



ELPAT Program Report

Background and Current Status

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Paul C. Schlecht 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 (OPPT) 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 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, and laboratories that do not intend to seek laboratory accreditation. 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⁾ NLLAP draft requirements include successful participation in the ELPAT Program for EPA recognition of accreditation. Two organizations, the American Association for Laboratory Accreditation (A2LA)⁽⁴⁾ and AIHA,⁽⁵⁾ have announced environmental lead laboratory accreditation systems. Each of these accreditation systems requires participation in ELPAT for environ-

mental 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, or by attending A2LA/AIHA jointly sponsored environmental lead laboratory accreditation seminars.^(4,5)

ELPAT Performance Evaluation

Laboratories are evaluated at NIOSH each quarter (designated a round) for each sample analyzed, by comparing the laboratory's reported result against an acceptable performance range. The acceptable performance range 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.⁽⁶⁾ Reference laboratories are pre-selected to provide the performance limits for each sample. Initially, reference laboratories are those ELPAT Program laboratories that:

1. have met the reference laboratory requirements of an industrial hygiene proficiency test program, the PAT Program. (PAT reference laboratories must be proficient in analyzing a wide variety of industrial hygiene air samples including airborne lead, and industrial hygiene laboratory operations must be accredited by AIHA); or
2. have performed well in a recent EPA-sponsored interlaboratory evaluation conducted by RTI of sample digestion techniques (microwave and hot plate) used to analyze paint chip and soil samples.⁽⁷⁾

Once a history of ELPAT performance is available, reference laboratories will include all participating laboratories in

the ELPAT Program that have previously demonstrated proficient performance in analyzing all matrices of the ELPAT Program. Eventually, a requirement will be added that ELPAT reference laboratories 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 criteria used by NIOSH to establish acceptable and outlier performance of industrial hygiene laboratories in the Proficiency Analytical Testing Program.⁽⁶⁾

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 the lead matrix if:

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.

Initial criteria for proficient performance are similar to the procedure used in the PAT Program.⁽⁶⁾ However, the ELPAT statistical protocol and related computer programs have been designed to permit future change to harmonize these proficiency test requirements with internationally harmonized proficiency test protocols. An

TABLE I. Environmental Lead Proficiency Analytical Testing (ELPAT) Program Summary Statistics of Reference Laboratories for Round 001

Sample Type	Sample	N	Mean	Minimum	Maximum	STD	RSD(%)	Acceptable Range
Paint chips (%)	1	23	0.0892	0.0659	0.1065	.011	12.6	0.0554-0.1231
	2	23	0.5568	0.48	0.61	.038	6.8	0.4428-0.6708
	3	23	0.7026	0.411	0.8044	.108	15.4	0.3772-1.028
	4	23	5.4744	4.664	6.07	.402	7.3	4.2683-6.6805
Soil (mg/kg)	1	18	700.4	554	830	83.7	12.0	449.2- 951.5
	2	18	3369.4	3002.6	3834.2	257	7.6	2597.1- 4141.7
	3	18	305.6	262	346.7	25.2	8.2	230.1- 381.1
	4	18	132.7	117	158	12.4	9.3	95.5- 169.8
Dust wipes (μ g)	1	22	868.1	679.3	997.3	86.9	10.0	607.4-1128.7
	2	22	4397.4	3351.6	4884	489	11.1	2929.7-5865.1
	3	22	168.1	141.8	200.1	17.4	10.3	116 - 220.2
	4	22	37.7	28.5	46.7	5.42	14.4	21.5- 54

international protocol for consensus values from reference laboratories using Z-Scores is being developed by the International Standards Organisation (ISO), the Association of Official Analytical Chemists International (AOAC), and the International Union of Pure and Applied Chemists (IUPAC).[®]

ELPAT Round 1, December 1992

Paint samples for Round 1 were prepared from paint chips collected from a hospital built in the late 19th century, a warehouse, and a military base. The chips were ground to a maximum particle size of 150 μ m.

