THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

ETV

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Verification Statement

TECHNOLOGY TYPE:	**X-RAY FLUORESCENCE**		
APPLICATION:	**MEASUREMENT OF LEAD IN DUST WIPES**		
TECHNOLOGY NAME:	**XL-300 Series XRF Instrument**		
COMPANY:	**NITON Corporation**		
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The U.S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification Program (ETV) to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by substantially accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this goal by providing high-quality, peer-reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations and stakeholder groups consisting of regulators, buyers, and vendor organizations, with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

Oak Ridge National Laboratory (ORNL) is one of the verification organizations operating under the Advanced Monitoring Technology (AMT) Center. AMT, which is administered by EPA's National Exposure Research Laboratory (NERL), is one of six technology areas under ETV. In this verification test, ORNL evaluated the performance of lead in dust wipe measurement technologies. This verification statement provides a summary of the test results for NITON's XL-300 Series x-ray fluorescence (XRF) instrument.

VERIFICATION TEST DESCRIPTION

This verification test was designed to evaluate technologies that detect and measure lead in dust wipes. The test was conducted at the Capitol Community Technical College in Hartford, CT, from November 5 through November 9, 2001. The vendors of commercially-available, field portable technologies blindly analyzed 160 dust wipe samples containing known amounts of lead, ranging in concentration from ≤ 2 to 1,500 µg/wipe. The experimental design was particularly focused on important clearance levels, such as those identified in 40 CFR 745.65 of 40, 250, and 400 µg/ft^2. The samples included wipes newly-prepared and archived from the Environmental Lead Proficiency Analytical Testing Program (ELPAT). These samples were prepared from dust collected in households in North Carolina and Wisconsin. Also, newly-prepared samples were acquired from the University of Cincinnati (UC). The UC dust wipe samples were prepared from National Institute of Standards and Technology (NIST) Standard Reference Materials (SRMs). The results of the lead analyses generated by the technology were compared with results from analyses of similar samples by conventional laboratory methodology in a laboratory that was recognized as proficient by the National Lead Laboratory Accreditation Program (NLLAP) for clearance testing. Details of the test, including a data summary and discussion of results, may be found in the report entitled *Environmental Technology Verification Report: Lead in Dust Wipe Detection Technology— NITON Corporation, XL-300 Series X-Ray Fluorescence Instrument,* EPA/600/R-02/059. NITON's XL-700 Series XRF was also evaluated in the test and a separate report has been prepared (*Environmental Technology Verification Report: Lead in Dust Wipe Detection Technology— NITON Corporation, XL-700 Series X-Ray Fluorescence Instrument,* EPA/600/R-02/055).

TECHNOLOGY DESCRIPTION

The XL-300 Series instrument, which is designed to quantify only lead, is an energy dispersive x-ray fluorescence (EDXRF) spectrometer that uses a sealed, 10 mCi cadmium-109 radioisotope source to excite characteristic x-rays of a test sample's constituent elements. These characteristic x-rays are continuously detected, identified, and quantified by the spectrometer during sample analysis. Stated simply, the energy of each x-ray detected identifies a particular element present in the sample, and the rate at which x-rays of a given energy are counted provides a determination of the quantity of that element that is present in the sample. Detection of the characteristic lead x-rays is achieved using a highly efficient, thermo-electrically cooled, solid-state, silicon PIN-diode detector, a part of the Dual Detector system. Signals from the Dual Detector are amplified, digitized, and then quantified via integral multichannel analysis and data processing units. Sample test results are displayed in total micrograms of lead per dust wipe. During this verification test, the instrument configuration was XL-309 and reporting limits were approximately 15 µg/wipe.

VERIFICATION OF PERFORMANCE

The following performance characteristics of the XL-300 Series XRF were observed:

Precision: Precision—based on the average percent relative standard deviation—was 8%.

Accuracy: Accuracy was assessed using the estimated concentrations of the ELPAT and UC samples. The average percent recovery value for all samples reported above 15 µg/wipe was 94%. The slight negative bias was statistically significant, but well within the acceptable range of bias (100% ± 25%).

Comparability: A comparison of the XL-300 results and the NLLAP-recognized laboratory results was performed for all samples (ELPAT and UC) that were reported above 20 µg/wipe. The correlation coefficient (r) for the comparison of the entire dust wipe data set was 0.999 [slope (m) = 0.849, intercept = 13.247], indicating good agreement with the NLLAP-laboratory data.

Detectable blanks: All twenty samples, prepared at concentrations around 1 µg/wipe, were reported correctly as < 15 µg/wipe by the XL-300.

False positive results: A false positive result is one in which the technology reports a result that is above the clearance level when the true (or estimated) concentration is actually below. Neither the XL-300 nor the NLLAP laboratory reported false positives, out of a possible 30 fp results.

False negative results: A false negative result is one in which the technology reports a result that is below the clearance level when the true (or estimated) concentration is actually above. Both the XL-300 and the NLLAP laboratory reported 21 of 30 possible fn results. The XL-300 had a lower percentage of fn results at the 40 µg/wipe level, a comparable amount at the 250 µg/wipe level, and a higher percentage at the 400 µg/wipe level than the NLLAP laboratory, but overall fn performance for the two methods was comparable.

Completeness: The XL-300 Series instrument generated results for all 160 dust wipes samples, for a completeness of 100%.

Sample Throughput: A single analyst achieved a sample throughput rate of 40 samples per day, with eight measurements taken for each dust wipe, for a total of 320 measurements per day.

Overall Evaluation: The overall performance was characterized as having a slight negative bias (but one within an acceptable range of bias), precise, and comparable to the NLLAP laboratory results. The verification team found that the XL-300 XRF instrument was relatively simple for the trained analyst to operate in the field, requiring less than an hour for initial setup. As with any technology selection, the user must determine if this technology is appropriate for the application and the project data quality objectives. Additionally, ORNL and ETV remind the reader that, while the ETV test provides valuable information in the form of a snapshot of performance, state, tribal, or federal requirements regarding the use of the technologies (such as NLLAP recognition where required) need to be followed. For more information on this and other verified technologies, visit the ETV web site at http://www.epa.gov/etv.

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