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Abatement: How To Do It

1. Have a risk assessment or paint inspection performed by a certified risk assessor or a certified inspector technician who is independent of the abatement contractor.

2. Develop a site-specific lead hazard control plan based on the hazards identified and financing available. Select the appropriate interior and/or exterior Worksite Preparation Level (from Chapter 8).

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

4. 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 (usually for large projects only).

6. 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 certified abatement contractor using the lowest *qualified* bidder.

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

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

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

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

12. 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. Collect preabatement soil samples, which may not have to be analyzed until postabatement soil samples have been collected, analyzed, and compared to clearance standards. If postabatement soil levels are below applicable limits, the preabatement samples need not be analyzed (see Chapter 15).

14. 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. Observe local or State regulations if applicable.

15. Store all waste in a secure area and make sure it is properly labeled with an accumulation start date (see Chapter 10).

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

17. 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. 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 certificate of completion required by the U.S. Department of Housing and Urban Development (HUD) or local authorities.

19. Pay contractor and clearance examiner.

20. Conduct periodic monitoring and reevaluation of enclosure 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.

Chapter 12: Abatement

Section I

I. Principles of Lead-Based Paint Hazard Abatement

A. Longevity of Abatement

Abatement is the removal of either the building component or the paint itself or the near-permanent enclosure of lead-based paint hazards. From a public health perspective, properly conducted abatement is the desired 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 since failure is less likely to occur. Abatement treatments provide a higher margin of safety than interim controls since the effectiveness of the work is less dependent on resident action, maintenance of housing stock, the conscientiousness of property managers, and the attention of maintenance workers during repair.

As used in this chapter, abatement can mean either correction of lead-based paint *hazards* (as defined in Title X) or treatment of all lead-based paint (as currently practiced in the U.S. Department of Housing and Urban Development (HUD) public and Indian housing program, where all lead-based paint is abated during rehabilitation work or when a child with an elevated blood lead level is identified). The methods explained in this chapter apply to abatement of both lead-based paint hazards *and* lead-based paint.

Interim controls, abatement, or a combination of the two are acceptable methods of addressing lead-based paint hazards. 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. Since 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 *Guidelines*. 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.

The definition of abatement (as used in this document) is different than the "traditional" abatement practices used in some local jurisdictions. Traditional abatement methods often involve dry scraping deteriorated paint, repainting, and dry sweeping without clearance. These methods are known to make leaded dust more accessible to young children and are therefore often counterproductive. Performed inadequately, or without sufficient protection, abatement is known to increase lead exposures to children (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, 1994; Staes and Rinehart, 1995).

Proper abatement refers to any measure designed to permanently eliminate lead-based paint hazards in accordance with standards

established by the U.S. Environmental Protection Agency (EPA) Administrator 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 of lead-based paint from painted building components (as a last resort); removal or covering of lead-contaminated soil with a durable covering (not grass or sod, which are considered interim control measures); and preparation, cleanup, disposal, postabatement clearance testing, recordkeeping, and monitoring (if applicable).

More than any other abatement method, removal of lead-based paint involves the greatest degree of disturbance and dust generation. Therefore, onsite 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 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. Enclosure and building component replacement are the least invasive and most preferred of the abatement methods.

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

For exterior work, preabatement soil samples should be collected but not necessarily analyzed

until postabatement soil samples have been collected, analyzed, and compared to clearance standards. If postabatement soil levels are below applicable limits, the preabatement samples need not be analyzed (see Chapter 15).

B. Prohibited Abatement Methods

Some techniques are prohibited because they are known to produce extremely high levels of lead exposure and result in dwellings that are difficult if not impossible to clean up.

The techniques shown in Table 12.1 are prohibited in the residential setting under HUD regulations (HUD, reserved) and several State regulations (Massachusetts, Maryland, Minnesota, and Rhode Island).

C. Periodic Monitoring and Reevaluation

Compared to interim controls, one of the chief advantages of abatement is that owner monitoring and professional independent reevaluation are either unnecessary (in the case of complete lead-based paint removal) or required only infrequently (in the case of enclosure), since abatement measures are much less likely to fail (see Chapter 6). This minimizes the expense, cost, and time associated with reevaluation.

Abatements can be undertaken after inspections or risk assessments determine the presence of lead-based paint or other lead hazards (see Chapters 3 and 5 for a description of the differences between risk assessments and inspections). If this initial identification phase is not completed before abatement, then all painted surfaces must be assumed to contain lead-based paint above the regulatory limit. This 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 either covered or replaced.

The cost of carefully conducted 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, since the costs of abatement are initially much higher than interim controls.

1. Recordkeeping

Recordkeeping is essential for all abatement methods, including removal. The location of enclosed or encapsulated lead-based paint should be made known to future residents, who may undertake remodeling or repair efforts that could reexpose the 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 issuing construction permits for renovation. The absence of lead-based

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. Uncontained hydroblasting or high-pressure wash.
4. Abrasive blasting or sandblasting without HEPA local vacuum exhaust tool.
5. Heat guns operating above 1,100 °F.

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

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

paint should also be made known to future occupants, in order to avoid unnecessary testing expenses.

D. 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).
- Onsite and offsite paint removal.
- Soil removal or covering.

The available information on paint abatement methods is summarized in Table 12.2.

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

E. 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. Because the performance standards mandated by Title X have not yet been developed, 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. 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).

F. 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 to, among other things, improve aesthetic living conditions, bring the dwelling up to code, preserve historical evidence, and promote energy efficiency. For example, window replacement could be considered to be a lead abatement method, renovation work, or weatherization work all at the same time.

While the intentions of each of these activities may differ, experience shows that many of them can be combined in order to yield savings. In the public housing program, for example, most of the abatement now underway occurs in the context of housing modernization or rehabilitation work. This approach has proven to be feasible and cost-effective.

Congress recognized the wisdom of combining lead abatement with rehabilitation work. In Section 1012 of Title X, any residential construction job receiving more than $25,000 per dwelling unit in Federal funds is *required* to have lead-based paint hazards abated. If $5,000 to $25,000 per dwelling unit in Federal funding is received, either abatement or interim controls must be implemented.

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

Table 12.2 Comparison of Lead-Based Paint Abatement Methods

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

This table is continued on next page.

Table 12.2 Comparison of Lead-Based Paint Abatement Methods (continued)

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

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

Building Component Replacement: How To Do It

1. Prepare the work area by selecting a Worksite Preparation Level (see Chapter 8). Plan how the new component will be installed. Whenever possible use new energy-efficient window, door, and insulating systems.
2. Prepare the hazardous building component for removal. Turn off and disconnect any electrical circuits inside or near the building component to be removed.
3. Lightly mist the component to be removed (unless electrical circuits are nearby).
4. Score all painted seams with a sharp knife.
5. Remove any screws, nails, or fasteners.
6. Use a flat pry instrument (crowbar) and hammer to pry the component from the substrate.
7. Remove or bend back all nails.
8. 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. HEPA vacuum any dust or chips in the area where the component was located.
10. Replace component (optional).
11. Conduct cleaning (see Chapter 14).
12. Conduct clearance and reclean if necessary.

