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LEAD PAINT: ABATEMENT AND MITIGATION

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Rehabilitation, restoration, and maintenance projects frequently address old painted surfaces that require preparation and refinishing. In many cases, old lead-based paint is present on these surfaces. Lead is identified as a poison. The presence of lead-based paint in buildings poses a clear danger to the health and safety of their users. Efforts to remove lead paint can create even greater hazards.

Many government agencies and health groups are discussing the issues related to lead-based paint. This paper is presented as a synthesis of arguments, and as a resolution of the conflict between the goals of preservation of historic materials versus removal of dangerous materials.

It is important to recognize that nothing that you do is entirely safe. Removing lead paint creates problems of lead dust, lead fumes, and toxic waste disposal. Encapsulating lead surfaces leaves the problem in potential form. Discarding affected elements destroys the buildings without abating the lead hazard. The risks associated with exposure to lead can be reduced, however, in nearly all circumstances. Consideration of all applicable concerns, and planning of rehabilitation projects with due regard both for health risks and for preservation of significant historic features, is the only prudent way to proceed.

Use of Lead in Old Buildings

Lead has been used in making paint, solder, plumbing (a term derived from the Latin word for lead, *plumbum*), sheet roofing, cames for stained glass windows, gasoline, and many other products. Lead pigments have been used as hiding pigments, colorants, and rust inhibitors in paints since the ancient Greek and Roman civilizations. In the United States, the durability of lead-based paints promoted their widespread use for wooden surfaces for over two centuries. In buildings, the hazards of lead are most often encountered in old paint.

Dangerous exposure to lead in old buildings, and risk of lead poisoning, can come by the following paths:

--Old painted surfaces that are peeling, chipping, flaking, or otherwise failing will provide a constant source of small particles of paint which can be ingested or inhaled.

--Moving surfaces that are painted can generate lead dust by friction. The dust is difficult to remove and may accumulate over a period of years. The friction of opening and closing window sash, for example, can generate lead dust.

--Renovation work and paint removal projects tend to generate tremendous amounts of lead dust. Heated or burned lead surfaces produce lead fumes that can be easily inhaled. Homeowners who undertake such projects should be aware that they may be contaminating their environment. Unless meticulous masking and clean-up methods are used, it may be safer in some cases to leave intact paint layers undisturbed.

--Lead dust or accumulated lead debris in the soil of play areas and vegetable gardens, lead from unsafe water systems, and other lead sources may also contribute to lead poisoning.

Most experts argue that while all of these sources of exposure to lead are dangerous, the greatest danger is the exposure of children to architectural features coated with lead-based paints. Surfaces that are most accessible to small children, painted features with protruding elements ("chewable surfaces"), and deteriorating paint surfaces are generally identified as the greatest source of the threat to children.

Dangers of Exposure to Lead

Roman architect Marcus Vitruvius Pollio, writing in the first century B.C., recognized the dangers of lead, and advised against its use in water pipes and other elements that came into contact with citizens. "No doubt the thing itself is not wholesome," wrote Vitruvius of lead:

> This we can exemplify from plumbers, since in them the natural color of the body is replaced by a deep pallor. For when lead is smelted in casting, the fumes from it settle upon their members, and day after day burn out and take away all the virtues of the blood from their limbs. Hence, water ought by no means to be conducted in lead pipes, if we want to have it wholesome.

Despite these warnings, lead remained in widespread use until the later twentieth century. By the mid-19th century, the problems associated with lead exposure were more widely acknowledged, and the medical profession began publishing articles warning of the dangers. Lead poisoning was described as "painter's colic." By 1868, the Bath (England) Hospital was advising painters and plumbers "not to eat or drink in the room or place wherein they work."[1] The New

[1]O.A. Roorbach, *The Painter's Handbook* (1868), quoted in Pamela W. Hawkes, "Economical Painting: The Tools and Techniques Used in Exterior Painting in the 19th Century," in H. Ward Jandl, editor, *The Technology of*

Jersey Zinc Company, in a 1906 advertisement, observed that:

