



## CHAPTER 4

### IDENTIFYING LEAD-BASED PAINT HAZARDS

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## Lead Abatement for Workers

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### Learning objectives

In this chapter you will learn about

- lead dust
- lead inspections
- when lead-based paint inspections are required
- risk assessments
- how inspectors and risk assessors test for lead-based paint and lead-based paint hazards using
  - paint chip analysis
  - X-ray fluorescence analysis
  - dust wipe tests
  - anodic stripping voltametry
  - wet chemical field tests
  - soil sampling



### **Skit: Recognizing lead-based paint**

Spiker and Vinnie are getting ready to set up for a rehab job. Let's listen in on their conversation.

**Spiker:** Let's get the windows and doors out before we set up. It will save us some time, and we're already behind schedule.

**Vinnie:** Is that safe? How do you know there isn't any lead-based paint on them?

**Spiker:** The owner said replace all the windows and doors. You know, combine rehab with the lead abatement job.

**Vinnie:** Yeah, I know. But what if there's lead-based paint on them?

**Spiker:** Look, they were painted just last year. What are you worried about? If the windows had lead-based paint, don't you think the owner would know? Come on, stop trying to stall. Grab a tool and let's get started!

**Vinnie:** OK, you're the boss. Or at least you act like him.

### **Discussion questions**

1. Is there a chance that the windows and doors would have lead-based paint on them? Why or why not?
2. Are lead-based paint and dust dangerous if they get on your clothes?
3. Can you tell if paint contains lead by looking at it?
4. What would you do if you were Vinnie?





### Lead dust

**Lead dust is poisonous when you breathe or swallow it.**

Lead dust comes from lead-based paint. The dust is so small that you may not even see it. Lead dust is easy to breathe and swallow. Lead-based paint turns into lead dust when

- **it peels, chips, or flakes.**

This may occur when paint gets old, moisture-damaged, or damaged by weather changes.

- **surfaces covered with lead-based paint break or get disturbed.**

This happens during abatement, renovation, or demolition. When you saw or drill into a lead-painted surface, you create lead dust.

- **surfaces covered with lead-based paint rub against something.**

This is called **friction**. Windows and doors have friction surfaces. When you open a window, painted edges get rubbed together and create dust. When you walk on lead-painted floors, lead dust gets kicked up. The friction wears through the top layers of paint and exposes the older lead-based paint. When you sand or scrape lead-based paint, you create friction and lead dust.

- **surfaces covered with lead-based paint get hit with force.**

This is called **impact**. Impact surfaces include floors, stairs, parts of walls, and doors. When you bang a lead-painted wall with the back of a chair, lead dust is released. When you close a door, there is an impact. If the door is painted or hits surfaces painted with lead-based paint, lead dust can be released.

**Whenever you create dust from a lead-painted surface, lead is released into the air.**

Lead dust particles in the air can be inhaled into your lungs. When lead dust falls, it sticks to anything it lands on—floors and other surfaces, people, pets, and even food. If you get lead dust on your hands and put your fingers in your mouth, you will swallow lead particles.

Young children are most at risk for lead poisoning. They play on the floor. They put their hands and toys in their mouths. If lead dust is on the floor and toys, children are likely to get lead dust in their mouths and swallow lead particles. Sometimes children eat paint chips. Sometimes they chew on lead-painted surfaces, like window sills. Even if the lead-based paint is in good condition, a child may still chew the paint and swallow lead particles.

**Lead dust is poisonous when you breathe or swallow it.**

**Lead dust comes from lead-based paint.**



**Test paint or assume it has lead.**

### Where is lead-based paint?

Any home built before 1978 may contain lead-based paint. Outside surfaces, kitchens, bathrooms, and windows are the areas most likely to have lead-based paint. However, lead-based paint can be found on any painted surface of a home. Sometimes the lead-based paint is buried under layers of latex paint.

