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Curtis A. Esche

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ELPAT Program

Background and Current Status

Curtis A. Esche and H. Amy Feng, Column Editors

Introduction

The Environmental Lead Proficiency Analytical Testing (ELPAT) Program is administered by the American Industrial Hygiene Association (AIHA)—in cooperation with researchers at the Centers for Disease Control and Prevention (CDC), the National Institute for Occupational Safety and Health (NIOSH), and the Environmental Protection Agency (EPA), Office of Pollution Prevention and Toxics—to evaluate and improve the performance of laboratories conducting analyses associated with lead abatement.[1,2] Proficiency test samples are prepared by an AIHA contractor, Research Triangle Institute (RTI), using real-world paint chips, dusts, and soils. Quarterly samples are sent to participating laboratories by RTI and the performance of the laboratories is evaluated at AIHA with sufficient time for laboratories to obtain repeat samples and to correct analytical problems before the next round of samples is sent.

The ELPAT Program is open to *all* interested laboratories, including laboratories outside the United States, laboratories seeking accreditation by various private or state laboratory accreditation systems, laboratories that do not intend to seek laboratory accreditation, and laboratories conducting analyses at permanent fixed locations, in self-contained mobile facilities, and at temporary locations (e.g., abatement sites). The ELPAT Program is part of an EPA Program, the National Lead Laboratory Accreditation Program (NLLAP), to recognize private and state laboratory accreditation systems.[3] U.S. Department of Housing and Urban Development (HUD) *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing*[4] require the use of NLLAP-recognized laboratories to ensure the consistency and quality of measurements of lead in paints, soils, and dusts. NLLAP requirements include successful participation in the ELPAT Program for EPA recognition of accreditation. Two organizations, the American Association for Laboratory Accreditation (A2LA)[5] and AIHA,[6] are recognized as accrediting organizations under NLLAP and have in place environmental lead laboratory accreditation systems. Each of these accreditation systems requires participation in ELPAT for environmental lead analysis of paint chips, dusts, and soils. Information on specific A2LA or AIHA laboratory accreditation requirements can be obtained from A2LA and AIHA at the addresses listed at the end of this column.

ELPAT Performance Evaluation

The evaluation of the individual laboratories in the ELPAT Program is based upon consensus values from reference laboratories and is modeled after the evaluation procedures previously used in an industrial hygiene proficiency testing program, the Proficiency Analytical Testing (PAT) Program.[7] Reference laboratories are preselected to provide the performance limits for each sample. These laboratories must meet the following criteria: the laboratory was proficient in the previous ELPAT round for paint chips, soils, and dust wipes, and the laboratory must be accredited by an EPA NLLAP-recognized accrediting organization.

After data from reference laboratories are collected and extreme reference laboratory data have been statistically treated, the mean ± 3 standard deviations of the treated reference laboratory data become the acceptable performance range. Laboratory results are acceptable if they fall within the performance limits. Results falling outside the performance limits are designated as outliers.

Laboratories are rated based upon performance in the ELPAT Program over the last year (i.e., four rounds) for each lead matrix—paint chips, soil, and dust wipes. The laboratory is proficient for each lead matrix if the following occurs:

1. All four results have been reported and all are designated as acceptable for the last two consecutive rounds; or
2. Three-fourths or more of the results reported in the last four consecutive rounds are designated as acceptable.

However, if a laboratory does not report values for the lead matrix on the round being evaluated, the laboratory is not rated.

ELPAT Round 23, May 1998

Paint samples for Round 23 were prepared from paint chips collected from a variety of sites in North Carolina and Ohio, including a school, hospital, and warehouse. The chips were ground to a maximum particle size of 120 micrometers (μm).

Soil samples came from driplines around North Carolina residences. Soil samples were dried and then sterilized by heating the soil to 325°F for a minimum of 2 hours, and finally sieved to a maximum particle size of 150 μm.