> White Lead is one of the oldest of artificial pigments . . . It has, however, many defects. It is, first of all, a cumulative poison, and the prevalence of lead colic among painters and lead workers has induced restrictive legislation in many countries.[2]

Lead accumulates in the body following exposure. Lead stays in the blood for several months, and it can be stored in the bone for many decades. Lead poisoning (plumbism) usually results from many small exposures over a period of weeks or years. The brain and nervous system are particularly susceptible. It has long been known that high levels of lead exposure can cause serious disability or death. Lead poisoning interferes with the formation of blood cells, which may cause anemia. Lead can also damage the kidneys, digestive system, reproductive system, and other organs.

More recent research has focused on the toxic effects of low level exposure. There is no established safe level of lead in the human body. No level of exposure can be regarded as free from potential harm. Low level exposure can damage hearing, learning ability, and coordination.

Children less than six years of age are of special concern because their developing brains and bodies can easily be damaged by lead. It is common for young children to put everything, including hands, pacifiers, and toys, into their mouths. Anything which contains lead, from small dust particles to large paint chips, can cause harm if swallowed. Lead poisoning commonly contributes to problems which may be permanent in young children. Learning disabilities, behavior abnormalities, attention deficit problems, and insomnia are common symptoms. Some studies estimate that one out of every six children in the United States has some degree of lead poisoning.

Symptoms of lead poisoning can go unnoticed. Blood tests are very important to detect lead poisoning early, and they should be part of the routine health care for all young children. Lead, even at very low levels, can have toxic effects on unborn children. Infants born with only slightly elevated blood lead levels have been found to have developmental problems.

If detected early, lead poisoning can be treated. In extreme cases, a medical procedure called chelation therapy may be initiated to help expel toxic levels of lead from the blood system.

Historic American Buildings: Studies of the Materials, Craft Processes, and the Mechanization of Building Construction (Washington, D.C.: Foundation for Preservation Technology, 1983), pp. 189-220.

[2]*Sweet's Indexed Catalogue of Building Construction for the Year 1906* (New York: The Architectural Record Co., 1906), p. 728.

Testing for Lead on Painted Surfaces

The National Institute of Building Sciences has estimated that dangerous levels of lead-based paint exist in 42 million of the estimated 80 million housing units in the country. Property owners should assume that most older paints contain lead. The presence of lead can be confirmed by qualified inspectors or laboratories. Two processes are used to test for lead on site: the application of sodium sulfide to the painted surface, and the use of a mobile X-ray fluorescence analyzer. Paint samples can also be sent to commercial laboratories for analysis. Each of these methods has advantages and disadvantages:

Testing Process	Advantages	Disadvantages
--Spot chemical test, 8% sodium sulfide solution	--Easy to use --Readily available in kits from many paint stores --Results are easily visible: paint that darkens usually contains lead	--Cannot quantify the amounts of lead present --Cannot be used on dark colors where color changes may be imperceptible --False readings can sometimes occur --Has a limited shelf life
--Mobile X-ray fluorescence analyzer	--Gives digital readouts quickly --Readouts are accurate --Gives lead measurements per unit area	--Seldom available to individual because of high cost --Cannot be used in inaccessible spaces --Cannot measure levels of lead dust
--Analysis of samples by commercial analytical laboratory	--Gives the most accurate results --Can give percentage lead by weight --Can verify other methods	--Laboratory work can be expensive --Results may not be available immediately

The mere presence of lead-based paint is not sufficient cause for abatement procedures. Some contractors and review authorities have acted on the assumption that any and all features that have lead-based paint must be removed. This is an expensive and destructive approach. Not only does this presumption lead to unnecessary loss of historic architectural elements, it has great potential to accelerate the dissemination of lead dust into the environment. Paint removal projects tend to generate tremendous amounts of lead dust. Homeowners who undertake such projects should be aware that they may be contaminating their environment.

