

Mercury Monitoring per New PS-12A with Portable CEMS

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EUEC 2011

Introduction

- Objective: Conduct 30 days of real time mercury monitoring to obtain reference and baseline data for a Steel Mill.
- PS-12A test requirements along with daily calibrations and integrity tests used to verify the data accuracy.

Question ??

Can a portable mercury CEMS pass all the requirements of PS-12A in the field?



Background

- Ohio Lumex IRM-915 Portable CEMS used for monitoring.
- Hovacal Hg²⁺ calibrator and Thermo 81i Hg⁰ calibrator used as reference gas sources for all monitor testing.

Background

- Catalyst Air Management oversaw the project, compiled and calculated the results and conducted the RATA using 30B sampling with Ohio Lumex sorbent traps and analysis.
- RMB conducted and compiled the results for the PS-12A testing.

Setup

- Probe installed in a duct 110' from the ground.
- Sample umbilical containing sample and calibration gas lines heated to 180C, run from duct port to trailer.
- Analyzer System and calibrators mounted on a table in the test trailer.
- Setup time, approx. 4 hours.

Sample Probe and Heated line Mounting



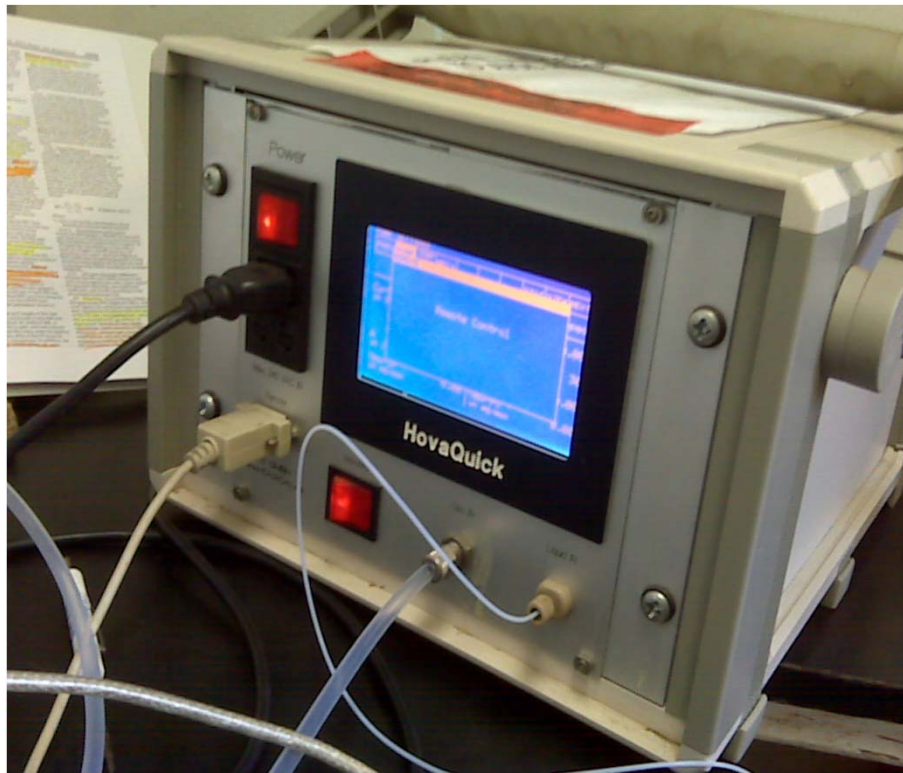
IRM-915 Analyzer



Test Per PS-12A

- **Measurement Error Test:** 3 reference gas concentration levels run 3 times each for Hg^0 (max error 5%) and Hg^{2+} (max error 10%)
- **Calibration Drift Test:** 7 day test run at two levels (max error 5%)
- **RATA:** Method 30B, 9 runs (max error 20%)
- **Ongoing QA/QC:** Daily Calibrations & Weekly System Integrity Checks.