Section II

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. 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.

Component replacement may be more expensive, however, especially for historic preservation projects, since 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.

For certain types of components, the owner may choose to simply remove them without replacement. This is acceptable as long as applicable codes are observed.

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 planners and designers can determine the appropriate level 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 overnight. Therefore, every effort should be made to remove and replace doors and windows on the same day.

2. Waste Storage

While architectural components may or may not be regulated as hazardous waste (see Chapter 10), they still must be properly managed. All building components coated with lead-based paint should be stored in a secure, locked area. They should not be sold or released to anyone who might reinstall them in another dwelling.

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.

Figure 12.1 Use a Pry Point Pad To Minimize Damage to Adjoining Surfaces During Component Removal.

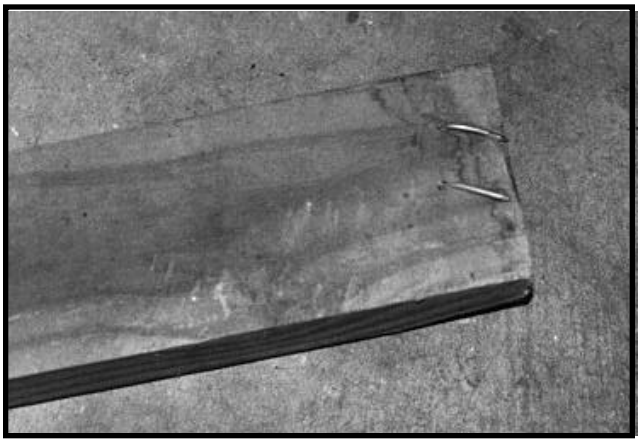


Figure 12.2 Bend Back All Nails on Removed Components.

- 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. By prying in this manner, the component will be removed intact and chip and dust generation will be minimized. 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.

- Since 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 6-mil 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 high-efficiency particulate air (HEPA) 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 cleaned up by at least one HEPA 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. Components with lead-based paint should be removed as described in the previous section.

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. A high-quality caulk warranted for at least 20 years should be used.

2. Windows

The term "window" applies to the sash, the stop and parting beads, and the window jambs. 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. 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.

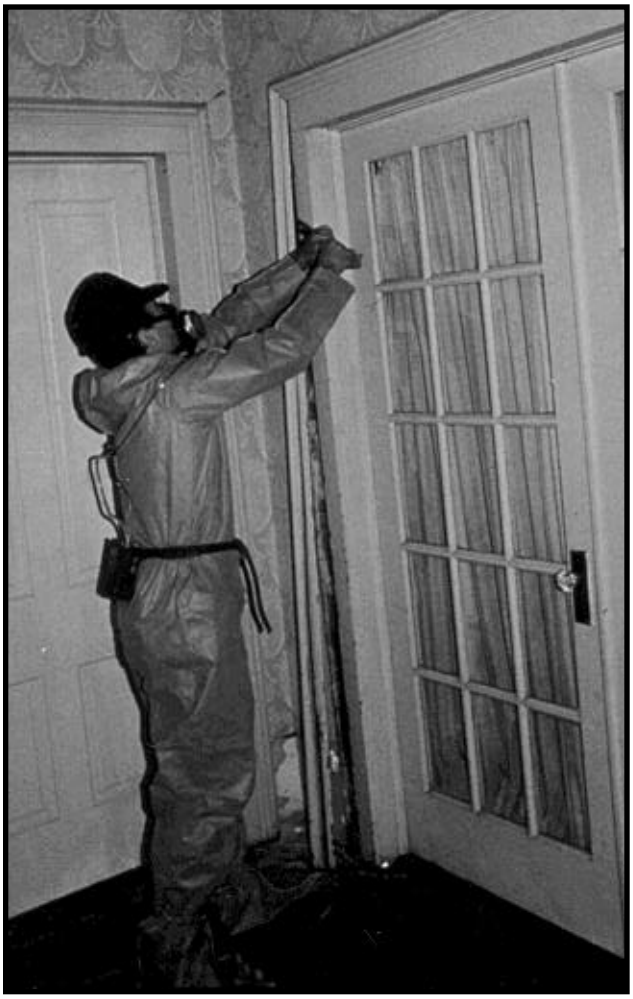


Figure 12.3a Remove and Replace Trim (interior).

Figure 12.3b Remove and Replace Trim (exterior).

Figure 12.4 Window Frame Enclosure System.

Figure 12.5 Window Replacement.

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.

3. Interior and Exterior Doors

Interior and exterior doors include the doorstops and doorjambs. Affected components should be removed as described above. Typical door replacement usually involves the removal of a wooden unit and the installation of a prehung 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 prehung 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 carefully stripping the old jamb.

Primers on Metal Doors

An exception is provided for certain metal doors and frames. If it can be determined clearly that hazardous levels of lead on metal doors and frames reside 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. However, finish coats of paint that cumulatively contain lead of 1 milligram per square centimeter or greater will have to be treated as lead hazards. (The alternative standard of equal to or greater than 0.5 percent by weight may be used.) If laboratory analyses of samples of the field-applied finishes are negative, the metal doors and frames do not require abatement but should be monitored to ensure that 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 cross-hatch 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 it was pigmented with red lead or yellow if it was pigmented with lead chromate), and thickness of layers. Or 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 finish field-applied 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 HEPA 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 can be removed and replaced. 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 offsite for contained abrasive blasting or other forms of paint removal, then reinstalled after repainting.

6. Exterior Siding

Exterior siding includes any materials used on a dwelling's exterior walls. Siding of concern is generally painted wood or brick. Under most conditions, siding will have to be abated through enclosure. However, in restoration

Figure 12.6 Exterior Siding Removal and Replacement.

Figure 12.7a Line Walking Surfaces With Plastic.

Figure 12.7b Line Pathways With Plastic.

or historically significant projects, it may be replaced. In such situations, the affected siding should be removed as described above. Care must be taken to avoid contamination of soil, walkways, window air conditioners, and the building interior.

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 6-mil 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, since 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.

Plaster walls coated with old lead-based paint should generally not be removed, since a great deal of dust will be generated. Enclosure is usually a better option.

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, even if they are not regulated as hazardous wastes (see Chapter 10). Bulk debris such as doors, windows, and trim should be wrapped in 6-mil plastic and sealed with tape. Smaller debris should be swept into 6-mil plastic bags after spraying.

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. Pathways to the dumpster should be lined with plastic so as not to contaminate the area.

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 must not be recycled. See Chapter 10 for a full discussion of hazardous and nonhazardous waste disposal.