Round 1 dust wipes were prepared by gravimetrically loading Whatman 40 filter paper with sterilized (gamma-irradiated) household and postabatement dust, sieved to a maximum particle size of 250 μ m. The loaded filters were moistened with a 70/30 solution

of isopropanol/deionized water. The blank wipe was prepared from a Whatman filter moistened with the same isopropanol solutions. Whatman filters are easier to digest than other wipe media (e.g., baby wipes, hand wipes) used by many laboratories.

In the future, wipe medium may be changed from the Whatman filter to a commercially available wipe to more closely represent field sample media if a single sample medium is recommended by various lead methods.

Soil samples came from two primary sources: drip lines around older houses and an industrial plant having lead contaminated soil. Soil samples were sterilized by heating the soil to 325°F for a minimum of 2 hours and sieved to a maximum particle size of 250 μ m.

A total of 110 laboratories were enrolled for the first round of the ELPAT Program, with 104 laboratories submitting results. Table I lists sum-

mary statistics of reference laboratories for each matrix and sample number. Agreement among laboratories is demonstrated by relative standard deviations ranging from 7 to 15 percent for paint chips, 8 to 12 percent for soils and 10 to 14 percent for dust wipes for reference laboratories. This is very good performance considering that this was the first round of the program, and laboratories used a wide variety of sample digestion and analytical methods. The percentage of all participating laboratory analyses that were identified as outliers was under 13 percent (5 to 13 percent for paint chips, 7 to 8 percent for soils, and 7 to 10 percent for dust wipes). Table II presents the ELPAT proficiency ratings by lead matrix. Currently, Table II is based on only one round's performance, but will be based on up to four rounds of performance (i.e., 1 year) as additional rounds are completed.

TABLE II. Summary of Performance—All Laboratories Participated

Sample Type	Sample No.	No. of Labs Rated	Acceptable Labs	Low Outlier	High Outlier
Paint chips (%)	1	101	96	0	5
	2	101	88	6	7
	3	101	89	5	7
	4	101	93	7	1
Soil (mg/kg)	1	84	78	3	3
	2	84	77	3	4
	3	84	78	2	4
	4	84	77	2	5
Dust wipes (μ g)	1	91	83	6	2
	2	91	85	4	2
	3	91	83	4	4
	4	91	82	1	8

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Table III gives a summary of outliers for the three lead matrices by digestion technique and analytical method used by participating laboratories. A series of Fischer's exact tests (nonparametric tests) were used to compare the four possible combinations of two digestion techniques (NIOSH hot plate and EPA microwave) and two analytical methods (flame atomic absorption (flame AA) and inductively coupled

plasma (ICP)]. This comparison was performed to determine statistically significant differences in the ability of these digestion techniques/analytical method combinations to meet ELPAT performance limits.⁽⁹⁾ (The NIOSH hot plate technique is a nitric acid, hydrogen peroxide hot plate digestion modified from NMAM Method 7082.⁽¹⁰⁾ The EPA microwave technique is a nitric acid-hydrochloric acid microwave

digestion technique modified from AREAL (RTP-MRDD-037) standard operating procedure.⁽⁷⁾ Fischer's exact tests were performed on each ELPAT sample, four tests for each matrix. To improve the power of the test to identify differences in performance, a criterion was then used where participating laboratories were classified into two groups: those that had no outliers on the four ELPAT samples of the ma-

