
Wadsworth Center

NEW YORK STATE DEPARTMENT OF HEALTH

Trace Elements Laboratory

TRACE ELEMENTS IN WHOLE BLOOD

Proficiency Test Report

Event #2, 2013

July 15th, 2013

July 15, 2013

**Trace Elements in Whole Blood
Event #2, 2013**

Dear Laboratory Director:

Results from the second proficiency test (PT) event in 2013 for Trace Elements in Whole Blood have been tabulated and summarized. Target values for Arsenic, Cadmium, Mercury and Lead in whole blood have been established along with acceptable ranges. Results are graded using element-specific criteria as indicated in each narrative section. A laboratory with an unacceptable significant analytical bias relative to the target value will be expected to investigate the source of the error. A confidential three-digit code number assigned by the PT program identifies participant laboratories. The data for blood lead were previously reported in the Blood Lead PT Report issued June 13th, 2013, and are reproduced here for completeness.

PT Materials

Test materials for the second event were prepared from caprine (goat) whole blood obtained from animals dosed with lead acetate to create physiologically bound lead (Pb). A total of five blood pools were supplemented with arsenic (as inorganic As^{3+}), cadmium (as Cd^{2+}) and mercury as both inorganic (Hg^{2+}) and organic (ethylmercury ($\text{CH}_3\text{CH}_2\text{Hg}^+$) and methylmercury (CH_3Hg^+)) species. In addition to As, Cd, Pb and Hg, blood pools were supplemented with the trace elements manganese (Mn), thallium (Tl), tin (Sn), titanium (Ti), nickel (Ni), cobalt (Co), chromium (Cr), tungsten (W) and vanadium (V).

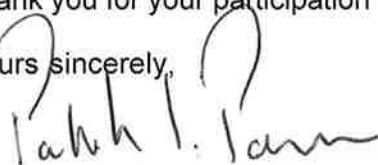
Additional Elements to Become Graded for Performance Assessment

PT results for select trace elements, including Co, Cr and Mn, will be graded as part the next PT event, although the data will be used for "Educational Purposes" only to inform laboratory participants of where improved practices may be necessary. Laboratories that test and report these, and other, trace elements on patient specimens should continue to report results obtained for whole blood PT samples.

The next PT event for trace elements in whole blood is scheduled to be mailed Wednesday, September 11th, 2013. Please inform our laboratory staff at (518) 474-4484 if the test materials have not arrived within five days of the scheduled mail out date. **The deadline for reporting results is Wednesday, October 2nd, 2013.**

Thank you for your participation in this event.

Yours sincerely,



Patrick J. Parsons, Ph.D.
Chief, Laboratory of Inorganic and Nuclear Chemistry
Deputy Director, Division of Environmental Health



Mary Frances Verostek, Ph.D.
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PT Program for Blood Lead /Trace Elements

New York State Department of Health
Event #2, 2013

Whole Blood Arsenic

Test materials for arsenic were prepared from caprine (goat) whole blood preserved with K₂EDTA anticoagulant. A total of five pools were supplemented with arsenic as inorganic As³⁺.

The Target Value assigned for each PT material is the robust mean of the results reported by all participants in this event. The robust statistics were obtained utilizing algorithms based on those presented in **ISO 13528:2005E** Statistical methods for use in proficiency testing by interlaboratory comparisons. Values for whole blood arsenic range from 8.5 µg/L (0.11 µmol/L) to 60.6 µg/L (0.81 µmol/L).

Acceptable range: The acceptable range for arsenic is set at ±6 µg/L or ±20%, whichever is greater. Thus, it is fixed at ±6 µg/L for concentrations below 30 µg/L.

Discussion: Based upon the above criteria, 96.8% of test results reported were judged as satisfactory, with none of the 19 laboratories reporting 2 or more of the 5 results outside the acceptable ranges.

**New York State Department of Health
Blood Arsenic Test Results, 2013 Event #2
ROBUST STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS

Results ($\mu\text{g/L}$ whole blood)

	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
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Robust Mean	60.6	22.8	37.7	13.8	8.5
Robust Standard Deviation	6.5	1.7	2.7	2.1	2.5
Standard Uncertainty	1.9	0.5	0.8	0.6	0.8
RSD (%)	10.8	7.5	7.1	15.4	29.5
Number of Sample Measurements	19	19	19	17	16
Acceptable Range:					
Upper Limit	72.7	28.8	45.2	19.8	14.5
Lower Limit	48.5	16.8	30.2	7.8	2.5

notes: Results reported as less than the method detection limit are excluded from statistical calculations.

New York State Department of Health
Blood Arsenic Test Results, 2013 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE13-06	BE13-07	BE13-08	BE13-09	BE13-10	
Target Values:		60.6	22.8	37.7	13.8	8.5	
103	DRC/CC-ICP-MS	64.9	22.5	38.7	12.9	6.8	Info
110	DRC/CC-ICP-MS	65.0	23.6	40.5	12.5	8.5	
114	ICP-MS	74.0 ↑	26.0	37.0	15.0	10.0	
147	ICP-MS	59.6	21.0	35.9	12.2	6.3	Info
156	ICP-MS	45.4 ↓	16.8	30.6	<11.0	<11.0	
164	ICP-MS	63.0	24.0	39.0	16.0	10.0	
179	ICP-MS	60.0	22.0	36.0	<12.0	<12.0	
197	DRC/CC-ICP-MS	64.0	23.0	39.0	15.0	<10.0	
200	ICP-MS	58.5	23.6	39.5	13.8	8.1	Info
206	DRC/CC-ICP-MS	65.5	26.0	38.6	17.3	13.3	
208	ICP-MS	59.9	23.4	39.5	15.1	10.6	
293	DRC/CC-ICP-MS	55.1	18.7	31.5	10.9	5.6	Info
305	ICP-MS	55.0	21.0	37.0	12.0	6.0	
312	DRC/CC-ICP-MS	57.0	23.0	36.0	11.0	6.7	
324	ICP-MS	62.3	27.0	42.5	19.5	14.7 ↑	Info
339	HR-ICP-MS	66.5	22.2	39.5	12.7	6.7	Info
359	ICP-MS	50.6	22.6	33.4	15.7	10.9	
391	DRC/CC-ICP-MS	69.0	23.5	40.8	13.0	6.8	Info
469	ICP-MS	54.4	20.8	34.6	14.2	8.4	

Percent satisfactory results for all participants: 96.8 %

notes: ↑ reported outside upper limit
↓ reported outside lower limit
▼ Unacceptable result

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
Info only: results included for informational purposes only.

