PARTNER
Engineering and Science, Inc.®

INDUSTRIAL HYGIENE ASSESSMENT

Wall Township Board of Education
1620 18th Avenue
Wall Township, New Jersey 07719

August 4, 2020
Partner Project Number: 20-286459.1

Prepared for:

Wall Township Board of Education
Wall, New Jersey

Engineers who understand your business

PARTNER
Engineering and Science, Inc.

August 4, 2020

Mr. Nicholas Moretta
Facilities Manager
Wall Township Board of Education
1620 18th Avenue
Wall Township, NJ 07719

Sent Via Email: nmoretta@wall.k12.nj.us

Subject: Mercury Investigation Services
Wall Township Board of Education
1620 18th Avenue
Wall, NJ 07719
Partner Project No. 20-283593.1

Dear Mr. Moretta:

Partner Engineering and Science, Inc. (Partner) is pleased to provide the findings of the Industrial Hygiene Assessment conducted at the above-referenced facility.

This survey included a site reconnaissance, sampling, and laboratory analysis. This assessment was performed utilizing methods and procedures consistent with good commercial or customary practices designed to conform to acceptable industry standards. The independent conclusions presented herein are based upon existing conditions and the information and data available to us during this assignment.

We appreciate the opportunity to provide these services to Wall Township Board of Education. If you have any questions concerning this report, or if we can assist you in any other matter, please contact me at 908-497-0894

Sincerely,

Partner Engineering and Science, Inc.

Dan Bracey, GSP, CHMM
Project Manager – Industrial Hygiene Services, Health & Safety Services

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APPENDICES

EXECUTIVE SUMMARY

Partner Engineering and Science, Incorporated (Partner) was retained by Wall Board of Education to perform an Industrial Hygiene Assessment (IHA) at Wall High School located at 1620 18th Avenue in Wall Township, NJ on July 21, 2020. The IHA was performed in general conformance with the scope of work outlined in Partner's proposal dated July 6, 2020. The objective of the study was to investigate the presence of mercury vapor in the South Gym. A previous investigation performed by Partner on June 3, 2020 revealed no detectable mercury vapor in the South Gym or surrounding areas. The Client requested Partner return to Wall High School to collect additional air samples on a hotter day as well as collect an additional air sample from a classroom further from the South Gym. Partner utilized a different laboratory for sample analysis than the previous investigation and collected direct-read measurements with a Lumex RA-915+ Mercury Vapor Analyzer. After collection, the sample media were sealed and sent to an American Industrial Hygiene Association (AIHA) accredited laboratory for analysis.

Results were evaluated against the relevant Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) and the maximum contaminant level outlined by the New Jersey Department of Health (NJDOH) guidance document titled "*Evaluation and Management of Mercury-Containing Floors in New Jersey Schools: Guidance for School Districts and their Environmental Consultants*". PELs are legal exposure standards developed by OSHA.

All analytical results for area air samples collected during this assessment measured below the analytical detection limit for the method used and consequently were below the OSHA PEL and NJDOH guidance maximum contaminant level for mercury. Direct-read mercury vapor measured during this assessment also revealed results below both the OSHA PEL and NJDOH guidance maximum contaminant level. Based on this data, Partner has no further recommendations with respect to Mercury vapor exposure. Additional assessment activities should be conducted according to local, state and federal regulations and guidelines

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

Partner Engineering and Science, Inc. (Partner) performed an Industrial Hygiene Assessment (IHA) for Wall Board of Education (BOE) in general conformance with the scope of work outlined in Partner's proposal dated July 6, 2020. The IHA was completed at Wall High School on July 21, 2020. Dan Bracey, Project Manager, with Partner completed the IHA. Nicholas Moretta of Wall BOE was Partner's primary contact at the facility during the assessment.

1.2 BACKGROUND

Partner conducted an initial Mercury investigation on May 18, 2020, which included bulk sampling of the rubber-polyurethane floor in the South Gym (refer to Partner's Mercury Investigation report dated May 28, 2020). The results of the bulk sampling are found below. Mercury was detected at each bulk sample location. Based upon these results, Partner recommended collecting a representative number of full-day, breathing zone air samples in the South Gym for analysis by an accredited laboratory using NIOSH Method 6009.

June 3, 2020 Sampling Event

On June 3, 2020 Partner collected air samples within the affected building areas for mercury analysis. Air sampling was conducted in the designated areas, including the High School south gym. The air samples were analyzed using NIOSH method 6009: Mercury. Direct-read measurements for mercury were also collected during the air sampling event utilizing a J505 Mercury Vapor Analyzer. Based upon the results of the air sampling, Partner determined that mercury vapor was not detected above the laboratories minimum detection limit (MDL) in any of the samples and the direct-read measurements revealed mercury vapor measurements between 0 µg/m^3 and 0.06 µg/m^3, which is below the NJDOH maximum contaminant level (refer to Partners June 18, 2020 Industrial Hygiene Assessment report for additional information).

June 5, 2020 Sampling Event

Following the air sampling event, the Client requested Partner collect additional bulk samples of the polyurethane floors in the south gym. Partner returned to the High School on June 5, 2020 and collected three (3) additional bulk samples of the floor for analysis. The bulk samples revealed elevated concentrations of mercury within the rubber-like floors in the South Gym.

June 30, 2020 Sampling Event

On June 30, 2020 Partner collected five (5) bulk samples of the concrete slab from the gymnasium at Wall High School. The bulk samples were then split into two (2) samples per core (i.e., top 2 inches and bottom 2 inches) to determine mercury concentrations throughout the depth of the

slab. Additionally, Partner collected four (4) soil samples from below the concrete slab. The sample results revealed the underlying soils did not contain mercury concentrations that exceeded New Jersey Department of Environmental Protection (NJDEP) Soil Remediation Standards (SRS). The concrete sampling results revealed de minimis concentrations of mercury, with the exception of sample WHS630-2, which revealed a slightly elevated mercury concentration when compared the NJDEP SRS for mercury. Bulk samples of the concrete slab were collected to determine the absence or presence of mercury and soil samples were analyzed utilizing EPA method 7471B. Results of the concrete and soil sampling revealed de minimis concentration of mercury in both the soil and concrete, with slightly elevated concentrations of mercury in one concrete sample collected from the southeast corner of the gym (refer to Partner's July 16, 2020 Mercury Investigation report for additional information).

1.3 LIMITING CONDITIONS

This study utilized the sample collection procedure identified within the NJDOH guidance document, which recommends the ventilation within the room operate at the usual capacity. The exhaust fans and air handling units, which are combination heating and fresh air intakes, within the south gym were operating at normal capacity on arrival to the site and throughout the study. No dedicated air conditioning units were located within the gym. Temperatures within the gym at the time of the study ranged from 82°F to 91.5°F. The outside temperature was approximately 97°F and relative humidity was approximately 57%. No obvious limiting conditions were identified during the mercury vapor study.

2.0 METHODOLOGY

2.1 AIR SAMPLES

Mercury Vapor Sampling

Area air monitoring was conducted to evaluate the presence of mercury vapors in the South Gym. The air samples were collected using Buck Libra Plus LP-5 personal air sampling pumps. During sampling, tygon tubing was run from the sampling pump to the sampling media. The sampling media was clipped to a camera stand set between approximately 4 and 4.5 feet, i.e. the typical "breathing zone." Air was then drawn through the sampling media at a known flow rate. Samples collected in this manner are industry standard to represent possible exposure.

The specific sampling protocol, media used, and air flow through the media is identified in the table below.

