Exposure Evaluation

During

Boiler Fire Tube Cleaning

Anderson University Center
Pacific Lutheran University

Conducted by

Sound Environmental Solutions, inc.

PO Box 731082 Puyallup, WA 98373
Phone (253) 841-2314 • Fax (253) 435-4881

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During

Boiler Fire Tube Cleaning

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Conducted for

Pacific Lutheran University
Environmental Health and Safety

by

David M. Kernan, CIH, CSP
President
Certified Industrial Hygienist, Certificate Number 3424 CP

August 24, 2018

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Table of Contents

Executive Summary

An evaluation of exposures to dusts from boiler fire-tube cleaning was performed on July 24 and 26, 2018. The purpose of the evaluation was to determine if employees may be exposed above Washington State Department of Labor and Industries Division of Occupation Safety and Health (WA-DOSH) exposure standards and to determine if the use of respiratory protection during fire-tube cleaning should be mandatory.

Employees performing fire tube cleaning were interviewed and the Anderson University Center boiler room was inspected. Air samples were collected for total carbon black dust and polynuclear aromatic hydrocarbons.

During the inspection and sampling a significant amount of soot dust was observed in the boiler room and adjacent hall. Some work seemed to increase dust releases. Total dust air sample results ranged from 0.2 to 1.3 milligrams per cubic meter (mg/m^3) of air. These results were below WA DOSH permissible exposure limits (PEL) for total dust, respirable dust and carbon black dust.

Some PAH was detected in the PAH air samples at concentrations from 0.13 to 0.93 mg/m^3 of air, but no regulated PAH was detected. There is a non-mandatory Recommended Exposure Limit (REL) published by the National Institute of Occupational Safety and Health (NIOSH) for carbon black dust. The carbon black dust REL is 3.5 mg/m3 of air. This REL drops to 0.1 mg/m^3 of air when PAHs are in the carbon black dust, which is indicated by the results of this evaluation. Other concerns noted during the evaluation included the potential for heat stress during work and lack of eye protection during some tasks

Recommendations were made to: require employees to wear NIOSH approved respirators with N95 or better particulate filters during boiler soot cleaning; require employees to wear eye protection during all work with risk of eye injury; perform air sampling while cleaning soot from boiler doors; clean boiler room equipment, work benches and other areas; provide local exhaust ventilation during cleaning; consider disposing of soot vacuum filters after each use; and evaluate heat stress during work and develop a work rest regimen.

Background

This exposure evaluation was initiated at the request of the Pacific Lutheran University (PLU) Environmental Health and Safety Department (EHS) to address concerns about exposures to soot during boiler fire-tube cleaning in Anderson University. Employees periodically clean soot buildup from fire tubes using a brush and vacuum system. Employees currently wear respirators during cleaning on a voluntary basis.

This evaluation was requested to determine whether permissible exposure limits (PELs) established by the Washington State Department of Labor and Industries, Division of Occupational Safety and Health (WA DOSH) were exceeded, and whether respirator use should be mandatory.

The PLU Environmental Health and Safety Department contracted with Sound Environmental Solutions, Inc. (SESI) to perform this exposure evaluation. Employee interviews and a preliminary inspection of the Anderson Hall boiler room were done on July 24, 2018. Air sampling during fire tube cleaning was done on July 26, 2018.

Methodology

This evaluation was performed using standard industrial hygiene procedures and practices. Employee interviews and the boiler room inspection were done first to assess the types of work performed during cleaning and to determine appropriate sampling methods and locations. Research was then done to identify common health hazards associated with boiler firetube cleaning and to select sampling methods.

Carbon black dust and the potential for carcinogenic polynuclear aromatic hydrocarbons (PAH) in the dust (soot) were determined to be the most significant exposure concerns. For this reason, NIOSH Method 500 and a modified version of NIOSH Method 5506 were selected to measure total carbon black dust and PAHs, respectively.

Air samples for total carbon black dust were collected on pre-weighed 37 mm 5.0 micron (µ) pore size PVC filters connected to battery operated air sampling pumps by flexible plastic tubing. Area samples were collected for total carbon black dust. The total dust sampling media were attached to each side of the boiler near the tubes being cleaned and the pump was secured to the side of the boiler.

Air samples for PAH were collected by connecting a 2 µ pore size PTFE filter mounted in a 37 mm cassette in series to 100mg/50mg XAD-2 in a glass tube. This sampling train was the connected by flexible plastic tubing to a battery operated personal air sampling pump. The sampling media was placed in the employee's breathing zone and the pump was attached to a belt worn by the employee.

Pumps were calibrated before and after sampling to a flow rate of 2.0 liters per minute using a Dwyer Rotometer.

After the air samples were collected, the PAH sorbent tubes were wrapped in foil, the tubes and PAH PTFE cassette were packed in ice and shipped by overnight delivery with a chain of custody. The total dust samples were placed securely in a separate shipping container with a chain of custody and also shipped by overnight delivery. Both sets of samples were shipped to LA Testing, a division of EMSL Laboratories, in Huntington Beach, California for gravimetric analysis for total dust and HPLC analysis for PAH.

After air sample results were received from the laboratory, sample results and field data were reviewed and analyzed. This report was then prepared summarizing the results of the evaluation, including potential exposure risks and other findings, conclusions and recommendations.

Results

The evaluation was performed on July 24 and 26, 2018. The evaluation results are below.

Initial Inspection and Interview

The initial inspection and interview were done on July 24, 2018. Employees were interviewed in the facilities maintenance office to determine what work was being done and how. The site was then inspected to determine appropriate sampling methods and locations.

