VIKEN DETECTION

lead-paint field alert

THE "FOUR Ls" HEALTH DEPARTMENTS SHOULD CONSIDER WHEN USING XRF ANALYZERS FOR LEAD PAINT INSPECTIONS

L-shell, Laboratories, Lawsuits, & Licensing

1) **L-shell** XRF methods, initially described in a 1993 ThermoNiton patent, are attempting to reemerge despite a problematic history of underreporting lead in paint and increased radiation exposure to inspectors
2) **Laboratories** have also been found to underreport lead levels, even in a blind test with precise NIST standards
3) **Lawsuits** disputing lead field tests are on the rise, brought by both impacted families and landlords
4) (X-ray) **Licensing** exemption for the leading XRF analyzer has been granted by the US Nuclear Regulatory Commission, marking an industry milestone and highlighting the device's exceptional safety

---

I. "L Shell" – An Assessment of a Method Susceptible to False Negatives, Raising Child-Safety Issues and Potentially Leading to Unnecessarily Higher Radiation Exposure to Inspectors

Significance of "L" and "K" shells. In XRF, L and K shells refer to positions of electrons that are excited by an X-ray radiation source and then detected to identify specific elements on the periodic table (like Pb/lead). K-shell electrons are nearest to the nucleus and thus require higher X-ray energies for excitation. Conversely, L-shell electrons are found in outer shells and require lower energy levels for excitation.

X-ray tube versus isotope radiation source. General-use XRF handheld devices are equipped with X-ray tubes that generate a vast amount of lower energy X-rays to enable multi-element identification. In contrast, isotope-based sources are selected to match a specific energy range for the target element, enabling devices that produce fewer X-rays (i.e., hundreds of times fewer X-rays than tube-based devices) and are much lighter and more compact.

Think of water pressure as X-ray energy and flow rate as X-ray intensity. Like a fire hose versus a pressure washer, tube-based systems produce far more X-rays to "drench" the target, making them almost 2x as heavy and much larger than isotope-based systems.

Tube-based XRF – flood of X-rays

Isotope-based XRF – targeted X-rays

Tube-based XRF analyzers are made to identify unobstructed elements at or near the surface. Tube-based XRF analyzers operate at lower energies, so precise elemental identification requires a clean surface without any material in between the target and the analyzer.

When intervening materials are present, they absorb the low-energy X-rays that move to and from the target, reducing the signals needed for precise measurements. As a result, tube-based XRF analyzers are primarily used to analyze uniform surface materials, like the mining and scrap metal industries. Even then, accurate readings require proper surface preparation, like removing oxidation or rust for metals analysis.

Significance to lead paint inspections. Due to the high K-shell energies of lead (Pb) which cannot be excited by tube-based XRF analyzers, these devices must solely rely on lower energy L-shell signals to detect lead. However, as previously noted, numerous overlying layers of X-ray absorbing paints make this method less accurate. While complex calculations and assumptions can be introduced to compensate, prolonged X-ray exposure times and/or higher intensities are invariably needed to reduce underreporting (that's simply the nature of the physics).


L-shell – no lead reading


K-shell – high lead reading

The idea of L-shell readings for detecting lead paint has been around for quite some time. Niton filed a patent for this technique in 1993 (US Patent 5,274,688), and Olympus made significant improvements to the method in 2013, by focusing on relatively higher-energy "L-gamma" lines (US Patent 9,182,363). Notably, ThermoNiton and Olympus did not implement their inventions in the U.S. for lead paint.

Incidentally, Olympus entered the portable XRF market by acquiring Innov-X, whose founder also started SciAps (now being acquired by UK-based Spectris).


L-shell – missed reading in field

There is no question that conducting lead paint inspections is vital to protect the health of young children. However, the use of tube-based XRF analyzers clearly introduces avoidable risks. These devices are known to underreport lead when multiple layers of paint are present, leading to (if done correctly) much higher X-ray intensities and/or prolonged readings (thereby increasing inspector radiation exposure from successive measurements). To further illustrate this issue, a recent test demonstrated that an L-shell analyzer could not detect a lead brick beneath just two layers of zinc-based paint (above). Recent field observations have further underscored this underreporting concern (left).

Clearly, HUD's PCS Test was not intended to certify L-shell only methods. HUD's PCS process, established in 1997, served as a "preliminary" protocol to certify K-shell XRF analyzers at action levels of 1.0 mg/cm². An "Archive" of approximately 150 samples was collected in the 1990s from just three cities (Louisville, Philadelphia, and Denver). The aim was to gather lead paint samples from various substrates (drywall, metal, plaster, wood, brick, and concrete) to evaluate K-shell XRF detection and substrate impact on measurements. At a level of 1.0 mg/cm2, the PCS test has been shown to be reliable for K-shell evaluation.

In contrast, to properly test tube-based L-shell XRF analyzers for lead, the underreporting risks would necessitate samples with various attenuating layers and types of paint, thus significantly increasing sample sizes at an order of magnitude higher than what is contained in the Archive (think of all the various paints, primers, layers over the last 50 years). Clearly, the Archive hasn't been updated in 30 years and no longer reflects today's housing stock. Additionally, the PCS's insufficient number of samples are evident from the shortened allowable times for L-shell readings. It is clear that PCS certifications for L-shell analyzers lack the rigor to endure scrutiny.

