Chapter DHS 163

APPENDIX I

WORKING LEAD–SAFE

Chapters 4 and 17, HUD Guidelines for the Evaluation and Control of Lead–Based Paint Hazards in Housing

www.hud.gov/offices/lead/lbp/hudguidelines/Ch04.pdf

www.hud.gov/offices/lead/lbp/hudguidelines/Ch17.pdf

Chapter 4: Lead–Based Paint and Housing Renovation

I. Introduction

This chapter provides general information on the hazards of lead–based paint in various kinds of housing renovation work, including demolition, remodeling, repainting, rehabilitation, weatherization, and other forms of home improvement. If these activities are performed in older dwellings where lead–based paint is sanded, scraped, or otherwise disturbed, workers and residents may become lead poisoned if protective measures and special cleanup procedures are not used. Occupational Safety and Health Administration (OSHA) regulations require certain procedures for any paint that contains lead, even if it is below the HUD standard of 1 mg/cm$_2$ or 5,000 μg/g(0.5%). Clearance testing should be performed whenever a job creates leaded dust.

The Environmental Protection Agency (EPA) is currently studying the extent of lead hazards produced during this kind of work and will issue detailed guidelines on how to do renovation work involving lead–based paint safely. Starting in October 1995, Title X requires all renovation contractors to provide an EPA pamphlet to owners before beginning work in older dwellings. The pamphlet will describe the hazards of lead poisoning that could be caused by renovation work. Title X also sets certain lead–based paint hazard control requirements for housing rehabilitation assisted by the Federal Government. Future HUD regulations will provide details.

Additionally, some aspects of housing renovation work are regulated by OSHA, which recently issued a new rule covering lead in the construction industry. If the work includes manual demolition, scraping, sanding, and the use of heat guns, needle guns, and power sanders on surfaces that are coated with lead–based paint, there are worker protection requirements involving air monitoring, respirators, medical surveillance, training, and other protective measures. Further information on the OSHA standard can be found in Chapter 9.

A. Evidence of Lead Poisoning Caused by Renovation

There is substantial evidence that uncontrolled housing renovation work can cause lead poisoning. One study found that refinishing activity performed in dwellings with lead–based paint was associated with an average 69–percent increase in the blood lead level of the 249 infants living there (Rabinowitz, 1985a). Another study of 370 recently lead–poisoned children found a statistically significant association between household renovation activity and elevated blood lead level (EBL) ($p<0.0001$)[1] (Shannon, 1992). Other researchers have also reported cases where renovation activity has resulted in EBLs (Fischbein, 1981; Marino, 1990). The Marino case report (named after the physician who treated the family) is summarized in Figure 4.1.

[1] A p value of less than 0.0001 means that there was less than 1 chance in 10,000 that the association observed was due to chance.

II. Lead–Based Paint Hazards in Housing Renovation

A. Similarities Between Lead Hazard Control Work and Housing Renovation

Table 4.1 shows the similarity between lead hazard control work and renovation activity. Depending on the intent of the repair work, some of the same activities could be considered to be either lead hazard control work or renovation work. Because of these similarities, HUD recommends that all renovation workers and contractors become knowledgeable about how to conduct their work safely by reviewing the controlled work practices described throughout these *Guidelines*.

During the 1980s, at least $100 billion was spent on residential repairs and improvements. When working on houses that were constructed prior to 1978 (and especially before 1960), it is very likely that normal renovation and remodeling practices will expose surfaces that are covered with lead–based paint. Table 3.2 in Chapter 3 shows that the older the dwelling, the more lead–based paint is likely to be present.

Figure 4.1 A Case Report: Renovation and Lead Poisoning.

The Marino case report (Marino, 1990) is an example of how uncontrolled renovation work can cause lead poisoning in both adults and children. The dwelling involved was a 2–story, 19th century Victorian farmhouse with 10 rooms. Most of the wooden floors, moldings, walls, ceilings, and doorframes had been painted with lead–based paint.

The renovation work included restoration of surfaces by removing the paint down to the bare surface on floors and woodwork and recoating with new varnish. Ceilings were repaired, and wallpaper and paint were removed from a number of walls. Two workers used rotary power sanders, hand sanders, scrapers, torches, heat guns, and chemical paint strippers. The family left the house during most of the renovation work, but returned after it was only partially completed. There was dust throughout the dwelling.

After one of the family's dogs started to have seizures, a veterinarian determined that the dog was lead poisoned. The mother and two children were subsequently tested. The children had blood lead levels of 104 µg/dL and 67 µg/dL, which is 5 to 10 times above the level of concern established by the Centers for Disease Control and Prevention (CDC) (10 µg/dL). The mother had a blood lead level of 56 µg/dL. All three were admitted to a local hospital where they were treated for severe lead poisoning. The mother was 8 weeks pregnant and opted for a therapeutic abortion. A babysitter who had two children of her own sometimes cared for all four children in the home. The babysitter's two children were also tested and found to have blood lead levels of 80 µg/dL and 68 µg/dL. These two children were also hospitalized and treated for severe lead poisoning.

B. Leaded Dust

It does not take much leaded dust to create a hazard. The use of palm sanders, belt sanders, and sandpaper can increase the amount of hazardous leaded dust by a great deal. Almost any activity that involves disturbing a lead–containing surface will temporarily increase the amount of microscopic leaded dust in the surrounding environment.

To understand how easily leaded dust hazards can be created from jobs disturbing lead–based paint, consider the following example. Suppose renovation work is done on only 1 square foot of painted surface and all the paint inside that square foot is turned into dust by sanding or some other work. If the paint has 1 mg/cm$_2$ of lead in it (the lowest level covered by HUD regulation) and if the dust is spread out over a 100–square–foot area, there will be about 9,300 µg/ft$_2$ of leaded dust present, which is nearly 100 times greater than the allowable level. HUD does not permit more than 100 µg/ft$_2$ of leaded dust to be left on floors following lead hazard control work. In short, dust–generating work performed on even a small area can cause a serious problem if not controlled and cleaned up. Of course working on a small area requires only modest cleaning and control measures, as described in Chapters 8 and 11.