During the interview, employees reported that fire-tube cleaning is part of a multi-day boiler cleaning and maintenance process. Boilers were cleaned by first shutting down the boiler, allowing it to cool, then opening up the boiler doors on both ends of the boilers. Doors were typically cleaned first, then the large Morrison fire tube, then the smaller fire tubes. Other maintenance such as gasket and door insulation repair and/or replacement burner replacement or work may also be done. The duration of soot cleaning was reported to vary depending on the extent of soot build-up.

All cleaning was done using an electric wire brush attached to a vacuum. Boiler doors and Morrison tube cleaning was done with a drill mounted wire brush with the hose from a Goodway Model GTC-540 Soot Vac (see Photo 4). Small firetubes were cleaned using a Goodway RAM-4X heavy duty tube cleaner connected to the Soot Vac. The RAM 4X had a wire brush connected to a flexible shaft which was connected to the soot vac.

Employees report personal protective equipment (PPE) typically worn during soot cleaning included coveralls, head cover, half face respirator, chemical splash type goggles and boots over personal clothing. Employees stated that boiler cleaning work was typically done as needed and was fit around other daily tasks and emergency work. Employees also reported the highest visible dust was observed during boiler door and vacuum filter cleaning.

After the interviews were completed, Anderson University Center boiler room was inspected. Work had already begun on Boiler #2. Both boiler doors were open and the

doors appeared to have been cleaned. Some soot was observed on the floor and on nearby tools, work benches and equipment. Employees stated again during the inspection that door and vacuum filter cleaning produced the most significant amount of dust.

At the end of the inspection, arrangements were made to perform air sampling during Morrison tube cleaning and small fire tube cleaning to evaluate that stage of the soot removal process.

Air Sampling

Air sampling was conducted on July 26, 2018. Before sampling began, a decision was made to collect breathing zone PAH samples and area total dust samples due to access limitations in the Morrison tube and because only one employee was cleaning. Area samples for total carbon black dust were placed on both ends of the boiler near the upper small fire tubes.

The first PAH breathing zone sample was placed on the employee at about 8:45 am. The employee then began cleaning the Morrison tube. The Morrison tube cleaning took about 25 minutes. See Photos 1 to 3 in Appendix A. After the Morrison tube cleaning was completed, the employee did some set up for small fire tube cleaning, then stopped, removed PPE, and took a break to cool down.

After the break, the employee donned PPE again and new PAH sampling media was attached to the sampling pump and then placed in the employee's breathing zone. The employee then cleaned the soot vacuum filters in an air shaft to the boiler room. A substantial amount of dust was produced during the soot vacuum filter cleaning. See Photos 5 and 6 in Appendix A. After finishing the filter cleaning, the small fire-tube cleaning equipment set up was completed, and small fire-tube cleaning began.

Small tube cleaning was performed from 10:20 am until about 11:15 am. It was noted during cleaning that soot was pushed out the rear of each small fire-tube. See Photos 10 and 11 in Appendix A. The employee took a lunch and cool down break at 11:15, returning about 12 pm. After donned PPE, fire tube cleaning began again at 12:12 pm. Cleaning stopped at about 1 pm because the employee was overheated.

During the cleaning and sampling the following conditions were noted:

- Soot was found on most surfaces throughout the boiler room.
- No eye protection was worn during vacuum filter cleaning and small fire tube cleaning (Photo 5). The employee reported that because fogging from sweat made it hard to see.
- The respirator and goggles were left on the boiler during a break (Photo 12).
- After work was finished, soot was seen on the floors in the hall outside the boiler room.

Air Sample Results

Two area samples were collected for total dust, one on each end of the boiler (Photo 1 & Photo 7). Total dust concentrations were 1.3 mg/m^3 in the rear of the boiler and 0.2 mg/m^3 at the front of the boiler. A substantial amount of soot was pushed out of the rear of the small fire-tubes during cleaning, with some collecting on the rear area sample (Photo 11, App. A). Soot dust results were below WA-DOSH PELs for total dust (10 mg/m^3), respirable dust (5 mg/m^3) and carbon black (3.5 mg/m^3).

Three breathing zone samples were collected for PAHs. Each of the samples was analyzed for each of the following PAHs:

Acenaphthene	Benzo (g,h,i) perylene	Fluorene
Acenaphthylene	Benzo (k)fluoranthene	Indeno(1,2,3-CD)pyrene
Anthracene†	Benzo(e) pyrene	Naphthalene
Benzo (a) anthracene	Chrysene†	Phenanthrene†
Benzo (a) pyrene†	Dibenz(a,h) anthracene	Pyrene†
Benzo (b)fluoranthene	Fluoranthene	

† = known human carcinogen

Only Acenaphthylene was detected in the three samples. Acenaphthylene concentrations ranged from 0.13 to 0.93 mg/m^3. The calculated 8 hour time weighted average was 0.13 mg/m^3. Details on results for each sample, including tasks performed during sampling, are in Table 1 below.

Table 1
Breathing Zone PAH Sample Results

Sample Number	Location and task(s) performed	Time (min)	Conc. (mg/m^3)	Calc. 8 hr TWA
B-1	Jeff Norris, Morrison tube cleaning	29	0.13††	0.13††
B-2	Jeff Norris, vacuum filter cleaning and small fore tube cleaning	50	0.25††	
B-3	Jeff Norris, small fire tube cleaning	48	0.93††	
B-5	Field blank	NA	ND	
B-5	Field blank	NA	ND	
	WA DOSH PEL for Acenaphthylene			None
	WA DOSH STEL for Acenaphthylene			None

†† for Acenaphthylene. No other PAHs were detected in any samples. mg/m^3 = milligrams per cubic meter of air
TWA = time weighted average PEL = WA-DOSH 8 hr TWA permissible exposure limit
STEL = WA-DOSH 15 min Short Term Excursion limit

Copies of the total dust and PAH laboratory analysis reports are in Appendices B and C.