Calibration Equipment



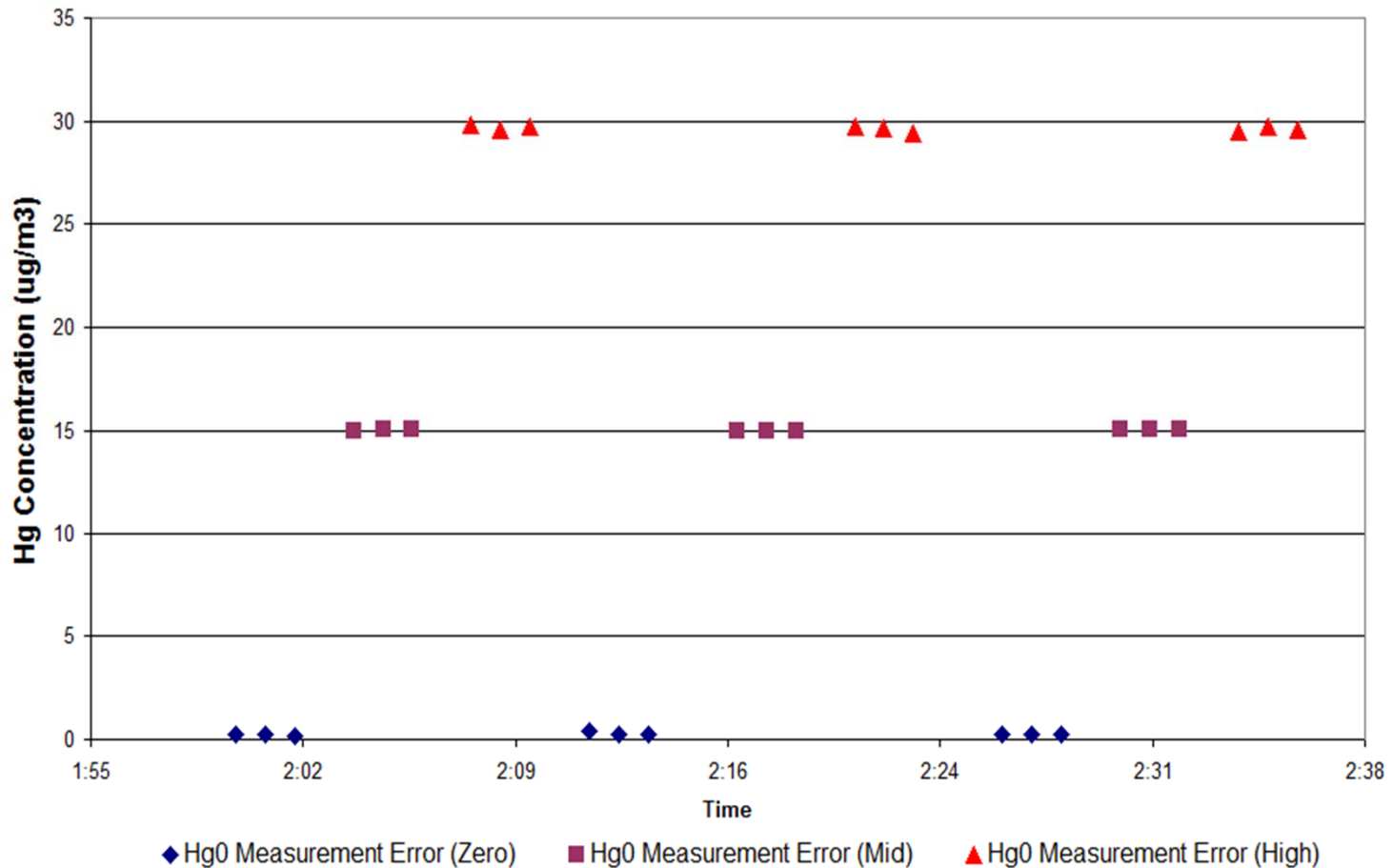
Hg⁰ Measurement Error Test

10/27/2010

		Reference Value ($\mu\text{g}/\text{m}^3$)	Analyzer Response ($\mu\text{g}/\text{m}^3$)	Measurement Error (R-A)/S	PASS / FAIL	
Gas Level	Zero	Run 1	0.0	0.2	0.7%	PASS
		Run 2	0.0	0.2		
		Run 3	0.0	0.2		
		Avg	0.0	0.2		
	Mid	Run 1	15.0	15.1	0.2%	PASS
		Run 2	15.0	15.0		
		Run 3	15.0	15.1		
		Avg	15.0	15.1		
	High	Run 1	30.0	29.7	1.3%	PASS
		Run 2	30.0	29.6		
		Run 3	30.0	29.6		
		Avg	30.0	29.6		

