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ELPAT Program Background and Current Status

Curtis A. Esche and Jensen H. Groff, 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), National Institute for Occupational Safety and Health (NIOSH), and the U.S. 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 NIOSH with sufficient time for laboratories to obtain repeat samples and 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 currently 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. This is the same criterion used by NIOSH to establish acceptable and outlier performance of industrial hygiene laboratories in the PAT Program.[7]

Laboratories are rated based on 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 17, November 1996

Paint samples for round 17 were prepared from paint chips collected from a variety of sites in North Carolina and Ohio, including a school and a hospital. The chips were ground to a maximum particle size of 120 μm.

Soil samples came from driplines around North Carolina residences. Soil samples were dried, 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 17 dust wipes were prepared from dust collected from households in North Carolina and Milwaukee, Wisconsin. Following sterilization by gamma-irradiation, the household and postabatement dust was sieved to 150 μm and gravimetrically loaded on a premoistened PaceWipe™. The loaded wipes were stored under refrigeration until shipment as an antimicrobial measure. It was also recommended that dust wipe samples be refrigerated until the laboratory analyses were performed, as an additional precaution to reduce or prevent the growth of mold. The blank wipe was a premoistened PaceWipe™ towelette.

A total of 394 laboratories were enrolled for round 17 of the ELPAT Program, with 364 laboratories (92%) submitting results. Table 1 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 6.7 to 8.4 percent for paint chips, 5.4 to 13.1 percent for soils, and 9.9 to 17.9 percent for dust wipes. The RSDs are similar to the findings on previous ELPAT rounds.

Table 2 shows the number of all participating laboratory analyses that were identified as outliers. The percentage of all participating laboratory analyses that were identified as outliers was less than

TABLE 1. ELPAT Program Summary Statistics of Reference Laboratories for Round 17

Sample Type	Sample	N	Mean	Minimum	Maximum	STD	RSD (%)	Acceptable Range
Paint chips (%)	1	95	1.4636	1.2676	1.6226	0.099	6.7	1.1677–1.7594
	2	95	8.8353	7.461	10.0336	0.701	7.9	6.732–10.9385
	3	95	0.0592	0.0505	0.0693	0.005	8.4	0.0442–0.0741
	4	95	0.2358	0.2039	0.27	0.018	7.5	0.1829–0.2887
Soil (mg/kg)	1	95	2788	2470	3032.3	152	5.4	2332.8–3243.2
	2	95	2784.9	2477.2	3048.1	152	5.4	2330.2–3239.5
	3	95	88	64.9	110	11.5	13.1	53.3–122.7
	4	95	523.2	453	587.2	35.4	6.8	417–629.4
Dust wipes	1	95	888.7	660	1004.9	87.6	9.9	625.9–1151.4
(μg)	2	95	239.7	185	284	26.1	10.9	161.4–318.1
	3	95	238	166.3	276	28.1	11.8	153.7–322.4
	4	95	29	20.8	41	5.21	17.9	13.4–44.7

8.4 percent (6.4 to 7.8% for paint chips, 4.5 to 8.4% for soils, and 3.3 to 4.6% for dust wipes). This is similar to the frequency of outliers reported on the earlier rounds of ELPAT for each matrix.

Table 3 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 digestion 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[8]), EPA SW846-3050A[9] (an EPA nitric acid/hydrogen peroxide method), American Society for Testing Methods (ASTM) hotplate methods, and other hotplate techniques. ASTM hotplate and microwave methods may be obtained by contacting ASTM at the address at the end of this column. Microwave digestion categories are: EPA SW846-3051[10] (a nitric acid digestion method), ASTM microwave methods, and other microwave techniques. The "other" category includes nonmicrowave and nonhotplate techniques, such as X-ray fluorescence sample preparation, leaching techniques, ultrasonic digestion, and Parr bomb. Instrumental methods are categorized into flame atomic absorption (FAA), inductively coupled plasma–atomic emission spectroscopy (ICP-AES), graphite furnace atomic absorption (GFAA), laboratory X-ray fluorescence (LAB-XRF), anodic stripping voltammetry (ASV), and others, which includes inductively coupled plasma–mass spectroscopy.