Chemical Agent	Sampling and Analytical Method	Sampling Media*	Air Flow
Metal Fumes	NIOSH 6009	7 cm long solid charcoal sorbent tube	0.20 liters per minute (lpm)

The air flow rate through the sampling media was field calibrated prior to and after the sampling period using a BIOS Defender 510-L. The air flow meter was calibrated against a National Institute of Standards and Technology (NIST) standard. A copy of the calibration certificate is contained in Appendix D.

Direct-Read Measurements

A Lumex RA-915+ Mercury Vapor Analyzer was utilized to measure mercury vapors in the South Gym and surrounding areas during the mercury vapor sampling event. The mercury vapor analyzer was factory-calibrated in accordance with manufacturer requirements prior to the assessment (refer to Appendix D). Measurements were repeated two times throughout the day to account for temperature variations. The measurements were collected from between approximately 4 and 4.5 feet, i.e. the typical "breathing zone." Additional measurements were collected from the former concrete sampling locations, which were not yet fully repaired at the time of the sampling event to determine if mercury is vaporizing from these damaged floor areas. The Lumex sampling device was held at ground floor level to collect these measurements

3.0 STANDARDS & GUIDELINES

3.1 AIR SAMPLES

Federal

OSHA has established federal regulations for employee exposures to air contaminants that are published in Title 29, Code of Federal Regulations (CFR), Part 1910.1000. These standards set permissible exposure limits (PELs), most often as 8-hour time-weighted averages (TWAs), for a variety of chemical hazards. OSHA has also adopted action levels for some regulated chemical and physical hazards. If the action levels are exceeded, the employer must institute specific programs to control exposures and to protect workers.

For a limited number of chemicals, OSHA has promulgated standards, called short-term exposure limits (STELs) that allow employee exposures above the TWA for a defined period of time, usually 15 minutes. OSHA has also promulgated standards for some substances, called ceiling limits. The maximum peak exposures that OSHA has established for these chemicals, designated by a "C" preceding the concentration, must not be exceeded at any time during the work shift.

It is the goal of the sampling plan to collect an 8-hour sample. In this sampling event an 8-hour sample was not possible. As such, Partner assumed uniform exposure as a worst-case scenario for the un-sampled time period when calculating the 8-hour TWA. Samples were collected for over 7 hours.

When attempting to establish compliance with a promulgated standard such as a PEL, the air samples are traditionally collected on workers to collect personal air samples. In this case as there is no practical way to collect personal air samples without a significant disruption to the school's operation, Partner opted to collect area air samples within the normal breathing range. These measurements are considered by OSHA as screening samples and cannot be directly compared to PELs for regulatory compliance.

The OSHA PEL for mercury is a ceiling limit of 0.1 milligrams per cubic meter of air (mg/m^3), which is currently enforced as an 8-hour time-weighted average. Other organizations suggest lower exposure levels. The National Institute for Occupational Safety and Health (NIOSH) recommends that exposures to mercury metal be limited to an average of 0.05 mg/m^3 over a 10-hour workday, in addition to a ceiling limit of 0.1 mg/m^3. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that metallic mercury exposures be limited to an average of 0.025 mg/m^3 over an 8-hour workday. Whereas as the OSHA standard is enforceable, the NIOSH and ACGIH values are recommendations.

New Jersey

As per the NJDOH guidance document titled "*Evaluation and Management of Mercury-Containing Floors in New Jersey Schools: Guidance for School Districts and their Environmental Consultants*", exposure limits such as those by OSHA should not apply to school exposures as they apply to workers and more protective limits are necessary because children are being exposed. The guidance suggests using a guidance maximum contaminant level of 0.8 µg/m^3 (i.e., 0.0008 mg/m^3) for long term repeated 8-hour exposures for up to 180-days. Any detectable concentration of mercury vapor in the gym below this level would also require additional quarterly air sampling to determine if seasonal changes effect the mercury vapor concentration in the gym.

The guidance document "*Evaluation and Management of Mercury-Containing Floors in New Jersey Schools: Guidance for School Districts and their Environmental Consultants* can be found in the Appendix E of this report.

4.0 RESULTS

4.1 AIR SAMPLES

Five area samples for mercury vapor were collected, three (3) samples located within the south gym, one (1) sample located in the auxiliary gym and one (1) sample located within classroom E-12.

The air samples collected are compared to the applicable PELs and the NJDOH guidance maximum contaminant level in the Tables of Appendix A. At the time of the study, the gym was vacant, and the area samples represented the worst possible condition for exposure (i.e., exposure over a full day).

The samples collected indicate that the mercury vapors monitored were below the applicable PELs, NIOSH and ACGIH recommended limits, as well as the NJDOH guidance maximum contaminant level. The analytical results indicated concentrations of elemental mercury below the analytical method limit of detection. Refer to Appendix A for the laboratory results, Appendix B for a sample location map, and Appendix C for photographs of sampling locations.

Direct-Read Measurements

Direct-read measurements from six locations in the gym and surrounding areas were screened for mercury vapors utilizing a Lumex RA-915+ Mercury Vapor Analyzer. The measurements yielded the following information:

Measurement Location	Time	Result (ng/m^3)	NJDOH Maximum Contaminant Level (ng/m^3)
South Gym – South	0940	5	800
South Gym – Center	0940	23	800
Auxiliary Gym	0941	34	800
Locker Room Hallway	0942	47	800
South Gym – Northwest	0944	32	800
South Hallway	0945	22	800
Cafeteria	0948	16	800
Classroom E-12	0952	5	800
South Gym – South	1356	26	800
South Gym – Center	1357	42	800
Auxiliary Gym	1400	23	800
Locker Room Hallway	1402	26	800
South Hallway	1407	8	800
Cafeteria	1408	5	800
Classroom E-12	1411	2	800
South Gym – Southeast Concrete Sample Location	1355	617	800
South Gym – Center Concrete Sample Location	1356	621	800

ng/m^3 = nanograms per cubic meter

The direct-read measurements collected are compared to the applicable NJDOH guidance maximum contaminant level. All the measurements collected indicate that the mercury vapors monitored were below the NJDOH guidance maximum contaminant level. Per the NJDOH Guidance document, quarterly air sampling is recommended to account for seasonal variations.

5.0 RECOMMENDATIONS

Mercury vapor levels can be managed by ventilation and temperature control. The gym is equipped with six (6) air handling units, as well as two (2) exhaust fans in the ceiling. In accordance with the NJDOH guidance document "*Evaluation and Management of Mercury-Containing Floors in New Jersey Schools: Guidance for School Districts and their Environmental Consultants*". Partner recommends the following to ensure mercury vapors are properly controlled:

- Continue to use the gym under similar ventilation system conditions that the samples were collected.
- Perform quarterly, seasonal air sampling for mercury vapors throughout the year to ensure seasonal variability has been assessed. Elevated mercury vapors concentrations are related to temperature.
- Maintain the room temperature and ventilation system to remain consistent with the HVAC operations at the time of sampling.
- If conditions of the flooring change (i.e., cracks, signs of deterioration or damage), additional air sampling for mercury vapors is recommended.

In addition, the gym floor should be cleaned using non-abrasive methods. The current holes in the gym floor should be repaired and sealed to prevent further vaporizing of mercury into the gym.

In the event the floors are damaged and/or additional air sampling reveals mercury vapor exceeding the NJDOH maximum contaminant level, the floors should be removed and replaced with a non-mercury containing floor.

It is Partner's understanding that the air handling units in the south gym are combination heating and fresh air intake units. To assist in controlling any mercury vapors it may be prudent for Wall Township Board of Education to install air conditioning/cooling units in the south gym to control temperatures, although this is not required.

6.0 CLOSING

Results of this study are based on the conditions and activities which occurred during the site investigation. Substantial changes in the materials, conditions, or methods could affect future results.

