UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF: C-14J

Mr. Edward Lee, Esq.
507 South Harrison Avenue
Kankakee, IL 60901

2 8 DEC 2005

Re: Lead Free Demonstrations

Dear Mr. Lee:

On our call with you and Mrs. Burrell on December 14, 2005, you indicated that it was your understanding that the properties referenced in our March 25, 2005 pre-filing notice letter are lead free, and asked us for a written statement of what we would require to demonstrate the properties were lead free. We indicated to you that the Kankakee health department "lead safe" certificates you provided in your response dated September 16, 2005 did not demonstrate that the units were free of lead. To do so, you need a Lead-based Paint inspection Report based on the *Guidelines for the Evaluation and Control of Lead-Based Paint in Housing* (HUD 1539-LBP, 1995, revised November 1997). I am enclosing a copy of those guidelines. The report should demonstrate that the target housing is lead free. As defined at 40 C.F.R. § 745.103, Lead-Based paint free housing means housing that has been found to be free of paint or other surface coatings that contain lead equal to or in excess of 1.0 milligram per square centimeter or 0.5 percent by weight. As stated on our call, the Kankakee lead safe certificates would not relieve a seller or lessor from the disclosures requirements for units that might contain lead.

Please provide documentation that the apartments in question are lead free by January 31, 2006.

I am also enclosing copies of our Section 1018 Disclosure Rule Enforcement Response Policy and the Supplemental Environmental Projects Policy.

Please do not hesitate to call me at (312) 886-6630, if you have any questions or comments regarding this matter.

Sincerely yours,

Maria Gonzalez
Associate Regional Counsel

Enclosure

cc: Willie Burrell

U.S. Department of Housing and Urban Development

Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing

Chapter 7: Lead-Based Paint Inspection

1997 Revision

lead in paint should be in mg/cm², unless the surface area cannot be measured or if all paint cannot be removed from the measured surface area. In such cases, concentrations may be reported in weight percent (%) or parts per million by weight (ppm).

6. Follow the radiation safety procedures explained in this chapter, and as required by the U.S. Nuclear Regulatory Commission and applicable State and local regulations when using XRF instruments.

7. Take at least three calibration check readings before beginning the inspection. Additional calibration check readings should be made every 4 hours or after inspection work has been completed for the day, or according to the manufacturer's instructions, whichever is most frequent. Calibration checks should always be done before the instrument is turned off and again after it has been warmed up (calibration checks do not need to be done each time an instrument enters an automatic "sleep" state while still powered on).

8. When conducting an inspection in a multifamily housing development or building, obtain a complete list of all housing units, common areas, and exterior site areas. Determine which can be grouped together for inspection purposes based on similarity of construction materials and common painting histories. In each group of similar units, similar common areas, and similar exterior sites, determine the minimum number of each to be inspected from the tables in this chapter. Random selection procedures are explained in this chapter.

9. For each unit, common area, and exterior site to be inspected, identify all testing combinations in each room equivalent. A testing combination is characterized by the room equivalent, the component type, and the substrate. A room equivalent is an identifiable part of a residence (e.g., room, house exterior, foyer, etc.). Painted surfaces include any surface coated with paint, shellac, varnish, stain, paint covered by wallpaper, or any other coating. Wallpaper should be assumed to cover paint unless building records or physical evidence indicates no paint is present.

10. Take at least one individual XRF reading on each testing combination in each room equivalent. For walls, take at least four readings (one reading on each wall) in each room equivalent. A different visible color does not by itself result in a separate testing combination. It is not necessary to take multiple XRF readings on the same spot, as was recommended in the 1990 Interim Guidelines for Public and Indian Housing.

11. Determine whether to correct the XRF readings for substrate interference by consulting the *XRF Performance Characteristic Sheet*. If test results for a given substrate fall within the substrate correction range, take readings on that bare substrate scraped completely clean of paint, as explained in this chapter.

12. Classify XRF results for each testing combination. Readings above the upper limit of the inconclusive range are considered positive, while readings below the lower limit of the inconclusive range are considered negative. Readings within the inconclusive range (including its boundary values) are classified as inconclusive. Some instruments have a threshold value separating ranges of readings considered positive from readings considered negative for a given substrate. Readings at or above the threshold are considered positive, while readings below the threshold are considered negative.

13. In single-family housing inspections, all inconclusive readings must be confirmed in the laboratory, unless the client wishes to assume that all inconclusive results are positive. Such an assumption may reduce the cost of an inspection, but it will probably increase subsequent abatement, interim control, and maintenance costs, because laboratory analysis often shows that testing combinations with inconclusive readings do not in fact contain lead-based paint. Inconclusive readings cannot be assumed to be negative.

Recommended Report Language On Disclosure For Use In Lead-Based Paint Inspections

"A copy of this summary must be provided to new lessees (tenants) and purchasers of this property under Federal law (24 CFR part 35 and 40 CFR part 745) before they become obligated under a lease or sales contract. The complete report must also be provided to new purchasers and it must be made available to new tenants. Landlords (lessors) and sellers are also required to distribute an educational pamphlet approved by the U.S. Environmental Protection Agency and include standard warning language in their leases or sales contracts to ensure that parents have the information they need to protect their children from lead-based paint hazards."

(See Section IV of Chapter 7 of the HUD *Guidelines* for further details)

Recommended Report Language for Inspections Where No Lead-Based Paint Was Identified

"The results of this inspection indicate that no lead in amounts greater than or equal to 1.0 mg/cm^2 in paint was found on any building components, using the inspection protocol in Chapter 7 of the *HUD Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing (1997 Revision)*. Therefore, this dwelling qualifies for the exemption in 24 CFR part 35 and 40 CFR part 745 for target housing being leased that is free of lead-based paint, as defined in the rule. However, some painted surfaces may contain levels of lead below 1.0 mg/cm^2, which could create lead dust or lead-contaminated soil hazards if the paint is turned into dust by abrasion, scraping, or sanding. This report should be kept by the inspector and should also be kept by the owner and all future owners for the life of the dwelling."

(See Section IV of Chapter 7 of the HUD *Guidelines* for further details)

also available through an automated telephone system by calling 1-888-LEADLIST (1-888-532-3547).

2. Qualifications of Inspectors

The inspector must be certified (licensed) in lead-based paint inspection by the State where the testing is to be done if it has an inspection certification program; if the State does not have such a program, the inspector should be certified by another State. Currently, more than half of all States have such licensing laws. By the fall of 1999, all lead-based paint inspections must be performed only by a certified lead-based paint inspector or risk assessor in accordance with the work practices of 40 CFR part 745, section 227 (see the regulation for specific effective dates for States and Indian Tribes).

C. Other Sources of Information Required to Use This Protocol

The other sources of information and materials needed for using this protocol include an *XRF Performance Characteristic Sheet*, U.S. Nuclear Regulatory Commission and State radiation protection regulations, and standards issued by the American Society for Testing and Materials (ASTM). The National Institute of Standards and Technology (NIST) produces Standard Reference Materials (SRMs) and provides supporting documentation for these materials.

1. XRF Performance Characteristic Sheet

An *XRF Performance Characteristic Sheet* defines acceptable operating specifications and procedures for each model of X-Ray Fluorescence (XRF) lead-based paint analyzer. An inspector should follow the *XRF Performance Characteristic Sheet* for all inspection activities. For most commercially available XRFs, *XRF Performance Characteristic Sheets* are available from the National Lead Information Center Clearinghouse or through the Internet at www.hud.gov/lea/leahome.html. They are also included in a new, easy-to-use format in Addendum 3 to this chapter.

2. XRF Radiation Protection Regulations

Regulations that govern radioactive sources used in XRFs are available from State radiation protection agencies, and the Nuclear Regulatory Commission (301-415-7000).

