SECTION 7

Sample Abatement Report

TCA 1200-1-18-.01 (8)(a)3

TCA 1200-1-18-.01 (8)(e)11

HUD Guidelines - Chapter 11: Interim Controls

HUD Guidelines - Chapter 12: Abatement

HUD Guidelines (July 2012) - Chapter 14: Cleaning

EXAMPLE Lead Abatement Report

A lead abatement report is to be prepared by a certified supervisor (for 10 units or less) or certified project designer (for 11 units or more). The lead abatement report shall be submitted to the Division no less than 15-days following the completion of the abatement project. The lead abatement report shall include the following information:

Lead Abatement Report

Lead Abatement Project Start Date: 1/1/16
Lead Abatement Project Completion Date: 1/31/16

Lead Abatement Project Address: 111 Main Street
Nashville, TN 30000

Date of Building (House) Construction: 1968

Owner Name: John Doe
Owner Address: 111 Main Street
Nashville, TN 37000
(615) 555-5555

Certified Supervisor Information: Jam es Doe,
Certification # TNLBP 2002-03S

Certified Abatement Firm Information: James Doe Environmental, Inc.
Certification # FTN 2002

Certified Abatement Firm Address: 401 Church Street
Nashville, TN 37000
Phone: (615) 555-5551

Inspection / Risk Assessment Conducted by: Linda Doe,
Certification # TNLBP 2002-02IRA
333 Main Street
Nashville, TN 37000
Phone: (615) 555-5552

Date Inspection / Risk Assessment conducted: April 2, 2001

Clearance Testing Conducted by: Linda Doe,
Certification # TNLBP 2002-02IRA
333 Main Street
Nashville, TN 37000

Phone: (615) 555-5552

Date Clearance Testing Conducted: January 31, 2001

Name and Address of the recognized National Lead Laboratory (NLLP) that analyzed the samples: LYZ Laboratory
Contact Person: Mr. Labin
321 Far Street
Nashville, TN 37000
Phone: (615) 555-2222

I. Pre-Abatement Information

Job Specifications:

A detailed written description of the abatement, including abatement methods used, location of rooms and/or components where abatement occurred, reason for selecting particular abatement methods for each component, and any suggested monitoring of encapsulants or enclosures.

(Note: A table format may be used to comply this information.)

1. All windows were replaced and sealed with lifetime caulking.

2. All interior kitchen trim was encapsulated except casing /header over ‘C” door which was replaced.

3. All interior surfaces were cleaned using the HUD cleaning method: HEPA, TSP wash, rinse, HEPA.

4. Exterior doors and ‘A’ and ‘C’ sides were replaced.

5. Exterior exposed painted surfaces were covered with tyvek (housewrap) and enclosed with aluminum/vinyl or replace. These surfaces included but were not limited to:
   - -Vinyl siding installed over fan fold;
   - -Vinyl soffit covering the soffit and porch ceilings;
   - - Back-caulked aluminum flashing around windows, doors, fascia;
   - - Porch posts and lattice were replaced.

6. Perimeter lead-contaminated soil was removed in play area ‘C’. The area was cover with soil that is not lead-contaminated. The area was seeded and covered with straw.

Operation and Maintenance Plan

1. Enclosures should be monitored on a yearly basis to ensure continued efficiency.

2. Interior encapsulated trim should be monitored one month, six months and annually thereafter, and redone as necessary.

(Note: ***If areas of frequent damage occur, these areas should be protected with a enclosure system.)***

(Note: ***Typically, sections of your abatement plan should be included here. Information should be altered to only include work completed.)***

Occupant Protection

A written occupant protection plan developed specifically for the abatement project pursuant to Rule 1200-1-18.01(8)e(5).

(Note: ***Add the Occupant Protection Plan in the document or list it as an attachment.)***

Copy of Inspection and/or Risk Assessor Report signed by a State of Tennessee certified lead-based paint inspector/risk assessor and prepared pursuant to Rule 1200-1-18.01(8)b(4); c(5); and/or d(11) with the inspection results expressed in terms appropriate for the sampling method(s) for all media tested (such as exterior and interior components, soil, etc.)

II. Post-Abatement Information

Post-abatement clearance procedures conducted pursuant to Rule 1200-1-18-.01(8)e(9) and (10).

Copy of clearance testing results and all soil analyses (if applicable) indicating whether the unit passed, or failed. If failed the measures used to reach clearance must be documented and the second clearance testing results must be included.

Hazardous Waste Disposal

All potential hazardous waste from paint chips, HEPA vacuum, peel-away, etc. collection are accumulated off-site. If less than 220 lbs. is accumulated per month it may be possible to dispose of the waste as nonhazardous waste from a small quantity generator after checking with the state and solid waste facility. Dispose of the waste through a

certified hazardous waste hauler according to state and local laws. (EPA Model Lead-Based Paint Abatement Worker Training Course - Ch. 8)

Pursuant to Chapter Rule 1200-1-18-06 Residential Property Renovation requires each person who performs a renovation of target housing for compensation to provide a lead hazard information pamphlet, *Protect Your Family From Lead In Your Home*, to the owner and occupant of such housing prior to commencing the renovation.

This Lead Abatement Report was completed by:
James Doe,
Certification # TNLBP 2002-03S
Date: ____/ _____/ _____

_____Signature

Rule 1200-1-18-.01 LEAD-BASED PAINT ABATEMENT

Work Practice Standards for Conducting Lead-Based Paint Activities: Target Housing and Child-Occupied Facilities

(8) Work Practice Standards for Conducting Lead-Based Paint Activities: Target Housing and Child-Occupied Facilities: [40 CFR 745.227]

(a) Effective Date, Applicability, and Terms

3. Documented methodologies that are appropriate for this paragraph are found in the following:

(i) The U.S. Department of Housing and Urban Development (HUD) Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing;

(ii) The EPA Guidance on Residential Lead-Based Paint, Lead-Contaminated Dust, and Lead-Contaminated Soil;

(iii) The EPA Residential Sampling for Lead: Protocols for Dust and Soil Sampling (EPA report number 7474-R-95-001);

(iv) Regulations, guidance, methods or protocols issued by States and Indian Tribes that have been authorized by EPA;

(v) National Institute of Building Sciences, “Guide Specifications for Reducing Lead-Based Paint Hazards”;

(vi) The Enterprise Foundation, Housing Developer Pro specification computer software package; and

(vii) Other equivalent methods and guidelines.

(e) Abatement.

11. An abatement report shall be prepared by a certified supervisor or project designer for single family dwellings or multi-family dwellings with 10 of fewer units. A certified project designer shall prepare an abatement report and project specifications for child-occupied facilities and multi-family dwellings having eleven (11) or more units. The completed Abatement Report shall be submitted to the Division no more than 15-days following the completion of the abatement project. The abatement report shall include the following information:

(i) Start and completion dates of abatement;

(ii) The name and address of each certified firm conducting the abatement and the name of each supervisor assigned to the abatement project;

(iii) The occupant protection plan prepared pursuant to part (e) 5 of this paragraph;

(iv) A copy of the risk assessment report signed by a State of Tennessee certified lead-based paint risk assessor and prepared pursuant to subpart (d)11 of this paragraph;

(v) The name, address, and signature of each certified risk assessor or inspector conducting clearance sampling and the date of clearance testing;

(vi) The results of clearance testing and all soil analyses (if applicable) and the name of each recognized laboratory that conducted the analyses; and

(vii) A detailed written description of the abatement, including abatement methods used, locations of rooms and/or components where abatement occurred, reason for selecting particular abatement methods for each component, and any suggested monitoring of encapsulants or enclosures.

(f) Collection and Laboratory Analysis of Samples.

Any paint chip, dust, or soil sample collected pursuant to the work practice standards contained in this paragraph shall be:

1. Collected by persons certified by the Commissioner as an inspector or risk assessor; and

2. Analyzed by a laboratory recognized by the EPA or the Commissioner as being capable of performing analyses for lead compounds in paint chip, dust, and soil samples pursuant to TSCA section 405 laboratory requirements.

(g) Composite Dust Sampling.

Composite dust sampling may only be conducted in the situations specified in subparagraphs (c) through (e) of this paragraph. If such sampling is conducted, the following conditions shall apply:

1. Composite dust samples shall consist of at least two subsamples;

2. Every component that is being tested shall be included in the sampling; and

3. Composite dust samples shall not consist of subsamples from more than one type of component.

(h) Determinations

1. Lead-based paint is present:

(i) On any surface that is tested and found to contain lead equal to or in excess of 1.0 milligrams per square centimeter or equal to or in excess of 0.5% by weight; or

(ii) On any surface like a surface tested in the same room equivalent that has a similar painting history and that is found to be lead-based paint.

2. A paint-lead hazard is present:

(i) On any friction surface that is subject to abrasion and where the lead dust levels on the nearest horizontal surface underneath the friction

surface (e.g., the window sill or floor) are equal to or greater than the dust hazard levels identified in subparagraph (b) of this subparagraph; or

(ii) On any chewable lead-based paint surface on which there is evidence of teeth marks; or,

(iii) Where there is any damaged or otherwise deteriorated lead-based paint on an impact surface that is caused by impact from a related building component (such as a door knob that knocks into a wall or a door that knocks against its door frame); or,

(iv) If there is any other deteriorated lead-based paint in any residential building or child-occupied facility or on the exterior of any residential building or child-occupied facility.

3. A dust-lead hazard is present in a residential dwelling or child occupied facility:

(i) In a residential dwelling on floors and interior window sills when the weighted arithmetic mean lead loading for all single surface or composite samples of floors and interior window sills are equal to or greater than 40 µg/ ft2 for floors and 250 µg/ft2 for interior window sills, respectively; or,

(ii) On floors or interior window sills in an unsampled residential dwelling in a multifamily dwelling, if a dust-lead hazard is present on floors or interior window sills, respectively, in at least one sampled residential unit on the property; or

(iii) On floors or interior window sills in an unsampled common area in a multi-family dwelling, if a dust-lead hazard is present on floors or interior window sills, respectively, in at least one sampled common area in the same common area group on the property.

4. A soil-lead hazard is present:

(i) In a play area when the soil-lead concentration from a composite play area sample of bare soil is equal to or greater than 400 parts per million; or

(ii) In the rest of the yard when the arithmetic mean lead concentration from a composite sample (or arithmetic mean of composite samples) of bare soil from the rest of the yard (i.e., non-play areas) for each residential building on a property is equal to or greater than 1,200 parts per million.

(i) Recordkeeping.

All reports or plans required in this paragraph shall be maintained on site by the certified Supervisor during abatement activities and by the certified firm or individual that prepared the report for no fewer than three (3) years. The certified firm or individual also shall provide copies of these reports to the building owner who contracted for its services.

Chapter 11: Interim Controls

TABLES

Chapter 11: Interim Controls

The Basic Steps Common to Most Jobs – How to Do It

1. **Decide on hazard control methods to be used and prepare specifications.** For building components, determine which lead-based paint hazards reported by a risk assessor or presumed to be present will be addressed with interim controls (dust removal, paint stabilization, and/or control of friction/abrasion points) and which will be permanently abated (component replacement, paint removal, enclosure, or encapsulation). (Note that, if renovation or rehabilitation is the intention of the work, some or all of the component replacement may not be abatement, but may be conducted as an interim control. See Appendix 6, regarding the applicable regulations.) For soil lead hazards, decide which interim control or abatement measure is appropriate for the climate, the planned use of the area, and how frequently children under age 6 will use the area. The amount of detail provided in specifications should be commensurate with the size of the job. The specifications should state how any abatement activities and other construction work (e.g., weatherization) will relate to the interim control work. It may be efficient to combine contracts or work orders for interim controls and those for abatement activities in many cases.

2. **Prepare a lead hazard control plan, especially for multi-family housing.** For a multi-family property in which work must be done in more than 10 dwelling units, the owner, together with a certified risk assessor, planner, or other designer, should develop a site-specific lead hazard control plan. The owner of a smaller property may wish to have a lead hazard control plan developed for that property, as well. The plan should be based on the lead-based paint hazards identified, the feasibility of the control measures, occupancy by young children, and financing. (See Section II.A of this chapter.)

3. **Determine that the contractor and supervisor are certified to do the work in a lead-safe manner.** Select a contractor that is certified as a renovation firm by the U.S. Environmental Protection Agency (EPA) or the State or Tribe to do renovation work in target housing in the State or Tribal area where the property is located. A property owner or manager using staff to conduct the work must obtain certification as a renovation firm, and ensure that the project obtains certification as a renovator. Workers must be trained and properly supervised to assure that lead-safe work practices are followed on the job. (See Section II.B.) Note that the requirement to use a certified renovation firm and certified renovator do not apply if the work in target housing is minor repair and maintenance work, as defined by EPA; if the work is in HUD-assisted target housing, the requirement does not apply if the work is at or below HUD's *de minimis* threshold (see Section II.C, below).

4. **Provide pre-renovation education to occupants.** EPA requires contractors to notify residents of the affected dwelling(s) of the work, describing its scope, locations when it is expected to begin and end, and provide residents with the "Renovate Right" pamphlet no more than 60 days before work begins. If the scope, locations or schedule change, provide notification of the change before work beyond that originally described is begun. (See Section II.E, and Appendix 6 for more detail.) Determine if State, Tribal and/or local pre-renovation education requirements apply. (Make a similar determination for other items discussed throughout this Chapter.)

5. **Prepare the worksite and protect the occupants.** Determine the appropriate worksite preparation and occupant protection measures for the job, based on guidance in Chapter 8. Inform the residents and install the barriers and containment.

6. **Perform the work.** Perform the work as planned, in accordance with guidance in Sections III, IV, V, and VI.

7. **Handle and dispose of waste correctly.** Wrap or bag all solid waste tightly, store it in a secure area, and dispose of it properly. Liquid waste can usually be disposed of in a sanitary sewer system, but not a storm sewer. Comply with state and local requirements. (See Chapter 10 for further guidance.)

8. **Conduct daily cleanups.** Clean up the work area and pathways used by workers at the end of each work day (or work shift, if work is being done in multiple shifts). (See Chapter 14, sections IV.B and C.)

9. **Conduct final cleanup.** The final cleanup should be started no sooner than 1 hour after completion of the work, to allow time for lead particles to settle. If the area to be cleared may have had high lead levels before the work and/or has rough horizontal surfaces that may make clearance difficult, consider using a pre-clearance screen to be sure the space is ready for clearance or cleaning verification. If the project fails the pre-clearance screen, conduct another final cleanup and pre-clearance screen. If the project fails the second pre-clearance screen, either: (1) complete interim controls and/or re-clean; or (2) conduct the clearance examination or cleaning verification. (For further guidance on cleanup, see Section II.I of this chapter and Chapter 14.)

10. **Clearance.** Have an independent, certified risk assessor, lead-based paint inspector, or sampling technician conduct a clearance examination no sooner than 1 hour after final cleanup to let dust settle (see Chapter 15). If clearance is not achieved, complete interim controls and/or re-clean. Following a successful clearance examination, the property owner should receive documentation to that effect.

    - Note that the EPA allows certain work areas in housing not covered by HUD's Lead Safe Housing Rule (24 CFR 35, subparts B–R) to be reoccupied after a visual inspection for residual dust, debris and residue, and a "cleaning verification," which is a visual comparison of wet disposable cleaning cloths that have been wiped over windowsills, uncarpeted floors, or countertops with a reference cleaning verification card, as a means of determining whether post-renovation cleaning has been properly completed. (See Appendix 6 for more detail.)

    - Note that the EPA's cleaning verification requirement does not apply if the work in target housing is minor repair and maintenance work; if the work is in federally-assisted target housing, HUD's clearance requirement does not apply if the work is at or below HUD's *de minimis* threshold (see Section II.C, below).

11. **Notification of residents.** The property owner or manager should notify residents of what lead-based paint hazards were controlled and how, and the results of the clearance examination. While residents do not have to be notified for interim control or other renovation work in target housing that is not federally-assisted – only the contractor's client has to be informed of the results of the cleaning verification and other results of the work – HUD recommends that the residents be notified whether or not the housing is assisted.

12. **Perform ongoing lead-safe maintenance.** The owner should conduct ongoing maintenance and monitoring of interim controls to ensure that they remain in place. (See Chapter 6 for detailed guidance on lead-safe maintenance.) If reevaluation is required by regulation or the hazard control plan for the property, reevaluations by a certified risk assessor should be completed at two-year intervals. (See Section II.M of this chapter and Section VII of Chapter 5.)

13. **Document the work and retain records.** The owner should assure that the work and the clearance examination (or cleaning verification) have been documented, and should maintain records of all lead hazard control, clearance, reevaluation, maintenance and monitoring activities. (See Appendix 6 for record retention requirements.) The owner must turn over all lead-related records the owner has to any new owner before sale of the property as part lead disclosure. (See Section II.N for a list of documents.) The owner must also make disclosure of lead-related documents to tenants before they become obligated under new leases or revised leases (see Appendix 6).

I. Introduction

Interim controls are intended to make dwellings lead-safe by temporarily controlling lead-based paint hazards. Abatement is intended to permanently control lead-based paint hazards. See Chapter 12 for a detailed discussion of the difference between abatement and interim controls. In Title X of the Housing and Community Development Act of 1992, interim controls are defined as

> "... a set of measures designed to reduce temporarily human exposure or likely exposure to lead-based paint hazards, including specialized cleaning, repairs, maintenance, painting, temporary containment, ongoing monitoring of lead-based paint hazards or potential hazards and the establishment and operation of management and resident education programs."

Interim control measures are fully effective only as long as they are carefully monitored, maintained, and, in some cases, professionally reevaluated. If interim controls are properly maintained, they can be effective indefinitely. As long as surfaces are covered with lead-based paint, however, they constitute potential hazards.

Interim lead hazard control measures include:

- Repairing all rotted or defective substrates that lead to rapid paint deterioration. (Note that repairing defective building systems that are causing substrate damage may be a prerequisite for effective interim control but is outside the scope of interim control per se).
- Stabilizing all deteriorated lead-based paint surfaces. Paint stabilization entails removing deteriorating paint, preparing the substrate for repainting, and repainting (see Section III).
- Making floors and interior window sills and window troughs smooth and cleanable.
- Eliminating friction surfaces with lead-based paint on windows, doors, stair treads, and floors, when they are generating dust lead hazards (see Section IV).
- Repairing doors and other building components causing impact damage on painted surfaces, if the paint is lead-based paint (see Section IV).
- Treating protruding, chewable surfaces, such as interior window sills, where lead-based paint may be present and there is either visual or reported evidence that children are mouthing or chewing them (see Section IV).
- Dust removal and control – i.e., cleaning surfaces to reduce levels of dust containing lead to acceptable levels, including cleaning carpets, if they are contaminated (see Section V).
- Covering (with planting, mulch, gravel, or other means) or eliminating access to all bare soil containing excessive levels of lead (see Section VI).

Activities that are required by HUD or EPA are identified in this chapter as being "required" or as actions that "must" be done. Activities that are not required by HUD but are recommended by these *Guidelines* are identified as being "recommended" or as actions that "should" be done. Activities that may be done at the discretion of the owner or manager are identified as "optional."

A. When Interim Controls Are Appropriate and When They Are Not

It is easiest and most appropriate to use interim controls when substrates are structurally sound and lead exposure comes primarily from deteriorating paint and excessive levels of lead in household dust and/or soil. Interim controls are also appropriate if the housing unit is slated for demolition or renovation within a few years and the investment in more costly abatement is not merited. In many cases resources will not be available to finance abatement, making interim controls the only feasible approach. (Abatement measures are either literally permanent, in the case of component removal, or are considered by Title X as being permanent because they last for at least 20 years, in the case of enclosure or encapsulation. These latter measures are "permanent" if they are maintained by establishing and implementing an ongoing lead-safe maintenance plan for at least 20 years, and, in the case of encapsulants, the products have a 20-year or longer warranty subject to the implementation of the maintenance plan. Enclosure or encapsulation without such an expected longevity and maintenance plan may be conducted as interim control measures.)

Interim controls are unlikely to be effective if the building has substantial structural defects or if interior or exterior walls, or major components, such as windows and porches, are seriously deteriorated or subject to excessive moisture. Paint cannot be effectively stabilized unless substrates are dry, structurally sound, and waterproof. Other interim control measures, such as window repair, will also not be very effective if structural problems are likely to result in rapid treatment failure. Any structural problems should be repaired before interim controls are implemented. If these problems cannot be repaired, more frequent monitoring will be necessary to identify possible early failures and more frequent hazard controls will probably be needed.

Abatement may be required by federal, state, or local regulations in certain situations; in such situations, interim controls are precluded. For example, HUD requires that public housing authorities abate all lead-based paint in dwelling units undergoing comprehensive modernization. HUD regulations also require that all lead-based paint hazards on a property be abated in the course of rehabilitation projects that use more than $25,000 of Federal rehabilitation funds per dwelling unit (24 CFR Part 35, Subpart J; see also HUD's Interpretive Guidance on its Lead Safe Housing Rule, particularly items J3 and J3a, at its ***http://portal.hud.gov/hudportal/documents/huddoc?id=DOC_25476.pdf***). Some State and local governments have enacted laws and regulations requiring that certain lead-based paint hazards be abated.

Energy-efficient products (such as energy-efficient doors and windows) should be considered whenever building components are replaced. A source of information on energy efficient products is ***www.energystar.gov*** (click on the "Find ENERGY STAR Products" or similar hotlink).

B. The Standard Treatments Option

Before controlling lead-based paint hazards, it is necessary to know where they are. This means that a risk assessment (as described in Chapter 5) must be conducted first. However, unless prohibited by State or local law, a property owner may elect to bypass the risk assessment and proceed directly to a set of maintenance and repair activities that will eliminate, at least temporarily, any lead-based paint hazard that might be present. This option is called "standard treatments." HUD regulations permit standard treatments as an option where interim controls are required in pre-1978 housing receiving Federal assistance, and pre-1978 housing being sold by the Federal government (24 CFR 35.120(a)).

Standard treatments consist of the following activities:

- Paint stabilization. All deteriorated paint on exterior and interior surfaces should be stabilized, following guidance in Section III of this chapter.
- Making surfaces smooth and cleanable. All horizontal surfaces, such as floors, stairs, interior window sills and window troughs, that are rough, pitted or porous, should be made smooth and easily cleanable. Minor surface damage may be correctable by spackling and recoating. Otherwise it may be necessary to cover or coat the surface with a material such as metal coil stock, plastic, polyurethane, sheet vinyl, or linoleum.
- Correcting dust-generating conditions. Conditions causing friction or impact on painted surfaces should be corrected, following guidance in Section IV of this chapter.
- Treating bare soil. Bare soil should be treated in accordance with guidance in Section VI of this chapter.
- Safe work practices and worker qualifications. All standard treatments should incorporate safe work practices as described in Section II.D of this chapter. Persons performing standard treatments should have the same training and/or supervision as those performing interim controls, as described in Section II.B.
- Clearance. A clearance examination should be performed in accordance with Chapter 15 after finishing standard treatments that are larger than HUD's *de minimis* threshold before they are concluded. In housing not receiving federal assistance, EPA requires interim control projects larger than its minor repair and maintenance threshold to have a "cleaning verification" step before they are concluded.
- Other recommended practices. All other recommended practices applicable to interim controls, as described in Section II, also apply to standard treatments. Also, although HUD regulations do not require treatment of chewable surfaces under the standard treatments option, these *Guidelines* recommend that owners or managers consider covering any protruding painted surfaces with teeth marks if young children under age 6 reside in the unit or frequent the common area. (See Section IV.)

In planning and carrying out standard treatments, owners and contractors should presume that all paint is lead-based paint and all bare soil contains soil lead hazards, unless a certified risk assessor or lead-based paint inspector has determined otherwise. The disadvantage of standard treatments is that unnecessary lead hazard control work may be done. The possible advantage is that the owner may save money by foregoing a risk assessment and can simplify the work of the property manager and the maintenance crew by training and tasking a crew to efficiently perform a routine set of work activities that will be lead-safe whether or not lead-based paint is actually present. Standard treatment options may be appropriate for a well-maintained multi-family property with its own appropriately trained maintenance staff.

When there is a substantial likelihood that some treatable surfaces do not contain lead-based paint, owners who hire risk assessors will usually save money overall because the risk assessment will focus the owners' efforts on confirmed hazards, and avoid unnecessary lead hazard control costs for work on building components that are not coated with lead-based paint.

Some state and local laws prescribe certain treatments in order for the housing unit to qualify as lead-safe. Insurance companies and lenders may also prescribe certain treatments if a property is to qualify for insurance coverage or a loan. In all cases, the property owner should ensure that, at a minimum, the required lead hazard control measures are carried out.

C. Combinations of Interim Controls and Abatement of Certain Hazards

In many dwellings, owners will choose a combination of interim controls *and* abatement. This decision is best made in consultation with a certified risk assessor. For example, it is possible to stabilize deteriorated lead-based paint and remove excess levels of leaded dust (interim controls), and at the same time enclose some lead-based painted surfaces, replace some lead-based painted components, or remove lead-based paint from some surfaces (abatement). Such combinations of interim control and abatement treatments will often be the most cost-effective response to a property owner's lead hazard problem, particularly if carried out when the dwelling unit is vacant.

D. Preventive Measures That Can Be Performed by Residents

There are also a number of preventive measures to minimize the likelihood or severity of lead-based paint hazards that owner-occupants or residents of rental dwellings can carry out. Owners of rental properties should provide residents with educational materials furnished by State or local agencies or lead poisoning prevention organizations that include the following basic information:

- Children's toys should not be placed beneath windows or near surfaces subject to frequent friction or impact or near deteriorated paint surfaces.
- If there is a sudden loosening of paint material through friction, impact, or any other reason, occupants should use the sticky tape method to remove loose paint described in Table 11.2.
- Porch decks, interior floors, and other horizontal surfaces should be wet mopped at least twice a month.
- A door mat should be placed inside doors with direct access to the outdoors, and thoroughly vacuumed weekly.
- Instances of deteriorating paint should be reported to management as soon as they are discovered.

II. Basic Practices and Standards Applicable to Interim Control Jobs

This section describes the basic practices and standards that are common to most interim control activities. Later sections of the chapter describe work practices that are specific to particular types of jobs, such as paint stabilization, treatment of friction surfaces, dust removal, and soil lead hazard controls.

A. Preparing a Lead Hazard Control Plan for Multi-family Housing

Conducting interim controls of lead-based paint hazards in multi-family housing presents issues not generally found in single-family housing. In most occupied multi-family developments, it is not feasible, financially or logistically, to carry out hazard control activity in all dwelling units at once. In properties with a relatively small number of dwelling units, it may be possible to proceed unit by

unit and complete the hazard control work quickly. In larger properties, however, decisions must be made as to the order of work in dwelling units and common areas, and perhaps, in rooms or components within dwelling units and common areas. Even when an entire building is vacant and undergoing renovation, hazard control elements of the work must be identified and scheduled. Therefore, it is usually advisable that there be a lead hazard control plan for properties with more than 10 units.

Owners should have an independent certified risk assessor prepare a lead hazard control plan to address lead-based paint hazards identified by the risk assessment. If no risk assessment has been conducted, the specific hazards that are presumed to be present should be addressed by using standard treatments. The plan should prioritize and schedule control measures and any additional hazard evaluations so that available resources are targeted for maximum benefit. Lead hazard control planners or designers may also be helpful in preparing such a plan. In developing the plan, the risk assessor should consult with the property owner to gain insights about the property to determine which strategies will be most appropriate. The goal of this consultation is to combine in the plan the risk assessor's knowledge of lead-based paint hazards with the property owner/manager's knowledge of the particular property – its maintenance history, persistent problems, occupancy profile, capital improvement program, etc.

An owner of a building in good condition may find it more efficient to omit the risk assessment, presume all paint is lead-based paint, and proceed directly to standard treatments. Standard treatments can be performed on a routine basis, at the time of turnover of dwelling units, and during periodic maintenance of units, common areas, and grounds.

In developing a lead hazard control plan, it is reasonable to consider treating units occupied by children under age 6 or by women who have informed the property owner or manager that they are pregnant first. Common play areas, child care centers, or dwelling units serving as child care centers are also candidates for early treatment. It is reasonable to consider the fact that it is less expensive to conduct hazard controls effectively and safely in vacant units than in occupied units.

Thus, it may be appropriate to postpone some hazard control treatments until unit turnover. In order to more quickly and cost effectively reduce childhood exposure to lead in the environment, it is reasonable to consider the relocation of families with young children from housing units with lead-based paint (LBP) hazards to vacant units where any hazards have been controlled.

At a minimum, a lead hazard control plan should include the following elements:

- A hazard control schedule for all units. Usually units with young children or women who have informed the property owner or manager that they are pregnant should be treated first, followed by other units.
- A commitment on the part of the owner and manager to ongoing lead-safe monitoring and maintenance as explained in Chapter 6. This should include visual assessments by owner or staff, and control of lead-based paint hazards that are generated during routine maintenance work or normal building aging, what those controls consist of, and how those controls will be implemented.
- A description of how maintenance workers and other staff will be trained to handle lead-based paint hazards safely and perform lead-safe renovations.

- Specific measures that will be taken during unit turnover (often paint stabilization, specialized dust removal, the provision of cleanable surfaces on floors, sills, and troughs and some minor building component replacement).
- A description of who will perform clearance examinations – whether by a certified independent consultant (which is recommended in all situations), or by a designated certified in-house staff (if the work is done by an independent contractor) as allowed under the Lead Safe Housing Rule.
- A schedule for hazard control actions to be completed in common areas.
- A schedule for reevaluations by certified risk assessors, if recommended.
- Designation of an individual, preferably on the staff of the owner or the property manager, who is responsible for issues associated with lead-based paint hazards.

B. Qualifications of Persons and Firms Performing Interim Controls

Interim control activities frequently disturb lead-based paint (LBP) and take place in areas with excessive levels of dust that contains lead. EPA and OSHA have established regulations that cover these activities, as has HUD for these activities conducted in federally-assisted housing.

1. **EPA RRP Rule,** EPA's Renovation, Repair and Painting (RRP) rule covers renovation projects in assisted and unassisted target housing and child-occupied facilities, unless they are smaller than EPA's minor repair and maintenance threshold. The term "renovation" includes repair and painting; interim control projects are "renovations." The RRP Rule requires a firm performing renovation in target housing to be certified as a lead-safe renovation firm, and an individual certified as a lead-safe renovator to provide on-the-job training for workers used on the project, perform or direct workers to follow the RRP rule's work practice standards, be at the job or available when work is being done, and perform the post-renovation cleaning verification (40 CFR 745, subpart E).

   A renovation firm must be certified (licensed) by the State or Tribe where the testing is to be done if the State or tribe has an EPA-authorized renovation certification program. The State or Tribe may have qualification requirements for firms and persons performing interim controls that are different than those of the Federal Government. If the State does not have such a program, the renovation firm must be certified by EPA. The list of EPA-authorized States and tribes is at the EPA's RRP web page ***http://www.epa.gov/opptintr/lead/pubs/renovation.htm***; the agencies administering their programs are linked from that page. For other States and Tribal areas, EPA administers the renovation certification program; contact information for the EPA Regional Lead Coordinators is at the Where Your Live web page, ***http://www.epa.gov/opptintr/lead/pubs/leadoff1.htm***, which can be reached from a link on the RRP web page. A list of certified renovation firms is available on another link from the RRP web page to ***http://cfpub.epa.gov/flpp/searchrrp_firm.htm***. Information on becoming a lead-safe certified firm is at ***http://www.epa.gov/opptintr/lead/pubs/lscp-renovation_firm.htm***.

2. **HUD LSHR.** HUD's Lead Safe Housing Rule (LSHR) requires the workers, as well as the project supervisor, to be trained in HUD-approved lead-safe work practices for work in federally-assisted target housing. This means that the workers and the supervisor must be certified renovators, or, if any of the workers are not certified renovators, the supervisor be a certified lead-based paint abatement supervisor in addition to being a certified renovator. The EPA's

RRP curriculum is HUD-approved for individuals performing interim controls; it meets both HUD interim controls training requirements and EPA's RRP training requirements.

Some States have policies on qualifications for persons performing interim controls that are different than those of the Federal Government. A list of State agencies that operate EPA-authorized programs to regulate lead-based paint activities is at ***http://www.epa.gov/lead/pubs/traincert.htm***. The EPA Regional Lead Coordinators oversee the development of lead-poisoning prevention efforts within the Region, including managing the lead certification programs in States which are not authorized to operate their own programs; their contact information is at ***http://www.epa.gov/lead/pubs/leadoff1.htm***.

3. **OSHA.** OSHA requires that all potentially exposed workers in the construction industry, which includes most interim control activities, be trained concerning hazards in their workplaces under its rule on Safety Training and Education, 29 CFR 1926.21(b)(2), even if lead exposures are below the action level (see Chapter 9). In addition, OSHA's lead in construction standard, at 29 CFR 1926.62(d)(2)(v)(F), requires hazard communication training on lead for all potentially exposed workers. This provision also requires that employers must provide additional lead-specific training to their workers who are exposed at or above the action level on any single day (also addressed in Chapter 9 and Appendix 6).

4. **Structured On-the-Job Training.** The EPA's Renovation, Repair and Painting (RRP) Rule allows for the certified renovator overseeing a renovation project to conduct on-the-job training (OJT) of workers instead of their becoming certified renovators (40 CFR 745.225(d)(6)(ix). EPA, in the RRP Rule's preamble (73 *Federal Register* 21691-21769, April 22, 2008, *at* 21721) discussed structured OJT (SOJT) and stated that it had decided not to establish an SOJT program as a requirement for training renovation project workers who are not themselves certified renovators.

These *Guidelines* encourage renovation firms to consider training uncertified workers using SOJT approach, as way to produce consistent, accurate, and comprehensive training outcomes. See Appendix 5.1 for information and references on SOJT.

C. Small Amounts of Paint Disturbance

As discussed in Chapter 6, unit II.C.3, of these *Guidelines*, EPA and HUD regulations state that lead-safe work practices and clearance are not required if the total amount of paint disturbed by the work is less than a small amount specified by each agency.

HUD's *de minimis* Threshold. In its regulations, HUD uses the classical legal term for this minimal amount, "*de minimis*." Requirements pertaining to worker qualifications also do not apply if the amount of work is *de minimis*. HUD's *de minimis* levels under its Lead Safe Housing Rule (LSHR; specifically at 24 CFR 35.1350(d)) are amounts up to:

(1) 20 square feet on exterior surfaces;

(2) 2 square feet in any one interior room or space; or

(3) 10 percent of the total surface area on an interior or exterior type of component with a small surface area (such as window sills, baseboards, and trim).

EPA's Minor Repair and Maintenance Threshold. EPA's RRP rule has a larger exemption for minor repair and maintenance work on interiors (6 square feet per room) than HUD's *de minimis* threshold,

but it does not have a small-component aspect, and it limits minor work exempted from its rule to those types that will not cause high levels of dust generation. Specifically, EPA's RRP Rule does not cover minor repair and maintenance activities (40 CFR 745.83) in target housing that disrupt no more than:

(1) 6 square feet or less of painted surface per room for interior activities, or

(2) 20 square feet or less of painted surface for exterior activities, and

where none of the work practices prohibited or restricted by that rule (open-flame burning or torching of lead-based paint, using machines that remove lead-based paint through high-speed operation without HEPA exhaust control; and operating a heat gun on lead-based paint at or above 1100 degrees Fahrenheit) are used and where the work does not involve window replacement or demolition of painted surface areas.

HUD *Guidelines* Recommendation: These *Guidelines* recommend, however, that, because much old paint has some lead, the following practices should *always* be observed when disturbing paint in pre-1978 housing and child-occupied facilities, even if the amount of paint to be disturbed is *de minimis*, unless it is known that all layers of paint to be disturbed have been applied after 1977 or the paint is not lead-based paint:

(1) Never use the prohibited methods of paint removal that are described in Section II.D, below; and

(2) When disturbing paint in housing *occupied by children of less than 6 years of age and/or women who have informed the property owner or manager that they are pregnant,* always clean the work area thoroughly after finishing, preferably with HEPA vacuuming and wet cleaning, and keep residents and pets out of the work area while work is underway and until after the cleanup, and the clearance or cleaning verification, as applicable, has been passed.

D. Lead-Safe Work Practices

Lead-safe work practices are ways to perform paint-disturbing work so that occupants, workers and workers' families, and the environment are protected from exposure to, or contamination from, lead in dust, debris and residue generated by the work. Lead-safe work practices include the following:

1. **Do not use the following paint removal practices except as specified.** Workers should not use the following paint removal methods in HUD-assisted target housing; the methods lettered f and g are permitted in unassisted target housing:

    a. **Open-flame burning or torching.** This can produce toxic gases that a HEPA filter cartridge on a respirator cannot trap (a second, organic, filter is necessary). This method can create high levels of toxic dust that are extremely difficult to clean up; and it can burn down a house.

    b. **Operating a heat gun at surface temperatures at or above 1100 degrees Fahrenheit**. Operating heat guns at such high temperatures can release lead dust and fumes and induce large increases in the blood lead levels of young children (Farfel and Chisolm, 1990; also cited by EPA in the preamble to its final rule on Requirements for Lead-Based Paint Activities in Target Housing and Child-Occupied Facilities. 61 *Federal Register* 45777, August 29, 1996, *at* 45795.)

c. **Machine sanding or grinding without a HEPA local exhaust control and a shroud.** Machine sanding or grinding with both a HEPA local exhaust control attached to the tool, and a shroud that meets the following performance requirement is permissible. The shroud must surround the surface being contacted by the tool with a barrier that prevents dust from flying out around the perimeter of the machine, *and* attached to a HEPA vacuum. However, this work method should be conducted used only by workers trained in its use. Because some dust may still blow out around the perimeter of the machine, workers near the machine should wear half-face respirators (with N100 cartridge) at a minimum. Also, the work area should be completely isolated if the machine is used inside.

d. **Abrasive blasting or sandblasting without HEPA local exhaust control.** These methods should be used only within an enclosure that contains the spread of dust, chips, and debris, and that has a HEPA exhaust. This work method should be conducted used only by workers trained in its use.

e. **Manual dry sanding or dry scraping**, except that dry scraping is acceptable in conjunction with heat guns with surface temperature of less than 1100°F, or within one foot of electrical outlets, or when treating defective paint spots totaling no more than 2 square feet in any one interior room or 20 square feet on exterior surfaces.

f. **Uncontained hydroblasting.** Removal of paint using this method can spread paint chips, dust, and debris beyond the work area containment. Contained pressure washing at less than 5,000 pounds per square inch (PSI) can be done within a protective enclosure to prevent the spread of paint chips, dust, and debris. Water run-off should also be contained. Because contained hydroblasting requires precautions that are beyond the scope of most courses in lead-safe work practices, it should only be used by certified lead abatement workers under the supervision of a certified abatement supervisor.

g. **Paint stripping in a poorly ventilated space when using a volatile stripper that is a hazardous substance** in accordance with regulations of the Consumer Product Safety Commission (CPSC) at 16 CFR 1500.3 and/or a hazardous chemical in accordance with the OSHA regulations at 29 CFR 1910.1200 or 1926.59, as applicable to the work. (This practice is prohibited by HUD regulations but not explicitly by EPA regulations.)

   Stripping with methylene chloride should be avoided. OSHA has found that adults exposed to methylene chloride "are at increased risk of developing cancer, adverse effects on the heart, central nervous system and liver, and skin or eye irritation. Exposure may occur through inhalation, by absorption through the skin, or though contact with the skin." (62 *Federal Register* 1493 (January 10, 1997)). OSHA's permissible exposure limit for methylene chloride in air was reduced in 1997 from 500 to 25 parts per million (29 CFR 1910.1052 for general industry, and the identical 29 CFR 1926.1152 for construction). Methylene chloride cannot be detected by odor at the permissible exposure limit, and organic vapor cartridge negative pressure respirators are generally ineffective for personal protection against it.

   Alternative paint strippers may be safer but have their own safety and/or health concerns. All paint strippers must be used carefully. Always follow precautions provided by the manufacturer.

   It is especially important that persons who use paint strippers frequently, use such chemicals in a well ventilated area. If good ventilation is not possible, professionals equipped with protective equipment should perform the work in accordance with CPSC regulations (16 CFR

1500.3) and /or OSHA's hazard communications standards (29 CFR 1910.1200 or 29 CFR 1926.59) and with any substance-specific standards applicable to the work.