Discussion and Conclusions

This evaluation was performed to address concerns about exposures to soot during boiler maintenance and determine whether PELs for exposures may be exceeded during soot removal and fire-tube cleaning and whether respirator use should be mandatory rather than voluntary.

The primary component of soot is carbon black which may contain potentially carcinogenic PAHs. Tests were performed for total dust, and for PAHs to determine whether PAHs were present, and if so, how much. Total dust concentrations in the area samples were below the WA DOSH PELs for total dust, respirable dust, and carbon black dust.

No regulated PAHs were detected in the breathing zone samples. One PAH was detected, Acenaphthylene. There is no PEL for Acenaphthylene. Nor were any consensus exposure standards such those published by the American Conference of Governmental Industrial Hygienists (ACGIH) or other similar organizations like the National Institute of Occupational Safety and Health (NIOSH) or the American Industrial Hygiene Association (AIHA) found.

However, NIOSH has published Recommended Exposure Limit (REL) for carbon black that is applicable. The carbon black dust REL is 3.5 mg/m^3, with a lowers limit of 0.1 mg/m^3 when PAH are present. Total dust samples were above this limit and PAH was detected in each breathing zone sample.

Breathing zone carbon black dust samples were not collected. However, area samples were above the 0.1 mg/m^3, and employees reported the highest visible dust was during door and vacuum filter cleaning. It is possible that carbon black breathing zone concentrations during door and filter cleaning would be higher than results of the area samples collected during this evaluation.

For this reason, employees should be required to wear respiratory protection during fire-tube cleaning. Respirators should be NIOSH approved half face respirators with N95 or better filters. Additional sampling should be performed during door cleaning to determine exposures. Also better drops and other dust protection should be used during soot cleaning.

During this evaluation several other concerns were observed that increase risks to employees These were:

- Soot build-up noted in the boiler room;
- Dust releases during fire tube and vacuum filter cleaning;
- Soot tracked from the boiler room into other occupied building areas;
- No eye protection during filter and small fire-tube cleaning;
- Respirator and goggles left on the boiler; and
- Heat stress.

Dust settled in other areas of the boiler room increases amount of exposure over time to employees working in the boiler room after cleaning has been completed, as does leaving PPE unprotected in the work area. Soot dust outside the work area presents a risk to occupants in other parts of the building. Not wearing eye protection increases the risk of eye injuries. Finally, there appears to be a significant potential for heat related injuries due to the type of PPE worn and temperatures in the boiler room during fire-tube cleaning.

Recommendations

The following recommendations are based on the results of this evaluation:

1. Require all employees to wear respiratory protection during boiler soot cleaning. The respirator should be NIOSH approved, be tight fitting, and have a particulate filter rating of N95 or better. Disposable respirators are acceptable if they are NIOSH approved.
2. Perform air sampling while cleaning soot from boiler doors.
3. Clean the boiler room to remove existing soot from equipment, work benches and other areas.
4. Provide local exhaust ventilation during cleaning to capture soot as it is released.
5. Consider dispose of soot vacuum filters after each use rather than cleaning them.
6. Require employees to wear eye protection during all work that presents a risk of eye injury. Provide anti-fogging if needed.
7. Evaluate heat stress during work and develop a work rest regimen to reduce the risk of heat exhaustion, heat stroke or other heat related injury during the work.

Limitations

This evaluation was performed in accordance with recognized industrial hygiene standards procedures and practices. Samples were collected and analyzed in accordance with recognized and accepted industrial hygiene sample collection methods and industrial hygiene laboratory analytical procedures. The results of this evaluation are limited to conditions identified during the evaluation and to data provided and reported by others. It was intended solely for the purpose of evaluating occupational exposures.

This report was not intended to identify or conclude as to extent of occupational exposures related to previous conditions or to diagnose disease. Conclusions, opinions and recommendations developed during this evaluation were based on currently recognized sources and data. Other than this no other warranty is intended or implied.

*** end of report ***

Appendix A Photographs

Photo 1, Cleaning Morrison tube. Area total dust sample is just above vacuum.

Photo 2, Employee inside Morrison tube, cleaning with electric brush and vacuum.

Photo 3, View of Morrison tube cleaning from burner side of boiler,

Photo 4, Goodway Model GTC-540 Soot Vac used for cleaning soot from boilers.

Photo 5, Dust released by shaking Soot Vac filter to remove soot.

Photo 6, Soot residue after cleaning vacuum filters

Photo 7, Cleaning upper fire tubes with brush and vacuum system while wearing air sampler for PAHs. Area total dust air sample on upper left side of boiler.

Photo 8, Soot buildup in small fire-tubes before cleaning. Top row has been cleaned.