3. ASTM and NIST Standards

Other helpful information and standards are available from ASTM (610-832-9585), including:

- ASTM E 1583 on evaluating laboratories used to determine lead levels
- ASTM E 1605 on terminology
- ASTM E 1613 on determining lead by atomic emission or atomic absorption spectroscopy
- ASTM E 1645 on laboratory preparation of paint-chip samples
- ASTM E 1729 on collecting paint-chip samples
- ASTM E 1775 on-site extraction and field-portable stripping voltammetry analysis for lead
- ASTM PS 53 on identifying and managing lead in facilities
- ASTM PS 87 on ultrasonic extraction for later analysis for lead
- ASTM PS 88 on determining lead by portable electroanalysis

NIST (301-975-6776) has developed series of paint films that have known amounts of lead-based paint and can be used for calibration check purposes. NIST Standard Reference Material 2579 is available as of mid-1997; NIST is planning to release additional series of paint films in late 1997 or early 1998 (see Section IV.D, below).

D. Paint Testing for Inspections and Risk Assessments

Risk assessments determine the presence of lead-based paint *hazards*, while inspections determine the presence of lead-based paint. The paint-chip sampling and measurement techniques used for paint inspections are similar to the techniques used for risk assessment. However, the number of paint measurements or samples taken for a paint inspection is considerably greater than the number of paint samples required for a risk assessment, because risk assessments measure lead only in deteriorated paint (risk assessments also measure lead in dust and soil). Inspections measure lead in both deteriorated and

In mg/cm² measurements, collecting small amounts of substrate material with the sample does not bias the results significantly, although having any amount of substrate in the sample can result in less precise results. In weight percent measurements, however, no substrate may be included because the substrate will "dilute" the amount of lead reported. Regardless of the units of measurement selected, the bottom layer of paint must always be included in the sample. If a visual examination shows that the bottom layer of paint appears to have "bled" into the substrate, a very thin upper portion of the substrate should be included in the sample to ensure that all lead within the sample area has been included in the sample. In cases where significant amounts of substrate are included in the sample, the results should always be reported in mg/cm².

See Section VI for additional information on laboratory analysis.

H. Additional Means of Analyzing Paint

Methods of analyzing lead in paint are available in addition to XRF and laboratory paint chip analysis, including transportable instruments and chemical test kits. Because these methods involve paint removal or disturbance, repair is needed after sampling, unless the substrate will be removed, encapsulated, enclosed, or repainted before occupancy (see Section VI), or if analysis shows that the paint is not lead-based paint, and leaving the damage is acceptable to the client and/or the owner.

1. Mobile Laboratories

Portable instruments that employ anodic stripping voltammetry and potentiometric stripping voltammetry are now available. Their use is described in ASTM Provisional Standard Practice PS 88. Also, ASTM Standard Guide E 1775 may be used as a basis for evaluating the performance of on-site extraction and electrochemical and spectrophotometric analyses. If the organization using a portable instrument is recognized under the EPA NLLAP and used that type of instrument to obtain the laboratory's recognition, they can be used in the same way as any other NLLAP-recognized laboratory. In short, both fixed-site and mobile laboratories may be used, provided they are recognized under NLLAP.

2. Chemical Test Kits

Chemical test kits are intended to show a color change when a part of the kit makes contact with the lead in lead-based paint. One type of chemical test kit is based on the formation of lead sulfide, which is black, when lead in paint reacts with sodium sulfide. Another is based on the formation of a red or pink color when lead in paint reacts with sodium rhodizonate.

EPA did not find that chemical spot test kits are sufficiently reliable for use in lead-based paint inspection, and recommended that they not be used (EPA 1995). HUD and EPA may recommend them in the future for inspections if chemical test kit technology is demonstrated to be equivalent to XRF or laboratory paint chip analysis in its ability to properly classify painted surfaces into positive, negative, and inconclusive categories, with appropriate estimates of the magnitude of sampling and analytical error. *XRF Performance Characteristic Sheets* currently provide such estimates for XRFs, and analytical error is well-described for laboratory analysis. HUD is currently funding the National Institute for Standards and Technology (NIST) and other researchers to evaluate commercially available chemical test kits and provide the basis for improved chemical test kits. Information on test kits or other new technologies for testing for lead in paint can be obtained from the National Lead Information Center Clearinghouse (1-800-424-LEAD).

II. Summary of XRF Radiation Safety Issues

Radiation hazards associated with the use of XRFs are covered in detail in Section VII. The shutter of an XRF must never be pointed at anyone, even if the shutter is closed. Inspectors should wear radiation dosimeters to measure their exposure, although excessive exposures are highly unlikely if the instruments are used in accordance with the manufacturer's instructions. If feasible, persons should not be near the other side of a wall, floor, ceiling, or other surface being tested.

- Baseboards and associated trim (such as quarter-round or other caps) are a single testing combination (do not group chair rails, crown molding or walls with baseboards)
- Painted electrical sockets, switches or plates can be grouped with walls

Each of these building parts should be tested separately if there is some specific reason to believe that they have a different painting history. In most cases, separate testing will not be necessary.

Table 7.2 provides six examples of different testing combinations. The first example is a wooden bedroom door. This is a testing combination because it is described by a room equivalent (bedroom), component (door), and substrate (wood). If one of these variables is different for another component, that component is a different testing combination. For example, if a second door in the room equivalent is metal, two testing combinations, not one, would be present.

For doors separating rooms, each side of the door is assigned to the room equivalent it faces and is tested separately. The same is true of door casings. For prefabricated metal doors where it is apparent that both sides of the door have the same painting history, only one side needs to be tested.

Table 7.2: Examples of Distinct Testing Combinations

Room Equivalent	Building Component	Substrate
Master Bedroom (Room 5)	Door	Wood
Master Bedroom (Room 5)	Door	Metal
Kitchen (Room 3)	Wall	Plaster
Garage (Room 10)	Floor	Concrete
Exterior	Siding	Wood
Exterior	Swing set	Metal

Building Component Types - A building component type consists of doors, windows, walls, and so on that are repeated in more than one room equivalent in a unit and have a common substrate. If a unique building component is present in only one room, it is considered to be a testing combination. Each testing combination may be composed of more than one building component (such as two similar windows within a room equivalent). Component types can be located inside or outside the dwelling. For example, typical component types in a bedroom would be the ceiling, walls, a door and its casing, the window sash, window casings, and any other distinct surface, such as baseboards, crown molding, and chair rails. If trends or patterns of lead-based paint classifications are found among building component types in different room equivalents, an inspection report may summarize results by building component type, as long as all measurements are included in the report. For example, the inspection may find that all doors and door casings in a dwelling unit are positive.

Test Location - The test location is a specific area on a testing combination where either an XRF reading or a paint-chip sample will be taken.

IV. Inspections in Single-Family Housing

Single-family housing inspections should be conducted by a State- or EPA-certified (licensed) lead-based paint inspector using the following seven steps, some of which may be done at the same time:

- List all testing combinations, including those that are painted, stained, shellacked, varnished, coated, or wallpaper which covers painted surfaces.
- Select testing combinations.
- Perform XRF testing (including the calibration check readings).
- Collect and analyze paint-chip samples for testing combinations that cannot be tested with XRF or that had inconclusive XRF results.
- Classify XRF and paint-chip results.
- Evaluate the work and results to ensure the quality of the paint inspection.
- Document all findings in a plain language summary and a complete report; include language in both the summary and the report indicating that the information must be disclosed to tenants and prospective purchasers in accordance with Federal law (24 CFR part 35 or 40 CFR part 745).

the same substrate in all of the first five room equivalents inspected, further testing of that component type may be discontinued in the remaining room equivalents within that dwelling unit, *if and only if* the purchaser of inspection services agrees beforehand to such a discontinuation. The inspector should then conclude that the similar building component types in the rest of the dwelling unit also contain lead-based paint. For example, if an inspector finds that baseboards in the first five room equivalents are all positive, the inspector -- with the client's permission -- may conclude that all remaining room equivalents in the unit contain positive baseboards.