Enclosure: How To Do It

1. 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. Select a Worksite Preparation Level (see Chapter 8).
3. Attach a durable drawing to the utility room or closet showing where lead-based paint has been enclosed in the dwelling.
4. Plan for annual monitoring of the enclosure by the owner. An independent inspector technician or risk assessor should evaluate the integrity of the enclosure according to the reevaluation schedule in Chapter 6 *and* after any significant damage due to plumbing or roof leaks, tornadoes, hurricanes, floods, earthquakes, etc.
5. Repair unsound substrates and structural members that will support the enclosure, if necessary.
6. Select appropriate enclosure material (drywall or fiberboard, wood paneling, laminated products, ridged tile and brick veneers, vinyl, aluminum, or plywood).
7. Install extension rings for all electrical switches and outlets that will penetrate the enclosure.
8. If enclosing floors, remove all dirt with a HEPA vacuum to avoid small lumps in the new flooring.
9. Seal and back-caulk all seams and joints. Back-caulk means applying caulk to the underside of the enclosure.
10. When installing enclosures directly to a painted surface, use adhesive and then anchor with mechanical fasteners (nails or screws).
11. Conduct cleanup.
12. Have a certified risk assessor or inspector technician conduct clearance testing and provide documentation and a Statement of Lead-Based Paint Compliance.

Section III

I. 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 in order 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 includes careful sealing of all edges, joints, and seams to create a dust-tight (not necessarily airtight) 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 since 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 from the property; instead, it makes the dwelling lead-safe.

B. Longevity of Enclosures

There is little doubt that hurricanes, earthquakes, tornadoes, 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 Enclosed Surfaces

To prevent the breach of an enclosure, a few simple safety rules are relevant. The surface to be enclosed should be labeled (behind the enclosure), horizontally and vertically, approximately every 2 feet with a warning, "Danger: Lead-Based Paint." The stamp lettering should be done 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. The drawing should be covered with plastic for protection. Enclosures should be highlighted on the diagram and identified as hazardous (see Figure 12.9 for an example of such a diagram).

2. Monitoring Enclosure Integrity

A visual evaluation of the enclosed surfaces should be conducted by owners or their representative at least every year or whenever water or other damage is reported. Residents should also examine the enclosure periodically. Enclosure integrity should be evaluated professionally by a certified risk assessor according to the schedule in Chapter 6. A signed and dated report of the risk assessor's observations, which

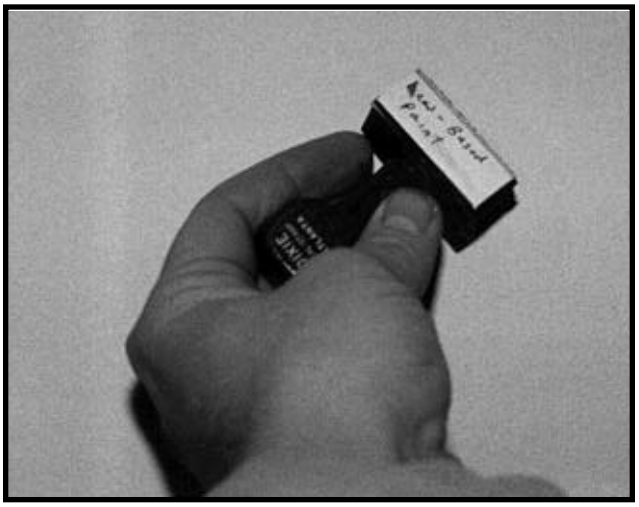


Figure 12.8a Label Surfaces With a Stamp Before Enclosure.

Figure 12.8b Caulk the Seams of a Window Frame Enclosure System.

also indicates the enclosed surface locations, should be retained by the owner, with copies available to the residents.

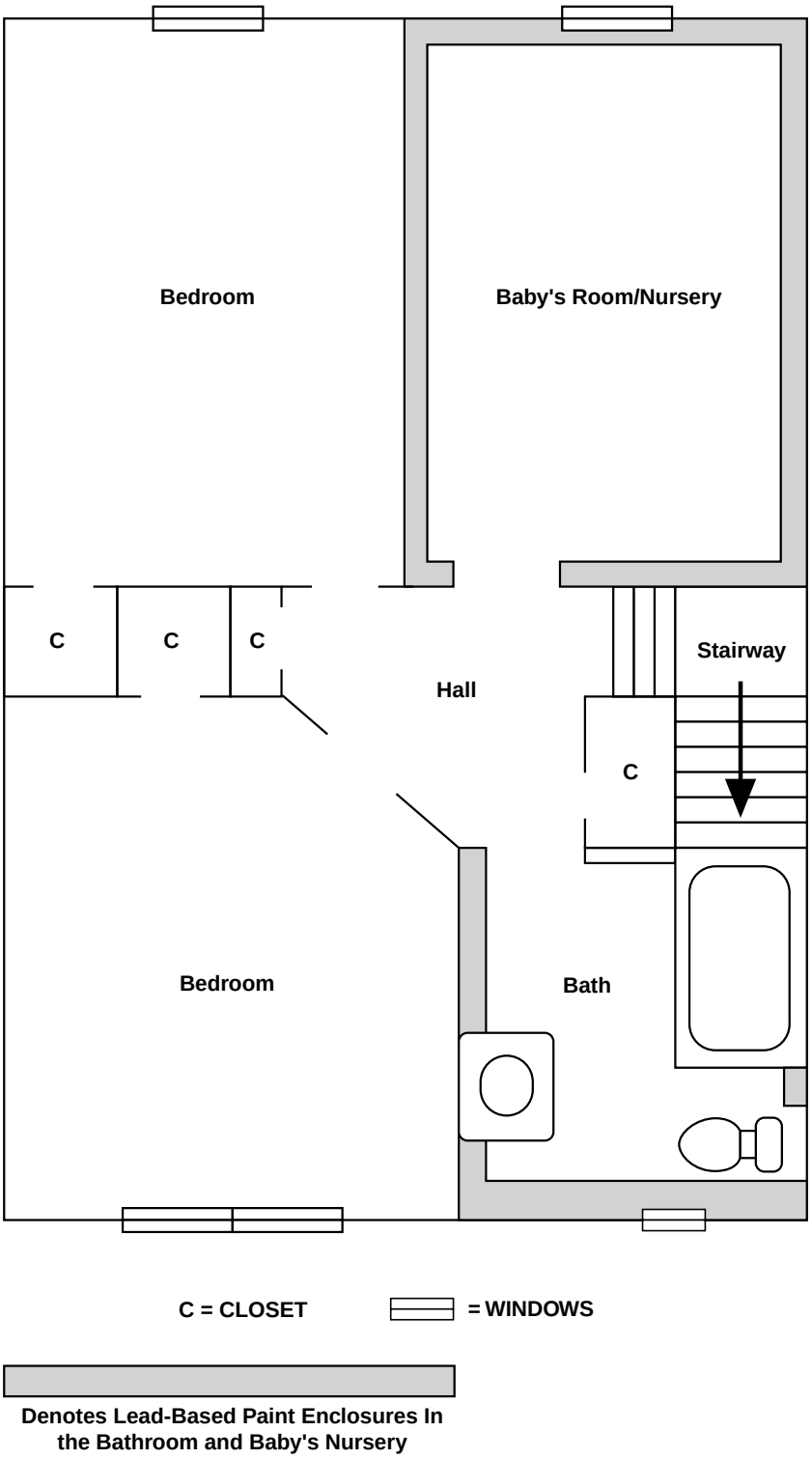
It is a simple matter to repair an enclosure using conventional construction techniques. The repair history of the enclosure should be maintained in the owner's records.

