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Environmental Technology Verification Program
ETV

Qualitative Spot Test Kits for Lead in Paint

The U.S. EPA Environmental Technology Verification (ETV) Program[1] in collaboration with the U.S. EPA Office of Pollution Prevention and Toxics (OPPT), evaluated the performance of four lead spot test kits (Table 1). The goal of the evaluation was to determine whether or not each test kit could achieve both the false negative and false positive performance criteria of 40 CFR 745.88(c) as published in the final Lead; Renovation, Repair and Painting (RRP) Rule (see box). ETV used an EPA-approved test/quality assurance plan (T/QAP) which was based on ASTM International's E1828, Standard Practice for Evaluating the Performance Characteristics of Qualitative Chemical Spot Test Kits for Lead in Paint, as well as input provided by stakeholders (buyers, sellers, permitters, consultants, financiers, exporters, etc.). Cost of kit, quickness of results, and ease of use were also evaluated for these kits.

Environmental, Health, and Regulatory Background of Lead at a Glance

The ingestion of household dust containing lead from deteriorating or abraded lead paints is a common cause of lead poisoning in children. Although the use of lead-based paint has been banned by the U.S. Consumer Product Safety Commission since 1978, EPA estimates that 37.8 million pre-1978 housing units and child-occupied facilities are still in use. Since many of these housing units and facilities may have interior or exterior paint containing lead, quick, simple and reliable test kits are needed to test or screen for the presence or absence of lead-based paint.

On April 22, 2008, EPA issued the final Lead; Renovation, Repair, and Painting (RRP) Program Rule. The rule addresses lead-based paint hazards created by renovation, repair, and painting activities that disturb lead-based paint in target housing and child-occupied facilities. Under this rule, EPA fostered the development of improved test kits for lead-based paint surfaces to meet the following response criteria: (1) A demonstrated probability (with 95% confidence) of a negative response less than or equal to 5% of the time for paint containing lead at or above the regulated level of 1.0 mg/cm^2 or 0.5% by weight (2) A demonstrated probability (with 95% confidence) of a positive response less than or equal to 10% of the time for paint containing lead below the regulated level, 1.0 mg/cm^2 or 0.5% by weight.

Technology Description and Verification Testing

A primary objective of ETV testing was to provide data for the second phase of EPA's lead paint test recognition program. Results from the verification test for each participating kit were submitted by the ETV Program to OPPT for consideration of recognition.

The tested technologies were portable and designed to be used by renovation contractors to test lead in paints in pre-1978 homes. Testing was conducted by using performance evaluation materials (PEMs) developed by EPA for the ETV project. The PEMs were painted panels with various known amounts of lead concentrations and made from different substrates (wood, metal, drywall and plaster). Kits were tested under controlled laboratory conditions and were not field tested. PEM samples were analyzed in duplicates by the test kits and also analyzed by the reference method (ICP-AES). The test kits were evaluated based on qualitative results, indicating only the presence or absence of lead in the paint at specified concentrations. Performance results were provided on sensitivity, precision, false positive/negative rates, matrix effects, and operational factors. The analyses were performed according to the vendor's recommended procedures in the user instructions or manual. No direct comparisons were made between technologies.

Table 2 summarizes some of the performance data for the tested technologies. Additional information is available in the full verification reports and verification summary statements which can be found at http://www.epa.gov/etv/este.html#pcqstklp.

Based on the results of the ETV study of vendor-submitted lead test kits, EPA recognized a test kit that when used by a certified renovator can reliably determine that regulated lead-based paint is not present on wood, ferrous metal (alloys that contain iron), drywall and plaster surfaces. See http://www.epa.gov/lead/pubs/testkit.htm.

[1]The ETV Program operates largely as a public-private partnership through competitive cooperative agreements with non-profit research institutes. The program provides objective quality-assured data on the performance of commercial-ready technologies. Agency priorities such as the project in this report, which require the use of contracts rather than cooperative agreements, are verified under Environmental and Sustainable Technology Evaluations (ESTE) projects. Verification does not imply product approval or effectiveness. ETV does not endorse the purchase or sale of any products and services mentioned in this document.