**You cannot tell if paint has lead in it by looking at it.** Painted surfaces must be tested for lead content. Remember, only certified lead-based paint inspectors or risk assessors can conduct lead-based paint inspections! Your employer is required to find out if the paint you will be working on could expose you to dangerous levels of lead in the air. To be safe, make sure the paint has been tested *before* you disturb it. If the painted surfaces have not been tested for lead, assume they contain lead-based paint.

#### HUD Requirements

Public and Indian housing units, common areas, and exteriors of family housing must be inspected for lead-based paint if

- built before 1978 (must have been inspected by December 1994) and
- children younger than six years old live or may live there.

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Most pre-1978 residential properties receiving HUD funds are subject to HUD requirements for lead-based paint (24 CFR 35). These regulations include requirements for notification, lead hazard evaluations, and lead hazard reduction. The lead hazard evaluation category includes the following activities

- visual assessment;
- paint testing;
- risk assessment.

#### Title X

As of December 1996, Title X requires that all known information about lead-based paint and lead-based paint hazards be provided at the time of sale or rental of any pre-1978 housing unit. It also allows home buyers ten days to arrange for a risk assessment to identify lead hazards or an inspection to identify the presence of lead-based paint.



### Inspections

Checking for lead-based paint is called an **inspection**. Inspections must be done by a certified lead inspector or risk assessor. The inspector tests the paint with an X-ray fluorescence analyzer (XRF) to see if it contains lead. An inspector may also collect paint chip samples and send them to a lab for testing. Inspections are often done before a lead hazard control project begins so the owner and contractor know which surfaces are painted with lead-based paint. **Inspections identify the location of lead-based paint.**

States have different rules about how and when to test for lead-based paint. (Find out what your state laws say.) The Department of Housing and Urban Development (HUD) has developed final guidelines for lead-based paint-related activities, including inspections. The HUD *Guidelines* are applicable to inspections of any residential housing, including private, public, or Indian housing.

The 1992 Residential Lead-Based Paint Hazard Reduction Act (Title X) required EPA to develop regulations related to lead-based paint inspections in housing built before 1978. EPA issued training and certification regulations for inspectors, risk assessors, supervisors, project designers, and workers on August 29, 1996. These regulations went into effect in March 2000 in all states and Indian tribes that did not already have their own EPA-approved lead certification program established.

**Inspections identify surfaces containing lead-based paint.**



**Any painted surface can have lead-based paint.**

### What surfaces need to be tested?

The HUD *Guidelines* recommend testing **all types of painted, stained, shellacked, and varnished surfaces.** (Your state may require testing all painted surfaces or just some.)

Anything painted is a painted surface. Any painted, stained, shellacked, or varnished surface may contain lead. Painted, stained, shellacked, or varnished surfaces are found both inside and outside the home. They include, but are not limited to,

- ceilings
- doors
- floors
- molding
- radiators
- cabinets
- shelves
- staircases
- walls
- windows
- porches
- baseboards
- siding and trim
- gutters
- roofs
- sheds
- interior trim
- and more





### What a lead inspector does

Lead inspectors must have special training and certification. To start an inspection, the lead inspector will find out when the home was built and get or make a sketch of the home. The inspector will number the rooms to be tested and label the sides of the house starting with the street or address side as "A." The windows and doors can be numbered and labeled according to the side of the house on which it is located (e.g., C1, C2). (See Figure 4-1.) Inspectors will test any surface that is painted or varnished to find out if any lead is on that surface and how much lead is present.

The inspector records the following information about each sample:

- what room the sample or reading was taken in;
- which part of the room the sample or reading was taken from (i.e., left window apron);
- where on the painted surface the reading or sample was taken (i.e., upper middle sash or lower left door frame).

An inspector or risk assessor also does clearance inspections at the end of an abatement project or some federally-assisted rehabilitation/renovation projects. For these clearance inspections, the inspector will take dust and soil samples (optional) to find out if the cleanup was done carefully. The inspector will identify each type of sample (i.e., dust wipes, soil samples) on specific data forms. XRF readings are also listed on specific data forms.