B. Number and Location of XRF Readings

1. Number of XRF Readings for Each Testing Combination

XRF testing is required for at least one location per testing combination, except for interior and exterior walls, where four readings should be taken, one on each wall. Previous editions of this chapter stated that three readings for each testing combination were needed to control for spatial variation and other sources of error. Recent analysis[2] of EPA data show a median difference in spatial variation of only 0.1 mg/cm² and a change in classification (positive, negative, or inconclusive) occurs less than 5 percent of the time as a result of different test locations on the same testing combination. Multiple readings on the same testing combination or testing location are, therefore, unnecessary, except for interior and exterior walls.

Because of the large surface areas and quantities of paint involved, and the possibility of increased spatial variation, take at least four readings (one reading on each wall) in each room equivalent. (For room equivalents with fewer than four walls, test each wall.) For each set of walls with the same painting history in a room equivalent, test the four largest walls. Classify each wall based on its individual XRF reading. If a room equivalent has more than four walls, calculate the average of the readings, round the result to the same number of decimal places as the XRF instrument displays, and classify the remaining walls with the same painting history as the tested walls, based on this rounded average. When the remaining walls in a room equivalent clearly do not have the same painting history as that of the tested walls, test and classify the remaining walls individually. For exterior walls, select at least four sides and average the readings (rounding the result as described above) to obtain a result for any remaining sides. If there are more than four walls and the results of the tested walls do not follow a classification pattern (for example, one is positive and the other three are negative), test each wall individually.

2. Location of XRF Readings

The selection of the test location for a specific testing combination should be representative of the paint over the areas which are most likely to be coated with old paint or other lead-based coatings. Thus, locations where the paint appears to be thickest should be selected. Locations where paint has worn away or been scraped off should not be selected. Areas over pipes, electrical surfaces, nails, and other possible interferences should also be avoided if possible. All layers of paint should be included and the XRF probe faceplate should be able to lie flat against the surface of the test location.

If no acceptable location for XRF testing exists for a given testing combination, a paint-chip sample should be collected. The sample should include all paint layers and should be taken as unobtrusively as possible. Because paint chip sampling is destructive, a single sample may be collected from a wall and used to characterize the other walls in a room equivalent (see section VI for additional details on paint chip sampling).

3. Documentation of XRF Reading Locations

Descriptions of testing combinations should be sufficiently detailed to permit another individual to find them. While it is not necessary to document the *exact* spot or the *exact* building component on which the reading was taken, it is necessary to record the *exact* testing combination measured. Current room uses or colors can change and should not be the only way of identifying them. A numbering system, floor plan, sketch or other system may be used to document which testing combinations were tested. While HUD does not require a standard identification system, one that could be used is as follows:

when the source is at its full radiation strength, and is obtained from the *XRF Performance Characteristic Sheet.*

For example, if the age of the source is equal to its half-life, the open-shutter time should be twice the nominal time. Thus, if the recommended nominal time is 15 seconds, the open-shutter time should be doubled to 30 seconds.

XRFs typically use Cobalt-57 (with a half life of 270 days) or Cadmium-109 (with a half life of 464 days).

XRF Performance Characteristic Sheets typically report different inconclusive ranges or thresholds (see section IV.G, below) for different nominal times and different substrates. This may affect the number of paint-chip samples that must be collected as well as the length of time required for the inspection. Some XRF devices have different modes of operation with different nominal reading times. Inspectors must use the appropriate inconclusive ranges and other criteria specified on the *XRF Performance Characteristic Sheet* for each XRF model, mode of operation and substrate. For example, inconclusive ranges specified for a 30-second nominal reading cannot be used for a 5-second nominal reading, even for the same instrument and the same substrate.

D. XRF Calibration Check Readings

In addition to the manufacturer's recommended warm up and quality control procedures, the XRF operator should take the quality control readings recommended below, unless these are less stringent than the manufacturer's instructions. Quality control for XRF instruments involves readings to check calibration. Most XRFs cannot be calibrated on-site; actual calibration can only be accomplished in the factory.

1. Frequency and Number of Calibration Checks

For each XRF instrument, two sets of XRF calibration check readings are recommended at least every 4 hours. The first is a set of three nominal-time XRF calibration check readings to be taken before the inspection begins. The second occurs either after the day's inspection work has been completed, or at least every 4 hours, whichever occurs first. To reduce the amount of data that would be lost if the instrument were to go out of calibration between checks, and/or if the manufacturer recommends more frequent calibration checks, the calibration check can be repeated more frequently than every 4 hours. If the XRF manufacturer recommends more frequent calibration checks, the manufacturer's instructions should be followed. Calibration should also be checked before the XRF is turned off (for example, to replace a battery or before a lunch break) and after it is turned on again. For example, if an inspection of a large house took 6 hours, there would be three calibration checks: one at the beginning of the inspection, another after 4 hours, and a third at the end of the inspection.

If the XRF is not turned off as the inspector travels from one dwelling unit to the next, calibration checks do not need to be done after each dwelling unit is completed. For example, in multifamily housing, calibration checks do not need to be done after each dwelling unit is inspected; once every 4 hours is usually adequate.

Some instruments automatically enter a "sleep" or "off" state when not being used continually to prolong battery life. It is not necessary to perform a calibration check before and after each "sleep" state episode, unless the manufacturer recommends otherwise.

2. Calibration Check Standard Materials

XRF calibration check readings are taken on the Standard Reference Material (SRM) paint film nearest to 1.0 mg/cm² within the National Institute of Standards and Technology (NIST) SRM used. These films can be obtained by calling (301) 975-6776 and referencing SRM 2579 (NIST is planning to release additional series of paint films in late 1997 or early 1998; the film nearest to 1.0 mg/cm² should be used for XRF calibration checks). The cost as of September 26, 1997, for the SRM 2579 set of five films, was $320, including 2-day delivery. Calibration checks should be taken through the SRM paint film with the film positioned at least 1 foot (0.3 meters) away from any potential source of lead. The NIST SRM film should not be placed on a tool box, suitcase, or surface coated with paint, shellac, or any other coating to take calibration check readings. Rather, the NIST SRM film should be attached to a solid (not plywood) wooden board or other nonmetal rigid

2. Substrate Correction Procedure

XRF results are corrected for substrate bias by subtracting a correction value determined separately in each house for each type of substrate where lead paint values are in the substrate correction range indicated on the *XRF Performance Characteristic Sheet*. In single-family housing, the substrate correction value is determined using the specific instrument(s) used in that house. The correction value (formerly called "Substrate Equivalent Lead" or "SEL") is an average of six XRF readings, with three taken from each of two test locations that have been scraped visually clean of their paint coating. The locations selected for removal of paint should have an initial XRF reading on the painted surface of less than 2.5 mg/cm², if possible. If all initial readings on a substrate type are greater than 2.5 mg/cm², the locations with the lowest initial reading should be chosen. Because available data indicate that surfaces with XRF readings in excess of about 3.0 mg/cm² or 4.0 mg/cm² are almost always coated with lead-based paint, and since bleed-through of lead into the substrate may occur, or pipes and similarly interfering building components may be behind the material being evaluated, locations with such high readings should be avoided for substrate correction.

After all XRF testing has been completed but before the final calibration check test has been conducted, XRF results for each substrate type should be reviewed. If any readings fall within the range for substrate correction for a particular substrate, obtain the substrate correction value.

On each selected substrate requiring correction, two different testing combinations must be chosen for paint removal and testing. For example, if the readings are inconclusive for some wooden baseboards, select two baseboards, each from a different room. If some wooden doors also require substrate correction, the inspector should take substrate correction readings on one door and one baseboard. Selecting the precise location of substrate correction should be based on the inspector's ability to remove paint thoroughly from the substrates, the similarity of the substrates, and their accessibility. The XRF probe faceplate must be able to be placed over the scraped area, which should be completely free of paint or other coatings.