Please contact us if you have any questions regarding this report. We thank you for this opportunity to be of service and hope you will consider us for any future occupational health and safety needs.

This report has been peer reviewed as a part of our internal quality process.

This report was prepared by:

Dan Bracey, GSP, CHMM
Project Manager
Industrial Hygiene & Health and Safety Services
PARTNER Engineering and Science, Inc.

This report was reviewed by:

Benjamin Jelin, Ph.D., CIH, CSP
Senior Project Manager,
Industrial Hygiene & Health and Safety Services
PARTNER Engineering and Science, Inc.

APPENDIX A

AIR SAMPLE RESULTS TABLES

PARTNER

Location:
Wall High School
1630 18th Avenue
Wall, NJ 07719

Table 1

Mercury Air Monitoring Results

July 21, 2020

PARTNER Engineering and Science, Inc.

Sample Type	Sample Number	Location	Contaminant	Measured Concentration	OSHA PEL	NJDOH Maximum Contaminant Level	Units	Duration Minutes	Flow (Lpm)
Area	WHS721-2	Locker Room Hallway	Mercury	<0.24	100 (C)	0.8	ug/m^3	420	0.2 / 0.2
Area	WHS721-3	South Gym - Northwest	Mercury	<0.12	100 (C)	0.8	ug/m^3	420	0.2 / 0.2
Area	WHS721-4	South Gym - Southeast	Mercury	<0.12	100 (C)	0.8	ug/m^3	417	0.2 / 0.2
Area	WHS721-5	Supply Closet	Mercury	<0.12	100 (C)	0.8	ug/m^3	415	0.2 / 0.2
Area	WHS721-6	South Gym - Southwest	Mercury	<0.12	100 (C)	0.8	ug/m^3	411	0.2 / 0.2

Notes:
C = Ceiling Limit

KEY:

ACGIH® - American Conference of Governmental Industrial Hygienists
C - Ceiling limit: A concentration that is not to be exceeded at any part of the workday
i – As the inhalable fraction
lpm – Liters per minute
mg/m3 – Milligrams per cubic meter
NE – Not established
NA – Not applicable
< - Denotes less than

PEL – Permissible Exposure Limit
ppm – Parts Per Million
R – As the respirable fraction
STEL – Short Term Exposure Limit
TLV® - The ACGIH® Threshold Limit Value
TWA – Time-Weighted Average (8-hour basis)
µg – Micrograms
µg/m³ – Micrograms per cubic meter
***** - Internal pump timer used for run time

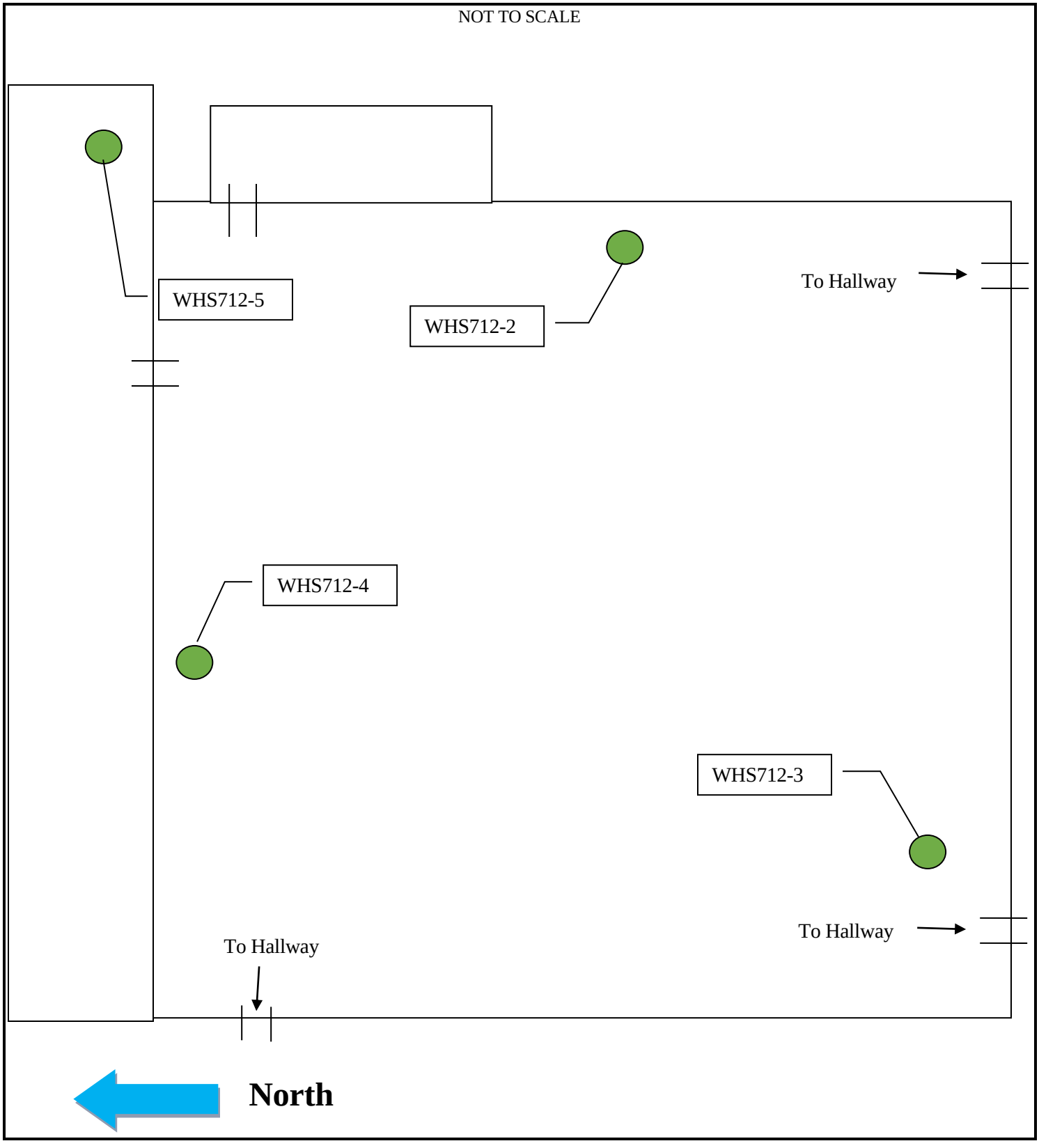
Calibrator Used:
BIOS Defender 510-L

Collected By:
Dan Bracey (Partner)

APPENDIX B

SAMPLE LOCATION DIAGRAM

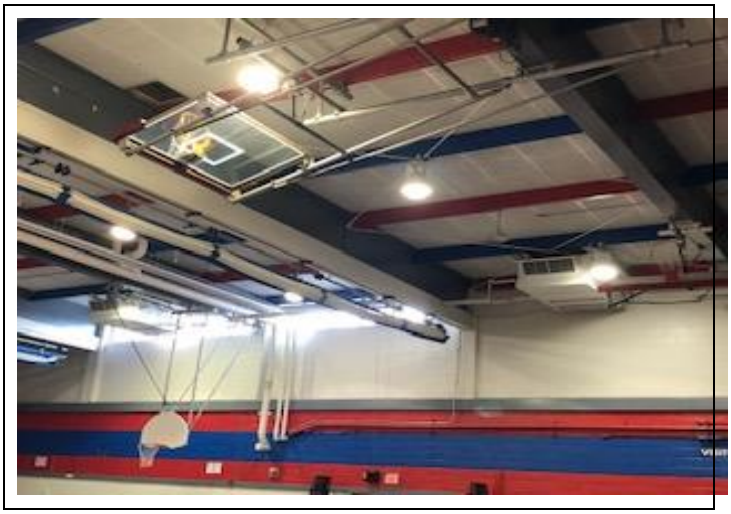
PARTNER


NOT TO SCALE
WHS712-5
WHS712-2
To Hallway
WHS712-4
WHS712-3
To Hallway
To Hallway
North
Approximate Sample Location
Wall High School
Air Sample Location

