In addition to the obvious shock potential, many deaths result from falls after a non-fatal electrical shock.

Worker Responsibilities

Workers may not be held responsible for all electrical preparations, but wisely are responsible for:

- Being aware of possible hazards.
- Knowing how hazards should be treated.
- Knowing what to do to protect themselves from electrical shock while working in an abatement area.

Steps for Reducing Electrical Hazards

During the pre-bid inspection, during preparation of the work site, and during the abatement project, potential electrical hazards should be identified and eliminated.

1. Inspect for existing wiring faults, such as open ground paths, reverse wiring polarity, "hot" neutral or "hot" ground wires. These common faults can be detected with pocket testers and should be corrected prior to the start of work.

2. Remove all electrically powered equipment, machinery, and lighting prior to starting work, whenever practical.

3. Be certain that any damaged fixtures or electrical equipment that cannot be removed are repaired to safe operation, or are disconnected, locked out and identified as damaged with warning labels.

4. Protect cables, lines and outlets. Utilize "hot line" covers over any energized cables or power lines, when possible.

5. Turn off, lockout and tag all circuits leading into the project area.

6. Assign a "Responsible Person" to:

   - Make visual inspections and tests to assure de-energizing of lines and equipment.
   - Report to the supervisor that all switches and disconnects have been de-energized, locked out and plainly tagged at the end of the project.
   - Confirm that all crew members are clear before tags and lockouts are removed at the completion of the project.
   - Ensure that a separate tag and lockout are provided for each crew member requiring de-energizing of the same line or equipment.

Light and Power inside and Abatement Area

1. Use portable flood light systems for lighting.

2. Use of Ground Fault Circuit Interrupters (GFCI).

   - One must be used on each circuit to provide safe power supplies
   - Keep GFCI's outside the enclosure and away from high humidity

3. Use extension cords and wiring safely. They must be the three-conductor type and ground wire conductivity must be verified.

   - Power must be supplied through a GFCI located at the power source.
   - Don't string electrical wiring or extension cords across floors. They could be easily damaged and are tripping hazards.
   - Hang wiring up on walls whenever possible but don't staple them in place or hang from nails or other sharp objects.

4. Establish a company equipment grounding program.

   - The program must include required regular inspection of all electrical tools, cords and other devices. Written records of the inspections should be kept.

Abatement projects in occupied buildings are common. As a consequence, electrical conduits and equipment inside a work area may have to be left on to provide power to occupied parts of building.

Special caution must be taken if panels and transformers must be left uncovered due to possible heat build up.

Electrical Equipment Safety Checklist

1. The use of wet methods increases the potential for electrical shock when working around electrical panels, conduit, light fixtures, alarm systems, junction boxes, computers or transformers.

2. De-energize as much equipment as possible. Use portable floodlight systems for lighting and regularly check the system and its wiring for damage.

3. Use extreme care in areas immediately adjacent to energized electrical equipment if de-energizing is not feasible.

4. Use non-conductive scrapers and vacuum cleaner attachments (wood, plastic, rubber).

5. Supply workers with insulated rubber boots and/or gloves when they are working around energized wiring or equipment.

6. Use "hot-line" covers over energized cables and power lines, whenever possible.

7. Make sure all electrical equipment is properly grounded before the job starts. This means checking outlets, wiring, extension cords and power pickups. Check for the ground-pin on all plugs. These checks should also be made while setting up and during the job.

8. Take care not to damage insulated wiring with scrapers. Rolling a heavy cart or scaffold over a wire can cause invisible internal damage.

9. Do not let electrical wiring lie on floors. Elevate the wiring to keep it away from water on the floor and from possible damage caused by foot traffic or rolling scaffolds.

10. Do not allow water puddles to form on work area floors.

11. Ensure that electrical outlets within the work area are sealed with tape and poly to protect from water sprays, and to prevent attempts to use them during the project.

Tools and Equipment

Must be equipped with a 3-wire cord and have a grounding wire permanently affixed to the tool frame.

- Must be double insulated type and labeled as such.
- Must be fitted with a vacuum device with HEPA filters.
- Must be inspected regularly for damage, proper grounding and integrity of insulation.

Fiberglass ladders:

- Preferably use fiberglass ladders which will not allow grounding if workers using them should contact an energized circuit.

LADDERS AND SCAFFOLDS

The use of ladders and scaffolds is necessary for many abatement and inspection tasks and may present special hazards because of:

- Wet, slippery, polyethylene covered floors and wet ladder rungs
- Bulky protective clothing
- Unstable work surfaces
- Inadequate lighting
- Tool use

Ladder Maintenance

- Keep all ladders and scaffolds well maintained.
- Inspect all ladders and scaffolds periodically.
- Do not improvise repairs. Do not use duct tape to hold broken ladders together.
- Immediately destroy or discard defective ladders.
- Be sure that ladder safety feet spreaders and all components of extension ladders are in good condition.
- Check all movable parts. They should operate easily, without binding or undue looseness.
- Keep ladder rungs free from grease or oil.
- Be sure that hook type or other ladders are positively fastened ("tied off") when in use.

Proper Ladder Use

- Use ladders only for their intended purpose.
- Use extension type ladders at a 1-4 lean ratio.
- Use step ladders only when they are fully opened.
- Face any ladder while going up and down on it.
- Do not use the very top step of any ladder. Get a longer ladder instead.
- Do not use the bracing on the back legs of step ladders for climbing.
- Portable ladders are not intended for group use. (One person to a ladder.)
- Use fiberglass ladders whenever possible to avoid the potential electrical hazards of metal ladders.

Scaffolds

Specific OSHA standards apply to the use of scaffolding which must be reviewed prior to construction or use. Key requirements include:

1. The height of a manually propelled mobile scaffold cannot exceed 4 times it's minimum (smallest) base width or length. This is because scaffolds can be easily tipped over when moved (see figure on following page).

2. When using motorized mobile scaffolding, follow its manufacturer's recommendations.

3. Workers may not ride on manually propelled mobile scaffolding while it is being moved.

4. Inspect all scaffolding components prior to use:

    - The wheels should turn freely and be well lubricated.

- Platform planking should be already available before scaffolding is assembled.

5. Keep debris off the floor where mobile scaffolds will be used. The additional force required to move a scaffold if a wheel catches on debris may be all that is needed to turn it over.