TABLE 2. ELPAT Round Program Summary of Performance—All Laboratories Participated for Round 17

Sample Type	Sample No.	No. of Labs Rated	Acceptable Labs	Low Outlier	High Outlier
Paint chips (%)	1	361	336	15	10
	2	361	334	22	5
	3	361	333	3	25
	4	361	338	6	17
Soil (mg/kg)	1	309	295	6	8
	2	309	292	13	4
	3	309	283	7	19
	4	309	290	12	7
Dust wipes (μg)	1	330	315	12	3
	2	330	319	6	5
	3	330	317	7	6
	4	330	316	3	11

ELPAT Round 17 Statistical Analysis

Statistical tests were performed on the ELPAT round 17 data as previously described in an article by Schlecht *et al.*[11] The purpose of these statistical tests was to detect differences in the ability of analytical methods to meet acceptable ELPAT performance limits as well as bias differences among analytical methods. No statistically significant differences in the ability of methods to measure lead used by participating laboratories were detected for paint chips, soils, or dust wipes.

Biases on round 17 were found in the sample preparation techniques category. Two-way analysis of variance procedures found statistically significant biases for paint chip sample 2. For paint chip sample 2 data, differences among sample preparation techniques were detected with a p value of 0.002. Digestion method EPA-SW846-3051 (microwave) had a positive bias over EPA SW846-3050A (hotplate) with a maximum relative difference of 23 percent.

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 standards. 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

TABLE 3. ELPAT Program Labs Performance Summary for Round 17

Instrument	Digestion	Method	Paint Chips (%)		Soil (mg/kg)		Dust Wipes (μg)	
			Acceptable (%)	Failures (%)	Acceptable (%)	Failures (%)	Acceptable (%)	Failures (%)
FAA	Hotplate	NIOSH-7082/7105	93	7	96	4	97	3
		EPA-SW846-3050A	95	5	94	6	97	3
	Microwave	EPA-SW846-3051	98	2	97	3	100	0
	Ultrasonic		100	0	0	0	0	0
GFAA	Hotplate	NIOSH-7082/7105	100	0	0	0	100	0
		EPA-SW846-3050A	80	20	81	19	75	25
	Microwave	EPA-SW846-3051	0	0	0	100	100	0
ICP-AES	Hotplate	NIOSH-7082/7105	92	8	92	8	100	0
		EPA-SW846-3050A	93	7	95	5	96	4
	Microwave	EPA-SW846-3051	92	8	89	11	88	12
	Ultrasonic		0	0	100	0	0	0
LAB-XRF	XRF sample prep		81	19	100	0	0	0
ASV	Ultrasonic		75	25	83	17	92	8
Total			93	7	94	6	96	4

sample preparation techniques used by participating laboratories.[11]

The results of NIOSH ELPAT bias studies are consistent with the 3 to 18 percent bias found by RTI in an EPA-sponsored collaborative test. In the EPA collaborative test, RTI followed up with participating laboratories and determined that some FAA laboratories failed to perform background corrections, which one would expect to result in a positive bias, and some ICP-AES laboratories failed to take matrix effects into account, which 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.[12] Laboratory studies of field portable methods such as ultrasonic extraction and 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 ASV to laboratory-based FAA on a series of laboratory-generated air samples and National Institute of Standards and Technology (NIST) standard reference materials (SRMs).[13]

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. ELPAT paint chip, soil, and dust wipe samples from completed ELPAT rounds are available from AIHA at the address listed at the end of this column. ELPAT materials differ from the certified reference materials listed in Table 4. Either ELPAT materials are destroyed in one analysis (dust wipes), or the amount of material in bottles is limited to reduce the number of times that analyses can be repeated by laboratories reporting in the proficiency test round. NIST SRM values report lead as total lead, whereas ELPAT- and EPA-certified reference materials report extractable lead.