C. Fumes

Whenever lead–based paint is heated above 1,100 °F, some of it may vaporize and later settle on the surrounding walls and floors. These small particles (fumes) are extremely dangerous because they can be inhaled by the lungs and rapidly absorbed into the body. These fumes are present whenever high–temperature heat guns or open flames heat the paint film excessively. Lead fumes can also be a problem when debris coated with lead–based paint is burned or metal coated with lead–based paint is welded.

Table 4.1
Similarities Between Lead Hazard Control and Renovation

Renovation Technique	Lead Hazard Control Technique
Repainting	Paint film stabilization
Window and door repair	Friction and impact surface treatments
Landscaping	Soil treatment
Installation of new building components (e.g., cabinet replacement)	Building component replacement
Paint stripping	Onsite paint removal
New wall installation	Enclosure

D. Paint Chips

Metal brushing, dry scraping, or water blasting any lead–containing surface creates many poisonous chips that will contaminate the ground, where they are accessible to children.

E. Exposed Surfaces

Surfaces that have had all lead–based paint removed may still have leaded particles trapped in the pores of the wood. While these surfaces are drying out and being prepared for recoating, they can cause lead poisoning if touched, mouthed, or chewed by small children. Recoating should always be completed before children are allowed back into the area.

F. Soil

For many years automobile gasoline contained lead that was deposited onto soil. Also, paint chips from previous paint–scraping jobs, and normal weathering of paint, may contaminate the top few inches of soil around older dwellings. Excavation, landscaping, concrete flatwork, and regrading that disturbs lead–contaminated soil into the dwelling may also cause lead poisoning by increasing the accessibility of the soil to children and by making the soil more easily tracked into the dwelling.

III. Combining Renovation and Abatement

While renovation work can pose certain dangers, it also provides the most cost–effective opportunity to permanently address lead–based paint hazards. Combining lead–based paint abatement with renovation work will result in substantial savings when compared to the cost of conducting each activity independently. HUD's public housing program has been combining lead–based paint abatement with housing renovation for several years with considerable success and cost savings. As a result a significant number of public housing units have been fully abated and a number of renovation contractors now possess the special skills required to perform lead–based paint abatement.

The best way of combining abatement and renovation is to determine which parts of the job will disturb lead–based paint or produce contaminated dust. The work that can create leaded dust hazards is best performed by a contractor certified in lead–based paint abatement (who may or may not also be the renovation contractor). The remainder of the job can be performed in the traditional fashion. In many cases this means that the abatement phase of the work will be completed first during the initial demolition work. In other cases a more complicated phasing process is necessary where abatement activities alternate with traditional construction work.

Window replacement is an example of renovation work that can also achieve abatement at the same time. A common finding of risk assessments is that old windows have deteriorated lead–based paint and very high levels of leaded dust on the window trough. A certified abatement contractor is best suited to prepare the work area for dust containment, remove the old window, dispose of it properly, and conduct cleaning. The new window can be installed in the traditional fashion without worker protection, as long as no other surfaces with lead–based paint will need to be disturbed during installation.

All cuts or penetrations into surfaces with lead–based paint that are needed to complete the job should be identified ahead of time so that they will be performed by the appropriate contractor (if multiple contractors are used) and so that cleanup, worker protection, and containment are employed at the appropriate times. For example, if new plumbing will require cutting into an existing wall containing lead–based paint, the abatement contractor should do the cutting and cleaning. Alternatively, the plumber can become certified as an abatement contractor and specialize in plumbing work on leaded surfaces. Of course, work that disturbs only a small amount of lead–based paint does not necessarily require a specialized, certified contractor. Nevertheless, the precautions recommended in these *Guidelines* should always be observed.

Separate contractors are not necessarily required when combining renovation and abatement work. All work can be completed by a single contractor, but only if the renovation contractor is also certified to conduct lead–based paint abatement. In many respects the ideal abatement/renovation project is performed by a contractor with good construction skills *and* abatement skills. Chapter 3 contains additional information on how to plan lead–based paint abatement projects.

IV. Safe Older Home Renovation Procedures

The information in these *Guidelines* can be used to ensure that renovation work does not cause lead poisoning in either children or adults or create lead hazards. There are certain basic precautions that should become part of the standard operating procedure of any renovation or remodeling project.

If lead–based paint or contaminated dust or soil is present, there are five basic precautions that should be taken:

* Resident protection (see Chapter 8).

* Adherence to OSHA regulations (see Chapter 9).

* Proper management of waste (see Chapter 10).

* Final cleaning techniques (see Chapter 14).

* Final clearance (see Chapter 15).

A. Testing

Testing can be done for paint, dust, and soil to determine if it is contaminated with lead. The tests can define the

building components that can be handled in a traditional way and the building components that must be treated with extra care. The best field testing method for lead in paint usually involves a portable x–ray fluorescence (XRF) lead paint analyzer backed up by laboratory analysis of paint chips, especially if many surfaces need to be tested. When properly used (see Chapter 7) this method has an adequate detection limit and an acceptable rate of false positives and negatives, and is relatively easy to use at a modest cost per test.

Dust testing shows how much leaded surface dust is on various horizontal building components. Usually the floors and the interior window sill and exterior window troughs will be tested as part of a risk assessment (see Chapter 5) and as part of clearance to determine if cleaning was adequate (see Chapters 14 and 15).