6. Guard rails:

   - Should always be installed on scaffolding used for abatement projects.
   - OSHA requires that guard rails must be used when scaffolding is from 4 to 10 feet tall and less than 45" wide and must be used when scaffolding is taller than 10 feet.

7. Planking:

   - Planking used on the scaffold should not extend more than 12" past the edges, and should always be secured to the frame.

8. Kickplates:

   - Kickplates should be used regardless of scaffolding height to keep tools, etc., from being knocked off and hitting someone.

9. Hard Hats:

   - When scaffolds or ladders are in use, approved hard hats must be worn by all workers to prevent injury from falling objects.

Scaffold Upset Formula

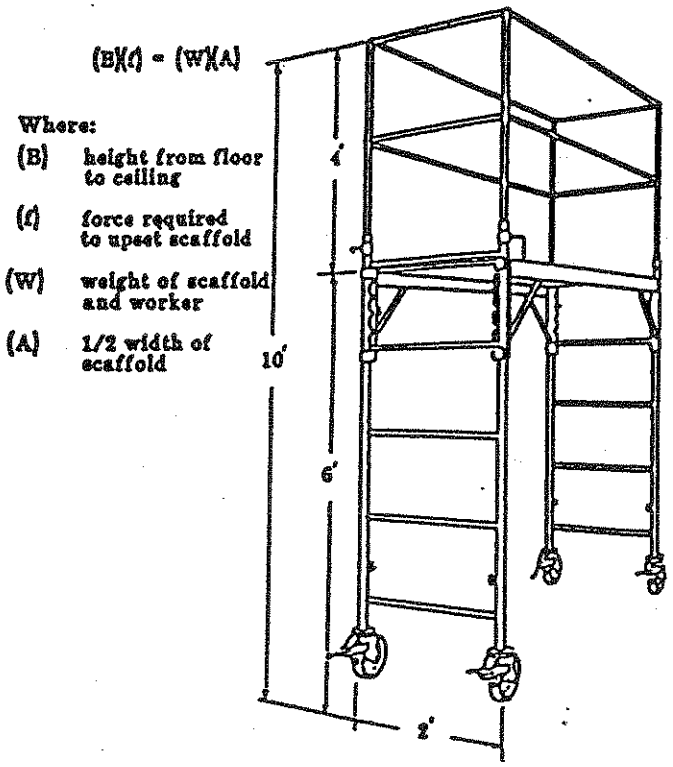


Figure 11-1
Scaffold Upset Formula

SLIPS TRIPS AND FALLS

Even areas properly constructed and maintained for lead abatement projects present slip, trip and fall hazards.

1. Floors of the work area which are covered with polyethylene are very slippery when wet.

2. Air, water and electrical lines create trip hazards if they are on the floor.

3. The feet of disposable protective coveralls as well as rubber boots can easily slip on wet polyethylene. Possible safeguards for workers may include:

    - Rubber boots with non-skid soles.
    - Slip on shoes with non-skid soles.
    - Safety shoes with non-skid soles.

After lead contaminated debris and paint chips are removed, they should be bagged, taken off the floor and stored out of the way as soon as possible. This may require some extra effort but the work area will be much safer.

No running, jumping or "horseplay" should ever be allowed in the work area. Such activities greatly increase the risk of injury from falls.

FIRE PREVENTION

Special Fire Hazards

- The enclosed work area makes escaping difficult.
- Bulky protective clothing interferes.
- Polyethylene and protective clothing can catch fire and/or melt.

All of these present special fire hazards which may interfere with emergency response.

Enclosed Work Area Hazards

Sealing off an area and blocking entrance/exit openings may conflict with OSHA, NFPA and local fire code requirements.

1. A pre-work fire safety survey should determine:

    - Potential fire hazards.
    - Sources of fire hazards.
    - "Hot-spots".
    - Location of exits.
    - The number of workers to be in the area.
    - The types and amounts of any combustible/flammable materials that must remain on site.

2. Remove all possible sources of ignition that could start a fire.

    - Be sure that gas and other fuel sources are cut off and that pilot lights on boilers, heaters, hot water tanks and compressors are extinguished.
    - Do not allow lighters or matches into the work area.

3. Drape certain equipment (computers, terminal boards, switch panels, transformers) with fire blankets instead of sealing it off, in order to prevent overheating.

4. Cut off the source of supply to steam lines, electric and steam heaters, and radiators.

5. Safe use of oxygen/acetylene torches and other high temperature sources:

    - Post a fire watch, with an appropriate fire extinguisher such as pressurized water, CO_2, or dry chemical.
    - Know what is on the other side of the wall and below the floor in case it could be affected by the torch flame.
    - Use either sheet metal or a treated tarpaulin to catch any sparks.

6. Flammable/combustible materials.

    - Reduce the amount of flammable/combustible materials inside a space to a minimum, prior to hanging any plastic.
    - Remove chemicals, flammable liquids or other heat sensitive materials. Keep flammable trash and debris to a minimum.

7. Flammable vapors:

    - Be alert for flammable vapors commonly present in industrial areas or during mastic removal operations (solvents such as naphtha, toluene or xylol). This is especially critical in vacuuming operations because vacuum motors may not be explosion proof (compressed air vacuums may be required instead).

Protective clothing

Some protective clothing can burn and melt quickly. The material can shrink or drip and adhere to skin as it burns. It also gives off heavy black smoke.

Polyethylene

Polyethylene combustible (even fire retardant poly). It will start to burn slowly and pick up speed as more heat is generated. It gives off heavy and highly toxic smoke as the fire progresses.

Polyethylene sheeting should be kept away from heat sources such as transformers, steam pipes and boilers that must remain hot during the removal project. Polyethylene and duct tape especially should not be allowed to contact surfaces that are above 140 degrees Fahrenheit.

FIRE EMERGENCY PROCEDURES

OSHA Requires a written emergency action fire prevention plan

All workers must be advised of and understand their roles in the plan, prior to beginning work. Such understanding must include:

- The manner in which emergencies are announced.
- Emergency escape procedures and emergency escape routes.
- Procedures for any employee who must stay back to deal with critical plant operations which may take time to safely shut down.
- Procedures to account for all employees after evacuation.
- Rescue and medical duties.
- Names and/or job titles of people to be contacted for additional information.
- A list of major workplace fire hazards.
- Names and/or job titles of people responsible for periodic inspection and maintenance of fire prevention equipment.
- Names and/or job titles of people responsible for control of fuel source hazards.