New York State Department of Health
Blood Arsenic Test Results, 2013 Event #2
STATISTICAL SUMMARY BY METHOD

Results ($\mu\text{g/L}$ whole blood)					
	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
DRC/CC-ICP-MS					
Number of Sample Measurements:	7	7	7	7	6
Mean:	62.9	22.9	37.9	13.2	8.0
Standard Deviation:	5.0	2.2	3.2	2.3	2.8
RSD (%):	7.9	9.5	8.5	17.1	35.0
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	66.5	22.2	39.5	12.7	6.7
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	11	11	11	9	9
Mean:	58.4	22.6	36.8	14.8	9.4
Standard Deviation:	7.4	2.8	3.3	2.2	2.7
RSD (%):	12.6	12.3	8.9	15.2	28.1
All Laboratories					
Number of Sample Measurements:	19	19	19	17	16
Mean:	60.5	22.7	37.3	14.0	8.7
Standard Deviation:	6.7	2.4	3.2	2.3	2.7
RSD (%):	11.1	10.7	8.5	16.2	30.7

notes: ? Insufficient data for calculation.

A Standard Deviation displayed as 0.0 should be interpreted as <0.1

New York State Department of Health
Event #2, 2013

Whole Blood Cadmium

Test materials for cadmium were prepared from caprine (goat) whole blood preserved with K₂EDTA anticoagulant. A total of five blood pools were supplemented with different amounts of cadmium (as Cd²⁺).

The Target Value assigned for each PT material is the robust mean of the results reported by all participants in this event. The robust statistics were obtained utilizing algorithms based on those presented in **ISO 13528:2005E** Statistical methods for use in proficiency testing by interlaboratory comparisons. Values for whole blood cadmium range from 2.2 µg/L (20 nmol/L) to 17.0 µg/L (151 nmol/L).

Acceptable ranges are based on the OSHA criteria of ±15%, or ±1 µg/L around the target value, whichever is greater. So, the range is fixed at ±1 µg/L for concentrations below 6.6 µg/L, where above 6.6 µg/L, it is ±15%.

Discussion: Based upon the above criteria, 95.4% of the results reported by all participants were satisfactory, with two of the 26 laboratories (7.7%) reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Cadmium Test Results, 2013 Event #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

Results ($\mu\text{g/L}$ whole blood)

	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
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Robust Mean	12.1	2.2	17.0	8.8	4.6
Robust Standard Deviation	0.8	0.2	1.2	0.8	4.6
Standard Uncertainty	0.2	<0.1	0.3	0.2	0.3
RSD (%)	6.9	8.1	6.9	8.5	0.1
Number of Sample Measurements	26	26	26	26	26
Acceptable Range:					
Upper Limit	13.9	3.2	19.6	10.1	5.6
Lower Limit	10.3	1.2	14.4	7.5	3.6

notes: Results reported as less than the method detection limit are excluded from statistical calculations.

New York State Department of Health
Blood Cadmium Test Results, 2013 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE13-06	BE13-07	BE13-08	BE13-09	BE13-10	
Target Values:		12.1	2.2	17.0	8.8	4.6	
103	DRC/CC-ICP-MS	12.8	2.4	18.2	8.9	5.0	Info
106	ICP-MS	12.8	2.2	18.0	9.4	4.9	Info
107	DRC/CC-ICP-MS	12.3	2.2	17.1	8.8	4.6	Info
109	ICP-MS	13.0	2.3	17.9	9.4	4.9	Info
110	ICP-MS	12.4	2.2	17.5	9.1	4.6	
114	ICP-MS	13.7	2.3	15.7	8.2	5.3	
116	ICP-MS	11.9	2.2	16.4	8.3	4.3	Info
147	ICP-MS	11.8	2.2	16.3	8.4	4.5	Info
156	ICP-MS	12.2	2.1	16.3	8.6	4.5	
164	ICP-MS	10.0 ↓	1.7	14.2 ↓	7.5	3.7	
179	ICP-MS	12.5	2.1	18.0	9.4	4.9	
197	DRC/CC-ICP-MS	11.4	1.9	15.8	8.3	4.0	
200	ICP-MS	12.0	2.4	17.1	7.8	4.5	Info
206	ICP-MS	12.8	2.5	17.7	10.2 ↑	4.8	
208	ICP-MS	12.2	2.5	18.1	9.5	4.9	
293	ICP-MS	11.5	2.2	16.1	8.5	4.4	Info
305	ICP-MS	12.7	2.2	17.3	9.6	4.5	
312	ICP-MS	12.0	2.6	17.0	9.1	4.7	
324	ICP-MS	11.0	2.0	16.2	8.3	4.4	Info
339	HR-ICP-MS	11.3	2.1	16.0	8.5	4.4	Info
359	ICP-MS	11.1	2.3	16.2	8.5	4.6	
366	ETAAS-Z	11.9	2.6	19.0	10.0	4.6	Info
367	DRC/CC-ICP-MS	13.6	2.5	20.0 ↑	10.9 ↑	4.9	Info
391	DRC/CC-ICP-MS	12.8	2.3	17.6	9.2	4.8	Info
410	ICP-MS	12.2	1.5	16.5	8.1	4.0	Info
469	ICP-MS	8.8 ↓	1.9	14.8	7.8	4.2	

Percent satisfactory results for all participants: 95.4 %

notes: ↑ reported outside upper limit
↓ reported outside lower limit
▼: Unacceptable result

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
Info only: results included for informational purposes only.