**Lead inspectors must have special training.**

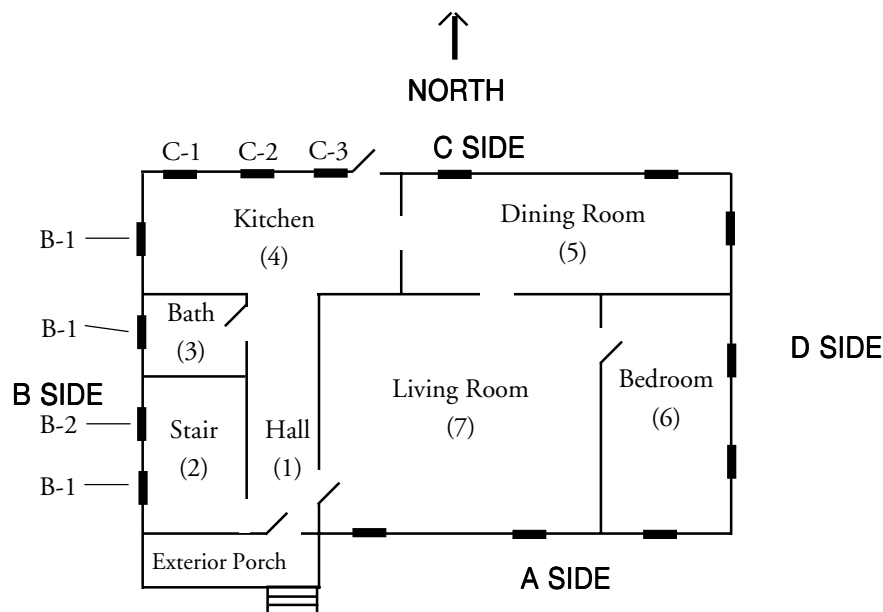


Figure 4-1. Example inspector's sketch of a home.



### Risk assessments look at:

- lead hazards;
- who lives in the home;
- how to control hazards.

**Lead dust is a health hazard.**

**Deteriorating lead-based paint causes lead dust.**

**Friction and impact cause lead dust.**

## Risk assessment

An inspection tells you where the lead-based paint is in a home. A risk assessment tells you if the lead-based paint could be a health hazard to the people who live in the home. A risk assessment looks at

- lead-based paint hazards;
- the people who live in the home;
- how these hazards can be controlled.

The person who does a risk assessment is called a risk assessor. A risk assessor has to get special training and certification.

### Lead hazards

The risk assessor first looks at the places where lead-based paint is in the home. This is the information that the inspector collected. If no inspection has been done, the risk assessor looks at the condition of the home and of the paint. Then the risk assessor figures out which surfaces might be creating lead hazards.

Any exposure to lead from contaminated dust, soil, or paint that could make you ill is a lead-based paint hazard. Lead is a hazard when you breathe or swallow it. Dust from lead-based paint is a major hazard. Risk assessors look for sources of lead dust in the home, such as

**Deteriorating lead-based paint**—Painted surfaces deteriorate for a number of reasons. The primary reason is moisture. Rain, leaks, condensation, and spills can cause paint to break down. Sun, heat, cold, and wind can wear down paint on exterior surfaces. Paint will also deteriorate if it is not put on properly. Putting paint on glossy or greasy surfaces or on rotting or termite-damaged wood is not proper application. Sometimes the new layer of paint is incompatible with the old paint layer. This can also cause deterioration.

**Friction surfaces**—Paint dust also forms any place where a painted surface rubs against another surface. When two surfaces rub against each other, the movement causes **friction**. Friction causes paint to flake, chip, and form dust. Lead-painted windows are the places where friction most often causes lead dust. Whenever a window goes up or down, it causes friction.

**Impact surfaces**—Paint can be weakened by impact or forceful contact. This happens when doors and windows close. Doors and windows have many impact points where paint can flake and chip.