The Emergency Plan Must Establish Exits

Considerations for establishing fire exits should include:

- If the work area is large and many workers are present, several emergency exits may be needed.
- Conduct a daily inspection to ensure that any secondary plastic covered emergency exits can be reached and used.

- Mark all exits from the work area and post directional arrows to them if they are not visible from all work areas.
- Be sure all emergency exits and exit routes are adequately lighted, even in the event of electrical failure.

Summary of Worker Responsibilities in the Event of Fire:

- Be sure you understand the written Fire Prevention Plan and Fire Emergency Plan *for each job* and *for each crew* you will work with.
- Be sure you know the system for alerting workers of a fire or other problem that may require evacuation of the work area.
- Know where a telephone is that can be used for notification of authorities in an emergency. Know how to make that notification.
- Know where local Fire Department and Rescue Squad phone numbers are posted.
- Ensure that there is an assigned person outside at all times trained in emergency procedures. Someone should be trained in first aid, and in the treatment of heat stress.
- Know where all emergency exits are located, both primary and secondary ones.

The Most Important Emergency Fire Rule:

In case of fire, the fire hazard becomes more immediate than the lead hazard and workers may break down the plastic and other barriers to escape from the enclosures.

NON-LEAD RESPIRATORY HAZARDS

There are various categories of respiratory hazards that might be encountered on lead abatement projects that may require the use of respirators other than HEPA negative pressure type.

Respiratory hazards are generally categorized as follows:

- Oxygen deficiency.
- Gas and vapor contaminants.
- Particulate contaminants (aerosols including dust, fog, fume, mist, smoke and spray).
- Combinations of gas, vapor and particulate contaminants.

The type of respirator to use depends on the category and concentration of the contaminant.

- The basic respiratory hazards listed above are classified according to the expected biological effects of the contaminants.
- Respirators are designed and selected on the basis of chemical and physical properties of the air contaminants.
- Respirators designed for use in protecting an individual against asbestos fibers are not necessarily good for protecting an individual against other types of respiratory hazards (the reverse is also true).

Selecting respirators:

- OSHA requires stringent procedures for the proper selection of respirators.
- Workers also must be thoroughly trained in the selection, use, fit and limitations of respiratory equipment.
- No workers should ever use respiratory equipment or attempt to select such equipment without prior training and evaluation of the workplace.

Carbon Monoxide Poisoning

Carbon monoxide (CO) poisoning is a major risk associated with the use of fossil-fueled equipment such as electrical generators, heaters and air compressors.

1. Carbon monoxide is:
   - Colorless
   - Odorless
   - Tasteless

2. Carbon monoxide poisoning symptoms include:
   - Dizziness
   - Nausea
   - Headache
   - Drowsiness
   - Vomiting
   - Physical collapse into unconsciousness and coma prior to death

3. Carbon monoxide sources include:
   - Oil lubricated compressor
   - Internal Combustion Engine
   - Open flame and fire
   - Unvented gas fumes
   - Kerosene heaters

4. Motorized equipment exhaust - In some abatement situations, it may be necessary to use fossil-fueled equipment in or near the abatement site. Be aware that LP gas-powered equipment, when used indoors, has the potential to generate heavy carbon monoxide concentrations with little "combustion" odor such as would be the case with gasoline or diesel fueled equipment.

5. If such equipment is necessary, make sure that:

    - It has been adequately tuned up.
    - There are no excessive carbon monoxide concentrations in the exhaust gases.
    - Provide adequate ventilation.
    - Conduct continuous carbon monoxide monitoring.
    - If available, use catalytic combustors designed to eliminate carbon monoxide from the exhaust.

It is important to recognize that carbon monoxide exposure can not be addressed through the use of air purifying respirators. Adequate ventilation and equipment exhaust should be the key approaches used in controlling the build-up of carbon monoxide within a work area.

CONFINED SPACES

Definition

OSHA has defined confined spaces as having the following characteristics:

- Large enough and so configured that a person can enter.
- Limited or restricted means for entry or exit.
- Not designed for continuous human occupancy.

Examples of Confined Spaces

- Railroad tank cars.
- Underground sewers, walkways, tunnels.
- Processing tanks (either top or side entry).
- Manholes.
- Above or below ground pits with limited access.
- Steam tunnels or crawl spaces.

OSHA defines a **Permit Required Confined Space** as a confined space with ***any one*** of the following additional characteristics:

- Contains or has the potential to contain a hazardous atmosphere.

- Contains a material with the potential for engulfing an entrant.
- Has an internal configuration such that an entrant could become trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized serious safety or health hazard.

Entering Confined Spaces

Lead abatement workers may find it necessary to enter such areas to conduct inspection, maintenance or abatement activity.

Before entering such areas, it is vitally important to establish if the space is a permit space. If so, entry can only be performed by properly trained and equipped personnel and an attendant with non-entry rescue equipment must be present.

Confined Space Rescue Attempts: WARNING !!

Do not enter a confined space to attempt rescue unless you are properly trained and outfitted with the correct protective equipment (including your own safety retrieval harness, with someone tending your line).

Respirators are limited in their ability to protect the wearer from atmospheric hazards. For example, a negative pressure or powered air purifying respirator will not protect you against insufficient oxygen or a host of other contaminants for which the respirator was not designed. Therefore, only self contained breathing apparatus can be worn during confined space rescues.

60 % of confined space deaths are among would-be rescuers. Don't become a statistic!

Rules for Confined Space Work

- Pre-plan for confined space work.
- Read and comply with OSHA 1910.146 "Permit Required Confined Spaces".
- Obtain the necessary training and equipment.

NOISE CONSIDERATIONS

Noise and Hearing Facts

1. Excessive noise destroys the ability to hear and puts stress on other parts of the body, including the heart.

2. There is no cure for most of the effects of excessive noise.

3. Causes of noise damage:

   - Damage depends mainly on how loud the noise is and how long the person is exposed to it without proper protection.
   - High-pitched noise is much more dangerous than low-pitched noise.

Lead Abatement Workers and Noise Exposure

Lead abatement workers can become exposed to very high noise levels on the job, from:

- Background noises.
- Loud processes going on in the area of the project.
- Passage of products such as high pressure steam through pipelines on which they are working.
- Use of heavy equipment during abatement.