The size of the area from which paint is taken depends on the size of the analytical area of the XRF probe faceplate; normally, the area is specified by the manufacturer. To ensure that no paint is included in the bare substrate measurement, the bare area on the substrate should be slightly larger than the analytical area on the XRF probe faceplate.

In all, six readings must be taken for each substrate type that requires correction. All six must be averaged together. Take three readings on the first *bare* substrate area. Record the substrate and XRF readings on the "Substrate Correction Values" form (Form 7.3) or a comparable form. Repeat this procedure for the second *bare* substrate area and record the three readings on the same form. Substrate correction values should be determined using the same instrument used to take readings on the painted surfaces. If more than one XRF model was used to take readings, apply the substrate correction values as specified on each instrument's *XRF Performance Characteristic Sheet*.

Compute the correction value for each substrate type that requires correction by computing the average of all six readings as shown below and recording the results on the "Substrate Correction Values" form. The formula given below should be used to compute the substrate bias correction value for XRF readings taken on a bare substrate that is not covered with NIST SRM film. A different formula should be used when SRM film must be placed over the bare substrate. The *XRF Performance Characteristic Sheet* specifies when this correction is necessary and provides the formula for computing the correction value.

For each substrate type requiring substrate correction, transfer the correction values to the "Single-Family Housing LBP Testing Data Sheet" (Form 7.1). Correct XRF readings for substrate interference by subtracting the correction value from each XRF reading.

Example: Suppose that a house has 50 testing combinations with wood substrates. The *XRF Performance Characteristic Sheet* states that a correction value for XRF results taken on those wood testing combinations that have values less than 4.0 mg/cm² must be computed. Select two test locations from the testing combinations that had uncorrected XRF results of less than 2.5 mg/cm².

value greater than the upper bound of the inconclusive range, or greater than or equal to the threshold, as specified on the applicable *XRF Performance Characteristic Sheet.*

A *negative* classification indicates that lead is not present on the testing combination at or above the HUD/EPA standard. A negative XRF result is any value less than the lower bound of the inconclusive range, or less than the threshold, specified on the performance characteristic sheet.

An *inconclusive* classification indicates that the XRF cannot determine with reasonable certainty whether lead is present on the testing combination at or above the HUD/EPA standard. An inconclusive XRF result is any value falling within the inconclusive range on the performance characteristic sheet (including the boundary values defining the range). In single-family housing, all inconclusive results should be confirmed by laboratory analysis, unless the client wishes to assume that all inconclusive results are positive.

Positive, negative, and inconclusive results apply to the actual testing combination and to any repetitions of the testing combination that were not tested in the room equivalents. Positive results also apply to similar component types in room equivalents that were not tested. For example, suppose that one baseboard in a room equivalent is tested, and that the inspector decided that all four baseboards are a single testing combination. The single XRF result applies to all four baseboards in that room equivalent.

When an inconclusive range is specified on the *XRF Performance Characteristic Sheet*, XRF results are classified as positive if they are greater than the upper boundary of the inconclusive range, negative if they are less than the lower boundary of the inconclusive range, or inconclusive if in between. The inconclusive range on the *XRF Performance Characteristic Sheets* in Addendum 3 of these *Guidelines* includes its upper and lower bounds. Earlier editions of this guide and earlier *XRF Performance Characteristic Sheets* did not include the bounds of the inconclusive range as "inconclusive." This 1997 edition of Chapter 7 of the HUD Guidelines changes that system, but the specific XRF readings that are considered positive, negative, or inconclusive for a given XRF model and substrate remain unchanged, so previous inspection results are not affected.

For example, if the inconclusive range given in the *XRF Performance Characteristic Sheet* is 0.51 mg/cm² to 1.49 mg/cm², an XRF result of 0.50 mg/cm² is considered negative, because it is less than 0.51; a result of 0.6 mg/cm² is inconclusive; and a result of 1.5 mg/cm² is positive. A result of 0.51 mg/cm², 1.00 mg/cm², or 1.49 mg/cm² would be inconclusive.

Different XRF models have different inconclusive ranges, depending on the specific XRF model and the mode of operation. The inconclusive range may also be substrate-specific.

In some cases, the upper and lower limits of the inconclusive range are equal; that value is called the *threshold*. If the reading is less than the threshold, then the reading is considered negative. If the reading is equal to or greater than the threshold, then the reading is considered positive.

Use of the inconclusive range and threshold is detailed in the performance characteristic sheet. The categories include substrate-corrected results, if substrate correction is indicated. XRF's with *only* threshold values listed on the *XRF Performance Characteristic Sheet* are advantageous in that classifications of results are either positive or negative (no XRF readings are inconclusive).

H. Evaluation of the Quality of the Inspection

The person responsible for purchasing inspection services -- the homeowner, property owner, housing authority, prospective buyer, occupant, etc.; also known as the client -- should evaluate the quality of the work using one or more of the methods listed below. Evaluation methods include direct observation, immediate provision of results, repeated testing, and time-and-motion analysis. Direct observation of the inspection should be used whenever possible. The inspection contract should outline the financial penalties that will occur if an inspector fails to perform as contracted during any visit.

1. Direct Observation

An evaluation of a lead-based paint inspection is best made if a knowledgeable observer is present for as much of the XRF testing as possible. This is the only way to ensure that all painted, varnished, shellacked, wallpapered, stained, or other coated testing combinations are actually tested, and that all XRF

3. Final Report

The final report must include both a summary and complete information about the site, the inspector, the inspection firm, the inspection process, and the inspection results. The full report should include a complete data set, including:

- Housing unit identifiers;
- Date of the inspection;
- Identity of the inspector and the inspection firm and any relevant certifications or licenses held by the inspector and/or the firm;
- Building component and room equivalent identification or numbering system or sketches;
- All XRF readings (including calibration check readings);
- All paint chip analyses;
- Testing protocol used;
- Instrument manufacturer, model, serial number, mode(s) of operation and age of radioactive source;
- Information on the owner's legal obligation to disclose the inspection results to tenants and/or purchasers before obligation under 24 CFR part 35 and 40 CFR part 745 (published in the *Federal Register,* Volume 61, Number 45, March 6, 1996, starting on p. 9064; copies of the regulations and related materials can be obtained from the National Lead Information Center Clearinghouse, 1-800-424-LEAD); and
- Final classification of all testing combinations into positive or negative categories, including a list of testing combinations, or building component types and their substrates, that were classified but not individually tested. *(Note that the final report should not list inconclusive readings as a third category. If the client wishes to assume all inconclusive readings are positive, the report should state that assumption and present all readings and testing combinations for which the readings were inconclusive. It is not permissible to assume all inconclusive readings are negative. The report should include the actual readings for any testing combinations for which readings were inconclusive, but were classified as positive. Also note that final classifications are needed for building component types and their substrates that were not actually tested. For example, if the client wants to suspend testing on testing combinations that were found to be positive in the first five room equivalents and are assumed to be positive in the remaining rooms, the final report should list those testing combinations that are assumed to be positive).*

The report should also contain a summary that answers two questions:

(1) Is there lead-based paint in the house? *and*
(2) if lead-based paint is present, where is it located?

The summary report should also include the house address where the inspection was performed, the date(s) of the inspection, the name, address and phone numbers of the inspector and inspection firm, any appropriate license or certification numbers, and the starting and ending times for each day when XRF testing was done. The summary should also contain language regarding disclosure, such as:

> "A copy of this summary must be provided to new lessees (tenants) and purchasers of this property under Federal law (24 CFR part 35 and 40 CFR part 745) before they become obligated under a lease or sales contract. The complete report must also be provided to new purchasers and it must be made available to new tenants. Landlords (lessors) and sellers are also required to distribute an educational pamphlet and include standard warning language in their leases or sales contracts to ensure that parents have the information they need to protect their children from lead-based paint hazards."