CPSC and EPA recommend that persons who strip paint provide ventilation by opening all doors and windows and making sure there is fresh air movement throughout the room. See the jointly published booklet, *What You Should Know About Using Paint Strippers*, CPSC document 423 (***http://www.cpsc.gov/cpscpub/pubs/423.html***), and EPA publication EPA-747-F-95-002 (search at ***http://nepis.epa.gov/*** for publication number 747F95002).

2. Working wet. Keep the surface damp, except near electrical outlets and fixtures, so sanding, scraping, planing, etc. generate less dust and the dust that is created does not spread as far. When working wet, take care to avoid slippery conditions and electrical shock. Always use Ground Fault Interrupter (GFI) outlets when using power tools. When working on a ladder, do not allow the rungs of the ladder to get wet when spraying or misting. Also, do not get protective plastic sheeting wet; it can become slippery.

3. Protecting occupants and containing dust in the worksite. The worksite should be set up and occupants should be protected in accordance with the guidance in Chapter 8. This guidance varies with the amount of dust that is expected to be generated by the work. Generally, occupants should not be allowed in the work area until after the work is finished and the area is cleaned and either clearance has been passed or cleaning has been verified. Temporary relocation may be necessary. Personal belongings should be moved from the area or covered and sealed. Floors should be protected with plastic sheeting. For dusty jobs, dust should be contained within the room or rooms in which work is conducted by installing plastic sheeting over doors and sealing HVAC vents. Workers should not track dust from the work area to the rest of the dwelling. Waste and debris from the job should be wrapped or bagged and sealed and properly disposed of.

4. Specialized cleaning. After finishing the work, the worksite should be cleaned to assure that the site is free of dust lead hazards and can achieve clearance, or cleaning verification, if applicable. Guidance on cleaning is provided in Section IV of this chapter and Chapter 14. Vacuuming (with HEPA vacuums) and wet cleaning are recommended, and required in most instances.

E. Pre-Renovation Education

While education of the residents, particularly the children's caregivers, is not in itself sufficient to prevent childhood lead poisoning, it can assist residents in reducing the risk that their children will be seriously poisoned. Therefore, education is an important adjunct to any lead hazard control system. See Chapter 6, unit IV.C.6, for information on communicating with residents. See Appendix 6 for information on the EPA's Renovation, Repair, and Painting (RRP) Rule, and HUD's Lead Safe Housing Rule (LSHR), both of which have pre-renovation education provisions.

EPA's RRP rule (most of which is found at 40 CFR Part 745, Subpart E) requires that persons who perform renovation, repair or painting (called, in brief, "renovation") of most pre-1978 housing for compensation provide a lead hazard information pamphlet to owners and residents affected by a renovation within 60 days before beginning the work, describe how, where and when the project will be conducted (and update notify if any of this changes), and, if the work is being conducted in common areas, ensure written notification to each affected unit with the information above and describing how the occupant can obtain the pamphlet, at no charge, from the firm performing the

renovation (40 CFR 745.84). Renovation is defined in the regulation as "the modification of any existing structure, or portion thereof, that results in the disturbance of painted surfaces, unless that activity is performed as part of an abatement" (40 CFR 745.83). Detailed information on implementing pre-renovation education is provided in the EPA's *Small Entity Compliance Guide to Renovate Right,* a handbook on the RRP rule for contractors, property managers and maintenance personnel working in homes and child-occupied facilities built before 1978 (EPA publication EPA-740-K-10-003; ***www.epa.gov/lead/pubs/sbcomplianceguide.pdf***).

This pre-renovation education requirement does not apply to activities are minor repair and maintenance activities (see section II.C, above), emergency renovations, renovations of components that have been found by a certified lead-based paint inspector to be free of lead-based paint, or renovations of housing that is exempt from Title X. Title X exemptions from "target housing" covered by its regulations include: housing built after 1977, housing that is designated as exclusively for the elderly or for persons with disabilities (provided no child of less than 6 years does resides there), and zero-bedroom units.

The pamphlet that must be distributed is the EPA lead pamphlet, *Renovate Right: Important Lead Hazard Information for Families, Child Care Providers and Schools ("Renovate Right"),* or an alternative state or tribal pamphlet approved for this purpose by EPA. The information contained in the lead renovation pamphlet that is given to owners and occupants before beginning the renovation should be provided in appropriate format(s) to meet the needs of all residents including persons with limited English proficiency and in formats that may be needed for persons who are visually or hearing impaired (Executive Order 13166, derived from Title VI of the Civil Rights Act of 1964).

Copies of "Renovate Right" can be obtained from the National Lead Information Center, at 1-800-424-LEAD (hearing- or speech-challenged individuals may access the NLIC number above through TTY by calling the toll-free Federal Information Relay Service at 800-877-8339), or by downloading it from the EPA's or HUD's web site. As of the publication of these *Guidelines,* the pamphlet is available in English and Spanish.

- On the EPA website, the English version is available at ***http://www.epa.gov/lead/pubs/renovaterightbrochure.pdf***, and the Spanish version, at ***http://www.epa.gov/lead/pubs/renovaterightbrochure-esp.pdf***.
- On the HUD website, the English version is available at ***http://portal.hud.gov/hudportal/documents/huddoc?id=DOC_12531.pdf***, and the Spanish version, at ***http://portal.hud.gov/hudportal/documents/huddoc?id=DOC_12532.pdf***.

Further information on the Pre-Renovation Education (PRE) Rule, as it has been modified by the RRP Rule, is available at the PRE Rule's website, ***www.epa.gov/lead/pubs/leadrenf.htm***.

F. Resident Protection and Worksite Preparation During Control Activities

Any activity that disturbs lead-based paint can generate leaded dust. Before beginning paint-disturbing work, workers should set up dust containment to fit the job in accordance with guidance provided in Chapter 8. Whenever dust-generating activities are carried out, residents and particularly young children should stay out of the contained area and should not return until all dust, debris and residue are removed and the containment area or the dwelling unit has been thoroughly cleaned and cleared (see details in Chapter 8). If the work disturbs no more than a *de minimis* amount, described in Section II.C, above, elaborate measures to protect occupants are not

necessary. But, it is always best practice to keep occupants out of the work area until after cleanup, and prohibited methods of paint removal should never be used.

G. Worker Protection

Workers should be protected from exposure to lead by using lead-safe work practices, wearing protective clothing, practicing personal hygiene, and, where these measures are insufficient, using additional engineering controls and, if needed, respiratory protection. Chapter 9 addresses this information in detail.

Some control measures may vary depending on the amount of dust that is expected to be generated by the work. A high dust, paint-disturbing job is defined in Chapter 8 as generally one in which dust caused by the work spreads more than five feet from the work surface. These extensive protections are usually not necessary for very small maintenance jobs. Lead-safe work practices described in Section II.D, above, reduce the amount of dust created by the work and the likelihood of worker exposure.

These protective measures will also help to protect workers' families. Contaminated clothing, shoes or boots brought outside of the worksite, and unwashed hands and other exposed skin surfaces, can result in lead contamination and poisonings from exposure to lead in workers' homes or cars.

H. Waste Handling

EPA has interpreted the household exemption of the Resource Conservation and Recovery Act (RCRA) as applying to all lead-based paint activities, including abatement, interim control, renovation, and remodeling of housing (EPA, 2000x). In 2003 EPA amended its solid waste regulations to codify this policy (EPA, 2003w). A summary fact sheet (publication EPA-530-F-03-007), is available through EPA's website RCRA Online at ***www.epa.gov/epawaste/nonhaz/municipal/landfill/lbp_fs.pdf***. For these purposes, types of housing included under the household waste exemption include multi-family buildings as well as single-family homes. Nevertheless, these *Guidelines* strongly recommend that persons conducting lead-based paint activities treat bulk waste (e.g., painted architectural components being replaced), paint chips, dust and waste water in accordance with the guidance in Chapter 10.

I. Cleanup

These *Guidelines* recommend cleanup at three stages of paint-disturbing work: (1) before the work begins, (2) during the work, and (3) after completion of the work (the final cleanup). Project supervisors should ensure workers should follow the guidance on cleanup during each stage that is provided in Chapter 14, especially its sections IV.B and C,.

J. Clearance

Clearance examinations (including a visual inspection for residual dust, debris and residue) must be conducted following abatement in target housing. (Chapters 12 and 15 describe abatement and clearance examinations, respectively.) Clearance is required after interim control work in target housing receiving federal assistance, unless the interim control work disturbs less than the HUD-specified *de minimis* amount of paint, described in Section II.C, above, and in Chapter 6, unit II.C.3.

These *Guidelines* recommend clearance in other pre-1978 housing even when not required by regulation, such as in most target housing that is not federally-assisted. For projects in unassisted target housing that are not minor repair and maintenance work, EPA requires a visual inspection for residual dust, debris and residue, followed by either clearance or cleaning verification, a visual comparison of the darkening of wet disposable cleaning cloths by wiping them over windowsills, uncarpeted floors, and countertops with the darkness of a reference cleaning verification card, as a means of determining whether post-renovation cleaning has been properly completed (40 CFR 745.85(b)). (See Appendix 6 for more detail.)

K. Notification to Occupants of the Results of Hazard Evaluation and Control

Two Federal regulations require that occupants of housing be informed about lead-based paint or lead-based paint hazards in their homes.

One is the lead-based paint disclosure regulation (Lead Disclosure Rule) issued jointly by HUD (24 CFR part 35, subpart A) and EPA (40 CFR part 745, subpart F). The Lead Disclosure Rule applies at the time of sale or lease of housing built before 1978; some exclusions apply (see Appendix 6 for more information). The Lead Disclosure Rule also applies at the time of lease renewal, if new information is available. Further information on the disclosure rule is available from HUD and EPA and can be found on the Internet at either ***www.epa.gov/lead/pubs/leadbase.htm*** or ***http://portal.hud.gov/hudportal/HUD?src=/program_offices/healthy_homes/enforcement/disclosure***.

Relevant information includes the findings of evaluations (i.e., risk assessments, lead-based paint inspections, and other testing), clearance examinations, and actions taken to reduce any hazards (including interim controls, abatement, or standard treatments). This gives residents the information they need to protect themselves from inadvertent exposure to lead in the home.

In addition to the Lead Disclosure Rule, HUD requires, under its Lead Safe Housing Rule (at 24 CFR 35.125), that occupants of housing receiving Federal assistance be notified of the results of evaluations and hazard reduction activities, including clearance.

- A notice of evaluation or presumption of lead-based paint must be provided within 15 days after the owner or other responsible party receives the evaluation report or makes the presumption. The notice of evaluation must include:

  (1) a summary of the nature, scope, results, and date of the evaluation,

  (2) a contact name, including address and phone number, for more information and to obtain access to the complete report and

  (3) the date of the notice.

- A notice of hazard reduction activity must be provided within 15 days after the work is completed and the clearance examination report has been received. The notice of hazard reduction must include:

  (1) a summary of the nature, scope, and results (including clearance) of the work;

  (2) a contact name for more information, including address and phone number;

(3) available information on the location of any remaining lead-based paint in the rooms, spaces, or areas where work was performed on a surface-by-surface basis; and

(4) the date of the notice.

Notices can be provided to the occupants by either:

- posting and maintaining them in a centrally located common area, with distribution to any dwelling unit where the head of household is disabled; or
- distributing to each occupied dwelling unit (HUD does not require a signed acknowledgment of receipt).

EPA requires, under its RRP Rule (at 40 CFR 745.86(d)), that, if dust clearance sampling is performed, the renovation firm must provide, within 30 days of the completion of the renovation, a copy of the dust sampling report to the person who contracted for the renovation. These *Guidelines* recommend that the person who contracted for the renovation provide at least a summary of the results to residents of the affected dwelling unit(s) within 15 days after receiving the results.

L. Ongoing Lead-Safe Maintenance

The success of interim control measures depends not only on the adequacy of their initial application, but also on whether they remain effective over time. To remain effective they must be maintained and monitored. Residents should be asked to report deteriorating paint. Property owners, or their agents, should routinely (e.g., annually) visit the property and visually ensure that interim controls remain in place. They should also respond promptly whenever an occupant reports any deteriorating paint. Any failure of interim controls that is identified should be corrected promptly. Common areas should be included in these activities as well as dwelling units. See Chapter 6 for a complete discussion of ongoing lead-safe maintenance.

The HUD Lead Safe Housing Rule (24 CFR Part 35, subparts B through R) requires ongoing maintenance in most target housing receiving HUD assistance, with exceptions for assistance in which HUD does not have an ongoing relationship with the property, e.g., disposition of HUD-owned single-family housing, and rehabilitation other than under the HOME program.

M. Reevaluation

These *Guidelines* recommend, and the Lead Safe Housing Rule requires for most HUD housing assistance programs, that a certified risk assessor conduct a reevaluation if hazard reduction has been conducted to reduce lead-based paint hazards found in a risk assessment or if standard treatments have been conducted (24 CFR 35.1355(b)). The schedule is two year intervals after completion hazard reduction until no lead-based paint hazards are found in two consecutive reevaluations. See Chapter 5, section VII, for guidance on reevaluation.

N. Documentation

Lead hazard evaluation, lead hazard control, and maintenance and monitoring activities associated with interim controls must be documented. Several specific documents are of particular importance. These include:

- **Risk Assessment and/or Inspection or Testing Reports**. These documents record the findings of any risk assessment or inspection, including any inspection or testing of painted surfaces and the collection and analysis of samples for determination of the lead content in dust, soil, and/or water. A risk assessment that finds no lead-based paint hazards would also justify issuance of a report.

- **Lead Hazard Control Plan**. This document explains the schedule of hazard control actions in multi-family housing (see Section II.A of this chapter).

- **Notices to Occupants**. This includes copies of notices to occupants of the results of hazard evaluations (risk assessments, lead-based paint inspections, or paint testing) and the results of lead hazard reduction activities, including clearance (see Section II.K of this chapter).

- **Description of Work Done**. For future reference, such as to help them implement the lead hazard control plan effectively, owners should have on file a written description of the nature and locations of the work, its starting and ending dates, who performed it, and any specific suggestions for monitoring. Owners or their property managers who performed, or whose employees performed, renovation work covered by the EPA's RRP rule must keep all records necessary to demonstrate compliance with that rule for at least 3 years after the end of the renovation (40 CFR 745.86). If the renovation work was performed by an outside firm, the owner or property manager should arrange have ongoing access to those records; if the outside firm is planning to dispose of the records at or after the end of the 3-year period, the owner or property manager should arrange to obtain the records for further use in implementing the lead hazard control plan.

- **Clearance Examination Reports**. These documents record the basis for clearance of the property so that it is ready for occupancy (see Chapter 15). If the housing (or the renovation) is not federally-assisted, the renovation firm's client (typically, the property owner or manager) must be provided a copy of the dust sampling report within 30 days of the completion of the renovation; if the housing (or the renovation) is federally assisted, the property owner or manager must send the report to the affected occupants within 15 days. Cleaning verification is different than clearance; both require documentation.

- **Spot Test Kit Results Notification**. When spot test kits are used, the firm must notify its client of the manufacturer and model of the test kits used, the description and locations of the components tested, and the test kit results (see Chapter 15).

- **Reevaluation Reports.** These reports indicate whether the hazard control measures are still in satisfactory condition and whether the dwelling is still in a lead-safe condition. If problems are identified, they prompt corrective action. Reevaluations are performed on a schedule discussed in Section VII of Chapter 5.

- **Maintenance and Monitoring Log**. This log records the results of the property owner's or property manager's monitoring visits. Any repairs made as a result of these visits, or notices of defects from occupants, should also be recorded.

- **Other Applicable Records**. Retain records of worker training in lead-safe work practices, any personal air monitoring, if performed, and correspondence with state and local government agencies on matters such as childhood lead poisoning cases, regulatory compliance (e.g., HUD Lead Safe Housing Rule, EPA RRP rule, OSHA Lead in Construction standard, EPA/State/Tribal waste and lead regulations), or other related matters.

III. Paint Stabilization

How To Do It

1. **Fix moisture problems.** Before stabilizing the deteriorated component(s), eliminate any exterior leaks in the building envelope and any interior water leaks that may be causing paint deterioration. Exterior leaks include: roofing leaks, gutter or downspout problems; missing or damaged doors; missing or deteriorated roof flashing; missing opening trim; missing glass in windows; defective or missing caulk and glazing; poor drainage at foundation walls; and loose fasteners. Interior water leaks include: plumbing leaks; clogged condensation drip lines for air conditioners; missing water pans for hot water heaters; inadequately ventilated attic spaces; clogged bathtub drains; missing tile, grout, or caulking in bathtubs; and windows that won't close completely.

2. **Prepare worksite.** Select and implement worksite preparation and occupant protection measures in accordance with guidance in Chapter 8.

3. **Soil sampling (optional).** For exterior paint disturbing work, if the owner or contractor wishes to document that the work does not increase soil lead levels above applicable standards, collect soil samples near the work surfaces before the work begins. These samples need not be analyzed unless samples collected after completion of the work show soil lead levels above applicable standards. This is an optional procedure that is appropriate if pre-work soil samples are not being taken as part of a risk assessment and if there is a special concern regarding the level of lead in the soil.

4. **Repair substrate.** Repair all rotted structural, siding, or railing components; defective plaster; missing door hardware; loose siding or trim; and loose wallpaper.

5. **Remove loose paint.** Prepare surface by wet scraping or wet sanding. Do not use prohibited methods of paint removal: Open-flame burning or torching, operating a heat gun at surface temperatures at or above 1100 degrees Fahrenheit, machine sanding or grinding without a HEPA local exhaust control and a shroud, abrasive blasting or sandblasting without HEPA local exhaust control, manual dry sanding or dry scraping, uncontained hydroblasting, paint stripping in a poorly ventilated space when using a volatile stripper that is a hazardous substance. (See Section II.D, above.)

6. **Other surface preparation.** Clean, degloss, neutralize (if a caustic paint stripper has been used), and rinse surfaces. Surfaces should be dry before priming or repainting.

7. **Select paint.** Select primer and top-coat by considering longevity, moisture resistance, and organic compound content with low volatility. Paint stabilization involves the application of at least two coats (the primer and the top-coat). Use a primer/top-coat system from the same manufacturer to ensure compatibility.

8. **Apply paint.** Apply all paints at appropriate thickness and according to manufacturer's directions. Apply paint only during proper temperature, wind, and humidity conditions. Allow sufficient time for each coat to dry fully.

9. **Cleanup.** Conduct final cleanup (see The Basic Steps Common to Most Jobs – How to Do It, items 8 and 9, on cleanups, above, and Chapter 14). Consider using a pre-clearance screen if the clearance area may have had high lead levels before the work and/or has rough horizontal surfaces that may make clearance difficult.

10. **Clearance.** At the end of the lead hazard control project, have a certified lead-based paint inspector, risk assessor, or sampling technician conduct a clearance examination and provide appropriate documentation. (See The Basic Steps Common to Most Jobs – How to Do It, item 10, on clearance, above, and Chapter 15.) (If clearance is not required and the project is covered by the EPA's Renovation, Repair, and Painting (RRP) Rule, conduct cleaning verification.)

11. **Ongoing lead-safe maintenance.** Perform ongoing lead-safe maintenance in accordance with guidance in Chapter 6. If required by regulation or the property owner or manager's preference, conduct reevaluations every two years in accordance with guidance in Section VII of Chapter 5.

A. Typical Lead Containing Coatings and Their Failures

The lead in lead-based paint may be found as white pigments (lead carbonate, sulfate, or silicate) or colored pigments (chrome yellow, red lead, gray, and other orange, green, and red pigments).

These pigments were mixed with other components in an oil vehicle, and traditionally thinned with volatile organic solvents and a drying agent. Driers containing lead were used to accelerate the conversion of the liquid coating to a dry film. Paint can fail rather quickly under real life conditions, making ongoing monitoring important. Paint should be quickly, but carefully, stabilized whenever a resident or owner reports that paint is deteriorating.

1. Moisture

Oil paints (virtually all lead-based paints are oil paints) form a hard, usually glossy, low permeable and inflexible coating. Water, either in the form of water vapor or liquid, is the single greatest cause of premature paint coating failures. Once a substrate gets wet, the impermeable paint coating is pushed away from the substrate due to vapor formed by heat from the sun or other sources. Repeated soaking/warming cycles result in microscopic failure of the paint and then accelerated failure as more and more openings become available, allowing the substrate to become increasingly wet.

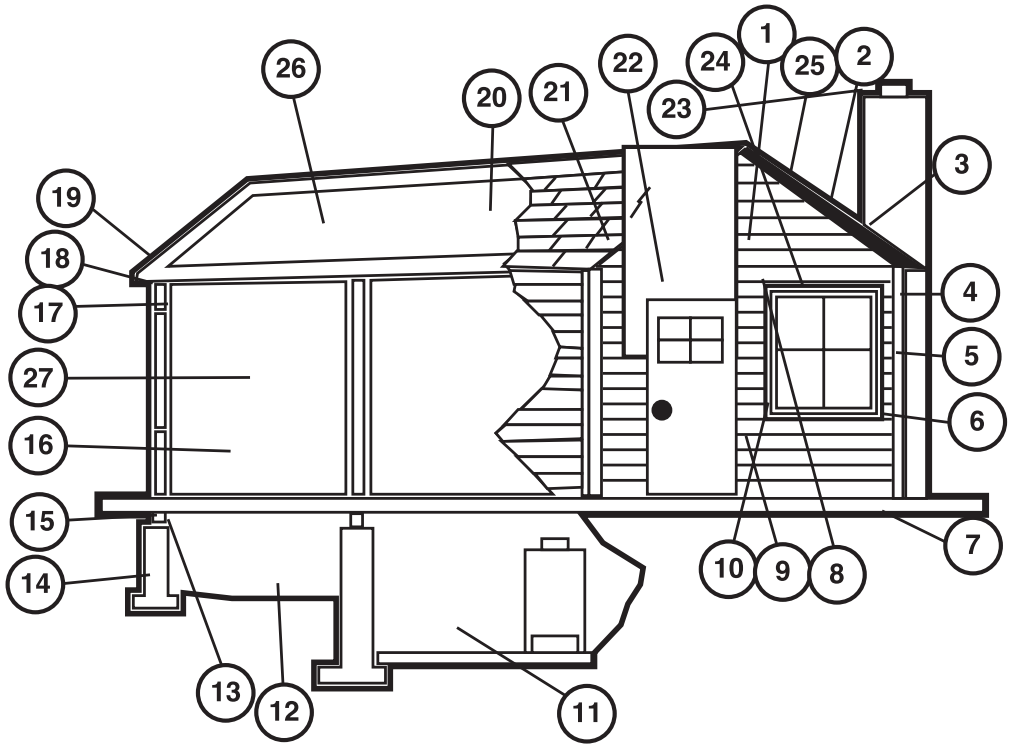
A significant number of homes are poorly constructed, ventilated, or maintained, and allow moisture to be trapped. Twenty-six main causes of premature paint failure from moisture are described in Figure 11.1.

2. Aging

All binders in paint age, and some cure over time. This continued curing causes the paint to become too brittle to accommodate the normal expansion and contraction of the substrate, resulting in cracking and peeling. Exterior paints are also attacked by sunlight, which can cause chalking. These slow aging processes mean that even a well managed and protected surface will deteriorate eventually.

3. Mechanical Damage

The two basic kinds of mechanical damage (abrasion and impact) can be minimized only by careful management. Paints exhibit tremendous variability in hardness, impact resistance, and abrasion resistance. High performance coatings (e.g., polyamide epoxy, urethane-reinforced alkyds, and epoxy-modified enamels) can withstand over 10,000 more scrubbing cycles than



Key to pointers in Figure 11.1:

(1) siding exceeds 14-percent water content
(2) no cricket where chimney meets roof
(3) no step flashing at side of chimney
(4) corner rim not caulked
(5) exposed nail heads rusting
(6) no window wash at window sill
(7) wood contacts earth
(8) no drip or gutter at eaves
(9) poorly fitted window and door trims
(10) waterproof paper not installed behind trim
(11) damp, wet cellar unventilated at opposite sides
(12) no ventilation of unexcavated space
(13) no blocking between unexcavated space and stud wall space
(14) no waterproofing or drainage tile around cellar walls
(15) no foundation water and termite sill
(16) plaster not dry enough to paint
(17) sheathing paper that is not waterproof;
(18) vapor barrier omitted – needed for present or future insulation
(19) roof built during wet, rainy season without taking due precaution or ventilating on dry days
(20) roof leaks
(21) inadequate flashing at breaks, corners, roof
(22) poorly matched joints
(23) no chimney cap
(24) no flashing over openings
(25) full of openings, loosely built
(26) no or inadequate ventilation of attic space
(27) plumbing leaks.

FIGURE 11.1 Moisture-Related Causes of Paint Failure

inexpensive flat vinyl paints (Banov, 1978), although some of these paints may not be appropriate for residential use. Failure from impact or friction is often accelerated by the selection of a low performance coating.

4. Chemical Incompatibility

Since oil and water do not mix, oil paints applied over wet substrates will not adhere. The failure may occur within a week, and may cause the paint to be pulled directly from the substrate. Although oil paints stick relatively well on surfaces slightly contaminated with organic material, dirt, and oil, they do not adhere well to fatty or heavily greased surfaces.

Most latex paints do not adhere to chalky, or smooth and glossy paint. Epoxies will fail prematurely when applied over latex coatings and some oil coatings. Some chemical based strippers contain such large amounts of wax and other stabilizers that almost no subsequent coating will maintain good adhesion. If the substrate has been stripped with a caustic paste and not neutralized properly, the highly alkaline pH will cause deterioration of the subsequent paint. On the exterior, salts may build up on the surface of paint in eaves and soffits and prevent paint adhesion. These salts must be removed with water to allow good adhesion.

Portland cement and older plaster substrates are extremely alkaline. They should be aged or etched with mild acid solutions prior to spot sealing with a primer.

5. Poor Surface Preparation

A 100 year-old house, repainted every 8 years, may have at least 12 coats of paint. If surface preparation for only one of those coats was insufficient, paint will peel. Because of the slow erosion of the binder in exterior paints, chalking can cause poor adhesion of new coatings. Chalking results from natural degradation of the organic binder and consequent exposure of unbound pigment particles on the paint surface that rub off easily like chalk. Chalk must be washed off and appropriate primers applied to prevent subsequent failures. Surfaces must be free from oil, grease, and dirt. Paint stripper residue must be removed, either with solvents or alkali cleaners. Hard, glossy oil films require deglossing to allow water borne coatings to adhere properly.

B. Substrate Condition and Repairs

1. Building Envelope Leaks

The quality and endurance of a paint coating is dependent on the quality of the substrate over which it is applied. The substrate must be dry, structurally sound, and waterproof. Roofing leaks, including porches, gutters, and downspouts, must be fully repaired prior to stabilizing the lead-based paint. Temporary roofing repairs like asphalt patching material, piecing in downspouts and gutters, and short term paint-on coatings are not recommended. Within 4 months, these quick fixes may fail and result in the subsequent failure of the lead-based paint.

In lead-based paint stabilization, the main goal is to create an intact coating that prevents excessive lead exposures. Paint stabilization is most effectively and economically completed after defects, such as the following, have been fully corrected:

- Damaged or missing roof flashing.
- Damaged or missing door or window flashing.
- Siding in contact with soil.
- Poor drainage at foundation walls.
- Water running down siding in excessive amounts, due to a broken or clogged gutter or downspout.
- Missing or deteriorated trim around openings.
- Missing glass in windows.
- Missing, damaged, or deteriorated caulking.
- Loose and rusty fasteners.

2. Interior Repairs and Water

The major type of repair that must be completed prior to paint stabilization involves eliminating moisture sources. Plumbing leaks, especially in bathrooms and kitchens, are often the cause of paint failure on the ceilings and walls below. A few major soak/dry cycles can bring the lead-based paint or leach lead salts to the surface.

Because excessively long hot showers in inadequately ventilated bathrooms may result in paint damage, paint stabilization may not last long if these continue to occur routinely. The ventilation in the bathroom may need to be increased; but see Section II.L, below, and Chapter 6, Section III.C.7, about informing residents on their helping avoid this problem.

The following interior defects should be corrected permanently in conjunction with interior lead-based paint stabilization projects:

- Visible leaks in waste lines, traps, supply lines, or plumbing fixtures above or in rooms undergoing stabilization, or where suspected lead-based paint is present.
- Clogged condensation drip lines for air conditioners.
- Water heaters, refrigerators, or washers without pans and overflows above or in rooms undergoing stabilization or where suspected lead-based paint is present.
- Inadequately ventilated attic spaces.
- Inadequately ventilated bathrooms, kitchens, and laundry areas.
- Clogged bathtub drains.
- Interior windows that are loose or do not close completely.
- Broken or missing glass in windows.
- Improper or deteriorated caulking in bathrooms and kitchens.
- Plugged or blocked weep holes in storm windows.

3. Water Vapor Management

Paint exposed to excess water vapor can fail within hours of initial application. Almost all exterior trim flashing and caulking serves a functional purpose by covering seams and joints and keeping out air and water. All missing or deteriorated trim, flashing, and caulking should be replaced prior to stabilizing the deteriorated component(s). In addition to keeping water from entering through the building envelope, it is equally important that the walls and roof be able to dry should they get wet. Exterior cladding and attic spaces should be ventilated to allow the escape of water vapor. Small wedges can be driven between clapboards at each stud (circle vents are of questionable effectiveness), or the walls may be sealed from the inside using caulking and a very low permeable primer. Soffit and ridge ventilation of at least 1 square inch of vent per 300 square inches of ceiling area is recommended. While venting the attic space, it is important also to seal all openings in the ceiling between the interior and the attic so: (1) the attic venting does not pull moisture from the interior into the attic space where it can condense and cause damage or (2) moisture is not pulled from the exterior into the attic and then into the living space when furnace, dryer, and ventilation fans are pulling air out of the interior of the home.

Open cracks in bathrooms and kitchens should be taped with fiberglass mesh wall tape, spackled, and then sealed to eliminate water penetration. Minor repairs to the plaster substrate should be completed, allowed to dry, and sealed with white shellac or acrylic latex.

The following vapor maintenance defects should be permanently corrected prior to stabilizing lead-based paint:

- Deteriorated or missing caulking or grout at tub and shower surrounds.
- Painted over vents on siding or roof.
- Deteriorated or missing caulking that allows air infiltration (e.g., at trim, outlets, light fixtures, pipe penetrations).
- Uncovered crawl spaces with low permeable vapor barriers. Crawl spaces can be dried by first reducing humidity, removing any standing water, and then applying 6-mil polyethylene plastic sheeting to the floor of the space, especially if it is soil, after all debris has been removed and the soil graded as evenly as possible. The plastic sheeting should go up the side walls of the crawlspace to just above outside grade level. Lapping the seams at least 12 inches or taping the seams is preferred. If there is a heated basement area, it may be possible to eliminate crawlspace vents, insulate the perimeter of the crawlspace, and open the space to the heated basement.

4. Substrate Repairs

Prior to stabilizing lead-based paint, defects such as the following should be permanently corrected:

- Dry rotted or rusty structural, siding, or railing components.
- Wall and ceiling plaster that is loose from the underlying lath (sagging plaster).
- Loose siding or trim.
- Loose wallpaper.

C. General Paint Application Guidelines

1. Appropriate Conditions

Because the guidelines in this chapter have been developed primarily to stabilize and seal lead-based paint, the general requirements for repainting should be rigorously followed. Painters should be professional, skilled, and willing to guarantee their work. Strict adherence to the paint manufacturers' recommendations for air and substrate temperatures, required primers, relative humidity, and recoating time should be conscientiously enforced. The completed primer and top-coat must be applied at the manufacturers' coverage rate, and the total coating thickness should never be thinner than 2.5 mil.

2. When Paint Stabilization Will Not Last Very Long

Under certain conditions, paint stabilization will not last very long. These conditions include:

- When prerequisite repairs are not possible.
- When there is a high probability of future physical damage. One possible example is walls of a narrow stairwell that have visible physical damage from continual bumping, scratching or abrasion. Enclosure with wood wainscot is an acceptable alternative to paint stabilization (as long as the narrower width still meets code requirements).
- Lead paint on children's play equipment. Better options are removal of paint or disposal of equipment.
- Wall surfaces that are structurally unsound.
- Walls with a layer of wallpaper over or under lead-based paint. If there are areas of wallpaper that are not intact to the substrate, consider covering these with fresh wallpaper after removing and patching loose areas, or steaming off the wallpaper, patching the substrate, and starting anew.
- Weep holes in storm windows not cleared to allow ventilation and drainage of water.

Paint stabilization will yield the best results when the surface and building system have been properly prepared. If prerequisite repairs cannot be completed before paint stabilization, the reevaluation period should be shortened substantially. The owner's monitoring frequency should also be increased.

3. General Recommendations for Applying Paint

- Paint only when surface and ambient temperatures are between 45°F and 95°F.
- Do not paint in direct warm sunlight. Very warm temperatures accelerate the drying time of the paint and may compromise the longevity of the paint. Paint after the sun has passed, or so that the paint is nearly dry before the direct sunlight reaches it.
- Maintain coatings in container at a temperature range of 65°F to 85°F at all times on the job.

- Paint only when the temperature is expected to stay above freezing.
- Paint only when wind velocity is below 15 mph.
- Paint only when relative humidity is below 80 percent.
- Observe the recommended spread rate for the coating.
- Tint each coat differently if the same paint is to be used for successive coats to ensure complete coverage.
- Allow sufficient time for each coat to dry before applying another. Use the same brand for each coat.
- Allow adequate time for the top-coat to dry before permitting clients to reoccupy the space.
- Do not put doors back into use until they have dried completely.
- Do not paint over weep holes in the bottom of storm window systems. If the weep holes are blocked or plugged, drill a hole to permit proper ventilation and drainage of rainwater. Failure to clear weep holes will cause premature paint failure in window troughs.

D. Worksite Preparation

See Chapter 8, Section III, Worksite Preparation, for subsections B, on interior worksites, C, on exterior work, and/or D, on windows, as applicable to the project.

Soil sampling is an optional procedure, both before and after the work (see Chapter 15). For exterior work, soil samples may be collected before the work begins if the owner or contractor wishes to document that the work does not increase soil lead levels above applicable hazard standards. These samples need not be analyzed until soil samples have been collected *after* the work has been completed, and such post work samples have been analyzed and compared to soil lead hazard standards. If the lead in soil samples collected after the work has been completed are below applicable standards, the samples collected before the work do not need to analyzed.

E. Surface Preparation

The recommended approaches to surface preparation are as follows:

- All loose surface material should be removed by hand treatments (i.e., wet scraping, wet sanding, or dry scraping with HEPA vacuum exhaust attachment).
- Surface contaminants that prevent adhesion should be eliminated by cleaning (e.g., chemical degreasing, or equivalent household cleaning agent, followed by thorough rinsing).
- Surface gloss should be eliminated by chemical etching, wet sanding, or HEPA vacuum assisted sanding.
- Adhesion to the substrate should be enhanced by chemical etching, applying rust inhibitors, spot sealing, and/or wet sanding.

1. Paint Removal Practices.

Do not use the prohibited paint removal practices described in Section II.D, above.

Wet Scraping. The goal of safe scraping is to minimize the creation of dust while removing loose paint. The best tool for this work is a scraper attached to a HEPA vacuum that very efficiently removes small dust particles generated during scraping.

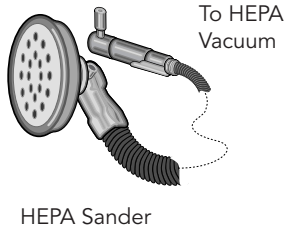
Large chips that fall to the floor are captured by the puncture resistant, disposable protective sheeting used for floor containment. Continuously misting the surface with water from a small atomizer or garden type sprayer reduces dust generation. A small amount of detergent can be used as a wetting agent. This procedure is best completed by two people – one scraping, the other wetting the surface. Simple dust gathering devices, like a damp rag wrapped around the head of a draw scraper, capture the smallest dust particles while directing the larger paint chips onto the floor containment area.

When working on a ladder, the steps or rungs of the ladder should be kept as dry as possible to avoid slippage. The ladder should not rest on the disposable, impermeable sheeting that is protecting the ground. Slits should be cut through the sheeting so the feet of the ladder can be secured to a firm base, or the feet of the ladder can rest on plywood that is put on top of the protective sheeting. If slits are cut in the protective sheeting, seal them with tape after moving the ladder. Many contractors have found that it is more efficient to rent lifts for high exterior work than to work from ladders.

Wet Sanding. When preparing a surface by sanding (especially with fine finishing grits), it is quite possible to contaminate an entire household with fine particles of lead-contaminated dust. Traditional orbital sanding devices may be used *only* in conjunction with a HEPA vacuum filter attachment (see Figure 11.2). Dry sanding should be replaced by wet sanding *except* near electrical circuits.

HEPA Sanders

Sanding generates huge amounts of dust. HEPA sanders are sanders fitted with HEPA vacuum to watch and filter lead-dust as it is created. Use a HEPA sander when sanding lead paint. Limit the use of HEPA sanding to flat surfaces for feathering or finishing only.



HEPA Sander

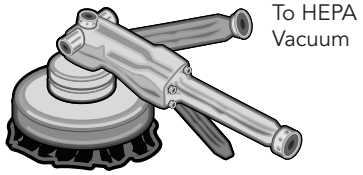


FIGURE 11.2 HEPA Vacuum Sanders

Any liquid that does not interfere with subsequent paint adherence may be used (e.g., water, Varsol, phosphoric acid etch for iron). Use sponges to wet sand patching material for drywall, plaster, and wood.

Wood, metal, and painted surfaces that require a fine cosmetic finish may be sanded using wet-dry sandpaper and water or an oil paint solvent. Relatively rough surfaces may be finished using wet foam sanding blocks created by dipping a sponge in aluminum oxide grit. These sponge sanders are ideally suited for wet sanding and can be easily cleaned by immersing in a bucket of cleaning solution.

Rather than wet sanding or HEPA sanding to degloss paint, the painter may chemically treat the surface with specialized products such as Liquid Sandpaper™, taking care to provide adequate ventilation if volatile substances are released.

2. Cleaning Surfaces of Dust and Chips.

Good surface preparation will remove damaged, oxidizing, and deteriorated paint surfaces, but will also create dust and chips that may be leaded. Therefore, after the surface has been allowed to dry, it should be vacuumed to collect surface dust. Prior to applying primer, the surface should be tested for its pH by placing litmus paper against the wet surface. The surface must be rinsed with clear water, or a weak acid solution, until it reaches a pH between 6 and 8 for most new paints.

Oils, Waxes, and Mold. While oil and alkyd paints have some tolerance for oil in the substrate, acrylic latex paints will fail prematurely if applied over greasy or oily surfaces. For waxes like crayons and some polishes, a combination of household ammonia and water should be used for cleaning, followed by a thorough rinse. Surfaces in baths and kitchens that may be prone to contamination by airborne grease and oils, or fatty soap can be cleaned with a suitable household cleaner and rinsed thoroughly. Remove mold with soap and water. For guidance on removing mold, two EPA documents may be helpful: *A Brief Guide to Mold, Moisture, and Your Home* (EPA 402-K-02-003) and *Mold Remediation in Schools and Commercial Buildings* (EPA 402-K-01-001) which can be found at ***www.epa.gov/mold/moldresources.html*** (see References for additional ordering information). On some varnished kitchen cabinets, the finished surface may become coated with organic films after extended use. The surface should be cleaned with a nonflammable solvent before painting.

F. Priming

To maximize the life of a paint job, a system of compatible coatings is necessary. Primers are designed to adhere tightly to the old paint while leaving a rough, bondable surface on the outside. Prior to priming wood and plaster, substrates should be dry. Top quality primers work better, last longer, and treat more substrate types. Consider the following factors when selecting a primer:

- Type of substrate (e.g., wood, metal, gypsum, masonry).
- Type of existing substrate coating (e.g., acrylic latex paint, varnish, oil enamel).
- Interior or exterior application.
- Top-coat (use manufacturers' recommended primers; use a single manufacturer for both primer and top-coat).

1. Oil- and Alkyd-Based Primers

Oil primers are compatible with a system of multiple coats of oil paint over a wood or plaster substrate. The similar solvents used in the old and new paints tend to soften the surface of the paint, creating a better bond. Oil primers are also effective vapor barriers. On the other hand, oil primers contain volatile organic chemicals that can cause adverse health effects and may cost more than waterborne paints. Many states regulate the amount of volatile organic chemicals in paint.