Controlling Noise Exposure

Noise exposure can be controlled. No matter what the noise problems may be in a particular work place, technology exists to adequately reduce the hazard.

It may be possible to:

- Use quieter work processes.
- Alter or enclose equipment to reduce the noise at its source.
- Use sound-absorbing materials to prevent the spread of noise by isolating the source.
- Use proper personal hearing protective devices.

Personal Hearing Protection Devices

Perhaps the most appropriate means of protecting workers from high noise levels is the use of protective hearing devices. Devices come in many different shapes and styles, in two categories:

1. Occluding ear phones, which surround the ear and prevent noise from hitting the outer ear.

2. Foam, soft plastic or rubber outer-ear inserts. These are generally shaped or moldable to be inserted into the ear canal. These devices can lower the noise level to which an individual is exposed by 15 to 20 decibels or more.

Responsibility

The responsibility for protecting workers' hearing lies with both the worker and the employer.

- If hearing protection is available to you, use it.
- If you are working in an area where the noise level seems excessive to you, request hearing protection from your employer.

Monitoring

Your company must monitor noise in the workplace and is required by OSHA to respond to all worker complaints.

MEDICAL EMERGENCIES

Regardless of precautions and reasonable care, medical emergencies can happen due to sickness or accident.

Your company must have established procedures to be followed in medical emergencies.

- Know your company accident and safety manual.
- Ask for training for dealing with medical emergencies.
- Know where first aid kits are and how to use them.
- Know where the nearest phone is to call for help. If not in a 911 area, know phone number of emergency services.
- If possible, obtain first aid and CPR instruction.

Heat Related Disorders

It is important for the employer to provide training in recognition and awareness of the symptoms and effects of heat stress and heat stroke. It is also imperative to emphasize the importance of drinking water and maintaining proper electrolyte balance when working in hot environments or while wearing protective clothing. The use of protective clothing and respirators greatly reduces the ability to properly regulate body temperature. As a consequence, any time full body protection is used, heat stress is a potential hazard which must be addressed.

The four types of heat related disorders are 1) heat rash, 2) heat cramps, 3) heat exhaustion, and 4) heat stroke. Of these disorders, only heat exhaustion and heat stroke are serious conditions which require immediate attention.

It should be noted that certain prescription and over-the counter drugs as well as alcohol use can cause individuals to be more prone to heat exhaustion and heat stroke. When working in hot environments, these factors must be considered.

Heat Exhaustion

The symptoms of heat exhaustion may include any or all of these:

- Fatigue
- Weakness
- Profuse sweating
- Normal body temperature
- Pale, clammy skin
- Headache
- Cramps
- Vomiting
- Fainting

Treatment for heat exhaustion include:

- Remove worker from hot environment
- Have worker lay down and elevate feet
- Apply cool wet cloths or water
- Loosen or remove clothing
- Provide fluid replacement (electrolyte drinks if available) unless vomiting.

Prevention of heat exhaustion can be enhanced by:

- Providing frequent breaks away from hot area.
- Increase fluid intake.
- Allow for acclimatization to heat over a period of days.
- Provide external cooling systems (vortex tubes, ice vests).

While not usually a medical emergency, heat exhaustion should be recognized and treated promptly or it will lead to heat stroke.

Heat Stroke

Heat stroke is a life threatening disorder and requires immediate medical attention. The field treatment tips provided below must only be considered emergency first aid to be provided until medical help arrives. The first action when encountering an individual who appears to be suffering from heat stroke should be to call emergency medical services!

Symptoms of heat stroke may include any or all of the following:

- Dizziness
- Nausea
- Severe headache
- Hot, dry, flushed skin
- Confusion
- Collapse
- Delirium
- Coma

Treatment for victims of heat stroke includes:

- Call for an ambulance.
- Remove worker from hot area.
- Remove clothing.
- Have worker lay down.
- Cool the body with shower or wet cloths.
- Do not give stimulants.
- Do not give fluids by mouth.

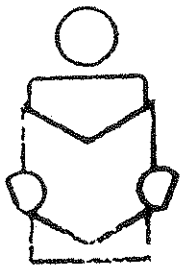
HAZARD COMMUNICATION/RIGHT TO KNOW

If chemical hazards are introduced to the workplace, the employer must have a written hazard communication program to inform employees of these hazards. Hazardous materials may be present on lead abatement sites for a number of reasons. Examples of potentially hazardous materials include: spray adhesives, surfactants, encapsulants, paints and coatings, paint removers (solvents or caustics) and cleaning agents.

Hazard Communication Plan Elements

- Comprehensive written program.
- Labeling of hazardous materials in the workplace.
- Availability of Material Safety Data Sheets (MSDS).
- Employee training.

Employers are required to inform affected workers about hazardous chemical they may be exposed to through. Information must be provided through the following methods:



WORKING WITH CHEMICALS

HOW TO USE THE RIGHT TO KNOW LAW

Where can I get information on the chemicals I use at work?

Check your company bulletin board. If your worksite is covered by the Right To Know law, there should be a notice that says you have a right to information on the chemicals you could be exposed to at work. This notice can come in many shapes and sizes, so look carefully. It will often identify the person or office you should contact. If no contact person is listed, ask your supervisor how to go about requesting chemical information.

What do I ask for?

Once the contact person has been identified, you should ask him or her for information on any chemical or mixture that concerns you. Try to be as specific as you can in identifying the chemical. It is a good idea to submit your request in writing and for you or the contact person to note the date and time when a request is made. Also keep a dated copy of the request for yourself. Your employer should be able to provide you with information within three workdays.

What information can I expect to receive?

You will usually be given a Material Safety Data Sheet (MSDS). The law lists several types of information that should be provided to you, most are found on MSDSs. They are:

- generic or chemical names of the substances;
- trade name of the substance;
- levels at which exposure to the substance may be hazardous, if known;
- short-term and long-term effects of exposure at hazardous levels;
- symptoms of such effects;
- flammability, explosion potential and chemical reactivity of the substance;
- appropriate emergency treatment for excess exposure;
- proper conditions for safe use and exposure to the substance;
- procedures for cleanup of leaks and spills.