Table 1. Verified Qualitative Spot Test Kits for Paint in Lead	
Test Kit	**Technology Description as Provided by the Vendor**
ANDalyze, Inc., Lead-in-Paint Test Kit	Utilizes a sensor/fluorimeter platform to quantitatively detect lead in paint. The test is based on a sensing technology which utilizes DNA to identify lead.
ESCA Tech, Inc., D-Lead® Paint Test Kit	Chemical spot test kit that detects the presence or absence of lead in surface coatings. This test selectively dissolves the lead from the paint sample with a proprietary solvent followed by a color change reaction with sulfide ion. A visual comparison to a color standard is then used to determine the presence of lead and a concentration range.
Industrial Test Systems, Inc., LeadPaintCheck	A semi-quantitative test kit that detects, using a photometer, the presence or absence of lead in paint. Samples are prepared by homogenizing the paint chip samples in the acid solution.
Silver Lake Research, LeadAVERT™ Test Kit	Antibody-based test for the detection of lead in paint samples. The test uses specific monoclonal antibodies that recognize and bind to lead atoms extracted from paint with a weakly acidic, low-toxicity extraction solution. Results are read visually.

Table 2. Selected Performance of Qualitative Lead Test Kits

Vendor	Observed Overall False Positive Rates[1] (%)	Observed Overall False Negative Rates[2] (%)	False Positive Rate Based on the Modeled Probability of Test Kit Response[3] (%)	False Negative Rate Based on the Modeled Probability of Test Kit Response[4] (%)	Overall Cost ($) / number of Test, Based on Consumables
ANDalyze, Inc	4 - 5	9 - 12	19.6 - 45.2	45 - 75	300/50
ESCA Tech, Inc.,	16 - 29	0	65.6 – 97.2	0.4 – 5.4	84.50/24
Industrial Test Systems, Inc.,	14 - 16	1 – 2	53.3 – 80.9	6.9 - 18.2	99.99/50
Silver Lake Research	12 - 22	37 - 56	1.7 – 82.4	23.7 – 99.1	39.95/20

1. Rates for both technical and nontechnical operators are based on a cut-off concentration of 0.8 mg/cm^2, as well as all levels evaluated below this concentration. Results are presented as overall false positive rates across all applicable PEMs combined and also based on lead paint type (i.e., white or yellow lead), substrate (i.e., drywall, metal, plaster, or wood), and topcoat paint color (i.e., grey, red or white). Note that the observed false positive rates presented provide a general representation of the ability of the test kit to correctly identify regulated lead paint when it is absent at the cut-off concentration of 0.8 mg/cm^2 and all levels evaluated below this concentration.
2. Rates for both technical and nontechnical operators are based on a cut-off concentration of 1.2 mg/cm^2, as well as all levels evaluated above this concentration. Results are presented as overall false negative rates across all applicable PEMs combined and also based on lead paint type (i.e., white or yellow lead), substrate (i.e., drywall, metal, plaster, or wood), and topcoat paint color (i.e., grey, red or white). Note that the observed false negative rates presented provide a general representation of the ability of the test kit to correctly identify regulated lead paint when it is present at the cut-off concentration of 1.2 mg/cm^2 and all levels evaluated above this concentration.
3. The false positive rate (at the upper bound of a 95%prediction interval) is evaluated only at 0.8 mg/cm^2. Evaluating at only this level ensures that a test kit can adequately perform at concentrations of lead paint closest to the current regulatory level. Under the RRP rule, a test kit must yield a demonstrated probability (with 95% confidence) of no more than 10% false positives at lead concentrations below 0.8 mg/cm^2 .
4. The false negative rate (at the lower bound of a 95% prediction interval) is evaluated only at 1.2 mg/cm^2. Evaluating at this level ensures that a test kit can adequately perform at concentrations of lead paint closest to the current regulatory level. Under the RRP rule, a test kit must yield a demonstrated probability (with 95% confidence) of no more than 5% false negatives at concentrations above 1.2 mg/cm2.

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OPPT Recognition of Lead Test Kits

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Performance Characteristics of Qualitative Spot Test Kits for Lead in Paint, http://www.epa.gov/nrmrl/std/etv/este.html#pcqstklp

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