2. Waterborne Primers

The most durable waterborne paints are made with an acrylic or acrylic-containing binder. While acrylic latex primers and top-coats are an excellent combination for new wood, they may not be compatible with the lead-based oil paints that cover the substrate. Waterborne paints usually emit less volatile organic compounds and may be less expensive than oil paints.

G. Top-coats

To maximize cost-effectiveness and prolong the efficiency of a coating used as a lead hazard control method, it is important to purchase paint with a long lifespan. Inexpensive, low grade paint or special mixes should not be used in lead-based paint stabilization programs. Paints and clear finishes used for paint stabilization jobs require outstanding adhesion, durability, chemical resistance, and flexibility. Therefore, the owner should request the most durable and the highest grade of paint. (See Table 11.1 for finishes typically used for lead-based paint stabilization.)

Marine paints free of lead and mercury, and varnishes (used on boats, docks, etc.) are especially durable and abrasive-resistant. They are formulated with more resin than house paints and the resin is of the highest quality. However, some marine paints are not appropriate for residential use. For example, bottom paints or mildew-resistant paints contain poisons and must be avoided, so that lead is not replaced by another toxic substance.

Table 11.1 Finish Coats for Paint Stabilization

Options	Base	Difficulty Level	Comments and Recommendations
Varnish	Oil Alkyd resin, clear finish		Can be touched up very easily.
Acrylic latex	Water	Safest and easiest to use.	May not adhere to alkyd enamels.
Polyurethane resins:			
Alkyd	Oil-volatile organic solvent	Easy to apply. Very durable.	Cannot be touched up without sanding off gloss.
Moisture cured	Volatile organic	Harder to apply.	Needs adequate relative humidity.
Waterborne clear finish	Polyurethane water	Can be hard to apply.	Safer to apply than organic solvent containing coatings.

Source: Adapted from A Consumer's Guide to Renovation, Repair and Home Improvement, J. Wiley & Sons, 1991.

High gloss floor and deck enamels offer the next best level of protection. In general, the higher the gloss, the more durable, impact resistant, and moisture resistant the coating. Among types of paint finishes, gloss, semi-gloss, and eggshell coatings are much more resistant to abrasive cleaners and the detergents used in follow-up maintenance procedures than flat finishes.

A satisfactory service life of 4 to 10 years may be achieved with latex and alkyd-based paints (see Cassens and Feist, 1991, regarding 100 percent acrylic latex paint), although much more rapid deterioration can occur under adverse conditions. Low-cost non-acrylic latex may last less than 4 years. The additional material costs (126 percent to 200 percent) of high priced paints and any special primers are minimal when compared to the cost of performing more frequent paint stabilization.

High performance coatings applied properly to ideal substrates may offer a service life of 10 to 25 years. High performance coatings include epoxy-modified alkyds, epoxies, urethanes, epoxy-polyesters, and polyesters. However, these types of coatings should only be selected after consulting the manufacturer as to the specific intended use(s) and after considering the following factors:

- Possible presence in the new coating of lead, chromate, mercury, or other heavy metals (and other toxic substances).
- Compatibility with existing paint.
- Ability to be repainted in future maintenance operations (epoxies and urethanes are difficult to repaint).

Some lead-based paint encapsulants are made out of similar materials and may last longer than paints on some surfaces (see Chapter 13).

H. Cleaning and Clearance or Cleaning Verification

Containment removal, extensive cleaning, and a clearance examination are required following stabilization and repainting, unless cleaning verification will be undertaken at the end of the work, or unless the size of the project is below the applicable threshold (*de minimis* area for performing clearance, or minor repair and maintenance activities area for performing cleaning verification). These steps are an essential part of the paint stabilization process. (See Section II.I of this chapter and Chapters 14 and 15 for additional discussion of cleaning and clearance.)

For exterior work, if the owner or contractor wishes to document that the work did not increase soil lead levels above applicable standards, soil samples should be collected before work begins and again at clearance. See Section III.D, above.

I. Maintenance

Immediately after completion of any paint stabilization job, the paint begins the slow process of deterioration from mechanical damage, ultraviolet rays, rain, snow, and wind. A well-prepared substrate, which is primed, and top-coated with premium house paints, can withstand between 4

and 10 years of weathering in temperate climates. At the other extreme, a small scratch in a metal railing located in a coastal town may lead to extensive corrosion and major paint failure within a much shorter time. Assuming a proper paint job, paint life is directly related to the environment to which it is exposed. Cyclical changes in the environment are responsible for the greatest rate of paint destabilization. Rapid changes in temperature, moisture content, and relative humidity cause small stress cracks at joints and between dissimilar materials. Exterior paint life can be extended considerably by annual inspections and maintenance (spot scraping, spot priming, and top-coating deteriorated areas). While a new paint job on interior plaster and wood can last 5 to 10 years with only minor fading, repainting will be required much more frequently in dwellings with more wear and tear. Spot priming and spot top-coating as soon as any deterioration is noticed can extend the life of the interior surfaces.

IV. Treatment of Friction, Impact, and Chewable Surfaces

How To Do It

1. **Prepare worksite.** Select and implement the appropriate worksite preparation (see Chapter 8).

2. **Window treatments.** For windows, remove stop bead and parting strip and dispose of properly. Wet scrape deteriorated paint. If the window trough is badly weathered, cap with back-caulked aluminum coil stock. If necessary, repair window weight and pulley system. If further protection is needed, consider installing a new window channel or slide system. Re-glaze if necessary.

3. **Door treatments.** For doors, remove stop from jamb and dispose of properly. Remove door by pulling out hinge pins. Mist and plane door to eliminate friction points. Replace hinges if necessary. Reinstall door and install new stop. If door knob is banging against the wall, install doorstop on floor or wall.

4. **Stair treatments.** For stairs, install a hard, cleanable covering on treads (e.g., rubber tread guards). Carpeting may be used instead, but it must be securely fastened so that it does not cause abrasion. Stabilize paint on banisters, balusters, and newel posts.

5. **Chewable surfaces.** For chewable surfaces such as window sills, remove lead-based paint, or enclose with back-caulked aluminum coil stock, or encapsulate with puncture-resistant epoxy-based or similar material.

6. **Drawers and cabinets.** For drawers and cabinets, remove and replace cabinet doors or remove paint by offsite stripping. Strip paint from drawers and drawer guides or plane impact points and repaint. As an alternative, install rubber or felt bumpers at points of friction or impact.

7. **Floors.** At a minimum, stabilize lead-based paint on porches, decks, and interior floors with polyurethane or high quality abrasion-resistant paint. For a more durable treatment, cover with carpeting, sheet vinyl, or tile, or enclose or replace with new flooring.

8. **Cleanup.** Conduct final cleanup (See The Basic Steps Common to Most Jobs – How to Do It, items 8 and 9, on cleanups, above, and Chapter 14).

9. **Clearance.** Have a certified risk assessor, certified lead-based paint inspector, or certified sampling technician conduct a clearance examination. (See The Basic Steps Common to Most Jobs – How to Do It, item 10, on clearance, above, and Chapter 15.)

10. **Ongoing lead-safe maintenance.** Perform ongoing lead-safe maintenance and monitoring of treatments (see Chapter 6). Reevaluations, if required by regulation or the property owner or manager's preference, should be conducted by certified risk assessors at two year intervals (see Chapter 5).

A. Definition of Terms

1. Friction Surfaces

Friction surfaces are those surfaces covered with lead-based paint that are subject to abrasion, which may generate leaded dust. For a friction surface to be a lead-based paint hazard, as defined by EPA regulations at 40 CFR 745.65(a), there must be a dust lead hazard on the nearest horizontal surface (e.g., floor or interior window sill) underneath or below the friction surface. A dust lead hazard is defined by EPA as equal to or exceeding 40 µg/ft² on floors or 250 µg/ft² for interior window sills based on wipe samples. See Chapter 5 for more information on identification of friction surface hazards. The most critical friction surfaces are generally those portions of a window that are rubbed when the window is opened and closed (see Figure 11.3). The actual area(s) of adjacent surfaces that rub together should not be painted. This includes the jamb, stop bead, and parting strip, and sometimes the sash. Other common friction surfaces include tight fitting or rubbing doors, cabinet doors and drawers, stairway treads and railings, and floors or stair treads painted with lead-based paint, including exterior decks and porches.

FIGURE 11.3 Window before and after friction treatment.

Friction surfaces on doors and windows will generate less leaded dust when they are kept in good operating condition and in a state of good repair. Friction surfaces can also often be covered with a temporary or permanent covering to eliminate the friction. The covering itself, however, must be abrasion resistant. However, if the component is deteriorated, it may be more cost effective to simply replace it than to attempt to treat friction surfaces (see Chapter 12).

2. Impact Surfaces

Impact surfaces are surfaces that tend to be bumped or banged repeatedly. To be a lead-based paint hazard that is associated with an impact surface, according to EPA regulations at 40 CFR 745.65(a), the surface must be painted with lead-based paint that is damaged or otherwise deteriorated as a result of impact from a related building component, such as a door knob that knocks into a wall, or a door that knocks against its door frame. Paint that is damaged as a result of misuse, such as from children banging toys against the wall, may be deteriorated paint. If that deteriorated paint is lead-based paint, it is a lead-based paint hazard, but it is not considered an impact surface.

Paint that is damaged as a result of impact can cause small chips of paint to become dislodged and fall to the floor, covering the floor with small amounts of loose lead-contaminated dust and chips. The most common impact surfaces are doors, and door jambs, and door trim (see Figure 11.4).

Impact surface problems can be lessened by re-hanging doors so they open and close properly, and by installing door stops with impact absorbing tips.

3. Chewable Surfaces

A chewable surface is an interior or exterior surface that a young child can mouth or chew (see Figure 11.4). A chewable surface is the same as an "accessible surface" as defined in Title X. Hard metal substrates and other materials that cannot be dented by the bite of a young child are not considered chewable.

According to EPA standards at 40 CFR 745.65(a)(3), a chewable surface is a lead-based paint hazard if the surface is coated with lead-based paint and there is evidence of teeth marks. Furthermore, these *Guidelines* take the position that it is not necessary to treat a chewable surface if a child of less than six years of age does not reside in, or regularly visit, the dwelling unit or common area.

FIGURE 11.4 Examples of impact surfaces (left) and chewable surfaces (right). The window sash has large teeth marks.

B. Lead Hazard Control Measures

The treatments described below require special construction and cleanup skills that should be implemented by trained personnel only.

1. Window Systems

If windows do not open and close smoothly, they may be a significant source of leaded dust and chips in the home. The following paragraphs describe interim control methods of reducing friction surface hazards associated with windows. It is generally acknowledged, however, that windows are the most complex components to treat short of replacement. Window paint tends to deteriorate more rapidly than other painted surfaces due to moisture, variations in temperature, and exposure to the elements. In addition, painted friction surfaces, including the jamb, stop bead, and parting bead may be abraded or "sanded" each time windows are opened and closed. If the wood becomes weathered, dust is trapped and is difficult to remove.

- Before beginning any window treatment, prepare the worksite in accordance with guidance in Chapter 8. Also, vacuum the interior sill and trough areas to remove any loose paint chips, dust, or debris (see Figure 11.5).

- For a typical double hung sash, mist the stop bead holding in the lower sash with water. Score the edges with a razor knife to facilitate its removal. Pry off the parting bead (see Figure 11.6), wrap it in plastic, and seal the package with tape for disposal. Next, remove the lower sash (see Figure 11.7), sash weights and stops (see Figures 11.8 and 11.9). The jamb, parting bead, sash, window trough, and peeling trim should be misted with water. Loose and flaking paint should be carefully scraped away, and repairs made (see Figures 11.10 and 11.11). Clean and reinstall the window (see Figures 11.12 to 11.14).

FIGURE 11.5 Prepare the worksite and pre-clean the window.

FIGURE 11.6 Remove parting Abead.

FIGURE 11.7 Remove the bottom sash, sash weights and stops.

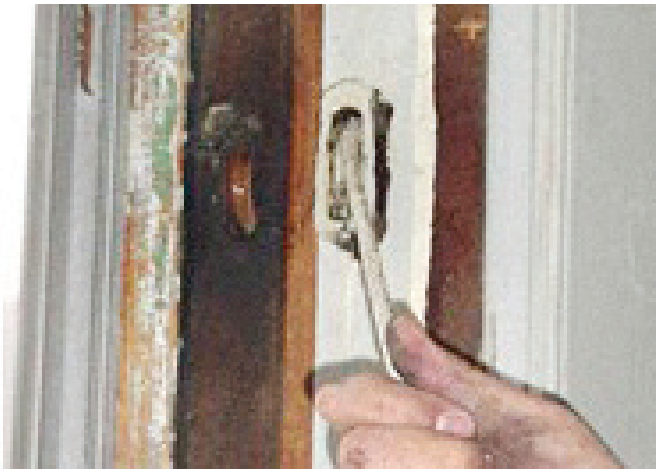


FIGURE 11.8 Remove sash controls/weights.

FIGURE 11.9 Window after removal of sash weights.

FIGURE 11.10 Rebuild damaged sash with filler or putty.

FIGURE 11.11 Wet plane edges of sash to fit new jamb liners.

FIGURE 11.12 Vacuum window again.

Figure 11.13 Fit sashes into jamb liners.

Figure 11.14 Reinstall sash into jamb.

- Vacuum all surfaces again, paying particular attention to the window trough. If badly weathered, the window trough should be capped with aluminum coil stock or vinyl (or equivalent), which is first back caulked and then nailed into place.
- Scrub all surfaces thoroughly with a cleaning agent suitable for leaded dust removal, and rinse with clean water. Any necessary repairs to the weight and pulley system should be made at this time. Reinstall the sash with a new stop bead. Wet scrap any additional paint that was loosened by the hammering. All surfaces should be vacuumed one more time. The new stop bead should be primed and painted.
- Cleanup the worksite in accordance with guidance in Chapter 14. Generally, the impermeable protective sheeting used to protect the surrounding area should be misted, folded with the dirty surface inside, and placed in a heavy duty plastic bag or wrapped with heavy duty polyethylene sheeting. The bag or package should be sealed and labeled to identify the contents for later disposal. Floor surfaces should be vacuumed beneath the protective sheeting and several feet around the sheeting on each side. Other horizontal surfaces in the containment area should also be vacuumed. The floor and other horizontal surfaces should be wet washed with the cleaning solution and rinsed with clean water. Vacuum any rough horizontal surfaces a final time.
- For further protection install replacement window channels or slides. Aluminum, vinyl, and polyvinyl chloride (PVC) plastic channels are available (see Figure 11.9). It should be noted, however, that these "jamb liners," as they are sometimes called, have a very high failure rate. The Evaluation of the HUD Lead-Based Paint Hazard Control Grant Program found that 46 percent of the jamb liners failed three years after installation. (NCHH, 2004) Over half of the failures were attributed to inadequate installation, and 29 percent failed because they were damaged.
- In this case, both the stop and parting beads should be removed, both sashes taken out, the chain and pulley system disconnected, and the pulleys removed. The old sashes should be planed (with HEPA exhaust), re-caulked, primed, and painted. All other surfaces should receive the same treatment as described above. The jambs should be repainted, the window channels installed with the old sashes, and a new interior stop bead.

- Covering painted surfaces with coil stock or channel systems may be considered by some State or tribal lead certification agencies to be an enclosure abatement measure combined with interim controls since the whole window system is not enclosed. It should be noted that this approach provides a great deal of flexibility to the property owner. In many cases, it will permit the most cost-effective strategy to be used.
- If windows are badly deteriorated, it may be more cost effective to replace them, particularly in young children's bedrooms, or in rooms in which young children frequently play.

2. Door Systems

Doors present a problem when the doorframe becomes misaligned due to settlement, or when multiple coats of paint reduce frame clearance to the point where the door sticks, rubs, or even chips paint on the door or doorstop when opened and closed (see Figure 11.15). The simplest approach is to re-hang the door so that it no longer rubs against the doorjamb.

FIGURE 11.15 Stabilizing paint on doors: Wet planning (left) and wet sanding (right) deteriorated paint can create significant amounts of dust.

To accomplish this, prepare the work area in accordance with guidance provided in Chapter 8. Heavily painted stops on jambs can be misted, scored with a knife, and pried loose. The stop should be wrapped in plastic and sealed with tape for disposal. Friction points on the door should be noted. Hinge pins should be removed and the door carefully planed (preferably outside the unit) to eliminate the friction points. (Note: Planing of doors will generate considerable leaded dust and paint chip contamination and may be more easily completed offsite in a controlled environment.) A new stop, if necessary, should be installed and any paint loosened by the hammering should be wet scraped. The new stop and planed areas should be primed, and all surfaces repainted, as described in Section II of this chapter. Cleanup the worksite in accordance with guidance provided in Chapter 14.

3. Stair Systems

There are a number of treatments that will control lead hazards on stairs. Installation of rubber tread guards will lessen or eliminate friction on the tread (see Figures 11.16 and 11.17). The tread guards should cover the entire width of the stairs. Do not use precut tread guards if they do not cover the entire width of the stair.

Covering the treads *and* risers with new carpeting can be useful in lessening friction and impact. It is important that carpeting be securely installed and cover the entire width of the stairs, since loose fitting carpeting can cause abrasion and subsequent dust releases. However, since carpeting must be vacuumed thoroughly and frequently to prevent the accumulation of deeply embedded dust lead, installation of a hard, cleanable surface is generally preferable to carpet.

4. Chewable Surfaces

The most common chewable surface is a protruding interior window sill, although other components have been chewed by children. The objective in treating such surfaces is to either remove the lead-based paint (using one of the paint removal methods described in Chapter 12) or cover the component with a puncture resistant material. For the latter approach, two options are aluminum coil stock or a hard, puncture resistant encapsulant. Install coil stock as described above for window troughs. Install encapsulants as described in Chapter 13.

FIGURE 11.16 Before and after stair treatments.

5. Baseboards and Outside Wall Corners

Damage to baseboards subject to frequent impact can be lessened by installing shoe molding at the bottom of the baseboard (see Figure 11.18). This relatively inexpensive treatment provides a barrier that prevents chair and table legs from actually striking the lead-based painted surface.

If there is existing shoe molding that has been damaged beyond repair, it should be removed by misting the surface, scoring with a razor, and prying the molding loose. The removed molding should be wrapped in plastic and sealed with tape for disposal. Since the baseboard is not necessarily removed, installation of new molding is a combined abatement/interim control measure. New shoe molding should then be back-caulked.

Impact or abrasion of outside corners of walls can be reduced by the installation of a wooden or plastic corner bead (see Figure 11.19).

A rubber tread with metal nosing works well. Rubber nosing that fits snugly on the nose may work if the stairs are not used very often.

- Enclose risers with thin plywood (like luan plywood) or some other hard material. Whatever you use must fit snugly.
- Back caulk the edges of treads. Place them and nail or screw them down. Screw or nail the metal nosing on.

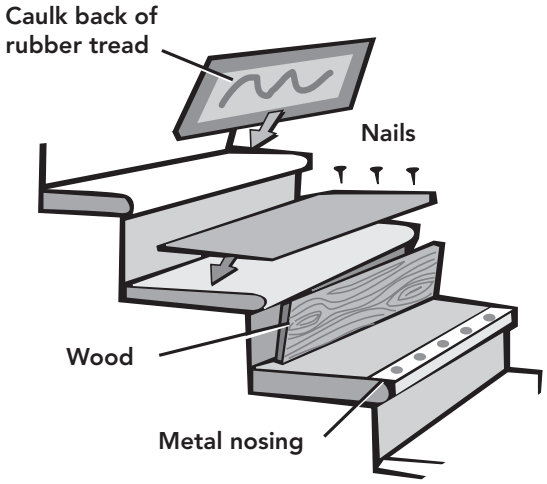


FIGURE 11.17 Covering Stairs with Tread Guards.

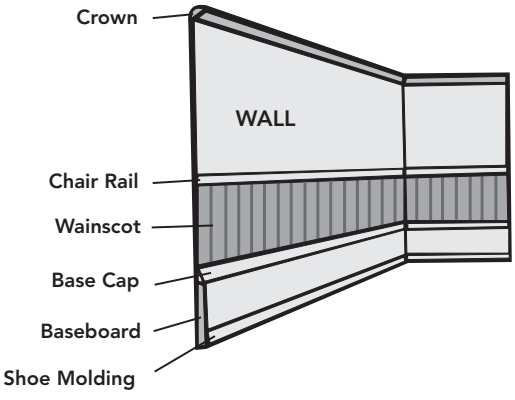


Figure 11.18 Shoe Molding Is an Acceptable Impact Surface Treatment for Baseboards

FIGURE 11.19 Corner Bead Coverings Can Be Used on Outside Corners of Walls.

6. Drawers and Cabinets

Drawers and cabinets coated with lead-based paint present a potential risk when doors or drawer facings do not fit properly. This is especially important when the cabinet or drawer is used for storing food, eating utensils, or bathroom articles, such as toothbrushes. Cabinet doors can be carefully removed and discarded, or can be stripped offsite and planed where necessary to fit properly, and repainted. These activities should only be performed after all articles are removed from the cabinet and the immediate area is contained. The exterior and interior of the cabinets should be thoroughly cleaned before articles are returned.

Drawers can also be removed and stripped offsite. Drawer covers can be planed at impact points and repainted. Installation of rubber or felt bumpers will also reduce impact with the painted surface of the cabinet.

7. Porches, Decks, and Interior Floors

Porches, decks, and interior floors with lead-based paint can be significant generators of paint chips and leaded dust particles through abrasion or impact. At a minimum, the paint should be carefully stabilized and covered with polyurethane or high quality paint. Decks and floors must be smooth enough so that dust can be removed by normal cleaning without special equipment. If funds are available, abatement of floors is strongly recommended, usually through enclosure with new flooring or covering or replacement.

Table 11.2 Sticky Tape Technique for Removing Loose Paint on Impact Surfaces for Owner / Occupants or Residents

1. Place a piece of plastic or paper beneath the area in question.
2. Press a piece of wide sticky tape firmly over the area of loose or chipping paint.
3. Wait a few seconds and then carefully remove the tape, taking the small chips of paint with it.
4. Place the tape in a plastic bag.
5. Carefully fold the piece of plastic or paper that was beneath the area and place it in the bag.
6. Seal the bag and clean the area.
7. Dispose of all waste materials in a secure manner.

V. Dust Removal and Control

How To Do It

1. **Dust lead hazard standards.** If dust wipe samples are collected and analyzed by a laboratory, and the level of lead in dust equals or exceeds the following levels the dust should be removed:

   - Floors (both hard surfaced and carpeted), 40 μg/ft².
   - Interior window sills, 250 μg/ft².
   - Window troughs, 400 μg/ft².
     - Bare floors and window components should also be made smooth and cleanable.

2. **Remove dust lead after controlling other hazards.** Correct any known or suspected lead-based paint hazards before dust removal.

3. **Inspect dust traps.** Visually inspect dust traps, such as radiators and floor grates. If visible dust is found, the component should be cleaned.

4. **Communicate with residents.** Distribute educational materials prepared by EPA or State or local government agencies to residents. The owners of rugs, carpets, drapes and upholstered furnishings are responsible for their care. Recommend to the owners that highly contaminated or badly worn items should be discarded. To discard a rug or carpet, mist the surface with water; seal in plastic sheeting, bags, or containers; and discard properly.

5. **Contain work area for carpet removal.** If contaminated carpets are to be removed, the work area should be contained in accordance with guidance for high dust jobs in Chapter 8.

6. **Vacuum and wet clean hard surfaces.**

   - **Clean all horizontal surfaces, beginning with vacuuming, with a HEPA vacuum, followed by wet cleaning.** A household cleaning agent (vs. a trisodium phosphate solution) is usually adequate. Test the cleaning solution before using it to determine if it will discolor or damage surfaces to be cleaned.
   - **Sequence of cleaning.** If cleaning an entire dwelling unit, begin dust removal at the top rear room in the dwelling, working forward and down. (Keeping a similar sequence of room cleanings on each floor may be helpful for assuring rooms are not missed.) When practical, clean dirty areas within a room while taking tare to avoid spreading dust. Within rooms, start with the highest surface and work down. Clean windows, other dust traps, and finally the floors.
   - **Take care in removing vacuum filters and/or bags.** If practicable, remove filters and/or bags from the vacuum offsite (not on the property) in a controlled environment. If filters or bags must be replaced onsite in the middle of the job, take the vacuum unit outside the house if practicable, and replace them – and protect the change area – as described in Section IV.B.1, below.
   - **Wet clean and rinse.** During wet cleaning, replace rags and mops frequently (at least once per dwelling). Use a three bucket system for floors: one for the cleaning solution, one into which the dirty mop or sponge is squeezed, and the other for rinsing. Change the rinse water at least once in each room. Clean until no surface dust is visible. After cleaning, rinse with clean water and a new rag or cloth. Dispose of dirty water in a toilet.

7. **Clean area rugs.** To clean area rugs, HEPA vacuum the top side with a beater bar or agitator attachment at a rate of 1 minute for each 10 square foot area. Fold the rug in half and vacuum the backing of the exposed half of the rug without using the beater bar at a rate of 1 minute per 10 square feet. Vacuum the exposed floor beneath the rug, the bottom of the rug, and the pad (if there is one), and fold the rug back into its original position. Repeat the process for the other half of the rug. Finally, vacuum the top side again with the beater bar at a rate of at least 2 minutes per 10 square feet. To summarize:

   - ✦ Vacuum the top side for 1 minute per 10 square feet.
   - ✦ Vacuum the bottom for 1 minute per 10 square feet.
   - ✦ Vacuum the top again for a final 2 minutes per 10 square feet.
     - — This is a total of 4 minutes for every 10 square feet of rug. Also vacuum the bare floor under the rug and the pad, if present.

8. **Clean wall-to-wall carpet.** For wall-to-wall carpeting that cannot be folded over, HEPA vacuum at a rate no faster than 2 minutes per 10 square feet in a side-to-side direction. Follow this by another pass at the same rate in a direction perpendicular to the direction of the first vacuuming, for a total of 4 minutes per 10 square feet. For wall-to-wall carpeting, it is not feasible to clean the floor underneath the carpeting. To attain an even higher level of cleanliness, steam clean the carpet using a regular commercial cleaning system after performing the HEPA vacuuming.

9. **Clean upholstered furnishings.** To clean other upholstered furnishings, vacuum each surface three to five times. Steam cleaning is generally not recommended because it may damage the fabric. However, newer steam cleaners have a water extraction feature to prevent water damage to fabric. Test a small section of the fabric for color fastness before cleaning the entire surface.

10. **Clean drop ceilings and ductwork when necessary.** Clean drop ceilings or the ductwork for forced air systems only when they are expected to be disturbed. Vacuum and wet clean air vents or registers. Replace air filters in the forced air systems at the time of cleaning.

11. **Conduct clearance dust wipe sampling on carpets, rugs or furnishings that were cleaned to determine if the cleaning was effective.** Have a certified lead-based paint inspector, risk assessor, or sampling technician conduct a clearance examination (see The Basic Steps Common to Most Jobs – How to Do It, item 10, on clearance, above, Chapter 15). Repeat cleaning, if necessary.

12. **Ongoing lead-safe maintenance.** Perform ongoing lead-safe maintenance in accordance with guidance in Chapter 6. If required by regulation or the property owner or manager's preference, conduct reevaluations every two years in accordance with guidance in Section VII of Chapter 5.

A. Introduction

Dust removal is a type of interim control that involves an initial treatment followed by clearance and re-cleaning as needed. This section provides information on when the removal of leaded dust alone is an appropriate interim control and how to accomplish it. Some dust removal will *always* be an element of interim control measures, either as a stand-alone treatment or as part of cleanup following other work.

1. Sources and Locations of Leaded Dust

Lead in settled house dust is the main source of lead exposure for young children. Leaded dust can come from deteriorating lead-based paint on interior and exterior surfaces, abrasion of lead-based paint on friction and impact surfaces, and the disturbance of lead-based paint during maintenance, renovation, or remodeling activities. Leaded dust can also originate from exterior soil or dust. Sources of lead-contaminated soil include weathering or scraping of exterior lead-based paint, past use of lead additives in gasoline, industrial point sources, and demolition and paint removal from buildings and steel structures. Lead-contaminated soil and exterior dust can be tracked inside by humans and pets or carried indoors by wind. Leaded dust can be produced by activities related to hobbies and can be carried home on the clothing of workers exposed to lead. Table 11.3 provides a summary of potential sources of lead in settled house dust.

Table 11.3 Potential Sources of Lead Containing House Dust.

Source	Process That Contributes to Lead in House Dust	Key Sites
Interior lead-based paint	Deteriorating paint. Friction/abrasion.	All surfaces. Windows, doors, stairs, floors, carpets, rugs, window coverings (drapes and curtains), mats, and upholstered furnishings.
	Impact.	Door systems, openings, baseboards, corner edges, chair rails, and stair risers.
	Water damage.	Walls, trim, windows, and ceilings
	Planned disturbances: (maintenance activities, repainting, remodeling, abatement).	All surfaces coated with lead-based paint.
Exterior lead-based paint	Tracking (by humans and pets) and blowing of leaded dust from weathered, chalked, or deteriorated exterior lead-based paint; also direct contact with such paint.	All exterior lead-based painted components, including porches and window sills.
	Demolition and other disturbances of lead-based paint on buildings and nearby steel structures.	Exposed soil, sandboxes, sidewalks, and window troughs.
Soil and exterior dust	Tracking (by humans and pets) and blowing of exterior soil/dirt contaminated with lead from deteriorating exterior lead-based paint; past deposition of lead in gasoline.	Exposed soil, sandboxes, sidewalks, streets, and window troughs.
Point sources	Releases from lead related industries (i.e., smelters, battery recycling, incinerators).	Location of point sources.
Hobby activities	Cutting, molding, and melting of lead for bullets, fishing sinkers, toys, and joining stained glass. Use of lead containing glazes and paints. Restoration of lead-based painted items.	Rooms in which hobbies are pursued.
Occupational sources	Transport of lead-contaminated dust from the job to home on clothing, tools, hair, and car or truck.	Vehicles, laundry rooms, changing areas, furniture, and entryway rugs.

Leaded dust can be found on surfaces and in crevices throughout a dwelling. Certain surfaces can act as major reservoirs of lead-contaminated dust, including window troughs, worn floors, carpets, and upholstered furnishings (see Table 11.4). Cleaning carpets, upholstered items, and worn floor surfaces can be difficult due to embedded dust and dirt. Furthermore, lead-contaminated dust can rapidly re-accumulate on household surfaces following dust removal if the conditions contributing to the contamination are not controlled (Tohn, 2002; Lanphear, 2000).

Table 11.4 Major Dust Reservoirs and Potential Dust Traps.

Interior		Exterior
Window sills	Upholstered furnishings	Porch systems
Floors/steps	Window coverings	Window troughs
Cracks and crevices	Radiators	Steps
Carpets and rugs	Grates and registers	Exposed soil
Mats	Heating, ventilation, air conditioning filters	Sandboxes

Lead-contaminated dust in carpets and rugs, window coverings (drapes and curtains), mats, and upholstered furnishings is a hazard whether those items are supplied by the owner of the dwelling or by residents. Owners of rental units are responsible for cleaning such items or removing and replacing them only if they belong to the owners. However, the owner should try to provide residents with educational material furnished by a government agency or a qualified lead poisoning prevention organization. Such material should include a warning that carpets and rugs, window coverings, mats, and upholstered furnishings may contain dangerous levels of leaded dust and that those items should be thoroughly cleaned or preferably removed and replaced if they are found to be contaminated.

2. Removing Leaded Dust From a Dwelling

Both large, visible dust particles, and small particles not visible to the naked eye, need to be removed (see Figure 11.13).

A combination of vacuuming and wet cleaning is recommended for leaded dust removal. Use of a HEPA vacuum is preferred. Wet cleaning is conducted with a solution of ordinary household detergent. Trisodium phosphate detergent is banned in many states because of potential environmental impacts, so it is not recommended. Even with special equipment

and procedures, leaded dust can be difficult to remove from dust traps, carpets, non-smooth surfaces, and surfaces abated by paint removal methods such as caustic chemicals (Ewers, 1994; Farfel and Chisolm, 1991; Farfel and Chisolm, 1987b).

Workers and residents removing leaded dust should not spread lead from one household surface to another (cross contamination). Avoiding cross contamination requires special knowledge, equipment, procedures, and precautions to protect residents, workers, and the environment. Enhanced routine cleaning procedures, and practices described in this chapter are recommended for use by property owners over ordinary cleaning practices and procedures. This is not to imply that routine housecleaning is totally ineffective. However, in certain cases, routine housecleaning may need to be augmented by the special procedures detailed in this chapter, since smooth surfaces are easier to clean (see Figure 11.20).

FIGURE 11.20 Turning a Window Sill and Trough Into a Smooth and Cleanable Surface. Window pre-treatment (left) and post-treatment (right).

The cleaning protocol contained in this chapter is different from that used following lead hazard controls and other paint disturbing work, which is described in Chapter 14. The main difference is that only horizontal surfaces (and vertical surfaces undergoing paint stabilization, as explained in Section II of this chapter) are usually cleaned for dust removal. For cleanup following lead hazard control, and other paint disturbing work, walls and horizontal surfaces are cleaned following high dust jobs.

3. Creating Cleanable Surfaces and Determining Whether Dust Removal Alone Is Adequate

A risk assessment is recommended to determine whether the removal of leaded dust alone is an appropriate interim control, or whether other interim controls are needed in addition to dust removal. If no lead-based paint inspection or risk assessment has been performed, the property owner should presume that lead-based paint is present on all painted surfaces and that all horizontal surfaces have excessive dust lead levels.

The rest of this section will describe how risk assessors and owners should check floors and floor coverings to plan for dust removal activities.

- **Check condition of floors.** Smooth and intact floor surfaces, such as vinyl or linoleum sheet goods that still have a smooth finish and wooden floors that have a good finish of sealant (e.g., polyurethane or deck paint) can be effectively cleaned. If a floor surface is not smooth or intact, it will require the application of an appropriate sealer or covering and/or repair in order to make it smooth and cleanable. Examples of non-smooth floor surfaces include floor coverings with worn areas or tears; wood floors with gaps, cracks, splinters, and areas with no sealant coating; unsealed concrete floors; and replacement flooring with no finish treatment (e.g., plywood).

- **Check carpets, rugs, entryways, and mats.** If possible, small rugs and mats should be machine washed. Wall-to-wall carpets and large area rugs in fair to good condition can be cleaned, or removed and discarded, or replaced (see section on carpets/rugs below). Consider discarding rugs, carpets, and mats that are at the end of their useful lives, since cleaning may not be effective (see below for precautions on removal of carpets) (Ewers, 1994; CH2MHILL, 1991).

- **Check for other potential dust traps.** In addition to carpets, rugs, and mats, other potential dust traps include radiators, floor grates and registers, drapes, blinds, and upholstered furnishings. These items should be included in the plan for dust removal. In rental properties some of these items may not belong to the building owner. Owners are responsible for the items they own, while residents are responsible for their own property. However, it may be in everyone's best interest to include all of these items in the dust removal plan.

4. Planning and Preparations

Once it has been determined that dust removal is an appropriate approach, the owner should determine if the dwelling unit will be occupied or vacant while the dust removal is occurring. Dust removal work may be performed by contractors, maintenance staff, or homeowners. Individuals performing the work should be properly equipped and trained in dust removal.

If dwelling units are occupied, the owner should coordinate with residents to ensure that the roles of all involved in the process are clear. The job should be organized so that dust removal work is performed in 1 day to minimize inconvenience to residents. Additional personnel and equipment may be required to perform simultaneous work in multiple rooms.

Role of residents. See Section I.D, above, regarding preventive measures that can be performed by residents.

Owners should provide residents with educational materials prepared by public agencies that indicate how residents can help in removing leaded dust. The materials should indicate that residents should perform the following tasks regarding property the residents own before the professional dust removal occurs:

- Wet wash all cleanable toys the residents own.

- Store all loose personal belongings that need not be professionally cleaned in boxes, closets, or drawers to provide easy access to floors and other surfaces during dust removal.

- Remove drapes and curtains the residents own and collect any washable area rugs the residents own for cleaning. Clean or arrange for cleaning of these items and store them in sealed plastic bags, or have the cleaners keep them until after the housing owner's lead dust cleaning work is completed.

- Wash blankets known to have been unprotected during renovation or remodeling activity that disturbed lead-based paint.
- Wash or dust un-upholstered furniture the residents own using disposable cloths and spray polish.
- Change filters in heating and air conditioning units, except where routinely performed by the property manager.

5. Responsibilities of Owners

Owners should perform the following tasks prior to dust removal:

- Attempt to schedule dust removal when the dwelling is vacant (such as during unit turnover).
- If the unit will be occupied, notify residents of the date dust removal will occur.
- Provide a written notice/flyer from the local health agency with information on resident responsibilities for preparation and cleaning.
- Provide for the safety of occupants.
- Arrange for dust removal of wood or metal components of windows, built in shelving, radiators, floors, porches, owner supplied carpets and rugs, window coverings, mats, upholstered furnishings, and other dust traps.
- Provide and install cleanable "walk-off" mats at interior entryways. This will help residents control exterior leaded dust that may be tracked into the home (Roberts, 1991).
- Ensure that dust removal contractors comply with contract specifications. Large multi-family contracts may require an onsite monitor.
- Obtain written authorization from residents for dust removal where legal authority does not exist for such activity.
- Arrange for clearance examination.

6. Responsibilities of Contractors

Contractors or maintenance staff should perform the following tasks prior to and during dust removal (City of Toronto, 1990):

- Coordinate with residents and owners or managers of property.
- Cooperate with the client's independent, onsite inspector or risk assessor or other authorized project monitor who may be present on large, multi-family dust removal projects.
- Perform work according to contract/work specifications. In the case where the owner's maintenance staff are performing the work, the owner is responsible for the following (otherwise the contractor is responsible).

- Ensuring that workers are properly trained and protected (see Chapter 9).
- Providing all safety and special cleaning equipment and supplies.
- Taking precautions to minimize damage to residents' belongings.
- Moving major furnishings within rooms to facilitate thorough cleaning.
- Responding to residents' questions, complaints, and concerns.

B. Methods of Dust Removal

The objective of any dust removal strategy is to provide a dwelling unit or common area in which the dust lead levels on all horizontal surfaces are less than the clearance levels. Any cleaning method carried out by a property owner is satisfactory if it meets this performance standard and if workers and occupants are fully protected. The procedures in the following pages describe how best to meet that performance standard.

The dust removal strategy presented in this section focuses on horizontal surfaces and dust traps that have accumulations of surface dust and embedded dust. Contractors and owners must use judgment in determining whether walls should be washed. Embedded dust is dust that is trapped within a fiber matrix (such as carpeting), in cracks and crevices (of wooden floors), under carpets, on greasy surfaces, or ground into surfaces. A combination of vacuuming – a HEPA vacuum is required – and wet cleaning is recommended to remove both surface and embedded leaded dust from household surfaces. For upholstered furnishings vacuuming alone is generally recommended.

1. Cleaning Hard Surfaces

The standard dust removal procedure for hard surfaces and components (e.g., hardwood floors and window components) is HEPA vacuuming followed by wet cleaning. One study found that vacuuming hard surfaces at a rate slower than 1 minute per square meter (approximately 10 square feet) did not remove substantially more leaded dust from hard surfaces than faster methods (Ewers, 1994). Therefore, no speed or time restrictions are necessary for hard surfaces (although such restrictions *are* appropriate for carpeted surfaces, as detailed below). On hard surfaces vacuums should be passed over the entire surface with overlapping strokes using normal speed.

General all-purpose household cleaners have been found to be effective for wet cleaning. Although lead specific cleaners may also be effective, one study found them to be no more effective than all purpose cleaners (Lewis et al. 2006). Trisodium phosphate is not recommended. Not only has it been banned in some areas because of negative effects on the ecology of aquatic systems but research indicates that phosphate content is not associated with effectiveness in removing lead-contaminated dust from residential surfaces (EPA, 1997a; EPA, 1998; Lewis et al 2006). Research also indicates that the effort put into the cleaning, i.e., the amount of pressure applied to the surface and the thoroughness of the cleaning, may be more important than the choice of cleaning agent (EPA, 1997a). Whenever a wet cleaner is used, a small area of the surface should be tested to make sure that it does not damage the surface or its coloring. If so, another wet cleaner should be used.