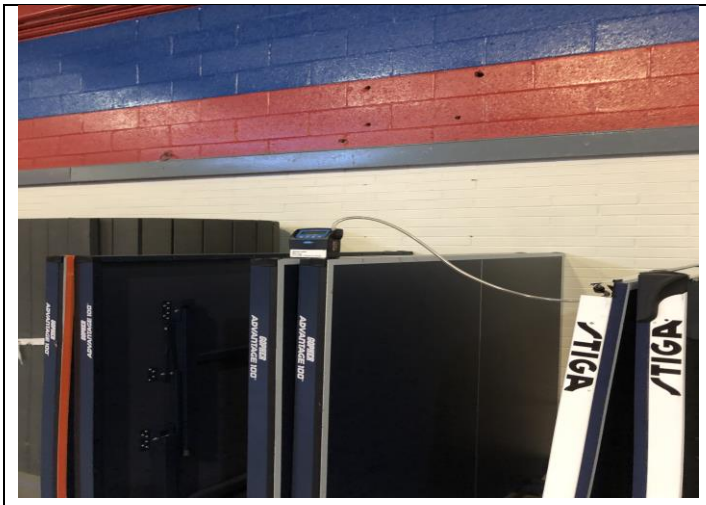
APPENDIX C

PHOTOGRAPHS

PARTNER



1. View of South Gym.



2. View of air sample setup.

3. View of ceiling exhaust fan.

4. View of auxiliary gym.

APPENDIX D

CALIBRATION DOCUMENTS

PARTNER

INSTRUMENT CALIBRATION REPORT

Pine Environmental Services LLC
92 North Main St, Building 20
Windsor, NJ 08561
Toll-free: (800) 301-9663

Pine Environmental Services, Inc.

Instrument ID 16346
Description BIOS Defender 510-L
Calibrated 7/13/2020 8:44:46AM

Manufacturer Bios
Model Number Defender 510
Serial Number/ Lot Number S/N 116663
Location New Jersey
Department

State Certified
Status Pass
Temp °C 25
Humidity % 36

Calibration Specifications

Group # 1
Group Name Tested against low flow pumps
Test Performed: Yes **As Found Result: Pass** **As Left Result: Pass**

Test Instruments Used During the Calibration

(As Of Cal Entry Date)

Test Standard ID	Description	Manufacturer	Model Number	Serial Number / Lot Number	Next Cal Date / Last Cal Date/ Expiration Date Opened Date

Notes about this calibration

Calibration Result Calibration Successful
Who Calibrated Kemar Rumble

Pine Environmental Services LLC according to the manufacturer's

INSTRUMENT CALIBRATION REPORT

Advanced Labs, Inc.

Pine Environmental Services, Inc

Instrument ID 16346
Description Bios Defender 510-L
Calibrated 7/6/2020

Manufacturer Bios
Model Number 510-L
Serial Number 116663
Location New Jersey
Temp 75

Classification
Status pass
Frequency Yearly EOM
Department Lab
Humidity 37

Calibration Specifications

Group # 1
Group Name Calibration
Stated Accy Pct of Reading

Range Acc % 0.0000
Reading Acc % 1.0000
Plus/Minus 0.00

Nom In Val / In Val	In Type	Out Val	Out Type	Fnd As	Lft As	Dev%	Pass/Fail
30.00 / 30.33	cc/min	30.33	cc/min	30.20	30.20	-0.43%	Pass
100.00 / 100.36	cc/min	100.36	cc/min	100.20	100.20	-0.16%	Pass
500.00 / 500.04	cc/min	500.04	cc/min	497.50	497.50	-0.51%	Pass

Test Instruments Used During the Calibration

Test Instrument ID	Description	Manufacturer	Serial Number	(As Of Cal Entry Date) Last Cal Date	Next Cal Date
ML-500-10	Met Lab ML-500-10	Bios International	119826	3/26/2020	3/26/2021
ML-500-24	Met Lab ML-500-24	Bios International	116617	3/26/2020	3/26/2021
ML-500-44	Met Lab ML-500-44	Bios International	120274	3/26/2020	3/26/2021
ML-500-B	Met Lab ML-500-B	Bios International	120696	3/26/2020	3/26/2021

Notes about this calibration

Calibration Result Calibration Successful
Who Calibrated David Galego

Advanced Labs, Inc. hereby certifies that this instrument is calibrated and functions to meet the manufacture's specifications using NIST traceable standards, or is derived from accepted values of physical constants.

INSTRUMENT CALIBRATION REPORT

Pine Environmental Services LLC
92 North Main St, Building 20
Windsor, NJ 08561
Toll-free: (800) 301-9663

Pine Environmental Services, Inc.

Instrument ID 13739
Description Ohio Lumex 915
Calibrated 7/17/2020 10:40:57AM

Manufacturer Lumex
Model Number 915
Serial Number/ Lot Number 1211
Location New Jersey
Department

State Certified
Status Pass
Temp °C 22.6
Humidity % 55

Calibration Specifications

Group # 1
Group Name Baseline Test - Deviation (R%) less then 25%
Test Performed: Yes
As Found Result: Pass
As Left Result: Pass

Test Instruments Used During the Calibration (As Of Cal Entry Date)

Test Standard ID	Description	Manufacturer	Model Number	Serial Number / Lot Number	Next Cal Date / Last Cal Date/ Expiration Date Opened Date

Notes about this calibration

Calibration Result Calibration Successful
Who Calibrated Kelly McGuire

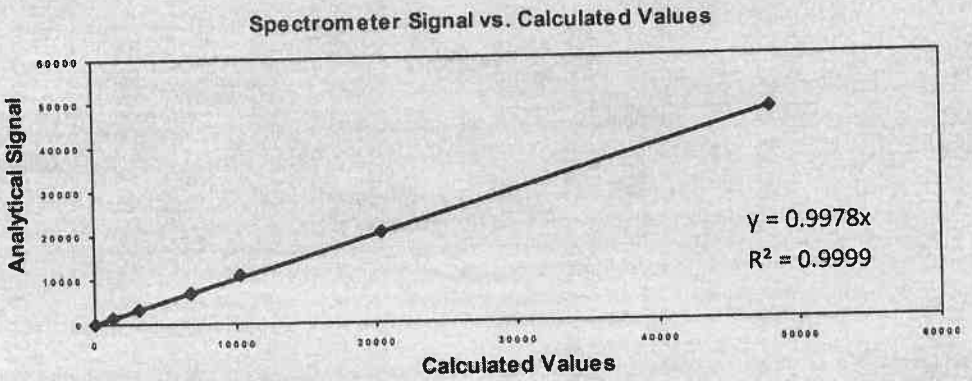
All instruments are calibrated by Pine Environmental Services LLC according to the manufacturer's specifications, but it is the customer's responsibility to calibrate and maintain this unit in accordance with the manufacturer's specifications and/or the customer's own specific needs.