Photo 9, Wider view of small fire-tubes after cleaning

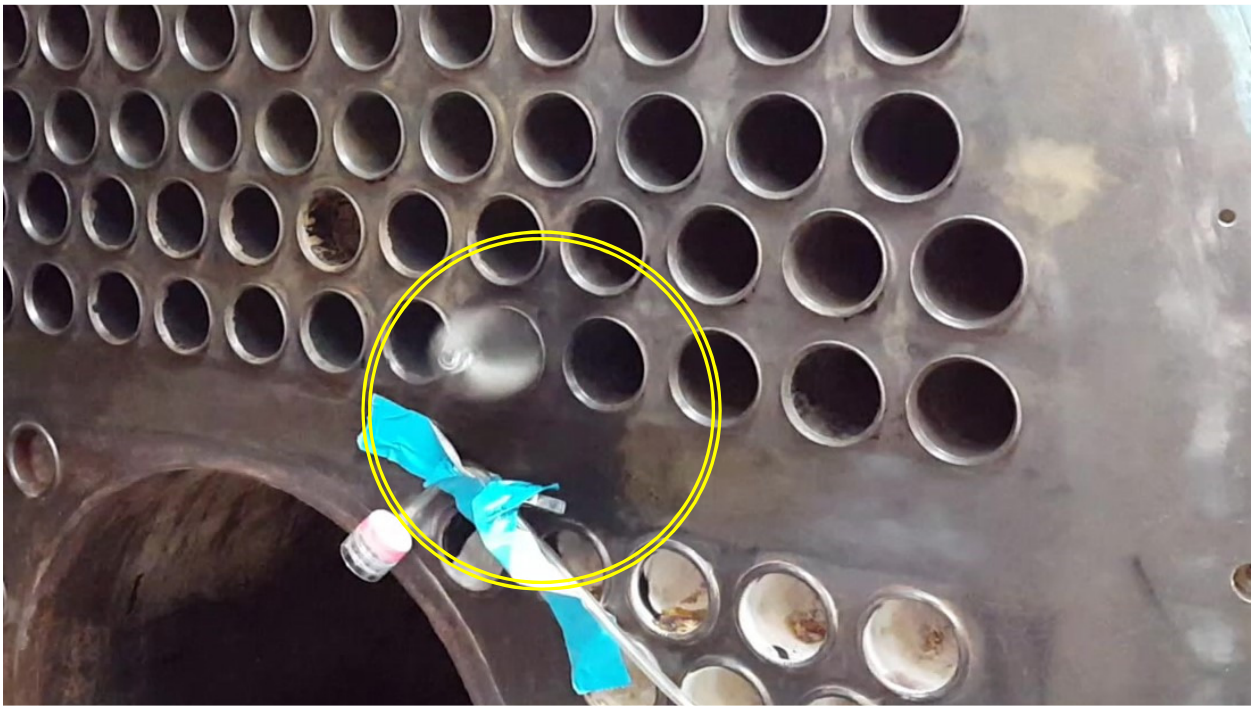

Photo 10, Brush pushing soot out of small fire tube

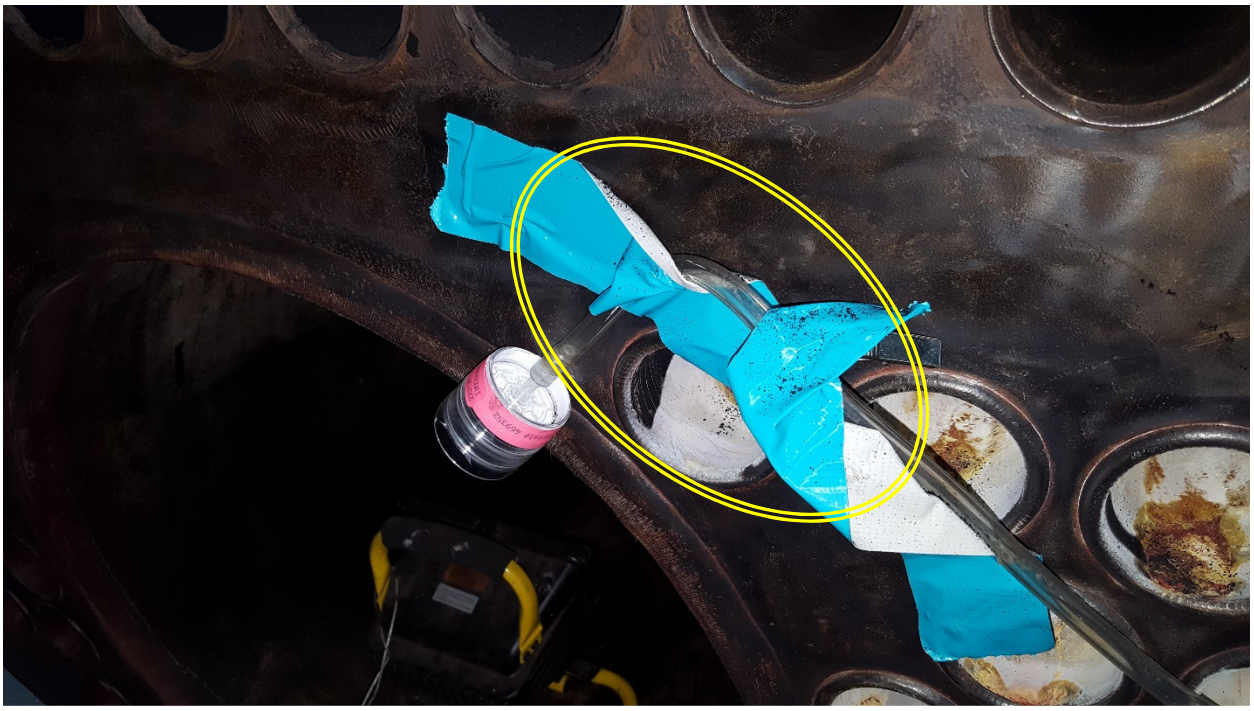

Photo 11, Soot residue on tape above air sample cassette from soot pushed out of tube

Photo 12, Respirator and safety goggles left on boiler during break.