New York State Department of Health
Blood Cadmium Test Results, 2013 Event #2
STATISTICAL SUMMARY BY METHOD

Results (µg/L whole blood)					
	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
DRC/CC-ICP-MS					
Number of Sample Measurements:	5	5	5	5	5
Mean:	12.6	2.3	17.7	9.2	4.7
Standard Deviation:	0.8	0.2	1.5	1.0	0.4
RSD (%):	6.4	10.2	8.7	10.8	8.5
ETAAS-Z					
Number of Sample Measurements:	1	1	1	1	1
Mean:	11.9	2.6	19.0	10.0	4.6
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	11.3	2.1	16.0	8.5	4.4
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	19	19	19	19	19
Mean:	11.9	2.2	16.7	8.7	4.6
Standard Deviation:	1.1	0.3	1.1	0.7	0.4
RSD (%):	9.4	12.3	6.5	8.4	8.0
All Laboratories					
Number of Sample Measurements:	26	26	26	26	26
Mean:	12.0	2.2	17.0	8.9	4.6
Standard Deviation:	1.0	0.3	1.3	0.8	0.4
RSD (%):	8.7	11.8	7.5	9.0	7.7

notes: ? Insufficient data for calculation.

A Standard Deviation displayed as 0.0 should be interpreted as <0.1

New York State Department of Health
Event #2, 2013

Whole Blood Mercury

Test materials for mercury were prepared from caprine (goat) whole blood preserved with K₂EDTA anticoagulant. A total of five pools were supplemented with different amounts of mercury as both inorganic (Hg²⁺) and organometallic (as both ethylmercury, CH₃CH₂Hg⁺, and methylmercury, CH₃Hg⁺) species.

Sample	Mercury species added
BE13-06	Hg ²⁺ , CH ₃ Hg ⁺ , and CH ₃ CH ₂ Hg ⁺
BE13-07	Hg ²⁺ , CH ₃ Hg ⁺
BE13-08	Hg ²⁺ and CH ₃ Hg ⁺ , and CH ₃ CH ₂ Hg ⁺
BE13-09	Hg ²⁺ and CH ₃ Hg ⁺ , and CH ₃ CH ₂ Hg ⁺
BE13-10	Hg ²⁺

The Target Value assigned for each PT material is the robust mean of the results reported by all participants in this event. The robust statistics were obtained utilizing algorithms based on those presented in **ISO 13528:2005E** Statistical methods for use in proficiency testing by interlaboratory comparisons. Values for whole blood mercury range from 1.7 µg/L (8 nmol/L) to 33.1 µg/L (165 nmol/L).

Acceptable ranges were fixed at ±30%, or ±3 µg/L around the target value, whichever is greater. That is, the range is fixed at ±3 µg/L for concentrations below 10 µg/L, while above 10 µg/L, it is ±30%.

Discussion: Based on the above criteria, 93.3% of results reported by all participants were satisfactory, with three of the 27 laboratories (11.1%) reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Mercury Test Results, 2013 Event #2
ROBUST STATISTICAL SUMMARY

TARGET VALUE ASSIGNMENT AND STATISTICS

Results ($\mu\text{g/L}$ whole blood)

	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
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Robust Mean	9.0	20.1	33.1	5.3	1.7
Robust Standard Deviation	1.1	1.8	4.1	0.6	0.5
Standard Uncertainty	0.3	0.4	1.0	0.1	0.1
RSD (%)	11.9	8.9	12.4	11.4	27.3
Number of Sample Measurements	27	27	27	27	21
Acceptable Range:					
Upper Limit	12.0	26.1	43.0	8.3	4.7
Lower Limit	6.0	14.1	23.2	2.3	0.0

notes: Results reported as less than the method detection limit are excluded from statistical calculations.

New York State Department of Health
Blood Mercury Test Results, 2013 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/L whole blood)					Info Only
		BE13-06	BE13-07	BE13-08	BE13-09	BE13-10	
Target Values:		9.0	20.1	33.1	5.3	1.7	
103	DRC/CC-ICP-MS	8.8	19.6	31.3	4.8	1.2	Info
106	ICP-MS	9.4	21.7	35.4	5.4	1.7	Info
107	DRC/CC-ICP-MS	8.7	20.1	32.7	5.0	1.6	Info
109	ICP-MS	9.7	21.4	34.9	5.8	1.7	Info
110	ICP-MS	8.2	17.8	31.9	4.9	1.5	
114	ICP-MS	9.5	24.0	30.6	5.7	2.1	
116	ICP-MS	9.1	20.9	34.0	5.2	1.4	Info
147	ICP-MS	9.8	21.3	35.7	5.4	1.5	Info
156	ICP-MS	8.8	20.4	33.0	4.9	<3.0	
164	ICP-MS	8.0	19.0	28.0	5.0	<4.0	
179	ICP-MS	7.0	19.0	29.0	5.0	1.0	
197	DRC/CC-ICP-MS	10.0	20.0	32.0	10.0 ↑	<5.0	
200	ICP-MS	9.4	19.2	32.0	5.6	1.8	Info
206	ICP-MS	7.0	19.0	28.0	5.0	<3.0	
208	ICP-MS	8.7	20.6	37.5	5.6	<5.0	
293	ICP-MS	9.8	20.2	41.3	6.5	2.8	Info
305	ICP-MS	13.0 ↑	25.0	46.0 ↑	7.0	2.0	
312	ICP-MS	10.0	22.0	37.0	6.2	1.7	
324	AFS	8.2	18.3	29.7	4.9	1.7	Info
339	HR-ICP-MS	8.6	19.3	31.6	4.7	1.3	Info
359	ICP-MS	6.8	16.2	30.3	4.8	1.7	
366	ICP-MS	9.5	20.0	42.0	4.6	0.9	Info
391	CV-AAS	8.63	16.40	29.06	5.99	3.26	Info
401	CV-AAS	3.61 ↓	17.85	11.84 ↓	2.41	<1	Info
410	ICP-MS	10.4	25.7	36.3	5.9	2.2	Info
453	Atomic Spectrometry Other	9.3	20.2	31.6	5.2	1.5	Info
469	ICP-MS	14.5 ↑	30.1 ↑	42.2	16.4 ↑	4.9 ↑	