Notify Pine Environmental Services LLC of any defect within 24 hours of receipt of equipment
Please call 800-301-9663 for Technical Assistance

OHIO LUMEX Spectrometer Calibration Certificate

RA-915+ 1211

Standard No.	Temp (°C)	Calculated Value	Signal (10m cell)
1	25	0	0
2	25	1228	1177
3	25	3143	3132
4	25	6745	6794
5	25	10346	10759
6	25	20422	20399
7	25	47922	47837



Calibration Gas certified value: 2.6 µg/m³ **Reading observed: 2.6 µg/m³**

Calibration Parameter A: 863 **Calibration Parameter B: 45730**

CALIBRATION DATE: 7/15/2020 **NEXT CALIBRATION DUE: 7/16/2021**

ON THE DATE CALIBRATED, THIS UNIT OPERATED WITHIN SPECIFIED TOLERANCES

Digital Barometer: Cert. 1081-8782151 Cal. Due 6/22/2021

Digital Thermometer: Cert. 1081-8782151 Cal. Due 6/22/2021

Gas NIST Traceable Standard: Themo Hg Calibrator Serial # 0722923640

Concentration: 2.6ug/m3, Analytical Accuracy: +/- 10%, Recertification Date: 6/23/2022

Service Technician:

Air Quality Instruments
27 Forge Parkway
Franklin, MA 02038 USA
(866) 282-0430
(508) 520-0430
www.thermoscientific.com/AQI

ThermoFisher SCIENTIFIC

Thermo Scientific Model 81i Calibrator Certification Report

Certification Date: 6/23/2020

	Candidate		*Reference*
Location:	THERMO	ID.	Vendor Prime
Device:	81i-Ohio Lumex Company	S/N:	0712322224
S/N:	0722923640		
RA# SE-2005290899	Chiller Temp 7 Deg C		Chiller S/N 202

As Found Data: *As Left Data:*

Candidate User Information		Candidate User Generator Certification					Reference Generator
		Certification Values		Certifications Uncertainties			Uncertainties
Setpoint	Value	Setpoint	Certified	1σ	2σ	Relative	Expanded
µg/scm	µg/scm	µg/scm	µg/scm	µg/scm	µg/scm	2σ, %	2σ, %
2.7	2.74	2.7	2.70	0.0264	0.0528	1.95%	2.11%
5.7	6.03	5.7	5.74	0.0359	0.0719	1.25%	2.05%
8.1	8.73	8.1	8.17	0.0468	0.0935	1.14%	1.98%

At each concentration level, the results of the bracketing certification procedure are acceptable if the expanded uncertainty of the elemental mercury generator concentration, calculated in accordance with Section 6.3 in the Interim EPA Traceability Protocol for Qualification and Certification of Elemental Mercury Gas Generators, does not exceed 5.0 percent of the certified value, or is not more than 2.0 percent above the Vendor Prime uncertainty at the closest set point, whichever is less restrictive (Source Interim EPA Traceability Protocol for Qualification and Certification of Elemental Mercury Gas Generators Section 6.4)

Protocol applies only to Hg monitoring system span values greater than or equal to 5.0 micrograms per cubic meter (µg/m3; (Source Interim EPA Traceability Protocol for Qualification and Certification of Elemental Mercury Gas Generators: Section 1.0)

This document certifies that the above instrument has been calibrated and tested in accordance with Thermo Fisher Scientific procedure conducted under the conditions noted with standards, which are certified traceable to the National Institute of Standards and Technology (NIST). This Calibration Certificate may not be reproduced expect in full, without written permissions from Thermo Fisher Scientific. The results of this report relate only to the instrument tested and calibrated as identified on this certificate.

Calibration

Certification

APPENDIX E

LABORATORY ANALYTICAL RESULTS

PARTNER

EMSL Analytical, Inc.
200 Route 130 North, Cinnaminson, NJ 08077
Phone: (856) 303-2500 Fax: (856) 858-4571 Email: EnvChemistry2@emsl.com

Attn: **Daniel Bracey** 7/30/2020
Partner Engineering and Science, Inc.
611 Industrial Way West
Eatontown, NJ 07724
Phone: (732) 380-1700
Fax: (732) 380-1701

The following analytical report covers the analysis performed on samples submitted to EMSL Analytical, Inc. on 7/23/2020. The results are tabulated on the attached data pages for the following client designated project:

Wall BOE/20-286459.1

The reference number for these samples is EMSL Order #012007647. Please use this reference when calling about these samples. If you have any questions, please do not hesitate to contact me at (856) 303-2500.

Approved By:

Phillip Worby, Environmental Chemistry
Laboratory Director

The test results contained within this report meet the requirements of NELAP and/or the specific certification program that is applicable, unless otherwise noted.
NELAP Certifications: NJ 03036, NY 10872, PA 68-00367, CA ELAP 1877

The samples associated with this report were received in good condition unless otherwise noted. This report relates only to those items tested as received by the laboratory. The QC data associated with the sample results meet the recovery and precision requirements established by the NELAP, unless specifically indicated. All results for soil samples are reported on a dry weight basis, unless otherwise noted. This report may not be reproduced except in full and without written approval by EMSL Analytical, Inc.

EMSL Analytical, Inc.
200 Route 130 North, Cinnaminson, NJ 08077
Phone/Fax: (856) 303-2500 / (856) 858-4571
http://www.EMSL.com EnvChemistry2@emsl.com

EMSL Order: 012007647
CustomerID: 32PRTN78G
CustomerPO:
ProjectID:

Attn: **Daniel Bracey**
Partner Engineering and Science, Inc.
611 Industrial Way West
Eatontown, NJ 07724

Phone: (732) 380-1700
Fax: (732) 380-1701
Received: 07/23/20 10:00 AM

Project: **Wall BOE/20-286459.1**

Analytical Results

Client Sample Description WHS721-2 S. Gym-East ***Collected:*** 7/21/2020 ***Lab ID:*** *012007647-0001*

Method	*Parameter*	*Result*	*RL*	*Units*	*Prep Date & Analyst*	*Analysis Date & Analyst*
METALS						
6009	Mercury	ND D	0.24	µg/m³	7/28/2020	07/28/20 17:52

Client Sample Description WHS721-3 S. Gym-SW ***Collected:*** 7/21/2020 ***Lab ID:*** *012007647-0002*

Method	*Parameter*	*Result*	*RL*	*Units*	*Prep Date & Analyst*	*Analysis Date & Analyst*
METALS						
6009	Mercury	ND	0.12	µg/m³	7/28/2020	07/28/20 16:31

Client Sample Description WHS721-4 S. Gym-N ***Collected:*** 7/21/2020 ***Lab ID:*** *012007647-0003*

Method	*Parameter*	*Result*	*RL*	*Units*	*Prep Date & Analyst*	*Analysis Date & Analyst*
METALS						
6009	Mercury	ND	0.12	µg/m³	7/28/2020	07/28/20 16:33

Client Sample Description WHS721-5 Aux Gym ***Collected:*** 7/21/2020 ***Lab ID:*** *012007647-0004*

Method	*Parameter*	*Result*	*RL*	*Units*	*Prep Date & Analyst*	*Analysis Date & Analyst*
METALS						
6009	Mercury	ND	0.12	µg/m³	7/28/2020	07/28/20 16:35

Client Sample Description WHS721-6 E-12 ***Collected:*** 7/21/2020 ***Lab ID:*** *012007647-0005*

Method	*Parameter*	*Result*	*RL*	*Units*	*Prep Date & Analyst*	*Analysis Date & Analyst*
METALS						
6009	Mercury	ND	0.12	µg/m³	7/28/2020	07/28/20 16:45

EMSL Analytical, Inc.
200 Route 130 North, Cinnaminson, NJ 08077
Phone/Fax: (856) 303-2500 / (856) 858-4571
http://www.EMSL.com EnvChemistry2@emsl.com

EMSL Order: 012007647
CustomerID: 32PRTN78G
CustomerPO:
ProjectID:

Attn: **Daniel Bracey**
Partner Engineering and Science, Inc.
611 Industrial Way West
Eatontown, NJ 07724