Appendix B Lab Analysis Report, Total Dust

LA Testing
5431 Industrial Drive, Huntington Beach, CA 92649
Phone/Fax: (714) 828-4999 / (714) 828-4944
http://www.LATesting.com gardengrovelab@latesting.com

LA Testing Order: 331815201
CustomerID: SOLU49
CustomerPO:
ProjectID:

Attn: **David Kernan**
Sound Environmental Solutions, Inc.
PO Box 731082
Puyallup, WA 98373

Phone: (253) 841-2314
Fax:
Received: 07/27/18 10:30 AM
Analysis Date: 8/1/2018
Collected:

Project: **PLU Boiler Tube Cleaning**

Test Report: Total Dust Analysis (Gravimetric) of Air Samples via NIOSH 0500, Issue 2, 8/15/94

Sample	*Location*	*Volume (L)*	*Sample Weight (mg)*	*Concentration (mg/m^3)*	*Reporting Limit (mg/m^3)*	*Notes*
A-1 *331815201-0001*	Backside Boiler Number 2	534	0.69	1.3	0.094	Large amount of visible dust on sample
A-2 *331815201-0002*	Frontside Boiler Number 2	574.2	0.11	0.20	0.087	Large amount of visible dust on sample
A-3 *331815201-0003*	Blank		<0.050	N/A	N\A	Field Blank

Notes: Discernable field blank submitted with samples.
Results are not field blank corrected.

Analyst(s)

Christine Do (3)

Michael Chapman

Michael Chapman, Laboratory Manager
or other approved signatory

Initial report from 08/01/2018 09:11:31

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

5431 Industrial Drive
Huntington Beach, CA 92649
PHONE: (714) 828-4999
FAX: (714) 828-4944

Industrial Hygiene Chain of Custody

EMSL Order Number (Lab Use Only): #331815201

Report To Contact Name: David Kernan		**Bill To Company:** Sound Environmental Solutions, Inc	**Client ID #:**
Company Name: Sound Environmental Solutions, Inc.		**Attention To:** David Kernan	
Street: PO Box 731082		**Street:** PO Box 731082	
City: Puyallup	**State/Province:** WA **Zip/Postal Code:** 98373	**City:** Puyallup	**State/Province:** WA **Zip/Postal Code:** 98373
Phone : (253) 841-2314	**Fax :** (253) 435-4881	**Phone:** (253) 841-2314	**Fax:** (253) 435-4881
Project Name: PLU Boiler Tube Cleaning		**Email Results To:** davidk@soundenvironmental.org	**U.S. State where Samples Collected:** WA
# Samples in Shipment:	**Date of Shipment:**	**Purchase Order:**	**Sampled By (Signature):** Dan Kernan

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:

Manufacturer/Part #: **Lot #:**

Client Sample ID	Location/Description	Analyte / Method	Media	Flow (lpm)	Sample Time On	Sample Time Off	Volume / Area	Sample Type	Sample Date	Comments
A-1	Back side boiler Number 2	NIOSH 500 - Total Dust	Preweighed Millicon PVC	2	0846	1313	534 liters ~~380~~ blank	☑ Area ☐ Personal	7/26/18	
A-2	Front side boiler Number 2	↓	↓	2.2	0850	1311	574.2 liters	☑ Area ☐ Personal	7/26/18	
A-3	Blank	↓	↓					☐ Area ☐ Personal	7/26/18	
								☐ Area ☐ Personal		
								☐ Area ☐ Personal		
								☐ Area ☐ Personal		
								☐ Area ☐ Personal		
								☐ 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
		(FX)	7.27.18 10:30

Comments:

Appendix C Lab Analysis Report, Polynuclear Aromatic Hydrocarbons

LA Testing
5431 Industrial Drive, Huntington Beach, CA 92649

Order ID: 331815253

Attn:	David Kernan Sound Environmental Solutions, Inc. PO Box 731082 Puyallup, WA 98373	Customer ID: Customer PO: Date Received: LA Testing Order:	SOLU49 07/27/18 331815253
Fax: Phone: Email: Report Date:	253-435-4881 253-841-2314 davidk@soundenvironmental.org 08/07/18	Project: Date Analyzed:	**PLU Boiler Tube Cleaning** 08/02/18

Polynuclear Aromatic Hydrocarbons by NIOSH 5506M
SKC225-1713

LA Testing Sample ID	Client ID	Air Volume) (L)	Component	Result (µg/Filter)	Result (mg/m³)	Result (ppm)	Reporting Limit (µg/Filter)
331815253-0001	B-1	58	Naphthalene	<5.0	<0.086	<0.070	5.0
			Acenaphthylene	7.6	0.13	0.11	5.0
			Acenaphthene	<10	<0.17	<0.14	10
			Fluorene	<1.0	<0.017	<0.014	1.0
			Phenanthrene	<0.40	<0.0069	<0.0056	0.40
			Anthracene	<0.10	<0.0017	<0.0014	0.10
			Fluoranthene	<0.50	<0.0086	<0.0070	0.50
			Pyrene	<0.50	<0.0086	<0.0070	0.50
			Benzo (a) anthracene	<0.50	<0.0086	<0.0070	0.50
			Chrysene	<0.50	<0.0086	<0.0070	0.50
			Benzo (b)fluoranthene	<0.40	<0.0069	<0.0056	0.40
			Benzo (k)fluoranthene	<0.40	<0.0069	<0.0056	0.40
			Benzo (a) pyrene	<0.50	<0.0086	<0.0070	0.50
			Dibenz(a,h) anthracene	<1.0	<0.017	<0.014	1.0
			Benzo (g,h,i) perylene	<0.80	<0.014	<0.011	0.80
			Indeno(1,2,3-CD)pyrene	<1.0	<0.017	<0.014	1.0
			Benzo(e) pyrene	<1.0	<0.017	<0.014	1.0

Sample received in acceptable condition unless otherwise noted. This report relates only to the samples reported above. This report may not be reproduced except in full, without written approval by LA Testing. Quality Control Data associated with this sample set is within acceptable limits. The results for this sample set have not been blank corrected.