There is insufficient evidence to fully endorse the use of chemical spot–test kits at this time. Research efforts on these kits indicate that they may hold promise for the future. The National Lead Information Center should be contacted to determine the current status of the kits. If for some reason, XRF or laboratory paint–chip testing cannot be performed, the chemical spot–test kits should be used. Because there is some evidence that these kits erroneously report the presence of lead, they are not recommended by HUD at this time.

B. Occupant Protection

1. Education

Before starting any renovation job that is likely to disturb suspected lead–containing surfaces, the owner and/or resident should be informed of the dangers of lead–based paint—its dust, chips, and the increased exposure that most construction work will generate. A brochure about this topic may be obtained by calling the National Lead Information Center (1–800–LEAD–FYI). Residents who are not educated about the dangers of lead poisoning may compromise the containment measures and revisit the home unexpectedly or allow their children to play in the worksite. Owners and residents who are educated about the potential dangers will become aware of the special protection and cleaning procedures that all renovation contractors and subcontractors should now include in their general requirements when dealing with lead–based paint.

2. Containment

Rooms or areas where surfaces suspected of containing lead are being penetrated, removed, or prepared should be isolated from the other sections of the dwelling that will not be cleaned or renovated. This is usually done with sheets of 6– mil plastic, masking tape, and preformed or field–built containments. Only adequately protected individuals should be allowed to enter the contained area before it has been cleaned.

Exterior containment involves covering the soil or pavement around the building to a distance of 10 to 20 feet (possibly less in some situations). The soil must be covered in order to capture dust and chips and to prevent the soil around the home from becoming more contaminated with lead. See Chapter 8 for a description of various worksite preparation practices.

3. Relocation

One of the safest ways to prevent lead poisoning is relocation of the residents and their "portable" belongings. With all of the small possessions out of the dwelling, there is relatively little to clean prior to reoccupancy. Occupants should not return to the work area until cleanup and final painting or finishing have been completed.

C. Cleaning Techniques

It is absolutely essential to clean the work area and any adjacent contaminated areas so that leaded dust levels are acceptable. All renovation contractors doing work on surfaces with lead–based paint must do more than simply clean up any visible dust. There are also small dust particles that cannot be seen by the naked eye. Cleaning should be done by using vacuums equipped with high–efficiency particulate air (HEPA) filters. HEPA filters trap very small particles from the vacuum exhaust so they do not recontaminate the work area or cause excessive exposures to workers. OSHA requires vacuums to have HEPA filters when working with lead. Ordinary vacuums release a cloud of small dust particles that cannot be seen with the naked eye.

To be most effective, HEPA vacuums should be used in combination with lead–specific detergents, high–phosphate detergents, or other suitable wet cleaning agents. The cleaning process starts with a HEPA vacuuming, followed by a wet wash, and a final HEPA vacuuming (see Chapter 14 for more details). If clearance can be established using only wet cleaning, the HEPA vacuuming step may not be needed. Carpeting and other dust traps may also have to be cleaned, discarded, or replaced before the family can reoccupy the dwelling. Renovation contractors working for owners who do not allow or wish to pay for this extensive cleaning should make it clear (in writing) that the contractor cannot be held responsible for lead contamination or lead poisoning.

D. Clearance Testing

Clearance testing should be completed after any renovation job that disturbs lead–based paint or creates

leaded dust to ensure that the dwelling is safe for occupancy (see Chapter 15).

E. Waste Disposal

For some types of renovation work involving lead–based paint, the waste will have to be sorted into various categories (see Chapter 10).

Some of this waste may need to be tested to determine whether it is hazardous. Even if the waste is "nonhazardous," lead–containing construction debris is still potentially dangerous and should not be placed directly on the ground. Debris piles should be placed on two layers of 6–mil plastic. The debris should be covered and clearly identified as containing lead. If the waste must be left onsite overnight, it must be stored in a secure area inaccessible to children or scavengers. Chapter 10 contains more specific information on waste disposal requirements.

For rolloff containers being used during extensive demolition jobs, debris should be handled in ways that minimize dust generation. Drop chutes cause too much dust and should not be used for lead–based paint construction debris unless proper precautions are taken to control dust. Loose plaster and dust should be thoroughly wetted down and/ or covered prior to open transportation to the container.

V. Prohibited Activities

Many traditional methods of preparing a painted surface for repainting, refinishing, or restaining are prohibited if the old paint contains lead, since these methods are known to poison both children and workers. Chapters 11 and 12 discuss safe ways of removing lead–based paint. Prohibited methods of paint removal include:

* Open–flame burning or torching.
* Machine sanding or grinding without a HEPA vacuum exhaust tool.
* Uncontained hydroblasting or high–pressure washing.
* Abrasive blasting or sandblasting without a HEPA vacuum exhaust tool.
* Heat guns operating above 1,100 _F.

Dry scraping (except for limited areas) and methylene chloride paint strippers are also not recommended.

A. Flame Treatment

The use of open torches, infrared scorchers, electric irons, or high–temperature heat guns are all prohibited when the surface has a lead content equal to or greater than 1 mg/cm$_2$ or 5,000 μg/g (0.5 percent). Traditionally, these methods are used to remove a number of layers of paint prior to repainting; however, they release very large amounts of lead fume, which can poison workers and be very difficult to clean up. They should be avoided even if the lead concentration is below the HUD standards.

B. Dry Sanding

Ordinary circular, reciprocating, belt, and palm sanding of lead–containing surfaces generates a great deal of dust. These methods should be done on a wet surface or by using a HEPA vacuum exhaust tool (see Chapter 12).

C. Dry Scraping

Dry scraping was the traditional method of surface preparation. Dry scraping has been replaced by wet scraping for work on lead–based paint surfaces. Wet scraping should not be done near electrical circuits, even if they have been de–energized.