Appropriate follow-up planning to deal with lead-contaminated features should include these steps:

1. Specification of which elements are affected. Not all rooms in a building, nor even all features in a space that contains some lead-based paint, may be affected.

2. Evaluation of the relative historic significance of the affected features, by themselves and in context of the overall property.

3. Evaluation of the necessity of abatement, in consideration of the location of the affected features, the significance of the affected features, and the proposed use of the building and the space.

Abatement

Abatement means the elimination of exposure to lead-based substances that may result in lead toxicity or poisoning, by the removal or encapsulation of lead-containing substances, by thorough cleanup procedures, and by post-cleanup treatment of surfaces.

The Lead Poisoning Prevent Act of 1971 is the only Federal law to date that applies to lead-based paint. It is limited to projects involving Federally-owned or assisted housing. State and local regulations vary, and abatement requirements differ according to the use to which an old building is placed. A treatment that may be acceptable for one old building may not be appropriate in another.

For projects seeking federal tax benefits or for projects involving federal financing or permits, *The Secretary of the Interior's Standards for Rehabilitation* take precedence over other regulations and codes in determining whether rehabilitation procedures are consistent with the historic character of the property and, where applicable, the district in which it is located.

Recommended Abatement Priorities

Complete removal of features affected with lead paint is not always required. Lead, like asbestos and rattlesnakes, is most dangerous when it is disturbed. Careless abatement procedures will probably increase the level of lead contamination in a building. Unless meticulous masking and clean-up methods are used, it may be safer in some cases to leave intact paint layers undisturbed.

Flat painted surfaces pose much less danger than protruding, irregular surfaces. Floors, most wainscots, and baseboards, for example, usually do not require abatement if the paint is intact and non-flaking. Intact painted surfaces on fixed window sash, upper members of window or door frames, and ceilings usually do not require treatment.

If the need for lead paint abatement can be clearly demonstrated, and if the contaminated features and finishes are important to the preservation of the property's historic character, the following priorities should be used. These are ranked on the principle of minimal intervention.

1. Removal of lead from architectural features *in situ*, using safe measures that do not put excessive amounts of lead dust or residue into the environment. Appropriate measures are

evaluated below.

2. Removal of architectural features from the building and controlled removal of lead paint off-site; followed by replacement of the treated features in their original locations.

3. Containment or encapsulation of features using non-destructive methods. When lead-based paint is present on flat plaster walls and ceilings, these features can be encapsulated with dry wall or sheetrock. When lead-based paint is present on simple floors, sealing the surface and covering the floors with carpeting that meets abatement criteria may be considered appropriate from a preservation perspective. Conventional wallpaper and new layers of paint have little or no encapsulation value.

4. Removal of contaminated features and replacement with in-kind replications. If permanent removal of contaminated features is unavoidable, in-kind replication may be an acceptable alternative. Such an approach should be considered only when the loss of the features would not seriously undermine the integrity of the historic property.

If contaminated features and finishes are determined to be not important for the preservation of the property's historic character, removal of contaminated features without replacement in kind may be appropriate.

Recommended Procedures for Removing Lead Paint on Historic Surfaces

Removal of lead-based paint from significant historic features should only be considered if it is demonstrated that the features are contaminated above regulated levels, and that the contamination is reasonably accessible to building occupants. The cheapest methods for removing lead-based paint are usually not appropriate for older buildings. Poorly chosen paint removal methods can lead to a loss of significant architectural features, damage to wood and plaster, or loss of early paint schemes. Speed is no substitute for quality. The dangers associated with removing lead-based paint demand careful planning and execution.

The following procedures are recommended when on-site abatement procedures are indicated.

1. **Restrict entry to the work area.** Only workers directly involved in the project should enter the work area. Young children and pregnant women must stay out of the work area until cleanup has been completed. Warning signs should be posted outside all entrances and exits to the work area. For any project involving abatement of lead hazards in a residence, or involving removal of more than a very limited amount of lead paint, it is advised that all residents of that home, including pets, find other housing. Residents are advised stay out of the building until cleanup has been completed.