**Lead dust buildup**—Lead dust is made of tiny lead particles. Lead particles are heavy and they stick to surfaces. They land close to the surface they came from. When a lead-painted wall is flaking and peeling, the lead dust particles fall close to the wall. Lead dust tends to build up in spaces close to friction surfaces, such as window troughs.

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## Identifying Lead-based Paint Hazards

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Lead dust can also build up in areas that are not cleaned properly. Lead dust gathers in cracks. It builds up behind cabinets, between floor boards, and behind baseboards. The dust may come out of the cracks over time due to air movement, impact, pressure, or even a child picking at the floor.

### People who live in houses with lead-based paint

Besides looking at possible lead-based paint hazards, the risk assessor looks at the people who live in the home. These are the people who may get lead poisoning. If there is a lot of lead dust, the risk increases that someone will get lead poisoning.

Children and pregnant women are at highest risk for lead poisoning. A home with deteriorating lead-based paint where a young child and a pregnant woman live would be a very high-risk home.

### Lead hazard controls

After the risk assessor has identified the lead-based paint hazards, he or she will put together a plan to control the lead-based paint hazards. Then a contractor and his or her workers implement the hazard control plan.



**Children and pregnant women are at highest risk for lead poisoning.**



### Tests for lead in paint, dust, and soil

An inspector can use a number of methods to test for lead in different sources such as paint, dust, or soil. Each test has advantages and disadvantages. The results are all measured differently. We'll take a look at the following tests in this chapter:

- paint chip lab analysis
- X-ray fluorescence (XRF) analysis
- dust wipe test
- anodic stripping voltametry
- wet chemical field tests
- soil sampling



### Paint chip lab analysis

The inspector takes paint samples from painted surfaces and sends them to a lab for lead tests. The test, called paint chip lab analysis, shows how much lead is in the paint. The inspector should wear safety goggles or glasses and gloves when taking samples. Gloves must be changed after each sample is collected.

#### Advantages

Paint chip analysis can be very accurate when the inspector correctly collects the sample. The paint chip sample must include **all the paint layers** of the tested surface but no wood, plaster, or other material underneath the paint. (This is not always easy to do.)

#### Disadvantages

Paint chip analysis costs \$5 to \$20 per sample. It takes two days to two weeks to get the results, sometimes longer. To get a sample, the inspector has to disturb the painted surface. Patches of paint in the area scraped (for the sample) may get left behind. The inspector or owner will have the added expense of repairing and repainting the surface.

#### Results

Paint chip analysis most often measures the amount of lead in the paint by weight. The weight of lead in the sample is compared to the weight of the entire sample. The lead in the sample is reported as a percentage by weight. If the sample is 0.5 percent lead or higher, HUD says that the surface tested should be considered a lead-based paint surface. Lead in paint chips can also be measured in milligrams per square centimeter ( $\text{mg}/\text{cm}^2$ ), but only if the exact area of the paint chip is measured. The 1995 HUD *Guidelines* recommend getting paint-chip results reported in  $\text{mg}/\text{cm}^2$  if at all possible.

**Samples must be clearly labeled.**

**Paint chip samples must include all paint layers.**

**Sometimes paint chip lab analysis is used to back up XRF tests.**



**XRFs can be used on site.**

## **X-ray fluorescence (XRF) analysis**

The inspector can also use a machine called an **X-ray fluorescence analyzer**, or **XRF**. An XRF works similar to an X-ray machine at the doctor's office, but the process is different. Radioactive waves are used to find the lead in paint. But, instead of taking a picture, the XRF tells us how much lead is in the paint. This test is called XRF analysis. XRF machines must be used very carefully because they produce radiation. Inspectors need special training to prevent radiation exposure.

### **Advantages**

The XRF machine is portable and can be used on site. For most painted surfaces, it can determine whether or not lead-based paint is present. Usually, it does not damage the painted surface as paint chip sampling does.

### **Disadvantages**

XRFs cost from \$8,000 to \$20,000. XRF inspectors must have radiation safety training. They also need special training to operate the machine. After this training, they must get a permit to use an XRF machine. Permits, training, and replacement parts can also be expensive—about \$3,000 to 4,000 per year.