Hg⁰ Measurement Error Test

10/27/2010



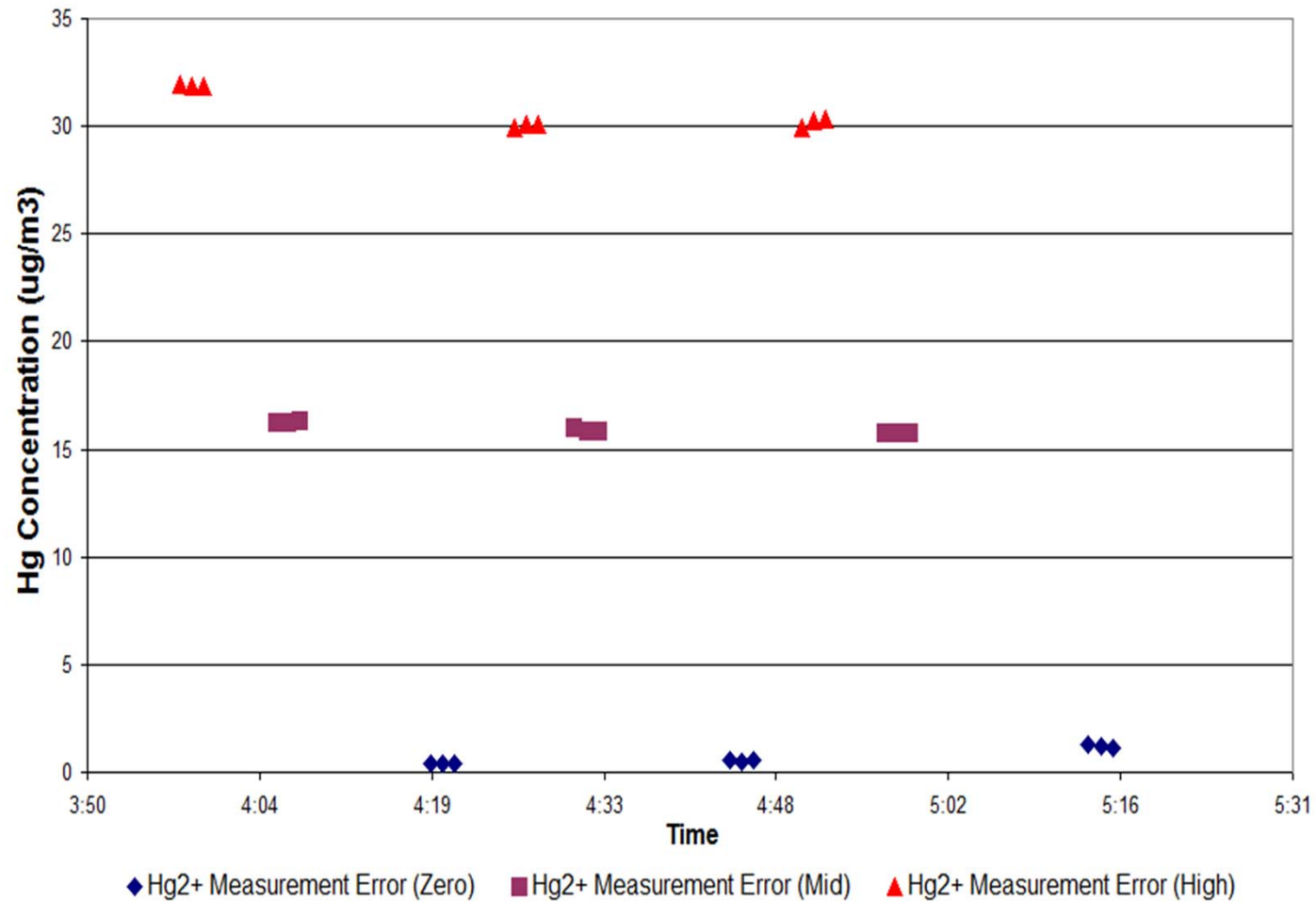
Hg²⁺ Measurement Error Test

10/27/2010

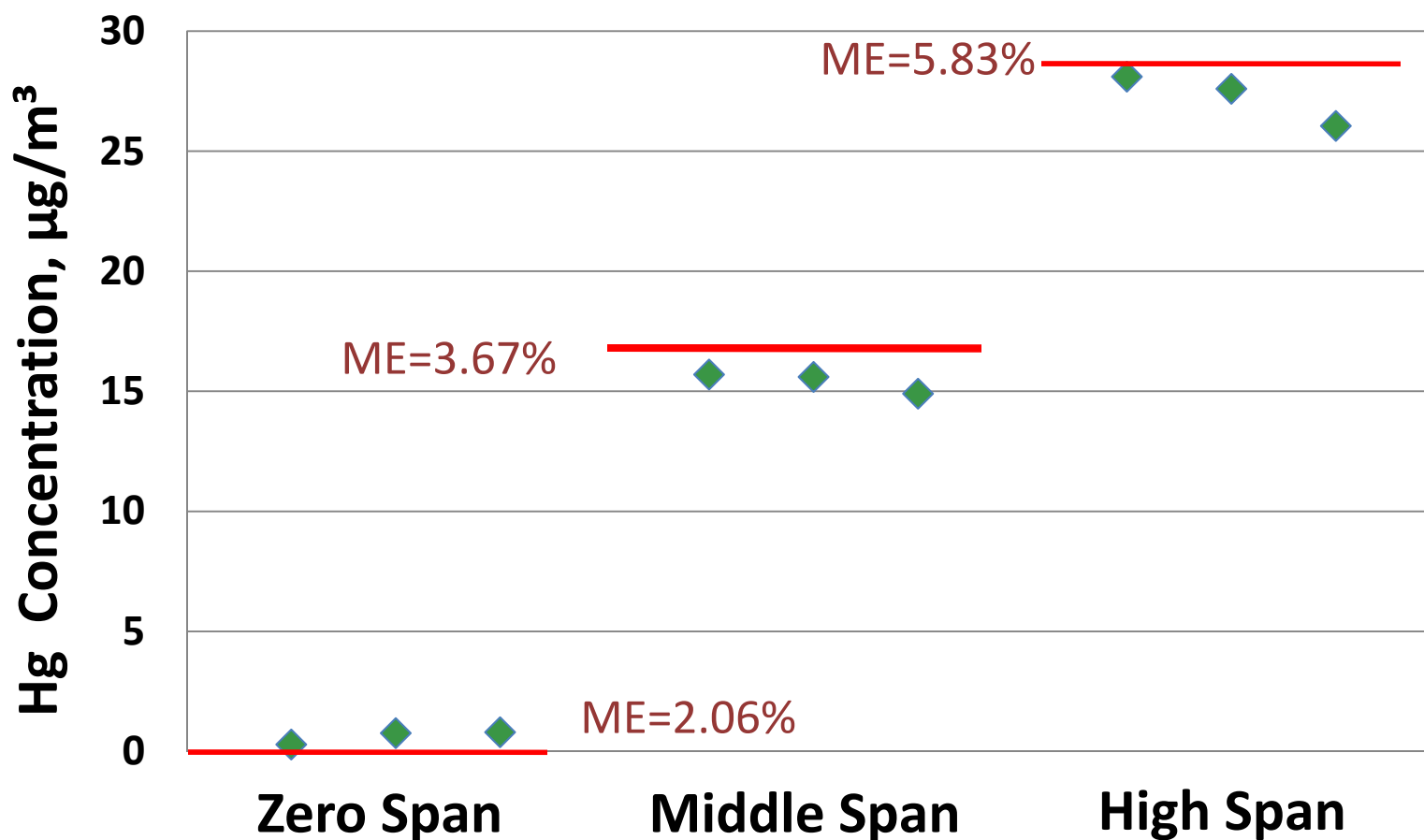
		Reference Value ($\mu\text{g}/\text{m}^3$)	Analyzer Response ($\mu\text{g}/\text{m}^3$)	Measurement Error (R-A)/S	PASS / FAIL	
Gas Level	Zero	Run 1	0.0	0.4	2.2%	PASS
		Run 2	0.0	0.4		
		Run 3	0.0	1.2		
		Avg	0.0	0.7		
	Mid	Run 1	15.5	16.2	1.3%	PASS
		Run 2	15.5	15.8		
		Run 3	15.6	15.8		
		Avg	15.5	15.9		
	High	Run 1	30.0	31.9	2.2%	PASS
		Run 2	30.0	29.9		
		Run 3	30.0	30.2		
		Avg	30.0	30.7		