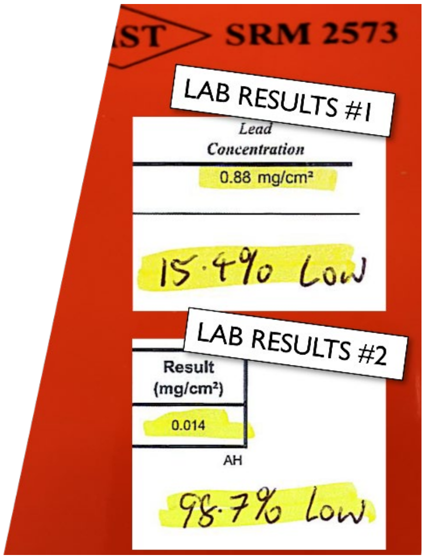
Finally, regarding the topic of reduced action levels, caution is recommended when decreasing action levels below 1.0 mg/cm². Viken stopped PCS testing at 0.5 mg/cm² and accepted an "inconclusive" result at 0.5 mg/cm² due to clear PCS test limitations. Further reducing the action level lacks statistical reliability and becomes somewhat irrelevant given the spatial variability in surface readings, attributed to the initial application of the lead paint.

2. Laboratory (Confirmatory) Testing Found to Underestimate Actual Lead Levels

Recently, Viken was asked to verify lead readings from certain dwellings where confirmatory lab results showed much lower lead levels than measured using XRF. Viken's retests matched their initial XRF findings. Viken then decided to collect its own lead paint samples for lab testing.

After noticing potential underreporting of lead from several laboratories, Viken then submitted NIST 1.0 mg/cm² samples for blind testing. Unexpectedly, the underreporting continued even with the precise 1.0 mg/cm² standard, though the degree of underreporting differed.

Even though Viken expected some discrepancies due to the extraction methods, it was surprised by substantial underreporting solely attributed to laboratory errors, as identified by using the NIST standards. As a result, Viken is notifying the field about its findings.



3. As Awareness of Lead Poisoning Testing and Effects Grows, Legal Actions Increase

Viken has been contacted by principals engaged in lawsuits concerning lead-poisoning and landlord remediation cases. Themes are starting to emerge. Despite laboratories claiming their high detection accuracy, field tests frequently reveal varying outcomes based on the laboratory method employed. Moreover, extracting samples is challenging, especially when trying to remove all paint without the substrate, which could result in labs to further underreport lead levels. It is too soon to consider laboratory results as the definitive "truth."

Moreover, PCS certifications have not been cited as a basis for XRF accuracy. Given the clear shortcomings of the PCS testing protocol for L-shell analyzers and the ease with which these certifications can be disputed, relying solely on the PCS when choosing an XRF analyzer is imprudent. It is becoming more crucial for municipalities to independently assess both the technology being used and the rationale for its implementation, particularly as it pertains to child safety.

Furthermore, it is important to highlight that with the use of tube-based XRF analyzers, and as their limitations become more apparent, there is a risk of dishonest landlords exploiting these shortcomings by purposely applying a few layers of particular paints to generate false negative results; thus, enabling them to sidestep expensive remediation efforts.

4. The Market-Leading K-shell Analyzer Has Obtained an Exemption from the US NRC, Marking an Industry First and Highlighting the Device's Exceptional Safety


NRC Exempt Smoke Detectors

From the start, Viken designed its ergonomic K-shell analyzer to use the smallest amount of radiation possible. The Pb200e focuses X-rays at energy levels that accurately identify lead down to the substrate, avoiding excess radiation found in general-purpose L-shell analyzers. In our field testing, some L-shell XRF analyzers release radiation hundreds of times greater than that emitted by K-shell analyzers, the cumulative effect can be significant with continual use, such as in lead paint inspections.

Demonstrating its commitment to safety, Viken has obtained an NRC exemption from licensing for its Pb200e K-shell analyzer, making it the first in the XRF industry to have no state or federal licensing requirements. In contrast to L-shell tube-based XRF analyzers that require state agency registration, registration fees, mandated radiation safety programs, and/or inspections, the Pb200e is as simple to own as a smoke detector, which is also exempt from NRC regulations.

Due to incorrect information in the market and for the safety of both children and inspectors, Viken is offering a limited trade-in program for those who may have purchased tube-based L-shell XRF analyzers. For further information, please reach out to us at sales@vikendetection.com.

Pb200e™ XRF LEAD ANALYZER

- ✓ The "gold standard" for lead-in-paint detection
- ✓ Verified K-shell method extends all the way down to the substrate
- ✓ Only radiation source exempted by the US NRC to reduce inspector exposure
- ✓ Weighs ~half as much and is significantly more compact than other analyzers
- ✓ US-manufactured analyzer and US-owned company
- ✓ The right choice for lead inspections