D. Abrasive Blasting

All forms of blasting are prohibited on leadcontaining surfaces unless a HEPA–filtered local exhaust tool is used (see Chapter 12).

E. Power Washing

High–pressure washing is often used prior to starting an exterior paint job. However, uncontainable power washing or water blasting on lead–based painted surfaces is a prohibited practice. The alternative practice involves exterior containment, collection of all water, filtration of the water, and proper disposal of the filter and debris.

F. Welding on Painted Surfaces

Welding on surfaces coated with lead–based paint is prohibited by OSHA regulations. The high temperatures will produce leaded fumes and high exposures.

VI. General Guidance for Selected Renovation Activities

Certain activities are very likely to generate hazardous leaded dust and chips during renovation activities. Table 4.2 provides a summary of measures for protecting residents, providing containment, selecting safer alternate methods, and conducting cleanup for a few types of renovation.

Table 4.2
Selected Renovation Jobs and Work Practices

	Containment (see Chapter 8)	**Relocation** (see Chapter 8)	**Recommended Practices** (see Chapters 11 and 12)	**Cleanup** (see Chapter 14)
Demolition	Use plastic sheeting to prevent airborne dust migration. Interior Worksite Prep. Level 4; Exterior Worksite Prep. Level 3	No residents in dwelling during any work.	Wet surfaces, use covered containers to move debris; best subcontracted to abatement contractor, or a demolition contractor certified for abatement.	HEPA vacuum, wet mop, and HEPA vacuum.
Repainting	Floors and ground covered with 6–mil plastic. Interior Worksite Prep. Level 4; Exterior Worksite Prep. Level 3	No entry into work area during interior work.	Wet scrape, wet sanding, HEPA–filtered vacuum power tools.	Daily cleanup with HEPA vacuum, wet wash, HEPA vacuum.
Floor Sanding	Full containment of rooms, negative air recommended if leaded dust hazard identified.	No entry into work area during work.	Sanding lead–containing floors should be completed by abatement contractor, or other contractor certified for abatement.	HEPA vacuum of entire house may be needed.
Plaster Repairs	Localized containment for walls, entire room for ceiling. Usually Interior Worksite Prep. Level 1 or 2 for small jobs	No entry into work area.	Wet prior to removing.	HEPA final cleanup.
Window Replacement	Localized containment around each opening. See Table 8.3.	No occupancy during removal and initial cleaning and sealing.	Seal interior with plastic. Remove window from exterior if possible.	HEPA vacuum all areas with replaced windows.
Carpet Removal	Do dust sampling to determine contamination level. Usually Interior Worksite Prep. Level 3 or 4.	No occupancy during removal and initial cleaning.	Carefully remove and package carpet and pad in 6–mil plastic with taped seams. Wet down carpet before removal or disturbance.	HEPA vacuum floor after carpet bagged and prior to removal.

Step–by–Step Summary
Routine Building Maintenance and Lead–Based Paint: How To Do It

1. Develop a written program assigning responsibilities for controlling lead hazards caused by maintenance work. Train maintenance workers who will be working with lead, covering all the topics listed in this chapter. Change any existing work order forms to include the items in the lead–based paint maintenance work order form contained in this chapter. If no work order is used, develop a system to inform workers when a job may involve a lead hazard or lead–based paint.
2. Determine if lead–based paint is present on the surface where work will be performed. If the surface *has not been tested*, take x–ray fluorescence (XRF) measurements or send a paint chip to a qualified laboratory. If testing cannot be conducted, then it will be assumed that lead–based paint is present on all painted surfaces built before 1978. If some building components are new or were replaced after 1978, it can be assumed that they do not have lead–based paint and maintenance work can proceed normally.
3. Develop a ready–to–use list of those surfaces that are known to contain lead–based paint, if the surface has been tested, using the inventory form in this chapter.
4. Determine whether the individual task is low risk or high risk, using the table in this chapter. High–risk jobs are those that typically produce a significant amount of dust by disturbing more than 2 square feet of a painted surface. Low–risk jobs are those that do not produce much dust by disturbing less than 2 square feet per room.
5. Require the use of disposable 6–mil, polyethylene plastic drop cloths (or equivalent) and thorough cleanup of the immediate work area using wet cleaners. However, *if the job is low risk*, respirators and protective clothing may not be needed.
6. Use respirators; protective clothing; plastic, disposable drop cloths; and work area isolation *if the job is high risk*. High–efficiency particulate air (HEPA) vacuuming should be used in connection with wet cleaning methods.
7. Educate residents on why workers will be taking special precautions before maintenance work begins in the unit. Inform residents that workers need more protection, since they have a higher risk of exposure.
8. Complete work order forms for each job, defining specific protective measures to be used. If no written work order system is used, verbally inform workers of the required protective measures.
    a. For low–risk jobs, put a small sheet of plastic immediately underneath the work area (approximately 5 feet by 5 feet), except for ceiling work. For ceilings, cover the entire floor with plastic. Keep all doors closed and do not let children into the work area.
    b. For high–risk jobs, cover the entire floor with plastic. Remove all furniture or toys from the room or cover them with plastic. Seal the doorway by taping the door closed with light–duty tape or placing a sheet of plastic over the doorway, cutting a slit down the middle, and covering the slit with a second layer of plastic to act as a flap. Relocate children away from the dwelling during the work. Use respirators and protective clothing.
9. Complete maintenance task.
10. Conduct cleaning. For low–risk jobs, wet clean the area twice using a phosphate cleaner or lead–specific cleaner or other equivalent cleaning agent. For high–risk jobs, cleaning should be performed using a HEPA vacuum/wet cleaning/HEPA vacuum cycle.
11. Conduct clearance. Visual assessments are adequate for most low–risk jobs. For high–risk jobs, periodic wipe sampling for every 20th job should be conducted as well. Wipe sampling frequency can be reduced after desirable cleanup practices are established and verified for a particular worker or work crew.