TABLE III. ELPAT Round: 001 All Labs Performance Summary

Method	Sample Preparation	Paint Chips (%)				Soil (mg/kg)				Dust Wipes (µg)			
		Acceptable		Failure		Acceptable		Failure		Acceptable		Failure	
		N*	%	N	%	N	%	N	%	N	%	N	%
F.A.A.	NIOSH-HOT	152	95	8	5	119	96	5	4	158	92	14	8
	Other-HOT	75	89	9	11	64	89	8	11	43	83	9	17
	EPA-MICRO	24	86	4	14	24	100	0	0	24	100	0	0
	Other-MICRO	0	0	0	0	4	100	0	0	4	100	0	0
G.F.A.A.	NIOSH-HOT	3	75	1	25	1	25	3	75	4	100	0	0
	Other-HOT	1	25	3	75	0	0	4	100	0	0	0	0
ICP-AES	NIOSH-HOT	54	96	2	4	43	98	1	2	51	98	1	2
	Other-HOT	25	89	3	11	27	96	1	4	25	89	3	11
	EPA-MICRO	19	95	1	5	12	100	0	0	8	67	4	33
	Other-MICRO	8	100	0	0	7	88	1	13	12	100	0	0
Others	NIOSH-HOT	4	100	0	0	0	0	0	0	4	100	0	0
	Other-HOT	1	25	3	75	5	63	3	38	0	0	0	0
	EPA-MICRO	0	0	0	0	4	100	0	0	0	0	0	0
	XRF-PDR	0	0	4	100	0	0	0	0	0	0	0	0
Total		366	91	38	9	310	92	26	8	333	91	31	9

*Number of samples.

trix, and those that had one or more outliers. Fischer's exact test was then repeated for each ELPAT matrix, and no statistically significant differences were found among the four combinations of NIOSH hot plate and EPA microwave digestion techniques with flame AA and ICP analytical methods.

Testing of other combinations of sample digestion techniques and instrumental methods was not performed because there was an insufficient number of participating laboratories for statistical analysis using the technique, and the other hot plate and microwave digestion technique categories encompassed a wide variety of digestion techniques. However, simple inspection of Table III shows that many laboratories using a wide variety of microwave and hot plate digestion techniques were able to meet ELPAT Program performance limits. Only six laboratories used analytical methods other than flame AA or ICP-AES. Their results are listed under Table III cate-

gories: Graphite Furnace Atomic Absorption (Graphite Furnace AA)—two laboratories; or Others—four laboratories. In the category Other Methods, one laboratory met all performance limits using inductively coupled plasma—mass spectrometry (ICP-MS) for all paint chip, wipe, and soil samples; one laboratory used an ion-specific electrode technique on paint and soil samples with mixed success; one laboratory used different atomic absorption methods (Flame and Graphite Furnace) on different soil samples that the ELPAT reporting system did not permit to be categorized with other atomic absorption results; and one laboratory was unsuccessful using field portable spectrum analyzer X-ray fluorescence (portable XRF) on paint chip samples. At least two laboratories requested additional ELPAT samples to attempt laboratory XRF, but no laboratory XRF results were reported for Round 1. ELPAT Round 1 data on Graphite Furnace AA, ICP-MS, and lead ion-

specific electrode are limited on the utility of these methods in analyzing lead in paint chip, soil, and dust wipe matrices.

A more detailed analysis of ELPAT Round 1 data is being undertaken at NIOSH. That analysis will categorize hot plate and microwave digestion techniques reported as "other" techniques, and compares method-to-method biases and interlaboratory precision differences among digestion techniques and instrumental methods.

Certified reference materials are commercially available from NIST and commercial reference material suppliers participating in the EPA/A2LA environmental reference material certification program.⁽¹⁰⁾ The materials listed in Table IV are useful for daily quality control of analyses and initial evaluation of methods associated with residential or steel structure lead abatement. Work continues on developing additional reference materials so this list of certified reference materials is