Percent satisfactory results for all participants: 93.3 %

notes: ↑ reported outside upper limit
↓ reported outside lower limit
▼: Unacceptable result

notes: Results reported as less than the method detection limit are excluded from statistical calculations.
Info only: results included for informational purposes only.

New York State Department of Health
Blood Mercury Test Results, 2013 Event #2
STATISTICAL SUMMARY BY METHOD

	Results (µg/L whole blood)				
	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
AFS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	8.2	18.3	29.7	4.9	1.7
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
Atomic Spectrometry					
Number of Sample Measurements:	1	1	1	1	1
Mean:	9.3	20.2	31.6	5.2	1.5
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
CV-AAS					
Number of Sample Measurements:	2	2	2	2	0
Mean:	6.1	17.1	20.5	4.2	
Standard Deviation:	3.5	1.0	12.2	2.5	
RSD (%):	—	—	—	—	—
DRC/CC-ICP-MS					
Number of Sample Measurements:	3	3	3	3	2
Mean:	9.2	19.9	32.0	6.6	1.4
Standard Deviation:	0.7	0.3	0.7	2.9	0.3
RSD (%):	—	—	—	—	—
HR-ICP-MS					
Number of Sample Measurements:	1	1	1	1	1
Mean:	8.6	19.3	31.6	4.7	1.3
Standard Deviation:	?	?	?	?	?
RSD (%):	—	—	—	—	—
ICP-MS					
Number of Sample Measurements:	19	19	19	18	14
Mean:	9.4	21.2	35.0	5.5	1.7
Standard Deviation:	1.9	3.2	5.1	0.6	0.5
RSD (%):	20.0	14.9	14.6	11.7	28.1
All Laboratories					
Number of Sample Measurements:	27	27	27	26	19
Mean:	9.1	20.6	33.1	5.4	1.6
Standard Deviation:	1.9	2.9	6.3	1.2	0.4
RSD (%):	21.4	14.2	19.0	22.9	26.5

notes: ? Insufficient data for calculation.

A Standard Deviation displayed as 0.0 should be interpreted as <0.1

New York State Department of Health
Event #2, 2013

Whole Blood Lead

Test materials for lead were prepared from caprine (goat) whole blood obtained from animals dosed with lead acetate to create physiologically-bound Pb. Whole blood was collected into collection bags containing K₂EDTA anticoagulant.

Target values were established as the mean of 21 measurements performed by 19 reference laboratories using ICP-MS, ETAAS and ASV methods. Values range from 4 µg/dL to 28 µg/dL. Among the reference group, imprecision (SD) varied from 0.7 - 1.3 µg/dL, increasing with Pb concentration.

Acceptable ranges are based on the CLIA '88 criteria (Federal Register Volume 57, Number 40, §§ 493.2 and 493.937, February 28, 1992). The criteria are set at ±10% or ±4 µg/dL, whichever is greater.

Discussion Based on the CLIA '88 criteria, 99.3% of results reported by all participants were judged as satisfactory, with none of 90 participant laboratories reporting 2 or more of the 5 results outside the acceptable ranges.

New York State Department of Health
Blood Lead Test Results, 2013 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE13-06	BE13-07	BE13-08	BE13-09	BE13-10		
Target values:		6	15	28	14	4		
103	ASV-LeadCare	6	16	30	16	4	1.09	Info
103	DRC/CC-ICP-MS	6	16	29	14	4	1.03	
104	ETAAS-Z	7	16	29	15	4	1.06	
106	ICP-MS	6	16	29	14	4	1.03	Info
107	ASV-LeadCare	7	19	33 ↑	17	4	1.22	Info
107	DRC/CC-ICP-MS	6	16	30	14	4	1.05	
109	ETAAS-Z	6	16	29	14	4	1.03	
109	ASV-LeadCare	5	15	27	15	4	1.01	Info
109	ICP-MS	6	16	28	14	4	1.02	
110	ETAAS-Z	7	16	29	16	4	1.08	
110	ASV-LeadCare	5	14	27	14	<3	0.97	Info
110	ICP-MS	6	15	28	14	4	1.00	
112	ETAAS-Z	7	17	30	15	4	1.09	
114	ICP-MS	6	15	27	14	4	0.99	
116	ICP-MS	6	16	29	14	4	1.03	Info
121	ETAAS-Z	6	19	30	15	4	1.14	Info
123	ETAAS-Z	6	14	31	15	5	1.04	
126	ETAAS-Z	6	14	25	13	4	0.92	
131	ETAAS-Z	9	16	30	14	4	1.05	
143	ETAAS-Z	5	14	26	13	2	0.93	
144	ETAAS-Z	6	15	26	13	4	0.95	
146	ETAAS-Z	5	13	24	12	3	0.86	
147	ICP-MS	6	16	27	14	4	1.01	
150	ETAAS-Z	6	15	29	14	3	1.01	
156	ICP-MS	5	14	27	13	3	0.94	
158	ICP-MS	6	16	29	14	4	1.03	
160	ICP-MS	6	15	27	13	4	0.96	
164	ICP-MS	6	15	28	14	4	1.00	
166	ASV-3010	3	13	27	12	<2	0.90	

notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info only: results included for informational purposes only.