Phone: (732) 380-1700
Fax: (732) 380-1701
Received: 07/23/20 10:00 AM

Project: **Wall BOE/20-286459.1**

Analytical Results

Client Sample Description F-1 ***Collected:*** 7/21/2020 ***Lab ID:*** *012007647-0006*

Method	*Parameter*	*Result*	*RL Units*	*Prep Date & Analyst*	*Analysis Date & Analyst*
METALS					
6009	Mercury	ND	0.010 µg/tube	7/28/2020	07/28/20 16:47

Client Sample Description F-2 ***Collected:*** 7/21/2020 ***Lab ID:*** *012007647-0007*

Method	*Parameter*	*Result*	*RL Units*	*Prep Date & Analyst*	*Analysis Date & Analyst*
METALS					
6009	Mercury	ND	0.010 µg/tube	7/28/2020	07/28/20 16:49

Definitions:

MDL - method detection limit
J - Result was below the reporting limit, but at or above the MDL
ND - indicates that the analyte was not detected at the reporting limit
RL - Reporting Limit (Analytical)
D - Dilution Sample required a dilution which was used to calculate final results

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Industrial Hygiene
Chain of Custody

EMSL Order Number (Lab Use Only): 012007647

EMSL ANALYTICAL, INC.
200 ROUTE 130 NORTH
CINNAMINSON, NJ 08077
PHONE (800) 220-3675
FAX (856) 858-3502

Report To Contact Name: Dan Bracey			Bill To Company: Same as Report to		Client ID #:
Company Name: Partner Engineering and Science			Attention To:		
Street: 611 Industrial Way W,			Street:		
City: Eatontown	State/Province: NJ	Zip/Postal Code: 07724	City:	State/Province:	Zip/Postal Code:
Phone: (908) 497-8901 Fax:			Phone:	Fax:	
Project Name: Wall BOE/20-286459.1			Email Results To: dbracey@partnersi.com		U.S. State where Samples Collected: NJ
# Samples in Shipment: 7	Date of Shipment: 7/22/20		Purchase Order:	Sampled By (Signature):	

Turnaround Time (TAT) – Please Check: If No Selection Made, Standard 2 Week TAT Will Apply

☐ 2 Week ☒ 1 Week ☐ 4 Day ☐ 3 Day ☐ 2 Day ☐ 1 Day ☐ Other (Call Lab)

Media Type: Carulite TUBE
Manufacturer/Part #: 286-17-1A Lot #: 13010

	Client Sample ID	Sample Date	Location	Description	Sample Type	Flow (lpm)	Sample Time On	Sample Time Off	Air Volume	Analyte Name	Media	Comments (serial #)
1	WHS721-2	7/21/20	S. Gym-East		☒ Area ☐ Personal	0.2	0845	1545	84	Mercury Hg	Carulite	8834603520
2	WHS721-3		S. Gym-SW		☒ Area ☐ Personal		0857	1557	84			8834603521
3	WHS721-4		S. Gym-N		☒ Area ☐ Personal		0903	1600	83.4			8834603527
4	WHS721-5		Aux Gym		☒ Area ☐ Personal		0909	1604	83			8834603524
5	WHS721-6		E-12		☒ Area ☐ Personal		0920	1611	82.2			8834603526
6	F-1		—	Field Blank	☒ Area ☐ Personal	—	—	—	—			8834603520
7	F-2		—	Field Blank	☒ Area ☐ Personal	—	—	—	—			8834603523
					☐ Area ☐ Personal							

Note: Most NIOSH and OSHA methods require field blanks. It is the IH field sampler's responsibility to submit the proper number of field blanks and duplicates.

Released By	Date	Received By	Date
	7/22/20	CP	7/23/20 10AM

Comments:

1 of 1 pages

21.3°

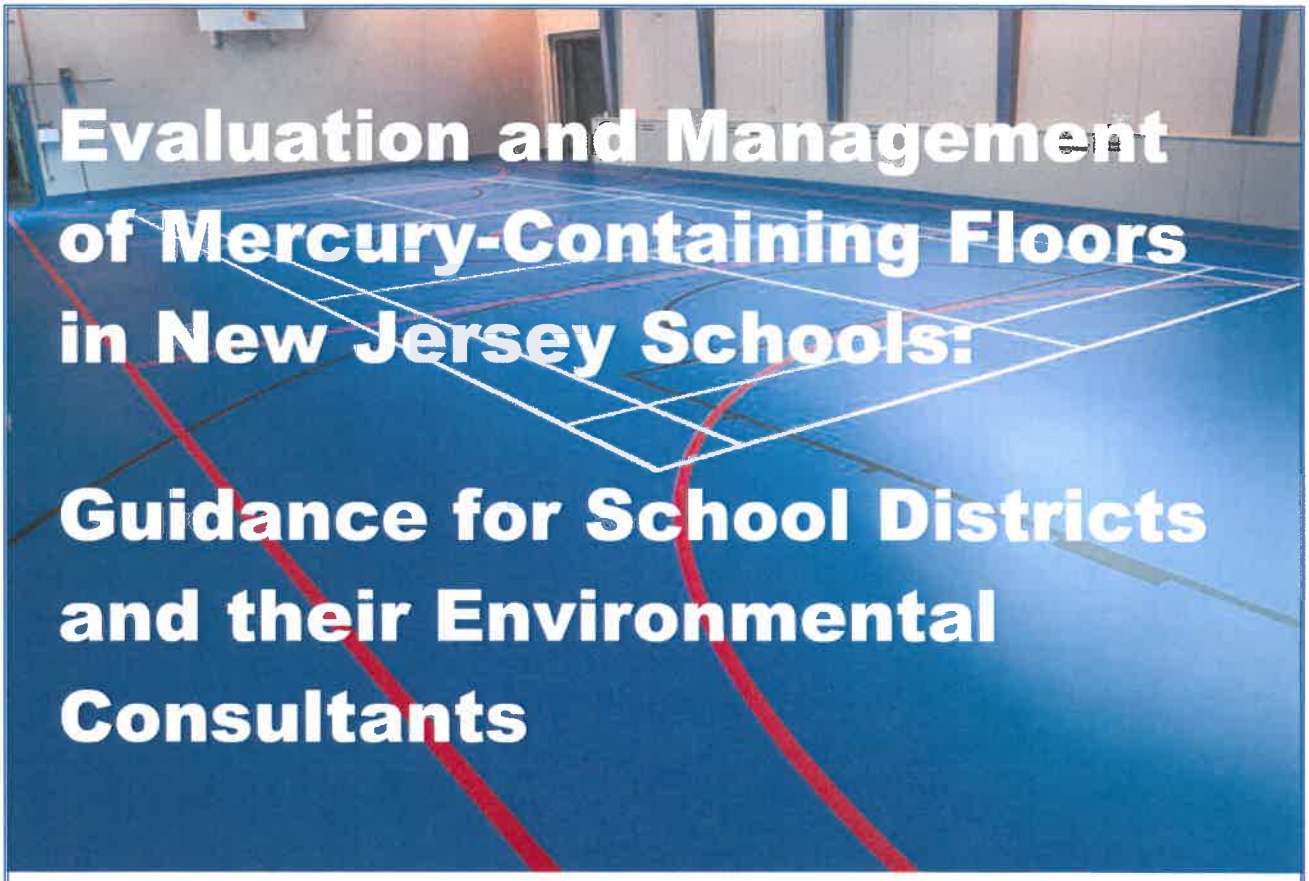
Page 1 Of 1

OrderID: 012007647

APPENDIX F

NJDOH GUIDANCE DOCUMENT

PARTNER



Evaluation and Management of Mercury-Containing Floors in New Jersey Schools:

Guidance for School Districts and their Environmental Consultants

February 6, 2020

Health Consultation
prepared by:

New Jersey Department of Health
Environmental and Occupational Health Surveillance Program

Table of Contents

Purpose

This guidance document provides a systematic approach for school districts and their environmental consultants to evaluate whether installed mercury-containing flooring systems emit mercury vapors in excess of New Jersey Department of Health's (NJDOH) recommended maximum contaminant level of 0.8 micrograms per cubic meter ($\mu g/m^3$) of air.