Although 24 CFR part 35 and 40 CFR part 745 do not require that inspectors and owners keep copies of inspection reports for any specified period of time, future buyers are entitled to all available inspection reports, should the property be re-sold.

If no lead-based paint has been detected in the house, the summary should say so. The following language may be used:

Refer to Appendix 12 of these Guidelines for the statistical rationale for this table. The Appendix shows the details of the calculation for pre-1960 housing; the calculation is the same for 1960-1977 housing, except for using the 10 percent criterion for 1960-1977 housing, rather than the 5 percent used for older housing.[3]

Number of Similar Units, Similar Common Areas or Exterior Sites in a Building or Development	Pre-1960 or Unknown-Age Building or Development: Number to Test	1960-1977 Building or Development: Number to Test
57-58	36	22
59	37	23
60-69	38	23
70-73	38	24
74-75	39	24
76-77	40	24
78-79	41	24
80-88	42	24
89-95	42	25
96-97	43	25
98-99	44	25
100-109	45	25
110-117	45	26
118-119	46	26
120-138	47	26
139-157	48	26
158-159	49	26
160-177	49	27
178-197	50	27
198-218	51	27
219-258	52	27
259-279	53	27
280-299	53	28
300-279	54	28
380-499	55	28
500-776	56	28
777-939	57	28

example, if apartment addresses are shown as 1A, 1B, 2A, 2B etc., they must be given a sequence number (1, 2, 3, 4, etc.).

Obviously, units without identifiers could not be selected for inspection and would thus bias the sampling scheme. The list of units should be complete and verified by consulting building plans or by a physical inspection of the development.

Specific units to be tested should be selected randomly using the formula below, and a table of random numbers or the random number function on a calculator. Tables of random numbers are often included in statistics books. Calculators with a random number function key can be obtained for less than $20 and are easier to use than tables. Inspectors are, therefore, advised to use them to obtain the random numbers, which can then be used to select the specific numbered units. A unit number is selected by rounding up the product of the random number times the total number of units in the development to the *next* whole number. That is:

Housing Unit number = Random number *times* Total number, rounded *up,*

where:

Housing Unit number = the identification number for a unit in a list;
Random number = a random number between 0 and 1; *and*
Total number = the total number of units in a list of units.

The same unit may be selected more than once by this procedure. Because each unit should be tested only once, duplicate selection should be documented and then discarded. The procedure should be continued until an adequate number of units has been selected.

The "Selection of Units" form (Form 7.4) is completed by filling in as many random numbers as are needed in the appropriate column. Numbers for the third column are obtained by multiplying the total development size by each random number. Numbers for the fourth column are obtained by rounding up from the previous calculation to the next whole number. If the whole number in the fourth column has already been selected, that selection should not be entered again. The notation "DUP" should be entered to show that the selection was a duplicate. This process should continue until the required number of distinct sample numbers have been selected. Common areas and exterior room equivalents should be identified at this time, but they are not considered to be separate units.

C. Listing Testing Combinations

The "Multifamily Housing LBP Testing Data Sheet" form (Form 7.5) -- or a comparable form -- should be used to list the testing combinations in each unit, common area and exterior site that was selected for inspection. In multifamily housing, the inventory of testing combinations often will be similar for units that have the same number of bedrooms. The inspector should, however, list testing combinations that are unique to each tested unit. For example, some units may contain built-in cabinets while others do not. The selection of testing combinations should, therefore, be carried out independently in each inspected unit.

As in single family housing, take readings on all testing combinations in all room equivalents in each unit selected for testing.

1. Common Areas

Similar common areas and similar exterior sites must always be tested, but in some cases they can be sampled in much the same way that dwelling units are. Common areas and building exteriors typically have a similar painting history from one building to the next. In multifamily housing, each common area (such as a building lobby, laundry room, or hallway) can be treated like a dwelling unit. If there are multiple similar common areas, they may be grouped for sampling purposes in exactly the same way as regular dwelling units are. However, dwelling units, common areas and exterior sites cannot all be mixed together in a single group.

All testing combinations within each common area or on building exteriors selected for testing must be inspected. This includes playground equipment, benches and miscellaneous testing combinations located throughout the development. The specific

described below. Record the number and percentage of testing combinations classified as:

- Positive for lead-based paint. This is based upon a positive XRF reading in accordance with the XRF's Performance Characteristic Sheet;
- Inconclusive and having XRF readings less than the midpoint of the XRF's inconclusive range ("low inconclusive");
- Inconclusive and having XRF readings equal to or greater than the midpoint of the XRF's inconclusive range ("high inconclusive"); and
- Negative for lead-based paint.

The "Multifamily Decision Flowchart" (Figure 7.1) should be used to interpret the aggregated XRF testing results in the "Multifamily Housing: Component Type Report" form. The flowchart is applied separately to each component/substrate type (wood doors, metal window casings, etc.) and shows one of the following results:

- **Positive**: Lead based-paint is present on one or more of the components.
- **Negative**: Lead based-paint is not present on the components throughout the development. (Lead may still be present at lower loadings and hazardous leaded dust may be generated during modernization, renovation, remodeling, maintenance, or other disturbances of painted surfaces.)

These results are obtained by following the flowchart. The decision that lead-based paint is present is reached with 99 percent confidence if 15 percent or more of the components are positive. (Refer to Appendix 12 for the statistical rationale for this percentage.) The decision that lead-based paint is not present throughout the development is reached if: (1) 100 percent of the tested component types are negative, or (2) 100 percent of the tested component types are classified as either negative or inconclusive *and* all of the inconclusive classifications have XRF readings less than the midpoint of the inconclusive range for the XRF in use. Note that the midpoint of the inconclusive range is *not* a threshold; it is used only for classifying XRF readings in multifamily housing in conjunction with information about other XRF readings as described here. (See section 2 below for guidance on what to do when the percentage of positive readings is less than 5%). For cases with greater than or equal to 5% positives *and* less than 15% positives, as well as no positives but greater than 15% high inconclusives, some confirmatory laboratory testing may be needed to reach a final conclusion, unless the client wishes to assume the validity of the XRF results and that all inconclusives are positive. For each testing combination with an inconclusive XRF reading at or above the midpoint of the inconclusive range, a paint-chip sample should be analyzed by a laboratory recognized by the EPA National Lead Laboratory Accreditation Program. If all the laboratory-analyzed samples are negative, it is not necessary to test inconclusive XRF results below the midpoint of the inconclusive range. If, however, *any* laboratory results are positive on a component type, all inconclusives equal to or above the midpoint of the inconclusive range should be analyzed. Once all laboratory results have been reported, the "Multifamily Housing: Component Type Report" form should be updated to include the laboratory results and classifications (either positive or negative).

The "Multifamily Decision Flowchart" is based on data collected by EPA in a large field study of XRF instruments (EPA 1995). Percentages were chosen so that, for each component type, there is a 98 percent chance of correctly concluding that lead-based paint is either absent on all components or present on at least one component of a given

type. Thus, the probability that a tested component type will be correctly classified is very high.

Percentages of positive or inconclusive results are computed by dividing the number in each classification group by the total number of testing combinations of the component type that were tested. For example, if 245 wooden doors in a multifamily housing development were tested and 69 were classified as inconclusive with XRF readings less than the midpoint of the inconclusive range, 28 percent [(69 / 245) x 100 percent = 28.2 percent] should be recorded on the form in the "<1.0 percent" columns under the heading "Inconclusive."

1. Unsampled Housing Units

If a particular component type in the sampled units is classified as positive, that same component type in the unsampled units is also classified as positive. For those cases where the number of positive components is small, further analysis may determine if there is a systematic reason for the specific mixture of positive and negative results.