Hg²⁺ Measurement Error Test

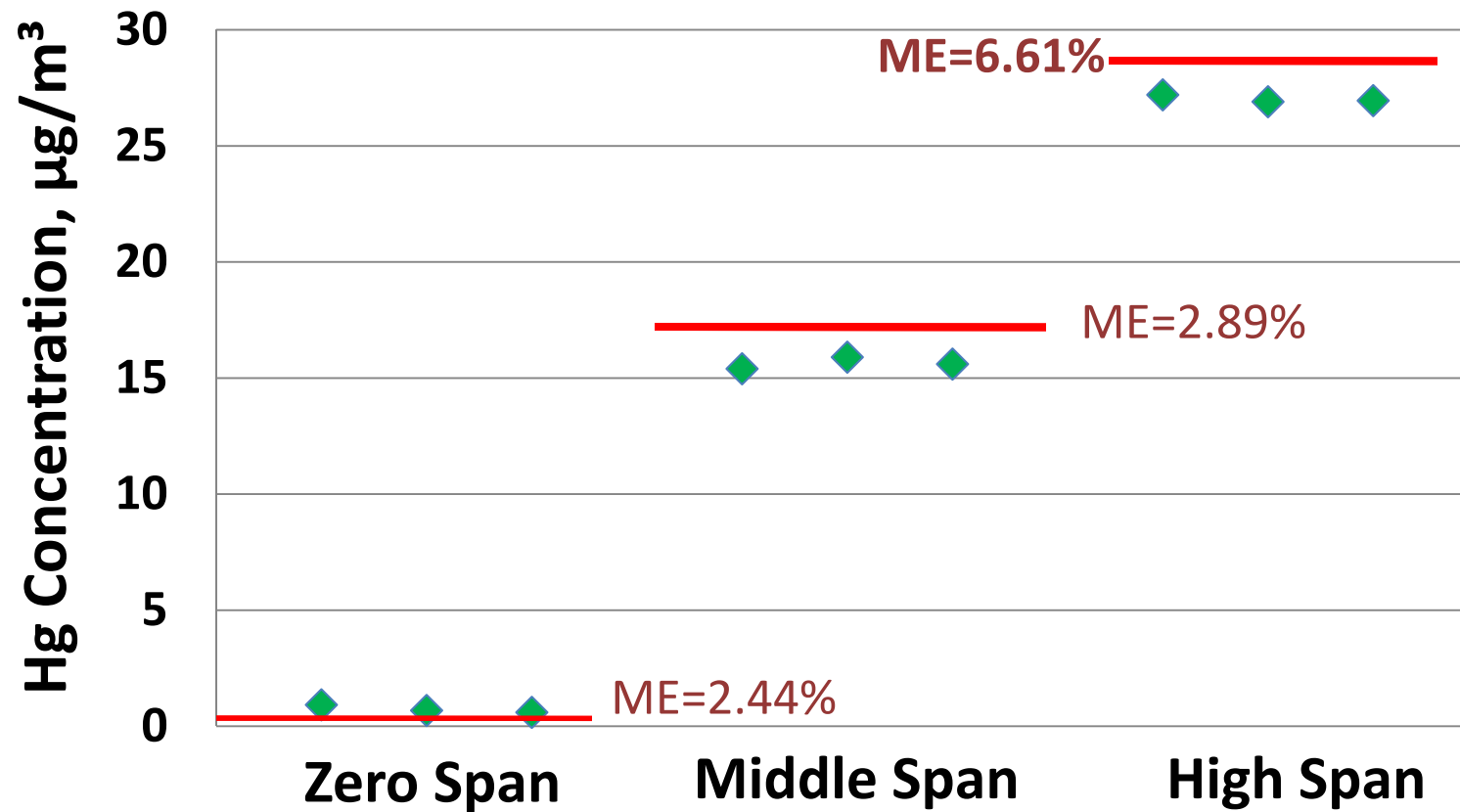
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CEMS Performance of 11/18/2010