Chapter 17: Routine Building Maintenance and Lead–Based Paint

I. The Relationship Between Building Maintenance Work and Lead Hazard Control Work

This chapter describes how routine maintenance work should be modified to protect workers and residents from lead poisoning and to comply with the Occupational Safety and Health Administration (OSHA) lead standards. Detailed information on worker protection is provided in Chapter 9. Maintenance workers may be covered by either the OSHA Lead Exposure in Construction standard (29 CFR 1926.62) or the OSHA General Industry Lead Standard (29 CFR 1910.1025), depending on the extent and type of job. This chapter describes safe practices for *routine* maintenance, not interim control or abatement work. If traditional, routine building maintenance is performed, 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 surfaces suspected to contain lead–based paint) or create a dust hazard, then it can proceed in the traditional fashion.

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 U.S. Department of Housing and Urban Development (HUD) minimum regulatory limit (1 mg/cm ^{2}):

1 mg/cm^2 x (2.54 cm/inch)^2 x (12 inches/ft)^2

x 1,000 μg/mg = 929,000 μg/ft^2

If we assume that more 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 μg/ft^2 on the floor.

This figure can be compared to the HUD clearance standard of 100 μg/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 cleanup 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, cleanable surfaces that are also easier to maintain. Similarly, good maintenance practices (such as repainting on a regular basis) can help maintain surfaces and thus prevent lead poisoning. Information on lead hazard control work (interim controls and abatement) and worker protection during this type of work are provided in other chapters.

II. Summary of Protective Measures for Low– and High–Risk Maintenance Tasks

To determine the extent of protective measures needed, the task should be classified into low or high–risk categories. Table 17.1 provides general guidance on classifying jobs based on how much dust each is likely to generate. The classification should be made on a case–by–case basis, since the surface area treated and the existing condition of the paint will be different for each job.

Once the job has been classified, protective measures can be determined. Table 17.2 summarizes protective measures for those tasks that are either low– or high–risk. Adjustments should be made depending on the size of the area to be disturbed. If more than 2 square feet are disturbed in the room, an increased degree of protection is usually needed. If the surface area to be disturbed is smaller, protective measures can be downgraded (but not eliminated entirely). If the paint is deteriorated, more protective measures may be needed.

Tables 17.1 and 17.2 should be used on a case by case basis. Each job may present unique situations that should be considered by the maintenance supervisor. For example, even though Table 17.1 suggests that repainting is a high–risk activity, it does not necessarily mean that *all* repainting jobs are considered high risk. If the painting job involves only minor touchup (less than 2 square feet per room) or there is no scraping or sanding involved, that particular painting job may be considered low risk.

More detailed descriptions of each protective measure are provided later in this chapter.

Table 17.1
Summary of Low– and High–Risk Job Designations for Surfaces Known or Suspected to Contain 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.

Table 17.2
Summary of Protective Measures for Low– and High–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 preliminary phase of the maintenance 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/m^3 if respirators and protective clothing will not be provided.

III. Ways in Which 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.

A. 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 (the paint must be removed before torch cutting or welding). Although most individual maintenance jobs do not last very long, it is possible to cause a significant exposure for the worker and the occupant. For example, power sanding on lead–based painted surfaces has been found to cause exposures as high as 11,000 µg/m_3 in the residential setting (Jacobs, 1991b), which is well above the OSHA permissible exposure limit (PEL) of 50 µg/m_3. 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 exposures last (NIOSH, 1990). While there is not adequate information on exposures during routine maintenance jobs, exposures can be kept well below the limit if the work is carefully conducted (NIOSH, 1990). In other words, paint deterioration should no longer be regarded as a minor cosmetic problem.

B. 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 or fixtures, improper building drainage around the perimeter, or accidental

resident neglect (e.g., leaving the windows open during rain). Both conditions can lead to paint failure, either by deterioration of the paint itself, or deterioration of the substrate behind the paint. 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 following the water leak repair 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. The paint should be repaired as quickly as possible using controlled work practices.

C. Dust Exposures

Many types of maintenance work can release substantial quantities of dust into the residence. Examples include repainting, floor sanding, window repair (window troughs often contain very high levels of leaded dust), and plastering. Typical maintenance practices employ the use of drop cloths and cardboard or newspapers to protect furniture, eating surfaces, and walkways. If the drop cloths are made of canvas, they may become full of leaded dust, possibly contaminating the next worksite. Poorly controlled dust during maintenance work has accounted for numerous cases of childhood lead poisoning (Farfel, 1990; Amitai, 1991; Rabinowitz, 1985a; Shannon, 1992).

Lead–contaminated dust exposures to both children and adults can be controlled by the following:

* Using wet methods.
* Covering furnishings with disposable, plastic drop cloths.
* Using foot coverings or dedicated footwear to minimize tracking of leaded dust out of the work area.
* Sealing rooms to avoid contamination of adjacent areas.
* Using approved respirators.

D. Groundskeeping

If the soil is contaminated, certain groundskeeping activities can pose a risk to workers and occupants. Excavation to lay new pipes, regrading, or sodding disturbs the soil. Bare soil can be more easily tracked into dwellings where it becomes part of the house dust and where a child can become exposed to it. If the soil is known to contain high concentrations of lead or has yet to be tested, simple protective measures can be introduced to control exposures. Keeping the soil wet is usually effective, as long as proper erosion control measures are established. Disposable shoe coverings or dedicated workshoes will prevent tracking contaminated soil into dwellings, worker's automobiles, and maintenance shops.