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, has the responsibility to review and determine if effective voluntary laboratory accreditation systems are in place. If EPA determines that effective voluntary laboratory accreditation systems are not in place, EPA is responsible to establish a federal laboratory certification system.[14]

The 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 on-site assessment of laboratory operations. NLLAP requirements are based on the recommendations of a Federal Interagency Taskforce on Lead Based Paint, a group of 17 federal agencies involved with lead issues, that recognition should be based

TABLE 4. NIST SRMs

RM 8680 Paint on fiberboard, nominal 1 to 2 mg/cm^2 lead	Each unit value individually assigned
RM 8681 Paint on (wood), nominal ? lead	(release date to be determined later)
SRM 1579a Powdered lead-based paint out of stock-see 2589	11.995 ± 0.031%
SRM 2580 Powdered paint, nominal 4% lead	4.34 ± 0.01%
SRM 2581 Powdered paint, nominal 0.5% lead	Jan/Feb 1997
SRM 2582 Powdered paint (low lead concentration)	208.8 ± 4.9 mg/kg (total lead by weight)
SRM 2589 Powdered paint, nominal 10% lead (replaces SRM 1579a)	9.99 ± 0.16%
SRM 2709 San Joaquin soil, baseline trace element concentrations	18.9 ± 0.5 mg/kg
SRM 2710 Montana soil, highly elevated trace element concentrations	5532 ± 80 mg/kg
SRM 2711 Montana Soil, moderately elevated trace element concentrations	1162 ± 31 mg/kg
SRM 2586 Trace elements in soil containing lead from paint, nominal 500 mg/kg lead	Feb/March 1997
SRM 2587 Trace elements in soil containing lead from paint, nominal 3000 mg/kg lead	(release date to be determined later) 1997
SRM 2583 Trace elements in indoor dust, nominal 90 mg/kg lead	Arsenic 7.0 ± 1.6 mg/kg
	Cadmium 7.3 ± 3.7 mg/kg
	Chromium 80 ± 22 mg/kg
	Lead 85.9 ± 7.2 mg/kg
	Mercury 1.56 ± 0.19 mg/kg
SRM 2584 Trace elements in indoor dust, nominal 1% lead	("Indoor" to be determined later) 1997
SRM 2585 Trace elements in dust, nominal ? lead	(release date to be determined later)
SRM 2579 Lead paint film on Mylar (set of 5) (Intended for checking the calibration of portable, X-ray fluorescence analyzers when testing for lead in paint coatings on interior and exterior building surfaces in the field.)	3.53 ± 0.24 mg/cm^2
	1.63 ± 0.08 mg/cm^2
	1.02 ± 0.04 mg/cm^2
	0.29 ± 0.01 mg/cm^2
	less than 0.001 mg/cm^2
SRM 1648 Urban particulate matter	0.655 ± 0.008%
SRM 2704 Buffalo River sediment	161 ± 17 mg/kg (total lead by weight)
SRM 1646A Estuarine sediment	11.7 ± 1.2 mg/kg

on both proficiency testing and laboratory accreditation.[15] 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. Laboratory accreditation 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 upon request to the public by the Lead Information Clearinghouse (1-800-424-LEAD). The ELPAT proficiency testing program is open to all interested laboratories. This means that laboratories 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 NLLAP list provided by the Lead Information Clearinghouse.

Upcoming ELPAT Round Information

Round 18 ELPAT samples were sent to participants on February 3, 1997. The reporting date of the laboratories was March 3, 1997. Round 18 was the second round for the new dust wipe medium, the PaceWipe. The PaceWipe replaced the Whatman filter paper used in previous ELPAT rounds and has been treated with benzalkonium chloride instead of hydrogen peroxide to retard fungal growth.

Disclaimer

Mention of company names or products does not constitute endorsement by the CDC.

Information

A2LA laboratory accreditation, certified reference materials, and seminars on environmental lead laboratory accreditation:

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

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

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

Orders for the ASTM Standards on Lead-Based Paint Abatement in Buildings publication:

ASTM Customer Service
1916 Race Street
Philadelphia, PA 19103
Phone: (215) 299-5585
FAX: (215) 977-9679

Orders for NIST SRMs:

National Institute of Standards and Technology
Standards Reference Materials Program
Room 204, Building 202
Gaithersburg, MD 20899
Phone: (301) 975-6776
FAX: (301) 948-3730

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