Round 23 dust wipes were prepared from dust collected from households in North Carolina and Milwaukee, Wisconsin. Following sterilization by gamma-irradiation, the household and post-abatement dust was sieved to 150 μm and gravimetrically loaded on

TABLE I
ELPAT program summary statistics of reference laboratories for Round 023

Sample type	Sample	*N*	Mean	Minimum	Maximum	STD	RSD (%)	Acceptable range
Paint chips (%)	1	115	0.0366	0.0316	0.0432	.003	9.2	0.0265–0.0467
	2	115	1.8085	1.56	2.01	.129	7.2	1.4203–2.1966
	3	115	0.4255	0.372	0.467	.026	6.2	0.3469–0.5042
	4	115	1.0131	0.8811	1.1291	.067	6.6	0.8111–1.2152
Soil (mg/kg)	1	115	1421.6	1272	1550	78.0	5.5	1187.5–1655.6
	2	115	57.4	45	70.6	6.82	11.9	36.9–77.9
	3	115	218.9	184.7	247.8	16.9	7.7	168–269.7
	4	115	460.2	417.7	508	24.0	5.2	388.2–532.2
Dust wipes (ug)	1	115	129.1	112	146.5	9.90	7.7	99.4–158.9
	2	115	271.5	235.7	303.5	20.4	7.5	210.4–332.7
	3	115	59	47.8	72.9	6.87	11.6	38.4–79.7
	4	115	562	478.8	636.4	41.2	7.3	438.3–685.7

a premoistened PaceWipe™, which has been shown to meet ASTM E 1792[8] specifications. The loaded wipes were stored under refrigeration until shipment as an antimicrobial measure. Also, it was recommended that dust wipe samples be refrigerated until the laboratory analyses were performed, as an additional precaution to reduce/prevent the growth of mold.

A total of 352 laboratories was enrolled for the twenty-third round of the ELPAT Program with 328 laboratories (93%) submitting results. Table I lists summary statistics of reference laboratories for each matrix and sample number. Agreement among reference laboratories using a variety of sample preparation techniques and analytical methods is demonstrated by relative standard deviations (RSDs) ranging from 6.2 to 9.2 percent for paint chips, 5.5 to 11.9 percent for soils, and 7.3 to 11.6 percent for dust wipes. The RSDs are similar to the findings on previous ELPAT rounds.

Table II shows the number of all participating laboratory analyses that were identified as outliers. The percentage was less than 7.8 percent (5.1 to 6.0 percent for paint chips, 3.2 to 7.8 percent for soils, and 5.4 to 6.1 percent for dust wipes). This is similar to the frequency of outliers reported on the earlier rounds of ELPAT for each matrix.

TABLE II
ELPAT round program summary of performance—all laboratories participated for Round 023

Sample type	Sample no.	No. of labs rated	Acceptable labs	Low outlier	High outlier
Paint chips (%)	1	316	300	5	11
	2	316	298	14	4
	3	316	297	12	7
	4	316	297	11	8
Soil (mg/kg)	1	281	272	6	3
	2	281	259	7	15
	3	281	270	5	6
	4	281	268	7	6
Dust wipes (ug)	1	296	280	9	7
	2	296	278	13	5
	3	296	280	8	8
	4	296	279	13	4

Table III shows a summary of acceptable results for the three lead matrices by sample preparation technique and instrumental method used by participating laboratories. Analytical methods that were not identified by laboratories were omitted from the table. Sample extraction techniques are grouped into hotplate, microwave, and "other" techniques reported by participants. Hotplate digestion categories are: NIOSH 7082/7105 (a nitric acid/hydrogen peroxide digestion method modified from the *NIOSH Manual of Analytical Methods*, Method 7082),[9] EPA SW846-3050A[10] (an EPA nitric acid/hydrogen peroxide method), American Society for Testing Materials (ASTM) hotplate methods,[11,12] and other hotplate techniques. Microwave digestion categories are: EPA SW846-3051[13] (a nitric acid digestion method), ASTM microwave methods,[14,15] and other microwave techniques. The "other" category includes nonmicrowave and nonhotplate techniques, such as x-ray fluorescence sample preparation, leaching techniques, ultrasonic extraction, and Parr bomb. Instrumental methods are categorized into Flame Atomic Absorption (FAA), Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES), Graphite Furnace