General work practices

- Clean from top to bottom. HEPA vacuum before wet cleaning. On multistory dwellings, start at the top level in the rear room and work in one direction toward the front. Then repeat the process on the remaining floors in sequence. Within a room, start with the highest horizontal surfaces and work down. This will typically result in the following cleaning sequence: tops of window heads, tops of sashes, mullions, and interior and exterior window sills and troughs. Clean dust traps such as radiators, followed by baseboards, and finally floors, vents/registers, and horizontal components of the ventilation ducts that can be easily reached. When practical, work from clean areas to dirty areas to minimize the spread of leaded dust to clean areas. It is usually not necessary to clean walls and ceilings for dust removal unless those surfaces have undergone paint removal or paint stabilization, or substantial leaded dust has been created in the course of other work.
- When vacuuming, use crevice and brush tools where appropriate.
- If possible, place the HEPA vacuum unit on a smooth, hard surface that has been cleaned, or on clean, durable, polyethylene sheeting rather than on a carpet. Vacuum exhaust, even on HEPA vacuums, can disperse dust when the exhaust airstream disturbs settled dust on a surface. A HEPA vacuum that exhausts air from the top or side, rather than the bottom, helps to minimize dust dispersal. (see Figure 11.21).
- Use disposable cleaning cloths or sponges. Be prepared to dispose of them during the cleaning process and replace them with new ones.
- When cleaning household surfaces other than floors, the cleaning solution may be mixed in a plastic jug and poured directly onto sponges or cloths (EPA, 1992a). This procedure is designed to minimize the contamination of the cleaning solution with leaded dust. Frequently rinse the sponge/cloth in a bucket of clean water.
- For floors, a three bucket system is recommended to minimize the potential for spreading leaded dust from one location to another. The cleaning solution should be mixed in one bucket. Dirty water is squeezed into a second bucket. A third bucket should contain rinse water for the mop head. Frequently, at least once per room, change the rinse water in the bucket. Use a string mop

How to use a HEPA vacuum

1. Lightly mist area with water to keep dust levels down
2. HEPA vacuum all horizontal surfaces

Start at the end farthest from the main entrance/exit. As you vacuum, move towards the main exit and finish there.

Begin at the top of each room and work down. For example, start with the top shelves, the top of the woodwork, and so on, and work down to the floor. Do every inch of the windows, especially the window troughs.

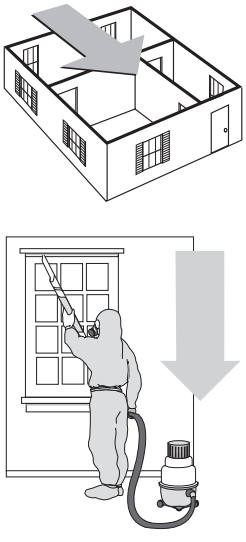
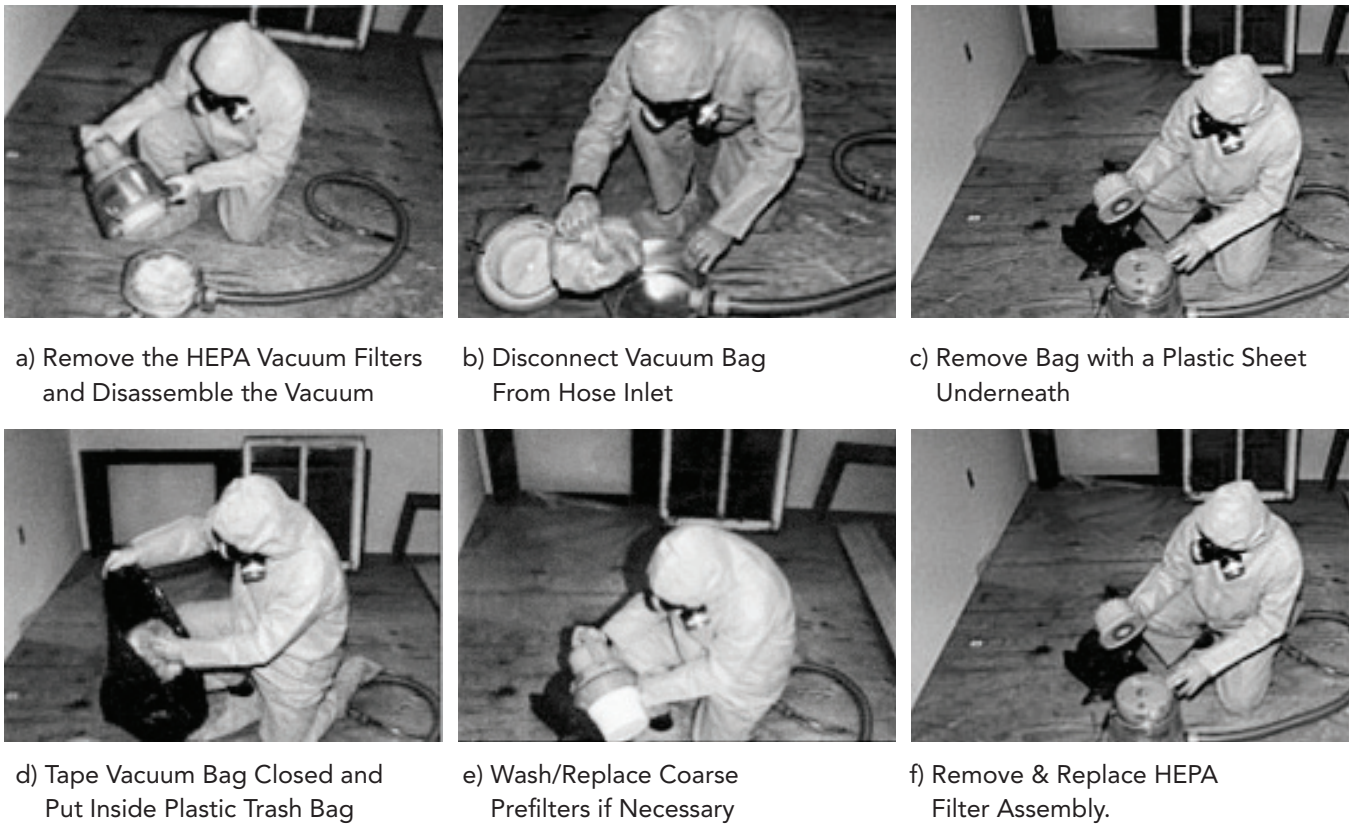


Figure 11.21 How to Use a HEPA Vacuum.

if possible. A sponge mop is likely to just push the dirt in front of it. A final cosmetic rinse is recommended using clean water.

- Clean until surface dust is no longer visible. After cleaning a window sill or a floor, rinse with clean water using a new sponge or cloth.
- To make a cleaning solution, mix with water according to the manufacturer's instructions for recommended concentrations. When using the cleaner, wear gloves and eye protection gear. Follow all manufacturer's instructions and precautions.
- Whenever possible, clean floors and pads underneath rugs and carpets.
- For dust removal projects in multi-family housing, a truck-mounted vacuum unit with a HEPA filter exhaust is preferable. Since the exhaust stream is located outside the dwelling it is not likely to disturb dust inside the dwelling.
- In a controlled environment capable of capturing any dust released by the procedure, remove and dispose of vacuum cleaner bags and filters offsite, according to the manufacturer's instructions. If the filters and/or bags need to be changed onsite in the middle of the job, take the vacuum unit outside the house if practicable. (see Figure 11.22).
  - If filters and/or bags must be replaced outside the building, but still on the property:
    - place the vacuum on a sheet of plastic,
    - replace the filters and/or bags,
    - wet clean the outside of the vacuum,
    - vacuum the plastic,
    - pull up the plastic,
    - vacuum the immediate area, and
    - dispose of the plastic.
  - If filters and/or bags must be replaced inside the building:
    - place the vacuum on a sheet of plastic,
    - replace the filters and/or bags,
    - wet clean the outside of the vacuum,
    - vacuum the plastic,
    - pull up the plastic,
    - vacuum and wet clean the immediate floor area, and
    - dispose of the plastic.



a) Remove the HEPA Vacuum Filters and Disassemble the Vacuum

b) Disconnect Vacuum Bag From Hose Inlet

c) Remove Bag with a Plastic Sheet Underneath

d) Tape Vacuum Bag Closed and Put Inside Plastic Trash Bag

e) Wash/Replace Coarse Prefilters if Necessary

f) Remove & Replace HEPA Filter Assembly.

Figure 11.22 Changing HEPA vacuum filter.

2. Removal or Cleaning of Carpets

Carpeting and area rugs (all referred to here as carpets) can be major traps and reservoirs of leaded dust. Dust embedded in the fibers of carpets and rugs is not easily removed by cleaning.

The two methods of cleaning carpets that are generally available for residential settings are dry vacuuming and hot water extraction vacuuming (which can deliver detergents as well as heated water). Based on limited research, it appears that dry vacuuming has greater efficiency in removing embedded dust particles from carpets than hot water extraction with detergents (Lewis, 2002; Brown, 1982; CH2MHILL, 1991). Wet methods may be a useful supplement to dry vacuuming, especially if the dust is oily, as perhaps from kitchen aerosols.

The fundamental difficulty in cleaning carpets with deeply embedded dust lead is that (1) it is often difficult to remove a high percentage of the deep dust, yet; (2) unless most of the deep dust is removed, periodic vacuuming is likely to draw contaminated dust to the surface, where it is available for exposure to young children. Research indicates that dust lead hazards can be removed from most carpets by sustained vacuuming. The cost of removal from some carpets may exceed the cost of replacement (Ewers, 1994; Roberts, 2004; Roberts, 1999).

Deciding whether to clean or dispose of carpets. The first step in carpet dust removal is to decide if the carpet is going to be cleaned onsite, removed for disposal, or removed for

professional offsite cleaning. It may be preferable to dispose of carpets that are in poor condition or those known to be highly contaminated with lead. In fact it may be more costly to clean a lead-contaminated carpet or rug than to replace it.

Research has found that the following factors are associated with difficulty of dust removal from carpets and rugs:

- **The height and density of the pile**. Shag rugs are most difficult because the longer fibers retain dust particles (Wang, 1995; EPA, 1997c). High density, plush carpets are more difficult than low density, low pile carpets (Lewis, 2002).
- **Wear.** Worn carpeting may have more tangled fibers that make it difficult for dislodged dust particles to travel to the vacuum nozzle (Lewis, 2002). New rugs that have been recently soiled are easier to clean.
- **High dust lead loading.** Very high dust lead loadings are associated with lower collection efficiency (Wang, 1995; EPA, 1997c).
- **Duration of contamination.** The longer the duration of contamination, the more likely the dust particles are deeply embedded.
- **Low relative humidity.** Low humidity may intensify the electrostatic field between the dust particle and the fiber, making it more difficult to dislodge the particle (EPA, 1997c; Wang, 1995).

Removal of carpets. When a carpet or rug is going to be removed from a dwelling for either disposal, or offsite cleaning, the following procedure is recommended to minimize the exposure of workers and residents to leaded dust:

Mist the entire surface of the carpet to keep dust from spreading. Carefully roll up the carpet along with any padding. Wrap the carpet in a sheet of plastic, seal it with tape, and remove it from the dwelling.

If the padding is not going to be removed, clean it using the lead hazard control procedures for cleaning an area rug (see below). Note that the cost of replacing padding is often less than the cost of cleaning it.

Removal of a wall-to-wall carpet may generate significant amounts of airborne lead-contaminated dust, even more than removal of a area rug. Worksite preparation should be similar to a high dust job (see Chapter 8), although, of course, protective sheeting should not be placed on the carpet that is being removed. Furniture that cannot be moved from the room should be covered with impermeable protective sheeting. Removal of an area rug generates less dust if done according to the guidance in the previous paragraph, so it can be handled as a low dust job. Always vacuum the floor after removing the carpet so leaded dust is not tracked to other parts of the dwelling. (The floors may be wet washed after vacuuming if they are made of a material that will not be damaged by large amounts of water on them; they should be vacuumed again after they are dry.)

Selecting a vacuum. Vacuum cleaners used for cleaning up dust as a lead hazard control measure must be high efficiency particulate air (HEPA) vacuums if the work is covered by OSHA's Lead in Construction rule, EPA's RRP Rule, or HUD's LSHR. (See Appendix 6, and, in particular, 29 CFR 1926.62(h)(4), 40 CFR 745.85(b)(2)(A) and (B), and 24 CFR 35.145 and 150(b), respectively.)

HEPA vacuums differ from conventional vacuums in that they contain high-efficiency filters that are capable of trapping extremely small, micron-sized particles. These filters can remove particles of 0.3 microns or greater from air at 99.97 percent efficiency or greater. (A micron is 1 millionth of a meter, or about 0.00004 of an inch.)

(Some vacuums are equipped with an ultra-low penetration air (ULPA) filter that is capable of filtering out particles of 0.13 microns or greater at 99.9995 percent efficiency. However, these ULPA filters are slightly more expensive, and may be less available than HEPA filters.)

The characteristics of a vacuum that are associated with effectiveness of cleaning carpets are:

- **Particle lifting velocity.** This appears to be a function of the design of the nozzle as well as the suction (static pressure in the nozzle). High suction alone does not predict efficient dust lead recovery. Vacuum velocity may be more important with shag carpets than with other types of pile. (Wang, 1995; Lewis, 2002; EPA, 1997c).
- **An effective agitator bar, or beater bar.** A power driven agitator helps dislodge dust particles and can significantly increase dust collection efficiency (Roberts, 1991; CMHC, 1992; Ewers, 1994; Lewis, 2002; EPA, 1997c; CH2MHILL, 1991).
- **Filters and/or bags that capture the dust particles.** HEPA filters are preferred from a technical perspective, in addition to being required by regulations in most cases (see above), because they are likely to catch very small particles that may include allergens as well as lead. However, recent research indicates that very little dust escapes through the exhaust of good-quality non-HEPA vacuums (EPA, 1995c; Rich, 2002; Yiin, 2002; California Department of Health Services, 2004). Also, some manufacturers of conventional vacuums offer filtration systems that capture smaller particles than do traditional systems. Therefore, if a HEPA vacuum is not required by regulation and is not available, a good-quality non-HEPA vacuum can be used effectively, especially if it is fitted with a "HEPA-type" or "Allergy" filter bag (EPA, 2000a).
- **Durability.** Removal of deep dust by vacuuming may take hours, depending on the size of the carpet and its condition. Continual, weekly vacuuming is advised to maintain a nonhazardous surface. Therefore, it is important to have a vacuum that will withstand frequent use and continue to be effective in dust collection.

One study concluded that a vacuum to be used for deep dust removal "should be a high quality, durable, traditional upright (with beater bar), two motor upright (with beater bar), or two motor canister (with powered head)" and that a HEPA filter is advisable (Lewis, 2002). Another researcher has found that a vacuum fitted with a dirt sensor is very useful. The sensor measures the amount of dust being picked up and shows when no more dust or dirt is being collected (Roberts, 1999; Roberts, 2004).

Duration of vacuuming. The vacuuming time required to remove enough deep dust from old carpets to assure that the surface lead loading will be reduced varies with the factors described above under "Deciding whether to clean or dispose of carpets." Reported times have varied from 2 to 85 minutes per square meter (10 sq. ft.) (Roberts, 2002). Intensive vacuuming is necessary to remove embedded dust from old carpets (see Table 11.5).

Table 11.5 Rug Cleaning Steps and Approximate Time Per 10 Square Feet.

Step	Description	Time/10 ft^2
1	HEPA vacuum pile side of rug with beater bar at a rate no faster than 1 minute for every 10 square feet.	60 seconds
2	Fold rug in half and HEPA vacuum bottom of rug without beater bar at a rate no faster than 1 minute per 10 square feet for traditional rugs, or normal speed for manufactured carpeting with plastic backing.	60 seconds for traditional rugs, or Approximately 10-30 seconds for manufactured carpeting with plastic backing.
3	HEPA vacuum bare floor and any padding (no rate restriction or beater bar).	Approximately 10–60 seconds
4	Fold other half of rug over and repeat steps 2 and 3 (no rate restriction and no beater bar).	Approximately 10–140 seconds
5	Fold rug back over so it is in its original position.	Approximately 10–30 seconds
6	HEPA vacuum top side of rug a final time with the beater bar. The rate is no faster than 2 minutes per 10 square feet.	120 seconds
	Total Approximate Time	**4.0–8.0 minutes**

Cleaning area rugs. If cleaning of area rugs is done onsite, the following steps are recommended:

- First, vacuum the pile side (the top side) with a vacuum equipped with a beater bar, or agitator attachment, on the vacuum head at a rate *no faster than* 1 minute for every 10 square feet.
- Fold the rug in half, exposing the backing of half of the rug. The backing of the rug should be vacuumed without using the beater bar attachment (City of Toronto, 1990) at a rate of 1 minute per 10 square feet.
- Vacuum the exposed pad under the rug, if present, at normal speed and fold back over the rug.
- Vacuum the exposed floor beneath the rug at normal speed, and unfold the pad and rug.
- Fold the rug in half again, exposing the backing of the other half of the carpet, and repeat the vacuuming of the bottom of the rug, the pad, and the floor underneath.
- Unfold the pad and rug.
- Vacuum the pile side of the rug again using the beater bar attachment. Vacuum at a rate no faster than 2 minutes per 10 square feet.

Consideration should be given to a final cleaning step consisting of a steam cleaning of the pile side of the rug. Steam cleaning can remove additional, but limited, amounts of lead from

rugs (CH2MHILL, 1991). This cleaning can be done by the contractor or owner using commercially available equipment. For multi-family buildings consideration should be given to the use of truck-mounted cleaning equipment since it may be significantly more powerful than typical rental equipment for residential use.

Cleaning wall-to-wall carpeting.
For cleaning wall-to-wall carpeting (see Figure 11.23), the following procedure is recommended:

Vacuum carpeting with a vacuum equipped with a beater bar or| agitator attachment on the vacuum head. The beater bar helps to dislodge embedded dust. The total vacuuming time recommended is at least 4 minutes per 10 square feet of carpeting (Ewers *et al*., 1994), divided into two segments of at least 2 minutes for each 10 square feet. The two vacuuming segments are performed in perpendicular directions. For example, the first segment may be done in an east-west direction, while the second is done in a north-south direction.

The provisions regarding steam cleaning and suitability of general all-purpose household cleaners discussed in Section V.B.1, above, apply to wall-to-wall carpeting.

Figure 11.23 Carpet with debris and after cleaning.

3. Cleaning Upholstered Furniture

The first step in dealing with upholstered furnishings is to determine if the item is going to be discarded or cleaned. It may be preferable to dispose of items that are in poor condition or known to be highly contaminated with lead.

The recommended dust removal procedure for upholstered furniture is vacuuming. Upholstery surfaces should be vacuumed with three to five passes over each surface at a total rate of 2 minutes per 10 square feet. Steam cleaning, and other wet cleaning procedures are generally not recommended because they may damage fabrics. However, newer steam cleaners have a water extraction feature to prevent water damage to fabric. If wet cleaning is desired, test a small section of the fabric for color fastness before cleaning the entire surface.

Cloth throw covers, slipcovers, or fitted vinyl covers should be provided for all cleaned, upholstered items. This is particularly important for items at the end of their useful lives that would not hold up well under an aggressive vacuuming. A cloth cover material that can be easily removed and washed should be selected.

4. Forced Air Systems and Drop Ceilings

If the ceilings or forced air systems contain leaded dust, they may present a hazard to maintenance or renovation workers who access them (City of Toronto, 1990).

Where possible, return and supply air vent registers that can be easily removed should be taken out, vacuumed, and wet cleaned (see Figure 11.24 and 11.25). If the vent registers are sealed to the wall or floor with paint, the edges should be misted and scored to help free the vent register with a minimum of leaded dust generation.

Air vent registers that cannot be easily removed should be vacuumed and wet cleaned in place. The horizontal surfaces in the ductwork that can be easily reached with the vacuum attachment should be cleaned. Water should not be poured down the air duct to clean the vent register; wiping with a damp sponge or mop is adequate. Take care not to cut hands on sharp metal in the vent.

Clean or replace the air filters on heating units and air conditioners with new filters at the time of dust removal. Used filters should be placed in plastic bags and sealed prior to disposal to minimize the potential spread of leaded dust.

Figure 11.24 Air vent before and after cleaning.

a. Vacuum and remove register covers;

b. Vacuum Accessible Parts of Duct Opening

c. Wet wash register covers and replace

Figure 11.25 Clean Air Vent Registers

Leaded dust in non-forced air systems and drop ceilings is not considered a hazard to residents unless major disturbances of the ducts or ceilings are planned, such as repairs or relocations of ducts. When major disturbances of any type of duct or ceiling work are anticipated, cleaning will probably be warranted. This includes instances when forced air systems have the direction of airflow reversed during maintenance.

5. Resident Protection

To facilitate dust removal work and provide protection for occupants, only workers and their supervisors should be in the work area during the dust removal process. This will also help ensure that work can be completed in 1 day. Worksite preparation for low dust jobs is usually adequate for dust removal unless lead-contaminated wall-to-wall carpets are being removed.

In addition, disposable or easily cleaned walk-off mats (door mats) should be placed at entryways to control the tracking of leaded dust into the dwelling (see Figure 11.26).

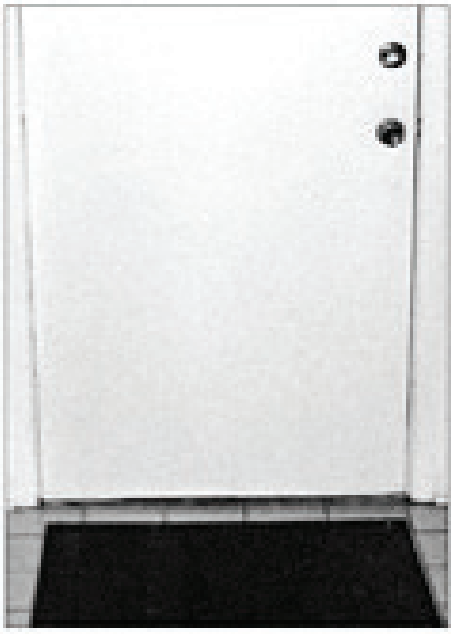


FIGURE 11.26 Walk-Off Mats

C. Follow-up to Dust Removal

If the clearance area may have had high lead levels before the work and/or has rough horizontal surfaces that may make clearance difficult, the owner or contractor may consider using a pre-clearance screen before calling the clearance examiner. See Section II.J, above, for additional information.

Lead-based paint inspectors, risk assessors, or sampling technicians performing clearance examinations should check to see that all visible dust, debris and residue have been removed from the dwelling before collecting dust samples. (See Chapter 15 for information on clearance.) The clearance dust sampling results will provide a means of checking that lead levels have been reduced by the dust removal work, and will serve as a baseline for comparison to future test results.

In addition to the standard EPA and HUD requirement to perform clearance on carpeted as well as uncarpeted floors, if area rugs have been cleaned as a lead hazard control measure, they, too, should be cleared in order to demonstrate the effectiveness of the cleaning.

Since it has been shown that lead-contaminated dust can re-accumulate on household surfaces following lead-based paint abatement and dust removal alone (Lanphear, 2000; Farfel and Chisolm, 1987b; Jacobs, 1992; Clark, 1993), ongoing lead-safe maintenance and professional reevaluation of the dwelling, resident education, and continued cleaning are important elements of a dust removal plan.

Educational materials prepared by State or local government agencies, or lead poisoning prevention organizations should explain the need for periodic wet cleaning of household surfaces, with particular attention to dust traps and reservoirs, and the importance of the r disposal of air conditioning and heating unit filters that are routinely cleaned or replaced by the residents. Some owners and municipalities provide cleaning kits to residents to encourage and support their ongoing dust removal efforts. (See Chapter 2 and Section I of this chapter for information on resident education.)

VI. Soil Interim Controls

How To Do It

1. **Plan Soil Interim Controls.**

   - ✦ Select appropriate soil interim controls, which may include soil alterations, soil surface coverings, land use controls, reduction of soil tracking, or drainage and dust controls.
   - ✦ Prepare a site plan of the yard, showing the soil lead hazard controls. Retain plans for use in ongoing monitoring.

2. **Contain and dampen dust.** Prepare worksite in accordance with guidance in Chapter 8. Use water to contain dust during the work, and clean play equipment.

3. **Establish soil alteration.** Impermanent surface coverings include grass (as seed or sod), other ground covers (e.g., ivy), artificial turf, bark, mulch, and gravel. If the area to be controlled is heavily traveled, impermanent surface coverings, such as grass, are not appropriate.

4. **Put soil surface coverings in place.**

   - ✦ If grass is selected, consult with the local agriculture extension service, or a reputable local nursery, to determine what grasses are appropriate for the locale, soil type, and sun/shade characteristics. Properly prepare the soil prior to seeding or sodding.
   - ✦ If mulch or bark is selected, apply the covering 4-6 inches deep (3 inches is more appropriate for gravel). New bark, gravel, or other materials should not contain more than 200 µg/g of lead, if possible, and never more than 400 µg/g.
   - ✦ If live ground covers (including grass) are selected, it is imperative that they are properly watered during the first 3 months and adequately maintained thereafter. Automatic sprinkler systems are appropriate for large properties.
   - ✦ If the soil is in a public recreation area, comply with Consumer Product Safety Commission standards on acceptable surface coverings in play areas.

5. **Install land use controls.** Land use controls include fencing, warning signs, changes in administrative practices, creation of alternative play areas (such as decking), and thorny bushes.

6. **Drainage and dust controls.** Control water erosion by proper grading to pitch the slope away from the building and installing drainage channels (drainage channels may need to be fenced or covered if they are accessible). Control wind erosion by periodic watering, windbreaks, or foot traffic controls.

7. **Reduce dust tracking.** Provide walk-off doormats at all entryways to reduce the tracking of contaminated dust and soil into the dwelling.

8. **Perform ongoing monitoring and maintenance.** Perform ongoing monitoring and maintenance of soil coverings and land use controls. If ongoing monitoring shows that bare soil remains, or reappears within 12 months of an interim soil control, the interim controls are not effective. Soil abatement should be conducted (see Chapter 12), unless other interim controls can be shown to be effective for the specific site.

9. **Reevaluation.** If required by regulation or the property owner or manager's preference, conduct reevaluations every two years in accordance with guidance in Section VII of Chapter 5.

A. Definition of Soil Lead Hazards

A soil lead hazard in residential property is bare soil that contains total lead equal to or exceeding:

- 400 parts per million (or µg/g) for play areas frequented by children under 6 years of age, or
- 1,200 parts per million (or µg/g) for other parts of the yard including the dripline/foundation area in non-play areas.

These values are from the federal lead hazard standards rule (at 40 CFR 745.65(c)). State and local standards may vary; if lower, they apply to the housing.

EPA does not provide for a *de minimis* area of bare soil outside the play area that can exceed the 1,200 µg/g standard, such as the 9 square feet per property that HUD had incorporated into its Lead Safe Housing Rule (24 CFR 35.1320(b)(2)(ii)(B)) issued 1½ years before the EPA issued the lead hazard standards rule. EPA noted that it had no analysis or data that relate the amount of bare soil to risk, and the incremental cost of including soil testing in a risk assessment is small. As noted in Chapter 5 of these *Guidelines*,

> "However, EPA highly recommends using the HUD Guidelines for risk assessment…. This would avoid declaring very small amounts of soil to be a hazard in the non-play areas of the yard. This would also help target resources by eliminating the need to evaluate soil or respond to contamination or hazards for properties where there is only a small amount of bare soil."

Once soil sampling establishes that a yard has soil lead hazards, it can be useful to create a map of soil lead concentrations in the yard, such as by using an XRF analyzer that is capable of direct measurement of soil lead concentrations (EPA, 2001a), or by soil sampling and analysis (see Chapter 5, Sections II.C and IV, respectively). This information can be useful for developing a customized interim control plan for the particular yard.

B. Temporary and Permanent Soil Treatments

Interim measures for controlling soil lead hazards include surface coverings with grass, gravel, mulch, wood chips, or similar materials, or land use controls, such as fences, thorny bushes, or decks, for preventing contact with the contaminated soil. These interim controls are designed to temporarily reduce exposure. How long they remain effective depends on many factors, including the durability and maintenance of the cover, amount or degree of foot traffic, and climate.

Soil abatement measures are described in Chapter 12, Section V. If the control measure consists of replacing soil that is a soil-lead hazard (see Section A, above) with soil of acceptable lead levels, or includes installing a permanent cover, such as asphalt or concrete, the method is classified as abatement.

C. Types of Interim Control Measures for Soil

Five types of measures may be used as part of an interim control plan for soil. They are:

- Measures that alter the contaminated soil.
- Measures that alter the surface cover.
- Land use controls.

- Measures that reduce soil tracking
- Measures to reduce offsite drainage or dispersal of the contaminated soil.

Each of these activities should be carried out in a manner that prevents further dispersal of the contamination and prevents the area undergoing the interim control treatment from being contaminated in the process. Work practices for soil interim controls are similar to those for soil abatement and are described more fully in Chapter 12, Section V.

1. Soil Alteration

Interim controls usually involve some alteration of the soil. Examples include surface cultivation, additives, or rototilling clean soil into existing soil to assist in establishing ground cover (e.g. grass, ivy). Grading of the soil is sometimes needed to assure proper drainage. Typically surface alteration is not effective enough to be used as the sole interim control measure. Tilling and mixing the soil to a depth of at least 8 inches may be effective. The addition of clean soils and compost can be used to reduce the lead concentration of vegetable garden soils that are only slightly above the recommended maximum 400 ppm lead concentration, however, for highly contaminated garden soils the contaminated soil should be removed and replaced with clean soil or the garden should be relocated.

2. Soil Surface Cover

The most common form of soil interim control is surface covering that creates a barrier between leaded soil and children. Typical materials include bark mulch, pea gravel, crushed stone, grass seeding, sod, other live ground covers (e.g., juniper, shrubs, ivies), and paving stones. Except with installations of grass seed or sod, a water permeable landscape fabric should always be used to create a barrier between the soil and the installed material. Landscape fabric controls for weeds, creates a clear barrier to leaded soil, and visually signals when the installed material needs to be replenished.

The choice of a covering for a particular area depends on the climate, expected use, planned maintenance, and aesthetic preferences. For aesthetic as well as practical reasons, a property owner may choose to improve the surface cover over an entire soil area even though only a portion is bare.

The success of grass and other live ground covers is dependent on proper planting, adequate water and sunlight, regular maintenance, and most importantly, the ability to control the use of the area. In high traffic areas use of grass as an interim control is unlikely to succeed. Where access to an area can be controlled, or where use is expected to be limited, grass and other live ground covers can be successful interim controls. Some ground covers, such as juniper bushes, can also effectively limit traffic through an area. Shade tolerant ground covers such as ivies are better suited than grass for areas that receive little sunlight.

Before using grass or live ground covers as an interim control measure, a property owner should consult with a lawn care professional about soil preparation, appropriate grasses and plants to use, and future maintenance requirements. The county cooperative extension service or a reputable local nursery may be contacted for advice on types of grass or other ground cover to be used in specific geographic areas and for specific soil types, slope, and sunlight conditions. Table 11.6 offers a brief summary of grass types and their suggested uses.

The local office of the U.S. Department of Agriculture's Natural Resources Conservation Service (***http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/home***) may also be able to provide advice about soil conditions in a specific geographic area. An owner of a large property may consider installing a sprinkler system to improve the maintenance effort. In any event some type of hose and sprinkler system should be made available.

An owner should consider whether sod or seeding is more appropriate when planting grass. Both grass seed and sod require restrictions on foot traffic until root systems and stems become established. Newly laid sod requires at least 2 weeks, while grass seed requires 1 to 2 months (Lane Publishing, 1989; Maryland Cooperative Extension, 1994). Sod can be laid during most of the year (as long as the ground is not frozen) and requires less initial care. However, sod is more expensive than seeding and is less likely to develop the deep root systems that will allow the grass to withstand regular wear and tear. It is best to lay sod during the growing season.

At least 3–4 inches of bark, mulch, wood chips or gravel are recommended to serve as a temporary ground covering (see Figure 11.18). If the covering is more than 3 inches thick, water will not reach plantings that may be in the area. Four inches is recommended for play areas. This level of material can be achieved by constructing a raised bed framed with 2" x 6" ACQ (alkaline copper quaternary) pressure-treated lumber. ACQ-treated lumber (or newer composite/non-wood materials) contains no EPA-listed hazardous compounds, whereas chemicals used in traditional pressure-treated lumber include compounds of, in addition to, copper, chromium and arsenic (commonly referred to as CCA-treated lumber), which may leach into the environment. Rock or other edging material may be used instead of lumber, depending on site specific conditions.

Do not use mulch made from recycled building components unless it has been tested and found to contain less than 400 µg/g of lead. EPA requires that replacement soil used in soil abatement contain less than 400 µg/g of lead. If possible, replacement bark, mulch, wood chips, and added soil should contain no more than 200 µg/g of lead, in order to provide a further safety factor.

Bark or other suitable soft material should be used as surface cover for contaminated soil near play equipment. This will offer a degree of protection from injuries that may result from falling. Consumer Product and Safety Commission regulations dealing with acceptable surface coverings in play areas may apply to public areas (CPSC, 1991). Artificial turf can also be used, but may cause drainage problems if it is not permeable.

Rubber cushioning specifically designed for playgrounds can also be used to cover contaminated, bare soil in play areas.

3. Raised Beds and Other Landscaping Options

The installation of raised beds can be an effective control measure in areas with high soil lead levels where grass would not be expected to grow well. They are often well suited for use in the drip zones of homes (i.e., the area extending approximately 3 ft. from the foundation). The beds can be created using 2" x 6" ACQ pressure-treated lumber, using landscape fabric to cover the ground followed by the application of top soil and mulch if the beds will be planted. If the beds are not planted, mulch, woodchips, or gravel can be placed directly over the landscape fabric.

A cost-effective approach to treat bare foot paths is to place stone or concrete stepping stones along the pathway and cover surrounding bare soils with a layer of gravel or mulch.
An option for play areas and picnic areas with contaminated bare soils is to create raised wooden platforms using ACQ pressure-treated lumber. This may be especially appropriate for small yards where relocation of such activities within the yard area is not possible.

4. Land Use Controls

Altering the use pattern of the yard is another common way to control human exposure to bare, contaminated soil. Measures include: fencing, to create a barrier to contaminated soil; planting thorny or dense bushes (see Figure 11.27) to discourage access; decks with lattice added below to restrict access to soil under the deck; relocating play areas to move a play area away from old painted structures, such as a fence or shed, and away from areas with high soil lead levels; warning signs; and educational efforts.

Preventing access to the bare, contaminated soil by fencing is most effective if other entrances and exits to the housing units can be maintained for use by residents, guests, commercial vehicles, and emergency vehicles (see Figure 11.28). Fencing may also be used to reduce exposure during a delay in the implementation of other interim control measures or soil abatement.

Educational efforts directed towards decreasing use of bare, lead-contaminated areas; avoiding eating or drinking in these areas; and frequent washing of hands may serve to reduce ingestion of the contaminated soil. The decision on whether to plant grass or erect barriers should be site-specific. Consideration should be given to the availability of alternative play areas, the location of contaminated soil with respect to entrances or exits, the likelihood that leaded dust may be tracked onto sidewalks or directly into the housing unit, the degree of supervision available, and local preferences.

FIGURE 11.27 Thorny Bushes as a Land Use Control

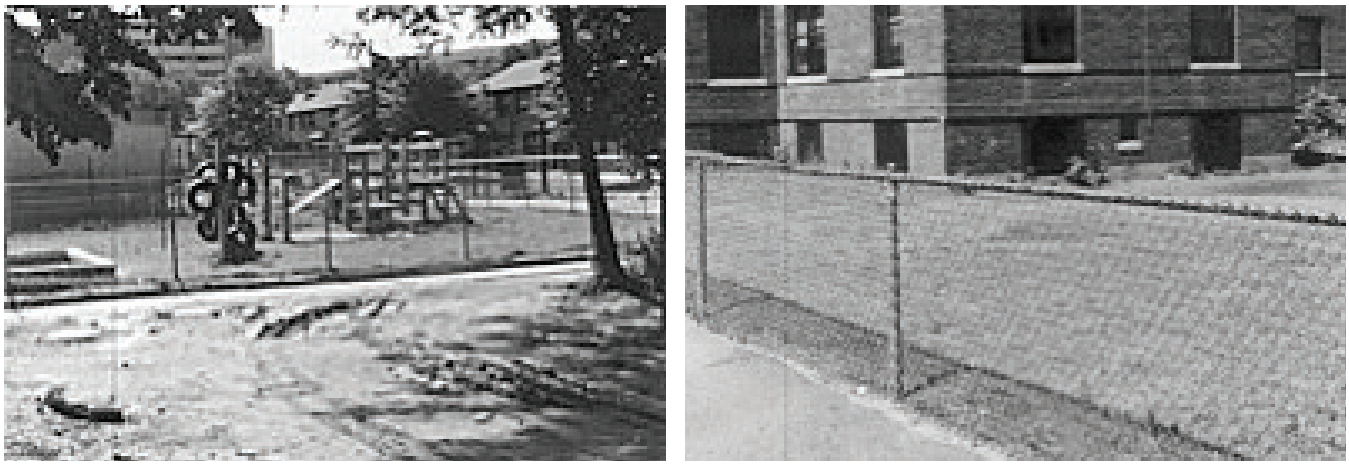


FIGURE 11.28 Using Fencing as an Interim Control. a) For Bare Soil. b) For other soil.

Table 11.6 Grasses and Their Appropriate Applications.

Grasses That Grow From Seeds	Texture	Climate	Durability
Bahia grass	Coarse	Warm	Excellent
Colonial Bent grass	Fine	Cool	—
Creeping Bent grass	Fine	Cool	—
Common Bermuda grass	Medium to Fine	Warm	Excellent
Kentucky Bluegrass	Fine	Cool	—
Rough Stalk Bluegrass	Fine	Cool	—
Centipede grass	Medium to Fine	Warm	—
Dichondra	Coarse	Warm	—
Chewings Fescue	Fine	Cool	Poor
Creeping Red Fescue	Fine	Cool	Poor
Hard Fescue	Fine	Cool	—
Tall Fescue	Coarse	Cool	Moderate to Excellent
Annual Ryegrass	Coarse	Cool	—
Perennial Ryegrass	Fine	Cool	Excellent
Grasses That Grow From Sod	**Texture**	**Climate**	**Durability**
Bahia grass	Coarse	Warm	Excellent
Hybrid Bermuda grass	Fine	Warm	Excellent
Kentucky Bluegrass	Fine	Cool	—
Centipede grass	Medium to Fine	Warm	Poor
Dichondra	Coarse	Warm	—
Tall Fescue	Coarse	Cool	—
Seashore Paspalum	Medium	Warm	—
Perennial Ryegrass	Fine	Cool	Excellent
St. Augustine grass	Coarse	Warm	—
Zoysia grass	Fine	Warm	Excellent

5. Reduction of Soil Tracking into Dwellings

Doormats can be used to minimize the entry of soil lead into the house. Doormats should be placed on the exterior and immediate interior of the entry doors. Mats should be cleaned by machine washing, or other wet methods, not by beating or sweeping. (See Section V of this chapter for further information.)

Removing shoes at the doorway also greatly minimizes the amount of leaded soil and dust tracked into the house.

6. Drainage and Dust Controls

Drainage controls may involve directing water flow away from the contaminated areas by alterations in adjacent grades and/or installation of drainage channels. Drainage channels that receive runoff from bare, contaminated soil areas may need to be fenced to reduce access. Dust generation can be reduced by periodic watering, the creation of windbreaks, or foot-traffic controls.

D. Making a Plan

It is recommended that a site plan of the yard be drawn to aid in planning soil lead hazard controls, and to serve as a documentation of the type and location of controls for future reference. The hazard control plan should be based on the nature and extent of hazards, yard use, topography, cost, future maintenance considerations, and property owner preference. In most situations, there is a range of acceptable treatments. Decisions are usually site specific. Working with a qualified landscaping professional to develop standards, details, and bid documents is recommended.