Table IV. Certified Reference Materials

NIST Standard Reference Materials (SRMs)	Lead
SRM 1579a Powdered Lead-Based Paint	11.995 ± 0.031%
SRM 2580 Powdered Lead-Based Paint to be released 09/93 (nominal value 4%)	
SRM 2581 Powdered Lead-Based Paint to be released 12/93 (nominal value 0.5%)	
SRM 2582 Powdered Lead-Based Paint to be released 06/94 (nominal value 500 ppm)	
Total lead by weight	
SRM 2709 Lead in Soil	18.9 ± 0.5 ppm
SRM 2710 Lead in Soil	5532 ± 80 ppm
SRM 2711 Lead in Soil	1162 ± 31 ppm
SRM 2579 Lead Paint Film on Mylar (Set of 5)	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
(Intended for checking the calibration of portable, hand-held, X-ray fluorescence analyzers when testing for lead in paint coatings on interior and exterior building surfaces in the field.)	
SRM 1648 Urban Particulate Matter	0.655% ± 0.008%
SRM 2704 Buffalo River Sediment	161 ± 17 ppm
Total lead by weight	
EPA/A2LA Certified Reference Materials	
Commercial Supplier	
RT Corp. through Fisher Scientific	
	Lead
SRS014-50 Bag House Dust	1914 ± 180 ppm*
SRS013-50 Paint Blasting Waste	643 ± 56 ppm*
SRS006-60 Paint Sludge	753 ± 51 ppm*

*The concentration of lead determined in a sample following digestion by EPA Methods 3010, 3020, or 3050. All concentrations expressed on dry weight basis. The 50-gram samples should be mixed well before removing subsamples.

subject to significant change. Updated lists of available certified reference materials are available from NIST, EPA/EMSL Cincinnati, and A2LA⁰⁰ at the addresses listed at the end of this column.

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 are 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 below. 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. National Institute of Standards and Technology (NIST) Standard Reference Materials values report lead as total lead, whereas ELPAT and EPA certified reference materials report extractable lead.

EPA National Lead Laboratory Accreditation Program (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 periodically review and determine if effective voluntary laboratory accreditation systems are in place. If EPA determines effective voluntary laboratory accreditation systems are not in place, EPA is responsible to establish a federal laboratory certification system.⁽²⁾

Requirements for the NLLAP are being finalized within EPA's Office of Pollution Prevention and Toxics (OPPT) for the recognition of U.S. pri-

vate and/or state laboratory accreditation systems covering lead analysis in paint chips, soils, and dusts associated with lead abatement. Although requirements for EPA recognition of laboratory accreditation systems are not final, proposed EPA recognition involves two aspects: (1) successful participation in the ELPAT Program; and (2) review of laboratory operations. NLLAP requirements are based upon the Laboratory Accreditation Guidelines of a Federal Interagency Lead-Based Paint Task Force, ISO Guide 25-1990, "General Requirements for the Competence of Calibration and Testing Laboratories" (a guide already in use by many national laboratory accreditation systems worldwide) as well as input obtained from various groups including laboratory accreditation organizations, for example, A2LA, AIHA.^(3,14) The review of laboratory operations involves both review of lab-

oratory accreditation applications and periodic on-site assessment by qualified assessors.

Both the A2LA and AIHA have developed programs for the accreditation of laboratories conducting environmental paint chip, soil, and dust analyses. A2LA and AIHA also jointly sponsor Environmental Lead Laboratory Accreditation seminars to meet proposed technical requirements for laboratory assessors/site visitors, and to orient laboratory personnel on environmental laboratory accreditation requirements.

Upcoming ELPAT Round Information

The shipment of the second round of ELPAT samples will be on March 15, 1993. The anticipated reporting date will be April 23, 1993. There will be only one minor change in the samples

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for the second round. The dust wipes will be preserved with 1 ml of 6 percent hydrogen peroxide instead of isopropyl alcohol. This is to retard the formation of any fungal growth in the samples, and should not have any effect on their digestion and analysis.

Information

A2LA Laboratory Accreditation, A2LA Certified Reference Materials, and A2LA/AIHA 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 A2LA/AIHA 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

NIST Standard Reference Materials (SRMs) and 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

SRS series reference materials:

RT Corporation
2931 Soldier Springs
P.O. Box 1346
Laramie, WY 82070
Phone: (307) 742-5452
FAX: (307) 745-7936
or your local Fischer Scientific representative at
(800) 766-7000

Information on other EPA Certified Reference Materials:

Jim Longbottom
EPA-EMSL
Quality Assurance Research Division
26 West Martin Luther King Drive
Cincinnati, OH 45268
Phone: (513) 569-7308
FAX: (513) 569-7115

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