MSDSs can be difficult to understand. Sometimes important information may be missing or written in confusing technical language. Your employer has an obligation to contact the manufacturer for any missing information and to explain any terms or language that you don't understand. The New York State Department of Health can help. If your employer has difficulty getting information from a manufacturer, the Health Department can help obtain the information. The department can also provide booklets for employees, that explain the Right To Know law and some of the language used in MSDSs.

For some products, like over-the-counter drugs, preparation of an MSDSs may not be required by federal law, and chemical information may not be available in that form. However, if you work with these materials you still have a right to the categories of information listed above. In cases like these, what your employer gives you may not look like an MSDS, but it should contain the same information.

Your employer cannot claim that a substance is not toxic or that no information exists on a substance without confirmation from the manufacturer, the New York State Department of Health, the Environmental Protection Agency and the National Institute for Occupational Safety and Health.

What if my employer doesn't respond to my request?

If you do not get the information within three workdays you have the right to refuse to work with that substance until the information is provided. Your employer could assign you to different duties. The law says that your employer cannot discriminate against you for exercising your rights. If you feel you have been penalized, contact the New York State Labor Department or the New York State Attorney General at the following addresses:

New York State Department of Labor
OSH Intergovernmental Relations
State Office Building Campus
Building 12 - Room 579
Albany, NY 12240
(518) 457-5508

New York State Department of Law
Environmental Protection Board
120 Broadway
26th Floor
New York, NY 10271
(212) 341-2706

Can someone else make a request for me?

The Right To Know law says that you or your representative can request information on the materials you may be exposed to at work. Your union steward, members of your family, your doctor or anyone else you select could ask for information on your behalf.

What if my work place is covered by the Federal OSHA Hazard Communication Standard instead of the NYS Right To Know law?

Everyone in New York State is covered by one law or the other. If your work place is covered by the Hazard Communication Standard, your employer should have MSDSs for all of the materials found in your work place and make them available to you during normal work hours.

What if I need chemical information and my employer doesn't have it?

In responding to a problem, you or your employer can contact the Health Department for chemical information. Health Department staff will provide any available information over the telephone and can usually send copies the same day. Some requests will require research and more time to prepare a response. If you call, have as much information on the substance as you can find, including the name of the substance, the name and address of the manufacturer and, if available, the Chemical Abstracts Service (CAS) number. The Health Department can be reached at the following address:

New York State Department of Health
Bureau of Toxic Substance Assessment
2 University Place
Albany, NY 12237
(518) 458-6392

Material Safety Data Sheet

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY *(As Used on Label and List)*	*Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.*

Section I

Manufacturer's Name	Emergency Telephone Number
Address *(Number, Street, City, State and ZIP Code)*	Telephone Number for Information
	Date Prepared
	Signature of Preparer *(optional)*

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% *(optional)*

Section III — Physical/Chemical Characteristics

Boiling Point		Specific Gravity (H_2O = 1)	
Vapor Pressure (mm Hg.)		Melting Point	
Vapor Density (AIR = 1)		Evaporation Rate (Butyl Acetate = 1)	

Solubility in Water

Appearance and Odor

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL

Extinguishing Media

Special Fire Fighting Procedures

Unusual Fire and Explosion Hazards

(Reproduce locally)

OSHA 174, Sept. 1985

Section V — Reactivity Data

Stability	Unstable		Conditions to Avoid
	Stable		

Incompatibility *(Materials to Avoid)*

Hazardous Decomposition or Byproducts

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur		

Section VI — Health Hazard Data

Routes of Entry: Inhalation? Skin? Ingestion?

Health Hazards *(Acute and Chronic)*

Carcinogenicity: NTP? IARC Monographs? OSHA Regulated?

Signs and Symptoms of Exposure

Medical Conditions Generally Aggravated by Exposure

Emergency and First Aid Procedures

Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material Is Released or Spilled

Waste Disposal Method

Precautions to Be Taken in Handling and Storing

Other Precautions

Section VIII — Control Measures

Respiratory Protection *(Specify Type)*

Ventilation	Local Exhaust	Special
	Mechanical *(General)*	Other

Protective Gloves | Eye Protection

Other Protective Clothing or Equipment

Work/Hygienic Practices

• USGPO 1986-491-329/45

GENERAL SITE SAFETY RULES

ACCIDENTS OR INJURIES, no matter how minor, must be reported to your supervisor for immediate treatment or first aid to prevent infection or complication.

JOB CLEANLINESS, housekeeping shall be practiced on all projects. Excess material and supplies not needed on present operations shall be properly stored until needed.

PERSONAL PROTECTIVE EQUIPMENT shall be provided and shall be used by employees where potential hazards exist. This includes lifelines where a danger of falling exists, respiratory equipment in a dangerous atmosphere, safety glasses, goggles or face shields on all operations where there is exposure to flying objects or anything injurious to the eyes. Employees will also be provided with hard hats, hearing protection, gloves, boots and disposable coveralls as required by project assignment. The employee is responsible for the proper use and care of all such equipment while on projects.

FOOT PROTECTION. Where required by project conditions, safety shoes or boots are to be worn. Check with supervisor prior to assignment to determine proper foot protection requirement for project.

BE ALERT when handling rough edges or abrasive materials. When work subjects' hands may be exposed to lacerations, puncturing, burns, or chemicals, special hand protection may be designated by the project supervisor.

CLOTHING shall be appropriate to the duties being performed and shall not include torn or loose articles.

HAND TOOLS shall not be used for any other purpose than that intended. Hand tools provided by either the employee or employer that are damaged or worn shall be promptly repaired or replaced.

POWER TOOLS shall be operated only be authorized personnel, in accordance with manufacturers' instructions, and if electrical, shall be grounded. Portable power tools shall be used with GFCI circuits only.

ELECTRICAL WIRES shall be considered "live" until checked and locked out. Keep a safe distance from electrical equipment such as transformers and switchgear.

MACHINE GUARDS shall be kept in place while machinery is in operation. Tampering with machine guards is prohibited.

COMPRESSED GAS CYLINDERS shall be chained or otherwise secured in an upright position, and shall be placed in cylinder carts whenever being transported to different locations on a project. Empty cylinders shall be removed promptly from the project. Flammable gases and oxygen/air cylinders shall be stored at least 20 feet apart from each other.

COMPRESSED GASES are not to be used for dusting off clothes or equipment. NEVER POINT AN AIR HOSE AT ANYONE!