IV. Maintenance Program Elements

This section describes how a maintenance program addressing lead–based paint hazards can be developed that clearly assigns the various responsibilities. The following responsibilities need to be assigned to a specific individual:

* Determining whether a specific job will disturb known or suspected lead–based painted surfaces.
* Determining whether a specific job will be low– or high–risk.
* Training workers.
* Purchasing supplies and equipment, including respirators, plastic sheeting, special cleaners, disposable shoe coverings, protective clothing, etc.
* Conducting visual assessments on all jobs to ensure adequate cleanup.
* Conducting wipe tests on some jobs to ensure adequate cleanup.
* Handling communication with residents.

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

A. Identification of Lead–Based Painted Surfaces

Individuals assigning maintenance tasks will need to determine whether work on certain surfaces will result in a lead hazard. The best method for doing this is to list all painted surfaces and then have an inspector technician determine whether lead–based paint is present (using the protocols in Chapter 7).

However, in many instances, such an inspection will not have occurred yet or was deficient (for example, a previous investigation may not have inspected every similar painted surface in each room). 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.* While this assumption could result in erroneously requiring controls for working on paint that does not contain lead, it would be dangerous to assume that the paint does not contain lead until an inspection shows that it does. In the latter case, a maintenance supervisor could fail to recommend controls where they are needed, resulting in a poisoned worker or child.

It is important to note, however, 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. For example, if all exterior doors and windows in a building are known to have been replaced in 1981, these surfaces need not be included in the inventory of known or suspected surfaces.

Form 17.1 at the end of this chapter can be used as an inventory form.

An inventory for a single room might look like the example above. Since floors were not painted in this example, floor work is unlikely to produce a lead hazard. Lead–based paint is known to exist on the window troughs because of historical records on exterior paint. Baseboards and doors were replaced after 1978, so it is doubtful that they contain lead–based paint. All other surfaces are listed as "suspect" surfaces, since they have not been tested.

Depending on the size and organization of the maintenance operation, the inventory could be organized by room (appropriate for small owners with only one or a few single–family dwellings) or by unit/apartment building (appropriate for larger landlords). For computerized maintenance systems, the lead–based paint inventory system can be added to the database to flag those jobs that could produce lead hazards. If workers or supervisors are unsure about whether or not they are working on a leaded surface, they can quickly consult the inventory.

Figure 17.1 Example of a Lead–Based Paint Inventory

Dwelling Unit Identifier _____
Room Identifier _____

Surface	Known Lead–Based Paint	Suspected Lead–Based Paint	No Lead–Based Paint
Floors			✓
Lower walls		✓	
Upper walls		✓	
Chair rail		✓	
Interior window trim		✓	
Window trough	✓		
Ceiling		✓	
Baseboards			✓
Doors			✓
Door trim		✓	
Crown molding		✓	
Other trim mantels, etc.		✓	
Exterior siding	✓		

B. Identification of Low– and High–Risk Jobs

Most maintenance work is unpredictable. Some repair jobs start small but then escalate. Replacement of a ceiling light fixture is an example of a relatively small job that can become a large job if a section of the ceiling falls apart when the fixture is removed.

Maintenance or building supervisors or others who categorize work orders should determine if the job entails a low or high risk of exposure to lead and leaded dust according to the guidance in Table 17.1. Protective measures should also be determined according to the guidance in Table 17.2. Some training is usually necessary to make these judgments.

C. Training

Since most maintenance supervisors and workers are not typically trained to recognize and correct lead hazards in the course of their regular duties, it may be difficult or impossible for maintenance personnel to determine the level of control necessary for a particular job. Presently, no formal U.S. Environmental Protection Agency (EPA) training curriculum specifically targeted at maintenance personnel exists, although a number of such courses have

been developed and provided (AFSCME, 1993; Jacobs/HES, 1992; SOEH, 1993). In addition, the OSHA Hazard Communication Standard (29 CFR 1910.1200) requires training of individuals who are exposed to hazardous substances during their work. Both the OSHA Lead Exposure in Construction standard (29 CFR 1926.62) and the OSHA General Industry Lead Standard (29 CFR 1910.1025) require training. The National Institute of Building Sciences has recently developed an operations and maintenance manual on lead–based paint (call (202) 289–7800).

Maintenance workers and supervisors who deal with lead–based paint hazards should receive a 1– or 2–day training session at their job site that includes hands–on practice in implementing various control measures. The training should include a discussion of how the maintenance program at the facility will be modified to reflect potential lead hazards, and who will make the decisions. The training should emphasize that maintenance workers are not permitted to perform abatement work unless they have completed the State–approved EPA lead–based paint abatement training course(s). Newly hired or trained supervisors or workers should be closely monitored to ensure that appropriate controls are established. Sources of training are provided in Chapter 2.

If outside contractors are employed to conduct maintenance work, they must also be trained and notified if their work will disturb lead–based painted surfaces. Proof of contractor staff training should be verified by the owner before any maintenance work is undertaken.

At a minimum, the training should cover the following topics:

* Definition of lead and lead–based paint hazards.
* Lead health effects.
* Regulations.
* Modifications to existing maintenance operations.
* Listing of known or suspected surfaces containing lead–based paint.
* Methods of identifying lead.
* Distinguishing between low– and high–risk jobs.
* Work practices (use of tools, HEPA vacuums, wet methods, and so forth).
* Prohibited methods of removing lead–based pain include: open–flame burning or torching, machine sanding or grinding, uncontained hydroblasting or high–pressure wash, abrasive blasting or sandblasting, and heat guns above 1100 _F. Methylene chloride strippers and dry scraping are also not recommended.
* Personal hygiene.
* Worksite preparation.
* Respirator program and fitting.
* Medical surveillance.
* Cleanup and post–job visual inspection.
* Clearance procedures.
* Waste handling and storage.
* Resident relations.