Depending on the jurisdiction, the original lead-based paint risk assessment or inspection report, the clearance report, and a copy of the enclosure drawing may be retained by the municipality as part of its standard records for that property. The reports also may be subject to disclosure requirements during the sale of the dwelling. If a permit is obtained to do renovation work, if demolition of the dwelling is undertaken, or if the title and deed are transferred, the history of the lead-contaminated surfaces hidden behind enclosures will caution future workers and property buyers. Leases should also disclose the location of enclosed lead-contaminated surfaces.

3. 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 deteriorating, stabilization or removal of deteriorated paint before the enclosure is installed should *not* be done due to dust generation.

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



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 it is difficult to seal 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. Ridged 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, since they are not mechanically fastened to the substrate. Regardless of whether they are enclosures or encapsulants, they tend to be inappropriate for broad application, since 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 (202)289–5440 on the two topics listed below:

- Recommendations for covering existing walls and ceilings with gypsum board (GA–650–86).
- Using gypsum board for walls and ceilings (GA–201–90).

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, 1993a, 1993b). 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 screwhole 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.

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, 1993a and 1993b).

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 10-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, 1993a, 1993b).

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 apt to occur in multifamily 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

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.

  a. 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.

  a. 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.)

Figure 12.10a Use of Tyvek on Building Exteriors Prior to Enclosure.

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 in order to bring those fixtures out flush with the new drywall overlay. A sealant or caulk should be used

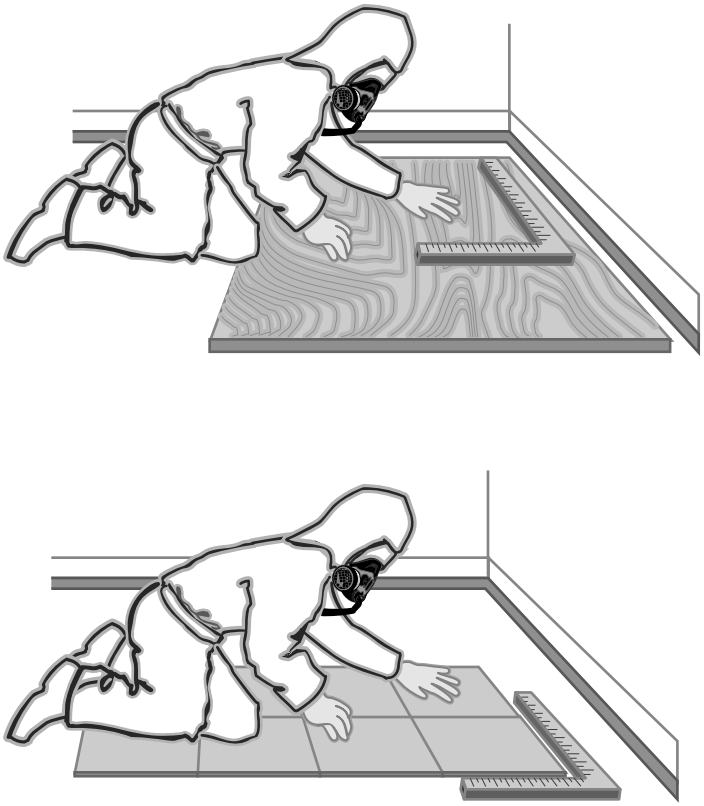


Figure 12.10b Install Underlayment and New Tile as a Suitable Lead-Based Paint Enclosure Method.

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 operations 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 with 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 multifamily 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. Onsite 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, since 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. 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 putting down the plywood. Old floor nails often lose much of their grip, which results in squeaky floor boards. 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 HEPA vacuumed thoroughly; otherwise small lumps will eventually appear in the soft vinyl finish goods.

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 HEPA vacuumed, protective gear should be worn by the workers, and the work area should be contained with 6-mil plastic (or equivalent). In multifamily housing, common stairways must be accessible to residents and workers during the construction work to avoid a fire code violation.

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 in order 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

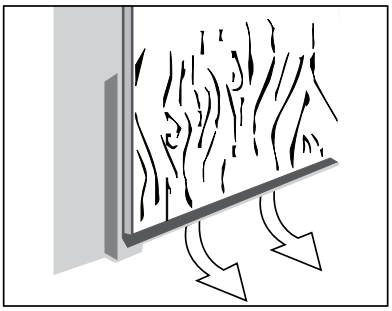
1. Siding

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, facia, barge board, 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. 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 prior to the aluminum covering (see Figure 12.10a). Tyvek® will help prevent leaded dust from escaping through gaps in the new siding, although it will be necessary to leave attic vents uncovered to

Figure 12.11 Seal All Seams for Enclosure.

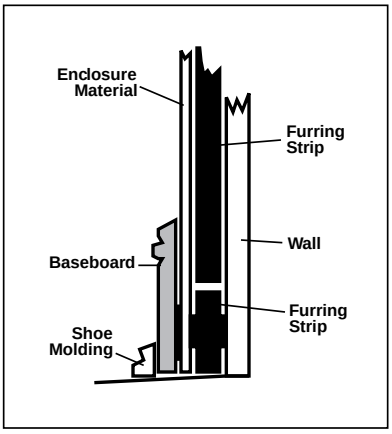
Create a dust-tight seal

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



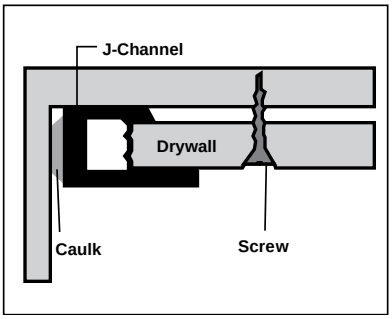
Seal the bottom edge

- Caulk the enclosure material at the bottom.
- Back-caulk and nail the 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.



permit adequate ventilation. Vent openings should not be covered with Tyvek® or other similar covering.

Since 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, since the enclosure is not dust 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 III). 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.