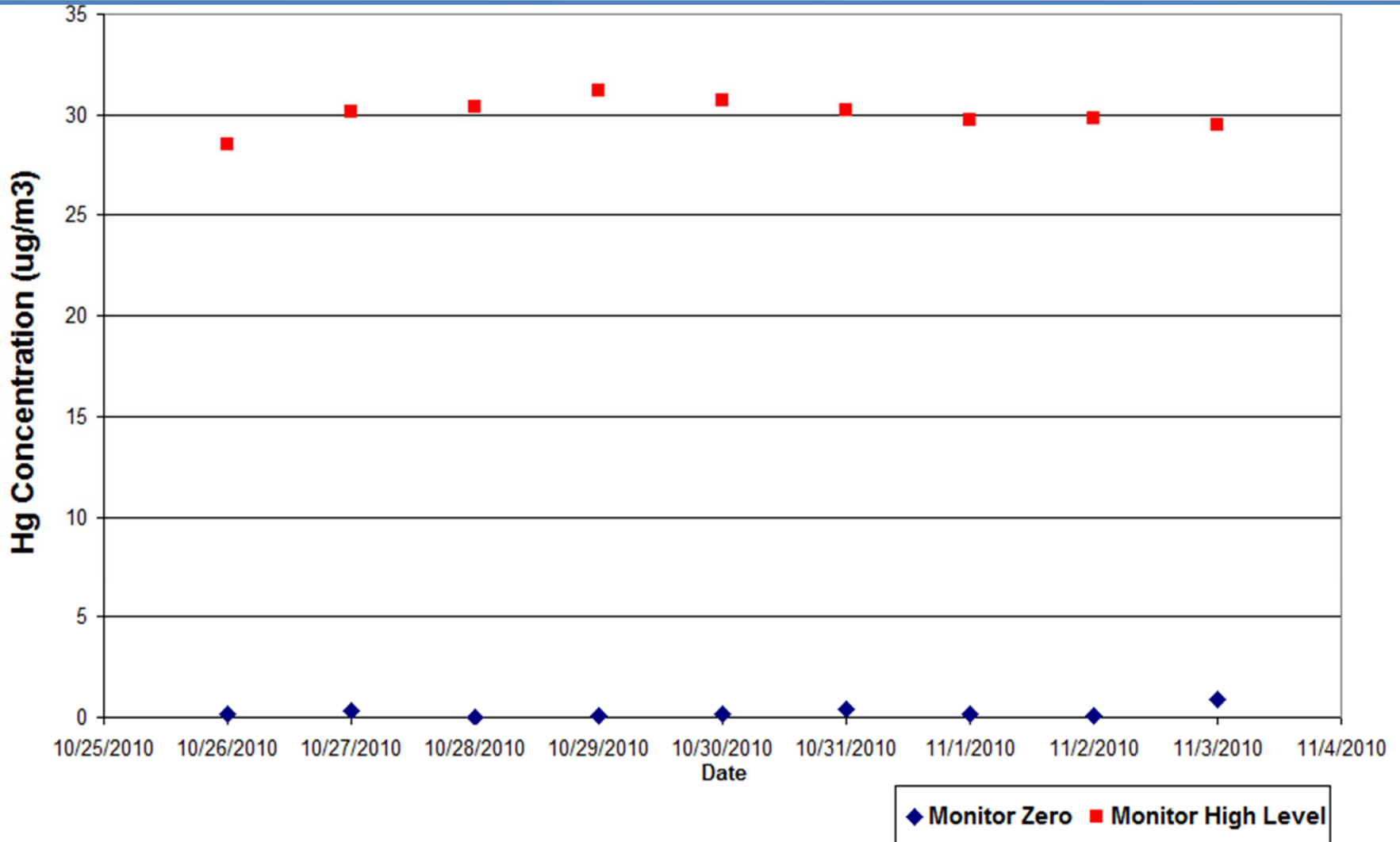
CEMS Performance of 11/30/2010



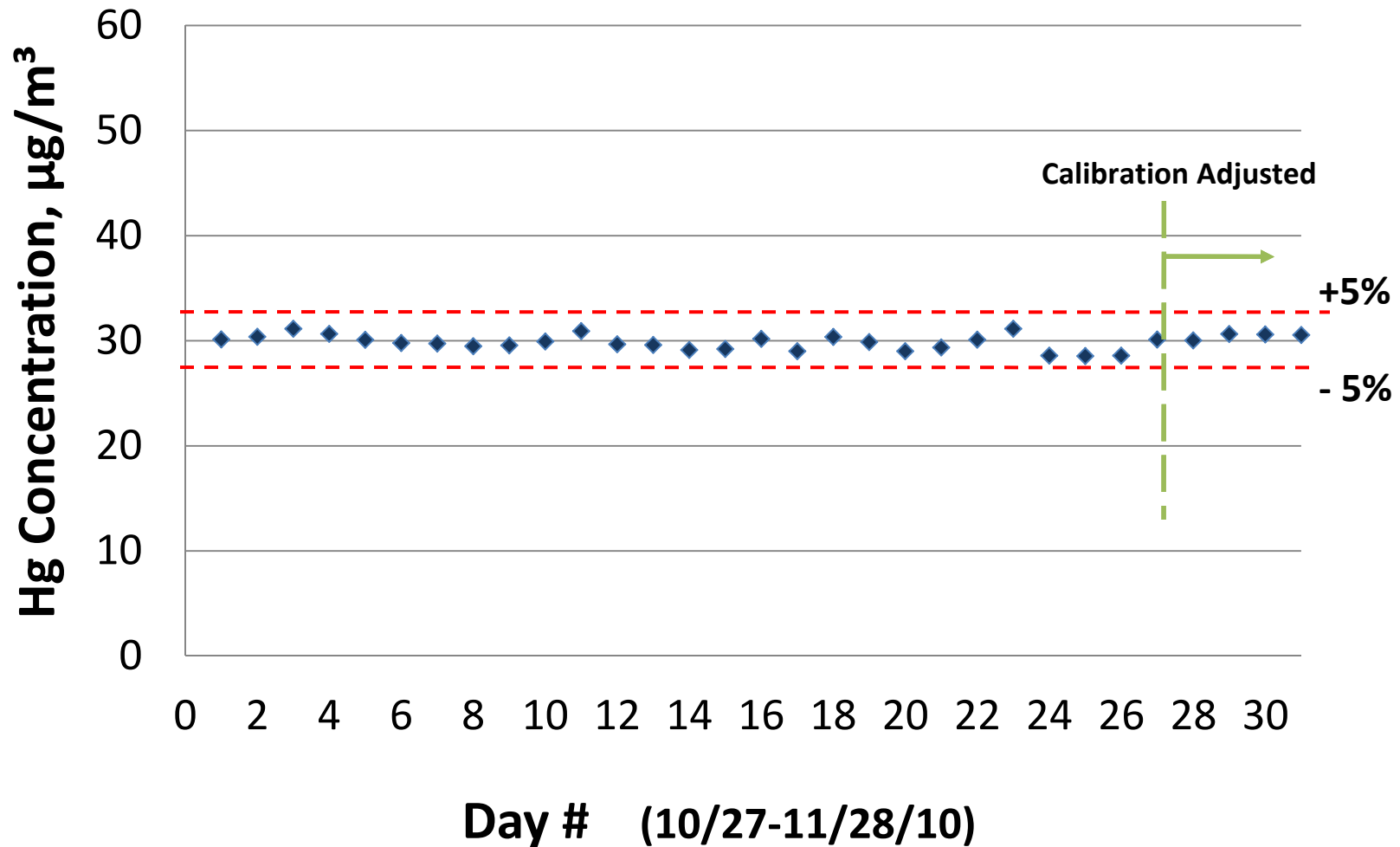
7-Day Calibration Drift Test

			Reference Value ($\mu\text{g}/\text{m}^3$)	Analyzer Response ($\mu\text{g}/\text{m}^3$)	Calibration Drift (R-A)/S	PASS / FAIL
10/26/2010	Gas Level	Zero	0.0	0.2	0.7%	PASS
		High	30.0	28.5	5.0%	PASS
10/27/2010	Gas Level	Zero	0.0	0.3	1.0%	PASS
		High	30.0	30.1	0.3%	PASS
10/28/2010	Gas Level	Zero	0.0	0.0	0.0%	PASS
		High	30.0	30.4	1.3%	PASS
10/29/2010	Gas Level	Zero	0.0	0.1	0.3%	PASS
		High	30.0	31.2	4.0%	PASS
10/30/2010	Gas Level	Zero	0.0	0.2	0.7%	PASS
		High	30.0	30.7	2.3%	PASS
10/31/2010	Gas Level	Zero	0.0	0.4	1.3%	PASS
		High	30.0	30.2	0.7%	PASS
11/1/2010	Gas Level	Zero	0.0	0.2	0.7%	PASS
		High	30.0	29.7	1.0%	PASS
11/2/2010	Gas Level	Zero	0.0	0.1	0.3%	PASS
		High	30.0	29.8	0.7%	PASS
11/3/2010	Gas Level	Zero	0.0	0.9	3.0%	PASS
		High	30.0	29.5	1.7%	PASS