SOURCES OF IGNITION shall be prohibited from areas where flammable liquids, gases or explosives are stored or issued, and appropriate warning signs shall be posted at these locations. "NO SMOKING" rules must be observed in posted areas.

ALCOHOL AND NON-PRESCRIBED DRUGS - possession or use during working hours is strictly forbidden.

FIRE EXTINGUISHERS - tampering with or unauthorized removal of fire extinguishers from assigned locations is prohibited. Partially used or empty fire extinguishers shall be reported to project supervisor or appropriate site representatives. Know the location and use of fire extinguishing equipment at each assigned project and procedures to give fire alarm.

FLAMMABLE LIQUIDS shall be contained in approved metal safety cans, and/or appropriate shipping cartons.

EQUIPMENT OPERATION - Employees shall not operate any machinery, equipment or tool unless instructed in the proper use and details of its operation.

BE AWARE of work going on around you. Keep clear of suspended loads and traffic areas. Work with care and good judgment at all times.

HORSEPLAY OR PRACTICAL JOKES shall not be permitted or tolerated on job sites before, during and after work hours.

AVOID SHORTCUTS - Use designated walkways, ramps, stairs, ladders, etc.

SAFETY PRECAUTIONS - Familiarize yourself with required safety precautions and procedures specific to each job-site before beginning work.

POSTED SAFETY RULES shall be obeyed in addition to the above general safety rules. Violation of these rules or posted rules may be cause for immediate dismissal of any employee.

SUPERVISORS' RESPONSIBILITY - Supervisors are responsible for enforcing all safety rules, instructing employees in safety performance of duties and inspecting work areas to ensure that no dangerous conditions exist.

SECTION 6
ROUTINE BUILDING MAINTENANCE AND LEAD BASED PAINT

INTRODUCTION

This section describes safe work practices for routine maintenance activities, not interim control or abatement work. During traditional, routine building maintenance work, surfaces with lead based paint can be disturbed, turning a potential problem into an immediate problem. However, if maintenance practices are modified to provide sufficient protection to workers and residents, lead hazards associated with maintenance work can be controlled. If the maintenance work does not disturb lead based paint, or create a dust hazard, then it can proceed in the traditional fashion.

THE IMPORTANCE OF PROTECTIVE MEASURES

To illustrate the importance of protective measures, even for small-scale jobs, consider how much leaded dust is contained within a 1 square foot area that is painted with lead based paint at the HUD minimum regulatory limit of 1 mg/cm^2:

$1\ mg/cm^2 \times (2{,}54\ cm/inch)^2 \times (12\ inches/ft)^2 \times 1{,}000\ \mu g/mg = 929{,}000\ \mu g/ft^2$

If we assume that none of this dust is cleaned up and that it is distributed evenly over an average room measuring 10 feet x 10 feet, then there would be 9,290 $\mu g/ft^2$ on the floor.

This figure can be compared to the HUD clearance standard of 100 mg/ft^2. In short, a significant amount of leaded dust can be released from a small painted area. Even though most maintenance jobs would not turn all the lead based paint into leaded dust (as this calculation assumes), it should be clear that large amounts of lead contaminated dust can be generated from even low concentrations of lead based paint. Therefore, protection and thorough clean-up are absolutely essential, even for small-scale jobs.

At the same time, it is not feasible to treat every small-scale maintenance job as if it were an abatement job. The following recommendations balance the need for controlling the hazard with the need to perform "routine" maintenance work in a practical way.

The purpose of maintenance work is different from lead hazard control efforts. Maintenance work is designed to simply keep buildings in good repair. On the other hand, lead hazard control efforts are designed to prevent lead poisoning. While these two goals are different, they are not contradictory. For example, lead hazard control work often results in the creation of smooth, clean-able surfaces that are also easier to maintain.

Similarly, good maintenance practices, such as repainting, can help maintain surfaces and thus prevent lead poisoning. Information on lead hazard control work and abatement work is provided in the following sections.

To determine the extent of protective measures needed, the maintenance task should be classified into low or high risk categories. Table 6-1 below provides guidance on classifying jobs based on how much dust each is likely to generate.

TABLE 6-1
LOW AND HIGH RISK JOB DESIGNATIONS FOR SURFACES CONTAINING LEAD BASED PAINT

Job Description	Low Risk	High Risk*
Repainting (includes surface preparation)		✓
Plastering or wall repair		✓
Window repair		✓
Window pane or glass replacement only	✓	
Water or moisture damage repair (repainting and plumbing)		✓
Door repair	✓	
Building component replacement		✓
Welding on painted surfaces		✓
Door lock repair or replacement	✓	
Electrical fixture repair	✓	
Floor refinishing		✓
Carpet replacement		✓
Groundskeeping	✓	
Radiator leak repair	✓	
Baluster repair (metal)		✓
Demolition		✓

* High-risk jobs typically disturb more than 2 square feet per room. If these jobs disturb less than 2 square feet, then they can be considered low-risk jobs.

Once the job has been classified, protective measures can be determined. Table 6-2 summarizes protective measures for those tasks that are either low or high risk. If more than 2 square feet of surface area are disturbed, an increased degree of protection is usually needed. If the surface area is smaller, the protection measures can be downgraded, but not eliminated entirely. If the paint is deteriorated, more protective measures may be needed.

TABLE 6-2
SUMMARY OF PROTECTIVE MEASURES FOR HIGH AND LOW RISK JOBS

Protective Measure	Low Risk	High Risk
Worksite preparation with plastic sheeting (6-mil thick)	Plastic sheet no less than 5 feet by 5 feet immediately underneath work area	Whole floor, plus simple airlock at door or tape door shut
Children kept out of work area	Yes	Yes
Resident relocation during work	No	Yes
Respirators	Probably not necessary*	Recommended
Protective clothing Note: Protective shoe coverings are not to be worn on ladders, scaffolds, etc.	Probably not necessary*	Recommended
Personal hygiene (enforced hand washing after job)	Required	Required
Showers	Probably not necessary	Recommended
Work practices	Use wet methods, except near electrical circuits	Use wet methods, except near electrical circuits
Cleaning	Wet cleaning with lead-specific detergent, trisodium phosphate, or other suitable detergent around the work area only (2 linear feet beyond plastic)	HEPA vacuum/wet wash/HEPA vacuum the entire work area
Clearance	Visual examination only	Dust sampling during the pre liminary phase of the mainte-nance program and periodically thereafter (not required for every job)

* Employers must have objective data showing that worker exposures are less than the OSHA permissible exposure limit of 50μg/m³ if respirators and protective clothing will not be provided.