For example, suppose that a few porch railings tested negative, but most tested positive. Examination of the sample results in conjunction with the building records showed that the porch railings classified as positive were all original and the railings classified as negative were all recent replacements. The records did not reveal which units had replaced railings, and due to historic preservation requirements, the replacement railings were identical in appearance to the old railings. Thus, all unsampled original porch railings could be classified as positive, and all unsampled recently replaced porch railings could be classified as negative if at least 40 of the replaced porch railings had been tested.

2. Fewer than 5% Positive Results

Where a small fraction of XRF readings, less than 5 percent, of a particular component type are positive, several choices are available:

- First, the inspector may confirm the results by laboratory analysis, which is considered definitive when performed as described in Section VI, below; a laboratory lead result of 1.0 mg/cm² or greater (or 0.5 percent by weight or greater) is considered positive.

- Second, the inspector may select a second random sample (using unsampled units only) and test the component type in those units. If less than 2.5% of the combined set of results is positive, the component type may be considered as not having lead-based paint development-wide, but, rather, having lead-based paint in isolated locations, with a reasonable degree of confidence. Individual components that are classified positive should be considered as being lead-based painted and managed or abated appropriately.

- Finally, if the client chooses not to confirm the results by laboratory analysis and not to take a second set of measurements, then the component type should be considered as having lead-based painted development-wide.

The inspector may wish to advise the client that the cost of additional XRF testing or laboratory analysis is usually much less than the cost of lead abatement or interim control projects, and that this is of particular interest in the situation where few results are positive, because there is a significant chance that the paint, development-wide, may not be lead-based.

Whatever approaches are used, all painted individual surfaces found to be positive for lead must be included in the inspection report, regardless of development-wide conclusions.

H. Evaluation of the Inspection

The methods for evaluating inspection services in multifamily housing are identical to those described for single-family housing (see Section IV.H) except for the retesting option: In multifamily housing, a total of 10 testing combinations should be selected for retesting in two units.

I. Documentation in Multifamily Housing

The method for documentation is identical for multifamily and single-family housing (see Section IV.I), with the following exception: Use forms 7.2

such as inclusion of substrate material (for results in weight percent), failure to remove all paint from an area (including paint that has bled into a substrate) and laboratory error. Nevertheless, paint-chip sampling generally has a smaller error than does XRF and is, therefore, appropriate as a final decisionmaking tool. Laboratory results of 1.0 mg/cm² or greater, or 0.5 percent or greater, are to be considered positive. If the laboratory reports both mg/cm² and weight percent for a sample, use whichever result is positive (if any) for final classification. In the rare situation where more than one paint-chip sample from a single testing combination is analyzed, the combination is considered positive if any of those samples is positive. All other results are negative. No inconclusive range is reported for laboratory measurements.

F. Units of Measure

Results should be reported in mg/cm², the primary unit of measure for lead-based paint analyses of surface coatings. Results should be reported as percent by weight only if the dimensions of the surface area cannot be accurately measured or if not all paint within the sampled area can be removed. In these cases, results should not be reported in mg/cm², but in weight percent.

Weight measurements are usually reported as micrograms per gram (μg/g), milligrams per kilogram (mg/kg), or parts per million (ppm) by weight. For example, a sample with 0.2 percent lead may also be reported as 2,000 μg/g lead, 2,000 mg/kg lead, or 2,000 ppm lead.

G. Sample Containers

Samples should be collected in sealable rigid containers such as screw-top plastic centrifuge tubes, rather than plastic bags which generate static electricity and make quantitative transfer of the entire paint sample in the laboratory impossible. Paint-chip collection should include collection of all the paint layers from the substrate, but collection of actual substrate should be minimized. Refer to ASTM E 1729 and Appendix 13 of these *Guidelines* for further details on collection of paint-chip samples.

H. Laboratory Analysis Methods

Several standard laboratory technologies are useful in quantifying lead levels in paint-chip samples. These methods include, but are not limited to, Atomic Absorption Spectroscopy (AAS), Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES), Anodic Stripping Voltammetry (ASV), and Potentiometric Stripping Voltammetry (PSV).

For analytical methods that require sample digestion, samples should be pulverized so that there is adequate surface area to dissolve the sample before laboratory instrument measurement. In some cases, the amount of paint collected from a 4-square-inch (25-square-centimeter) area may exceed the amount of paint that can be analyzed successfully. It is important that the actual sample mass analyzed not exceed the maximum mass the laboratory has successfully tested using the specified method. If subsampling is required to meet analytical method specifications, the laboratory must homogenize the paint-chip sample (unless the entire sample will eventually be analyzed and the results of the subsamples combined). Without homogenization, subsampling would likely result in biased, inaccurate lead results (see ASTM E 1645). See ASTM PS 87 for an ultrasonic extraction method for preparing paint samples for subsequent analysis for lead.

If the sample is properly homogenized and substrate inclusion is negligible, the result can be reported in either milligrams per square centimeter (mg/cm²; the preferred unit), percent by weight, or both. The following equation should be used to report the results in milligrams per square centimeter:

$$\text{mg/cm}^2 = \frac{\text{weight of lead from subsample (in mg)} \times \frac{\text{total sample weight (in g)}}{\text{subsample weight (in g)}}}{\text{sample area (in cm}^2\text{)}}$$

To report results in weight percent, the following equation should be used:

from among available NLLAP-recognized laboratories.

J. Laboratory Report

The laboratory report for analysis of paint samples for lead should include both identifying information and information about the analysis. At a minimum, this should include:

- Laboratory identifying information: including the laboratory's name, address, and phone number, and NLLAP and other applicable certification and accreditation information; similarly, the client and/or project's name and address should be provided.

- Analytical method information: including the information provided in accordance with NLLAP procedures, and ASTM E 1613, ASTM PS 88 or equivalent method(s) for analysis for lead.

- Sample information: including field sample number and any information (e.g., sample type and/or location) given to the laboratory about the sample, unique laboratory sample number, analytical method (including a description of any variations from the standard method), quality control/quality assurance results, date of analysis, operational or testing problems or unusual occurrences.

VII. Radiation Hazards

Portable XRF instruments used for lead-based paint inspections contain radioactive isotopes that emit X rays and gamma radiation. Proper training and handling of these instruments is required to protect the instrument operator and any other persons in the immediate vicinity during XRF usage. The XRF instrument should be in the operator's possession at all times. The operator should never defeat or override any safety mechanisms of XRF equipment.

A. XRF Use Licenses and Certification

In addition to training and certification in lead-based paint inspection, a person using a portable XRF instrument for inspection must have valid licenses or permits from the appropriate Federal, State, and local regulatory bodies to operate XRF instruments because of radioactive materials they contain. All portable XRF instrument operators should be trained by the instrument's manufacturer (or equivalent). XRF operators should provide related training, licensing, permitting, and certification information to the person who has contracted for their services before an inspection begins. Depending on the State, operators may be required to hold three forms of proof of competency: manufacturer's training certificate (or equivalent), a radiation safety license, and a State lead-based paint inspection certificate or license. To help ensure competency and safety, HUD and EPA recommend that clients hire only those inspectors who hold all three.

The regulatory body responsible for oversight of the radioactive materials contained in portable XRF instruments depends on the type of material being handled. Some radioactive materials are Federally regulated by the U.S. Nuclear Regulatory Commission (NRC); others are regulated at the State level. States are generally categorized as "agreement" and "non-agreement" States. An agreement State has an agreement with NRC to regulate radioactive materials that are generally used for medical or industrial applications. (Most radioactive materials found in XRF instruments are regulated by agreement States). For non-agreement States, NRC retains this regulatory responsibility directly. At a minimum, however, most State agencies require prior notification that a specific XRF instrument is to be used within the State. Fees and other details regarding the use of portable XRF instruments vary from State to State. Contractors who provide inspection services must hold current licenses or permits for handling XRF instruments, and must meet any applicable State or local laws or notification requirements.