Seven-Day Calibration Drift Test

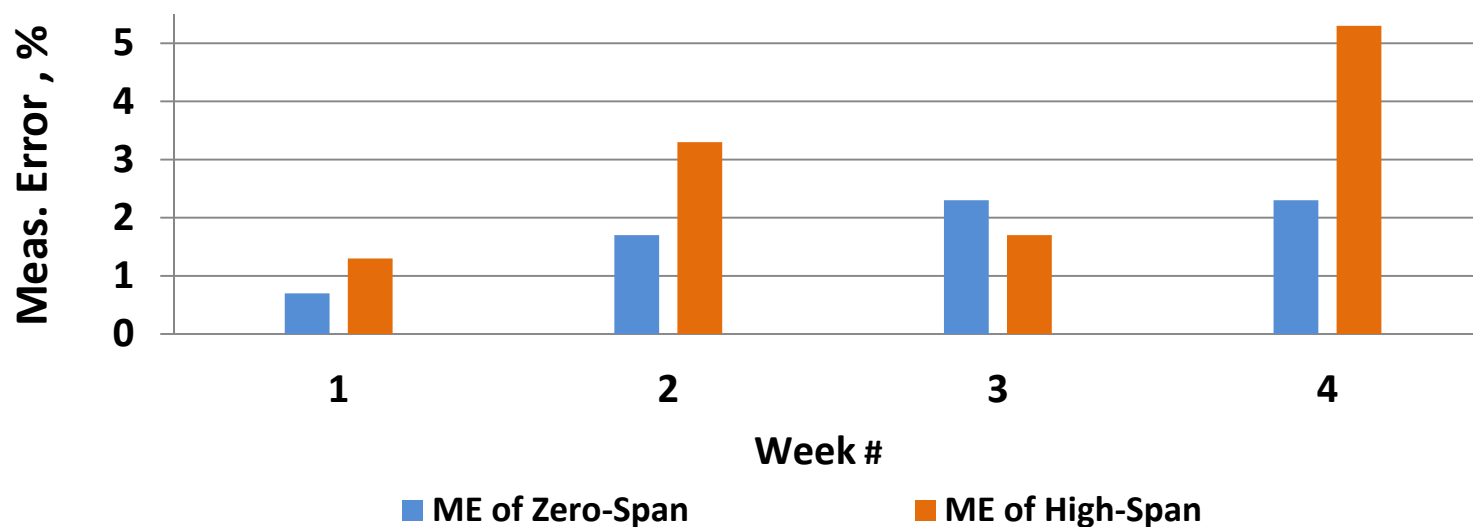


Daily Calibrations (10/27/10-11/28/10)



Weekly System Integrity Check with Hg²⁺

		Reference Value ($\mu\text{g}/\text{m}^3$)	CEMs Response ($\mu\text{g}/\text{m}^3$)	Measurement Error (R-A)/S	Pass / Fail
Week 1 10/26/10	12:40-12:50	0.0	0.2	0.7%	Pass
	12:50-13:05	30.0	29.6	1.3%	Pass
Week 2 11/6/10	12:40-12:50	0.0	0.5	1.7%	Pass
	12:50-13:05	29.5	30.5	3.3%	Pass
Week 3 11/14/10	12:00-12:26	0.0	0.7	2.3%	Pass
	12:26-12:36	30.0	29.5	1.7%	Pass
Week 4 11/21/10	12:00-12:15	0.0	0.7	2.3%	Pass
	12:13-12:33	29.6	28	5.3%	Pass



Spike Recovery Test

Train ID	Hg in Sec.1 ng	Hg in Sec.2 ng	Total Hg ng	Breakthrough %	Spike Mass ng	Spike Recovery R, %
1A	347.0	0.1	347.1	0.0	300.0	95.4
1B	55.0	0.5	55.5	0.9	0.0	
2A	436.0	0.9	436.9	0.2	300.0	97.6
2B	132.0	0.0	132.0	0.0	0.0	
3A	537.0	0.1	537.1	0.0	300.0	103.6
3B	208.0	0.0	208.0	0.0	0.0	