Paint Removal: How To Do It

1. Do not use prohibited paint removal methods:
   - Open flame burning or torching.
   - Heat guns operating above 1,100 °F.
   - Machine sanding or grinding without a HEPA vacuum exhaust tool.
   - Uncontained hydroblasting or high-pressure wash.
   - Abrasive blasting or sandblasting without a HEPA vacuum exhaust tool.
2. Avoid using the following methods:
   - Methylene chloride chemical paint removers.
   - Dry scraping (except for limited areas).
3. Select the appropriate Worksite Preparation Level (see Chapter 8).
4. 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.
5. For mechanical removal methods, use tools equipped with HEPA exhaust capability. 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.
6. For wet scraping, use a spray bottle or wet sponge attached to the scraper 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.
7. For chemical paint removers, determine if the building component can be removed and stripped offsite. Offsite stripping is generally preferred to onsite paint removal. Observe all manufacturer's directions for use of paint removers.
8. For offsite 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 offsite (e.g., doors). This will ensure that the individual component is reinstalled in the same location. Inform the offsite paint remover that lead-based paint is present before shipping. Wrap the component in plastic and send to the offsite stripping location. Clean all surfaces before reinstallation to remove any lead residues by HEPA vacuuming all surfaces, cleaning with other lead-specific cleaners, or phosphate detergents, and HEPA vacuuming again. Conduct cleanup and clearance.

9. For onsite 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 chemically 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 onsite. 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.

10. Dispose of waste properly; most wastes from paint removal projects, such as paint chips and paint remover sludges, will need to be managed as hazardous waste.

11. Conduct cleanup.

12. Have a certified risk assessor or inspector technician conduct a clearance examination and provide documentation and a Statement of Lead-Based Paint Compliance.

Section IV

I. 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 onsite or offsite. 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. Extensive onsite paint removal should usually have an Interior Worksite Preparation Level 4 and an Exterior Worksite Preparation Level 3. 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 hazardous waste and may be the most costly of all lead abatement methods (HUD, 1991).

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 and by a certified risk assessor based on the Reevaluation Schedule for the specific property (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 1,100 °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 clean up. 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 preprimed 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. 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

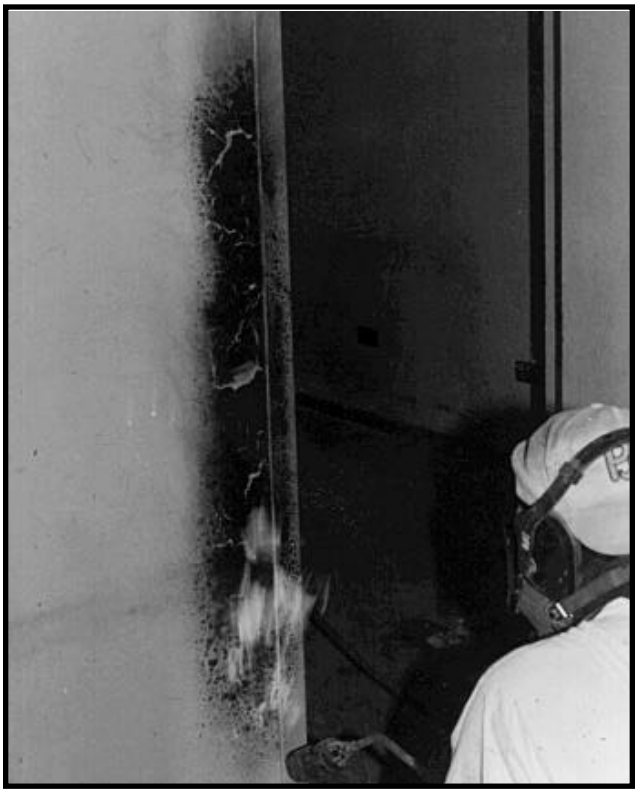


Figure 12.12a Open Flame Burning Is Prohibited.

Figure 12.12b Open-Faced Power Sanding or Grinding Is Prohibited.

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. Uncontained Hydroblasting or High-Pressure Water Wash

Uncontained hydroblasting and high-pressure water washing are prohibited. Because of the potential for widespread environmental contamination, such activities should be undertaken with full containment. All water should be captured, contained, and treated as potentially hazardous waste (contact the local water and sewage agency for guidance on local requirements). Since capturing and containing *all* water is not feasible, this method of paint removal is not permitted for lead-based paint abatement work in housing.

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

If for some reason abrasive blasting must be done in a residential structure, the area must be sealed and placed under negative pressure with at least 10 air changes per hour. 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.

C. Methods Not Recommended

1. 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 include scraping surfaces near electrical outlets, which cannot be wet scraped because of the obvious electrocution hazard, and scraping when using a heat gun since this cannot be performed wet. For both of these cases, dry scraping is only appropriate for limited surface areas.

2. Chemical Paint Removers Containing Methylene Chloride

Chemical paint removers containing methylene chloride are not recommended, although they are still widely sold in paint stores. This also applies to methylene chloride paint removers that have waxes or other coatings to retard evaporation. Some local regulations may prohibit the use of methylene chloride. Since methylene chloride evaporates readily and is colorless and odorless at the permissible exposure limit, workers may be unaware of their exposure. Methylene chloride can cause liver and kidney damage and carbon monoxide poisoning (as a metabolite) and is suspected to cause cancer (ACGIH, 1992; IARC, 1990). Air-purifying respirators with organic vapor cartridges *do not provide adequate protection* against methylene chloride. In those projects where methylene chloride must be used, air-supplied respirators (or self-contained breathing apparatuses) are required under OSHA regulations (29 CFR 1910.134).

D. Recommended Methods

1. Heat Guns

Since open flame burning is prohibited, heat removal methods are limited to electric-powered flameless heat guns.

Before beginning work, fuses and an adequate electrical supply should be verified. Larger fuses should not be installed because of the possibility

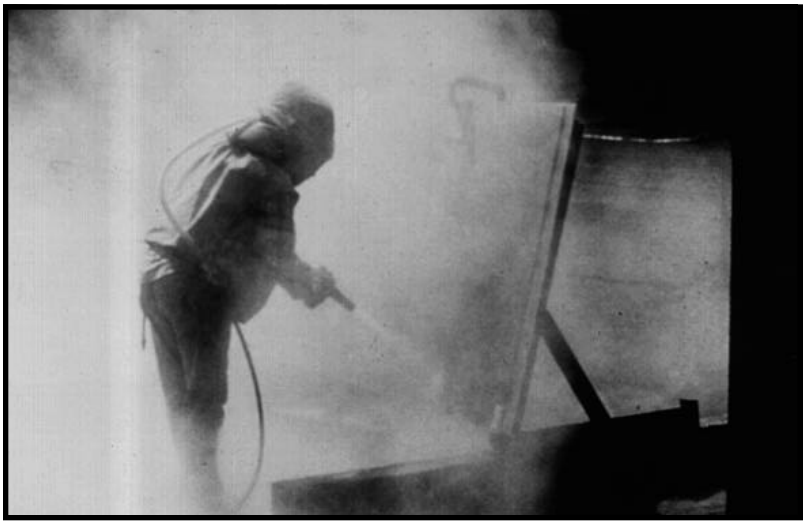


Figure 12.13 Traditional Abrasive Blasting Is Prohibited (note the visible dust surrounding the worker).

Figure 12.14 Do Not Wet Painted Surfaces Near Electrical Circuits.