Requirements for radiation dosimetry by the XRF instrument operator (wearing dosimeter badges to monitor exposure to radiation) are generally specified by State regulations, and vary from State to State. In some cases, for some isotopes, no radiation dosimetry is required. Because the cost of dosimetry is low, it should be conducted, even when not required, for the following four reasons:

VIII. REFERENCES

EPA 1995. "A Field Test of Lead-Based Paint Testing Technologies: Technical Report, EPA 747-R-95-002b, U.S. Environmental Protection Agency, Washington DC, May 1995.

EPA and HUD 1996. 24 CFR 35, subpart H, and 40 CFR 745, subpart F. Requirements for Disclosure of Known Lead-Based Paint and/or Lead-Based Paint Hazards in Housing. Published, along with their preamble, in the *Federal Register,* volume 61, pp. 9064-9088, March 6, 1996. Implements Section 1018 of Title X.

EPA 1996. 40 CFR 745, subparts L and Q. Requirements for Lead-Based Paint Activities in Target Housing and Child-Occupied Facilities. Published, along with its preamble, in *Federal Register*, volume 61, pp. 45777-45830, August 29, 1996. Implements Sections 402 and 404 of the Toxic Substances Control Act.

State of Wisconsin 1994. Wisconsin Department of Health and Social Services, memo from Mark Chamberlain dated April 28, 1994. Measurements showed that exposures to radiation during operation of a Scitec MAP 3 XRF were 132 µrem/day, which can be compared to about 1,400 µrem/day from natural background radiation.

successful calibration check test, and consulted the manufacturer's recommendations. After trying, the instrument could not be brought back into control. Consequently, the inspector began using a backup instrument, after performing a calibration check and manufacturer's warm up and quality control procedure. The calibration check test showed that the backup instrument was operating acceptably. The inspector used the backup instrument to reinspect the room equivalents checked with the first instrument, and then all the other room equivalents in the home. Next, because substrate correction was required for all results on wood and metal below 4.0 mg/cm² as specified in the *XRF Performance Characteristic Sheet* for the XRF model in use, the inspector prepared to take readings for use in the substrate correction computations. Using the random number function on a calculator and the list of sample location numbers, the inspector randomly selected two testing combinations each with wood and metal substrates where initial readings were less than 2.5 mg/cm², removed the paint from an area on each selected testing combination slightly larger than the faceplate of the XRF instrument, took three readings on the bare substrates, and recorded the readings on the "Substrate Correction Values" form (Completed Form 7.3). The inspector calculated the correction values for each substrate by averaging the six readings from the two test locations, rounded the result to the 2 places after the decimal point that the XRF instrument displayed, and recorded the information in the Correction Value row. The inspector then transferred the correction values to the "Single-Family Housing LBP Testing Data Sheet" for each corresponding substrate.

After the inspector had finished taking the readings needed to compute the substrate correction values, the inspector took another set of three calibration check readings. The inspector recorded the results on the "Calibration Check Test Results" form, under Second Calibration Check, for readings taken by the backup XRF instrument (Completed Form 7.2). The second (and final) calibration check average did not exceed the 0.20 calibration check tolerance. The inspector, therefore, deemed the XRF testing to be complete.

The inspector then calculated the corrected readings by subtracting the substrate correction value from each XRF result taken on a wood or metal substrate. The substrate correction value was obtained by averaging readings on bare surfaces that had initially measured less than 2.5 mg/cm² with the paint still on the surface (Completed Form 7.3). The inspector also used the inconclusive ranges obtained from the XRF Performance Characteristic Sheet (0.41 mg/cm² to 1.39 mg/cm²) for all substrates except plaster (inconclusive range 1.01 mg/cm² to 1.09 mg/cm²). Based on the valid window sill XRF readings, including substrate corrections for wood, there were initially 10 positive results, 2 inconclusive results, and 3 negative results in the bedroom. The two inconclusive results required paint-chip sampling with laboratory confirmation; this resulted in one positive and one negative result. The inspector then filled out the "Single-Family Housing: Component Type Report" (Completed Form 7.1A). A description of each component type was recorded in the first column, the total number of each tested component type was entered in the second column, and the number of testing combinations classified as positive for each component type from the "Single-Family Housing LBP Testing Data Sheet" (Completed Form 7.1) was calculated and entered in the third column. The inspector then did the same for the testing combinations classified as negative. Based upon the XRF results as modified by the laboratory confirmation of the two inconclusive samples, Completed Form 7.1A shows 11 positive and 4 negative results for wood window sills. The remaining component types were entered in a similar fashion.

B. Example of Multifamily Housing Inspection

This section presents a simple example of a multifamily housing development inspection. An actual inspection would have many more testing combinations than are provided here.

The inspector's first step was a visual examination of the development to be tested. During this pretesting review, buildings with a common construction and painting history were identified and the date of construction -- 1948 -- was determined. The construction and painting history of all the units was found to be similar, so that units in the development could be grouped together for sampling purposes. The inspector determined that the development had 55 units, and by consulting Table 7.3, determined that 35 units should be inspected.

Once inspections were completed in all of the 35 selected units of the development, the inspector completed the "Multifamily Housing: Component Type Report" form (Completed Form 7.6). A description of each component type was recorded in the first column, the total number of each tested component type was entered in the second column, and the number of testing combinations classified as positive for each component type from the "Multifamily Housing LBP Testing Data Sheet" (Completed Form 7.5) was calculated and entered in the third column. The inspector then did the same for the testing combinations classified as negative, that is, XRF readings up to and including 0.40 mg/cm², and for inconclusive classifications with XRF readings less than the midpoint of the inconclusive range, that is, XRF readings from 0.41 mg/cm² to 0.89 mg/cm², and for inconclusive classifications with XRF readings equal to or greater than the midpoint of the inconclusive range, that is 0.90 mg/cm² to 1.39 mg/cm². Using these readings and the total number of the component type sampled, the inspector computed and recorded the percentages of positive, negative, and inconclusive classifications for each component type.

After entering the number of testing combinations for each component type in the "Multifamily Housing Component Type Report" form, the inspector noticed that only 34 wood door casings had been inspected. Because it is necessary to test at least 40 testing combinations of each component type, the inspector arranged with the client to test six more previously untested door casings. Additional units were randomly selected from the list of unsampled units. An initial calibration check test was successfully completed and the six door casings were tested for lead-based paint. Another calibration check test indicated that the XRF instrument remained within acceptable limits. The inspector then updated the "Multifamily Housing: Component Type Report" form by crossing out with one line the row of the form that showed the original, insufficient number of component types for testing; the inspector then wrote the information on the full 40 wood door casings in a new row.

The inspector used the "Multifamily Decision Flowchart" (Figure 7.1) to evaluate the component type results. Because 100 percent of the plaster walls and metals baseboards tested negative for lead, the inspector concluded that no lead-based paint had been detected on any walls or baseboards in the development, including those in uninspected units, and entered "NEG" in the Overall Classification column. The inspector also observed that shelves, hall cabinets, and window casings had no positive results. For all of the other component types, 15% or more of the readings for each type were positive; after choosing *not* to perform additional XRF readings or laboratory analysis on those components, that is, to rely on the XRF readings, the inspector entered "POS" in the Overall Classification column for them. For the shelves, all the XRF results were negative or inconclusive and less than 0.90 mg/cm² ("low inconclusive") so the inspector, in accordance with the flowchart, entered "NEG" in the Overall Classification column. The hall cabinets and window casings were classified as inconclusive with some readings greater than or equal to 0.90 mg/cm² ("high inconclusive"). The inspector determined that over 15 percent of the readings taken on these component types were high inconclusives. The inspector chose to take additional samples for laboratory analysis, to see if any or all of the samples would be determined to be negative by laboratory analysis.