Many things can interfere with XRF readings and result in inaccurate results. Brick, metal, and other building materials that the lead-based paint is on can affect the XRF readings. Temperature, humidity, radio waves, and vibration can also cause false readings. Some surfaces—like corners and narrow edges—cannot be measured by an XRF.

### **Results**

XRF readings tell how much lead is in the tested surface area. Results are reported in milligrams (mg) per square centimeter (cm<sup>2</sup>). A milligram is one-thousandth of a gram. A square centimeter is about the size of your thumbnail.

In single-family housing XRF readings will be taken of each painted or stained surface type (e.g., baseboard, floor, door) present in each room. In multifamily housing (large developments with a lot of apartments or units) an inspector doesn't have to inspect every unit. The number of units that must be inspected depends upon the year the housing was built *and* how many total units or apartments there are in the development. If the XRF readings are equal to or greater than 1.0 mg/cm<sup>2</sup>, those surfaces are coated with lead-based paint. Some states or localities have rules or regulations that set a lower (or higher) level of lead in paint for it to be called lead-based paint. If a state or local rule or regulation sets a different level of lead in paint, the more stringent (i.e., lower) regulation should be used. Check your state, tribal, and local laws.



### Laboratory testing method

Sometimes, an inspector will take a paint chip test sample from the same surface area to confirm the XRF readings. The paint chip lab results will be compared with the XRF results. Paint chip analysis performed by an accredited laboratory is more accurate than XRF testing.



Dust wipe tests tell you if there is lead dust.

### Dust wipe test

Dust wipe tests measure lead dust on surfaces. High levels of surface lead dust are an immediate danger. Dust tests do not determine the presence of lead-based paint that is several layers down. They show whether there is lead in the dust.

The inspector or risk assessor collects dust from surfaces with commercial wipes. Inspectors must wear disposable gloves when collecting samples. Most dust wipes are taken during a clearance inspection or a risk assessment (see page 4-20). Inspectors can take single dust wipe samples from one surface and have it analyzed, or they can wipe several of the same surfaces (e.g., floors) and have them analyzed together. The latter is called composite sampling. When doing composite sampling, inspectors do not have to change gloves between dust wipes until they are going to wipe a different surface (e.g., the inspector takes dust wipe samples from several floors in a dwelling and then changes gloves and takes several dust wipe samples from window sills). The dust wipe samples are sent to an accredited laboratory to find out how much lead dust each sample contains.



### Advantages

The dust wipe test is easy to do and costs about \$5 to \$20 per test. The results tell you whether lead is in the dust. It gives you a good indication if there is a lead dust hazard on the surface wiped.

### Disadvantages

The dust wipe test cannot tell you exactly how much lead is in the paint. It cannot tell you which surfaces will need to be abated. It can tell you only **if lead dust is present** and give you **an idea of how much**. Lead dust may be coming from sources other than lead-based paint.

### Results

Results are measured in micrograms of lead per square foot ( $\mu\text{g}/\text{ft}^2$ ). A microgram is one-millionth of a gram.

Dust wipe tests are taken at two times. First, they are used to test homes to see if dust-lead hazards exist. These dust tests are crucial in preventing lead poisoning.

Some homes cannot be abated right away. While the family waits, they can do things to reduce the amount of lead dust. These actions are called “interim controls.” When lead dust is reduced, the source of lead poisoning is reduced. (For more information on interim controls, see Chapter 5.) Dust wipe tests can show if interim controls are helping.





## Identifying Lead-based Paint Hazards

Second, dust wipe tests are used at the end of an abatement project or some federally-assisted rehabilitation/renovation projects. The dust samples show whether the cleanup of these jobs was done well enough. They tell you if the house is ready for the occupants to return.