Often owners will be partial to certain types of soil lead hazard treatments (e.g. grass, gravel, mulch, fencing). Owners' preferences need to be balanced with lead levels, yard uses, and budget when selecting treatment methods. For example, an owner may want a lawn but grass treatments can be difficult to sustain in an urban yard due to excessive shade, compacted soil, or lack of watering by an owner. Property owner involvement in decision making will help motivate owners to maintain lead hazard control measures over time. Some important questions to ask during planning are:

- How highly contaminated is the soil?
- How is the yard used? Play, gardening, pets, picnicking, parking?
- Does the yard have primarily sunny or shady conditions?
- Are the plants selected appropriate to the yard conditions and region of the country?
- What is the budget for the project?
- Who will maintain the yard improvements after the work is completed?

E. Guidance on Specifications for Interim Controls of Soil Lead Hazards

Appendix 7.4 includes suggested language that may be helpful in drafting specifications for methods and products used in interim controls of soil lead hazards is provided below, and notes to specification developers.

Specification developers may adapt the specification language as needed to fit each particular site and each plan or design. Landscape contractors may be unfamiliar with the issue of lead in soil. Their standard practices may not be in line with lead-safe treatment methods. It is advisable to work closely with contractors on their first few lead-safe jobs to ensure that they are clear on how to properly implement interim controls. If abatement of soil lead hazards is planned, specifications should be written by a person certified in accordance with regulations of EPA or an EPA-authorized state, tribe or territory.

F. Monitoring and Maintaining Soil Interim Controls

If grass or sod is planted, or if bark, gravel, or other similar covering is used, it should be monitored visually. The monitoring should occur frequently immediately after installation and can be reduced thereafter. If ongoing monitoring shows that bare soil remains or reappears within 12 months of an interim soil control, the selected interim control is not effective. Soil abatement should be conducted (see Chapter 12), unless other interim controls can be shown to be effective for the specific site.

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Chapter 12: Abatement

FIGURES

TABLES

Chapter 12: Abatement

Abatement – How To Do It

1. **Arrange for risk assessment or paint inspection**. Have a lead hazard risk assessment or lead-based paint inspection performed by a certified risk assessor or a certified inspector who is independent of the abatement contractor.

2. **Develop hazard control plan**. Develop a site-specific lead hazard control plan based on the hazards (risk assessment) or lead-based paint (inspection) identified and financing available. Prepare the work area (see Chapter 8); avoid high-dust jobs and procedures.

3. **Obtain waste permits**. Have the contractor obtain any necessary building or waste permits; notify local authorities if the local jurisdiction requires it.

4. **Select needed materials**. Together with the contractor (or designer or risk assessor), select specific building component replacement items, enclosure materials, paint removal equipment and/or chemicals, tools, and cleaning supplies. Consider waste management and historic preservation implications of the selected treatment.

5. **Develop specifications**. Develop specifications (usually for large projects only).

6. **Schedule other construction work**. Schedule other construction work so that leaded surfaces are not inadvertently disturbed and unprotected workers are not placed at risk. Include time for clearance examinations and laboratory dust sample analysis in the scheduling process (see Chapters 3 and 15).

7. **Select a contractor**. Select a certified abatement contractor using the lowest *qualified* bidder.

8. **Conduct preconstruction conference**. Conduct a preconstruction conference to ensure the contractor fully understands the work involved (for large projects only).

9. **Notify residents**. Notify residents of the dwelling and adjacent dwellings of the work and the date when it will begin. Implement relocation (if appropriate).

10. **Correct housing conditions that might impede work**. Correct any existing conditions that could impede the abatement work (e.g., trash removal, structural deficiencies).

11. **Post warning signs**. Post warning signs and restrict entry to authorized personnel only. Implement the worksite preparation procedures.

12. **Consider a pilot project**. For large projects only, consider conducting a pilot project to determine if the selected abatement method will actually work (pilot projects are sometimes completed before step 4).

13. **Consider collecting soil samples as an option**. As an optional quality control procedure, consider collecting pre-abatement soil samples, which may not have to be analyzed until post-abatement soil samples have been collected, analyzed, and compared to clearance standards. If post-abatement soil levels are below applicable limits, the pre-abatement samples need not be analyzed (see Chapter 15). Soil sampling is not required by EPA regulations as part of clearance. This is an optional activity (see Chapter 15).

14. **Execute construction work**. Execute abatement work. See the other sections of this chapter for step-by-step summaries for building component replacement, enclosure, paint removal, and soil abatement methods. See Chapter 13 for encapsulation methods. Observe local or State regulations if applicable.

15. **Store waste**. Store all waste in a secure area (see Chapter 10).

16. **Cleanup**. Conduct daily and final cleanup (see Chapter 14). Execute waste disposal procedures.

17. **Arrange for clearance**. Have an independent certified inspector technician or risk assessor conduct a clearance examination after waiting at least 1 hour after cleanup has been completed to let dust settle (see Chapter 15).

18. **Repeat cleaning if clearance fails**. If clearance is not achieved, repeat cleaning and/or complete abatement work. Repeat clearance examination and, if clearance is achieved, obtain any required formal release or, if required by the U.S. Department of Housing and Urban Development (HUD) or local authorities, owner's certification that the project has been completed required.

19. **Notify Residents.** Notify residents of affected dwellings of the nature and results of the abatement work.

20. **Pay contractors**. Pay contractor and clearance examiner.

21. **Conduct periodic monitoring**. Conduct periodic monitoring and reevaluation of enclosure or encapsulation systems (if applicable) or lead-based paint that was not abated as indicated in Chapter 6. Maintain records of all abatement, monitoring, reevaluation, and maintenance activities, and turn them over to any new owner upon sale of the property as part of lead disclosure. Provide proper disclosure and notification to tenants. See Appendix 6 for more information.

Building Component Replacement – How To Do It

1. **Prepare work area and plan new component installation**. Prepare the work area (see Chapter 8); avoid high-dust jobs and procedures. Plan how the new component will be installed. Whenever possible, use new, energy efficient window, door, and insulating systems.

2. **Prepare building component for removal**. Prepare the building component for removal. Turn off and disconnect any electrical circuits inside or near the building component to be removed.

3. **Mist component**. Lightly mist the component to be removed (unless electrical circuits are nearby).

4. **Score seams**. Score all painted seams with a sharp knife.

5. **Remove screws**. Remove any screws, nails, or fasteners.

6. **Pry component**. Use a flat pry instrument (crowbar) and hammer to pry the component from the substrate.

7. **Remove nails**. Remove or bend back all nails.

8. **Wrap component**. Wrap and seal bulk components in plastic and take them to a covered truck or secured waste storage area along pathways covered with plastic. Shovel any debris; see Chapter 10 for proper disposal methods.

9. **Vacuum dust**. Vacuum any dust or chips in the area where the component was located.

10. **Replace component** (optional).
11. **Cleanup**. Conduct cleaning (see Chapter 14).
12. **Conduct clearance**. Conduct clearance and reclean if necessary.

Enclosure Methods – How To Do It

1. **Post warnings on affected components**. Stamp, label, or stencil all lead-based painted surfaces that will be enclosed with a warning approximately every 2 feet both horizontally and vertically on all components. The warning should read: "Danger: Lead-Based Paint." Deteriorated paint should not be removed from the surface to be enclosed.
2. **Determine whether low- or high-dust job**. Prepare the worksite in accordance with guidance in Chapter 8; avoid high-dust jobs and procedures.
3. **Identify enclosure**. Attach a durable drawing to the utility room or closet showing where lead-based paint has been enclosed in the dwelling.
4. **Plan for monitoring**. Plan for annual monitoring of the enclosure by the owner.
5. **Repair substrates**. Repair unsound substrates and structural members that will support the enclosure, if necessary.
6. **Select enclosure material**. Select appropriate enclosure material (drywall or fiberboard, wood paneling, laminated products, rigid tile and brick veneers, vinyl, aluminum, or plywood).
7. **Prepare electrical fittings**. Install extension rings for all electrical switches and outlets that will penetrate the enclosure.
8. **Clean floors**. If enclosing floors, remove all dirt with a vacuum to avoid small lumps in the new flooring.
9. **Seal seams**. Seal and back-caulk all seams and joints. Back-caulk means applying caulk to the underside of the enclosure.
10. **Anchor enclosures**. When installing enclosures directly to a painted surface, use adhesive and then anchor with mechanical fasteners (nails or screws).
11. **Conduct cleanup**.
12. **Arrange for clearance**. Have a certified risk assessor or inspector technician conduct clearance testing and provide documentation.

Paint Removal Methods – How To Do It

1. **Use only approved removal methods**. Be sure all paint-removal methods are not prohibited methods. Avoid the following:

    a. Open flame burning or torching.

    b. Heat guns operating above 1100 °F.

    c. Machine sanding or grinding without a HEPA vacuum exhaust tool.

    d. Abrasive blasting or sandblasting without a HEPA vacuum exhaust tool.

    e. Paint stripping in a poorly ventilated space using volatile stripper.

    f. Dry scraping (except for limited areas).

2. **Determine whether low- or high-dust job**. Prepare the worksite in accordance with guidance in Chapter 8; avoid high-dust jobs and procedures.

3. **Ensure safe use of heat guns**. For heat gun work, provide fire extinguishers in the work area and ensure that adequate electrical power is available. Use for limited areas only. Train workers to avoid gouging or abrading the substrate.

4. **When using mechanical tools, USE only HEPA-equipped tools**. Be sure workers keep the shroud against the surface being treated. Vacuum blasting and needle guns should not be used on wood, plaster, drywall, or other soft substrates. Observe the manufacturer's directions for the amount of vacuum airflow required.

5. **Wet scrape**. For wet scraping, use a spray bottle or wet sponge to keep the surface wet while scraping. Apply enough water to moisten the surface completely, but not so much that large amounts run onto the floor or ground. Do not moisten areas near electrical circuits.

6. **Use off-site chemical stripping facilities, if feasible**. For chemical paint removers, determine if the building component can be removed and stripped off-site. Off-site stripping is generally preferred to on-site paint removal. Observe all manufacturers' directions for use of paint removers.

7. **Remove components carefully**. For off-site stripping, determine how to remove the component. Score the edges with a knife or razor blade to minimize damage to adjacent surfaces. Punch or tag the building component if similar building components are also being stripped off-site (e.g., doors). This will ensure that the individual component is reinstalled in the original location. Inform the off-site paint remover that lead-based paint is present before shipping. Wrap the component in plastic and send to the off-site stripping location. Clean all surfaces before reinstallation to remove any lead residues by vacuuming all surfaces, cleaning with other lead specific or all-purpose cleaners detergents, and vacuuming again. Conduct cleanup and clearance.

8. **Test effectiveness of on-site stripper, if used**. For on-site paint removal, first test the product on a small area to determine its effectiveness. Chemical paint removers may not be effective or desirable on exterior, deteriorated wood surfaces, aluminum, and glass. Provide neoprene, nitrile, rubber, or polyvinyl chloride (PVC) gloves (or other type of glove recommended by the manufacturer); face shields; respirators with combination filter cartridges for leaded-dust and organic vapors (if appropriate); and

chemical-resistant clothing. Be sure to select the right type of organic vapor filter cartridge, gloves, and clothing for the specific chemical being used. Portable eyewash stations capable of providing a 15-minute flow must be on-site. Apply the chemical and wait the required period of time. Maintain security overnight to prevent passersby from coming into contact with the chemical. For caustic chemical paint removers, neutralize the surface before repainting using glacial acetic acid (not vinegar). Repaint and conduct cleanup and clearance.

9. **Dispose of waste properly** (see Chapter 10).

10. **Conduct cleanup**.

11. **Arrange for clearance**. Have a certified risk assessor or lead-based paint inspector conduct a clearance examination and provide documentation (see Chapter 15).

Soil and Exterior Dust Abatement – How To Do It

1. **Identify any soil hazard**. Determine if a soil-lead hazard exists. For a hazard to exist, a total of at least 9 square feet of soil in a single yard or area must be bare and soil concentrations must be equal to or exceed either 1,200 µg/g of lead for the yard or building perimeter or 400 µg/g of lead for small, high-contact play areas. Bare soil above these levels should be treated by either interim controls or abatement. Soil abatement is most appropriate when levels of lead are extraordinarily high (equal to or greater than 5,000 µg/g) and when use patterns indicate contact frequency and exposure will be high.

2. **Optionally, collect pre-abatement soil samples**. As an option, collect pre-abatement soil samples to determine baseline levels. These samples need not be analyzed if post-abatement soil samples are below applicable clearance levels.

3. **Determine soil abatement method**. Determine the method of soil abatement (soil removal and replacement, soil cleaning, or paving). Soil cultivation (rototilling or turning over the soil) is not recommended.

4. **Prepare carefully for paving**. If paving, use a high-quality concrete or asphalt. Observe normal precautions associated with traffic load weight and thermal expansion and contraction. Obtain any necessary permits. Keep soil cultivation to a minimum.

5. **Plan soil removal carefully**. If removing and replacing soil:

   - ✦ Determine if waste soil will be placed in an on-site or off-site burial pit. Prepare vehicle operation and soil movement plan. Test new replacement soil (should not contain more than 400 µg/g lead).
   - ✦ Contact the local information source to determine location of underground utilities, including water, gas, electric, cable TV, and sewer, or contact each utility individually. Mark all locations to be avoided.
   - ✦ Remove fencing if necessary to allow equipment access and define site limits with temporary fencing, signs, or yellow caution tape.
   - ✦ Tie and protect existing trees, shrubs, and bushes.
   - ✦ Have enough tools to avoid handling clean soil with contaminated tools.

- Remove soil.
- Clean all walkways, driveways, and street areas near abatement area.
- Replace soil at proper grade to allow drainage.
- Replacement soil should be at least 2 inches above existing grade to allow for settling.
- Install new soil covering (grass or sod) and maintain it through the growing season.
- Have enough workers and equipment available to complete the job in 1 day.

6. **Manage disposal of soil waste carefully** (see Chapter 10).
7. **Conduct final cleanup and visual inspection for clearance** (see Chapter 15).
8. **Provide walk-off mat(s) for residents**. Provide walk-off doormats to residents and educate them on the benefits of removing shoes at the dwelling entryway.

I. Principles of Lead-Based Paint Hazard Abatement

A. Longevity of Abatement

There are several approaches to abatement. Abatement is either: the removal of the building component, the removal of the paint itself, or the long-lasting – at least 20 years – enclosure or encapsulation of lead-based paint hazards. (For enclosure, see Section III of this chapter, and for encapsulation, see Chapter 13.) From a public health perspective, properly conducted abatement is the preferred permanent or long-lasting response to lead hazards. Abatement has two principal advantages: it provides a long-term solution, and little (if any) monitoring or reevaluation of the treated surface is necessary because failure is less likely to occur. Abatement treatments provide longer-lasting safe conditions than interim controls because 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.

As used in this chapter, abatement can mean either correction of lead-based paint ***hazards*** (as defined in Title X) or removal, "permanent" encapsulation or "permanent" enclosure of all lead-based paint, as describe below. The methods explained in this chapter apply to abatement of both lead-based paint hazards ***and*** lead-based paint. From the Federal perspective, construction activities intending only to remodel, renovate or paint, are not considered abatement. Abatement does include work intending to permanently eliminate lead-based paint or lead-based paint hazards.

Interim controls, abatement, or a combination of the two are acceptable methods of addressing lead-based paint hazards. In contrast to interim controls, lead-based paint 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. As 20 years is the expected lifespan of many commonly used building components, abatement is the closest one can get to a "permanent" solution in housing. The abatement methods described in this chapter should be capable of lasting 20 years under typical conditions. Any methods developed in the future that also last 20 years will be acceptable as abatement methods. This orientation toward performance standards should provide owners and the abatement industry with opportunities for innovation and flexibility, ensuring that the abatement method selected is the one that is most cost effective for a particular component.

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 and are covered elsewhere in these *Guideline*s. The reader must study and understand the material in these other chapters prior to undertaking an abatement project. This chapter alone does not provide all the information necessary to complete a successful abatement job. When abatement is performed inadequately, or without sufficient protection, lead exposures to children increase (Amitai, 1987; Chisholm, 1985; Farfel, 1990; Rabinowitz, 1985a). When performed properly, abatement is known to be effective (Amitai, 1991; Staes, 1994; HUD, 1991; Jacobs, 1993a; Farfel, 1994a; Staes and Rinehart, 1995).

Abatement refers to any measure designed to permanently eliminate lead-based paint or lead-based paint hazards in accordance with standards established by the U.S. Environmental Protection Agency (EPA) pursuant to Title IV of the Toxic Substances Control Act (TSCA). Abatement strategies include removal of lead-based paint; enclosure of lead-based paint; encapsulation of lead-based paint (according to the standards and procedures set forth in Chapter 13); replacement of building

components coated by lead-based paint; removal of lead-contaminated dust; removal or covering of lead-contaminated soil with a durable covering (not grass, gravel, or sod, which are considered interim control measures); and preparation, cleanup, disposal, post-abatement clearance testing, recordkeeping, and monitoring (if applicable).

More than any other abatement method, on-site paint removal involves the greatest degree of disturbance and dust generation. Therefore, on-site removal of lead-based paint from a substrate should be carried out only if abatement rather than interim control is required and no other abatement method is feasible. For example, removal of paint from metal doorframes may be the only feasible abatement option, especially if the frames cannot be removed or enclosed and the paint cannot be stabilized. Paint removal may increase the level of lead in household dust and make effective cleaning more difficult. Even if dust clearance standards are met, any increase in leaded-dust levels over baseline levels means some increase in exposure. Furthermore, all paint removal methods leave behind some residues embedded in the substrate, which could continue to pose a hazard if the surface from which the paint is removed is later disturbed. Therefore, paint removal is the most invasive of abatement methods and should be avoided if possible.

Abatement also 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.

In fact, many forms of abatement require special construction skills in addition to protective measures and dust control techniques. For example, one of the most common forms of lead-based paint abatement is window replacement. Abatement contractors need to possess adequate carpentry skills to install (for example) new windows, as well as the demolition, dust containment, and cleaning skills held by abatement contractors. While providing some guidance, this chapter is not intended to impart carpentry, painting, resurfacing, and other construction knowledge required for most types of abatement. Abatement contractors should either subcontract this type of construction work or acquire the necessary construction skills before the job begins. Of course, all construction work must be performed in accordance with local code requirements and all abatement work must be done by certified firms and individuals.

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 and windows, are replaced, the *Guidelines* recommend that they be replaced with products that are more energy efficient. This will help reduce energy consumption and increase cost efficiency.

EPA has established standard training curricula 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 individuals who supervise lead abatement projects and conduct clearance examinations. EPA's regulations are generally implemented through State, Tribal, or territorial programs. All abatement contractors and firms must be certified to perform this type of work, and all abatement workers and supervisors must be trained and certified. Certification of abatement contractors and completion of clearance examinations by independent, certified risk assessors, lead-based paint inspectors or sampling technicians, ensures that abatement work is conducted properly and safely.

For exterior work, as an optional quality control procedure, consider collecting pre-abatement soil samples, which may not be analyzed until post-abatement soil samples have been collected, analyzed and compared to clearance standards. If post-abatement soil levels are below applicable

limits, the pre-abatement samples need not be analyzed. Soil sampling is not required by EPA regulations as part of clearance. This is an optional activity (see Chapter 15).

B. Prohibited Abatement Methods

HUD and EPA prohibit certain techniques (see 24 CFR 35.140, and 40 CFR 745.227(e)(6), respectively) because they are known to produce extremely high levels of lead exposure and make dwellings difficult to clean up. In addition, for abatement in federally-owned and assisted residences, HUD prohibits an additional technique if toxic volatile chemical stripping compounds are used, in order to prevent hazardous levels of the chemicals in the air of the residence being abated. See Table 12.1. State and local regulations may also prohibit some or all of these techniques or other techniques.

These *Guidelines* recommend strongly against the use of uncontained hydroblasting. Removal of paint using this method can spread paint chips, dust, and debris beyond the work area. Pressure washing is also discouraged. Contained pressure washing at less than 5,000 pounds per square inch (PSI) can be done within a protective enclosure to prevent the spread of paint chips, dust, and debris. Water runoff should also be contained (see Chapter 8).

Table 12.1 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. Abrasive blasting or sandblasting without HEPA local vacuum exhaust tool.
4. Heat guns operating above 1100° F or charring the paint.
5. Dry scraping (except for limited surface areas).
6. Paint stripping in a poorly ventilated space using volatile stripper.

C. Vacuum Cleaning

In this chapter, vacuum cleaning is recommended a number of times. These *Guidelines* recommend that a HEPA-filtered (high-efficiency particulate air) vacuum should be used if possible, but that a high-quality household or commercial vacuum should be used if a HEPA vacuum is not available. (Note that, for RRP work, EPA's RRP Rule requires that any vacuum cleaners used be HEPA-filtered; see Chapter 11.) See Section III.A of Chapter 14 for a discussion of factors in choosing an effective vacuum cleaner and Section V of Chapter 11 for cleaning of carpets.

D. Periodic Monitoring and Reevaluation

Among the advantages of abatement compared to interim controls is that ongoing monitoring by the owner is either unnecessary (in the case of complete lead-based paint removal) or relatively

simple (in the case of enclosure or encapsulation). Failures of enclosures and encapsulations are relatively easy to observe visually. (Failures should be repaired immediately. See Chapter 6.) Also, whereas professional independent reevaluation may be required at 2-year intervals for some federally assisted multi-family properties that have been treated with interim controls or standard treatments, such reevaluation is not necessary for properties that have had all lead-based paint abated. This is true even if lead-based paint has been enclosed or encapsulated, *provided* ongoing visual monitoring and lead-safe maintenance are performed by the owner in assisted units as recommended in Chapter 6. (Also see Chapter 5 on reevaluation.)

Abatement can be undertaken after lead-based paint inspections or risk assessments determine the presence of lead-based paint or other lead hazards (see Chapters 3, 5 and 7 for a description of the differences between risk assessments and inspections). If this initial evaluation phase is not completed, then all painted surfaces must be presumed to contain lead-based paint. This presumption may be cost-effective if it is likely that all surfaces that might be treated contain lead-based paint or if the housing unit is to be rehabilitated and all surfaces and components will be either covered or replaced.

The cost of a carefully conducted lead-based paint inspections or risk assessments, however, is usually recovered by a more focused abatement effort, especially when component replacement or enclosure is considered. The cost savings of a more targeted abatement effort based on complete testing are noteworthy in the case of abatement as opposed to interim controls, because the costs of abatement are initially much higher than interim controls.

Recordkeeping

Recordkeeping is essential for all abatement methods. The location of enclosed or encapsulated lead-based paint must be made known to future residents and owners, who may undertake remodeling or repair efforts that could disturb the remaining lead-based paint and thereby create a lead-based paint hazard. Depending on the jurisdiction, the location of enclosed or encapsulated lead-based paint may need to be filed with the appropriate municipal agency for future reference when the agency needs to issue construction permits for renovation. Provide proper disclosure and notification to current tenants as well (see Appendix 6).

E. Types of Abatement

This chapter covers four types of abatement:

- Building component replacement.
- Enclosure systems (this section does not include encapsulation, which is addressed in Chapter 13).
- On-site and off-site paint removal.
- Soil removal or covering.

The available information on paint abatement methods is summarized in Table 12.2. The reader should not conclude that a particular method is not permitted simply because it is not discussed here. With the exception of the prohibited techniques listed above, new techniques should be developed, studied, and reported to HUD, the Centers for Disease Control and Prevention (CDC), EPA, and other

Government agencies for distribution to the public.

F. Encapsulation

Encapsulants are coatings or rigid materials that rely on adhesion to a lead-based painted surface and are not mechanically fastened to the substrate. Encapsulants are considered separately in Chapter 13. *Enclosures* (not to be confused with encapsulants) are defined as durable, rigid construction materials that are mechanically fastened to the substrate with screws, nails, or other mechanical fastening system that can be expected to last at least 20 years under normal conditions. (See Section III of this chapter on enclosures.) These *Guidelines* do not consider encapsulation to be the same as enclosure. Depending on the particular circumstances and product, encapsulation can be either a form of paint stabilization (an interim control) or abatement (see Chapter 13).

G. Relationship to Renovation, Repainting, Remodeling, Rehabilitation, Weatherization, and Other Construction Work

Many forms of abatement involve the same physical work as other types of construction often performed in housing. In many cases, only the intent of the work differs. Lead-based paint abatement is intended to produce conditions that prevent lead poisoning. Other construction work is intended, among other things, to improve aesthetic living conditions, bring the dwelling up to code, preserve historical evidence, and promote energy efficiency. For example, depending on its intent, window replacement could be considered to be a lead-abatement method, renovation work, or energy conservation/weatherization work.

HUD's Lead Safe Housing Rule requirements vary depending on the type and amount of federal housing assistance (see Appendix 6) (HUD, 1999). The Rule applies to certain private owners and specific federally-funded housing activities. Individuals at the State or local level who are responsible for making determinations about weatherization or rehabilitation projects must have a clear understanding of the federal requirements applicable to specific funding sources. DOE-funded weatherization work is considered to be "renovation" under EPA's RRP rule (See Chapter 4; see also DOE, 2002).

It is well known that lead-based paint-disturbing activities have the potential to create dust-lead hazards. Therefore, regardless of funding source, HUD strongly recommends that all activities disturbing known or presumed lead-based paint use trained workers, lead-safe work practices and undergo a clearance examination.

While the intentions of each of these activities 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 occurs in the context of housing modernization or rehabilitation work. This approach has proven to be feasible and cost effective.

Congress recognized the wisdom of combining lead abatement with rehabilitation work. Under Title X, any residential construction job receiving more than $25,000 per dwelling unit in Federal rehabilitation funds is ***required*** to have all lead-based paint hazards on the property abated. If $5,000 to $25,000 per dwelling unit in Federal rehabilitation funding is received, either interim controls or abatement must be implemented (HUD, 2009).

Finally, lead abatement procedures cannot guarantee that children will not be exposed to lead in the future. Enclosure systems or encapsulants could fail, exposing the hazard again. Soil coverings could also fail, or other sources of lead could recontaminate the soil, resulting in exposures. Surfaces that were made cleanable may deteriorate or may not be kept clean, allowing leaded dust to re-accumulate to

hazardous levels. Nevertheless, abatement constitutes the most extensive and protective intervention currently available. If practiced properly, abatement will greatly reduce the risk of lead poisoning.

II. Building Component Replacement

Building component replacement is defined as the removal of doors, windows, trim, and other building items that contain lead-based paint hazards and their replacement with new lead-free components. Component replacement is the most desirable abatement method because it offers a permanent solution to the lead-based paint problem for the particular component(s); but it may not be feasible for all of the LBP present. If done properly, it also minimizes contamination of the property and exposure of the workers. In addition, building component replacement can be integrated into general building rehabilitation activities. Components, such as doors and windows, should be replaced with more energy efficient models, which will help to reduce energy consumption and increase cost efficiency. In some cases, component replacement may cost less than abatement, especially when ongoing maintenance and energy costs are considered. Component replacement may be more expensive, however, especially for historic preservation projects, as new building components that match the originals may have to be custom made. For some historic preservation projects, replacement may not be permitted (see Chapter 18).

The skills required to perform building component replacement properly are similar to those of the skilled carpenter. For example, it is important to know how the various building components were joined so that they can be taken apart with minimal contamination and damage to adjoining surfaces.

The owner may choose to simply remove certain types of components without replacement. This is acceptable as long as applicable codes are observed. HUD does not recommend reinstalling salvaged building components containing lead-based paint in other properties unless the lead-based paint is removed.

A. Worksite Preparation

The appropriate worksite preparation level should be selected based on the size of the building component, its state of deterioration, and the ease of removal. The more deteriorated the component and the larger the surface area to be disturbed, the higher the worksite preparation level should be. Certified risk assessors or certified abatement supervisors or trained project designers may determine the appropriate worksite preparation for a project (see Chapter 8).

1. Security

Security of the premises is an important issue. If windows and doors are removed but not replaced on the same day, it may be necessary to install temporary barriers over window and door openings to prevent vandalism and theft over night. Therefore, every effort should be made to remove and replace doors and windows on the same day.

Table 12.2 Comparison of Lead-Based Paint Abatement, Component Removal and Enclosure

	Abatement and Removal						Enclosure			
Attributes	HEPA Needle Gun	Heat Gun	HEPA Sanding	Remove/ Replace	Caustic Paste/ Solvent	Off-site Stripping	Plywood Paneling	Gypsum	Prefab Metal	Wood, Metal, Vinyl Siding
Skill Level	High	Moderate	Moderate	High	Moderate	Moderate	Moderate	Moderate	High	Moderate
Aesthetics (1)	Erodes surface	Gouges	Gouges/ roughens	Good	Gouges	Good	Good	Good	Good	Good
Applicability	Very low, limited to metal and masonry	Wide, can damage some components	Low, limited by surface contour	Wide, dependent on skill	Wide, can damage some components	Low, components only	Wide, walls	Wide, walls and ceilings	Varied, limited by components	Wide, walls
Lead Presence	Largely removed	Largely removed	Largely removed	Removed	Largely removed	Largely removed	Remains	Remains	Remains	Remains
Generation of Hazardous Waste (2)	Low to moderate	Low to moderate	Low to moderate	Low	High	High, but maintained off-site	Low	Low	Low	Low
Weather Limitations	Moderate	High	Moderate	Minimal	High	None	Minimal	Minimal	Minimal	Minimal
Applicable to Friction Surface	Some	Yes	Some	Yes	Yes	Yes	No	No	Yes	No
Surface Speed of Methodology	Slow	Slow	Slow	Moderate	Slow	Can be slow, requires coordination	Moderate	Moderate	Moderate	Moderate
Training Required	High	Moderate	Moderate	High	Moderate	Moderate	High	High	High	High
Capital Required	High	Low	Moderate	Moderate	Low	Low	Low	Low	High	Moderate
Worker Protection Required (3)	High	High	High	Moderate	High	Moderate	Low	Moderate	Low	Low
Finish Work Required	Tentatively	Moderate	Moderate	Low	Moderate	Moderate	Wide	Wide	Limited	Wide
Product Availability	Limited	Moderate	Limited	Wide	Moderate	Limited	Moderate	Moderate	Wide	Wide
Durability	Long	Long	Long	Long	Long	Long	Moderate	Moderate	Moderate	Moderate
Labor Intensity	High	High	High	High	High	Moderate	High	High	High	High
Overall Safety (3)	Moderate	Moderate	Moderate	Very high	Moderate	High	High	High	High	High
Surface Preparation	None	None	None	None	Minimal- adjacent areas	Minimal-hardware removal	Minimal	Minimal	Minimal	Minimal
Cost	High	High	High	High	High	High	Moderate	Moderate	High	Moderate

Notes: (1) – The degree of damage to the surface will depend on the expertise of the operator.

(2) – Concentrated lead-based paint waste or sludges from paint removal using caustic or organic solvent removers have to be TCLP tested to determine if they are hazardous waste. See Chapter 10.

(3) – Any construction work involves increased safety risks.

2. Planning for Waste Storage

While most lead hazard control work in housing is exempt from hazardous waste regulation, discarded architectural components must still be properly managed (see Chapter 10). All building components coated with lead-based paint should be stored in a secure, locked area, as should all lead-contaminated waste until it is disposed of. They should not be sold or released to anyone who might reinstall them in another dwelling unless all of the lead-based paint is removed first. Therefore, it is important to identify where waste will be stored and how it will be secured during the project. (See Section II.D, Transportation and Storage of Waste, below.)

B. General Procedures for Building Component Replacement

- Using a garden sprayer or atomizer, lightly mist the component to be removed with water to help keep the dust down during the removal process. Before applying the water, be sure there are no electrical circuits inside the component. (If electrical circuits are present inside the component, they must be turned off and disconnected before removal. No water mist should be applied even if electrical circuits are turned off or de-energized.)

- Using a utility knife or other sharp instrument, carefully score all affected painted seams. This will provide space for a pry instrument and will minimize paint chipping and dust generation during removal.

- Remove any screws or other fasteners. Using a flat pry instrument and a hammer, carefully pry the affected building component away from the surface to which it is attached. The pry bar should be inserted into the seam at the nail (or other fastening device) at one end of the component and pressure applied. This process should be repeated at other fastening locations until the end of the component is reached. The component will be removed intact and chip and dust generation will be minimized when prying is done this way. A pry point pad or softener may be required to minimize damage to adjoining substrates. Wider replacement trim can sometimes be used to cover adjacent area damage.

- As there is often a considerable amount of leaded-dust underneath or behind the component being removed, begin cleanup immediately after the individual component has been removed.

- Carefully remove or bend back all nails (or other fastening devices) and wrap the component in durable, puncture-resistant plastic sheeting and seal with duct tape. Wrapping components in plastic may not be necessary if the dwelling is vacant and if the truck and the pathway to the truck are lined with plastic. Use a vacuum to remove any dust that may have accumulated behind the components as soon as they have been removed. Vacuuming may be performed by another person while the removal is underway. Preparing the area for the new component (e.g., squaring, reducing, or enlarging openings) may also release accumulated dust that should be removed. Dispose of wrapped components properly.

- Bring new lead-free components into the work area only after all dust-generating activity is complete and the dust has been cleaned up by at least one vacuuming.

C. Removal and Replacement Procedures for Specific Components

1. Baseboards, Casings, and Other Trim

The term "other trim" applies to such components as window casings, interior sills (stools), aprons, door casings, baseboards (including caps and shoe moldings), chair rails, exterior fascia, soffits, shutters, and crown moldings (see Figure 12.1). Components with lead-based paint should be removed as described in the previous section.

FIGURE 12.1 Removing and Replacing Trim: interior (left), exterior (right).

New lead-free components should be installed in a professional manner using standard carpentry practices. In situations where trim is being applied to lead-based painted walls, ceilings and floors that were enclosed, or casings for windows or doors where the jambs have been enclosed, the trim should be back-caulked before installation as an added precaution. Back-caulking refers to the application of caulk to the perimeter of the backside of rigid building materials to seal them before installation, preventing leaded-dust from entering the living space through cracks and crevices. Use a high quality caulk that is warranted for at least 20 years.

2. Windows

The term "window" applies to the sash, the stop and parting beads, window jambs, door frame and trim. Affected components should be removed as described in Section B. Window replacement can involve the removal of a wooden or metal unit and the installation of a wood, vinyl, or metal unit in its place (see Figure 12.2 and 12.3). If the jamb is not removed, it can often be enclosed by the new window frame system, which should be caulked and fastened. The remaining exterior portion of the jamb, if any, can be wrapped with coil stock (aluminum or vinyl or equivalent) after back-caulking. In situations where window units must be replaced in kind (e.g., historic preservation), the jambs should be removed and replaced also to make sure that no friction surfaces coated with lead-based paint remain. Generally, friction surfaces should not be painted.

FIGURE 12.2 Protecting the interior of a unit for exterior window abatement.

FIGURE 12.3 Replacement window system.

Depending on the building construction, it may be possible to remove the entire window system. The new lead-free components should be installed in a professional manner using standard carpentry practices. Windows may be replaced from the interior or exterior of the property. If windows are replaced from the exterior and only exterior clearance is planned, the interior of the unit must be protected by polyethylene sheeting.

3. Interior and Exterior Doors

Interior and exterior doors include the doorstops, door jambs and door frame (see Figure 12.4). Affected components should be removed as described above. Typical door replacement usually involves the removal of a wooden unit and the installation of a pre-hung wooden unit in its place. In this type of door replacement, the jamb is rarely removed, but is usually saved and enclosed with the new doorjamb after back-caulking. Wooden jamb extensions or coil stock, properly back-caulked, can be used to enclose any remaining portion of the jamb. In situations where pre-hung door units are not permissible (e.g., code requirements, historic preservation regulations), the original jamb should also be removed and replaced, if possible, to make sure that no friction surfaces coated with lead-based paint remain. If the jamb cannot be replaced, the stop should be removed and replaced with new material after the old jamb is carefully stripped.

Primers on Metal Components

In regard to whether lead-containing primers applied at the factory to metal doors, door frames, railings and other metal building components could create a hazard to people, if it can be determined that the lead on metal doors and frames resides only in the primers, and that the primers were factory applied and are in sound condition, then the primers themselves need not be abated or removed. , This is an exception to the general lead hazard control requirement, However, finish coats of paint that cumulatively contain lead of 1 milligram per square centimeter or greater, or the alternative standard of 0.5 percent by weight or greater, are treated as lead-based paint. If laboratory analyses of samples of the field-applied finishes are negative (no lead-based paint), the metal doors and frames do not require abatement but should be monitored to ensure that

FIGURE 12.4 Pre-and post-abatement interior doors.

the lead-bearing primer does not become defective. If the base metal is exposed while sampling the field-applied finish paint, then the existence of a permanent bond cannot be assumed and the entire sample should be analyzed for presence of lead. Any damage to the primer resulting from sample collection should be repaired immediately in a manner that restores the integrity of the primer coat.

For the metal doors and frames under this exception, primers should be intact and doors should be operating properly, free from impact or abrasion between moving parts that will damage any surfaces. If this exception for factory-applied primers is used, risk assessors should advise property owners or building managers of the importance of continued monitoring of the paint surfaces to ensure that subsequent surface deterioration or other factors do not result in exposing defective lead-based paint surfaces (the primers). Under this exception, property owners or building managers must commit to a plan for ongoing monitoring of the condition of the painted surfaces. The subsequent appearance of rust indicates a failure of the paint and primer, and the component must be abated.

Although unlikely, adhesion of the primer could be a problem. A simple "x" cut or crosshatch test will show if this is a problem. If adhesion is poor, the paint will tend to flake away from a cut. An adhesion test should also give an indication of the number of coats; color of finish versus primer (which would be orange if pigmented with red lead or bright colors such as yellow if pigmented with lead chromate); and thickness of layers. Of course, other colors of lead-based paint may also be present. Any damage resulting from an adhesion test should be repaired immediately in a manner that restores the integrity of the primer and finish coats to prevent subsequent deterioration.

When it can be determined that lead-based paint is present in a field-applied coating over an intact factory-applied primer, and paint removal is the abatement method of choice, only the field-applied finish coatings need to be removed. An intact primer need not be removed.

4. Kitchen and Bathroom Cabinets

Old lead-based painted kitchen and bathroom cabinets can be removed and replaced. Affected cabinets should be removed as described above. Lead-based paint on walls to which cabinets are attached should not be disturbed during cabinet removal. Applying masking tape around the cabinet perimeter and vacuuming immediately after removal will help to control leaded-dust.

5. Railings

Railings include the railing caps, banisters, posts and spindles (balusters), and newel posts that can be removed and replaced (see Figure 12.5). Railings may or may not be part of a stair system. Affected components should be removed as described in Section B. New lead-free components should be installed in a professional manner using standard carpentry practices. Metal railings and other grillwork can be removed and taken off-site for contained abrasive blasting or other forms of paint removal, then reinstalled after repainting. See Section II.C.3, above, regarding lead-containing factory-applied primers.

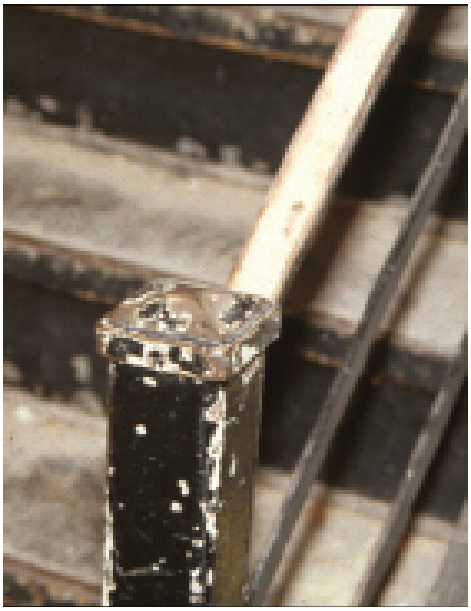

FIGURE 12.5 **A metal railing before abatement.**

6. Exterior Siding

Many materials are used on a dwelling's exterior walls. Materials of concern are generally painted wood or brick. Under most conditions, deteriorated siding identified as a lead hazard will be abated through enclosure without removing the original material. However, in restoration or historically significant projects, it may be replaced. Siding is now available that closely resembles wood. If the siding is to be replaced, the affected siding should be removed. Care must be taken to avoid contamination of soil walkways, window air conditioners, and the building interior (see Figures 12.6 and 12.7).