JD
Analyst

Michael Chapman
Michael Chapman, Laboratory Manager

AIHA-LAP, LLC Accredited - Laboratory ID #101650

LA Testing
5431 Industrial Drive, Huntington Beach, CA 92649

Order ID: 331815253

Attn:	David Kernan Sound Environmental Solutions, Inc. PO Box 731082 Puyallup, WA 98373	Customer ID: Customer PO: Date Received: LA Testing Order:	SOLU49 07/27/18 331815253
Fax: Phone: Email: Report Date:	253-435-4881 253-841-2314 davidk@soundenvironmental.org 08/07/18	Project: Date Analyzed:	**PLU Boiler Tube Cleaning** 08/02/18

Polynuclear Aromatic Hydrocarbons by NIOSH 5506M
SKC225-1713

LA Testing Sample ID	Client ID	Air Volume) (L)	Component	Result (µg/Filter)	Result (mg/m³)	Result (ppm)	Reporting Limit (µg/Filter)
331815253-0002	B-2	100	Naphthalene	<5.0	<0.050	<0.041	5.0
			Acenaphthylene	25	0.25	0.21	5.0
			Acenaphthene	<10	<0.10	<0.081	10
			Fluorene	<1.0	<0.010	<0.0081	1.0
			Phenanthrene	<0.40	<0.0040	<0.0033	0.40
			Anthracene	<0.10	<0.0010	<0.00081	0.10
			Fluoranthene	<0.50	<0.0050	<0.0041	0.50
			Pyrene	<0.50	<0.0050	<0.0041	0.50
			Benzo (a) anthracene	<0.50	<0.0050	<0.0041	0.50
			Chrysene	<0.50	<0.0050	<0.0041	0.50
			Benzo (b)fluoranthene	<0.40	<0.0040	<0.0033	0.40
			Benzo (k)fluoranthene	<0.40	<0.0040	<0.0033	0.40
			Benzo (a) pyrene	<0.50	<0.0050	<0.0041	0.50
			Dibenz(a,h) anthracene	<1.0	<0.010	<0.0081	1.0
			Benzo (g,h,i) perylene	<0.80	<0.0080	<0.0065	0.80
			Indeno(1,2,3-CD)pyrene	<1.0	<0.010	<0.0081	1.0
			Benzo(e) pyrene	<1.0	<0.010	<0.0081	1.0

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Analyst

Michael Chapman
Michael Chapman, Laboratory Manager

AIHA-LAP, LLC Accredited - Laboratory ID #101650

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Order ID: 331815253

Attn:	David Kernan Sound Environmental Solutions, Inc. PO Box 731082 Puyallup, WA 98373	Customer ID: Customer PO: Date Received: LA Testing Order:	SOLU49 07/27/18 331815253
Fax: Phone: Email: Report Date:	253-435-4881 253-841-2314 davidk@soundenvironmental.org 08/07/18	Project: Date Analyzed:	**PLU Boiler Tube Cleaning** 08/02/18

Polynuclear Aromatic Hydrocarbons by NIOSH 5506M
SKC225-1713

LA Testing Sample ID	Client ID	Air Volume) (L)	Component	Result (µg/Filter)	Result (mg/m³)	Result (ppm)	Reporting Limit (µg/Filter)
331815253-0003	B-3	96	Naphthalene	<5.0	<0.052	<0.042	5.0
			Acenaphthylene	89	0.93	0.76	5.0
			Acenaphthene	<10	<0.10	<0.085	10
			Fluorene	<1.0	<0.010	<0.0085	1.0
			Phenanthrene	<0.40	<0.0042	<0.0034	0.40
			Anthracene	<0.10	<0.0010	<0.00085	0.10
			Fluoranthene	<0.50	<0.0052	<0.0042	0.50
			Pyrene	<0.50	<0.0052	<0.0042	0.50
			Benzo (a) anthracene	<0.50	<0.0052	<0.0042	0.50
			Chrysene	<0.50	<0.0052	<0.0042	0.50
			Benzo (b)fluoranthene	<0.40	<0.0042	<0.0034	0.40
			Benzo (k)fluoranthene	<0.40	<0.0042	<0.0034	0.40
			Benzo (a) pyrene	<0.50	<0.0052	<0.0042	0.50
			Dibenz(a,h) anthracene	<1.0	<0.010	<0.0085	1.0
			Benzo (g,h,i) perylene	<0.80	<0.0083	<0.0068	0.80
			Indeno(1,2,3-CD)pyrene	<1.0	<0.010	<0.0085	1.0
			Benzo(e) pyrene	<1.0	<0.010	<0.0085	1.0

Sample received in acceptable condition unless otherwise noted. This report relates only to the samples reported above. This report may not be reproduced except in full, without written approval by LA Testing. Quality Control Data associated with this sample set is within acceptable limits. The results for this sample set have not been blank corrected.

JD
Analyst

Michael Chapman
Michael Chapman, Laboratory Manager

AIHA-LAP, LLC Accredited - Laboratory ID #101650

LA Testing
5431 Industrial Drive, Huntington Beach, CA 92649

Order ID: 331815253

Attn:	David Kernan Sound Environmental Solutions, Inc. PO Box 731082 Puyallup, WA 98373	Customer ID: Customer PO: Date Received: LA Testing Order:	SOLU49 07/27/18 331815253
Fax: Phone: Email: Report Date:	253-435-4881 253-841-2314 davidk@soundenvironmental.org 08/07/18	Project: Date Analyzed:	**PLU Boiler Tube Cleaning** 08/02/18