The inspector collected paint-chip samples from the inconclusive component types, but only from testing combinations where XRF readings were equal to or greater than 0.90 mg/cm², the midpoint of the inconclusive range. Paint-chip samples were taken from 32 sampling locations: 12 hall cabinets, 7 window casings and 13 metal radiators. The paint-chip samples were collected from a 4-square-inch (25-square-centimeter) surface area on each component. Each paint-chip sample was placed in a hard-shelled plastic container, sealed, given a uniquely-numbered label, and sent to the laboratory for analysis.

The laboratory returned the results to the inspector, who entered the laboratory results and classifications on the appropriate "Multifamily Housing LBP Testing Data Sheet" (Form 7.5). Laboratory results of all 5 paint-chip samples taken from the window casings were classified as negative. The laboratory results of 5 samples from the hall cabinets were classified as positive, and 7 as negative. The metal radiator results were classified as 9 positives and 4 negatives.

The "Multifamily Decision Flowchart" was applied to the results shown in the "Multifamily Housing: Component Type Report" to determine the appropriate classification for each component type. The inspector classified all shelves and

Endnotes

1. Most XRF instruments detect K-shell fluorescence (X-ray energy), some L-shell fluorescence, and some K and L fluorescence. In general, L X rays released from greater depths of paint are less likely to reach the surface than are K X rays, which makes detection of lead in deeper paint layers by L X rays alone more difficult. However, L X rays are less likely to be influenced by substrate effects.

2. Westat, Inc. An Analysis and Discussion of the Single Family Inspection Protocol Under the 1995 HUD Guidelines: Draft Report. 1996.

3. Dixon, S., National Center for Lead-Safe Housing, Sample Size as a Function of Multifamily Development Size. 1997.

4. The statistical rationale and calculations used to develop sample sizes in multifamily housing is based on a data set which contains approximately 164,000 XRF readings from 23,000 room equivalents in 3,900 units located in 65 housing developments. Statistical and theoretical analyses completed for HUD are available through the Lead Clearinghouse and on HUD's World Wide Web Home Page.

Appendix 13.2
Paint Chip Sampling

Dust sampling must always be done **before** paint chip sampling in order to minimize the prospect of cross-sample contamination. Paint chip sampling is a destructive method that may release a small quantity of lead dust. Although paint chip samples are to be collected from inconspicuous areas, the occupant must always be notified that paint chip sampling may be necessary.

1. Paint Chip Sampling Tools and Materials

a. Sharp stainless steel paint scraper (such as Proprep™ Scraper, $7.50, 1-800-255-4535) available at many paint stores.

b. Disposable wipes for cleaning paint scraper.

c. Non-sterilized non-powdered disposable gloves.

d. Hard-shelled containers (such as non-sterilized 50-ml polypropylene centrifuge tubes) that can be rinsed quantitatively for paint chip samples if results are to be reported in mg/cm². Ziplock baggies can be used only if results are to be reported in µg/g or percent by weight.

e. Collection device (clean creased piece of paper or cleanable tray).

f. Field sampling and laboratory submittal forms.

g. Tape measure or ruler (if results are reported in mg/cm²).

h. Ladder.

i. Plastic trash bags.

j. Flashlight.

k. Adhesive tape.

l. Heat Gun or other heat source operating below 1100°F to soften the paint before removal.

2. Containment

a. Method One: Plastic Sheeting Underneath Sampling Area

A clean sheet of plastic measuring four feet by four feet should be placed under the area to be sampled to capture any paint chips that are not captured by the collection device or creased piece of paper. Any visible paint chips falling to the plastic should be included in the sample. Dispose of the plastic after each sample is collected by placing the sheeting in a trash bag. Do not throw away the plastic at the dwelling. Wet wipes may be used to clean the area.

b. Method Two: "Glovebag" Approach

If further containment is deemed necessary, a "glovebag" approach may be used. A durable sheet of plastic is loosely taped to the surface to be sampled, with a paint scraper, collection device, and shipment container housed inside the plastic. There should be enough "play" in the plastic to permit a scraping motion without dislodging the tape holding the plastic to the surface. Large plastic baggies can be used in lieu of the sheet of plastic if paint chips are to be shipped to the lab in plastic baggies. Properly conducted, this method completely seals the surface during the actual scraping operation. A four by four foot sheet of plastic is still required under the glove bag to capture any debris that falls to the ground during the glove bag removal. The tape should be slowly removed from the surface to avoid lifting any additional paint off of the surface.

3. Paint Sample Collection

The paint chip sample need not be more than 2-4 square inches in size (consult with the laboratory for the optional size). Persons collecting paint chips should wear new disposable gloves for each sample.

The most common paint sampling method is to scrape paint directly off the substrate. The goal is to remove all layers of paint equally, but none of the substrate. A heat gun should be used to soften the paint before removal to reduce the chances of including substrate with the sample and to help prevent sample loss. Including substrate in the sample will dilute the lead content if results are reported in µg/g or weight percent. Hold the heat gun no closer than six inches from the surface. Do not scorch the paint. Discontinue heating as soon as softening or blistering is observed.

Use a razor-sharp scraper to remove paint from the substrate. Paint samples collected in this fashion are usually reported in µg/g or % lead only. The sample may be placed in a baggie for shipment to the laboratory.

If the area sampled is measured exactly, and all the paint within that area can be removed and collected, it is possible to also report the results in mg/cm^2. All of the sample must be placed in a hard-shelled container for shipment to the laboratory. The hard-shelled container is used since the laboratory will analyze the entire sample submitted. The exact dimensions of the area sampled must be recorded on the field sampling form. For mg/cm^2, including a small amount of substrate in the sample is permitted.

4. Composite Paint Chip Sample Collection

Paint chip samples may be composited by collecting individual subsamples from different surfaces. If results are reported in mg/cm^2, each subsample should be exactly the same size in surface area. If results are reported in weight percent or µg/g, each subsample should have about the same weight (weighing is done in a laboratory). The result is then compared to the standard for lead-based paint divided by the number of sub-samples (the composite standard). If the result is above this number, one or more of the samples may be above the standard. Each sub-sample should be reanalyzed individually in this case. If the result is below this number, none of the sub-samples can contain lead above the standard. No more than 5 subsamples should be included in the same sample container or ziplock baggie. If both single-surface and composite samples

are collected side-by-side, the individual samples can be submitted for analysis without returning to the dwelling if the composite result is above the composite standard. If the laboratory does not analyze the entire composite sample, it must use a validated homogenizing technique to ensure that all sub-samples are completely mixed together.

5. Cleanup and Repair

a. All settled dust generated must be cleaned up using wet wipes.

b. The surface can be resealed with new paint if necessary. If desired, apply spackling and/or new paint to repair the area where paint was removed.

c. Personnel conducting paint sampling should avoid hand-to-mouth contact (specifically, smoking, eating, drinking, and applying cosmetics) and should wash their hands with running water immediately after sampling. The inspector should ask to use the resident's bathroom for this purpose. Wet wipes may be used if no running water is available or if the bathroom is not available.

6. Laboratory Submittal

The samples should be submitted to a laboratory recognized by the EPA National Lead Laboratory Accreditation Program. Appropriate sample submittal forms should be used. The field sample number should appear on the field sampling form, the laboratory submittal form, and the container label. The name of the laboratory, the date the samples were sent to the lab, and all personnel handling the sample from the time of collection to the time of arrival at the laboratory should be recorded on a chain of custody form, if appropriate.

See Appendix 14 for the laboratory analytical procedures to be used.

7. Qualifications of Paint Sampling Technicians

All individuals performing paint sampling should be certified. Where possible, field experience in environmental sampling is preferable.

8. Other Information

See ASTM ES 28-94 and ES 37-94 for additional information