TABLE III
ELPAT program labs performance summary for Round 023

			Paint chips (%)		Soil (mg/kg)		Dust wipes (ug)	
Instrument	Digestion	Method	Acceptable %	Failures %	Acceptable %	Failures %	Acceptable %	Failures %
FAA	Hotplate	NIOSH-7082/7105	97	3	94	6	98	2
		EPA-SW846-3050A	93	7	93	7	93	7
	Microwave	EPA-SW846-3051	97	3	94	6	94	6
	Ultrasonic		100	0	100	0	100	0
GFAA	Hotplate	NIOSH-7082/7105	75	25	0	0	100	0
		EPA-SW846-3050A	100	0	100	0	100	0
	Microwave	EPA-SW846-3051	0	0	0	0	100	0
	Ultrasonic		0	0	100	0	0	0
ICP-AES	Hotplate	NIOSH-7082/7105	89	11	100	0	91	9
		EPA-SW846-3050A	95	5	96	4	93	7
	Microwave	EPA-SW846-3051	93	7	100	0	97	3
	Ultrasonic		100	0	100	0	100	0
LAB-XRF	XRF sample prep		92	8	100	0	0	0
ASV	Ultrasonic		89	11	90	10	88	13
Total			94	6	95	5	94	6

Atomic Absorption (GFAA), Laboratory X-Ray Fluorescence (LAB-XRF), Anodic Stripping Voltammetry (ASV), and others, which includes Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS).

ELPAT Round 23 Statistical Analysis

Statistical tests were performed on the ELPAT Round 23 data as previously described in a paper by Schlecht, PC, et al.[16] The purpose of these statistical tests is to detect bias differences among analytical methods. Biases on round 23 were found in the instrumental methods category. Two-way analysis of variance (ANOVA) procedures found statistically significant biases for paint chip sample 1 and dust wipe sample 1. For paint chip sample 1, FAA and ASV had a positive bias over ICP-AES. For dust wipe sample 1, FAA has a positive bias over ICP-AES.

NIOSH ELPAT bias studies have found evidence of bias among the principal instrumental methods used by participating laboratories for all three matrices: paint chips, soils, and dust wipes. The biases range from 2 to 26 percent of the corresponding reference laboratory mean, with the largest biases occurring at low lead levels for dust wipes, generally well below HUD and EPA lead action levels. Although it was expected that differences among sample preparation techniques would be found, NIOSH ELPAT bias studies have found no conclusive evidence of bias among the principal sample preparation techniques used by participating laboratories.[16] Another NIOSH study examined the effects of inter- and intra-laboratory variabilities on total variability.[21]

The results of NIOSH ELPAT bias studies are consistent with the 3 to 18 percent bias found by Research Triangle Institute (RTI) in an EPA-sponsored collaborative test. In this test, RTI followed up with participating laboratories and determined that some FAA laboratories failed to perform background corrections, a failure one would expect to result in a positive bias; also, some ICP-AES laboratories failed to take matrix effects into account, a failure one would expect to result in a negative bias. NIOSH does not follow up with participating laboratories to determine if each participating ELPAT laboratory has performed all of the steps of the analytical method reported by the laboratory. However, NIOSH has advised both cooperating accrediting organizations that ELPAT bias could be the result of some ELPAT laboratories not following all steps of the analytical method. NIOSH has recommended that accrediting organizations emphasize FAA background correction and ICP-AES matrix effect minimization procedures when evaluating laboratory accreditation applications, and in conducting on-site assessments for EPA NLLAP recognition. Laboratories should refer to the RTI collaborative test for a more complete discussion on how bias can be minimized.[17]