Ave. Field Recovery of Spike (R) : 99.00%

* Tested on 11/18/2010

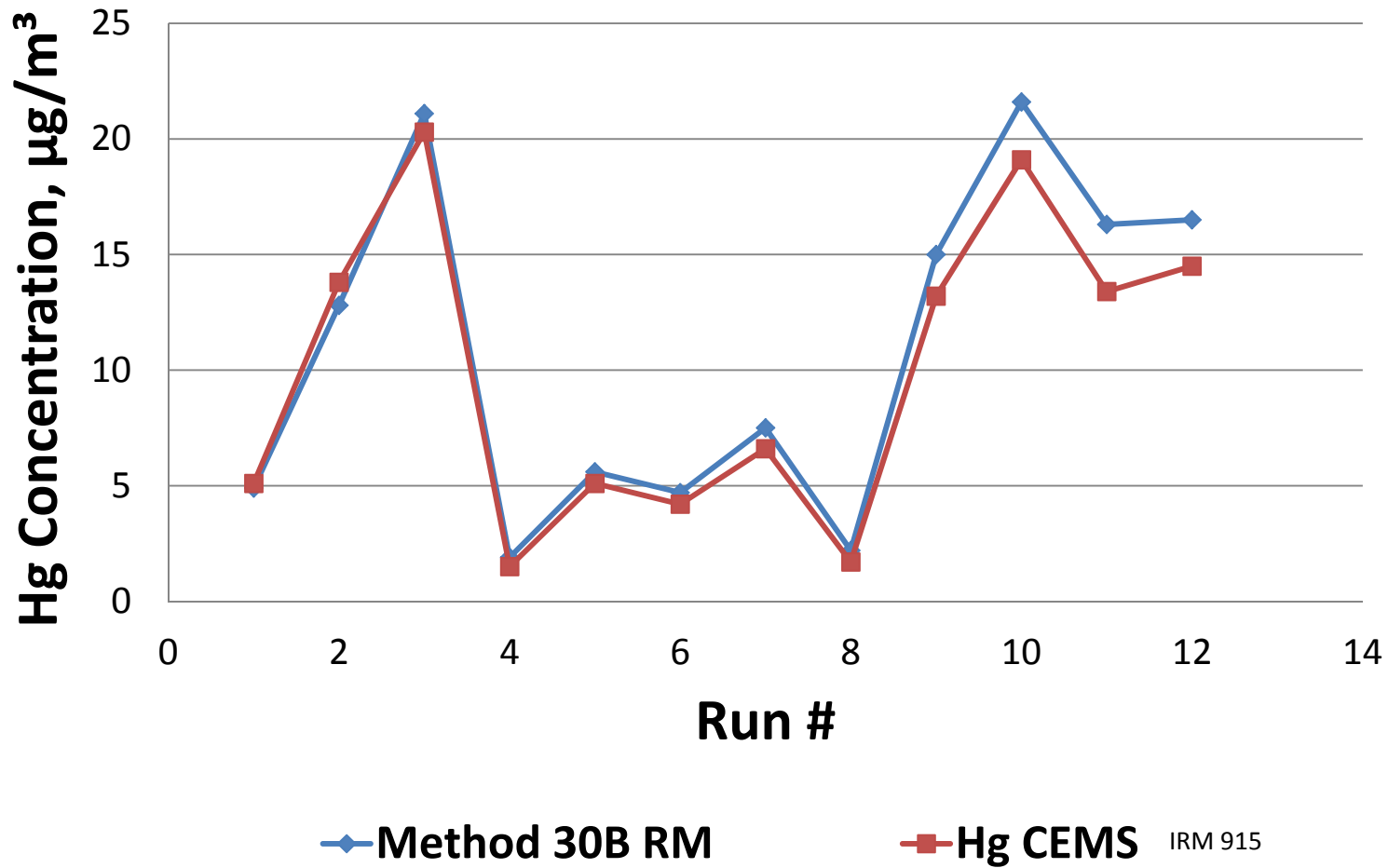
* Method 30B requires average spike recovery to be between 85-115%

Hg RATA Results Summary

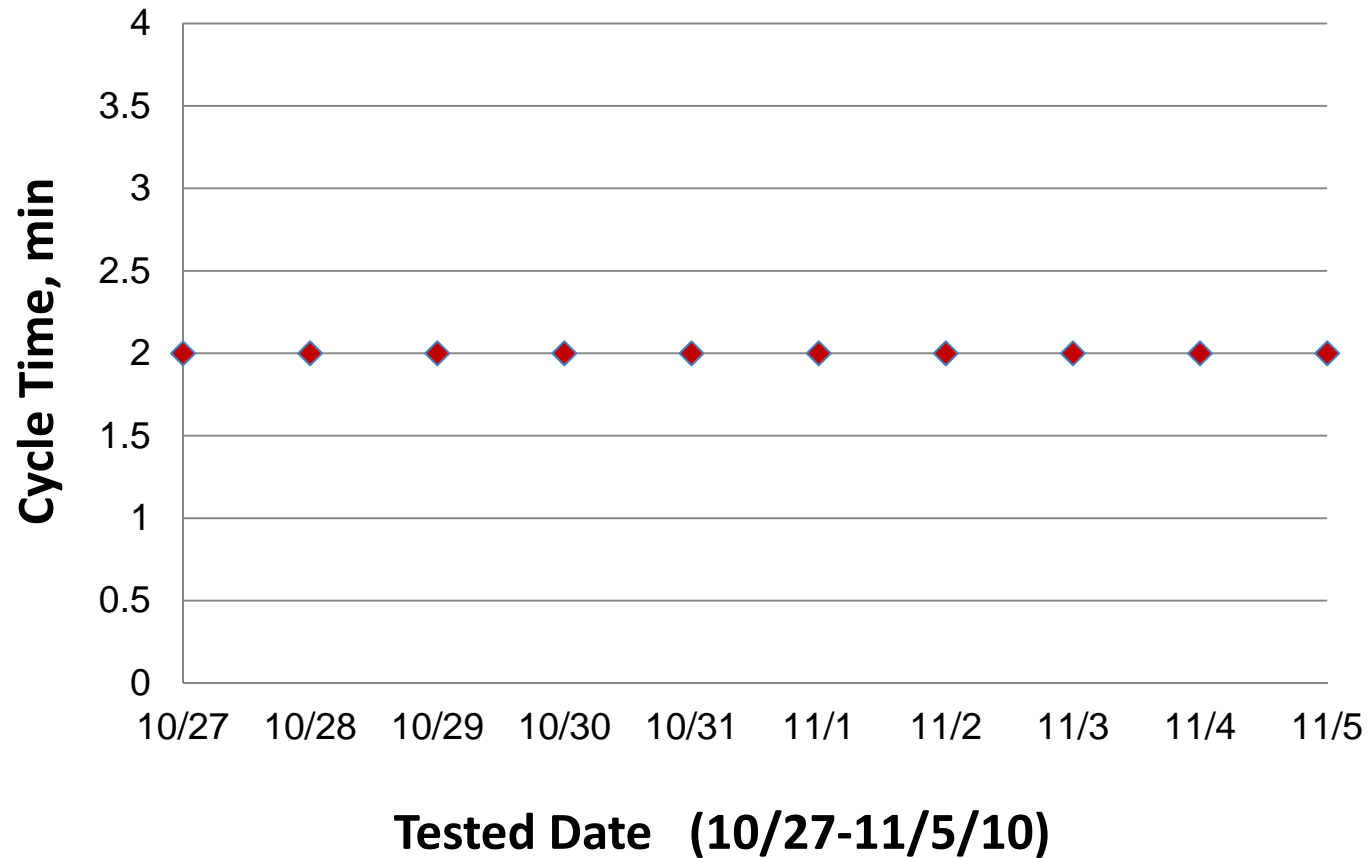
Run ID	RM Avg Concentration ($\mu\text{g}/\text{m}^3$)	Hg CEMS IRM915 (HgT) Concentration ($\mu\text{g}/\text{m}^3$)	Difference ($\mu\text{g}/\text{m}^3$)
1 ^a	4.9	5.1	-0.20
2 ^a	12.8	13.8	-1.00
3 ^a	21.1	20.3	0.80
4	1.9	1.5	0.45
5	5.6	5.1	0.48
6	4.7	4.2	0.53
7	7.5	6.6	0.91
8	2.2	1.7	0.48
9	15.0	13.2	1.80
10	21.6	19.1	2.55
11	16.3	13.4	2.90
12	16.5	14.5	2.03
Mean	8.4	7.9	0.47