Polynuclear Aromatic Hydrocarbons by NIOSH 5506M
SKC225-1713

LA Testing Sample ID	Client ID	Air Volume) (L)	Component	Result (µg/Filter)	Result (mg/m³)	Result (ppm)	Reporting Limit (µg/Filter)
331815253-0004	B-4	-	Naphthalene	<5.0	NA	NA	5.0
			Acenaphthylene	<5.0	NA	NA	5.0
			Acenaphthene	<10	NA	NA	10
			Fluorene	<1.0	NA	NA	1.0
			Phenanthrene	<0.40	NA	NA	0.40
			Anthracene	<0.10	NA	NA	0.10
			Fluoranthene	<0.50	NA	NA	0.50
			Pyrene	<0.50	NA	NA	0.50
			Benzo (a) anthracene	<0.50	NA	NA	0.50
			Chrysene	<0.50	NA	NA	0.50
			Benzo (b)fluoranthene	<0.40	NA	NA	0.40
			Benzo (k)fluoranthene	<0.40	NA	NA	0.40
			Benzo (a) pyrene	<0.50	NA	NA	0.50
			Dibenz(a,h) anthracene	<1.0	NA	NA	1.0
			Benzo (g,h,i) perylene	<0.80	NA	NA	0.80
			Indeno(1,2,3-CD)pyrene	<1.0	NA	NA	1.0
			Benzo(e) pyrene	<1.0	NA	NA	1.0

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SKC225-1713

LA Testing Sample ID	Client ID	Air Volume) (L)	Component	Result (µg/Filter)	Result (mg/m³)	Result (ppm)	Reporting Limit (µg/Filter)
331815253-0005	B-5	-	Naphthalene	<5.0	NA	NA	5.0
			Acenaphthylene	<5.0	NA	NA	5.0
			Acenaphthene	<10	NA	NA	10
			Fluorene	<1.0	NA	NA	1.0
			Phenanthrene	<0.40	NA	NA	0.40
			Anthracene	<0.10	NA	NA	0.10
			Fluoranthene	<0.50	NA	NA	0.50
			Pyrene	<0.50	NA	NA	0.50
			Benzo (a) anthracene	<0.50	NA	NA	0.50
			Chrysene	<0.50	NA	NA	0.50
			Benzo (b)fluoranthene	<0.40	NA	NA	0.40
			Benzo (k)fluoranthene	<0.40	NA	NA	0.40
			Benzo (a) pyrene	<0.50	NA	NA	0.50
			Dibenz(a,h) anthracene	<1.0	NA	NA	1.0
			Benzo (g,h,i) perylene	<0.80	NA	NA	0.80
			Indeno(1,2,3-CD)pyrene	<1.0	NA	NA	1.0
			Benzo(e) pyrene	<1.0	NA	NA	1.0

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Polynuclear Aromatic Hydrocarbons by NIOSH 5506M
SKC226-30-04

LA Testing Sample ID	Client ID	Air Volume) (L)	Component	Result (µg/tube)	Result (mg/m³)	Result (ppm)	Reporting Limit (µg/tube)
331815253-0001	B-1	58	Naphthalene	<5.0	<0.086	<0.070	5.0
			Acenaphthylene	<5.0	<0.086	<0.070	5.0
			Acenaphthene	<10	<0.17	<0.14	10
			Fluorene	<1.0	<0.017	<0.014	1.0
			Phenanthrene	<0.40	<0.0069	<0.0056	0.40
			Anthracene	<0.10	<0.0017	<0.0014	0.10
			Fluoranthene	<0.50	<0.0086	<0.0070	0.50
			Pyrene	<0.50	<0.0086	<0.0070	0.50
			Benzo (a) anthracene	<0.50	<0.0086	<0.0070	0.50
			Chrysene	<0.50	<0.0086	<0.0070	0.50
			Benzo (b)fluoranthene	<0.40	<0.0069	<0.0056	0.40
			Benzo (k)fluoranthene	<0.40	<0.0069	<0.0056	0.40
			Benzo (a) pyrene	<0.50	<0.0086	<0.0070	0.50
			Dibenz(a,h) anthracene	<1.0	<0.017	<0.014	1.0
			Benzo (g,h,i) perylene	<0.80	<0.014	<0.011	0.80
			Indeno(1,2,3-CD)pyrene	<1.0	<0.017	<0.014	1.0
			Benzo(e) pyrene	<1.0	<0.017	<0.014	1.0

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Polynuclear Aromatic Hydrocarbons by NIOSH 5506M
SKC226-30-04

LA Testing Sample ID	Client ID	Air Volume) (L)	Component	Result (µg/tube)	Result (mg/m³)	Result (ppm)	Reporting Limit (µg/tube)
331815253-0002	B-2	100	Naphthalene	<5.0	<0.050	<0.041	5.0
			Acenaphthylene	<5.0	<0.050	<0.041	5.0
			Acenaphthene	<10	<0.10	<0.081	10
			Fluorene	<1.0	<0.010	<0.0081	1.0
			Phenanthrene	<0.40	<0.0040	<0.0033	0.40
			Anthracene	<0.10	<0.0010	<0.00081	0.10
			Fluoranthene	<0.50	<0.0050	<0.0041	0.50
			Pyrene	<0.50	<0.0050	<0.0041	0.50
			Benzo (a) anthracene	<0.50	<0.0050	<0.0041	0.50
			Chrysene	<0.50	<0.0050	<0.0041	0.50
			Benzo (b)fluoranthene	<0.40	<0.0040	<0.0033	0.40
			Benzo (k)fluoranthene	<0.40	<0.0040	<0.0033	0.40
			Benzo (a) pyrene	<0.50	<0.0050	<0.0041	0.50
			Dibenz(a,h) anthracene	<1.0	<0.010	<0.0081	1.0
			Benzo (g,h,i) perylene	<0.80	<0.0080	<0.0065	0.80
			Indeno(1,2,3-CD)pyrene	<1.0	<0.010	<0.0081	1.0
			Benzo(e) pyrene	<1.0	<0.010	<0.0081	1.0

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Polynuclear Aromatic Hydrocarbons by NIOSH 5506M
SKC226-30-04