An accredited lead training provider should conduct the training. The training can also be conducted by a licensed risk assessor; a certified industrial hygienist, nurse, or physician; or another qualified adult educator. If necessary, maintenance supervisors can provide the training if they have completed the EPA supervisor course.

D. Education of Residents

Maintenance workers may be required to use respirators and protective clothing in occupied units, erect containment systems, and use special equipment; therefore, residents must be informed about the reasons for these measures. It is important that all elements of the lead hazard control plan be fully developed to reassure residents that no hazards will be created as a result of the work. Local health departments and childhood lead–poisoning prevention programs can assist owners in properly educating residents about lead health hazards.

E. Work Order Systems

Work order systems should be modified to reflect whether the job will disturb the lead–based paint, whether the job is low– or high–risk, and which protective measures will be required. Even if an owner does not have a formal work order system developed, the hazard warning information must be transmitted to those conducting the work.

To account for lead hazards, the owner's work order form will need to be modified. Specifically, a check–off box should be added to indicate that the work will disturb known or suspected lead–based paint. If this box is checked, the supervisor or worker should receive a second form with detailed information on required work practices and control measures required. A standard Lead–Based Paint Maintenance Work Order Form is shown in Figure 17.2, which can be added to the existing maintenance form.

Figure 17.2 A Typical Work Order Form

Lead–Based Paint Maintenance Work Order Form

Reference to work order number _____

Respirator required? ____ Yes ____ No

Protective clothing required? ____ Yes ____ No

Size of plastic sheeting to be placed under work area _____

Cover whole floor with 6–mil plastic sheeting? ____ Yes ____ No

Cover doorway to room with plastic sheeting and construct airlock? ____ Yes ____ No

Tape door shut? ____ Yes ____ No

Move furniture out of room? ____ Yes ____ No

Shut down HVAC system? ____ Yes ____ No

Wet down item to be repaired? ____ Yes ____ No

(CAUTION: Do not wet down areas near electrical circuits.)

Relocate occupant? ____ Yes ____ No

Cleanup:

HEPA vacuum needed? ____ Yes ____ No

Disposal of waste will be done by _____

Visual inspection of cleanup by supervisor:

____ Sufficient ____ Repeat cleaning

Dust sampling required after task is completed? ____ Yes ____ No

Modifications to work _____

Work assigned by _____

Work completed by _____

Final inspection by _____

Date of completion _____

F. Written Program: Assignment of Responsibilities

When the five elements of the maintenance program (described above) have been assembled, a management plan should be put into writing. The plan should authorize specific individuals to perform the following functions:

1. Develop and maintain a list of all suspect and known lead–based painted surfaces.
2. Determine those jobs that pose low and high risks.
3. Train maintenance workers, supervisors, and managers, and implement respiratory protection and medical surveillance programs.
4. Provide notification to residents about lead–based paint maintenance work.
5. Complete work order forms and lead–based paint maintenance work order form.
6. Purchase supplies and equipment, including respirators, plastic sheeting, special cleaners, and protective clothing.
7. Designate those workers permitted to work on lead–based painted surfaces.
8. Conduct wipe tests and visual assessments to determine whether the cleaning in a dwelling has been adequate following the job.

For small staffs, a single person may handle all of these tasks; for larger staffs, coordination is essential. This program should also be included in an interim control plan, if one exists for the property (see Chapter 11). If there is only a single maintenance person and owner/supervisor, a written program is not necessary.

V. Methods To Protect Workers and Residents During Typical Maintenance Jobs

Due to the toxic nature of lead, *all* jobs disturbing lead−based paint require *some* protection.

A. Worksite Containment and Occupant Protection

1. Jobs That Do Not Pose a Lead Hazard

Jobs that do not disturb any lead−based paint or that do not create a lead−contaminated dust hazard can be performed in the traditional fashion.

2. Low−Risk Jobs

For low−risk jobs disturbing a small surface area and not generating much dust, worksite containment consists of a relatively small sheet of plastic (no less than 5 by 5 feet) placed underneath the immediate work area. An exception to this rule is ceiling work where dust contamination is likely to be widespread. For most types of ceiling work, the entire floor and all furnishings should be covered with plastic.

Doors to the work area should be kept closed until cleanup has been completed. The gap at the bottom of the door should be taped shut. Children are not permitted in the work area until the supervisor has visually inspected the cleanup. However, children may be present in adjoining rooms and need not be removed from the entire dwelling (although relocation is preferable). Worksite Preparation Level 1 should be adequate (see Chapter 8).

3. High−Risk Jobs

For those jobs that are high risk and that disturb a large surface area, a more involved worksite containment procedure is required. Typically, the whole floor should be covered with plastic sheeting. Furniture, toys, and other belongings should be either moved out of the room or covered with plastic sheeting. A simple airlock should be constructed at the entryway to the room. (If two entryways exist, one should be completely sealed in plastic.) The airlock consists of two sheets of plastic. One sheet is completely taped along all four edges. The tape must extend all the way around the top, two sides, and the floor. This plastic sheet is then cut down the middle. The second sheet is only taped along the top and acts as a flap covering the slit in the first sheet of plastic. As an alternative, the doorway can be taped on all sides. A weak tape should be used so that workers can quickly break the tape seal in the event of an emergency.

Children should be temporarily relocated from the dwelling while the work is proceeding. If more than 1 day is required to complete the work, a supervisor must have a thorough cleanup conducted, followed by a visual examination, at the end of each workday. Children and residents are permitted to reenter the dwelling at the end of the workday, after the dwelling has been completely cleaned and visually inspected. A high−risk job should be followed by HEPA vacuuming, wet washing with a suitable cleaner, and repeated HEPA vacuuming (see Chapter 14).