New York State Department of Health
Blood Lead Test Results, 2013 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE13-06	BE13-07	BE13-08	BE13-09	BE13-10		
Target values:		6	15	28	14	4		
168	ETAAS-Z	7	17	31	16	4	1.13	
179	ICP-MS	6	16	29	14	4	1.03	
197	ICP-MS	6	15	28	14	4	1.00	
198	ETAAS-Z	6	15	27	14	4	0.99	
200	ICP-MS	6	16	27	15	4	1.03	
204	ASV-3010	4	12	25	12	<2	0.85	
206	ICP-MS	6	16	28	14	4	1.02	
208	ETAAS-Z	5	14	25	12	3	0.89	
221	ETAAS-Z	6	15	27	14	4	0.99	
232	ASV-3010	6	16	28	14	3	1.02	
237	ETAAS-Z	6	15	29	14	3	1.01	
243	ASV-3010	4	14	27	12	2	0.92	
254	ETAAS-Z	5	16	29	13	2	1.01	
255	ETAAS-Z	6	15	27	14	4	0.99	
269	ETAAS-Z	5	15	28	13	2	0.98	
271	ETAAS-Z	5	15	25	12	3	0.92	
272	ETAAS-Z	6	16	28	14	4	1.02	
279	ETAAS-Z	6	15	27	14	4	0.99	
290	ICP-MS	6	16	30	14	4	1.05	
291	ASV-3010	5	15	30	14	<3	1.02	
293	ICP-MS	5	14	26	13	4	0.93	
295	ASV-3010	6	15	30	14	3	1.02	
301	ETAAS Other	5	17	31	13	3	1.06	
305	ETAAS-Z	6	15	27	13	4	0.96	
312	ICP-MS	6	16	29	15	4	1.06	
317	ETAAS-Z	6	14	26	13	3	0.93	
324	ICP-MS	5	14	27	13	4	0.94	
325	ETAAS-Z	6	14	25	13	3	0.92	
333	ETAAS-Z	7	17	30	15	4	1.09	

notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info only: results included for informational purposes only.

New York State Department of Health
Blood Lead Test Results, 2013 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE13-06	BE13-07	BE13-08	BE13-09	BE13-10		
Target values:		6	15	28	14	4		
337	ASV-LeadCare	6	16	28	12	5	0.97	
339	HR-ICP-MS	6	15	26	13	4	0.95	Info
340	ETAAS-Z	6	17	30	15	4	1.09	
343	ASV-LeadCare	6	15	28	15	4	1.02	Info
348	ETAAS-Z	6	17	30	15	4	1.09	
349	ETAAS-Z	5	14	26	13	4	0.93	
350	ASV-3010	7	16	29	14	2	1.03	
353	ETAAS-Z	5	14	27	13	3	0.94	
365	ETAAS-Z	7	16	30	15	5	1.07	
366	ETAAS-Z	7	16	28	15	5	1.05	Info
367	DRC/CC-ICP-MS	7	17	30	15	41 ↑	3.38	Info
368	ASV-3010	6	16	28	14	5	1.02	
369	ASV-3010	6	16	31	16	5	1.11	
374	ASV-3010	6	16	31	15	3	1.08	
383	ETAAS-Z	6	16	27	13	4	0.99	
384	ASV-3010	5	16	28	11	5	0.95	
388	ASV-3010	6	16	33 ↑	13	5	1.06	
389	ETAAS-Z	5	14	28	13	2	0.95	
391	ETAAS-Z	6	15	27	14	4	0.99	Info
393	ASV-LeadCare	7	17	31	16	4	1.13	
401	ETAAS Other	6	16	30	14	4	1.05	Info
410	ICP-MS	7	19	29	15	5	1.12	Info
461	ASV-3010	6	15	28	15	3	1.02	
463	ASV-LeadCare	5	18	32	16	5	1.16	
464	ASV-LeadCare	5	15	27	13	3	0.96	
469	ICP-MS	7	13	25	12	4	0.87	
470	ASV-LeadCare	6	16	30	15	<3	1.07	
473	ASV-LeadCare	6	17	31	18	4	1.18	
474	ASV-LeadCare	5	13	26	13	3	0.91	

notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info only: results included for informational purposes only.

**New York State Department of Health
Blood Lead Test Results, 2013 Event #2
PERFORMANCE OF PARTICIPATING LABORATORIES**

Lab Code	Method	Results (µg/dL whole blood)					Normalized Mean	Info Only
		BE13-06	BE13-07	BE13-08	BE13-09	BE13-10		
Target values:		6	15	28	14	4		
475	ASV-LeadCare	6	17	32	16	4	1.14	
476	ASV-LeadCare	4	15	32	15	2	1.07	
477	ASV-LeadCare	6	19	32	17	6	1.21	
Percent satisfactory results for all participants:							99.3 %	

notes: ↑ reported value outside upper limit
↓ reported value outside lower limit

Normalized mean: The average of each reported result divided by the corresponding target value. It measures bias.
Info only: results included for informational purposes only.