2. **Select the safest methods for paint removal.** Depending on the materials to be treated and the specific circumstances of each building, paint removal procedures that will cause the least damage to the historic materials and yet keep lead residue under control should be chosen. Possible methods, with their advantages and disadvantages, are discussed in detail below.

3. **Wear appropriate clothing.** Disposable coveralls are recommended to minimize contamination of clothing by lead dust. Disposable shoe covers, to prevent tracking of lead dust outside of the work area, are recommended. Neoprene or butyl gloves are indicated when working with methylene-chloride based chemicals.

4. **Use required safety equipment.** A respirator is recommended. If any lead dust or lead fumes will be produced, a respirator with appropriate filters is necessary.

5. **Do not smoke, eat, or drink in the work area.** Lead dust can easily settle on food or cigarettes. All workers involved in projects must leave the work area and wash hands and faces before eating, drinking, or smoking.

6. **Contain lead dust and debris within the work area.** While it may not be possible to control all lead dust, simple measures can greatly reduce the degree of contamination. Plastic sheeting (six-mil polyethylene) sealed at its edges with duct tape, for example, is effective in keeping most lead dust within the immediate work area, where it can be picked up with HEPA vacuuming. Furniture, rugs, plants, and other items can be removed from the work area prior to beginning treatment.

7. **Change clothes, wash hands and face.** All persons involved in treatment procedures must take care not to carry dust-contaminated clothing into cleaner environments.

8. **Clean up.** Recommended measures for cleanup after lead abatement procedures should consist of High Efficiency Particulate Air (HEPA) vacuuming and washing with tri-sodium phosphate (TSP) solution. Ordinary household vacuum cleaners will not pick up most lead dust. Recommended cleanup specifications are outlined below.

A. Interior spaces must be cleaned from ceiling to floor by at least two passes of HEPA vacuuming and wet sponge mopping with TSP solution. New batches of TSP must be mixed often to avoid redepositing lead particles. After inspection, abated surfaces should be recoated with appropriate finishes before the spaces are returned to use. If substantial amounts of lead dust were generated by the abatement procedures, routine washing with TSP solution is indicated for several weeks after the abatement.

B. Exterior abatement procedures should be preceded by masking ground surfaces with six mil polyethylene, carefully secured to the building. Thorough exterior cleanup should take place at the end of every work day. Lead dust from sanding, residue, and paint chips should be collected by HEPA vacuuming. Building surfaces should be washed twice

with TSP solution. The top layer of polyethylene masking should be removed at the end of each work day and disposed of properly.

C. Tools, equipment, supplies and materials should not be removed from the site once lead abatement has begun, unless they have been decontaminated with HEPA vacuuming and TSP washing. Upon completion of a project, all equipment that cannot be cleaned should be wrapped and sealed in two layers of four mil polyethylene and disposed of properly, along with all sponges, rags, mop heads, and other abatement materials.

D. All lead dust, paint chips, equipment, supplies and materials used in abatement should be considered hazardous waste and disposed of in accord with local regulations.

9. **Dispose of toxic Wastes in Proper Manner.**

Methods for Removing Lead Paint

Mechanical Methods: Mechanical (abrasive) methods of treating lead-painted surfaces have two major drawbacks. They produce high levels of dangerous residue, and they have potential to damage the underlying substrate.

SCRAPING: Traditional scraping with hand tools is a slow process that can remove lead coatings only with great effort. Aggressive scraping can gouge wooden surfaces and molding profiles. In general, scraping is best suited for use on completely flat surfaces. Scraping tends to create less dust than many other methods, though. Paint chips removed by scraping can be controlled much more easily than the more minute residue generated by other methods.