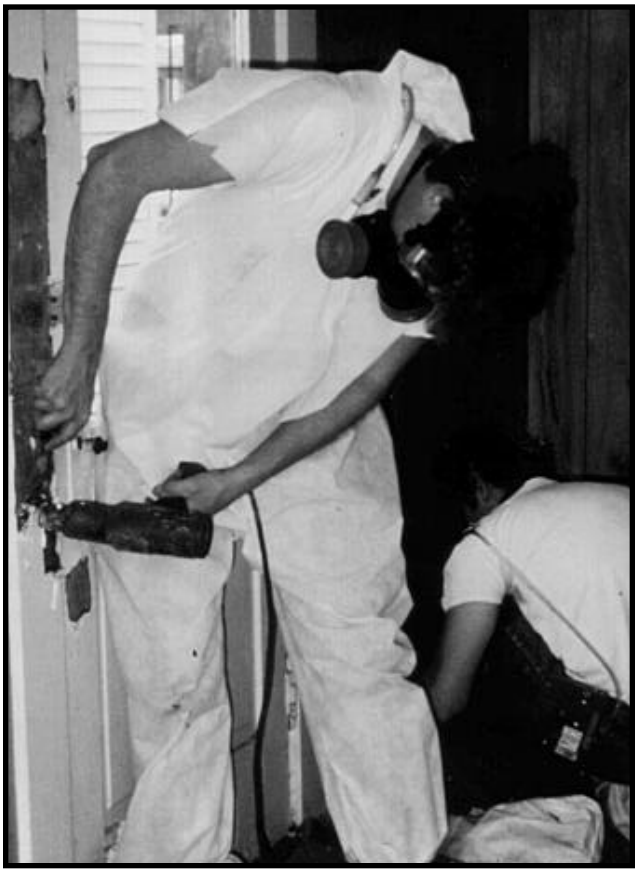


Figure 12.15 Heat Guns Operating Below 1,100 °F Are Useful for Limited Areas.

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, since other hazardous materials may be released when heating old painted surfaces (NIOSH, 1990).

While there is little danger of producing dangerous levels of lead fumes at temperatures below 1,100 °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 1,100 °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. 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. At the very first sign of paint softening, blistering, or bubbling, discontinue the use of heat and immediately scrape the loose paint off the surface.

2. Mechanical Removal Methods

HEPA Sanding

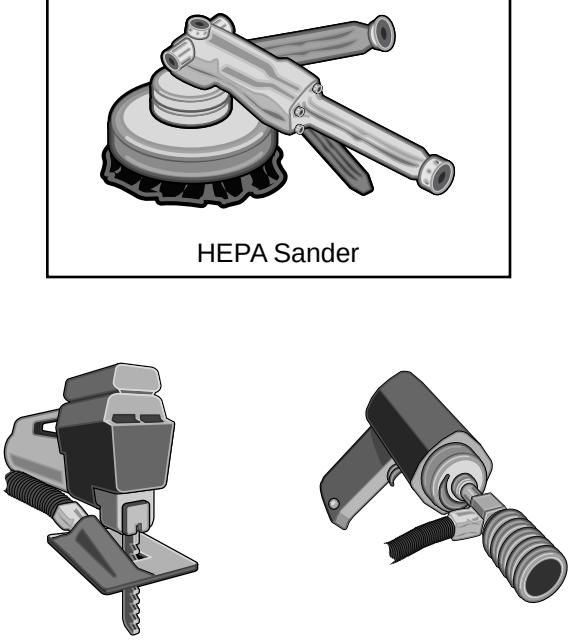
HEPA sanders are valuable for surface preparation prior to repainting. Since chemical stripping sometimes raises the grain of the wood and some removal methods are not effective at removing all visible traces of paint, some sanding prior to repainting may be needed. Sanding can cause generation of significant levels of airborne and settled lead dust; therefore, HEPA-assisted sanders are recommended whenever sanding must be done. HEPA sanders do not work well on detailed moldings.

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. 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.

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.

Figure 12.16 HEPA Vacuum Power Tools.



Wet Scraping

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. Wet scraping is often used to remove loose and

Figure 12.17 Scraping Tools.

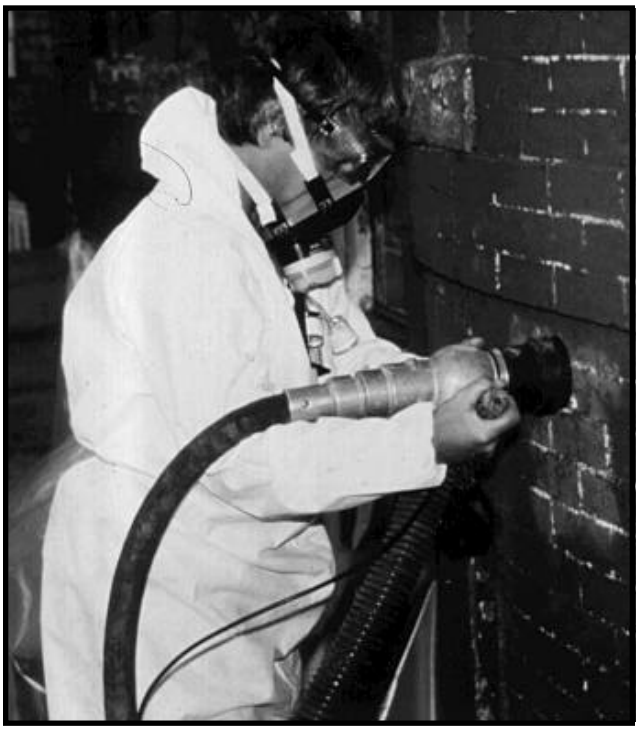


Figure 12.18 Vacuum Blasting.

flaking paint prior to 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 surface should be lightly misted with water from a garden sprayer or plant mister. Using a paint scraper, loose material should be scraped from the surface and deposited on the containment plastic. 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 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. 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, since the blast material will probably be treated as hazardous waste.

Use of the equipment for long periods of time can result in worker fatigue, particularly if working with the arms above the head. Since fatigue can cause a worker to momentarily lose contact with the surface, resulting in the release of leaded dust, 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. 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. 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

Figure 12.19a. Needle Gun With HEPA Exhaust Ventilation (without shroud).

Figure 12.19b. Needle Gun With HEPA Exhaust Ventilation (with shroud).

Figure 12.20 Proper Protective Gear, Including Gloves, Faceshield, Goggles, and Eyewash is Required When Working With Chemical Paint Removers.