FIGURE 12.6 **Installation of replacement siding.**

FIGURE 12.7 **Certified workers are needed to replace siding when the project's intent is lead abatement.**

7. Interior Walls

If abatement is performed along with gut rehabilitation, old lead-based painted interior walls and ceilings may be removed and replaced. This activity, unlike those previously described, is more like demolition work. In addition to the layers of heavy duty plastic used to protect the floors from contamination, sheets of plywood should be placed over the plastic to protect it from damage during aggressive demolition, and to make cleanup of debris easier. Prior to demolition, affected areas should be sprayed lightly with water. Workers should wear ribbed rubber boots when walking on slippery, wet plastic. If ladders must be used, the plastic should be punctured to provide secure anchoring of the footings to the surface underneath. Ladder footings should not be placed on top of the plastic because this will create a slip hazard. Excessive water should not be applied, and the creation of puddles and streams that may flow through breaks or gaps in the containment should be prevented.

Removing plaster walls as a means to remove all of the old lead-based paint generates a great deal of dust. Unless this is required as part of a renovation occurring at the time of the abatement, the option of enclosure should be considered when determining abatement strategies.

D. Transportation and Storage of Waste

Building component replacement and demolition generate a considerable amount of waste material. Lead-contaminated building components and demolition debris should be handled carefully (see Chapter 10). Bulk debris such as doors, windows, and trim should be wrapped in durable puncture resistant plastic sheeting and sealed with tape. Smaller debris should be swept into heavy duty plastic bags after spraying. Exterior ground surfaces must also be protected. Outside storage needs to be secure and protect the ground (see Figure 12.8)

All debris should be removed from the site as soon as possible. In larger jobs where a dumpster is being used, it may be possible to eliminate the wrapping and bagging of bulk debris as long as the dumpster has a lockable lid and is lined with plastic and secured with a fence and signs.

FIGURE 12.8 Line surfaces with plastic in the work area (left) and pathways (right)

Contaminated building components and demolition debris should be transported in covered vehicles to an appropriate disposal facility. Old building components coated with lead-based paint should not be recycled unless the paint is removed beforehand. See Chapter 10 for a full discussion of waste disposal.

III. Enclosure Methods

A. Definition

Enclosure is the installation of a rigid, durable barrier that is mechanically attached to building components, with all edges and seams sealed with caulk or other sealant. Surfaces with lead-based paint are enclosed to prevent access and exposure and to provide a dust-tight system. Unlike encapsulation, the enclosure system is not dependent on the painted surface of the substrate for its durability. Enclosures should have a design life of at least 20 years. While adhesives are frequently used for initial mounting purposes and for assistance in covering the lead-based painted surface with the enclosure material, it is primarily mechanical fasteners that give enclosures their longevity.

Standard construction materials are employed to create a solid and relatively rigid end product (see Appendix 7.2 for a description of materials commonly employed for lead-based paint enclosure). The primary differences between enclosure for lead-based paint and ordinary construction include careful sealing of all edges, joints, and seams to create a dust-tight (not necessarily air-tight) enclosure; site containment; worker safety (particularly during any needed surface or substrate repairs); and special cleanup. There is generally little or no hazardous waste disposal and little degradation of the lead-based paint as part of the enclosure process, unless substrate repairs are necessary. The hazard and expense of removing deteriorated paint can be avoided when the enclosure material is mounted flush to a structurally sound lead-based painted substrate and all the seams are sealed. This method produces little leaded-dust (HUD, 1991). These advantages hold down labor costs compared to paint removal and building component replacement, although cleanup and clearance are still required. A lower level of containment can often be used as less dust is generated.

For broad surfaces such as walls, ceilings, floors, and siding, enclosure is often considerably cheaper and less hazardous than building component replacement and paint removal. However, enclosure does not remove lead-based paint from the property; instead, it makes the dwelling lead-safe.

B. Longevity of Enclosures

There is little doubt that hurricanes, earthquakes, tornados, and flooding can substantially compromise an enclosure's viability. Less dramatic but more common events can also increase the risk of lead exposure, such as damage to the enclosure by the occupant or water damage from a leaking roof, overflowing tubs, or broken pipes. Any type of enclosure is potentially vulnerable to water damage. Future occupants can also be threatened by remodeling endeavors that break through the enclosure.

1. Labeling of Surfaces to be Enclosed

A few simple procedures should be followed to promote lead safety in case an enclosure is breached. The surface to be enclosed should be labeled with a warning, "Danger: Lead-Based Paint." The label, spray-paint, or stamp lettering should be in permanent ink.

A durable drawing of the property floor plan should be mounted on a sturdy metal or wood base and affixed with screws to a wall in the utility room next to the electrical panel or at any other closet location that can be easily seen by maintenance personnel (see Figure 12.9). The drawing should be covered with plastic for protection. Enclosures should be highlighted on the diagram and identified as hazardous. (For a multi-family property, another copy of the drawing should be maintained in the property management office's file.)

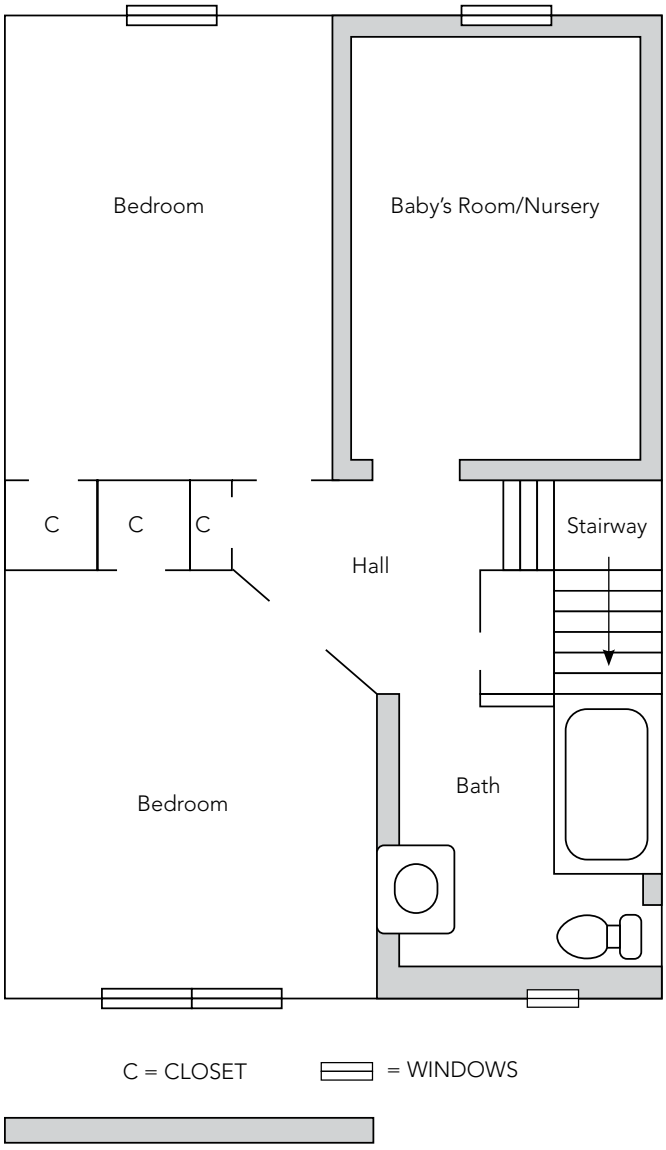

FIGURE 12.9 Example of a Diagram Showing the Location of Lead-Based Paint Enclosures.

2. Unsound Substrates

Any substrate material can be enclosed, including plaster, concrete block, brick, and concrete. All soft, moveable, or otherwise structurally unsound structural members should be repaired prior to enclosure if they are needed to support the enclosure. If repair is not feasible, then the defective area will need to be removed and enclosure will not be possible. Hazards associated with preparing the site for enclosure increase as more remedial work is needed. Structural repairs may require lead-based paint removal or component replacement, with all the accompanying safety protocols these practices entail. If the substrate is sound but the paint is deteriorating, stabilization or removal of deteriorated paint before the enclosure is installed should *not* be done because it will generate dust.

3. Ongoing Monitoring and Reevaluation

Because the building components used for enclosure may be impacted during building use, or may shift or deteriorate, the property owner or manager must arrange for regular monitoring and repairs, as needed. Visual monitoring should be performed no less often than every two

years. If signs of wear or deterioration are apparent from visual assessments or other observations by maintenance and repair workers or during any reevaluation examination, the enclosure should be repaired using lead-safe work practices using a certified firm and workers, followed by clearance. In addition, residents should be instructed to notify management of the need for repairs on a timely basis. For HUD-assisted housing that is subject to periodic reevaluation, the monitoring of the performance of the enclosure should be part of that reevaluation to determine if deterioration or failure of the enclosure has occurred since the previous reevaluation.

C. Interior Surface Enclosure Materials

1. Wood Paneling

Wood paneling is an appropriate enclosure material, except for ceilings. It is of limited use, however, because of the difficulty of sealing seams around electrical outlets, switch boxes, and heating, ventilation, and air conditioning (HVAC) registers. There should be no gaps in the seams, outlets, boxes, and registers, which should all be screwed directly to the paneling and to any framing behind the panels. All seams should be caulked. Paneling made of composite board backing materials is vulnerable to dampness, particularly in below-grade situations such as basements. In some instances, the use of these materials may violate building and/or fire codes. On the other hand, plywood paneling may be stronger, more impact resistant, and more water resistant than other enclosure materials, such as drywall.

Paneling can be glued and mechanically fastened directly to the substrate, but the appearance is improved when the area to be covered is first furred or framed out and the paneling is anchored to these braces. The paneling should not extend past the depth of door or window frames or other trim pieces. Baseboards can be removed and the new cove base then glued directly to the paneling. Even heavy grades of paneling flex and vibrate when receiving mild impact. Over time, this could compromise the seal of the seams that join the paneling with other building components. Joints and edges must be fully supported; furring strips should be installed at the appropriate distance from each other, usually 12 inches apart. All seams at these transition points should be caulked before panel trim and corner moldings are installed as finish pieces.

2. Laminated Products

Laminated wall sheeting products, such as Marlite™, are designed to withstand surface moisture and are commonly used in bathrooms and kitchens. Their surfaces have a high sheen and clean easily. However, they may become defective when moisture gets behind the board's placement. This can occur from a leaking pipe or a seam opening in the bathtub/ shower area. When a significant leak is detected, the enclosure must be reexamined.

3. Rigid Tile and Brick Veneers

Plastic and ceramic tile, synthetic brick and stone veneers, and other similar products are either glued or cemented directly to the painted surface. These products qualify as rigid encapsulants rather than enclosures because they are not mechanically fastened to the substrate. Regardless of whether they are enclosures or encapsulants, they tend to be inappropriate for broad application: The cost associated with labor and materials is often prohibitive for anything more than incidental use.

4. Drywall and Fiberboard

The steps to install drywall and fiberboard are shown in Table 12.3 and detailed specifications are provided by the Gypsum Association in Washington, DC (202-289-5440) Application and Finishing of Gypsum panel Products (GA-216-04). Available at ***http://www.gypsum.org/download.html***.

Gypsum drywall or fiberboard is a very common and cost-effective interior finish. It is not difficult to locate skilled workers to install this product. Training materials are available from trade groups (Gypsum Association, 2004). When applied directly to a surface, the drywall is generally glued in place with construction adhesives and then mechanically fastened to the studs or structure behind the plaster. The screws must be long enough to go through the drywall, the plaster, and the wire mesh or lath and extend an inch into the stud or structure. To avoid having dust escape from the screw hole as the drilled screw displaces plaster, a dab of shaving cream can be applied to the area to be drilled.

Moisture-resistant greenboard should be installed in damp areas. It is difficult to completely control the long-term damaging effects of a severe moisture problem without invasive waterproofing and/or water diversion from the exterior of the property. Any type of enclosure is potentially vulnerable to water damage.

Table 12.3 Steps To Install Drywall and Fiberboard on Interior Walls.

- Check to make sure the depth of the trim will accommodate the thickness of the drywall (minimum of 3/8 inch preferred). If it does not, this method may not be suitable.
- Set up the plastic containment of the work area (see Chapter 8).
- Remove any trim being disposed of, and install the drywall over any cavity left by the removed moldings, except large cavities over 16 inches in any direction. Repair any structural deficiencies.
- Repair or remove any "soft" wall areas. Removal of painted plaster generates a great deal of leaded-dust.
- Use construction adhesive to glue the drywall directly to the surface being enclosed.
- Screw the drywall to the studs behind the existing wall. Caulk all seams that meet molding.
- Use extension rings to bring out electrical devices flush with the new gypsum based drywall and retrofit any HVAC registers. Caulk all seams.
- Tape and finish the drywall.
- Prime and paint the finished area, as well as the unenclosed surfaces in the same room so that all walls match the new installation. (See specifications and recommendations from the Gypsum Association.)

Quarter-inch thick drywall tends to conform to the contours and imperfections of the original substrate or wall, compromising the appearance of the finished product. To avoid this, use of 3/8-inch thick (minimum) drywall is recommended. The enclosed wall may in fact look much improved over the original wall. If the original wall surface is highly irregular, it may be necessary to install furring strips 12 inches apart and use 1/2-inch thick drywall to improve the appearance. If 1/4-inch thick drywall is used, it must be applied in accordance with the manufacturer's specifications (Gypsum Association, 2004).

D. Interior Building Components Suitable for Enclosures

All joints between drywall pieces should be taped and spackled with joint compound. Wherever the drywall meets wood framing or any other finish material (including electrical devices and HVAC registers), the seams should be sealed with a caulk or other sealant that has at least a 20 year warranty. Similarly, where sealed pipes penetrate an enclosure, the opening around the pipe must be sealed. Drywall is painted when installation is complete. Fastening schedules are available from industry trade groups (Gypsum Association, 2004).

1. Wood Trim and Drywall

The profile of the wood trim on windows and doors must be evaluated before overlaying an adjacent wall with drywall; the wall finish should protrude past the depth of the moldings. In homes built before 1960, this problem is less frequent because the trim tended to be more ornate and generally of thicker wood. Regardless of age, the problem is more likely to occur in multi-family public housing and institutional settings where the construction is basic and trim is thin.

If the drywall overlay is too thick, it may be possible to remove the baseboard and run the drywall to the floor. The baseboard can then be reinstalled over the new drywall (unless the baseboard itself presents a lead hazard, in which case it should be replaced). Obviously, care must be taken to avoid breaking the original baseboard during its removal. The seam at the bottom of the drywall should be sealed with caulk prior to the installation of the baseboard or cove base.

2. Electrical Outlets and Vents

All electrical devices, including switches and outlets, will need extension rings to bring those fixtures out flush with the new drywall overlay. A sealant or caulk should be used at cutouts for electrical boxes. Similarly, all grillwork at openings for heat vents and cold air returns should be retrofitted. These are minor but necessary steps in the drywall enclosure process.

3. Ceilings

Ceilings are more difficult to enclose than walls. Drywall applied directly to the ceiling will frequently result in an uneven appearance because there may not be a smooth transition from one board edge to the next. The solution is to draw a chalk line, usually every 16 inches on center, so that metal hat channels (or metal furring channels) or wood furring strips can be screwed into each ceiling joist. Three- to four-inch screws should be used to ensure that the screw penetrates the hat channel, plaster (or other substrate), and the wire mesh holding the plaster enough to bite firmly into the joist. The hat channel may be shimmed to get a perfectly level finished surface.

Next, the drywall should be affixed to the hat channel for an excellent finished product. An

extension ring will be needed for ceiling light fixtures. Prior to lowering the ceiling slightly, the contractor should be confident that there is no interference with the top of ornate, oversized window frames, pipes, vent covers, or crown moldings. The overall height of the lowered ceiling should conform to building code clearances.

All screws for furring channels or strips must penetrate into the ceiling joists prior to installation of the drywall. On occasion, some multi-family housing or commercial buildings converted to residential use may have cast-in-place, reinforced concrete ceilings. Anchoring supports for the new ceiling may not be practical in these instances. Though this construction is generally very strong, a structural engineer should be consulted about attaching a drywall system to the concrete. On-site architectural or engineering advice is needed on a case-by-case basis to determine if this approach is appropriate.

Acoustical lay-in panels (drop-in ceilings) do not constitute lead-based paint enclosures; they will not adequately guard against the escape of leaded-dust into the living space and cannot be sealed.

4. Floors

Lead-based painted floors should be enclosed with 1/2-inch or thicker plywood or other underlayment (see Figure 12.10). The joints in underlayment should be flash patched. Shoe molding running along the baseboard should be removed before plywood installation and reinstalled when the finished floor is completely in place. If the shoe molding contains lead-based paint, new shoe molding should be installed since new molding is inexpensive and more cost effective than removing the paint from the old shoe molding. This will ensure that all floor covering runs tight to the baseboard and the joints at vertical surfaces are covered by the quarter-round molding. The plywood should be covered with vinyl tile or sheet goods to provide a cleanable surface. Covering the plywood with wall-to-wall carpeting is generally not recommended because the carpet does not provide a sealed top cover and is harder to clean. Vinyl floor coverings should be finished off with a metal threshold at all doorways or at any access to an uncovered open floor to protect the exposed edge. When placing tile over old flooring, a row of nails (preferably screws) should be run a few inches apart in a straight line over each joist before the plywood is put down. Old floor nails often lose much of their grip, which results in squeaky floorboards. This movement can in turn cause the edges of floor tile to lift in spite of the plywood underlayment that was installed. It is most important to remember that all the plywood sheets must be installed flush with each other. Gaps must be filled with flash patching cement. Also, a bead of caulk should be run at the edge of every board before it is set in place. All nails must be hammered flush and all dirt vacuumed thoroughly; otherwise small lumps will eventually appear in the soft vinyl finish goods.

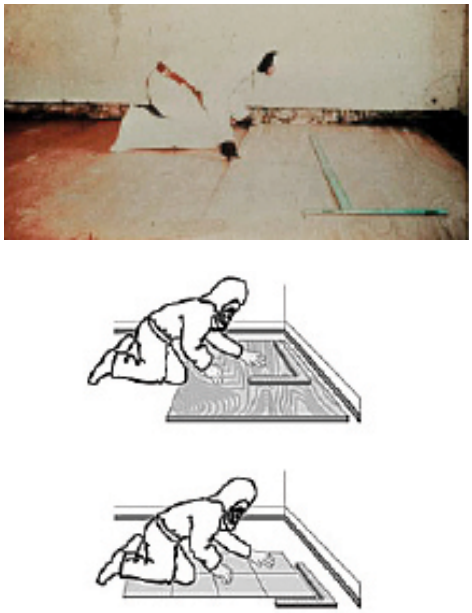

FIGURE 12.10 Install underlayment and new flooring as a suitable LBP enclosure method. The personal protective equipment is for a high-dust project.

If the floor to be enclosed is poured slab or cast-in-place concrete, the surface will have to be predrilled to accept each screw that anchors the plywood enclosure. A structural engineer should be consulted for situations other than slab-on-grade construction. Floor adhesive can offer an added measure of reinforcement and sealant. Each screwhead should be just

below the level of the underlayment top surface and, along with the seams, should be covered with a smooth coat of flash patching cement to prevent dimples in the vinyl top cover.

5. Stairs

Dirt and loose paint should be removed prior to enclosure. Defective paint should be wet scraped and vacuumed; protective gear should be worn by the workers; and the work area should be contained with 6-mil plastic (or equivalent). In multi-family housing, common stairways must be accessible to residents and workers during the construction work to avoid a fire code violation.

FIGURE 12.11 Enclosed stairs.

Wooden steps with lead-based paint should be completely covered with vinyl or rubber treads and risers. These materials should have a minimum specification that would qualify for Federal Housing Administration (FHA) product approval or should be commercial grade. The vinyl should be stapled as well as glued with floor adhesive to avoid sagging. Long staples are preferred to reinforce the tread cover at this critical point and prevent the vinyl from being pulled up by the toe of a shoe. Metal bull nosing can also be used at this wear point.

In addition, long staples or metal bull nosing should be used at the end of the vinyl that butts up tight to the wood riser of the next step.

Plywood can be used to cover step risers and squared-off treads. Plywood is also useful as additional protection, supplementing the vinyl covers mentioned above. Precast concrete steps will have to be drilled, screwed, and glued to anchor the covers in place.

6. Pipes

Painted pipes can be enclosed with the same tape used to make plaster casts, which provides a hard-finished end product. Loose paint and dirt should be safely removed first. The wrapped tape should overlap itself so that it is not dependent on adhering to the painted surface.

Pipes can also be enclosed with drywall. However, this type of enclosure will insulate and limit the ability of radiator pipes carrying steam or hot water to contribute to household heating.

7. Door Frames

Preformed metal door buck or frame covers come in standard sizes to accommodate most components, and as such they can be used to enclose both wood and metal door frames, either interior or exterior. All seams must be caulked. Primers on such bucks should be lead-free.

8. Plywood Enclosures

Knee walls, painted structural supports, and trim such as baseboards, skirt boards, and stringers can be enclosed with plywood that is cut to fit tightly. These items should be sealed with

adhesive and nailed. All joints should be caulked.

E. Exterior Enclosure Systems

1. Siding

Vinyl or aluminum siding may be used to enclose painted exterior surfaces. In addition, porch columns (both square and round) and porch ceilings can be enclosed with these materials. Aluminum coil stock can be used on soffits, fascia, bargeboard, decorative crown moldings (though original detailing will be lost), door and window frames, parapets, and other moldings. All seams need to be caulked and back-caulked. Soffit coverings under roof areas often need to be vented to prevent dry rot (see Figure 12.12). However, as old paint degrades behind this covering, a small amount may migrate through the vents. Breathable cloth materials such as Tyvek™ or an equivalent are available in rolls for this purpose and can be installed before the aluminum covering is put in place. The breathable cloth materials will help prevent leaded-dust from escaping through gaps in the new siding, although it will be necessary to leave attic vents uncovered to permit adequate ventilation. Vent openings should not be covered with Tyvek™ or other similar covering. Because siding may not provide an airtight enclosure, rigid or flexible dust barriers like Tyvek™ should be installed before broad surface enclosure. Perforated metal stock should not be used to enclose soffits, fascia, or eaves as the enclosure is not dust

Create a dust-tight seal

Paint deteriorates more quickly behind an enclosure. All edges of an enclosure—especially the bottom—must be sealed well.

Seal the bottom edge

- Caulk the enclosure material at the bottom
- Back-caulk the nail and baseboard in place.
- Back-caulk, bottom-caulk, and nail the shoe molding in place.

Seal the seams and other edges

- Back-caulk all the seams that aren't taped and spackled. Use a high quality adhesive caulk.
- Use a "J-channel" where drywall meets a finished surface. A J-channel is a final strip attached to the rough edge of drywall to make a finished edge. It's called a "J-channel" because of its shape. Caulk the outside edge so it seals with the finished surface. Screw the drywall in place.

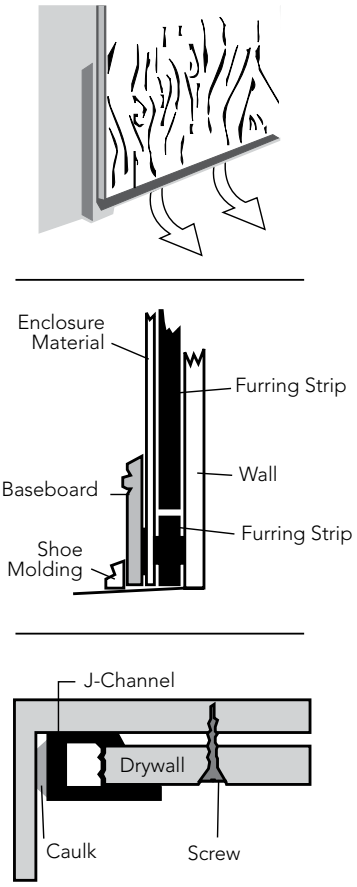

FIGURE 12.12 Seal All Seams for Enclosure.

tight. Rotten or loose wood and any other defective substrate must be repaired or replaced to provide a sturdy foundation for the siding installation and edges.

2. Windows

For standard sized windows, snap-in replaceable aluminum and vinyl tracks are available. These devices help eliminate the painted friction point (and thus the generation of leaded-dust) where the moving sash abrades the painted surface. The track covers should be pressed into a bead of caulk at each joint. Painted sashes should be planed to remove lead-based paint and then reinstalled (see Chapter 11, Section IV). Friction surfaces on windows should not be painted.

Window troughs should be covered with fitted metal and screwed into place. Again, the metal should be pressed into a bead of caulk at the joints and edges.

3. Exterior Walls

Board products made of various materials (e.g., synthetic fiberboard, wood byproduct composites, and cementitious materials) are commonly used in the construction industry for exterior purposes. These heavy, sometimes brittle coverings often have resins, fiberglass, or other durable ingredients that make them resistant to weathering and may require little maintenance, including painting. An added benefit of using these products is that they may have thermal insulation value. The products are best installed over flat surfaces that are not soft, crumbling, unstable, or otherwise defective. A defective substrate must be repaired prior to enclosure. All joints need to be sealed after installation.

Properly installed, natural or synthetic brick and stone veneers can be used to enclose exterior walls. In addition, stucco can be used as a covering material using wire mesh to physically anchor the cement to solid building components. A defective, weak surface needs to be stabilized before covering. Vinyl and aluminum siding are usually the least expensive options.

F. Summary

Enclosures are solid materials that are physically anchored to building components and that cover lead-based paint. Enclosure usually involves common construction techniques and has a 20-year design life. The enclosure abatement option is an effective, stable remedy for minimizing the danger of lead-based paint exposure. Because any barrier can be breached, annual monitoring by the owner and reevaluation by a certified risk assessor or inspector technician are necessary.

Enclosure may be less hazardous and cheaper than paint and building component removal. There is less dust generated and little hazardous waste disposal. Unlike encapsulation, the enclosure is not dependent on the adhesion of the underlying coats of paint on the substrate surface for its durability, nor does it require deteriorated paint removal or surface cleaning and deglossing before installation.

Drywall is often a cost-effective interior finish, and aluminum or vinyl siding provides an acceptable exterior barrier. Aluminum coil stock is effective for enclosing outside trim. Floors require underlayment and vinyl or other sheet finish goods. Vinyl or rubber tread and riser coverings are recommended for steps.

IV. Paint Removal Methods

A. Introduction

Paint removal means the separation of the paint from the substrate using heat guns, chemicals, or certain contained abrasive measures, either on-site or off-site. As an abatement technique, paint removal is usually reserved for limited areas and for those surfaces where historic preservation requirements may apply.

While paint removal can be performed safely and effectively, it also demands the highest level of control and worker protection for several reasons. Paint removal usually creates the greatest hazard for the worker, either from the hazards associated with the removal process (e.g., heat, chemicals, and sharp tools) or from the lead that becomes airborne or is left as a residue on the surface after removal. On-site paint removal will usually be a high-dust job. Prepare the worksite in accordance with the guidance in Chapter 8. Lower levels are possible if the size of the area to be treated is small (see Chapter 8). Because of the lead residues left behind by all paint-removal methods, particularly on porous surfaces such as wood or masonry, more extensive cleaning is usually required to meet clearance criteria. Paint removal methods also generate a significant amount of waste and may be the most costly of all lead abatement methods (HUD, 1991).

All work involving lead-based paint should be performed in a manner that minimizes all dust production. All high-dust paint removal operations should be avoided, and all work be planned and designed to reduce all dust generation. Using work practices and procedures such as wet work practices and the use of tools with attached HEPA-vacuum exhaust will help protect children, workers and residents.

In spite of these limitations, paint removal has the benefit of a low reevaluation failure rate. If some lead-based paint is left in the dwelling, its condition will need to be monitored by the owner (see Chapter 6).

B. Prohibited Methods

Certain methods of lead-based paint removal are absolutely prohibited, either because of unacceptably high worker exposures to lead or release of lead into the environment through production of dust or fumes or both.

1. Open Flame Burning or Torching

Burning, torching, fossil fuel-powered heat plates, welding, cutting torches, and heat guns operating at temperatures greater than 1100°F are prohibited as a means of paint removal because of the high temperatures generated in the process. So-called heat plates (those using propane to heat a grid, which in turn heats the paint) are also prohibited because of the high temperatures generated. At these temperatures, lead fumes may be produced.

Lead fumes are formed when lead is heated into a gas. The gas cools when it comes into contact with the cooler surrounding air and condenses into very small particles. These particles travel easily, are readily inhaled and absorbed into the body, and are difficult to cleanup. Several researchers have found that worker exposures are extraordinarily high when doing this kind of work (NIOSH, 1992a; Jacobs, 1991b; Rekus, 1988). The fumes may also travel throughout

the dwelling, contaminating all surfaces with which they come into contact. Other hazardous substances may be released from the paint film using heat.

Using cutting torches to remove fire escapes, railings, or other metal components coated with lead-based paint is also prohibited unless the paint is removed first. Similarly, welding of painted metal components (such as pre-primed structural steel) is prohibited by Occupational Safety and Health Administration (OSHA) regulations (29 CFR 1926.354(d)).

2. Machine Sanding or Grinding Without a HEPA Exhaust Tool

Machine sanding or grinding is prohibited (regardless of the grit used) because of the large volume of leaded-dust generated (see Figure 12.13). As a result of these methods, workers have been exposed to extremely high leaded-dust levels, and blood-lead levels in resident children have increased (Amitai, 1991; Farfel, 1990; Jacobs, 1991b). However, machine sanding with a HEPA abatement exhaust tool *is* permitted and is discussed further below. Extensive dry hand sanding is not recommended, but wet sanding can be done if no electrical outlets are nearby. Limited dry sanding or scraping near electrical circuits is permitted.

3. Abrasive Blasting or Sandblasting

Traditional abrasive blasting or sandblasting is prohibited in residential structures, regardless of whether the abrasive material is recycled or if the area is fully contained. These methods

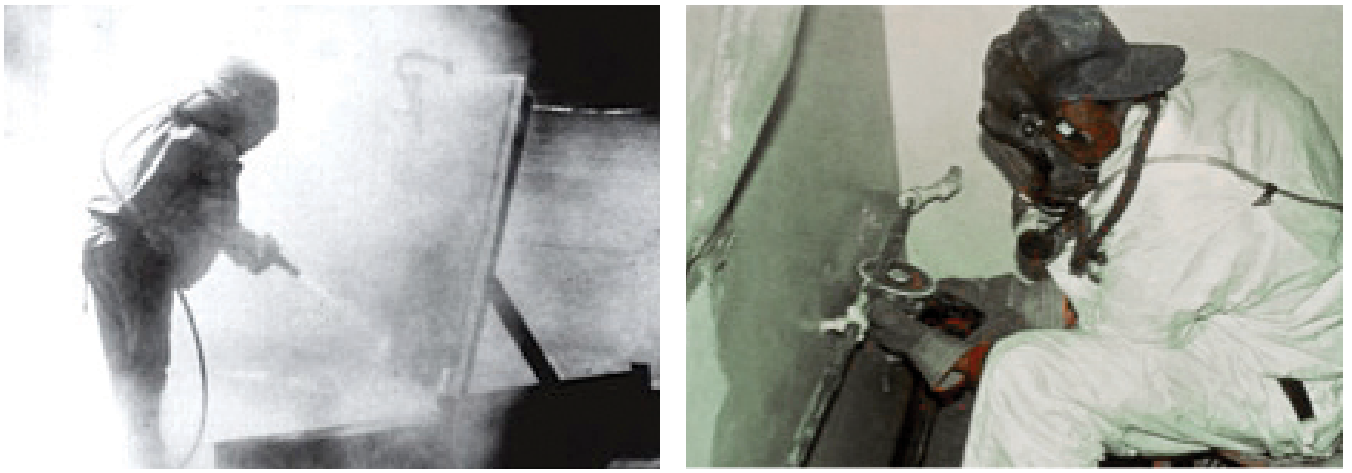

FIGURE 12.13 Prohibited work practices (traditional abrasive blasting (left) and grinding without HEPA exhaust).

produce widespread dust contamination; full containment is nearly impossible to maintain and guarantee in a residential environment. Abrasive blasting should only be done using HEPA vacuum local exhaust equipment, discussed below.

If abrasive blasting must be done in a residential structure, the area must be sealed and placed under negative pressure with enough clean fresh air so at least 10 times the volume of air in

the contained space is brought in to the space and, after filtration, exhausted from it each hour (i.e., the ventilation rate is at least 10 air changes per hour) to ensure the dust can be controlled. If the exterior must be blasted, the entire building must be covered with a tent and placed under negative pressure with at least 10 air changes per hour. In both cases, all exhaust air must be passed through a HEPA filter. Fresh air should be provided to the containment zone at a lower rate than the exhaust airflow to maintain the negative pressure zone.

4. Heat Guns Above 1100° F

Heat guns operating above 1100° F or charring the paint should not be used. See discussion of operating heat guns below 1100° F in section IV.C below.

5. Dry Scraping

Dry scraping is not recommended because of the large volume of particulate matter that is generated (including high levels of leaded-dust).

The two situations where dry scraping is appropriate are scraping surfaces near electrical outlets, which cannot be wet scraped because of the obvious electrocution hazard, and scraping when using a heat gun as this cannot be done wet. For both of these cases, dry scraping is only appropriate for limited surface areas.

6. Chemical Paint Stripping in a Poorly Ventilated Space

Workers should not remove paint in poorly ventilated space when using a volatile stripper that is a hazardous substance in accordance with regulations of the Consumer Product Safety Commission (CPSC) at 16 CFR 1500.3 and/or a hazardous chemical in accordance with the OSHA regulations at 29 CFR 1910.1200 or 1926.59, as applicable to the work. (This practice is prohibited by HUD regulations but not explicitly by EPA regulations as of the publication of the second edition of these *Guidelines*.)

Paint strippers with methylene chloride should be avoided. OSHA has found that adults exposed to methylene chloride "are at increased risk of developing cancer, adverse effects on the heart, central nervous system and liver, and skin or eye irritation. Exposure may occur through inhalation, by absorption through the skin, or through contact with the skin." (62 FR 1493, January 10, 1997). OSHA's permissible exposure limit for methylene chloride in air was reduced in 1997 from 500 to 25 parts per million (29 CFR 1910.1052 for general industry, and the identical 29 CFR 1926.1152 for construction). Methylene chloride cannot be detected by odor at the permissible exposure limit, and organic vapor cartridge negative-pressure respirators are generally ineffective for personal protection against it.

Alternative paint strippers may be safer, but have their own safety and/or health concerns, so all paint strippers must be used carefully. Always follow precautions provided by the manufacturer. It is especially important that people who use paint strippers frequently not use such chemicals in a poorly ventilated area. If good ventilation is not possible, professionals equipped with protective equipment should perform the work in accordance with CPSC regulations (16 CFR 1500.3) and/or OSHA's hazard communications standards (29 CFR 1910.1200 or 29 CFR 1926.59, which are identical) and with any substance-specific standards applicable to the work.

CPSC and EPA recommend that people who strip paint provide ventilation by opening all doors and windows and making sure there is fresh air movement throughout the room ("What You Should Know About Using Paint Strippers," CPSC Document 4423, and EPA Document EPA 747-F-95-002). (***www.cpsc.gov/CPSCPUB/PUBS/423.html***)

C. Recommended Methods of Paint Removal

1. Heat Guns

Open flame burning is prohibited, so removal methods using heat are limited to electric powered flameless heat guns (see Figure 12.14).

Before beginning work, fuses and an adequate electrical supply should be verified. Larger fuses should not be installed because of the possibility of creating a fire hazard. A portable electric generator may be needed, especially if several heat guns will be required. Care should be exercised around wallpaper, insulation, and other flammable materials. An accessible garden hose with a pressure-release spray nozzle, a crowbar to remove smoldering wood, and a long-handled sledgehammer to open up walls exposed to smoldering insulation should be readily available. Under OSHA regulations (29 CFR 1926.150), a fully charged ABC-type 20-pound (minimum) fire extinguisher must be available within 100 feet of the work area. Work should be conducted only in well-ventilated spaces. Other hazardous materials may be released when old painted surfaces are heated (NIOSH, 1992a).

FIGURE 12.14 Using a heat gun to remove paint is labor-intensive.

While there is little risk that dangerous levels of lead fumes will be produced at temperatures below 1100°F, significant airborne particulate lead is generated by the accompanying scraping of the paint. Also, significant amounts of potentially harmful organic vapors can be released from the action of the heat upon the paint, even at temperatures below 1100 °F. For this reason, air-purifying respirators should be outfitted with both a HEPA-filtered cartridge and an organic vapor cartridge. Organic vapor cartridges may not be available for some powered air-purifying respirators.

Depending on the size of the area and the substrate, paint removal by heat gun can be a slow, labor-intensive process and may result in a high final clearance failure rate if used extensively and without proper cleanup. Removing paint completely, particularly from crevices, requires attention to detail. Significant leaded residue may remain on surfaces unless cleanup is thorough. Heat guns do not appear to be particularly effective on metal or masonry substrates, which are too porous to be scraped effectively; the heat may cause small particles to fly up and hit the worker, causing burns or eye damage. Although heat guns work well on wood, they will usually damage drywall and plaster.

Workers may tend to place the nozzle of the heat gun too close to the surface, burning out the heating elements prematurely, sometimes inadvertently even if they have been trained not to do so. One way to prevent this is to attach a small metal wire cage or extension tube to the

end of the heat gun to prevent it from being placed too close. For most heat guns, the optimal distance from the surface is 3 to 6 inches. The heat gun is recommended only for limited surface areas in well-ventilated spaces. Other problems with heat guns include additional fire hazards from dry rot, insulation, and dust, especially in window troughs, roof areas, and hollow porch columns. Scraping often leaves the substrate very rough and may singe adjacent wallpaper. Telephone wires mounted on baseboards can melt, and heat can crack glass with a cold exterior or dry glazing.

To use heat guns properly, allow the heat stream leaving the gun to merely soften the paint. Do not allow the paint film to scorch or smoke. Scrape the loose paint off the surface at the very first sign of paint softening, blistering, or bubbling.

2. Mechanical Removal Methods

HEPA Sanding

HEPA sanders are valuable for surface preparation prior to repainting. As chemical stripping sometimes raises the grain of the wood and some removal methods are not effective at removing all visible traces of paint, some sanding prior to repainting may be needed. Manual sanding can generate significant levels of airborne and settled lead-dust; airborne levels more than 10 times OSHA's permissible exposure limit, have been observed (Zhu, 2012). Therefore, HEPA-assisted sanders are recommended whenever sanding must be done. HEPA sanders do not work well on detailed moldings. In such situations, chemical stripping, use of a heat gun or offsite removal may be suggested.

HEPA sanding uses traditional electric sanders, such as disc sanders or orbital or vibrating sanders, equipped with specially designed shrouds or containment systems that are placed under a partial vacuum (also known as local exhaust ventilation). All exhaust air is passed through a HEPA filter (often using an ordinary HEPA vacuum) to reduce the amount of airborne particulate lead (see Figure 12.15). The HEPA vacuum must be correctly sized to provide adequate airflow to permit the system to operate properly. If hoses are longer than normal, a larger HEPA vacuum may be needed to handle the increased pressure drop.

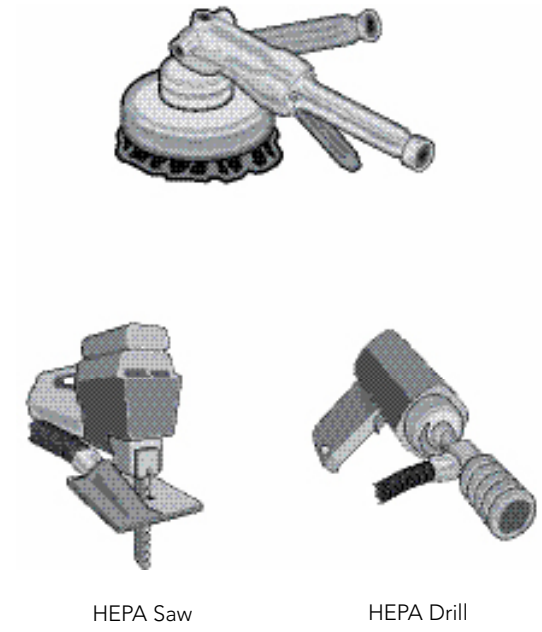

FIGURE 12.15 HEPA-filtered power tools.

There are two main types of HEPA sanders. The first uses a flexible shroud to surround the sanding head, with the HEPA vacuum hose attached to the shroud. The shroud must be

in constant contact with the surface to be effective. If the shroud extends beyond the surface being sanded, large amounts of particulate lead will be released into the air. In addition, this configuration makes it impossible to sand to the edge of protruding surfaces, such as baseboards or window and door casings.