**New York State Department of Health
Blood Lead Test Results, 2013 Event #2
STATISTICAL SUMMARY**

TARGET VALUE ASSIGNMENT AND STATISTICS						
Lab Code	Method	Results (µg/dL whole blood)				
		BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
103	DRC/CC-ICP-MS	6	16	29	14	4
104	ETAAS-Z	7	16	29	15	4
107	DRC/CC-ICP-MS	6	16	30	14	4
109	ETAAS-Z	6	16	29	14	4
109	ICP-MS	6	16	28	14	4
110	ETAAS-Z	7	16	29	16	4
110	ICP-MS	6	15	28	14	4
112	ETAAS-Z	7	17	30	15	4
147	ICP-MS	6	16	27	14	4
156	ICP-MS	5	14	27	13	3
160	ICP-MS	6	15	27	13	4
164	ICP-MS	6	15	28	14	4
166	ASV-3010	3	13	27	12	<2
179	ICP-MS	6	16	29	14	4
198	ETAAS-Z	6	15	27	14	4
200	ICP-MS	6	16	27	15	4
243	ASV-3010	4	14	27	12	2
293	ICP-MS	5	14	26	13	4
324	ICP-MS	5	14	27	13	4
325	ETAAS-Z	6	14	25	13	3
350	ASV-3010	7	16	29	14	2
Number of Sample Measurements:		21	21	21	21	20
Mean (target value):		6	15	28	14	4
Standard Deviation:		1.0	1.0	1.3	1.0	0.7
RSD (%):		16.9	6.9	4.7	7.1	17.8
Acceptable Range:						
Upper Limit:		10	19	32	18	8
Lower Limit:		2	11	24	10	0

notes: Results reported as less than the detection limits are treated as zero for statistical and grading purposes.

**New York State Department of Health
Blood Lead Test Results, 2013 Event #2
STATISTICAL SUMMARY BY METHOD**

		Results (µg/dL whole blood)				
		BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
ASV-3010						
Number of Sample Measurements:		13	13	13	13	10
Mean:		5.4	15.1	28.8	13.5	3.6
Standard Deviation:		1.1	1.3	2.1	1.5	1.3
RSD (%):		20.8	8.8	7.3	10.7	35.1
ASV-LeadCare						
Number of Sample Measurements:		15	15	15	15	13
Mean:		5.7	16.1	29.7	15.2	4.0
Standard Deviation:		0.8	1.7	2.3	1.7	1.0
RSD (%):		14.4	10.7	7.9	10.9	25.0
DRC/CC-ICP-MS						
Number of Sample Measurements:		3	3	3	3	2
Mean:		6.3	16.3	29.7	14.3	4.0
Standard Deviation:		0.6	0.6	0.6	0.6	0.0
RSD (%):		—	—	—	—	—
ETAAS Other						
Number of Sample Measurements:		2	2	2	2	2
Mean:		5.5	16.5	30.5	13.5	3.5
Standard Deviation:		0.7	0.7	0.7	0.7	0.7
RSD (%):		—	—	—	—	—
ETAAS-Z						
Number of Sample Measurements:		36	36	36	36	36
Mean:		6.0	15.3	27.8	13.9	3.6
Standard Deviation:		0.8	1.2	1.9	1.1	0.8
RSD (%):		14.0	8.1	6.8	7.7	21.9
HR-ICP-MS						
Number of Sample Measurements:		1	1	1	1	1
Mean:		5.7	14.7	26.2	12.8	3.6
Standard Deviation:		?	?	?	?	?
RSD (%):		—	—	—	—	—
ICP-MS						
Number of Sample Measurements:		20	20	20	20	20
Mean:		6.0	15.5	27.9	13.9	4.0
Standard Deviation:		0.5	1.2	1.2	0.7	0.3
RSD (%):		8.6	8.0	4.4	5.4	8.1
All Laboratories						
Number of Sample Measurements:		90	90	90	90	84
Mean:		5.9	15.5	28.4	14.0	3.8
Standard Deviation:		0.8	1.3	2.0	1.3	0.8
RSD (%):		14.2	8.7	7.0	9.0	21.4

notes: ? Insufficient data for calculation.

A Standard Deviation displayed as 0.0 should be interpreted as <0.1 (see DRC/CC-ICP-MS and HR-ICP-MS participants)

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Blood Lead Test Results, 2013 Event #2
STATISTICAL SUMMARY BY CLASS**

Results ($\mu\text{g/dL}$ whole blood)					
	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
Evaluated					
Number of Sample Measurements:	55	55	55	55	52
Mean:	5.8	15.4	28.5	13.9	3.7
Standard Deviation:	0.8	1.3	2.2	1.4	0.9
RSD (%):	13.8	8.5	7.8	9.9	24.4
Info					
Number of Sample Measurements:	14	14	14	14	12
Mean:	6.1	16.3	28.8	14.7	4.1
Standard Deviation:	0.7	1.7	1.8	1.0	0.4
RSD (%):	11.0	10.2	6.2	7.0	10.2
Reference					
Number of Sample Measurements:	21	21	21	21	20
Mean:	5.8	15.2	27.9	13.8	3.7
Standard Deviation:	1.0	1.0	1.3	1.0	0.7
RSD (%):	16.9	6.9	4.7	7.1	17.8
All Laboratories					
Number of Sample Measurements:	90	90	90	90	84
Mean:	5.9	15.5	28.4	14.0	3.8
Standard Deviation:	0.8	1.3	2.0	1.3	0.8
RSD (%):	14.2	8.7	7.0	9.0	21.4

notes: ? Insufficient data for calculation.

New York State Department of Health
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Additional Trace Elements Reported in Whole Blood

Participant laboratories reported their analytical results for any additional trace elements (other than As, Cd, Hg and Pb) that are routinely reported so that a more complete characterization can be recorded for these proficiency test materials. Results for additional trace elements are reported here, but no target value is implied nor are any acceptable ranges provided. These data are provided solely for educational and informational purposes.