Introduction

In the 1960s, a number of companies began manufacturing and installing a thin layer of synthetic, polyurethane flooring on top of concrete sub-floors, to provide a resilient and rubberlike surface (ATSDR 2010; ATSDR 2006a; ATSDR 2006b). Typically, liquid polyurethane was poured directly over concrete sub-floors, and in some cases over a rubberized shock-absorbing cushion material. Certain formulations of polyurethane incorporated mercury catalysts, such as phenylmercuric acetate (PMA), to produce a solid, seamless rubber-like floor. Depending on the required thickness of the floor, multiple pours of polyurethane were often employed. The concentration of mercury in such polyurethane flooring systems are reported to contain between 0.1 and 0.2 percent total mercury (Bush 2011; ATSDR 2006a; Reiner 2005).

Mercury-containing polyurethane floors were widely installed in school gymnasiums across the United States until being reportedly discontinued amid concerns over their emissions of elemental mercury vapor (NEWMOA 2010). It is to be noted that depending on the type and brand of polyurethane flooring, these floors may have been installed even as late as in 2005 or 2006 (Washington Township, New Jersey 2019; Bush 2011).

The following list of manufacturers are consistently referenced as having produced polyurethane products known to contain PMA in their formulation (Garrison, 2019). It is important to recognize this list is not an all-inclusive list. It is believed other manufacturers may also have included mercury catalysts in their polyurethane flooring systems.

- 3M under the name of Tartan® floors and Tartan® track
- American Biltrite Rubber Co. Inc.
- Amtico Rubber Flooring
- Athletic Polymer Systems (APS)
- Chemothane
- Crossfields Products (DexOTex)
- Mondo Rubber
- Pitzer Inc.
- Pulastic Systems
- Robbins Sport Surfaces - Chemturf
- Selby Battersby & Company Surfacing Systems

- Sportan Surfaces, Inc.
- Whittaker Synthetic Surfaces

Studies have shown that some of these flooring systems emit mercury vapor into the indoor air, leading to a concern about mercury exposures in schools. It is not known how many of these floors currently exist, whether they are still being installed, or what schools have them (ATSDR 2004; ATSDR 2006a; ATSDR 2006b; ATSDR 2010; Bush 2011; Garrison 2019).

This document provides guidance to school districts investigating the potential mercury vapors being emitted from these floors.

Steps for Assessment of Flooring

1. School districts should conduct a visual inspection to determine if poured-polyurethane floors (soft material in one contiguous piece that is clearly not wood or tile) have been installed in the school. If this type of flooring is identified in the school, a licensed indoor environmental consultant should be hired. A list of these consultants can be found on the Department's website at: https://www.nj.gov/health/ceohs/documents/childcare/conslt.pdf

2. Check if the manufacturer is noted in the list above and/or review the floor's Safety Data Sheet (SDS) for PMA. If the presence of PMA is confirmed, then skip step 3 below (as bulk sampling is not necessary to confirm the presence of mercury). It is not possible to rule out the potential presence of mercury based on the list above as other flooring system manufacturers and installers may have incorporated PMA in their polyurethane formulations. Further, the SDS may not be conclusive as the company might list the PMA ingredient as proprietary information.

3. If the record review was inconclusive, the district and its consultant may choose to collect a bulk sample of the flooring material to test for the presence of mercury. A bulk sampling plan overview is outlined below for the consultant to follow. The consultant will determine the timing between the bulk sampling and any indoor air sampling as these should not occur concurrently. The bulk sampling test may be informative in confirming there is no mercury present. The bulk sample must be analyzed by an American Industrial Hygiene Association (AIHA) accredited laboratory available at: https://www.aihaaccreditedlabs.org/

4. If the record review or bulk sampling confirmed the presence of mercury in the flooring, an appropriate air testing and monitoring program is warranted. A sampling plan overview is outlined below for your consultant to follow.

Sampling Plan Overview

A sampling plan that includes specific sampling and analytical methods is critical for evaluating mercury levels contained in synthetic flooring and the mercury levels in the indoor air. The district should hire and work with a licensed environmental consultant to understand the sampling plan before the plan is implemented. The consultant must provide sampling protocols, procedures, and an understanding of how to interpret the results to the district. The details for these procedures are provided in the sections below.

Bulk Sampling

The purpose of the bulk sampling is to determine if mercury is present in the flooring material and if indoor air monitoring is necessary. A sampling plan must be developed to ensure that the bulk samples are representative of the floor area(s) being evaluated. As noted above, the consultant will determine the timing between the bulk sampling and any indoor air sampling as these should not occur concurrently. The plan must include a diagram of the floor(s) showing the sampling locations and the laboratory results of the bulk samples. The environmental consultant should identify the rooms that contain the suspect flooring, coordinate the collection of bulk samples with school facilities staff, and execute the bulk sampling plan. The environmental consultant must ensure that all floor sampling locations are sealed and repaired after the bulk samples are collected.

Sampling Methods and Procedures

1. An appropriate size sample of the flooring material needs to be collected for analysis. The thickness of most poured polyurethane floors typically ranges from ¼-inch to 1-inch. Bulk samples of rubberized floor must represent the entire thickness/depth of the floor material. Sampling of only the surface or partial thickness of the floor must be avoided. Coring tools are commonly used to collect the bulk sample of the floor material. The environmental consultant must provide information on the bulk sample collection tools as well as the procedure to collect the sample from the entire thickness of the floor.

2. The recommended number of samples is: one floor sample from rooms that are less than 1,000 square feet, two samples from rooms 1,000 to 5,000 square feet, and three samples from rooms greater than 5,000 square feet. The sample locations should be selected, to the extent possible, in areas where the sample extraction is less likely to present a visual blemish (such as in room corners, in closets, behind doors, etc.)

Bulk samples of floor material must be analyzed using USEPA Method 7471B to determine the mercury content. An accredited laboratory should be contacted to ensure the proper amount of floor material is being collected. Typically, laboratories require 10 grams of floor material to analyze for mercury content.

If the floor contains mercury at any concentration, the NJDOH recommends sampling of the indoor air to evaluate the mercury vapor levels.

Indoor Air Sampling

The primary route of exposure to mercury vapor is through inhalation. Therefore, it is important to conduct air sampling to provide data which characterizes the mercury vapor levels in the indoor air.

General Requirements

- An indoor air sampling plan must be developed before any samples are collected. The sampling plan should ensure that air samples are taken from several locations to be representative of the floor area or room being evaluated. Samples should be collected at the breathing zone level, which is typically between three to five feet above the floor. Your consultant should include procedures for using a direct read instrument, the NIOSH 6009 method or both in the plan. See below for general sampling requirements using these methods. For all sampling plans, a diagram of the floor area or room showing the locations of the air samples must be developed. Sampling adjacent hallways and rooms should be included in the sampling plan. Ambient readings should be collected outside the facility to establish background levels.

Airborne mercury levels are affected by the operation of the Heating, Ventilation and Air Conditioning (HVAC) system. Given this relationship, the indoor air samples should be collected under typical HVAC operational conditions. Sampling under these conditions will represent the typical ventilation and temperature conditions under which the building is being maintained and occupied. The room temperature and typical operational settings of the HVAC system should be documented prior to collecting any air samples.