EPA has established levels of lead in dust that should be considered a hazard. These levels only apply to dust wipe samples collected on floors and window sills. The average of the dust test results for each type of surface must be below the levels presented in Chapter 3. If the dust levels are equal to or higher than this, there is a dust-level hazard. For clearance, all samples must be below the clearance standards. If any sample is equal to or higher than the clearance standards, then the type of surface represented by that sample must be recleaned. For example, if a window sill sample fails clearance, the workers only have to reclean the sills.

The Baltimore City Department of Health used a wipe sampling to do a study of 20 houses that were abated of lead-based paint. The average results are below.

During the abatement, work practices were carefully monitored. The use of heat guns and dry scraping was not allowed. After abatement, wet cleaning and HEPA vacuums were used to thoroughly clean the houses.

DUST LEVELS BEFORE AND AFTER ABATEMENT			
Surface	Before Abatement	After Chemical Stripping*	After Replacement, Encapsulation, and Enclosures*
Floors	1,300 $\mu\text{g}/\text{ft}^2$	59 $\mu\text{g}/\text{ft}^2$	44 $\mu\text{g}/\text{ft}^2$
Window sills	7,634 $\mu\text{g}/\text{ft}^2$	125 $\mu\text{g}/\text{ft}^2$	17 $\mu\text{g}/\text{ft}^2$
Window troughs	59,202 $\mu\text{g}/\text{ft}^2$	252 $\mu\text{g}/\text{ft}^2$	49 $\mu\text{g}/\text{ft}^2$

\* The clearance dust levels for floors, sills, and troughs were higher when this study was conducted than the levels in effect today.



**ASV allows  
sample analysis  
at the job site.**

## **Anodic stripping voltametry**

Anodic stripping voltametry (ASV) is another analytical method for identifying small amounts of metals within paint chip, soil, dust, or water samples. The ASV equipment is small and portable so that analysis can be at the job site. Depending on where the job site is located, ASV may provide quicker results from sample analysis than if the samples had to be sent off to a laboratory.

### **Advantages**

The ASV allows samples to be analyzed at the job site. It is relatively easy to use and provides a quicker turnaround time for results than laboratory analysis.

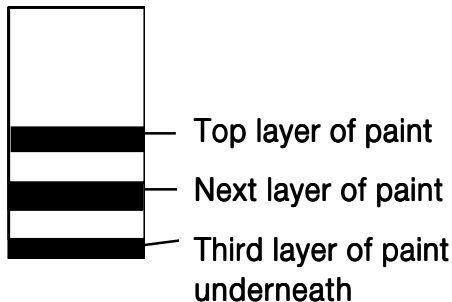
### **Disadvantages**

ASV requires training in chemical handling. The per sample price is about the same as for a fixed-site laboratory analysis. The equipment requires a source of electricity. Firms using the equipment need to be accredited as a laboratory.



### Wet chemical field tests

Some inspectors use wet chemical field tests (spot tests) to find out if paint contains lead. The sodium sulfide test and the sodium rhodizonate test are two examples. EPA, CPSC (the agency that established the legal limit of lead in paint), and HUD currently do not recommend chemical field tests, because research has not proven their effectiveness.



Wet chemical field tests may not be reliable.

The chemical test solutions are clear (sodium sulfide) or yellow (sodium rhodizonate) liquids. To do the test, the inspector scrapes the painted surface down to the wall surface or substrate. All the layers of paint must be exposed. Then the inspector puts a drop of test solution on the painted surface.

### Results

If lead is in the paint, sodium sulfide turns gray, brown, or even black. Sodium rhodizonate turns pink or red when lead is present.

### Advantages

This is a quick, easy test to do. It is done on site. It is inexpensive.

### Disadvantages

- Sodium sulfide works well only with white paint. Colored paints are hard to read.
- The changes in color can be missed.
- Other metals can cause the same color change that lead does.
- These tests do not tell how much lead is in the paint.
- These tests only test exposed layers of paint. These tests will not tell you if coats of paint that are not exposed have lead in them.
- Sometimes these tests say lead is present when it is not.
- Dirt or plaster can hide a color change.
- EPA, CPSC, and HUD currently *do not* recommend chemical field tests, because research has not proven their effectiveness.