SANDING: Both hand sanding and power sanding generate extremely high levels of paint dust. Rotary, disk, and belt-sanding procedures, in addition to the problem of lead dust generation, can destroy carved work and molding profiles altogether. For these reasons, power sanding procedures are usually not appropriate for surface preparation *in situ*, especially in occupied buildings. If the elements to be treated can be safely removed and taken to a controlled site for treatment, some sanding methods may be appropriate. Belt sanders can be used on flat stock, and orbital sanders, if used with great care, can be used with damage kept to a minimum. If off-site treatment is considered, proper care must be taken to remove features without damaging them; to identify each element so that it can be restored to its proper location; and to re-install the treated elements in their proper places. High Efficiency Particulate Air (HEPA) equipped sanders, often used by professionals, help control the amount of lead dust put into the air. If power sanding is to be considered, HEPA equipment is strongly recommended.

BLASTING: All methods of abrasive blasting work on the principle of semi-controlled

pulverization of the surface being treated. Under most conditions, the damage to the substrate will be irreparable.[3] It does not matter whether the blasting is dry, wet, fine-grit, coarse-grit, low-pressure, or high-pressure; or whether the aggregate is sand, crushed walnut shells, glass beads, water, or air: abrasive blasting is destructive. Abrasive blasting will remove lead-based paint, but it will also create tremendous amounts of lead dust. The dust will permeate interior spaces, and in exterior applications it can be carried over a wide area, contaminating neighboring properties. Because of these potent hazards, abrasive blasting should never be used to remove lead paint.

Heat Methods: Blowtorches and other open-flame techniques are extremely dangerous and should never be used.[4] In addition to the very real danger of burning down the building and the threat to human lives, open flame techniques produce very high levels of toxic lead dust and fumes. These fumes can be easily inhaled.

Heat guns and heat plates generate lower levels of heat than do torches. Even at these lower levels of heat, there is still a danger of generating lead fumes, and of igniting sawdust, construction debris, animal nests, or other materials. Heat guns and heat plates should only be used under carefully controlled circumstances.

Chemical Methods: Standard paint-stripping chemicals include solvents (methylene chloride) and caustics (sodium hydroxide or potassium hydroxide.) Methylene chloride is toxic, and must be handled with appropriate precautions. Chemical stripping can be done on-site or off-site. Each procedure has its own problems and recommended precautions.[5]

ON SITE: Methylene chloride is the basis for most solvent-based paint strippers. Methylene chloride is particularly effective on wooden surfaces. Because it causes little damage to wooden surfaces, it is often used for older buildings. Good ventilation, protective clothing, and respirators are essential when using methylene chloride, since it can cause severe burns, liver and heart damage, and possibly cancer. Strict control over the worksite is essential when using this toxic chemical stripper. Caustic paint removers tend to be less toxic, but they have a greater tendency to pit wooden surfaces and raise wood grain. The runoff from chemical stripping procedures is often hazardous, and must

[3] For detailed information on the effects of abrasive blasting, see the Department of the Interior's *Preservation Brief* no. 6, "Dangers of Abrasive Cleaning to Historic Buildings," available without charge from the Department of Historic Resources.

[4] See "Burning the Paint Off: The Dangers Associated with Torches, Heat Guns, and other Thermal Devices for Paint Removal" (FYI 10), available without charge from the Department of Historic Resources.

[5] See "Chemical Paint Strippers," *Old-House Journal*, Vol. XIX, No. 1, January-February 1991, for current recommendations on using methylene chloride, caustics, and other chemical paint strippers.

be treated accordingly. When the runoff includes lead paint residue, even greater care must be taken to dispose of it properly. Generally, these methods generate much less paint dust than abrasive or thermal methods.

OFF SITE: In many cases, painted elements can be removed from buildings and treated at commercial stripping joints. Elements are immersed in tanks of chemical remover, either solvent-based or caustic, scrubbed down and returned to the building. This method will not create dust or fumes that are the chief hazard of on-site treatment, and the toxic chemicals are restricted to controlled areas. Other problems associated with off-site treatment of affected architectural elements include limiting the damage to the elements as they are removed; the proper reinstallation of the treated elements in their correct locations and configurations; and the limitations to the size of elements that can be removed for treatment.

The Department of Historic Resources can answer questions on lead paint. Contact Bill Crosby at (804) 367-2323 if you desire further information.

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