Field notes should include a visual inspection of the condition of the floor at locations where samples are collected, specifically noting if the floor surface is compromised in any manner.

Sampling Methods and Procedures

The following two widely used sampling and analytical methods are available for quantifying mercury levels in the indoor air.

1. Direct Reading Instruments:

- The Lumex RA-915M Mercury Vapor Analyzer (OhioLumex Co., Inc.,) or the Jerome J505 (AMETEK Arizona Instrument) can be used to measure mercury vapor concentrations in air. These direct read instruments are portable mercury

vapor analyzers that have very little cross-sensitivity to chemicals other than elemental mercury. These instruments have low detection limits (ranging from 0.002 micrograms per cubic meter ($\mu g/m^3$) to 0.05 $\mu g/m^3$) and can measure mercury vapor levels under a variety of sample collection protocols.

Sample Collection Procedures

- Ensure that the instrument has been properly calibrated according to the manufacture's recommended procedures. Calibration records must be retained to document that the instrument is functioning correctly.
- Temperature, humidity, and air pressure measurements must be collected during the sampling events.
- Direct read measurements should be taken in a predetermined pattern throughout the gym/room where the flooring material is located.
- Direct reading measurements should be taken at various heights above the floor.
- Readings collected at locations where the floor surface is compromised should be noted.

2. Industrial Hygiene Sampling:

- NIOSH Method 6009 - Analysis of Mercury in Air, is a common method for collecting airborne mercury vapors for laboratory analysis. Using this method, samples may be collected over customized periods of time to represent typical occupied conditions. The sample collection method includes a solid sorbent tube (Hopcalite sample collection media) which is connected to a properly calibrated sampling pump. Sampling pumps must be calibrated using a recognized primary standard to document the sampling flowrate. The NIOSH 6009 method should be consulted for the sample collection flowrates and detection limits.

Sample Collection Procedure

- To be representative of the gym/room, three to five samples should be collected. The number of samples within the gym/room may vary depending on the size of the room being evaluated. When determining the number of samples to be collected, the consultant should ensure that there are a sufficient number of samples to represent the gym/room and adjacent areas being evaluated.
- Temperature, humidity, and air pressure measurements must be collected during the sampling events.
- Samples should be collected at a height between three and five feet above the floor.
- The sampling time should be between six to eight hours to represent a typical day within the gym/room.
- Samples should be collected at a flowrate between 0.20 – 0.25 liters per minute (LPM)
- Collect between 90 and 100 liters of air to ensure that the lowest limit of detection (LOD) for the method is reached.

- Record the sampling information on a chain of custody form for submission to the accredited laboratory.
- Follow the quality control procedures outlined in the method for the submission of blank samples to the laboratory.
- Submit the samples to an accredited laboratory for analysis.

Risk Assessment

The primary exposure to mercury vapor is by inhalation. The NJDOH has adopted Standards for Indoor Environment Certification and for Licensure of Indoor Environmental Consultants (N.J.A.C. 8:50[1]). These regulations provide a risk assessment model that can be used to evaluate indoor air contaminants for school children and staff. This model is very conservative and adjusts for body weight, inhalation rate, and the amount of time spent in school for both children and staff. Based on the toxicological information and this regulated risk assessment model, the NJDOH has issued a guidance maximum contaminant level of 0.8 µg/m^3 for evaluating mercury in flooring. **This level is protective for children as young as three years old and is based on an exposure frequency of 8-hours per day for 180 days (NJDOH 2017).** The NJDOH acknowledges that there are other guidance levels for mercury vapors established by ATSDR, USEPA and other states, but there is no national standard (ATSDR 2004; 2006a; 2006b; 2010; Bush 2011; OEHHA; USEPA). The NJDOH guidance value is based on the exposure scenario in the risk model that is protective of preschool-aged children and a level at which adverse health effects are not likely to occur.

Evaluate and Mitigate Exposures

Based on the air sampling results, school districts may encounter the following scenarios:

Airborne mercury levels lower or equal to 0.8 µg/m^3

- Continue to use the gym/room under the occupied conditions that the samples were collected.
- Quarterly, seasonal sampling is recommended to ensure that the seasonal variability's impact on mercury concentrations is captured. Assessing the seasonal mercury level variation will ensure that the mercury indoor air level is always lower than 0.8 µg/m^3. Mercury vapor levels are related to temperature, so it is important to test during all seasons, especially during the heat of the summer.
- Maintain the room temperature and ventilation system to remain consistent with the operations at the time of sampling.

[1] https://www.nj.gov/health/ceohs/documents/eohap/njac_850_adoption.pdf

- If conditions of the flooring change, i.e., if there are cracks or other signs of deterioration or damage, resampling of mercury vapors in indoor air is necessary.
- Mercury vapor levels can be managed by active ventilation and temperature control of the room.

Airborne mercury levels above 0.8 µg/m³

- Work with the environmental consultant to develop a feasible plan to reduce the mercury vapor levels below 0.8 µg/m³. Mercury vapor levels can be reduced by active ventilation and temperature control of the room.
- Make adjustments to the HVAC system including increasing the ventilation/fresh air intake and/or lowering the temperature in the room. Verify (by retesting) that these adjustments have reduced mercury vapor levels to equal to or less than 0.8 µg/m³.
- If these adjustments are inadequate to maintain the levels to 0.8 µg/m³ or below, reduce the amount of time spent in the room to less than 8 hours per day or do not allow use of the room.
- If ventilation adjustments sufficiently reduce the levels to less than or equal to 0.8 µg/m³, monitor the indoor air at least quarterly to evaluate the mercury levels during other seasons.
- If ventilation adjustments do not sufficiently reduce the levels to less than or equal to 0.8 µg/m³, additional actions including removal of the flooring should be considered. Discussions with the environmental consultant will be needed to determine the appropriate course of action.

In addition, the gym floor should be cleaned using non-abrasive cleaning methods to avoid damaging the floor which could result in an increase in mercury emissions into the air.

Disposal of Floor Materials

If the flooring contains mercury and a decision is made to remove it, a determination needs to be made whether the material would be regulated as a hazardous waste for disposal. Contact the NJDEP's Bureau of Solid and Hazardous Waste[2] for information on the proper disposal of the flooring material. The Bureau of Solid and Hazardous Waste can be reached at (609) 633-1418 or (609) 984-0565.

For general questions, please contact the NJDOH - Consumer, Environmental, & Occupational Health Services at 609-826-4920.

[2] https://www.nj.gov/dep/enforcement/hw.html; https://www.nj.gov/dep/easyaccess/compenf.htm#hazwastecompenf

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Washington Township Public Schools, Gloucester County, New Jersey March 2019. Rubberized Flooring Mercury Investigation – Occupied Air Sampling Report. March 26, 2019.

Technical Resources

Analytical Methods for Mercury

- EPA 7471B Mercury in solid or semisolid waste (manual cold-vapor technique) https://www.epa.gov/sites/production/files/2015-07/documents/epa-7471b.pdf
- EPA TCLP Method 1311 SW-846 Test Method 1311: Toxicity Characteristic Leaching Procedure https://www.epa.gov/sites/production/files/2015-12/documents/1311.pdf
- NIOSH Method 6009 https://www.cdc.gov/niosh/docs/2003-154/pdfs/6009.pdf
- TCLP test https://www.epa.gov/sites/production/files/2015-12/documents/1311.pdf

Sources for Direct Reading Instruments for Mercury

- Lumex of Ohio, https://www.ohiolumex.com/mercury-analyzer-915m
- Arizona Instruments/Jerome, https://www.azic.com/jerome/j505/

REPORT PREPARATION

This health consultation providing guidance for evaluation of mercury in flooring was prepared by the New Jersey Department of Health.

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