MAINTENANCE WORK CAN CREATE OR INTENSIFY LEAD HAZARDS

There are a variety of ways in which maintenance work can inadvertently create lead hazards where none previously existed or worsen hazards that are already present.

Paint Abrasion or Other Disturbance

The most common problem involves maintenance work that disturbs or rubs against a painted surface. Common activities such as sanding, scraping, hammering, cutting, or grinding on surfaces coated with lead based paint or lead contaminated dust can create large exposures. Torch cutting or welding on painted metal surfaces is especially dangerous and is prohibited under OSHA regulations.

Power sanding on lead based painted surfaces has been found to cause exposures as high as 11,000 $\mu g/m^3$ in residential settings. Other typical tasks such as carpet removal, have also been shown to result in exposures well above the OSHA PEL, depending on how long the exposure lasts.

Water Damage

Water damage can occur from sudden circumstances, such as bursting pipes, overflowing tubs and sinks, broken fixtures, or storm damage. Water damage can also occur from less obvious problems, such as condensation, slow leaks in pipes and fixtures, improper building drainage around the perimeter, or accidental resident neglect (leaving the window open during rain).

In traditional maintenance work, it is customary to repair only the source of the water leak, especially in emergency situations. In some cases, the paint deterioration may not be evident until several weeks later, and it may be left to the resident to repaint.

If lead based paint is known or suspected to be present, however, paint deterioration deserves as much attention as the hole in the roof would receive.

Dust Exposure

Many types of maintenance work can release substantial quantities of dust into the residence. Examples include repainting, floor sanding, window repair, and plastering. Typical maintenance practices employ the use of drop cloths and cardboard or newspapers to protect furniture, eating surfaces, and walkways. If drop cloths are made of canvas, they may become full of leaded dust, possibly contaminating the next work site. Poorly controlled dust during maintenance work has accounted for numerous cases of childhood lead poisoning.

- Conducting wipe tests on some jobs to ensure adequate clean-up.

- Handling communication with residents.

For small staffs, all of these responsibilities may be handled by a single person, while with larger staffs, coordination is essential.

Identification of Lead Based Painted Surfaces

The best method for doing this is to list all painted surfaces and then have an inspector determine whether lead based paint is present. However, in many instances, such an inspection will not have occurred yet or was deficient for any number of reasons.

Therefore, it may be necessary to make assumptions. All painted surfaces in dwellings constructed before 1978 should be presumed to contain lead based paint, until proven otherwise. It is important to note that not all painted surfaces in all dwellings constructed before 1978 will contain lead. If it is known that certain building components are relatively new or were replaced or added after 1978, it can be assumed that they do not contain lead.

SECTION 7
ABATEMENT METHODS

INTRODUCTION

Abatement is the removal of either the building component or the paint itself or the near permanent enclosure of lead based paint hazards. Abatement has two principal advantages over interim controls which are addressed in the following section:

- Abatement provides a long term solution, with little if any monitoring or re-evaluation necessary.

- Abatement provides a higher margin of safety than interim controls since the effectiveness of the work is less dependent on resident action, maintenance of housing stock, the conscientiousness of property managers, and the attention of maintenance workers during repair work.

The methods explained in this section apply to abatement of both lead based paint hazards *and* lead based paint. Interim controls, abatement, or a combination of the two are acceptable methods of addressing lead based paint hazards.

DEFINITIONS

Abatement refers to a group of measures that can be expected to eliminate or reduce exposures to lead hazards for at least 20 years under normal conditions.

The term "abatement" also includes a number of other activities that are not directly related to the work itself, but that must be included in the overall effort for the abatement to be successful. These activities include lead hazard evaluation, planning, cleaning, clearance, and waste disposal.

Abatement differs from the "traditional" concept of abatement practices historically used which often involved dry scraping of deteriorated paint, repainting, and dry sweeping without clearance. These methods are now known to make leaded dust more accessible to young children and are therefore often counterproductive.

Proper abatement therefore, refers to any measures designed to permanently eliminate lead based paint hazards in accordance with standards established by the U.S Environmental Protection Agency, and includes:

- Removal of lead based paint.

- Enclosure of lead based paint.
- Encapsulation of lead based paint.
- Replacement of building components coated by lead based paint.
- Removal of lead contaminated dust.
- Removal of lead based paint from painted building components (as a last resort).
- Removal or covering of lead contaminated soil with durable covering (not grass or sod, which is considered an interim control measure).
- Preparation, clean-up, disposal, post-abatement clearance testing, record-keeping, and monitoring (if applicable).

SELECTION OF ABATEMENT METHODS

Paint removal involves the greatest degree of disturbance and dust generation and should be avoided unless no other abatement or interim control method is feasible. Enclosure and building component replacement are the least invasive and most preferred of the abatement methods.

Abatement offers the greatest challenge to planning, since it is often performed in the context of other building construction work, while interim controls are more likely to be performed alone or as part of other maintenance work.

Many forms of abatement can be integrated into construction work, which provides an opportunity to install systems that will have long-term impact. For example, whenever building components, such as doors or windows are replaced, it is recommended that they be replaced with products that are more energy efficient. This will help reduce energy consumption and increase cost-efficiency.

Many forms of abatement involve the same physical work as other types of construction often performed in housing. In many cases, only the intent is different. While the intentions of each of these activities may differ, experience shows that many of them can be combined in order to yield savings. In the public housing program, for example, most of the abatement now underway occurs in the context of housing modernization or rehabilitation work. This approach has proven to be feasible and cost effective. Congress also recognized the wisdom of combining lead abatement with rehabilitation work. In section 1012 of Title X, any residential construction job receiving more than

$25,000 per dwelling unit in Federal funds is *required* to have lead based paint hazards abated. If $5,000 to $25,000 per dwelling unit in Federal funding is received, either abatement or interim controls must be implemented.

Finally, lead abatement procedures cannot guarantee that children will not be exposed to lead in the future. Enclosure systems could fail, exposing the hazard again. Soil coverings could also fail, resulting in excessive exposures. Surfaces that were made cleanable may deteriorate or may not be kept clean, allowing leaded dust levels to re-accumulate to hazardous levels. Nevertheless, abatement constitutes the most extensive and protective intervention presently available. If practiced properly, abatement will greatly reduce the risk of lead poisoning.