The second type of HEPA sander pierces the sandpaper with holes through which the vacuum draws the dust. This allows the instrument to be used to the edge of protruding surfaces. However, care must be exercised to keep the sandpaper flat on the surface. Neither one of these methods is completely effective; respirators are always recommended. Worker fatigue can also prevent the worker from holding the tool flush with the surface, making it necessary to provide frequent breaks or rotate workers.

Wet Scraping

FIGURE 12.16 Wet scraping (left)
FIGURE 12.17 Scraping tools (right).

Wet scraping is feasible on most surfaces and results in lower lead exposures than dry scraping. Since surfaces near electrical outlets should never be moistened (due to the electrocution hazard), these areas should be dry scraped.

Wet scraping can be performed by using a spray bottle or sponge attached to a paint scraper (see Figure 12.16 and 12.17). Wet scraping is often used to remove loose and flaking paint before paint film stabilization or encapsulation. If wet scraping is employed as an abatement technique, a more durable covering than new paint is needed. Working a few square feet at a time, the worker should mist the surface lightly using a garden sprayer or plant mister. Loose material should be scraped from the surface and deposited on the containment plastic with a paint scraper. Damp paint chips should be cleaned up as soon as possible so that they are not tracked throughout the work area or crushed beneath the feet of workers.

Scraper blades should be kept sharp to minimize abrasion and gouging. Additional scraper blades should be on hand and should be selected for the type of surface being scraped. To obtain a smooth finish, it may be necessary to follow wet scraping with wet sanding. A variety of scraping tools are available from hardware and paint supply stores.

HEPA Vacuum Blasting

HEPA vacuum blasting is simply abrasive blasting with a shroud under a vacuum that is attached to the blast head. All exhaust air is passed through a HEPA filter, using a properly sized HEPA vacuum system. Vacuum blasting is appropriate for metal, brick, concrete, and other masonry surfaces. To date, attempts to use the process on wood, plaster, and other soft materials have

FIGURE 12.18 Vacuum blasting is not often used on housing.

FIGURE 12.19 Needle Gun with HEPA Exhaust Ventilation.

not been successful, as they usually cause severe substrate damage.

Various blasting media can be used (e.g., aluminum oxide, metal shot, walnut shells) depending on the type of substrate. Blast heads, usually a brush-type arrangement, come in various sizes and shapes. The blast head must remain in continuous contact with the surface to avoid dispersal of both the blast medium and particulate lead (see figure 12.18). The equipment can be outfitted with a device that separates the blast media from the paint, effectively recycling the blast material, and dramatically reducing the volume of waste. This is particularly important because the blast material should be disposed of very carefully (see Chapter 10).

Use of the equipment for long periods of time can result in worker fatigue, particularly if working with the arms above the head. Fatigue can cause a worker to momentarily lose contact with the surface, resulting in the release of leaded dust, so the goal is to minimize the degree to which workers must reach above their shoulders. Scaffolding and platforms should be constructed to minimize such stress, and frequent work breaks should be taken. Vacuum blasting is not typically used in interior residential work.

HEPA Vacuum Needle Gun

The HEPA vacuum needle gun is similar to vacuum blasting in concept but avoids the use of a blast medium (see Figure 12.19). In the vacuum needle gun, metal needles rapidly pound against the painted surface, dislodging the paint. The HEPA vacuum, which is connected to the gun head, draws paint chips and dust into the vacuum, minimizing the dispersion of the particulate.

The needle gun is appropriate for metal surfaces but may cause significant damage to masonry. Problems of worker fatigue are similar to those encountered in vacuum blasting. Losing shroud contact with the surface can cause the deposition of significant amounts of chips onto the containment surface. Chips should be cleaned up as soon as possible following the work to avoid tracking.

One way of maintaining the seal with the surface is to select the proper shroud for the shape of the surface treated. At least one manufacturer (Penntek) has developed different shrouds for corners, edges, and flat surfaces. Needle guns are not effective in capturing large paint chips, so use of plastic sheeting underneath is required.

3. Chemical Removal Methods

Chemical removal may result in less leaded dust generation than other removal methods. It is often used in situations where historic preservation requirements apply. However, it may leave leaded residues on porous surfaces, which may pose a hazard to resident children in the future.

One study has demonstrated that windows treated with chemical paint removers had high leaded-dust levels a few months after treatment, even though cleanup and clearance had

been conducted properly (Farfel, 1992).

Other drawbacks to chemical removal include high cost and potential harm to workers from splashes and chemical burns if proper gloves, face shields, and clothing are not provided and used (see Figure 12.20).

FIGURE 12.20 Workers should wear protective clothing when using chemicals.

Proper ventilation is necessary when using chemical paint removal. Plastic may not be effective in protecting floors and may have to be augmented by paper or cardboard. Chemical residues can be tracked into other areas on workers' shoes if proper decontamination is not conducted. Adjacent surfaces, especially plaster, can also be damaged. High humidity may retard the chemical remover's effectiveness. If protective clothing is penetrated and becomes matted against the skin, it must be removed *immediately*. A full shower is strongly recommended.

Off-site Paint Removal

Off-site paint removal is preferred so that most of the contamination and residues are generated away from the dwelling. The general approach is as follows.

Building components to be stripped must first be removed from the building. Misting with water prior to removal will help minimize the amount of airborne lead. The painted seam between the component and the wall should first be cut with a utility razor knife to minimize damage to the adjacent plaster. If there is more than one similar component, each component should be labeled to identify exactly where the component came from, eliminating the need for changing doors or other retrofitting problems.

Potential damage to components during stripping includes damage to hardware (this should be removed before stripping), broken glass, loss of glue joints and fillers, damage to wood fibers (wood swelling), and raising of the wood grain. The component may even fall apart and have to be blocked and re-glued. Old glazing compounds on windows may also be weakened. The stripping firm should be instructed to *thoroughly* wash and neutralize the components after stripping.

Before materials are returned from the paint stripper, they should be wrapped in heavy duty plastic and sealed with tape. This will minimize contamination of those handling the materials (leaded residue may remain on the surface). Materials should remain sealed until other on-site dust-generating activities are concluded and the dust cleaned up.

Before reinstallation, the treated components should be cleaned using the standard vacuum/wet clean/vacuum cycle to remove any residues left by the paint stripper. Components must be completely dry before repainting. Always check the pH (acidity or alkalinity) after cleaning and *before* repainting.

On-site Paint Removal

Many paint removers must be allowed to remain on the surface anywhere from 1 hour to a day or more to accomplish effective stripping.

Most paint removers are efficient within a limited temperature range and may be completely ineffective in cold weather. The contractor must therefore be certain of weather conditions before outdoor application. Also, rain or snow can cause environmental contamination from the lead and the chemical remover.

Paint removers are either caustic (corrosive) or non-caustic. The non-caustic chemical removers are generally safer to use than the caustic ones (assuming they do not contain methylene chloride). Material Safety Data Sheets should always be consulted to determine potential chemical hazards.

When using chemical strippers, securing the area where the strippers are used and the areas where they are stored is important, particularly with caustics, to prevent injuries to people who may gain access to the work area. Caustic paint removers can cause severe skin burn and eye damage to workers, other adults and children who may gain access to the work area. Pain receptors in the eyes are not as sensitive to caustic substances as they are to acids, so workers may suffer damage without immediately realizing it.

Personal protective equipment should be appropriate to the chemical paint stripping work being done; see Chapter 9, Worker Protection.

FIGURE 12.21 Eye- and body-wash stations are required when working with corrosive or irritant chemicals.

An abundant source of water within the abatement area for quick drenching or flushing injurious corrosive chemicals from skin or eyes is required by OSHA regulations (29 CFR 1910.151(c)). The water can come from a tap or portable eyewash station(s) (see Figure 12.21).

If contact with the eyes occurs, a full 15-minute rinse of the eyes is necessary on-site *before the individual leaves to seek medical attention* because permanent damage to the eyes occurs quickly. While 15 minutes may seem excessive, a quick rinse is ineffective, and permanent damage usually occurs on the way to seek medical attention.

Usually, non-caustic strippers are not as effective at removing multiple layers of paint in a single application compared to the caustic products. When using non-caustic removers, small areas should be tested before full-scale treatment to determine their efficacy. For vertical surfaces, adhesion of the liquid or gel type paint removers should also be tested to determine runoff potential (particularly a problem in warm weather). Most caustic paint removers work best on nonporous surfaces such as steel. They generally should not be used on aluminum or glass surfaces.

Paint removers that contain volatile substances should be used only in areas equipped with mechanical ventilation and only when workers are properly equipped with gloves, face shields, protective clothing, and respirators, as needed.

The paint remover should be applied with a spatula, trowel, brush, or spray gun. Spray gun use should be minimized because they increase

worker exposures. The time the remover must stay on the surface will depend upon the number of layers of paint, the type of paint, the temperature, and the humidity, and can range from a few hours to a day or more. The paint remover should not be allowed to dry out. Some manufacturers provide a polyethylene or paper blanket that is pressed into the surface to retard drying; others contain a film that is formed on the surface of the paint remover as it sits to prevent drying. Caution must be used when applying the paint remover overhead to avoid its dripping onto workers below.

After the appropriate period of time, the softened paint should be removed using a scraper or putty knife and the material deposited in a watertight and corrosion-proof container (usually supplied by the manufacturer). The waste should be managed and disposed of in accordance with the guidance in Chapter 10.

With wood surfaces, it is important to complete the entire neutralization and cleaning process without letting the surface dry. If the wood dries before cleanup is complete, the pores in the wood may close, locking potentially significant leaded residues inside. When repainting, some of the leaded residue may leach into the new paint.

Alkali neutralization and residue removal are accomplished as follows. Immediately after paint removal (while wood surfaces are still damp), the surface should be thoroughly scrubbed with a solution of glacial acetic acid. Use of vinegar to neutralize the alkali should be avoided because vinegar may be inadequate as a neutralizing agent and will also result in a significantly larger volume of liquid (and potentially hazardous) waste.

Glacial acetic acid is hazardous and can cause skin burns and eye damage. It should be used carefully and only with neoprene, nitrile, rubber, or PVC gloves; chemical-resistant clothing; eye shields; a NIOSH-approved acid gas cartridge; and a HEPA filter on air-purifying respirators.

The damp, stripped surface should be thoroughly scrubbed with the acetic acid solution. The solution should be monitored with pH litmus paper and discarded if the pH exceeds 6. After use, the solution should be placed in corrosion proof containers and treated as potentially hazardous waste. Sponges and other cleaning materials should not be reused but deposited in heavy duty (double 4-mil, or single 6-mil) trash bags that are sealed, labeled, and put in a secure waste storage area.

Following neutralization, the damp surface should be thoroughly scrubbed with a detergent and water. Scrubbing should continue until no residues are visible. The cleaning solution should be changed when it becomes dirty. Following the detergent scrub, a clean water wash should be performed to remove residue. The pH of the water wash should be checked after use. If the pH exceeds 8, further neutralization of the surface with the acetic acid solution is necessary prior to repainting since an alkaline surface will cause the new paint to fail in a matter of days or weeks.

Surfaces should be completely dry before repainting. For wood surfaces, this may take several days to a week. If the moisture has raised the grain and sanding of wood surfaces is required before repainting, a HEPA sander should be used.

Since porous surfaces such as wood or masonry may still have slight alkali residues, some types of oil paints should not be used after caustic paint remover application. To do so may result in saponification (a "soap-making" reaction between the paint and the substrate, leading to rapid

paint failure). Therefore, latex paints are probably most appropriate. Wood surfaces (especially exterior ones) can deteriorate after paint removers have been applied, making new paint difficult to apply. Also, the new paint may not last long on deteriorated substrates. Some old plasters with a high pH (that is, highly alkaline) may require primers that are no longer manufactured, so a special sealant may be needed on such surfaces. The specific paint remover manufacturer should be contacted for further guidance on appropriate paints to use.

High-pressure water removal of caustic paint removers should be avoided because control of solid and liquid contamination is difficult. Release of solids or liquids into the soil is likely to result in costly cleanup. Care must be used when applying caustic paint removers to friction surfaces, such as window jambs. Such surfaces are often weathered, making residue removal even more difficult. If these residues are embedded in a coat of new paint, the friction caused by opening and closing the windows can lead to the release of leaded-dust.

D. Waste Disposal

Wastes produced during paint removal may be highly concentrated, but low in volume. The toxic characteristic leaching procedure (TCLP) test should be used to determine if the waste is hazardous. See Chapter 10, Housing Waste, and the EPA regulations. Many local jurisdictions pick up small amounts of hazardous waste on certain days. If off-site paint removal is performed, the waste is the responsibility of the facility performing the removal.

V. Soil and Exterior Dust Abatement

A. Introduction

Lead-contaminated soil and exterior dust have been shown to cause elevations in blood-lead levels of children in a number of studies (EPA, 1993c). Exposure to lead in soil and exterior dust can occur both outside during play and inside from soil and dust carried into houses on shoes, clothing, pets, or by other means.

Soil can become contaminated over a period of years from the shedding of lead-based paint on nearby buildings, windblown leaded-dust from adjacent areas, and fallout of leaded-dust from the atmosphere (either from a local point source or from leaded gasoline emissions in the past). Uncontrolled paint removal from nearby houses or painted steel structures can also result in contaminated soil (controlling soil lead levels should be a consideration in every exterior lead-based paint abatement project).

Soil lead hazards are determined by measuring the concentration of lead in the soil, examining the location and use of the soil, and determining the degree to which the soil is "bare" (see Chapter 5). For a yard or area to require hazard control, a total of at least 9 square feet of bare soil must be present. Any size bare area in a play area containing more than 400 µg/g of lead is a hazard. Appendix 13.3 contains details on a sampling method to measure lead in soil. When assessing the condition of the surface cover, it is important to determine why the soil is bare. Bare soil is common in the following areas and circumstances:

- Heavily used play areas.
- Pathways.
- Areas shaded by trees or buildings.
- Areas with damaged grass.
- Drought conditions.

Measuring the lead content of soil will aid in the selection of an appropriate abatement method that has a reasonable likelihood of being maintained. Soil *abatement* (as opposed to interim controls) is generally appropriate when lead is present in extraordinarily high concentrations (more than 5,000 µg/g), use patterns indicate exposures are likely, or interim controls are likely to be ineffective (e.g., planting grass in high-traffic areas). Soil interim controls are covered in Chapter 11, Section VI. This section describes soil treatments that should be effective for at least 20 years.

Pre-abatement soil samples should be collected but not necessarily analyzed until post-abatement soil samples have been collected, analyzed, and compared to clearance standards. If post-abatement soil levels are below applicable limits, the pre-abatement samples need not be analyzed (see Chapter 15).

B. Soil Abatement Methods

Soil abatement methods include:

- Soil removal and replacement followed by off-site or on-site disposal; including covering with clean soil (Mielke, 2006; Mielke, 2011).
- Soil cultivation (rototilling).
- Soil treatment (e.g., organic matter, chemical, phytoremediation) and replacement.
- Paving with concrete or asphalt.

Soil removal is discussed in detail below; however, before choosing to remove contaminated soil, other treatment options should be considered. The advantages of using soil treatment methods (as opposed to soil removal) are three-fold (Elias, 1988):

- The costs of hauling large quantities of contaminated soil are eliminated or greatly reduced.
- Disposal sites for soil are not needed except for a much smaller volume of wastes generated during the treatment process.
- The need for uncontaminated replacement soil is greatly reduced.

1. Soil Removal and Replacement

For most soil removal projects, removal of 6 inches of topsoil is adequate. The depth of soil lead contamination is usually restricted to the top of the soil, with contamination decreasing markedly below the top few inches. However, in urban areas it is not uncommon for the contamination to extend to up to 1 or 2 feet in depth. This may be because these areas were once the

location of buildings contaminated with lead-based paint. Alternatively, past practices may have resulted in a gradual buildup of the elevation of the soil grade over time. In such circumstances, the removal of the top layer of soil may leave behind contaminated soil at lower depths. In mixed residential/ industrial areas, or where industry once existed, the depth of the contamination may vary widely. The desired decision on the depth of removal should also consider the depth of soil disturbance during the course of usual activities, such as gardening. If the top layer of soil will not be penetrated, then it should not be necessary to remove lead-contaminated soil at deeper levels, since there will be no exposure.

For practical purposes, properly conducted soil removal to a depth of 6 inches should suffice in urban residential areas that are restricted to grass, shrubs, or shallow gardens. However, the depth of soil contamination should be assessed at each site, and the decision regarding depth should be made based on the results of the soil sampling and anticipated use of the land. For most residential areas, the depth of removal will not exceed 6 inches (Jones, 1987; Ontario, 1987; Stokes, 1987 and 1988). Records of the soil sampling and abatement that occurs should be maintained with the permanent records of the property. These records will alert property owners who are planning excavations to depths below the abatement depth, such as for water or sewer line work, to use caution to avoid contaminating the surface soil with excavated soil. The owners should be advised to sample the soil below the abatement depth to determine the lead concentrations so that procedures can be implemented to segregate this deeper soil, if contaminated, and to use it as fill for the deeper areas of the excavation when the work is completed. With EPA's standard for the maximum allowable lead concentration in replacement soil being that it is less than 400 µg/g, the lead concentration in the replacement soil must be less than that concentration; it is advisable that, where feasible, it be half or less than that, i.e., 200 µg/g or less, to provide a precautionary safety factor.

1. **Types of Equipment** – Removal and replacement of soil in residential abatement situations may take place in both large and small sites. Some urban yards are very small, consisting of only a few square feet; others are larger, but are sometimes surrounded by buildings. Therefore, residential soil abatement will often require the use of extensive manual labor in addition to mechanical soil removal. When soil is removed by hand, it generally can be loaded into wheelbarrows and then off-loaded to other vehicles to be transported to the disposal site. Rather than off-load the wheelbarrows to dump trucks, it is usually more efficient to dump the soil directly into roll off containers, which are then loaded onto trucks for transport to the disposal site.

2. **Sod and Seeded Grass Maintenance** – All grass sod planted as part of the abatement process should be maintained until the end of the growing season. This maintenance should include initial frequent watering to establish the rooting of the sod and germination of the grass seed, followed by watering on a regular basis to keep the grass in a healthy state. Under some conditions, seeding the soil may be practical, but often it is not realistic to restrict use of the soil area for the length of time needed to establish newly seeded grass.

3. **Identify Utilities** – The owner or contractor should contact the local coordinated information source for all utilities before beginning work to obtain exact locations of all underground utility lines. If a utilities information service does not exist in the community, the individual utilities should be contacted directly. In addition, the Common Ground Alliance's (CGA's) One Call Systems International committee maintains an 811 telephone number which will notify local utility companies about the intent to dig so that, within a few days, they can "send a locator

to mark the approximate location of your underground lines, pipes and cables, so you'll know what's below – and be able to dig safely" (***http://www.call811.com/how-811-works/default.aspx***). CGA also maintains an on-line interactive map (***http://www.cga-onecall.com/map/***) and a state-by-state listing (***http://www.call811.com/state-specific.aspx***) of contact information for "one call" centers for each U.S. state and Canadian province that should be able to help with finding underground service lines.

4. **Protect Utilities** – Care should be taken to protect existing utilities during abatement to prevent any damage to existing underground and overhead utilities and to prevent any harm to human life and property. If a contractor is used, the owner should require the contractor to protect the existing utilities and to make good any damage to these utilities as quickly as possible.

5. **Existing Fences** – Care should be taken while removing existing fencing for worksite access. Such fencing should be salvaged and reinstalled (if it does not contain lead-based paint) to the satisfaction of the owner. In some cases, fencing may have to be replaced.

6. **Protection of Adjacent Areas** – When working adjacent to excluded areas, including sidewalks, fences, trees, and patios, the soil should be excavated at a slope away from the excluded areas of less than 2 percent so that contamination does not wash or roll into the excluded area.

7. **Inclement Weather** – Removal and/or replacement operations should be suspended at any time when satisfactory control of the overall operation cannot be maintained on account of rain, wind, or other unsatisfactory weather or ground conditions. Determination of such conditions should be made by the owner or project consultant. When such conditions exist, the work area should be cleaned up immediately and work suspended. High winds can disperse contaminated soil and dust to off-site areas and runoff from rain can carry contamination outside the abatement area.

8. **Vehicle Operation** – Prior to hauling contaminated soil, a vehicle operation plan should be prepared for the equipment and hauling vehicle operators, which includes but is not limited to information on the cleaning of vehicles, securing of tarps and tailgates, ticketing of trucks, unloading of material, and handling of spilled soil.

   All trucks, hauling vehicles, and containers loaded with contaminated soil should be inspected for loose material adhering to the outside of the body, chassis, or tires before departure from the worksite. Such material should be cleaned up before the vehicle leaves for the disposal site. If the truck tires made contact with the contaminated soil, they should be cleaned before the trucks leave the work area. The tires should be brushed off on a plastic sheet and the contaminated soil loaded onto the truck or returned to the lot being excavated.

   Soil should be loaded directly into dump trucks or disposal containers from the worksite. If possible, there should be no "double- handling" of contaminated material, such as shoveling the soil into a wheelbarrow, moving it to another location, dumping it, and shoveling it again into another container. This double handling not only wastes time but also increases the likelihood of spreading the contamination and tends to make site cleanup more difficult. The trucks should have secure fitting tarps and sealed tailgates to reduce leakage as much as possible.

FIGURE 12.22 Replacing resident pathway after soil removal.

9. **Soil Replacement and Cleanup** – Prior to soil replacement, all walks, driveways, lanes, and streets adjacent to the excavation area should be cleaned of all contaminated soil (see Figure 12.22). All loose soil should be scraped, washed, and swept from the above-mentioned surfaces. No clean soil should be placed down until all contamination has been removed from these areas.

   At the completion of the workday, all loose contaminated soil within the limits of the work area should be collected. The collected soil should be transferred to a dump truck or other container for subsequent disposal.

   All hard surfaces, such as sidewalks, paved driveways, and patios, should be cleaned at the completion of each workday. This daily cleanup should consist of scraping, washing, vacuuming, and wet sweeping all soil from the above-mentioned surfaces.

   Cleanup procedures should begin early enough so that they can be completed before the end of the workday.

10. **Prevention of Contamination from Underlying Soil** – Regardless of the depth of removal, the possibility of contamination of the replacement soil from the underlying unexcavated soil exists, particularly from future activities. One way to minimize this occurrence is by laying a water-permeable fabric (geotextile) or similar lining at the bottom of the excavated areas to provide a visual demarcation between replaced soil and original soil (Weitzman, 1993). This liner can serve as a warning for persons digging in the future to exercise caution so that contaminated soil beneath the liner does not become mixed with the replacement soil.

11. **Contaminated Soil Load Manifest System –** In order to keep track of the contaminated soil being hauled away from the site, a load manifest system should be used to keep an exact record of the time and location of disposal. The manifest should consist of a two-part ticket, with one ticket given to the owner at the time of truck departure and the other held by the hauler. The disposal site ticket should be presented to the site owner or inspector technician before the end of the workday on which the material was deposited in the dump site. The purpose of the manifest system is to ensure that the contaminated soil is not used as fill in other residential areas. Soil waste should be managed and disposed of carefully; it may be considered hazardous as a result of a TCLP test (see Chapter 10, Housing Waste).

12. **Final Grade** – The final grades of replaced soil should be 2 inches above existing grades to allow for settling and to ensure that all drainage is away from existing structures.

13. **Existing Vegetation** – A number of precautions are needed to protect existing vegetation, such as bushes and trees. It is advisable to tie trees and shrubs to ensure stability. Hand tools are needed to scrape soil from around roots without undermining or damaging them. Any large roots should be left undisturbed.

14. **Tool Contamination** – To minimize the cross-contamination between excavation and

replacement worksites, separate tools should be provided for the excavation and replacement activities. A less-expensive alternative is to employ an acceptable method for decontamination of tools, workers' clothing, and footwear. The decontamination should include physically removing as much soil as possible and then washing and rinsing the contaminated items with water.

All workers should clean their boots thoroughly before leaving the work area. The soil removed from boots should be disposed of either in a truck used for hauling contaminated soil or left in the worksite.

15. **Prevention of Off-site Movement of Contaminated Soil** – Contaminated soil should be removed from the site as soon as possible to prevent wind and water erosion. To prevent off-site migration and to avoid the possibility of tampering by children, piles of contaminated soil should not be left on-site overnight. Wind erosion can occur on any site. Water erosion is more likely on hilly sites or during heavy precipitation. Exposed sites can be covered with plastic and secured in place to prevent off-site migration of contaminated soil. An alternative method is to wet down the site at the end of the workday to prevent wind erosion. Similar problems will be encountered when contaminated soil is stockpiled during the day prior to disposal at the end of the day. In this case, wind and water erosion should be controlled by using a combination of plastic sheeting and silt fencing.

16. **Site Control** – The following precautions should be taken:

- To prevent the spread of contaminated soil, secure working limits should be defined for each area of excavation. Access to this area should be restricted to authorized personnel with entrances and exits controlled.
- The abatement work area should be enclosed with temporary fencing or adequate barricades to prevent unauthorized personnel or animals from entering the work area.
- Yellow caution tape should be installed across doors leading to abatement areas.
- Access routes to homes should be maintained at all times. Such routes should not require passing through the area of excavation.
- The removal of a partial grass cover in preparation for the laying of sod or grass seeding may *temporarily* increase the amount of bare contaminated soil. On-site exposure could result when children play on the exposed soil. Abatement workers can control this during the day by means of adequate site control. However, control is difficult, if not impossible, after the end of the workday. Lead hazard warning signs should be posted to warn residents.
- In order to minimize inconvenience to residents and neighbors and to minimize exposure, abatement of a particular site should be completed within 1 workday.

2. Soil Cultivation

Soil lead concentration often decreases with increasing depth, so soil mixing can be considered to be an abatement strategy. If the average lead concentration of the soil to be abated is below 1,200 µg/g, thorough mixing is an adequate abatement method. Pilot testing may be necessary to determine the type of mixing process needed. Rototilling may not be effective.

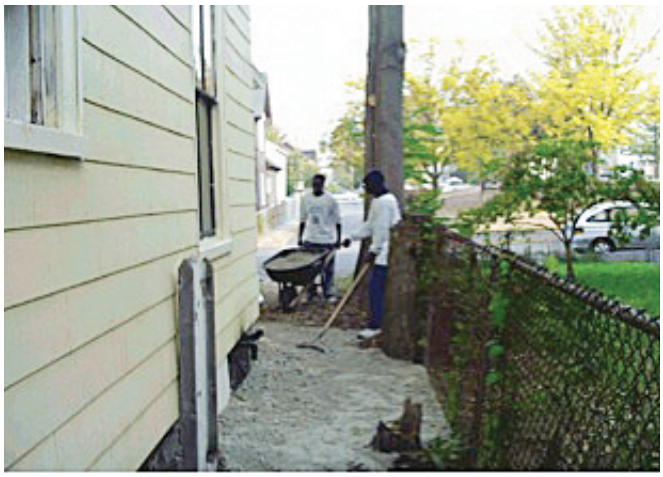

FIGURE 12.23 Preparing to pave high traffic area.

3. Paving

If contaminated soil is present in high-traffic areas, the soil can be covered by a high-quality concrete or asphalt (see Figure 12.23). In this case, contaminated soil need not be removed before paving. Normal precautions associated with thermal expansion or contraction and traffic load should be considered. Hard surfaces are not appropriate in play areas where falls are possible from slides, jungle gyms, etc. The Consumer Product Safety Commission has developed recommendations for fall surfaces in public play areas (e.g., addressing the need for impact attenuating protective surfacing under and around equipment, installation and maintenance procedures, and general hazards presented by protrusions, etc. CPSC, 2008; *www.cpsc.gov/CPSCPUB/PUBS/325.pdf*).

4. Other Soil Treatment Methods Under Study

HUD has funded studies to investigate other potential methods to reduce soil lead hazards. Plants can reduce the soil lead level (phytoremediation) but their use has not been widely tested or applied. The use of chemical additives (e.g. phosphate) to reduce the biological availability of lead appears to be attractive, but studies are continuing.

C. Exterior Dust Control

Lead in exterior dust can be a source of exposure to children because it can be tracked inside and carried on the skin, especially the hands (Bornschein, 1986). For example, in older urban areas in Cincinnati, exterior leaded-dust concentrations are on average about four times higher than interior leaded-dust concentrations, and exterior lead surface loadings are much higher than for interior dust (Clark, 1993). Just as children can be directly exposed to leaded-soil, they can also be exposed to exterior leaded-dust. Exterior dust can also migrate by various means (children, adults, pets, or wind) to the interior of homes where there are many opportunities for exposure to children. Exterior leaded-dust concentrations up to 50,000 µg/g (equivalent to 5 percent lead in dust) have been measured in urban areas in the EPA Soil Lead Abatement Demonstration Project (EPA, 1993c).

If only an individual property is involved in the exterior dust-control activity, the type of equipment that can be used will be limited by the size of the area involved and the person responsible for the area. Owners are not required to clean streets, for example. Because of the mobility of exterior dust, the length of time that the dust cleanup remains effective will be limited by the size of the abatement area and therefore may need to be repeated periodically.

Exterior dust control consists of two components:

- Controlling sources of lead-contaminated dust.
- Removing lead-contaminated dust from paved areas.

Without adequate control of the sources of lead in exterior dust, recontamination of the exterior areas will occur. Studies of a schoolyard area indicated that leaded-dust concentrations equaled pre-abatement levels within 1 year in Winnipeg, Ontario (Stokes, 1988). Recontamination of some paved areas in Cincinnati occurred within a few days (Clark, 1991), indicating that repeated cleaning and control of the *sources* of the lead are necessary.

1. Types of Equipment

Exterior dust cleanup consists of removing as much dust and dirt as possible from all paved surfaces on the property or properties involved. Lead-contaminated dust can be found on paved surfaces such as sidewalks, patios, driveways, and parking areas. For multiple adjacent proper ties that are being abated, cleanup of streets, alleys, or other common areas should be considered, although this is normally a municipal responsibility. Brick paved areas present the biggest challenge in removing exterior dust because they contain numerous cracks. For individual properties, hosing off walkways and play areas periodically may reduce exterior leaded-dust levels.

In order to meet this cleaning challenge, it is necessary to have available the most efficient hard-surface vacuum cleaning equipment. Many commercial contract cleaning firms located in urban areas have such equipment.

There are several different types of suitable paved-surface cleaning machines:

- Hand-pushed vacuum cleaners.
- Vacuum-assisted sweepers, which are similar to the traditional broom sweeper, with the added feature of a slight vacuum that assists in controlling dust and transporting material from the broom bristles to the hopper.
- Vacuum sweepers, which lift material from paved surfaces – some are equipped with curb brushes to assist in transporting the material from the edge of the cleaning area to the vacuum head and into the hopper.
- Trucks equipped with strong vacuums and large HEPA filters for the exhaust.

EPA research has found that regenerative air machines, which depend on rapidly moving air to capture particles from the surface of the pavement, frequently remove only a small fraction of the dust and thus may not be suitable for lead abatement work (Pitt, 1985).

2. Evaluation of Equipment

A number of pavement-cleaning machines were tested as part of the Cincinnati Soil Lead Abatement Demonstration Project (Clark, 1993). The machines tested were the vacuum-assisted sweeper, the vacuum sweeper, and the regenerative air machine. Initial tests demonstrated that several machines operated above the 90 percent efficiency level. A machine performing at the 90 percent efficiency level will pick up 90 percent of the available dirt after two passes. Equipment tested involved both large machines suitable for streets and parking lots and some walk-behind, vacuum-assisted broom sweepers suitable for sidewalks and other smaller areas. Several larger machines performed at or above the 90 percent efficiency rate. Some of the smaller walk behind sweepers did not perform at an acceptable level of efficiency.

Care must be taken when emptying the collected dust from the machines. The most appropriate method to minimize dust release is to dampen the contents of the hopper using an accessible hose. If water is to be used for dust control, it will be necessary to devise a means of containing excess water. This can be achieved by placing 6-mil polyethylene plastic on the ground where the equipment is being emptied and carefully collecting the water after the hopper has been emptied. It is also necessary to perform this activity in a secure area so that children are not exposed.

3. Removal of Heavy Accumulation

The first step in cleaning an area should be the removal of heavy accumulations of dust and debris. The heavily accumulated areas can be cleaned either by manually removing the material with scrapers, shovels, or brooms, or by vacuuming the heavily accumulated areas if vacuuming proves to be adequate in removing the contamination. Just as in handling lead-contaminated soil, the heavy accumulations of exterior dust should be dampened.

4. Vacuum Cleaning

Small areas, such as sidewalks and patios that are inaccessible to larger cleaning machines, may be cleaned with an acceptable vacuum cleaner (see Chapter 14 for discussion of vacuum cleaners). Surfaces should be vacuumed continuously until no additional visible dust is being removed by further vacuuming.

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Chapter 14: Cleaning

Chapter 14: Cleaning

How to Do It

1. **Include cleaning in plans for the work.** Include written step-by-step procedures for precleaning, cleaning during the job, and daily and final cleanings in the project design or specifications, using information contained in this chapter. Assign responsibilities to specific workers for cleaning and for maintaining cleaning equipment. Have sufficient cleaning equipment and supplies *before* beginning work, including:

   - Detergent
   - Waterproof gloves
   - Disposable rags
   - Mops
   - Buckets
   - Vacuum (preferably HEPA-equipped) with attachments (crevice tools, beater bar for cleaning rugs, etc.)
   - Plastic bags for disposal of debris and heavy duty protective sheeting (of sufficient thickness to prevent puncture)
   - Debris containers (heavy duty plastic bags are adequate for most jobs)
   - Containers for dirty wash water
   - Shovels
   - Rakes
   - Water-misting sprayers
   - Heavy duty polyethylene sheeting (or equivalent) of sufficient thickness to prevent puncture (e.g., 6 mil).

2. **Restrict access to work area.** Do not allow residents to enter the work area until cleaning is completed and clearance is established.

3. **Clean before starting work.** If contamination is extensive, conduct precleaning of the dwelling unit and furnishings, if needed, before beginning paint-disturbing work. Move and/or cover all furniture and other objects.

4. **Conduct ongoing cleaning during the work.** Conduct ongoing, continual cleaning during high-dust jobs, including regular removal of large and small debris and dust. Decontamination of all tools, equipment, and worker protection gear is required before such items are removed from containment areas. Electrical equipment should be wiped and vacuumed, not wetted down, to minimize electrocution hazards.

5. **Clean at the end of each work day.** For high-dust jobs, schedule sufficient time (usually 30 minutes to one hour) for a complete daily cleaning, starting at the same time near the end of each work day after paint-disturbing activity has ceased.

6. **Wait one hour before final cleaning.** For final cleaning, wait at least 1 hour after active paint-disturbing activity and other dust-generating work has ceased to let dust particles settle.

7. **Clean and remove protective sheeting used for dust containment.**

8. **Use both vacuuming and wet cleaning.** Clean all surfaces, using the two basic cleaning methods, vacuuming and/or wet cleaning. Cleaning procedures may vary, depending on the amount of dust generated by the job and the smoothness of the surfaces to be cleaned. A three-phase, vacuum-wet cleaning-vacuum cycle is recommended for high-dust jobs with some rough or porous surfaces. For low-dust jobs with all smooth surfaces, wet cleaning may be adequate to pass clearance. Surfaces that are badly soiled often require extra manual effort, involving hand wiping until no more visible dirt comes up. Other cleaning methods are acceptable, as long as clearance criteria are met and workers are not overexposed.

9. **A HEPA vacuum is required if a vacuum is used**.

10. **Follow the cleaning sequence, "ceiling to floor and out the door."** For high-dust jobs, vacuum all surfaces in the room (ceilings, walls, trim, interior window sills, window troughs, hard surface floors, and other horizontal surfaces). Start with the ceiling and work down, moving toward the entry door ("ceiling to floor and out the door"). Completely clean each room before moving on. For low-dust jobs, it is not necessary to clean ceilings and walls, except that they should be cleaned if they were the surfaces on which the work was done. See Chapter 8 for a description of low-dust and high-dust jobs.

11. **Use a common detergent, not TSP (Trisodium Phosphate).** Use a standard household detergent, not a high-phosphate detergent, to dislodge any ground-in contamination. Use either the three-bucket system described in this chapter, or a use-once-and-toss system, as also described below. If buckets are used.

12. **Inspect visually.** After final cleaning, the supervisor should perform a visual inspection to ensure that all visible dust and debris has been removed. Reclean if necessary.

13. **Paint and/or seal, if necessary.** Paint or otherwise seal treated surfaces and interior floors, if necessary.

14. **Final wet cleaning.** After painting that has followed high-dust jobs, conduct a final wet cleaning of horizontal surfaces.

15. **Clearance.** Workers should stay out of cleaned rooms until after the clearance examination. Conduct a clearance examination (see Chapter 15). (Clearance, while recommended by HUD, is not required by regulations in certain circumstances, such as for *de minimis* projects under HUD's Lead Safe Housing Rule or under the EPA's Renovation, Repair, and Painting Rule., which requires cleaning verification for most projects; see Chapter 11.)

16. **Repeat cleaning and clearance (or cleaning verification), if necessary. Continue clearance testing (or cleaning verification) until the dwelling unit or work area passes.** If the unit fails, repeat cleaning of all of the surfaces that failed and all other surfaces represented by the surfaces that failed.

    - As an incentive to conduct ongoing cleaning and a thorough final cleaning, the cost of repeated cleaning after failing to pass clearance or cleaning verification should be borne by the contractor, not the owner, as a matter of the job specification.

I. Introduction

This chapter describes cleaning procedures to be employed before, during and following lead-based paint abatement, interim controls and other renovation or maintenance work that may create lead-contaminated dust. Dust removal as an interim control measure is covered in Chapter 11.

All lead hazard control activities and many other paint-disturbing jobs can produce dangerous quantities of lead-contaminated dust. Unless this dust is properly removed, a dwelling unit may be more hazardous after the work is completed than it was originally. Whenever possible, ongoing and daily cleaning of settled dust during lead hazard control and renovation projects is recommended. Ongoing and daily cleaning are also necessary to minimize worker exposures by removing excess dust from the work area.

Cleaning is the process of removing visible dust and debris *and* dust particles too small to be seen by the naked eye. Removal of lead-based paint hazards in a dwelling unit will not make the unit safe unless excessive levels of leaded-dust are also removed. This is true regardless of whether the dust was present before the work or generated by the work itself. Improper cleaning can increase the cost of a project considerably because additional cleaning and clearance sampling will be necessary. However, cleaning and clearance can be achieved routinely if care and diligence are exercised.

The cleaning methods and procedures described in this chapter are for hard surfaces. Workers should not attempt to clean carpets or rugs following lead hazard control or other paint disturbing work unless they know that the carpets are new and therefore are not likely to contain lead-contaminated dust embedded in the fibers and backing, or unless the workers are prepared to spend hours vacuuming the carpeting over and over again until the deeply embedded dust is removed. Vacuuming an old carpet may bring some of the embedded dust to the surface of the carpet, increasing the dust-lead loading levels on the surface and thus increasing the likelihood that children will be exposed to lead in the dust and that the carpet will *not* pass clearance (Ewers, 1994). Therefore it is better to clean and carefully remove the protective sheeting that is over the carpet (as described later in this chapter), and then have clearance dust-wipe sampling performed on the carpet. If lead levels on the surface of the carpet are found to exceed the clearance standard (which is the same as the hazard standard in EPA regulations), it will be necessary to either thoroughly clean the carpet or dispose of it. See Section V.B.2 of Chapter 11 for guidance on dust removal from carpets.

A. Performance Standard

The cleaning methods described in this chapter are designed to achieve clearance. (The clearance examination, which includes a visual assessment and dust sampling, is described in Chapter 15.) Although these cleaning methods are feasible and have been shown to be effective in meeting clearance standards, other methods may also be used if they are safe and effective. This performance-oriented approach should stimulate innovation, reduce cost, and ensure safe conditions for both residents and workers.

According to EPA (40 CFR 745.227(d)(8)(viii)) and the HUD regulations (24 CFR 35.1320(b)(2)(i)) that follow the EPA regulations, the permissible amount of lead in dust remaining on each of the following surfaces following lead hazard control work – the clearance standards – must be less than the following levels:

- 40 µg/ft² on floors (both hard-surfaced and carpeted),
- 250 µg/ft² on interior window sills (stools), and

- 400 µg/ft² on window troughs (the area where the sash sits when closed, plus the area of the exterior sill between the sash and the frame for the screen and/or storm window, if present).