Relative Accuracy **12.6%**

RATA Results Summary



System Rise/Fall (Cycle Time) Test



* Average system cycle time is **2 minutes** based on 10-days system rise time test.

Tests Summary



Daily Calibration



Weekly Integrity Test



CD Test
(7-Day Calibration Drift Test)



Hg⁰ ME Test
(Measurement Error Test)



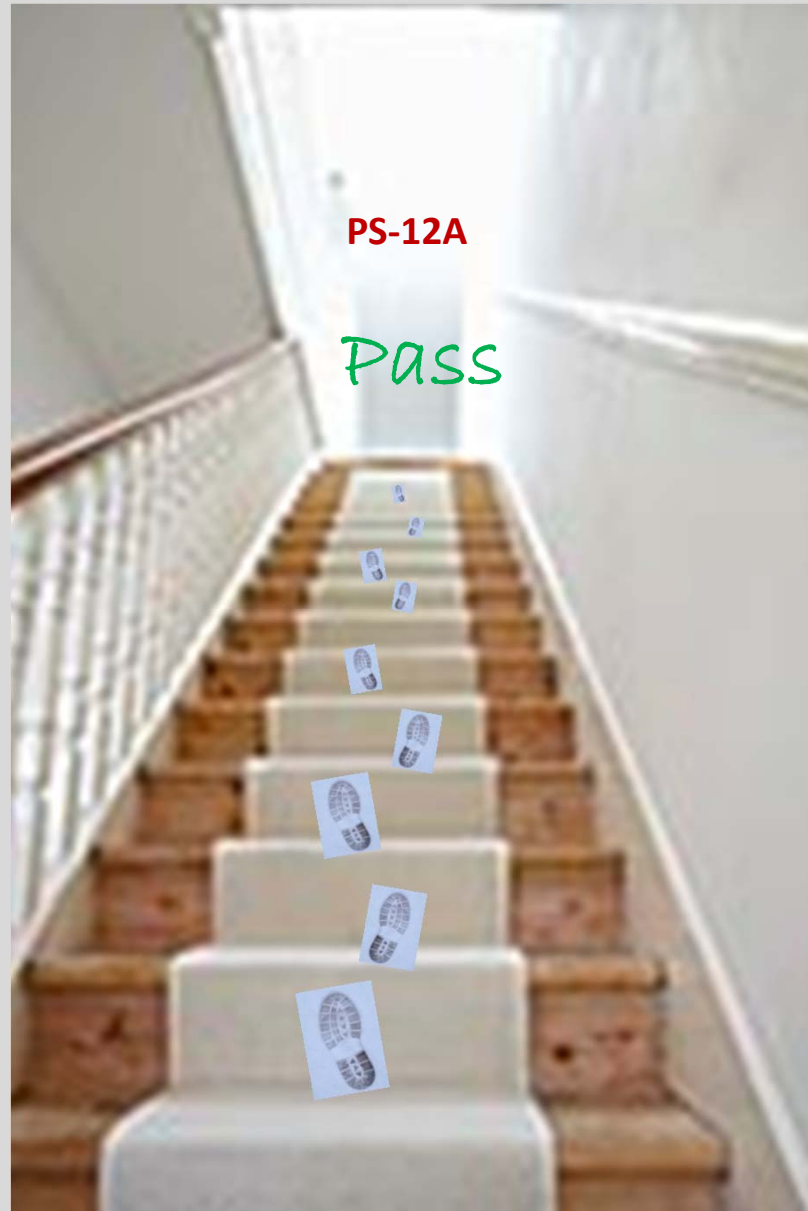
Hg²⁺ ME Test
(Measurement Error Test)



RA Test
(Relative Accuracy Test)



System Rise/Fall Test



Results & Conclusions

- All PS-12A Testing Requirements and QA were completed and passed using the Ohio Lumex IRM-915 Portable Monitor.
- A highly mobile, real time monitoring system, can be used to obtain accurate mercury data in difficult sampling areas and source with high Hg fluctuation.
- Long term sampling & analysis using a portable CEMS with short setup time is available.

OHIO LUMEX

www.OhioLumex.com

IRM-915 REAL TIME HG CEMS

***FOR MORE INFORMATION PLEASE
CALL OR EMAIL OHIO LUMEX AT:***

888-876-2611 OR 330-405-0837

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