**Soil can contain hazardous amounts of lead.**

### Soil sampling

Soil can have high levels of lead. You usually find the highest levels of lead in soil close to the surface (top 2.5 cm or 1 inch). Lead in soil can be a major hazard. Children play outside in the soil. They can get lead-containing dust or dirt on their hands, clothes, and toys. Children can get lead poisoned by playing in soil that contains lead.

Soil sampling and analysis tells how much lead is in the soil. Soil samples are most often collected as part of a lead risk assessment. The risk assessor doing the test needs special training. He or she will dig into the soil with a special tool called a **coring tool**. The coring tool takes samples from the top 1/2 inch of soil. An inspector may also use a disposable syringe, spoon, or other tool to scoop up the soil. Soil on all sides of the building should be tested. Play areas with bare soil will also be sampled.

The test results compare the amount of lead to the amount of soil in the sample. Results are reported in parts per million, or ppm. High levels of lead are usually found close to a house with lead-based paint on the exterior. High levels of lead are often found in the soil close to the street. Lead in the soil close to the street often comes from leaded gasoline.

EPA has established hazardous levels of lead in soil. A soil-lead hazard is present if the level of lead in bare residential soil is at or above 400 parts per million in a play area or an average of 1,200 ppm or higher lead in other bare areas of a yard.


Neither EPA nor HUD require soil sampling after abatement or rehab work. However, inspectors may test for lead in soil when lead-related work was done on the outside of a house or building or if lead-painted debris was stored on the property. These tests may be part of a clearance inspection.


**Lead soil levels are sometimes highest close to the house and the street.**





### Key facts for Chapter 4


 A lead-based paint hazard is any exposure to lead from contaminated dust, soil, or paint that makes you sick.

 Lead dust is a hazard when you breathe or swallow it.

Any painted surface can have lead-based paint.

HUD *Guidelines* recommend testing all painted surfaces.

Test paint or assume it has lead.

 Inspections show which paint has lead.

Lead-based paint inspectors must have special training and certification.

 Risk assessments look at whether a home contains lead hazards.


Lead risk assessors must have special training and certification.

Lead-based paint dust is a health hazard.

Sources of lead-based paint dust include

- deteriorating lead-based paint
- friction on a lead-based painted surface
- impact on a lead-based painted surface
- places where lead dust builds up

Children and pregnant women are at highest risk for lead poisoning.

 Testing for lead in paint and lead hazards

XRFs are used on site.

Paint chip analysis is used on its own and to back up XRF tests.

Paint chip samples must include all paint layers.

Dust wipe tests tell you where there are lead dust hazards.

Dust wipe tests are also done after every abatement job as the final clearance test for the job. The test results show if the post-abatement cleanup was adequate.

Soil tests tell you how much lead is in the soil and if soil-lead hazards exist. Soil may also be tested for lead after lead work is done on the outside of a home or building.



## For more information

These publications have more information on the topics covered in this chapter. Your instructor has a copy of the publications marked with a star (\*). You can order your own copy by calling 1-800-424-LEAD.

Alliance to End Childhood Lead Poisoning, *Guide to State Lead Screening Laws* (October 1991).

Alliance to End Childhood Lead Poisoning, *Resource Guide for Financing Lead-Based Paint Cleanup* (October 1991).

Environmental Defense Fund, *At a Crossroads: State and Local Lead Poisoning Prevention Programs in Transition*.

\* EPA, *Lead: Identification of Dangerous Levels of Lead; Final Rule*; 40 CFR Part 745 (January 2001)

\* EPA, *Reducing Lead Hazards When Remodeling Your Home* (September 1997).

\* EPA, HUD, and CPSC, *Protect Your Family From Lead in Your Home* (June 2003).

\* HUD, *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing* (June 1995).

\* National Lead Information Center, *Testing Your Home for Lead*, Fact Sheet (1993).

National Lead Information Center Hotline: 1-800-424-LEAD.