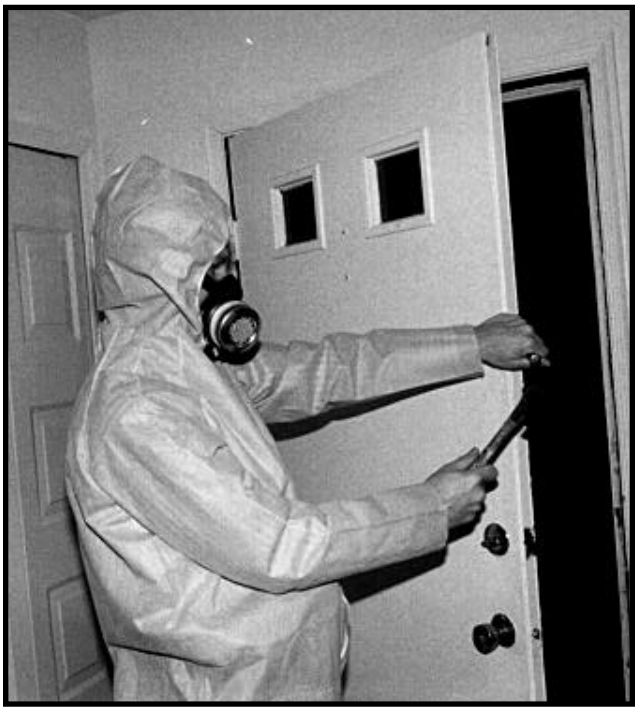


Figure 12.21 Use Punches To Identify the Location of Components Before Sending Them Offsite for Paint Removal.

recommended; the skin must be washed and thoroughly rinsed.

Chemical paint removal can be broken into two broad categories: offsite paint removal and onsite paint removal.

Offsite Paint Removal

Offsite paint removal is preferred, since 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, they should be labeled using a punch system in an obscure location (e.g., the bottom or side of a door), then wrapped in plastic and sealed with tape to avoid the spread of contamination during transport. Tag systems are not recommended since they must be removed when the component is dipped. Markers should not be used since they will dissolve during stripping. The punch will 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 reglued. 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 6-mil plastic and sealed with tape. This will minimize contamination of those handling the materials since leaded residue may remain on the surface. Materials should remain sealed in plastic until other onsite dust-generating activities are concluded and the dust cleaned up.

Before reinstallation, the treated components should be cleaned using the standard HEPA/wet wash/HEPA cycle to remove any residues left by the paint stripper. Components must be

completely dry before repainting. Always check the pH after cleaning and *before* repainting.

Onsite 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 prior to outdoor application. Also, rain can cause environmental contamination from the lead and the chemical remover.

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

When using chemical strippers, security is important, particularly with the caustics. Caustic paint removers can cause severe skin burn and eye damage to workers 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.

The use of chemically resistant clothing; long neoprene, nitrile, rubber, or PVC gloves; and face shields is mandatory under OSHA regulations. OSHA also requires a portable eyewash station whenever eye-irritating paint removers are used in housing.

An abundant source of running water in the abatement area for flushing chemicals from skin or eyes is required by OSHA regulations. The water should come from a nearby tap or portable eyewash stations. If contact with the eyes occurs, a full 15-minute rinse of the eyes is necessary onsite, *before the individual leaves to seek medical attention*, since 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, noncaustic strippers are not as effective at removing multiple layers of paint in a single application, compared to the caustic products. When using noncaustic 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.

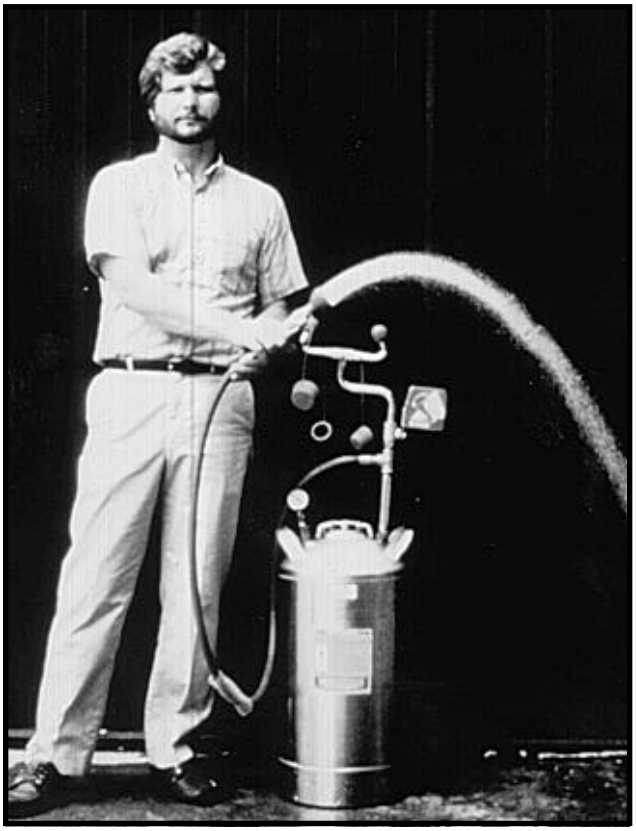


Figure 12.22 Eye Wash Stations Are Required When Caustic or Chemical Paint Removers Are Used.

Figure 12.23a Neutralize Surfaces When Using Caustic Paint Removers.

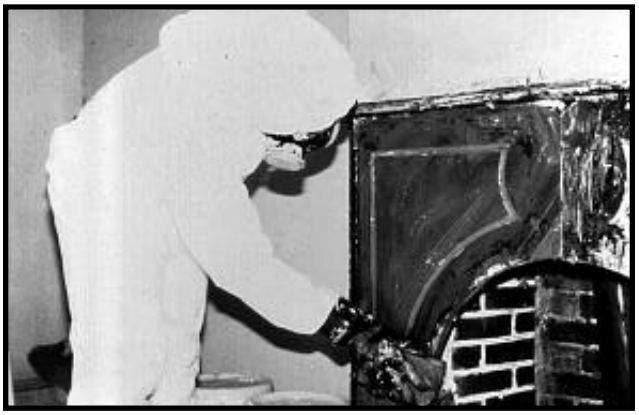


Figure 12.23b Neutralize Surfaces With a Glacial Acetic Acid Wash When Using Caustic Paint Removers.

The paint remover should be applied with a spatula, trowel, brush, or spray gun. Spray gun use should be minimized since worker exposures are greater. 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 in order to avoid 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 submitted for "Toxicity Characteristic Leading Procedure" (TCLP) tests to determine if it qualifies as hazardous waste. Alternatively, the owner can assume that it is hazardous waste and manage it accordingly (see Chapter 10). Chemical stripper waste is almost always hazardous waste. The stripped surface must be thoroughly cleaned to remove lead and paint remover residues.

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 since 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; chemically 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 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 high-phosphate detergent or other cleaner. 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 may require special primers, which are no longer manufactured. 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 since 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.

E. Waste Disposal

Wastes produced during paint removal are highly concentrated, but low in volume. The waste may be exempt from some hazardous waste regulations if less than 220 pounds is generated per month (see Chapter 10). Many local jurisdictions pick up small amounts of hazardous waste on certain days. If offsite paint removal is performed, the waste is the responsibility of the facility performing the removal.

Figure 12.24 Use Litmus Paper on a Bare Stripped Surface Before Repainting.