TRAINING

EPA has established standard training curriculums and regulations for the training and certification of all individuals engaged in lead based paint risk assessment, inspection, and abatement, and minimum performance standards for the purpose of certifying those individuals who supervise lead abatement projects and conduct clearance examinations. EPA's regulations will generally be implemented through State programs. All abatement contractors and firms must be certified to perform this type of work, and all abatement workers must be trained and certified. Certification of abatement contractors and completion of clearance examinations by independent, certified risk assessors or inspectors ensures that abatement work is conducted properly and safely.

PROHIBITED ABATEMENT METHODS

Some techniques are prohibited because they are known to produce extremely high levels of lead exposure and result in dwellings that are difficult if not impossible to clean up. The techniques listed in Table 7-1, below are prohibited in the residential setting under HUD regulations as well as several State regulations.

TABLE 7-1
PROHIBITED LEAD BASED PAINT ABATEMENT METHODS

1. Open flame burning or torching (includes propane-fueled heat grids).
2. Machine sanding or grinding without HEPA local vacuum exhaust tool.
3. Uncontained hydroblasting or high-pressure wash.
4. Abrasive blasting or sandblasting without HEPA local vacuum exhaust tool.
5. Heat guns operating above 1,100 °F.

Methods that may be prohibited in some jurisdictions and that are not recommended by HUD:

1. Methylene chloride paint removal products.
2. Dry scraping (except for limited surface areas).

TYPES OF ABATEMENT

There are four types of abatement:

- Building component replacement.
- Enclosure systems.
- On-site and off-site paint removal.
- Soil removal or covering.

Experimental and innovative abatement techniques are currently being developed. The reader should not conclude that a particular method is not permitted simply because it is not discussed here.

Component Replacement

Surfaces, fixtures or building components (door, windows, etc.) containing lead based paint may be physically removed and replaced with new non-lead based painted surfaces, fixtures or components.

Encapsulation

Encapsulants are coatings or rigid material that rely on adhesion to a lead based painted surface and are not mechanically fastened to the substrate.

Enclosure

Enclosure is defined as a durable, rigid construction material that is mechanically fastened to the substrate with screws, nails, or other mechanical fastening systems that can be expected to last at least 20 years under normal conditions.

Paint Removal

Paint removal on-site may include scraping, sanding, application of heat or chemical stripping. Scraping and sanding operations must be performed with wet methods and/or HEPA filtered equipment. Paint removal off-site involves removing the component and transporting it to a central paint stripping operation for chemical treatment.

Soil Removal or Covering

Soil removal and replacement permanently removes the source of exposure (as long as the origin of the soil contamination has also been addressed). Soil may also be covered by paving or other means to isolate the contaminated soil. Planting grass or sod is not considered abatement but rather, an interim control.

Comparison of Lead-Based Paint Abatement Methods

Attributes	Method										
	Removal							Enclosure			
	HEPA Needle Gun	Heat Gun	HEPA Vacuum Blast	HEPA Sand	Remove/ Replace	Caustic Paste	Offsite Stripping	Plywood Paneling	Gypsum	Prefab Metal	Wood, Metal, Vinyl, Siding
Skill Level	High	Moderate	High	Moderate	High	Moderate	Moderate	Moderate	Moderate	High	Moderate
Esthetics	Erodes surface	Gouges	Erodes surfaces	Gouges/ roughens	Good	Gouges	Good	Good	Good	Good	Good
Applicability	Very low, limited to metal and masonry	Wide, can damage some components	Very low, limited to metal and masonry	Low, limited by surface contour	Wide, dependent on skill level	Wide, can damage some components	Low, limited to components	Wide, walls	Wide, walls and ceilings	Varied, limited by components	Wide, walls
Lead Presence	Removed	Largely removed	Largely removed	Largely removed	Removed	Largely removed	Largely removed	Remains	Remains	Remains	Remains
Hazardous Waste Generation	Moderate	Moderate	Moderate	Moderate	Potentially high, pending TCLP test	High	High, but maintained offsite	Low	Low	Low	Low
Weather Limitations	Moderate	High	Moderate	Moderate	Minimal	High	None	Minimal	Minimal	Minimal	Minimal
Applicable to Friction Surface	Some	Yes	Some	Some	Yes	Yes	Yes	No	No	Yes	No
Speed of Methodology	Moderate	Slow	Slow	Slow	Moderate	Very slow	Can be slow, requires coordination	Moderate	Moderate	Moderate	Moderate
Training Required	High	Moderate	High	Moderate	High	Moderate	Moderate	High	High	High	High

This table is continued on next page.

Comparison of Lead-Based Paint Abatement Methods (continued)

Attributes	Method										
	Removal							Enclosure			
	HEPA Needle Gun	Heat Gun	HEPA Vacuum Blast	HEPA Sand	Remove/ Replace	Caustic Paste	Offsite Stripping	Plywood Paneling	Gypsum	Prefab Metal	Wood, Metal, Vinyl, Siding
Capital Required	High	Low	High	Moderate	Moderate	Low	Low	Low	Low	High	Moderate
Worker Protection Required	High	High	High	High	Moderate	High	Moderate	Low	Moderate	Low	Low
Finish Work Required	Tentatively high	Moderate	Tentatively high	Moderate	Low	Moderate	Moderate	Wide	Wide	Limited	Wide
Product Availability	Limited	Moderate	Limited	Limited	Wide	Moderate	Limited, strip shops decreasing	Moderate	Moderate	Long	Long
Durability	Long	Long	Long	Long	Long	Long	Long	Moderate	Moderate	Moderate	Moderate
Labor Intensity	High	High	High	High	High	High	Moderate	High	High	High	High
Overall Safety	Moderate	Moderate	Moderate	Moderate	Very high	Moderate	High-high	High	High	High	High
Surface Preparation	None	None	None	None	None	Minimal—adjacent areas	Minimal—hardware removal	Minimal	Minimal	Minimal	Minimal
Cost	High	High	High	High	High	High	High	Moderate	Moderate	High	Moderate

Source: Adapted from Dewberry and Davis, HUD Lead-Based Paint Federal Housing Administration (FHA) Abatement Demonstration Project.