Laboratory studies of field portable methods such as ultrasonic extraction and anodic stripping voltammetry (ASV) of lead from environmental samples show promise as viable techniques. For a more complete discussion, laboratories can refer to a NIOSH study comparing ultrasonic extraction to hotplate and microwave digestion and field portable anodic stripping voltammetry

to laboratory-based FAA on a series of laboratory-generated air samples and National Institute of Standards and Technology Standard Reference Materials.[18]

Lead Reference Materials

The ELPAT Program is designed to supplement, but not replace, a laboratory's internal quality control program. Use of materials of known lead content in suitable matrices is important in obtaining accurate and reliable lead results. Such materials should be used to validate methods when sample preparation techniques or instrumental methods are adopted or modified. In addition, the materials should be used for daily quality control charting of laboratory/analyst performance. A2LA and AIHA should be contacted about potential sources of primary and secondary reference materials.

EPA NLLAP

Under Title X of the Housing and Community Development Act of 1992, EPA, in consultation with the Department of Health and Human Services (DHHS), has the responsibility to review and determine if effective voluntary laboratory accreditation systems are in place. If EPA determines they are not, EPA is responsible for establishing a federal laboratory certification system.[19]

EPA has established an NLLAP to recognize laboratories performing analysis associated with lead abatement. Published HUD *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing* require the use of NLLAP-recognized laboratories to ensure the consistency and quality of measurements of lead in paints, soils, and dusts.[4] NLLAP recognition of laboratories analyzing lead in paint chips, soils, and dusts has two requirements: (1) successful participation in proficiency testing using real-world matrices, and (2) laboratory accreditation including onsite assessment of laboratory operations. NLLAP requirements are based upon the recommendation of a Federal Interagency Task Force on Lead-Based Paint, a group of 17 federal agencies involved with lead issues, that recognition should be based upon both proficiency testing and laboratory accreditation.[20] Similarly, proficiency testing and laboratory accreditation requirements were also part of the recommendations for environmental laboratories of a 1991 National Conference on Laboratory Issues in Childhood Lead Poisoning Prevention sponsored by the Association of State and Territorial Public Health Laboratory Directors, the CDC, and EPA.

Laboratory accreditation takes some time to achieve. It involves submittal of a description of a laboratory's quality system and manual to the accrediting organization and the on-site evaluation by NLLAP-qualified assessors of laboratory operations including equipment, facilities, analytical methods, staff, and internal quality control. Laboratories interested in obtaining accreditation information such as the program requirements, time needed to complete the process, and cost should contact the recognized laboratory accreditation organizations. If other laboratory accreditation organizations are recognized, this information will be included in subsequent ELPAT columns.

Lists of laboratories that have performed successfully and are accredited in the ELPAT Program are provided to the public upon request on "The Lead Listing" Internet site (www.leadlisting.org). The ELPAT proficiency testing program is open to all interested laboratories. This means those outside the United States and laboratories that do not wish to be accredited can continue to participate in ELPAT. However, only accredited laboratories will appear on "The Lead Listing" web site.

Information

For information on A2LA laboratory accreditation and seminars on environmental lead laboratory accreditation contact:

American Association for
Laboratory Accreditation (A2LA)
656 Quince Orchard Road
Gaithersburg, MD 20878
Phone: (301) 670-1377
Fax: (301) 869-1495

For information on AIHA laboratory accreditation, ELPAT Program information, ELPAT sample orders, and seminars on environmental lead laboratory accreditation contact:

ELPAT Coordinator
American Industrial Hygiene
Association (AIHA)
2700 Prosperity Avenue, Suite #250
Fairfax, VA 22031
Phone: (703) 849-8888
Fax: (703) 207-3561

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EDITORIAL NOTE: Curtis A. Esche and H. Amy Feng are with the Centers for Disease Control and Prevention and the National Institute for Occupational Safety and Health.

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