Soil and Exterior Dust Abatement: How To Do It

1. 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 exceed either 2,000 μg/g of lead for the yard or building perimeter or 400 μg/g of lead for small, high-contact play areas (pending the development of an EPA soil standard). 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 (greater than 5,000 μg/g) and when use patterns indicate contact frequency and exposure will be high.

2. Collect preabatement soil samples to determine baseline levels. These samples need not be analyzed if postabatement soil samples are below applicable clearance levels.

3. 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. 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. If removing and replacing soil:

   a. Determine if waste soil will be placed in an onsite or offsite burial pit. Prepare vehicle operation and soil movement plan. Test new replacement soil (should not contain more than 200 μg/g lead).

   b. Contact the local United Utilities Protection Service (UUPS), Miss Dig, Miss Utility, or the American Public Works Association at (816) 472–6100, ext. 584, 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.

   c. Remove fencing if necessary to allow equipment access and define site limits with temporary fencing, signs, or yellow caution tape.

   d. Tie and protect existing trees, shrubs, and bushes.

   e. Have enough tools to avoid handling clean soil with contaminated tools.

   f. Remove soil.

   g. Clean all walkways, driveways, and street areas near abatement area.

   h. Replace soil at proper grade to allow drainage. Replacement soil should be at least 2 inches above existing grade to allow for settling.

   i. Install new soil covering (grass or sod) and maintain it through the growing season.

   j. Have enough workers and equipment available to complete the job in 1 day.

6. Determine if soil waste is hazardous and manage it accordingly (see Chapter 10).
7. Conduct final cleanup and clearance.
8. Provide walk-off doormats to residents and educate them on the benefits of removing shoes at the dwelling entryway.

Section V

I. 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 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 were covered in Chapter 11, Section V. This section describes soil treatments that should be effective for at least 20 years.

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

B. Soil Abatement Methods

Soil abatement methods include:

- Soil removal and replacement followed by offsite or onsite disposal.
- Soil cultivation (rototilling).
- Soil treatment 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 threefold (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.

In the EPA Urban Soil Lead Abatement Project (EPA, 1993c), the depth chosen for demonstration purposes was 6 inches. In residential areas in Canada, where secondary lead smelters are the primary source of contamination, soil also was removed to a depth of 6 inches (Stokes, 1988). Guidelines for soil removal developed by the Ontario Ministry of the Environment (1987) recommended removal of the top 12 inches. The 12-inch recommendation was based in part on earlier experiences where considerable recontamination was observed 7 to 8 years after soil was removed to a 6-inch depth (Stokes, 1987). However, the reason for the recontamination was thought to be due to contamination of the replacement soil by adjacent polluted soil that had not been removed (Jones, 1987), not by contaminated soil from deeper levels.

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. 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. The maximum allowable lead concentration in replacement soil shall not exceed 200 μg/g.

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 offloaded to other vehicles to be transported to the disposal site. Rather than offload the wheelbarrows to dump trucks, it is usually more efficient to dump the soil directly into rolloff containers, which are then loaded onto trucks for transport to the disposal site.

Sod and Seeded Grass Maintenance

All grass sod planted as part of the abatement operation 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.

Utilities

The owner or contractor should contact the local United Utilities Protection Service (UUPS), "Miss Dig," or "Miss Utility" (coordinated information sources 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. The American Public Works Association (APWA)—(816) 472–6100, ext. 584—can also provide local phone numbers for utility line identification services (APWA, 1993).

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.

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.

Protection of Adjacent Areas

When working adjacent to excluded areas, including sidewalks, fences, trees, and patios, the soil should be excavated at a 45° (1:1) slope away from the excluded areas so that contamination does not wash or roll into the excluded area.

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 offsite areas and runoff from rain can carry contamination outside the abatement area.

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.

All soil removed from the worksite should be placed in dump trucks for transport to the disposal site. The trucks should have secure fitting tarps and sealed tailgates to reduce leakage as much as possible.

Loaded trucks or containers may be left onsite overnight provided they are secured to prevent access or leakage. It is not advisable to leave loaded trucks or containers onsite over the weekend. Any piece of equipment, whether a dump truck or excavation equipment, should be cleaned before it is removed from the site. Before decontamination, the equipment should be placed on 6-mil polyethylene plastic. Decontamination of equipment can be achieved by first scraping soil from all surfaces and then brushing to remove all visible soil, using water spray to prevent dispersion. The soil removed must be contained for appropriate disposal.

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.

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.

Tool Contamination

To minimize the cross-contamination between excavation and replacement worksites, separate tools should be provided for the excavation and replacement operations. 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.

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. 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.

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.

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.

If the soil is considered to be hazardous waste, the EPA manifest system must be used before any transportation or disposal offsite occurs (see Chapter 10). Even if the soil is not hazardous waste, it should be manifested using an alternative system such as the one described above.

Prevention of Offsite Movement of Contaminated Soil

Contaminated soil should be removed from the site as soon as possible to prevent wind and water erosion. To prevent offsite migration and to avoid the possibility of tampering by children, piles of contaminated soil should not be left onsite 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 offsite 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.

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. Onsite exposure could result from children playing 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

Since soil lead concentration often decreases with increasing depth, soil mixing can be considered to be an abatement strategy. If the average lead concentration of the soil to be abated is below 1,500 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.

3. Soil Cleaning

The following soil treatment methods are being investigated for possible use on residential sites:

- Magnetic separation.
- Froth flotation.
- Washing.

Magnetic separation and froth flotation are currently under development and are not addressed in these *Guidelines*. The method that has received the most attention thus far is soil washing. Soil washing is a waterborne process for mechanically scrubbing soils to remove lead

and other contaminants (EPA, 1990b). The soil is removed from the yard but usually washed onsite. The process removes contaminants in one of two ways: by dissolving or suspending them in the wash solution (which is later treated by conventional wastewater treatment) or by concentrating them into a smaller volume of soil through simple particle size separation techniques. Soils containing coarse sand and gravel are more responsive to cleaning techniques than soils containing a large amount of clay and silt. If the washing process involves the addition of surfactants or other chemicals to separate the lead-containing particles, care must be taken to ensure that amounts remaining in the remediated soil do not interfere with reuse of the soil at the site. Most soil washing in the United States has been done at Superfund sites. Soil washing has not yet been attempted at residential sites. EPA is currently investigating the applicability of soil washing to residential soil abatement.

4. Paving

If contaminated soil is present in high-traffic areas, the soil can be covered by a high-quality concrete or asphalt. 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 (CPSC, 1991).

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 equalled preabatement 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,

parking areas, etc. For multiple adjacent properties 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 at least three different types of suitable paved-surface cleaning machines:

- Hand-pushed HEPA 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.

EPA research has found that regenerative air machines, which depend on rapidly moving air to capture particles from the source 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.

Figure 12.25 Paving Bare Soil May Be the Best Option for High-Traffic Areas.

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 operation 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 HEPA filter-equipped vacuum cleaner. Surfaces should be vacuumed continuously until no additional visible dust is being removed by further vacuuming.