In addition to As, Cd, Pb and Hg, the whole blood pools were supplemented with the following additional trace elements as indicated below

Additional Elements

Co, Cr, Mn, Sn, Tl, Ti, V, W, Ni

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Whole Blood Additional Elements, 2013 Event #2
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Blood Aluminum (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
359	ICP-MS	36.6	31.1	34.9	31.7	35.4

Blood Antimony (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
110	ICP-MS	<0.1	<0.1	<0.1	<0.1	<0.1
206	ICP-MS	<2.0	<2.0	<2.0	<2.0	<2.0

Blood Barium (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
110	ICP-MS	9.6	13.0	19.4	8.8	13.7
147	ICP-MS	9.06	12.07	19.22	6.95	13.46
197	ICP-MS	9.4	12.7	20.4	7.4	14.3
312	ICP-MS	8.0	10.9	18.7	5.9	12.6
Arithmetic Mean		9.0	12.2	19.4	7.3	13.5
SD		0.7	0.9	0.7	1.2	0.7
n		4	4	4	4	4

Blood Beryllium (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
147	ICP-MS	<0.90	<0.90	<0.90	<0.90	<0.90
197	ICP-MS	NA	NA	NA	NA	NA

Blood Bismuth (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0
305	ICP-MS	<0.5	<0.5	<0.5	<0.5	<0.5

Blood Cesium (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
110	ICP-MS	0.66	0.54	0.61	0.60	0.66

Blood Chromium (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
110	DRC/CC-ICP-MS	27.0	9.7	3.7	13.4	0.5
147	DRC/CC-ICP-MS	25.69	9.57	3.86	12.74	1.08
156	ICP-MS	28.5	10.1	3.5	13.3	<1.0
164	ICP-MS	23.4	9.0	3.3	11.1	0.4
197	DRC/CC-ICP-MS	27.2	10.1	4.1	13.0	1.1
305	ICP-MS	22.0	7.7	3.1	10.4	0.5
312	DRC/CC-ICP-MS	31.0	11.0	4.4	15.0	0.9
391	ETAAS-Z	29.80	12.30	3.61	15.40	0.71
Arithmetic Mean		27	10	3.7	13	0.7
SD		3	1	0.4	2	0.3
n		8	8	8	8	7

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Blood Cobalt (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
110	ICP-MS	16.2	4.8	4.3	9.3	1.2
147	ICP-MS	16.03	4.63	4.14	8.84	0.996
156	ICP-MS	16.6	4.7	3.9	8.9	<1.0
164	ICP-MS	14.8	4.3	3.8	8.0	0.9
197	ICP-MS	17.5	5.4	4.5	9.8	1.2
206	ICP-MS	16.3	4.8	5.2*	8.6	1.2
305	ICP-MS	16.8	4.8	4.3	8.9	1.1
312	ICP-MS	17.0	5.1	4.5	9.5	1.1
324	ICP-MS	15.8	4.6	4.2	8.7	1.0
391	DRC/CC-ICP-MS	17.1	4.9	4.2	8.9	0.9
<i>*Outlier</i>	Arithmetic Mean	16.4	4.8	4.2	8.9	1.1
	SD	0.8	0.3	0.2	0.5	0.1
	n	10	10	9	10	9

Blood Copper (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
147	ICP-MS	1188	1201	1163	1201	1226
197	ICP-MS	1340.0	1350.0	1270.0	1290.0	1330.0
312	ICP-MS	1260.0	1290.0	1240.0	1250.0	1360.0
	Arithmetic mean	1263	1280	1224	1247	1305
	SD	76	75	55	45	70
	n	3	3	3	3	3

Blood Iodine (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
147	ICP-MS	53.16	43.92	50.13	42.03	42.66

Blood Manganese (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
103	DRC/CC-ICP-MS	22.4	16.4	45.1	37.2	21.7
107	DRC/CC-ICP-MS	22.7	18.9	46.7	36.8	24.6
110	ETAAS-Z	22.7	16.9	43.4	34.6	22.4
147	ICP-MS	22.09	16.7	44.07	34.56	22.15
156	ICP-MS	25.4	19.9	45.8	35.8	24.6
179	ETAAS-Z	20.8	15.5	40.8	31.2	21.2
197	DRC/CC-ICP-MS	19.7	14.3	39.0	31.5	19.0
293	ICP-MS	20.2	14.8	40.0	31.7	19.9
305	ICP-MS	23.3	15.3	42.9	34.5	21.7
312	DRC/CC-ICP-MS	29.0*	22.0	55.0*	42.0	29.0*
324	ICP-MS	20.5	19.6	44.5	31.1	20.8
391	DRC/CC-ICP-MS	23.0	22.7	43.5	33.1	21.7
<i>*Outlier</i>	Arithmetic mean	22	18	43	35	22
	SD	2	3	2	3	2
	n	11	12	11	12	11

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Blood Molybdenum (µg/L)

Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
147	ICP-MS	19.58	27.54	17.56	22.36	10.36
197	ICP-MS	22.3	31.7	20.0	26.3	11.9
305	ICP-MS	23.4	26.9	22.1	26.5	12.2
312	ICP-MS	24.0	32.0	22.0	26.0	13.0
324	ICP-MS	21.5	27.7	18.3	22.1	9.8
Arithmetic mean		22	29	20	25	11
SD		2	2	2	2	1
n		5	5	5	5	5

Blood Nickel (µg/L)

Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
147	ICP-MS	15.15	4.04	2.39	8.34	<0.294
197	ICP-MS	17.5	5.7	3.4	9.5	<2.0
312	ICP-MS	20.0	6.0	3.0	12.0	<3.0
391	DRC/CC-ICP-MS	13.06	4.41	3.19	7.23	1.81
Arithmetic mean		16	5	3.0	9	-
SD		3	1	0.4	2	-
n		4	4	4	4	-