These levels are based on wipe sampling. They apply to single-surface wipe samples and to composite wipe samples with only two subsamples. To evaluate the results of a composite sample with more than two subsamples, the standards listed above must be divided by one-half the number of subsamples. (Note that these *Guidelines* do not recommend the use of composite wipe sampling; see Chapter 15.)

If state, local or tribal standards are more stringent, they apply. Note that EPA and HUD require clearance of window troughs for abatement and for other lead hazard control work covered by HUD's Lead Safe Housing Rule above *de minimis* amounts. A clearance examination includes wipe sampling of window troughs as well as interior window sills and floors.

Clearance is not easily attained. Over 20 percent of the dwellings enrolled in the evaluation of the HUD Lead Hazard Control Grant Program failed to pass clearance on the first try, and the clearance levels applicable at the time of the study were at least twice as high as those listed above and thus less difficult to achieve (NCHH, 2004).

B. Small Dust Particles

Dust particles that are invisible to the naked eye remain on surfaces after ordinary cleaning procedures. A visibly clean surface may contain unacceptably high levels of lead in dust particles and require special cleaning procedures.

C. Difficulties in Cleaning

Although cleaning is an integral and essential component of any lead hazard control activity, it is also the part of the activity that when conducted improperly is most likely to cause clearance failure. Common causes for this failure include worker inexperience, high dust-producing methods, rough surfaces, and tight deadlines.

1. Worker Inexperience

To understand the level of cleanliness required to meet the established clearance standards, workers often require a significant reorientation to cleaning. Many construction and maintenance workers are used to cleaning only dust that they can see, not the invisible dust particles that are also important to remove.

Any worker performing cleaning for either clearance or cleaning verification needs training and hands-on practice in the stringent levels of cleaning required to pass clearance or cleaning verification.

Many of the cleaning methods described in this chapter are not standard, traditional procedures for general home improvement contractors and maintenance crews. Therefore, owners and managers must ensure that contractors and crews follow the specialized cleaning procedures recommended herein or specially designed alternative procedures, even though some steps may appear to be redundant or unnecessary. These methods have been shown to be feasible and effective in many situations, and skipping steps in the cleaning procedures may increase the possibility of failing clearance and harming children.

2. High Dust-Producing Methods and/or Inadequate Containment

High dust-generating methods during the hazard control or renovation work, inadequate dust containment, and poor work practices can all make achievement of clearance particularly difficult. Dust generated by the work should be contained, to the extent possible, to the inside of work areas. Floors and any furnishings left in the work area should be carefully covered with impermeable protective sheeting. Inadequately constructed or maintained containment or poor work practices will result in additional cleaning efforts, due to dust that has blown out or been tracked out of the work area. Work practices necessary to prevent spreading of dust throughout a dwelling (e.g., by tracking dust out of work areas) are essential. See Chapter 8 for guidance on worksite preparation and other work practices.

3. Rough Surfaces

It is often difficult to dislodge dust in the crevices of rough, pitted or cracked surfaces, yet small amounts of dust in such locations can be picked up in clearance wipe samples and cause clearance failure. Making surfaces smooth and cleanable increases the likelihood of achieving clearance.

4. Rushing to Meet Tight Deadlines

Daily and final cleanings have sometimes been compromised due to project deadlines, since cleaning comes at the end of the job. Hurried efforts often result in clearance failure. Delayed and over-budget projects are often the result of repeated, unplanned recleanings that are necessitated by inadequate containment and careless work practices, including rushed clean-ups.

II. Coordination of Cleaning Activities

A. Checklist

The owner or contractor may use the following cleaning checklist before any lead hazard control or renovation activity.

- ✦ Is the critical importance of cleaning understood by the project supervisor / certified renovator / abatement supervisor, and all workers on the job?
- ✦ Have all workers been trained for hazard control work or lead-safe work practices?
- ✦ Have all workers carefully studied the step-by-step procedures for precleaning before the work begins (if needed), in-progress cleaning, and daily and final cleanings?
- ✦ Have the before-work, daily, and final cleanings been scheduled properly and coordinated with the other participants in the project?
- ✦ Have cleaning equipment, materials and supplies been obtained?
- ✦ Do the workers know how to operate and maintain special cleaning equipment, do they have directions for the proper use of all cleaning materials, and are they receiving adequate supervision of their cleaning activities?

- Are all workers properly protected during the cleaning processes (see Chapter 9)?
- Have provisions been made to properly handle and dispose of waste (see Chapter 10)?
- Have visual inspections and clearance testing (or cleaning verification) been arranged (see Chapter 15)?
- Are the clearance (or cleaning verification) criteria to be met fully understood?
- Have all appropriate surfaces been properly painted or otherwise sealed?

B. Equipment Needed for Cleaning

The following equipment is needed to conduct cleaning: a high-efficiency particulate air (HEPA) filter vacuum cleaner, and attachments (crevice tools, beater bar or agitator head for cleaning carpets and rugs, etc.) (see Figure 14.1); detergent; waterproof gloves; rags, mops, and buckets; heavy-duty plastic bags (preferably 6-mil) for debris; waste water containers; shovels (and rakes, if needed) for debris removal; water-misting sprayers; and disposable, impermeable protective sheeting, such as polyethylene plastic sheeting of a thickness to prevent puncture (e.g., 6-mil).

FIGURE 14.1 There are many brands of HEPA vacuums on the market.

C. Waste Handling and Disposal

Generally, dirty water used in cleaning should be disposed of down a toilet. Do not pour dirty water onto the ground or down a storm sewer. Vacuum and/or wet clean protective sheeting. Vacuum contaminated disposable clothing. Wrap or bag (with heavy-duty plastic) disposable clothing and protective sheeting, architectural debris, paint strippings, paint chips and dust, vacuumed debris and vacuum filters, rags, and other material. Seal the packages with tape and store them temporarily in a secure location (such as a locked large metal bin for refuse, e.g., a Dumpster®). Dispose of the waste in an appropriate State-permitted solid waste facility, unless the waste is exempt from that requirement. See the next paragraph and Chapter 10 for further information on waste disposal.

EPA has stated that waste generated by lead-based paint activities in housing falls under the household waste exemption in the Resource Conservation and Recovery Act (RCRA) (EPA, 2000b). The household waste exemption applies to waste generated by contractors as well as to waste generated by residents, and it applies to all lead-based paint activities, including abatement, interim control, and renovation and remodeling of housing. Types of housing included in the household waste exemption are single-family homes, apartment buildings, public housing, and military barracks. HUD and EPA both recommend that the lead-safe practices described above and in Chapter 10 be followed to reduce the likelihood that household waste will contaminate the environment.

States and local governments may institute hazardous waste requirements applicable to lead activities in housing. Owners and contractors should determine what, if any, state or local regulations apply, and should comply with them.

III. Cleaning Methods

Two basic cleaning methods have proven effective, especially when used concurrently: (1) vacuuming, using a high-quality vacuum cleaner equipped with a HEPA exhaust filter, and (2) wet cleaning with a household detergent and rinsing. Trisodium phosphate (TSP) is not recommended, as explained below in Section III.D. A proven cleaning procedure is a three-pass system, in which the surface is first vacuumed to remove as much dust and small debris as possible, then wet-cleaned to dislodge fine dust, and finally vacuumed again to remove any remaining particles. However, it may not be necessary to use all three steps on all surfaces. As explained in Section V below, research indicates that the way these methods should be used depends on whether the work was a high-dust or low-dust job and whether the surfaces being cleaned are smooth or rough (Dixon, 2004; California Dept. of Health Services, 2004).

A. Vacuums: HEPA vs. non-HEPA

If a vacuum cleaner is used during lead hazard control projects, renovation projects, or other work covered by OSHA regulations, the vacuums must be a HEPA vacuum. This section provides technical information on the various types of vacuum cleaners.

HEPA vacuums differ from conventional vacuums in that they contain high-efficiency filters that are capable of trapping extremely small, micron-sized particles. These filters can remove particles of 0.3 microns or greater from air at 99.97 percent efficiency or greater. (A micron is 1 millionth of a meter, or about 0.00004 inches.) Some vacuums are equipped with an ultra-low penetration air (ULPA) filter that is capable of filtering out particles of 0.13 microns or greater at 99.9995 percent efficiency. However, these ULPA filters are slightly more expensive, and may be less available than HEPA filters. (Note that, when HEPA vacuums are specified by regulations or specifications, ULPA filter vacuums may be used because of their grater dust collection efficiency.)

Experts have recommended using HEPA vacuums to cleanup leaded-dust because conventional vacuums, without the high efficiency filter, may send very fine lead-dust particles out the exhaust and back into the indoor environment. One study in 1992 supported this view (CMHC, 1992). More recent studies, however, have found that the difference in collection efficiency between HEPA and non-HEPA vacuums is not significant (California Department of Health Services, 2004; Rich, 2002; and Yiin, 2002).

There is more to a vacuum than the filter. Other important factors that determine the effectiveness of a vacuum are particle lifting velocity (which is a function of the motor, the design of the suction tool, and the extent to which the rest of the system does not release air before it is supposed to), quality of construction (which may determine the durability of the machine and whether there are air pressure leaks before the filtration), and whether the vacuum has special tools, such as a crevice tool (see Figure 14.1). These *Guidelines* recommend that a high-quality HEPA vacuum be used if possible; however, a high-quality household or commercial vacuum should be used if a HEPA vacuum is not available. The California study cited in the previous paragraph found that a HEPA vacuum was actually less effective in removing dust-lead from vinyl floors than non-HEPA vacuums, probably because the suction tool was not well designed for the job. Also, filters are available that, while not HEPA, are better than those that formerly were standard on household and commercial vacuums. One additional benefit of a HEPA filter is that it may catch other contaminants in the residential environment, such as allergens, in addition to very fine lead particles.

B. HEPA Vacuums

This section provides background information on HEPA vacuums.

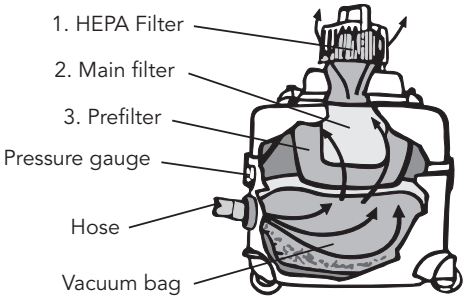
Operating Instructions

There are numerous manufacturers of HEPA vacuums. Although all HEPA vacuums operate on the same general principle, they may vary considerably with respect to specific procedures, such as how to change the filters. To ensure the proper use of equipment, the manufacturer's operating instructions should be carefully followed and if possible, training sessions arranged with the manufacturer's representative.

Although HEPA vacuums have the same "suction" capacity as ordinary vacuums that are comparably sized, their filters are more efficient. Improper cleaning or changing of HEPA filters may reduce the vacuum's suction capability.

Special Attachments

Because the HEPA vacuum will be used to vacuum surfaces other than floors, operators should buy attachments and appropriate tool kits for use on different surfaces (such as brushes of various sizes, crevice tools, angular tools, etc.), as is true with conventional vacuums (see Figure 14.2).

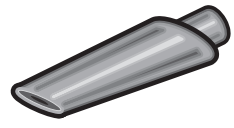


Parts of a HEPA-vacuum
Most HEPA-vacuums have three filters: HEPA filter, main filter, and pre-filter. Debris gets sucked in through the hose into the vacuum bag. The air and dust get filtered through the pre-filter, the main filter, and the HEPA filter. The HEPA filter captures the lead dust before the air is released into the work area again.

Use special attachments
Use the rubber cone where the floor meets the baseboards and along all the cracks in the floor boards. Use the brush tool for walls and woodwork.

Use the wheeled floor nozzle for bare floors and the carpet beater for rugs.

Move slowly
Vacuum slowly so the HEPA vacuum can pick up all the lead-dust.


Rubber Cone


Dust Brush


Powered Carpet Beater

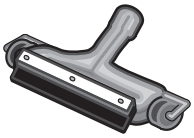

Wheeled Floor Nozzle

FIGURE 14.2 Vacuum with a HEPA filter and special attachments.

Selecting Appropriate Size(s)

HEPA vacuums are available in numerous sizes, ranging from a small lunch bucket-sized unit, which may be carried like a backpack, up to truck-mounted systems. Two criteria for size selection are the size of the job and the type of electrical power available. Manufacturer recommendations should be followed (see Figure 14.3).

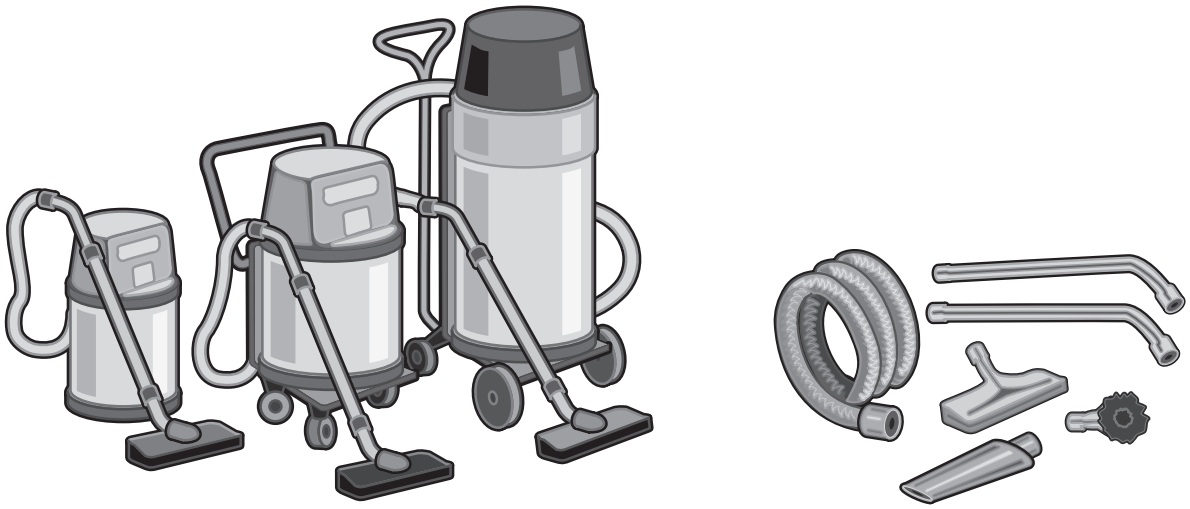


FIGURE 14.3 Sizes of HEPA vacuums and attachments.

Prefilters

HEPA filters are usually used in conjunction with a prefilter or series of prefilters that trap the bulk of the dust in the exhaust air stream, particularly the larger particles. The HEPA filter traps most of the remaining small particles that have passed through the prefilter(s). All filters must be maintained and replaced or cleaned as specified in the manufacturer's instructions. Failure to do so may cause a reduction in suction power (thus reducing the vacuum's efficiency and effectiveness). Failure to change prefilters may damage the vacuum motor and will also shorten the service life of the HEPA filter, which is far more expensive than the prefilters.

Wet-Dry HEPA Vacuums

Wet-dry HEPA vacuums are equipped with a special shut-off float switch to protect the electrical motor and the HEPA filter from water contact. Some hazard control contractors have found these vacuums to be particularly effective in meeting clearance standards and in avoiding damage to vacuum equipment.

C. Emptying the Vacuum

Used filters and vacuumed debris should be handled and disposed of in accordance with guidance provided in Chapter 10. Emptying should be done in the containment area or in a secure

and controlled space off-site (such as at the contractor's facility). The vacuum should be placed on a large sheet of plastic to contain dust and debris released during the opening, emptying and replacement steps. Vacuum users should use extreme caution when opening the vacuum for filter replacement or debris removal to avoid accidental release of accumulated dust into the environment. This may occur, for example, if the vacuum's seal has been broken and the vacuum's bag is disturbed. Operators should wear protective clothing and appropriate respiratory protection when performing this maintenance function

D. Wet Cleaning

It is recommended that a general all-purpose household cleaner be used for wet cleaning. Cleaners made specifically for lead may also be useful, although one study found that lead specific cleaners performed no better than all-purpose household cleaners, and that no published studies have shown lead-specific cleaners to be more effective than all-purpose cleaners (Lewis, 2006). Cleaning with water alone can also be effective, but detergents and lead-specific cleaners are recommended because they probably keep dust and soil in suspension better than plain water (EPA, 1997a; EPA, 1998). HUD does not recommend trisodium phosphate (TSP). Not only has TSP been banned in some areas because of negative effects on the ecology of aquatic systems, but research indicates that phosphate content is not associated with effectiveness in removing lead-contaminated dust from residential surfaces (EPA, 1997a; EPA, 1998, Lewis, 2006).

Research also indicates that the effort put into the cleaning, i.e., the amount of pressure applied to the surface and the thoroughness of the cleaning, may be more important than the choice of cleaning agent (EPA, 1997a). Note that whenever a wet cleaner is used, a small area of the surface should be tested to make sure that it does not damage the surface or its coloring. If so, another wet cleaner should be used.

Proper procedures for using detergents include the following steps:

Manufacturer's Dilution Instructions

Users of cleaning agents for leaded dust removal should follow manufacturer's instructions for the proper use of a product, especially the recommended dilution ratio.

Appropriate Cleaning Equipment

Because a detergent may be used to clean leaded dust from a variety of surfaces, several types of application equipment are needed, including cleaning solution spray bottles, wringer buckets, mops (including several clean mop heads), brushes, and rags. Follow manufacturer's instructions for the equipment used. Using the proper equipment on each surface is essential to the quality of the wet wash process.

Wet Cleaning Procedures

Some wallpaper surfaces may be damaged by wet washing with detergents. Test a small area first. If it appears that damage will occur, try another detergent, use plain water, or as a last resort clean by repeated vacuuming only.

Use of string mops is recommended for floors. Sponge mops may only push the lead around on the floor, not pick it up. A three-bucket system is recommended with mops (see Figure 14.4). The first bucket contains the cleaning solution, the second includes a mop squeezer, and the third

FIGURE 14.4 Three-bucket cleaning system.

FIGURE 14.5 HEPA vacuum and wet wash technology.

contains rinse water. Use a clean mop head for rinsing. Three-bucket system is also discussed below under Section V.E, Final Cleaning.

Some experienced contractors have used, instead of the three-bucket mopping system, a "wet, wipe and toss" procedure. This method requires a large quantity of clean rags, which are put into a bucket of detergent and water solution to *wet* them. The worker pulls a rag from the bucket, wrings it out over the bucket, *wipes* clean an area of about 16 sq. ft., *tosses* the used rag away, pulls another rag, and so on. If the detergent requires rinsing, repeat with clean water. For sills, troughs, counters, shelves, walls and tight floor spaces like behind toilets, the wet wipe and toss method is the best alternative to the mop. Some contractors prefer the method even for large floor areas. A major advantage is that it avoids the potential problem of recontaminating the area by cleaning with dirty water. This method may also use less water than a mop, which can be an advantage for some household areas. The rags are commercially available, disposable cloth scraps or paper products. Cloth rags usually are not cleaned and reused because of the risk of contaminating other laundry (White, 2003). Alternatively, some people use wet-dry HEPA vacuums (see Figure 14.5).

Changing the Cleaning Mixture

Many manufacturers of cleaners will indicate the surface area that their cleaning mixture will cover. To avoid recontaminating an area by cleaning it with dirty water, users should follow manufacturer-specified surface area limits. (Note that this issue is largely avoided if the "wet, wipe and toss" method is used, because each rag is used only once.) However, regardless of manufacturers' recommendations, the cleaning mixture should be changed after its use for each room. As a rule of thumb, 5 gallons should be used to clean no more than 1000 square feet. Dirty cleaning mixture should be handled and disposed of in accordance with guidance provided in Chapter 10. Wash water should never be poured onto the ground. It is sometimes filtered, and usually poured down a toilet.

IV. Cleaning Procedures Before and During the Work

The special cleaning procedures to be followed *before and during* a hazard control or renovation project are discussed in chronological order below. Skipping steps in the process may result in failure to meet clearance standards.

A. Cleaning Before Work Begins

Precleaning (i.e., cleaning conducted before lead hazard control or other paint-disturbing work is begun) is necessary only in dwelling units or common areas that are heavily contaminated with lead in dust and paint chips. Precleaning involves the removal of debris and paint chips, followed by vacuuming (see Figure 14.4). These steps may be followed by removal of occupant personal possessions, furniture, or carpeting, depending on the worksite preparation being used (see Chapter 8). If the furniture will not be cleaned, it should be removed from the area and/or covered with protective sheeting prior to beginning the precleaning procedure. Carpeting (including rugs) should always be misted before removal to control the generation of hazardous dust.

It is usually the resident's responsibility to remove most of his or her personal possessions. However, if necessary, owners or project management should be prepared, with necessary boxes, packing materials, and staff, to complete this activity before lead hazard control work begins. As a last resort, the contractor or the maintenance staff may pack any remaining belongings and carefully seal and move the boxes from the work area.

Once the residents' possessions that can be removed from the work area have been removed, the contractor shall ensure that the residents leave the work area and do not return until after clearance (or cleaning verification) has been passed.

Clearance should be conducted after final cleaning but *before* resident's items are moved back in. (See Chapter 15.) Following cleaning and clearance, the contractor should return all resident-owned items to their appropriate places. Leaving these tasks to the contractor or the management may be expensive and inefficient, since the contractor will need to be insured against the possibility that the occupant's belongings may be damaged.

B. Ongoing Cleaning During the Job

On all jobs, it is good practice to regularly clean the work area and the travel pathways used by workers, by removing debris and vacuuming dust during the work shift, in order to keep the areas free of excessive accumulations of dust and/or debris.

For high-dust jobs, when a large amount of paint chips or dust is being generated, continual debris removal and vacuuming of dust during the work day may be necessary to minimize worker exposure and tracking of dust and paint chips from one area to another. Extra attention should be paid to ongoing cleaning so that daily clean-up goes quickly.

Research conducted shortly before the publication of this edition of these *Guidelines* on whether if differences exist between two new and two older methods for removal of lead-contaminated dust from three wood surfaces of varying roughness or texture found that the reduction in lead dust achieved by vacuuming and wet wiping, the traditional method, was somewhat greater and more consistent than the electrostatic dry cloth and wet Swiffer-brand mop, a newer method. (Lewis, 2012) As noted in that paper, the wipe product industry continues to develop products; future cloths may have higher dust reduction efficiencies.

C. Daily Cleaning

Cleaning activity should be scheduled at the end of each work day when all active work has ceased, whether or not this is a regulatory requirement for the particular job. Sufficient time should be allowed for a thorough and complete cleaning, usually about 30 minutes to an hour, less if cleaning has been done throughout the work shift. (If work is being done in multiple shifts, it is recommended

that there be a cleanup at the end of each shift.) Daily cleaning helps achieve clearance dust-lead levels by minimizing problems that may otherwise occur during final cleaning, and it limits worker exposures. Daily cleaning can be skipped within vacant buildings. Daily cleaning is essential when occupants will return in the evening to occupy spaces outside the containment area. Under no circumstances should dust or debris from the project, or protective sheeting be left outside overnight, even if the dwelling is vacant. (Storing bagged dust and debris from the project, and protective sheeting in secure containers outside is permissible.) Daily cleaning should consist of:

- Wrapping or bagging dust and debris from the project, and storing it in a secure area
- Vacuuming protective sheeting on floors and furnishings
- Vacuuming other horizontal surfaces
- Vacuuming and wet cleaning floors of hallways and rooms used as pathways by workers to travel outside the work area, if such spaces are accessible to residents during non-work hours
- Cleanup of exterior debris and paint chips, and removal of exterior protective sheeting
- Patching and repairing protective sheeting
- Putting any protective sheeting that is removed in a secure place

1. Large Debris

Large demolition-type debris (e.g., doors, windows, trim) should be wrapped in heavy duty (6-mil plastic or similar sheeting that will resist puncture), sealed with tape, and moved to a secure area on the property designated for waste storage. All sharp corners, edges, and nails should be hammered down to prevent injury and minimize the tearing of plastic. It is not necessary to wrap each individual piece of debris in plastic if the entire load can be wrapped. A secure area either outside or inside the property should be designated as a temporary waste-storage area. Covered, secured, and labeled dumpsters placed on or near the property may be used. (See Chapter 10.)

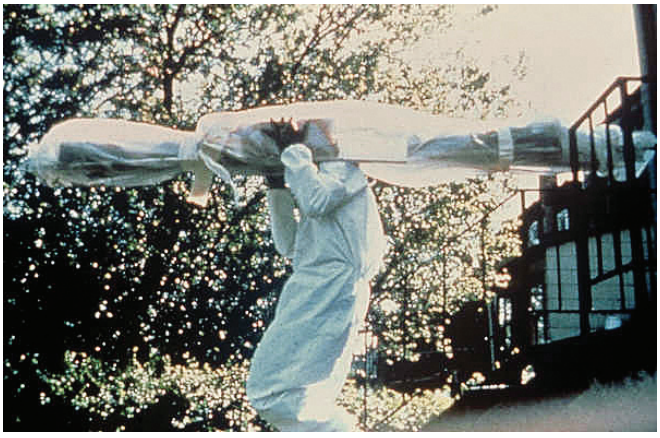


FIGURE 14.6 Removing large debris.

2. Dust and Small Debris

Dust and small debris should be vacuumed and wet wiped or mopped, or, alternatively, after being misted with water, it should be swept up, collected, and disposed of properly. The swept debris should be placed in heavy duty (double 4-mil or single 6-mil polyethylene plastic bags or equivalent), properly sealed, and moved to the designated trash storage area. Trash bags should not be overloaded, as overloaded bags may rupture or puncture during handling and transport.

3. Exterior Cleaning

Exterior and interior areas potentially affected by exterior lead hazard control or other paint-disturbing work should

be protected with a containment system (see Chapter 8). Because weather can adversely affect the efficacy of exterior containment, the protective sheeting on the ground should be removed at the end of each work day. On a daily basis, as well as during final cleaning, the immediate exterior area should be examined visually to ensure that no debris has escaped containment. Any such debris should be raked or vacuumed and placed in single 6- mil or double 4-mil plastic bags, which should then be sealed and stored along with other contaminated debris (see Figure 14.7). Vacuuming is appropriate for hard exterior surfaces, but not for soil.

FIGURE 14.7 Exterior clean up.

4. Worker Protection Measures

Worker protection measures are discussed in Chapter 9. Studies indicate that during daily cleaning activities, especially while sweeping, lead hazard control workers may be exposed to high levels of airborne dust. When appropriate, workers should wear protective clothing and equipment respiratory protection.

5. Maintaining Containment

The integrity of the protective sheeting used in a lead hazard control project should be maintained. During their daily cleaning activities, workers should monitor the sheeting and immediately repair any holes or rips with durable sheeting (e.g., 6-mil polyethylene) and duct tape.

V. Final Cleaning Procedures

Before treated surfaces can be painted or sealed, final cleaning should be completed. Because airborne dust requires time to settle, the final cleaning process should start no sooner than 1 hour after active lead hazard control or other paint-disturbing work has ceased in the room.

A. Decontamination of Workers, Supplies and Equipment

Decontamination is necessary to ensure that worker's families, other workers, and subsequent properties do not become contaminated. Specific procedures for proper decontamination of equipment, tools and materials prior to their removal from containment areas should be implemented, as described below and in Chapter 9.

Work clothing, work shoes, and tools should not be placed in a worker's automobile unless they have been laundered, cleaned, or placed in sealed bags. All vacuums and tools that were used should be wiped using rags wetted with detergent solution. In addition, workers should dispose of the rags.

Consumable/disposable supplies, such as mop heads and rags, should be replaced after each dwelling is completed. Using a contaminated mop head can be a major impediment to achieving clearance. Soiled items should be handled and disposed of in accordance with guidance provided in Chapter 10.

FIGURE 14.8 Vacuuming the floor containment.

Durable equipment, such as power and hand tools, generators, and vehicles, should be cleaned prior to their removal from the site. The cleaning should consist of a thorough vacuuming followed by wet wiping.

B. Cleaning and Removal of Protective Sheeting

Protective sheeting should be cleaned before being removed. This minimizes the generation of airborne dust and/or spillage of dust and debris while the sheeting is being folded up and bagged. Remove large debris as described above in Section IV.C.1. Clean dust and small debris by vacuuming and wet wiping or mopping (see Figure 14.8). Remove upper-level sheeting, such as that on cabinets and counters, first, after it has been cleaned. When removing sheeting, it should be carefully rolled or folded up so that the more-contaminated side is inward. Next, remove sheeting from the floor. All protective sheeting should be folded carefully from the corners/ends to the middle to trap any remaining dust.

Protective sheeting used to isolate work areas from other spaces should remain in place until after the cleaning and removal of other sheeting. These should then be vacuumed, wet-wiped, and removed last.

Removed sheeting should be placed into double 4-mil or single 6-mil plastic bags, or plastic bags with equivalent (or better) performance characteristics, which are sealed and removed from the premises. As with daily cleanings, this removal process usually requires workers to use protective clothing and respiratory protection, especially for high-dust jobs.

C. Vacuuming and Wet Cleaning

After the protective sheeting has been removed, the entire area should be cleaned, using the combination of vacuuming and wet cleaning recommended below. The area to be cleaned is the area that will be subject to the clearance examination, including all rooms, hallways, stairways, elevators, etc. used by workers as passageways to and from the work area, plus areas used to store tools and bagged or packaged debris from the work. (See Section IV.A of Chapter 15 regarding the determination of the clearance area.) Porches, sidewalks, driveways, and other hard exterior surfaces should be vacuumed if exterior hazard control or other paint-disturbing work was conducted, or if debris was stored or dropped on such surfaces.

Interior cleaning for high-dust jobs should begin on the ceilings and end on the floors (following the catch phrase "ceiling to floor and out the door") For low-dust jobs, it is not necessary to clean ceilings and walls unless paint-disturbing work has been conducted on those surfaces. (See Chapter 8 for a description of low-dust and high-dust jobs.) Cleaning should be sequenced to avoid passing through rooms already cleaned, with the dwellings' entryway cleaned last.

Surfaces frequently cleaned include ceilings, walls, floors, window panes and mullions, interior window sills, window troughs, exterior window sills, doors, heating, ventilation, and air conditioning (HVAC) equipment (heating diffusers, radiators, pipes, vents), fixtures of any kind (light, bathroom, kitchen), built-in cabinets, and appliances.

Surfaces such as porous concrete, old uncoated, worn and porous hardwood floors, and areas such as corners of rooms and window troughs pose especially difficult cleaning challenges. Porous concrete and corners of rooms normally require additional vacuuming to achieve an acceptable level of cleanliness.

After a high-dust job, the recommended first cleaning step is vacuuming to pick up large amounts of dust and small debris. All surfaces should be vacuumed: ceilings, walls, windows, doors, shelves, floors, etc. Research indicates that walls and ceilings retain leaded-dust after lead hazard control projects (Dixon, 2004). Vacuuming is especially important if some of the surfaces are rough. The second step is a wet cleaning, using the wipe or mopping method, as described above in Section III.D. Wet cleaning is probably the most effective method of picking up small particles of lead-dust (California Dept. of Health Services, 2004). (Be sure to vacuum and wet-wipe window troughs, because they are tested for dust-lead by the clearance examiner.) Vacuuming and wet-cleaning once should be sufficient if the surfaces are smooth, but it is recommended that rough surfaces be vacuumed a second time, after the wet-cleaned surface has dried, to increase the likelihood of achieving clearance. As an alternative to the second vacuum pass, some contractors have found that better clearance results on rough surfaces are achieved by thoroughly wiping by hand the wet-cleaned surface until it is dry, using disposable towels (Rupp, 2003). The amount of wiping needed to clean a surface may depend on how soiled it is, as well as its smoothness or roughness.

After low-dust jobs, the first pass with the vacuum is usually not necessary, especially if the surface is smooth. It is often effective to begin with a wet cleaning. But if there is a substantial amount of dust or small debris on the surfaces to be cleaned, begin with the vacuum and then go to the wet cleaning. This will make the wet cleaning more efficient. Vacuuming following the wet cleaning is recommended for rough surfaces but may not be necessary for smooth surfaces. It is generally not necessary to clean ceilings and walls after low-dust jobs, unless paint disturbing work has been conducted on those surfaces. Remember to clean the window troughs. These recommendations are summarized in Table 14.1.

Table 14.1 Summary Guidance on Cleaning Methods by Dustiness of Work and Condition of the Surface.

Conditions	Cleaning Procedure	Surfaces
High-dust job, with some rough surfaces	Vacuum, wet clean, vacuum (after surface is dry)	All surfaces, including ceilings, walls, and window troughs.
High-dust job, with all smooth surfaces	Vacuum, wet clean	
Low-dust job, with some rough surfaces	Vacuum (optional, depends on amount of dust), wet clean, vacuum (after surface is dry)	All surfaces except ceilings and walls, unless those surfaces have been treated.
Low-dust job, with all smooth surfaces	Vacuum (optional, depends on amount of dust), wet clean	

FIGURE 14.9 **Inspecting for completeness of the work performed.**

D. Supervisor's Preliminary Visual Inspection

After the cleaning is completed, the supervisor should visually evaluate the entire area subject to clearance (including work areas, worker passageways and storage areas) to ensure that all work has been completed and all visible dust and debris has been removed (see Figure 14.9). The supervisor's preliminary inspection does not replace the independent visual assessment and dust testing conducted by the clearance examiner. If the clearance examiner's visual assessment results are unsatisfactory, dust testing is postponed until identified surfaces are recleaned and/or retreated. This process makes it cost effective to have the supervisor perform a preliminary visual inspection.

E Surface Painting or Sealing of Non-Floor Surfaces

The next step of preparing for clearance (or cleaning verification) is painting or otherwise sealing all treated surfaces except floors. Surfaces, including walls, ceilings, and woodwork, should be coated with an appropriate primer and repainted. Surfaces enclosed with vinyl, aluminum coil stock, and other materials traditionally not painted are exempt from the painting provision.

Painters should use the following lead-safe work practices:

- Using "drop cloths," which should be disposable, impermeable sheeting – not cloth,
- Cleaning their work tools before bringing them into the clearance area, and
- Ensuring no dust is tracked in from outside the clearance area.

F. Sealing Floors

The next step before clearance is to seal all hard-surface floors that do not already have an intact, nonporous coating. Sealed surfaces are easier for residents to clean and maintain over time than those that are not sealed. Wooden floors should be sealed with clear polyurethane or painted with deck enamel or durable paint. Vinyl tile, linoleum, and other similar floors should be sealed with an appropriate floor wax (or equivalent product). Concrete floors should be sealed with a concrete sealer or other type of concrete deck enamel. However, if these floors are already covered by an effective coat of sealant, it may be possible to skip this step.

As an alternative to sealing, floors may be covered with new vinyl tile, sheet vinyl, linoleum flooring, or the equivalent to create a more permanent cleanable surface. New surfaces should be cleaned with a cleaning solution that is appropriate for that type of surface.

Workers applying floor sealants or coverings should take care to wipe clean tools brought into the work area and to avoid tracking in dust from outside the clearance area.

G. Final Wet Cleaning, EPA Cleaning Verification, and Possible Pre-Clearance Dust Testing

Even if painters and floor covering workers use lead-safe work practices, lead-contaminated dust may still migrate into previously cleaned areas. Therefore, it is recommended that the final step before the clearance examination is to wet clean all horizontal surfaces one more time (see Figures 14.10 through 14.13).

HEPA vacuum all surfaces
Start at the end farthest from the main entrance/exit. As you vacuum, move towards the main exit and finish there.

Begin at the top of each room and work down. For example, start with the top shelves, the top of the wood work, and so on, and work down to the floor. Do every inch of the window, especially the window trough.

Courtesy: Alice Hamilton Occupational Health Center

FIGURE 14.10 The HEPA Vacuum-Wet Wash-HEPA Vacuum Cycle Helps Meet Clearance Standards.

Wash *all surfaces* in the work area with suitable detergents, including areas that had been covered with plastic. Some wallpaper should only be HEPA vacuumed, since it may be damaged by the detergent.

Wipe All Surfaces

Wet Mop Floor

Don't Dry Sweep

FIGURE 14.11 Wet Cycle Requires Washing All Surfaces with Suitable Detergents.

To wash: Use string mops and mop buckets with wringers. (Some experts say NEVER use a sponge mop on the floor. Sponge mops may only push the lead around on the floor, not remove it.)

Dip the string mophead in the detergent wash in bucket #1. Mop the floor.

Squeeze out the mophead in empty bucket #2. Return no bucket #1 for more detergent solutions and continue mopping. Repeat.

Use the third bucket for rinsing the floor.

Use the 3-Bucket System

FIGURE 14.12 Use a Three-Bucket System and Then HEPA Vacuum Again to Minimize Recontamination.

HEPA vacuum all surfaces a final time
HEPA vacuum *all surfaces* in the work area, including areas that had been covered with plastic.

Starting at the far end, work towards the decontamination area. Begin with ceilings or the top of the walls and work down, cleaning the floors last. Do every inch of the windows, especially the troughs. Use the corner tool to clean where the floor meets the baseboard and all the cracks in the floor boards. Use the brush tool for the walls. Move slowly and carefully to get all the dust.

FIGURE 14.13 HEPA vacuum all surfaces a final time.

Under EPA's Renovation, Repair and Painting rule, after the renovation has been completed, the firm must clean the work area until no dust, debris or residue remains (see Appendix 6). The post-renovation cleaning verification requirements must be performed by a certified renovator. If the certified renovator directs the other workers to perform the work practices, the certified renovator must be at the work site during cleaning of the work site. For more information on EPA's RRP rule and the cleaning it requires, see ***www.epa.gov/lead/pubs/renovation.htm***.

At this point in the process, supervisors of work for which achievement of clearance is known to be difficult may wish to consider preliminary dust testing before requesting the clearance examination. Factors that tend to be associated with clearance failure are (1) high levels of lead in dust and paint before the work began, (2) hard floor and window surfaces that are not smooth and cleanable, and (3) high-dust work in rooms from which furniture has not been removed (NCHH, 2004).

Methods exist for reliably screening wipe samples on-site instead of in a fixed laboratory. These include portable X-ray fluorescence (XRF) analysis and anodic stripping voltammetry (ASV) (Ashley 2001; EPA, 2002b; Clark, 2002) or potentiometric stripping analysis (PSA). These methods may provide testing results much more quickly than fixed laboratory analysis, because transportation of samples is not necessary and handling time is reduced. Note that analysis of samples taken from target housing of pre-1978 child-occupied facilities must be conducted by a laboratory, whether fixed-site or mobile, recognized by the Environmental Protection Agency (EPA) under its National Lead Laboratory Accreditation Program (NLLAP) (***http://www.epa.gov/lead/pubs/nllap.htm***).

Any person who is trained and otherwise qualified to operate the XRF instrument or use the ASV method may use these methods to conduct *preliminary* dust testing to determine whether the clearance area is clean and ready for the clearance examination. A person conducting a preliminary screen does not have to be a technician working for an NLLAP-recognized laboratory; the sample may be collected by the contractor or the owner, and given to the laboratory for analysis. Owners and contractors may wish to use such screening tests to minimize the likelihood of clearance failure. Federal and State regulations on the use of devices with radioactive elements (i.e., some XRF analyzers) must be observed (see Chapter 7, section VII.A).

H. Clearance

The clearance examination should take place more than 1 hour after the final cleaning. This ensures that any airborne lead particles stirred up by the cleaning have settled. Clearance is usually performed after the sealant is applied to the floor. See Chapter 15 for information on clearance examination procedures. For cleaning verification, a waiting period is not required for the initial wipe, nor after the first failed wipe, but a 1-hour waiting period is required after the second failed wipe before the work area is released from the project.

I. Recleaning After Clearance Failure

If the area fails the clearance examiner's visual assessment or clearance dust sampling tests, all surfaces represented by the failing clearance dust wipe samples must be recleaned. Failure is an indication that the cleaning has not been successful. If the surfaces are smooth, a wet wash should be used. If the surfaces are rough, a vacuum, wet-cleaning, vacuum cycle is recommended. If the failing surfaces include carpeting, the decision must be made whether to try to clean the carpet or to dispose of it. See Section V.B.2 of Chapter 11 for guidance. Care should be exercised during the recleaning of "failed" surfaces or components to avoid recontaminating "cleared" surfaces or components.

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