B. Respirators

1. Low−Risk Jobs

Respirators are not required unless time−weighted average exposures are greater than 50 $\mu g/m^3$ as an 8−hour, time−weighted average. Unfortunately, virtually no data exist that characterize maintenance worker exposures. Chapter 9 noted that OSHA requires respirators to be used whenever certain tasks are performed, unless air sampling demonstrates that exposures are low. These tasks include the following:

* Manual demolition.

* Manual scraping.

* Manual sanding.

* Heat gun use.

* Power tools (belt sanders, needle guns, and so forth).

* Spray painting with lead−based paint.

Manual scraping and sanding should be performed only after the surface has been moistened. Power tools should be used with HEPA local exhaust vacuum systems. Since typical maintenance worker exposures may not exceed the permissible limit, half−face air purifying respirators equipped with HEPA cartridges should be used even for small jobs while the surface is being disturbed. The use of respirators for this brief time period is not particularly burdensome and is likely to provide significant protection.

Respirators must be used in conjunction with a respirator program (29 CFR 1910.134) that requires respirators to be fitted to the individual, cleaned and stored properly, and used within their design limits by individuals medically fit to use them (as determined by a physician), among other requirements.

2. High−Risk Jobs

Respirators are required for all high−risk jobs. If an unusually high level of leaded dust is expected to be generated, a full−face powered air−purifying respirator should be used.

C. Protective Clothing

1. Low−Risk Jobs

Protective clothing is not required for low−risk jobs. However, workers must not wear their work clothing

home and should ensure that their clothing is laundered separately from their family's clothing.

Protective clothing should be worn if a low–risk job disturbs more than 1 square foot.

Workshoe disposable coverings should be worn to avoid tracking leaded dust throughout the dwelling, unless work will be conducted on ladders. Shoe coverings are not recommended for situations that create a significant risk of workers falling or slipping.

2. High–Risk Jobs
Protective clothing and protective footwear are required for all high–risk jobs.

D. Personal Hygiene and Showers

1. Low–Risk Jobs
Many studies have revealed that poor personal hygiene of workers during lead hazard control jobs can cause lead poisoning. Therefore, thorough washing of the hands and face is required even for low–risk jobs disturbing less than 1 square foot. Eating, smoking, drinking, and applying cosmetics while in the work area should not be permitted. Hand–to–mouth contact should also be minimized. For low–risk jobs, showers are not required.

2. High–Risk Jobs
For high–risk jobs, showers should be taken at the maintenance shop before the worker leaves at the end of the day. Thorough washing of the hands and face should be completed before all breaks (meals, etc.). If showers are not provided, workers should change their clothing and put the contaminated work clothing in a plastic bag for separate cleaning.

E. Work Practices
Protective work practices are the same for both low– and high–risk jobs. Surfaces should be wetted when possible to retard the entrainment of leaded dust into the air. A garden sprayer or pump/squeeze bottle can be used for this purpose. Enough water should be used to just coat the surface; use of excessive water can cause runoff and substrate damage. Work should proceed carefully and deliberately to reduce the amount of dust generated.

Wet methods *must not* be used near electrical circuits due to electrocution hazards.

Children are not permitted in the work area until after completion of all cleanup and final visual inspection.

F. Cleaning

1. Low–Risk Jobs
A HEPA vacuum is not required for low–risk jobs, since all the leaded dust will be caught by the plastic sheeting. However, limited wet cleaning with trisodium phosphate detergent or other lead–specific cleaners or equivalent should be performed twice on all horizontal surfaces at least 2 linear feet beyond the plastic in all directions. Vertical walls or other building components near the work area should also be cleaned. A mild detergent can be used on those surfaces where the finish is likely to be marred by the use of trisodium phosphate. There should be no visible dust in the cleaned area. Brooms should not be used to clean up dust; only wet methods are recommended.

2. High–Risk Jobs
A HEPA vacuum is required for cleanup of high–risk jobs. The entire room should be cleaned following the full HEPA vacuum/wet wash/HEPA vacuum cleanup method described in Chapter 14. Cleaning should proceed from clean to dirty areas and from ceiling to floor. All surfaces in the room that were not covered with plastic should be cleaned. Finally, the floor should be cleaned after the plastic has been removed. The cleaning solution should be changed frequently (at least after each room is cleaned, more frequently, if needed).

G. Clearance

1. Low–Risk Jobs
For low–risk jobs, a visual inspection conducted by a trained supervisor is sufficient. The supervisor should ensure that all required work has been completed and that there is no visible dust in the immediate vicinity of the work area.

2. High–Risk Jobs
For high–risk jobs, clearance dust sampling is recommended for at least every 20th job, in addition to visual examination for every job (see Table 15.1).

H. Waste Disposal
Since maintenance work is part of the routine operations in a dwelling, any waste generated is considered ordinary household refuse and is not regulated under the Resource Conservation and Recovery Act as hazardous waste. Depending on the interpretation of the local regulatory agency, permits may not be required to dispose of waste generated as a result of ordinary maintenance and repair work.

However, the waste can still pose a threat to youngsters who gain access to it. All waste generated as a result of lead–based paint maintenance work should be sealed in a container or plastic bag and stored in a secure, locked area until final disposal. In addition, solid waste should be wrapped in plastic to prevent any release of leaded dust during transport out of the dwelling and to the final disposal site. Lead–contaminated waste should be disposed of in a lined landfill.

Form 17.1
Inventory Form

Dwelling unit address _____

Room or area identifier _____

Surface	Known Lead–Based Paint	Suspected Lead–Based Paint	No Lead–Based Paint
Floors			
Lower walls			
Upper walls			
Chair rail			
Interior window trim			
Window trough trim			
Ceiling			
Baseboards			
Doors			
Door trim			
Crown molding			
Other trim (molding, mantels, etc.)			
Cabinets			
Radiators			
List all other surfaces here:			