Blood Platinum (µg/L)

Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
110	ICP-MS	<0.1	<0.1	0.1	<0.1	<0.1
312	ICP-MS	<0.2	<0.2	<0.2	<0.2	<0.2

Blood Selenium (µg/L)

Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
107	DRC/CC-ICP-MS	294	316	328	277	301
109	ICP-MS	324	333	350	296	332
147	ICP-MS	278	292	329	254	280
197	ICP-MS	336.0	373.0	381.0*	291.0	371.0
305	ICP-MS	303.0	310.0	331.0	296.0	313.0
312	ICP-MS	293.0	313.0	327.0	274.0	302.0
324	ICP-MS	312	327	344	299	337
359	ICP-MS	287.0	303.0	323.0	275.0	313.0
<i>*Outlier</i> Arithmetic Mean		303	321	333	283	319
SD		20	25	10	15	28
n		8	8	7	8	8

Blood Silver (µg/L)

Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0

Blood Tellurium (µg/L)

Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
147	ICP-MS	<0.06	<0.06	<0.06	<0.06	<0.06
197	ICP-MS	<1.0	<1.0	<1.0	<1.0	<1.0

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Blood Thorium (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
147	ICP-MS	<0.12	<0.12	<0.12	<0.12	<0.12

Blood Thallium (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
147	ICP-MS	4.82	9.69	7.56	18.48	0.106
156	ICP-MS	<11.0	<11.0	<11.0	19.83	<11.0
179	ICP-MS	5.0	10.0	8.0	19.0	<1.0
197	ICP-MS	4.2	8.3	6.9	16.6	<1.0
206	ICP-MS	4.9	10.3	7.8	19.8	<1.0
305	ICP-MS	5.8	11.5	9.2	22.3	<0.2
312	ICP-MS	5.0	10.0	8.2	20.0	<0.1
324	ICP-MS	4.6	9.3	7.9	18.5	0.1
Arithmetic mean		4.9	10	7.9	19	-
SD		0.5	1	0.7	2	-
n		7	7	7	8	-

Blood Tin (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
110	ICP-MS	2.2	6.3	14.0	21.3	0.1
147	ICP-MS	2.11	6.09	14.37	19.8	<0.119
156	ICP-MS	<11.0	<11.0	15.2	20.6	<11.0
197	ICP-MS	<5.0	6.5	13.1	NA	<5.0
Arithmetic Mean		-	6.3	14.2	20.6	-
SD		-	0.2	0.9	0.7	-
n		-	3	4	3	-

Blood Tungsten (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
103	DRC/CC-ICP-MS	6.3	4.4	2.2	5.1	0.1

Blood Uranium (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
110	ICP-MS	<0.02	<0.02	<0.02	<0.02	<0.02
147	ICP-MS	<0.007	<0.007	<0.007	<0.007	<0.007
312	ICP-MS	<0.1	<0.1	<0.1	<0.1	<0.1

Blood Vanadium (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
147	DRC/CC-ICP-MS	8.11	2.27	1.13	5.1	0.134
312	DRC/CC-ICP-MS	9.9	3.1	1.8	5.5	0.3

Blood Zinc (µg/L)						
Lab Code	Method	BE13-06	BE13-07	BE13-08	BE13-09	BE13-10
114	ICP-MS	1930.0	2020.0	2350.0	3280.0	3020.0
147	ICP-MS	1824	1909	2209	2882	2824
197	ICP-MS	1760.0	1890.0	2090.0	2820.0	2800.0
312	ICP-MS	2090.0	2180.0	2590.0	3290.0	3460.0
Arithmetic mean		1901	2000	2310	3068	3026
SD		144	133	215	252	306
n		4	4	4	4	4

**New York State Department of Health
Blood Lead Test Results, 2013 Event #2**

METHOD NOTES

ATOMIC SPECTROMETRY METHODS

- A-1 ETAAS-Z (Electrothermal atomic absorption spectrometry with Zeeman background correction)
- A-2 ETAAS other (i.e., D₂, S-H background correction)
- A-3 FAAS (Flame atomic absorption spectrometry)
- A-4 CV-AAS (Cold vapor atomic absorption spectrometry)
- A-5 HG-AAS (Hydride generation atomic absorption spectrometry)
- A-6 AFS (Atomic fluorescence spectrometry)
- A-7 Other

INDUCTIVELY COUPLED PLASMA

- P-1 ICP-MS (Inductively coupled plasma - mass spectrometry)
- P-2 DRC/CC-ICP-MS (ICP-MS used in the Dynamic Reaction Cell or Collision Cell mode)
- P-3 ICP-AES/OES (ICP atomic/optical emission spectrometry)
- P-4 HR-ICP-MS (High resolution ICP-MS)
- P-5 ETV-ICP-MS (Electrothermal vaporization ICP-MS)
- P-6 ID-ICP-MS (Isotope dilution ICP-MS)
- P-7 Other

ELECTROCHEMICAL METHODS

- E-1 ASV (Anodic stripping voltammetry without digestion)
- E-2 ASV-LeadCare® (Anodic stripping voltammetry using the ESA LeadCare® system)
- E-3 Fluoride specific electrode
- E-4 Other

MOLECULAR FLUORIMETRY

- F-1 EtOAc (Ethyl acetate-acetic acid extraction method for determination of erythrocyte protoporphyrin)
- F-2 Aviv hematofluorometry (for determination of EP at hematocrit 35)
- F-3 Helena ZPP (for determination of zinc protoporphyrin in $\mu\text{mol ZPP/mol heme}$)
- F-4 Other

OTHER METHODS

If your method is not listed in the above list, please describe it briefly.