LA Testing Sample ID	Client ID	Air Volume) (L)	Component	Result (µg/tube)	Result (mg/m³)	Result (ppm)	Reporting Limit (µg/tube)
331815253-0003	B-3	96	Naphthalene	<5.0	<0.052	<0.042	5.0
			Acenaphthylene	<5.0	<0.052	<0.042	5.0
			Acenaphthene	<10	<0.10	<0.085	10
			Fluorene	<1.0	<0.010	<0.0085	1.0
			Phenanthrene	<0.40	<0.0042	<0.0034	0.40
			Anthracene	<0.10	<0.0010	<0.00085	0.10
			Fluoranthene	<0.50	<0.0052	<0.0042	0.50
			Pyrene	<0.50	<0.0052	<0.0042	0.50
			Benzo (a) anthracene	<0.50	<0.0052	<0.0042	0.50
			Chrysene	<0.50	<0.0052	<0.0042	0.50
			Benzo (b)fluoranthene	<0.40	<0.0042	<0.0034	0.40
			Benzo (k)fluoranthene	<0.40	<0.0042	<0.0034	0.40
			Benzo (a) pyrene	<0.50	<0.0052	<0.0042	0.50
			Dibenz(a,h) anthracene	<1.0	<0.010	<0.0085	1.0
			Benzo (g,h,i) perylene	<0.80	<0.0083	<0.0068	0.80
			Indeno(1,2,3-CD)pyrene	<1.0	<0.010	<0.0085	1.0
			Benzo(e) pyrene	<1.0	<0.010	<0.0085	1.0

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331815253-0004	B-4	-	Naphthalene	<5.0	NA	NA	5.0
			Acenaphthylene	<5.0	NA	NA	5.0
			Acenaphthene	<10	NA	NA	10
			Fluorene	<1.0	NA	NA	1.0
			Phenanthrene	<0.40	NA	NA	0.40
			Anthracene	<0.10	NA	NA	0.10
			Fluoranthene	<0.50	NA	NA	0.50
			Pyrene	<0.50	NA	NA	0.50
			Benzo (a) anthracene	<0.50	NA	NA	0.50
			Chrysene	<0.50	NA	NA	0.50
			Benzo (b)fluoranthene	<0.40	NA	NA	0.40
			Benzo (k)fluoranthene	<0.40	NA	NA	0.40
			Benzo (a) pyrene	<0.50	NA	NA	0.50
			Dibenz(a,h) anthracene	<1.0	NA	NA	1.0
			Benzo (g,h,i) perylene	<0.80	NA	NA	0.80
			Indeno(1,2,3-CD)pyrene	<1.0	NA	NA	1.0
			Benzo(e) pyrene	<1.0	NA	NA	1.0

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			Acenaphthylene	<5.0	NA	NA	5.0
			Acenaphthene	<10	NA	NA	10
			Fluorene	<1.0	NA	NA	1.0
			Phenanthrene	<0.40	NA	NA	0.40
			Anthracene	<0.10	NA	NA	0.10
			Fluoranthene	<0.50	NA	NA	0.50
			Pyrene	<0.50	NA	NA	0.50
			Benzo (a) anthracene	<0.50	NA	NA	0.50
			Chrysene	<0.50	NA	NA	0.50
			Benzo (b)fluoranthene	<0.40	NA	NA	0.40
			Benzo (k)fluoranthene	<0.40	NA	NA	0.40
			Benzo (a) pyrene	<0.50	NA	NA	0.50
			Dibenz(a,h) anthracene	<1.0	NA	NA	1.0
			Benzo (g,h,i) perylene	<0.80	NA	NA	0.80
			Indeno(1,2,3-CD)pyrene	<1.0	NA	NA	1.0
			Benzo(e) pyrene	<1.0	NA	NA	1.0

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EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

5431 Industrial Drive

Huntington Beach, CA 92649
PHONE: (714) 828-4999
FAX: (714) 828-4944

Industrial Hygiene Chain of Custody

EMSL Order Number (Lab Use Only): #331815253

Report To Contact Name: David Kernan		**Bill To Company:** Sound Environmental Solutions, Inc	**Client ID #:**
Company Name: Sound Environmental Solutions, Inc.		**Attention To:** David Kernan	
Street: PO Box 731082		**Street:** PO Box 731082	
City: Puyallup	**State/Province:** WA **Zip/Postal Code:** 98373	**City:** Puyallup	**State/Province:** WA **Zip/Postal Code:** 98373
Phone : (253) 841-2314	**Fax :** (253) 435-4881	**Phone:** (253) 841-2314	**Fax:** (253) 435-4881
Project Name: PLU Boiler Tube Cleaning		**Email Results To:** davidk@soundenvironmental.org	**U.S. State where Samples Collected:** WA
# Samples in Shipment: 5	**Date of Shipment:**	**Purchase Order:**	**Sampled By (Signature):** David Kernan

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:

Manufacturer/Part #: **Lot #:**

Client Sample ID	Location/Description	Analyte / Method	Media	Flow (lpm)	Sample Time On	Sample Time Off	Volume / Area	Sample Type	Sample Date	Comments
B-1	Jeff Norris - cleaning Morrison tubes	NIOSH 5506 A+	37mm PTFE + XAD-2	2	0846	0915	58 liters	☐ Area ☑ Personal	7/26/18	
B-2	Jeff Norris - cleaning fire tubes	↓	↓	2	10:00	1050	100 liters	☐ Area ☑ Personal	7/26/18	also cleaned vacuum
B-3	Jeff Norris - cleaning fire tubes			2	12:12	1300	96 liters	☐ Area ☑ Personal		
B-4	Blank							☐ Area ☐ Personal	7/26/18	
B-5	Blank							☐ Area ☐ Personal	7/26/18	
								☐ Area ☐ Personal		
								☐ Area ☐ Personal		
								☐ 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
		(FX)	7.27.18 10:30

Comments: