

## Industrial hygiene services

09/07/2016

Pat Darby, Construction Safety Manager  
City Of Ptld Bes/pwb Ph5 Ocip  
5001 N Columbia Blvd  
Portland OR 97203

Theresa Carey-brill (wrap-up Program)  
Marsh U S A Inc  
111 Sw Columbia St Ste 500  
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SAIF policy: 854142

Dear Pat,

This report contains the results of the industrial hygiene survey I conducted for the manhole sub-contracted step installation and sewer pipe liner installation work as part of the Hollywood – Grant Park Sewer Rehabilitation Project in Portland, Oregon.

At your request, the specific name references for each sub-contractor have been removed from the report. Contractor A and Contractor B are used in place of the actual contractor names. Contractor A performed the step installation work in the C98 section of the project, on NE 49<sup>th</sup> Street. Contractor B performed the pipe liner installation work in the C05 section of the project, on NE Milton Street. The survey was conducted for both locations on 8/10/2016. The purpose of the survey was to evaluate employee exposure to styrene during pipe liner installation and respirable crystalline silica during manhole step installation.

The executive summary outlines the survey results. The associated Industrial Hygiene Sampling Report contains more detailed information about the process, sampling and analysis, occupational health standards, and results interpretation.

### Executive Summary

Exposure assessment results are provided below according to the type of hazard and sampling performed for the day of the industrial hygiene evaluation.

#### Silica

The personal breathing zone sample result for respirable crystalline silica exceeded the current Oregon OSHA permissible exposure limit (PEL) of 100 micrograms per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ) and the American Conference of Governmental Industrial Hygienists (ACGIH<sup>®</sup>) threshold limit value (TLV<sup>®</sup>) of 50  $\mu\text{g}/\text{m}^3$ . The Occupational Safety and Health Administration (OSHA) recently lowered the PEL to 50  $\mu\text{g}/\text{m}^3$  with an action level (AL) of 25  $\mu\text{g}/\text{m}^3$ . Oregon OSHA is slated to follow suit at the end of September 2016.

The sample time for the sample collected for silica was shorter than a routine work shift. Due to Contractor A equipment failure, the step installation work was stopped for the day. The calculated TWA also exceeded the PEL.

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## Styrene

The personal breathing zone results for styrene during pipe liner installation were all below the American Conference of Governmental Industrial Hygienists (ACGIH®) threshold limit value (TLV®) short-term exposure limit (STEL) and the Oregon OSHA ceiling limit and PEL, respectively.

## **Recommendations**

1. Discuss survey results with project contractors and ensure affected employees and all similarly exposed employees receive results. This communication is intended to promote cooperation and the effective use of control measures. This communication can be achieved during a safety meeting, in a letter, or verbally.
2. Contractor A is required to implement a silica exposure control program based on the results of the survey. The program should include engineering controls and other protective measures, medical surveillance, and employee training for this type of activity. The new silica regulations will be adopted by Oregon OSHA September 25, 2016. A hammer drill with a commercially-available shroud or cowl with a dust collection system is currently listed as an approved specified exposure control (engineering control) method by Oregon OSHA.
3. A respiratory protection program is required for employees performing step installation. This includes:
  - Provision of appropriate respirators and filter cartridges (P100 cartridges)
  - A written program which includes the procedure for selecting respiratory protection. Only NIOSH-approved respirators should be used.
  - Training employees on the proper use, fit, and limitations of respirators.
  - Fit-testing
  - A program for inspection, cleaning, maintenance, and storage of respirators
  - Medical evaluations
  - Periodic surveillance of the work conditions and evaluation of the program to ensure continued effectiveness.
4. Further sampling for silica is recommended to more accurately represent full work day exposures during step installation.
5. Retain a copy of this report for your records for at least 30 years [ref. OAR 437-002-360 (1910.1020 (d) (1) (ii)]. Industrial hygiene reports contain important information about occupational health at your facility and are considered employee exposure records. SAIF recommends retaining a copy of this report indefinitely.

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Pat, it was a pleasure working with you and the crews on this project. If you have any questions about the report, please call or email me.

Sincerely,



Kim Henry, Industrial Hygienist  
400 High Street SE  
Salem, OR 97312

Peer Reviewed by: Lea Jensen, CIH, Industrial Hygienist, SAIF Corporation

Attachments:

Galson Laboratories – Lab Analytical Report (Report ID 951728)

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## **Industrial Hygiene Report**

**Prepared for: City Of Ptlld Bes/pwb Ph5 Ocip**

**Date of Site Visit: 08/10/2016**

**Date of Report: 09/07/2016**

### **Description of Process and Activities**

The City of Portland Environmental Services designed the Hollywood – Grant Park sewer rehabilitation project to repair the public sewer system and reduce stormwater flow into the system. The Hollywood-Grant Park Sewer and Stormwater Project was initiated in 2015 to repair or replace approximately 38,000 feet (about 7 miles) of public sewer pipes aged between 75 and 110 years old and deteriorating due to age.

The project was in Phase 5 at the time of the industrial hygiene survey. The survey took place in two separate sections of the sewer project that spanned the 7 miles in the Hollywood – Grant Park districts. The purpose of the industrial hygiene survey was to evaluate employee exposure to respirable crystalline silica during manhole step installation. In addition, employee exposures to styrene were evaluated during sewer pipe liner installation on the same day; August 10, 2016.

A general contractor was hired by the City of Portland Environmental Services for the project. Contractor A was sub-contracted by the general contractor to install new steps in sewer manholes located within the project boundaries. A truck with supplies was positioned in the middle of a residential street, Project Section C98, containing the first manhole to be worked on. The work process included confined space entry of one person per manhole, removing the old steps and installing new steps. Drilling into concrete was required to perform this work. A DeWalt rotary hammer drill was used for drilling into the concrete sidewall of the manhole. Dust control technology was not observed during the work. One manhole was completed during the survey (5 steps were installed). The axle on the service truck broke and the work was stopped for the day after the first set of steps installed.

Contractor A employees wore high visibility shirts, hard hats, and half-face respirators with P100 cartridges, coveralls, gloves, and safety glasses during step installation. There were two employees performing the task.

Contractor B was contracted by the general contractor to perform sewer pipe lining and repair services. The camera truck, steam supply truck, and other service trucks were located on a residential street, Project Section C05, for the pipe lining work at that location. The line had been cleaned and a camera inspection was being performed when the sampling was set up for employees performing the installation.

Four employees were sampled during the installation activity. One employee opened and removed the new liner from a service truck to set up for installation. This employee also worked the steam supply portion of the liner installation, manning the steam truck at the steam supply end of the sewer pipe run. Two employees worked at the end of the run, where pipe line air pressure and temperature was monitored and steam was exhausted for the end manhole. One employee worked in the camera truck and

performed confined space entry into the sewer line to install sensors for monitoring the curing process and help get the liner started into the run.

The sewer line was cleaned and a camera inspection performed before installation of the pipe liner. The liner was then removed (uncoiled) and inserted into the line. The liner was pressurized to inflate into the line and steam heat was added to the line to cure the resin and adhere the liner to the interior wall of the sewer pipe.

Contractor B workers wore high-visibility vests, hard hats, safety glasses, and safety boots. Ear plugs were worn when steam was applied for curing. Gloves were worn by employees when handling the liner and when handling hoses at the end of the run.

Average environmental conditions on the day of the survey according to Weather Underground ([www.wunderground.com](http://www.wunderground.com)) were as follows: 70°F; 65% relative humidity; northwest winds of 6 miles per hour; and no precipitation.

### **Description of Hazards**

Based on process knowledge from Pat Darby, City of Portland Construction Safety Manager, and Melissa M. Diede, Senior Safety Management Consultant, silica was reported as the hazard associated with sewer manhole step installation. Styrene was reported as the health hazard associated with sewer pipe liner installation. A safety data sheet (SDS) was provided and reviewed for the pipe liner material. The liner product, CIPP ISO Resin, was an unsaturated polyester resin manufactured by Interplastic Corporation, 1225 Willow Lake Boulevard, St. Paul, Minnesota, 55110. The ingredient listed on the SDS was styrene (CAS 100-42-5) at 30-33%.

### **Respirable Crystalline Silica**

Dust particles smaller than 5 microns in diameter can penetrate the alveoli or inner recesses of the lungs. Although a few particles up to 10 microns in diameter may occasionally enter the lungs, nearly all the larger particles become entrapped in the nasal passages, throat, larynx, trachea, and bronchi, from which they are expectorated or swallowed into the digestive tract.

Silicon dioxide, also known as silica, is the most common mineral in the earth's crust and is recognized by its colorless crystals or white powders that are also odorless and tasteless. Quartz is the most common form of crystalline silica. Two other forms of crystalline silica have been recognized for their impact on health; tridymite and cristobolite. These are rare, however, and typically found in volcanic rock. Crystalline or free silica dust, when inhaled can cause silicosis. Silicosis is a form of pneumoconiosis resulting from the inhalation of silica dust and is characterized by the formation of small discrete nodules. In advanced stages, a dense fibrosis and emphysema with impairment of respiratory function may develop. Three types of silicosis exist:

- Simple, chronic silicosis – exposure to low levels of crystalline silica over a period of 15 to 20 years. This disease may cause people to have trouble breathing and may be similar to chronic obstructive pulmonary disease (COPD).
- Accelerated silicosis - occurs after exposure to larger amounts of crystalline silica over a shorter period of time (5 - 15 years). Swelling in the lungs and symptoms occur faster than in simple silicosis.

- **Acute silicosis** - results from short-term exposure to very large amounts of crystalline silica. The lungs become very inflamed and can fill with fluid, causing severe shortness of breath and low blood oxygen levels.

Exposure to respirable crystalline silica dust may also lead to tuberculosis (TB) and lung or stomach cancer.

### Styrene

Styrene is an eye, skin, nose, and respiratory tract irritant. This substance affects the central and peripheral nervous system including changes to color perception and hearing. The ACGIH® established the 20 parts per million (ppm) 8-hr time-weighted average (TWA) and the 40 ppm STEL to minimize the potential for central and peripheral nervous effects and mucous membrane and respiratory irritation.

Exposures to styrene at 100 ppm or more resulted in consistent reports of headache, fatigue, nausea, and dizziness. Very high levels of exposure may affect brain and liver function. Chronic over-exposure can cause problems with concentration, memory, balance and learning ability, and can result in confusion and slowed reflexes. Chronic styrene exposure may contribute to development of diseases of the central nervous system. In an international historical cohort of 35,443 workers employed from 1945 to 1991 in the reinforced plastics industry, mortality from diseases involving the central nervous system increased with time since first exposure, duration, average level of exposure, and cumulative exposure. Mortality from epilepsy increased with all measures of exposure (Welp et al, 1996).

Styrene can cause cracked skin and defatting dermatitis following repeated skin contact (NIOSH/OSHA). Styrene is an ototoxic substance which means the combined exposure with noise increases the risk of hearing loss.

**Reference:** RightAnswer® Knowledge Solutions HazardText™ Documents and ACGIH® TLV® Documentation

### **Evaluation Criteria**

Airborne exposures were evaluated and compared to published occupational exposure limits (OELs). OELs are developed to protect against health effects related to the inhalation of substances in the workplace for various timeframes during an average work week.

Different limits from governmental agencies or private associations may exist for the same substance. Those limits may differ numerically because of the data used to establish the guideline, the health effects targeted for protection, timeliness of updating a limit based on current scientific data, or in the way the air sample is collected or analyzed. When limits from different sources disagree, SAIF Industrial Hygiene recommends that the greatest protective value used as the OEL.

The following sources for occupational exposure limits were reviewed and used for this exposure assessment.

**ACGIH® Threshold Limit Values (ACGIH® TLVs®):** TLVs® for exposure assessment have been established by the American Conference of Governmental Hygienists

(ACGIH®) and are updated annually. TLVs® do not consider technical or economic feasibility, but are based solely on health effects. The ACGIH® updates TLVs® based on available information from industrial experience; experimental human and animal studies; and when possible, from a combination of all three.

The TLVs® refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. Because of a wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from, or be affected by, some substances at concentrations below the threshold limit.

These limits are not fine lines between safe and dangerous concentrations and are developed as guidelines to assist in the control of health hazards.

***Oregon OSHA Permissible Exposure Limits (Oregon OSHA PELs):*** PELs are legally enforceable limits established by the Occupational Safety and Health Administration (OSHA). The PELs in the Z-tables were incorporated into the OSHA regulations in 1970. They can be viewed at

<http://osha.oregon.gov/OSHArules/div2/div2Z-437-002-0382-air-cont.pdf>

Federal OSHA recognizes that many of its PELs are outdated and inadequate for ensuring protection of worker health. Most of OSHA's PELs were issued shortly after adoption of the Occupational Safety and Health (OSH) Act in 1970, and have not been updated since that time. Industrial experience, new developments in technology, and scientific data clearly indicate that in many instances these adopted limits are not sufficiently protective of worker health.

To provide employers, workers, and other interested parties with a list of alternate occupational exposure limits that may serve to better protect workers, OSHA has annotated the existing Z-Tables with other selected occupational exposure limits. OSHA has chosen to present a side-by-side table with the Cal/OSHA PELs, the NIOSH RELs, and the 2016 ACGIH® TLVs®. The tables at <https://www.osha.gov/dsg/annotated-pels/index.html> list air concentration limits, but do not include notations for skin absorption or sensitization.

***Time-Weighted Averages (TWAs):*** Eight-hour TWAs refer to airborne concentrations averaged over a conventional 8-hour workday and a 40-hour work week. The TWA exposure can be measured by a single 8-hour sample or calculated from a series of sequential samples covering the work shift.

***TWA Calculations:*** The estimated 8-hour TWA exposure was determined using the following formula:

$$\text{TWA} = \frac{(C_1 * T_1) + (C_2 * T_2) + \dots (C_n * T_n)}{480 \text{ minutes}}$$

***Short-term Exposure Limit (STEL):*** A STEL is defined as a 15-minute TWA exposure which should not be exceeded at any time during a workday. It is the concentration to which it is believed that workers can be exposed for a short period of time without suffering from irritation; chronic or irreversible tissue damage; dose-rate-dependent

toxic effects; or narcosis that increases the likelihood of accidental injury, impaired self-rescue, or materially reduced work efficiency.

**Ceiling Limit:** A Ceiling limit for a selected substances is the concentration that should not be exceeded during any part of the working exposure. Although the time-weighted average (TWA) concentration often provides the most satisfactory, practical way of monitoring airborne agents, there are certain predominantly fast-acting substances whose OEL is more appropriately based on this particular response. Substances with this type of response are best controlled by a ceiling limit that should not be exceeded. If instantaneous measurements are not available, sampling should be conducted for the minimum period of time sufficient to detect exposures at or above the ceiling value.

**TABLE 1**  
**Occupational Exposure Limits**

<i>Substance</i>	<i>Agency</i>	<i>Concentration</i>	<i>Time Period</i>
Silica	ACGIH® TLV®	25 µg/m³ (R)	8-hour TWA
	Oregon OSHA PEL	50 µg/m³ (R)	8-hour TWA
	Oregon OSHA AL	25 µg/m³ (R)	8-hour TWA
<i>TLV® basis: Pulmonary fibrosis; lung cancer</i>			
Styrene	ACGIH® TLV®	20 ppm	8-hour TWA
	ACGIH® STEL	40 ppm	15-minute
	Oregon OSHA PEL	100 ppm	8-hour TWA
	Oregon OSHA Ceiling Limit	200 ppm	*15-minute
<i>TLV® basis: Central nervous system impairment; upper respiratory irritant; peripheral neuropathy</i>			
(R) = respirable fraction		TWA = time weighted average	
ppm = parts per million		STEL = short term exposure limit	
µg/m³ = micrograms per cubic meter		*Ceiling limit (15 minute sample)	
PEL = Permissible Exposure Limit		TLV® = Threshold Limit Value	
AL = Action Level			

### Sampling Strategy, Methods and Analysis

Pat Darby, Construction Safety Manager, and Melissa M. Diede, Senior Safety Management Consultant recognized the potential silica exposure during concrete drilling to install steps in city street manholes. In addition, Melissa recognized the potential styrene exposure during pipe liner installation into city sewer lines due to the material used and odor generated from this activity. A review of the safety data sheet for the pipe liner material confirmed that styrene was approximately 30-33% of the resin material used in the pipe liner.



Styrene has a short-term and ceiling occupational exposure limit as well as a time-weighted average for an 8-hour workday. Thus, short term sampling was conducted in conjunction with time-weighted average sampling in order to represent both types of potential exposures.

Time-weighted average and short-term air samples for styrene were collected on N566 Organic Vapor Samplers developed by Assay Technology and analyzed by Galson Laboratories. The N566 organic vapor sampling device utilizes passive diffusion to collect organic vapors in air. The vapors enter the passive sampler by diffusion and are absorbed onto an activated charcoal medium and analyzed using gas chromatography with a flame ionization detector (GC/FID) following a modified NIOSH 1005 analytical method which desorbs the contaminant from the charcoal medium using carbon disulfide and a co-solvent. The amount of organic vapor is determined based on the amount of contaminant extracted, sampling time and diffusion rate of the sampler. The passive diffusion samplers were opened during the survey and snapped closed when sampling was complete. A field blank was submitted with the samples. The field blank was a sampler that was handled the same way as the other samples, however, it was not opened in the field.

A time-weighted average air sample for respirable crystalline silica was collected using a Gilair Plus personal sampling pump and a pre-weighed 5-micron polyvinyl chloride (PVC) filter contained in a three stage cassette with aluminum cyclone. Particles smaller than 4.0 microns are captured in the filter and larger particles collect in the aluminum cyclone at a flow of 2.5 liters per minute. Media (pre-weighed polyvinyl (PVC) filter with cyclone) was attached to the pump with Tygon tubing and placed in the worker's personal breathing zone (PBZ) outside respiratory protection worn.

The Gilair Plus sampling pump was pre- and post-calibrated with the Gilian Primary Flow Calibrator (flow calibration cell S/N 15686-S, factory calibrated 5/24/2016). Post-sampling flow rates were within 5 percent of pre-sampling values.

A field blank was submitted with the silica sample. The field blank was filter media that was handled in the same way as the air sample, except that no air was drawn through the filter.

The samples were sent for analysis to SGS Galson Laboratories in East Syracuse New York utilizing the NIOSH 1501; GC/FID method for styrene analysis and NIOSH 7500/OSHA ID-142; XRD method for respirable crystalline silica analysis. SGS Galson Labs is accredited by the AIHA (American Industrial Hygiene Association) Laboratory Accreditation Programs, LLC (#100324) and participates in the AIHA proficiency testing program for metals, beryllium, organic solvents, silica, and diffusive samplers.

## Results

Air sampling results are summarized in Tables 2 and 3. Sample results are presented on the enclosed laboratory data sheets.

**TABLE 2. Silica Exposure  
Contractor A  
Process: Sewer manhole step installation  
Date of Sampling: August 10, 2016**

<i>Name &amp; Tasks</i>	<i>Respirable Crystalline Silica <math>\mu\text{g}/\text{m}^3</math></i>	<i>Respirable Crystalline Silica <math>\mu\text{g}/\text{m}^3</math> 8-hour Calculated TWA</i>
<b>Step Installer.</b> Suited up and installed one set of steps in sewer manhole (five steps installed). Total sampling period was 83 minutes before truck broke down and work ended for the day. Sampled 83 minutes.  Sampled from 8:28 a.m. - 9:51 a.m.  Lab Sample ID L383085-1.	<b>130</b>	122
<b>ACGIH TLV® TWA</b>	25	25
<b>Oregon OSHA Action Limit TWA</b>	25	25
<b>Oregon OSHA PEL TWA</b>	50	50

$\mu\text{g}/\text{m}^3$  = micrograms per cubic meter of air  
 TWA = time-weighted average for 8-hour workday  
 TLV = threshold limit value  
 PEL = permissible exposure limit

### TWA Calculation:

A silica sample was collected in the personal breathing zone (PBZ) of the employee who was performing step installation. Although the sample was stopped after 83 minutes, the assumption was made that exposure to silica would have continued for the remainder of the shift, except for lunch time. The TWA would be calculated as follows:

$$\text{TWA} = \frac{(130 \mu\text{g}/\text{m}^3 * 450 \text{ minutes}) + (0 \mu\text{g}/\text{m}^3 * 30 \text{ minutes} - \text{lunch})}{480 \text{ minutes}}$$

$$\text{TWA} = 122 \mu\text{g}/\text{m}^3$$

**The calculated time-weighted average for step installation for an 8-hour shift with a 30 minutes lunch is 122  $\mu\text{g}/\text{m}^3$ .**

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**TABLE 3. Styrene Exposures**  
**Contractor B**  
**Process: Sewer Pipe Liner Installation**  
**Date of Sampling: August 10, 2016**

<i><b>Name &amp; Tasks</b></i>	<i><b>Styrene STEL (ppm)</b></i>	<i><b>Styrene TWA (ppm)</b></i>	<i><b>Styrene Calculated 8-hour TWA (ppm)</b></i>
<b>Worker 1</b> , Opened liner and removed from truck. Assisted with installing liner and ran steam supply. STEL sample (15 minutes) 7:47 a.m. - 8:02 a.m. TWA sample (279 minutes) 7:45 a.m. - 12:24 p.m.  Lab Sample ID L383085-3 (STEL) Lab Sample ID L383085-9 (TWA)	< 9	< 0.5	<0.5
<b>Worker 2</b> , Worked camera line and suited up with harness to enter manhole (at beginning of run) to install sensors and help get liner started in sewer pipe run. Worked on street level the remainder of time. TWA sample (260 minutes) Sampled 8:02 a.m. - 12:22 p.m.  Lab sample ID L383085-5 (TWA)	Not collected	0.7	0.38
<b>Worker 3</b> , Worked at end of the run, where pipe line air pressure and temperature were monitored and steam was exhausted. The boiler truck stopped working and Worker 3 left site to pick up different truck, gone for approx. less than an hour. TWA sampling continued during this time. STEL sample (15 minutes) 8:52 a.m. - 9:07 a.m. TWA sample (279 minutes) 7:55 a.m. - 12:20 p.m.  Lab Sample ID L383085-8 (STEL) Lab Sample ID L383085-4 (TWA)	< 9	14	8.18
<b>Worker 4</b> , Monitored temperature and air pressure in sewer pipe where steam was exhausted during curing. Two STEL samples taken, (16 minutes and 15 minutes). Sampled 9:01 a.m. - 9:17 a.m., and 9:23 p.m. - 9:38 a.m.  Lab Sample ID L383085-7 (STEL) Lab Sample ID L383085-6 (STEL)	< 9 < 9	Not collected	N/A
<b>ACGIH STEL and TLV® TWA</b>	40	20	20
<b>Oregon OSHA Ceiling limit and Oregon OSHA PEL</b>	200	100	100
ppm=parts per million      STEL = short-term exposure limit      TLV® = threshold limit value			
TWA = time-weighted average      PEL = permissible exposure limit      N/A = Not applicable			

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## Discussion and Conclusions

Sampling data obtained during this survey is representative of the time period sampled and the level of work performed during that time period. A time-weighted average calculation was performed to provide the full-shift exposure estimate if exposures occurred for a time other than a full shift workday.

Employee exposure levels during periods of higher levels of work and different types of tasks may vary from these results. Whenever there is a question about exposure levels or for temporary, potentially high exposures, appropriate engineering, administrative and personal protective equipment (e.g., respiratory protection) and/or other measures, should be utilized as necessary to reduce and control employee occupational exposure levels.

### Silica survey

The personal breathing zone sample result for the step installer during sewer manhole step installation exceeded the Oregon OSHA PEL. The sample time was not fully representative of a full shift work day since work ceased after 1 ½ hours. Sampling for full shift exposure is recommended since the exposure time was well below routine exposure time. A TWA calculation was performed using the sample result. If work and silica exposures were to continue for work shift, the PEL would still be exceeded.

Employees exposed to respirable crystalline silica are covered under the new silica rules adopted by federal OSHA. Oregon OSHA is on schedule to adopt these rules September 25, 2016. Construction employers are required to comply with the rules by June 23, 2017, except for the sample analysis requirements which must be complied with June 23, 2018.

A silica exposure control program is required for employees covered under the new rules to include:

If air sample results are over the PEL:

- Repeat monitoring quarterly;
- Notify affected employees of monitoring results;
- Implementation of engineering and work practice controls are required to reduce employee exposures to as reasonable low as possible;
- Respiratory protection must be worn to supplement controls if exposures are still not reduced below the PEL;
- Medical surveillance for all employees represented by the sample results;
- Employee training that includes health hazards of respirable crystalline silica and protective measures to reduce exposures.
- Restriction of access to areas where silica exposures exist along with written procedures and the identification of a Competent Person to implement site controls.

**Engineering Controls:** Feasible engineering controls for performing concrete drilling with a hammer drill should include a drill equipped with commercially available shroud or cowl with dust collection system. The dust collector must provide air flow recommended by

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manufacturer and have a filter with 99% or greater efficiency. A HEPA-filtered vacuum should be used when cleaning drilled holes.

**Respiratory Protection:** Based on the sampling results from this survey, employees drilling concrete to install manhole steps are required to wear a respirator. Half-face respirators with P100 cartridges were currently being used. This practice should continue until engineering controls can reduce exposures to below the PEL.

Employees should also be included in a respiratory protection program which includes fit-testing, training, provision of PPE, and medical surveillance.

**Work Practices:** Employees should be trained to use good work practices (i.e., use appropriate personal protective equipment (PPE) and avoid placing breathing zone directly in/above process points where air contaminants are generated) to minimize their exposures. When engineering controls are made available, workers should receive training to ensure that they are used effectively and supervisors should ensure employees implement these controls. PPE should be stored in such a way to reduce contamination and should be cleaned regularly.

### **Styrene Survey**

The personal breathing zone samples for all employees sampled were below all relevant occupational exposure limits. Time-weighted average calculations were performed for this task assuming a work day of one pipe liner installation per day. If more than one pipe lining project is performed in a day, further sampling is recommended.

**Respiratory Protection:** Respiratory protection is not required based on sampling results. Voluntary use of respiratory protection (either tight-fitting or filtering facepiece (dust mask) respirators with nuisance organic vapor relief) may be permitted by the employer where the occupational exposure limits have not been exceeded. If tight-fitting respirators are provided for voluntary use, employees must complete the OSHA medical surveillance questionnaire (Appendix C) and receive training on fit, use, and care of the protective device. If a filtering facepiece (disposable mask) is provided for voluntary use, the employer must provide a copy of Appendix D, Information for Employees Using Respirators When Not Required under the Standard (Mandatory) to employee(s).

**Work Practices:** Employees should continue to wear gloves when handling pipe liner material as good hygiene work practices. Work site was kept clean and well-organized. Current work practices and clean-up of work areas should continue.

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**PHOTOS – Sewer Pipe Liner Installation**

Photo 1: Removing pipe-liner from service truck.



Photo 2: Camera truck with video of sewer line in progress.

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Photo 3: Liner sleeve (helps guide liner through pipe) and liner feed into sewer line.



Photo 4: End of sewer line, monitoring air pressure. Steam not coming up to pressure (before steam generator change-out).

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Photo 5: Steam exhausting out of end of line manhole and exhaust manifold during resin curing.



Photo 6: Temperature sensor monitoring sewer line temperature during resin curing.



Photo 7: New steam generator truck.

This report is advisory only. It may not list all existing hazards. SAIF assumes no responsibility for correction of conditions identified as hazardous. Safety remains your responsibility.

400 High Street SE  
Salem, OR 97312  
P: 800.285.8525  
F: 503.373.8020



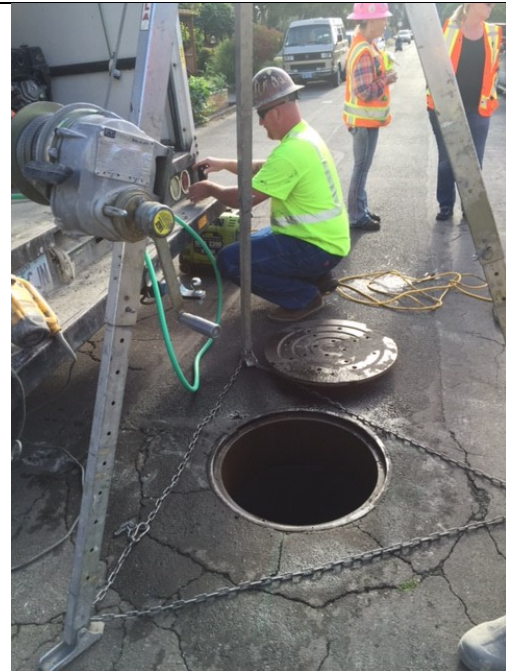
**PHOTOS – Manhole Step Installation**

Photo 1: Manhole tripod set up for step installation



Photo 2: Hammer drill used for concrete drilling during step installation

This report is advisory only. It may not list all existing hazards. SAIF assumes no responsibility for correction of conditions identified as hazardous. Safety remains your responsibility.

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**GALSON**

Ms. Kim Henry  
SAIF Corporation  
400 High Street, S.E.  
Salem, OR 97312-1000

August 22, 2016

DOH ELAP #11626  
AIHA-LAP #100324

Account# 13625

Login# L383085

Dear Ms. Henry:

Enclosed are the analytical results for the samples received by our laboratory on August 15, 2016. All test results meet the quality control requirements of AIHA-LAP and NELAC unless otherwise stated in this report. All samples on the chain of custody were received in good condition unless otherwise noted.

Results in this report are based on the sampling data provided by the client and refer only to the samples as they were received at the laboratory. Unless otherwise requested, all samples will be discarded 14 days from the date of this report, with the exception of IOMs, which will be cleaned and disposed of after seven calendar days.

Current Scopes of Accreditation can be viewed at [www.galsonlabs.com](http://www.galsonlabs.com) in the accreditations section under the "about Galson" tab.

Please contact Nicole Tormey at (888) 432-5227, if you would like any additional information regarding this report. Thank you for using SGS Galson Laboratories.

Sincerely,

SGS Galson Laboratories

A handwritten signature in black ink that reads "Lisa Swab". The signature is written in a cursive, flowing style.

Lisa Swab  
Laboratory Director

Enclosure(s)

Galson Laboratories, Inc. is now a part of SGS, the world's leading inspection, verification, testing, and certification company. As part of our transition to SGS, you will begin to see some formatting changes with reports that will improve the presentation of data and allow for the transition to the new logo.



# GALSON

## LABORATORY ANALYSIS REPORT

6601 Kirkville Road  
East Syracuse, NY 13057  
(315) 432-5227  
FAX: (315) 437-0571  
www.galsonlabs.com

Client : SAIF Corporation  
Site : City BES/PWB Phase 5

Account No.: 13625  
Login No. : L383085

Date Sampled : 10-AUG-16  
Date Received : 15-AUG-16

Date Analyzed : 17-AUG-16  
Report ID : 951728

### Styrene

<u>Sample ID</u>	<u>Lab ID</u>	<u>Time</u> <u>minutes</u>	<u>Raw</u> <u>ug</u>	<u>Total</u> <u>ug</u>	<u>Conc</u> <u>mq/m3</u>	<u>ppm</u>
LW0187	L383085-3	279	<5	<6	<2	<0.5
LW0458	L383085-4	265	130	150	60	14
LW0687	L383085-5	260	6	7	3	0.7
LW1420	L383085-6	15	<5	<6	<40	<9
LW1641	L383085-7	16	<5	<6	<40	<9
LW0582	L383085-8	15	<5	<6	<40	<9
LW0284	L383085-9	15	<5	<6	<40	<9
LAB BLANK	L383085-10	NA	<5	<6	NA	NA

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Level of quantitation: 5 ug  
Analytical Method : mod. NIOSH 1501; GC/FID BADGE  
OSHA PEL : 100 ppm (TWA)  
Collection Media : Assay 566

Submitted by: BDK  
Approved by : DNF  
Date : 22-AUG-16  
Supervisor: KLD  
NYS DOH # : 11626  
QC by: TJB

< -Less Than      mg -Milligrams      m3 -Cubic Meters      kg -Kilograms      NA -Not Applicable      ND -Not Detected  
> -Greater Than      ug -Micrograms      l -Liters      NS -Not Specified      ppm -Parts per Million



# GALSON

## LABORATORY ANALYSIS REPORT

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Client : SAIF Corporation  
Site : City BES/PWB Phase 5  
Date Sampled : 10-AUG-16  
Date Received : 15-AUG-16

Account No.: 13625  
Login No. : L383085  
Date Analyzed : 17-AUG-16  
Report ID : 951149

### Respirable Dust

<u>Sample ID</u>	<u>Lab ID</u>	<u>Air Vol</u> <u>liter</u>	<u>Total</u> <u>mg</u>	<u>Conc</u> <u>mg/m3</u>
1-SILICA	L383085-1	209	0.50	2.4
B-SILICA	L383085-2	NA	<0.050	NA

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Level of quantitation: 0.050 mg  
Analytical Method : mod. NIOSH 0600; Gravimetric  
OSHA PEL : PNOR 5 mg/m3 (TWA)  
Collection Media : PVC PW 37mm

Submitted by: KBD/PAH  
Approved by : KRK  
Date : 19-AUG-16  
Supervisor: KRK  
NYS DOH # : 11626  
QC by: TJB

< -Less Than      mg -Milligrams      m3 -Cubic Meters      kg -Kilograms      NA -Not Applicable      ND -Not Detected  
> -Greater Than      ug -Micrograms      l -Liters      NS -Not Specified      ppm -Parts per Million



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## LABORATORY ANALYSIS REPORT

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Client : SAIF Corporation  
Site : City BES/PWB Phase 5

Date Sampled : 10-AUG-16  
Date Received : 15-AUG-16

Account No.: 13625  
Login No. : L383085

Date Analyzed : 17-AUG-16 - 19-AUG-16  
Report ID : 952326

### Respirable Crystalline Silica (RCS): Quartz

Sample ID	Lab ID	Analyte	Air Vol	ug	ug/m3
			l		
1-SILICA	L383085-1	Quartz	209	28	130
		Cristobalite	NA	NA	NA
		Tridymite	NA	NA	NA
		RCS	209	28	130
B-SILICA	L383085-2	Quartz	NA	<5.0	NA
		Cristobalite	NA	NA	NA
		Tridymite	NA	NA	NA
		RCS	NA	<5.0	NA

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Level of quantitation: Q:5ug	Submitted: NLO
Analytical Method : mod. NIOSH 7500/mod. OSHA ID-142; XRD	Approved: AJD
OSHA PEL : 50 ug/m3 RCS	Date : 22-AUG-16 NYS DOH # : 11626
Collection Media : PVC PW 37mm	Supervisor: KRK QC by: TJB

< -Less Than	mg -Milligrams	kg -Kilograms	ppm -Parts per Million
> -Greater Than	ug -Micrograms	m3 -Cubic Meters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	l -Liters	mppcf -Million Particles per Cubic Foot



# GALSON

## LABORATORY FOOTNOTE REPORT

Client Name : SAIF Corporation  
Site : City BES/PWB Phase 5

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East Syracuse, NY 13057  
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FAX: (315) 437-0571  
www.galsonlabs.com

Date Sampled : 10-AUG-16  
Date Received: 15-AUG-16  
Date Analyzed: 17-AUG-16 - 19-AUG-16  
Account No.: 13625  
Login No. : L383085

This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Unless otherwise noted below, all quality control results associated with the samples were within established control limits or did not impact reported results.

Note: The findings recorded within this report were drawn from analysis of the sample(s) provided to the laboratory by the Client (or a third party acting at the Client's direction). The laboratory does not have control over the sampling process. The findings herein constitute no warranty of the samples' representativeness of any sampled environment and strictly relate to the samples as they were presented to the laboratory.

Unrounded results are carried through the calculations that yield the final result and the final result is rounded to the number of significant figures appropriate to the accuracy of the analytical method. Please note that results appearing in the columns preceding the final result column may have been rounded and therefore, if carried through the calculations, may not yield an identical final result to the one reported.

The stated LOQs for each analyte represent the demonstrated LOQ concentrations prior to correction for desorption efficiency (if applicable).

Unless otherwise noted below, reported results have not been blank corrected for any field blank or method blank.

L383085 (Report ID: 951728):

Total ug corrected for a desorption efficiency of 90%.  
SOPs: GC-SOP-16(16), GC-SOP-12(11), GC-SOP-9(17)

L383085 (Report ID: 951728):

Accuracy and mean recovery data presented below is based on a 95% confidence interval (k=2). The estimated accuracy applies to the media, technology, and SOP referenced in this report and does not account for the uncertainty associated with the sampling process. The accuracy is based solely on spike recovery data from internal quality control samples.

Parameter	Accuracy	Mean Recovery
Styrene	+/-9.3%	104%

L383085 (Report ID: 951149):

SOPs: GRAV-SOP-5(16), GRAV-SOP-6(15)  
Gravimetric analytical accuracy of the sampling media is -0.001 +/- 0.006 mg (average blank weight change +/- 95% confidence interval or k=2). The estimated uncertainty applies to the media, technology, and

<	-Less Than	mg -Milligrams	m3	-Cubic Meters	kg -Kilograms	ppm -Parts per Million	
>	-Greater Than	ug -Micrograms	l	-Liters	NS -Not Specified	ND -Not Detected	NA -Not Applicable



# GALSON

## LABORATORY FOOTNOTE REPORT

Client Name : SAIF Corporation  
Site : City BES/PWB Phase 5

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Date Sampled : 10-AUG-16  
Date Received: 15-AUG-16  
Date Analyzed: 17-AUG-16 - 19-AUG-16

Account No.: 13625  
Login No. : L383085

L383085 (Report ID: 951149):

SOP(s) referenced in this report and does not account for any uncertainty associated with the sampling process.  
PNOR = Particulates Not Otherwise Regulated.

L383085 (Report ID: 952326):

SOPs: ix-xrdreview(13), ix-xrdashprep(25), ix-calibrate(11), ix-xrdstdprep(25)

L383085 (Report ID: 952326):

Accuracy and mean recovery data presented below is based on a 95% confidence interval (k=2). The estimated accuracy applies to the media, technology, and SOP referenced in this report and does not account for the uncertainty associated with the sampling process. The accuracy is based solely on spike recovery data from internal quality control samples.

Parameter	Accuracy	Mean Recovery
Quartz	+/-11.8%	98.1%

<	-Less Than	mg	-Milligrams	m3	-Cubic Meters	kg	-Kilograms	ppm	-Parts per Million		
>	-Greater Than	ug	-Micrograms	l	-Liters	NS	-Not Specified	ND	-Not Detected	NA	-Not Applicable



129444423110004012

Date: 08/15/16

Shipper: UPS

Initials: ZRK



Prep: UNKNOWN

LSON

## CHAIN OF CUSTODY

85

Turn Around Time (TAT): (surcharge)		Client Acct No.: 13625		Report To: Ms. Kim Henry		Invoice To: Ms. Kim Henry	
<input checked="" type="checkbox"/> Standard	0%	Company Name: SAIF Corporation		Company Name: SAIF Corporation		Company Name: SAIF Corporation	
<input type="checkbox"/> 4 Business Days	35%	Address 1: 400 High Street, S.E.		Address 1: 400 High Street, S.E.		Address 1: 400 High Street, S.E.	
<input type="checkbox"/> 3 Business Days	50%	Address 2:		Address 2:		Address 2:	
<input type="checkbox"/> 2 Business Days	75%	City, State Zip: Salem, OR 97312-1000		City, State Zip: Salem, OR 97312-1000		City, State Zip: Salem, OR 97312-1000	
<input type="checkbox"/> Next Day by 6pm	100%	Phone No.:		Phone No.:		Phone No.:	
<input type="checkbox"/> Next Day by Noon	150%	Cell No.:		Cell No.:		Cell No.:	
<input type="checkbox"/> Same Day	200%	Email reports to:		Email reports to:		Email reports to:	
<input type="checkbox"/> Samples submitted using the FreePumpLoan™ Program		Email EDD to:		Email EDD to:		Email EDD to:	
<input checked="" type="checkbox"/> Samples submitted using the FreeSamplingBadges™ Program		Comments: Please provide lab blank for styrene (N566 badge). Thank you!		Comments: Please provide lab blank for styrene (N566 badge). Thank you!		Comments: Please provide lab blank for styrene (N566 badge). Thank you!	
Comments: Please provide lab blank for styrene (N566 badge). Thank you!				State Sampled: Oregon		Please indicate which OEL(s) this data will be used for:	
						<input type="checkbox"/> OSHA PEL <input checked="" type="checkbox"/> ACGIH TLV <input type="checkbox"/> MSHA <input type="checkbox"/> Cal OSHA <input type="checkbox"/> IAO: Specify Limit(s) <input type="checkbox"/> Other: Specify Other	
Site Name: City BES/PWB Phase 5		Project:		Sampled By: Kim Henry		List description of industry or Process/interferences present in sampling area:	
Sample ID (Maximum of 20 Characters)	Date Sampled	Collection Medium	Sample Volume Sample Time Sample Area	Liters Minutes in <sup>2</sup> , cm <sup>2</sup> , ft <sup>2</sup>	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
1-SILICA	8/10/2016	3pc 37mm PW PVC	209	L	Silica, crystalline quartz (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
B-SILICA	8/10/2016	3pc 37mm PW PVC	N/A (BLANK)	N/A	Silica, crystalline quartz (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
<input checked="" type="checkbox"/> ^ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.							
Chain of Custody	Print Name / Signature		Date	Time	Print Name / Signature		Date
Relinquished By:	Kim Henry SIGNED ELECTRONICALLY		8/11/2016	08:42	Received By: Zachary King		8/15/16
Relinquished By:					Received By:		9:34
Samples received after 3pm will be considered as next day's business.         Online COC No.: 112491 Prep No.: Account No.: 13625 Finalized: 8/11/2016 11:44:16 AM							
All services are rendered in accordance with the applicable SGS General Conditions of Service accessible via: <a href="http://www.sgs.com/en/Terms-and-Conditions.aspx">http://www.sgs.com/en/Terms-and-Conditions.aspx</a>							





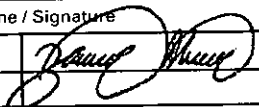
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## CHAIN OF CUSTODY

Comments :

Sample ID (Maximum of 20 Characters)	Date Sampled	Collection Medium	Sample Volume Sample Time Sample Area	Liters Minutes in <sup>2</sup> , cm <sup>2</sup> , ft <sup>2</sup>	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
LW0187	8/10/2016	Assay N566	279	min	Styrene	mod. NIOSH 1501; GC/FID BADGE	
LW0458	8/10/2016	Assay N566	265	min	Styrene	mod. NIOSH 1501; GC/FID BADGE	
LW0687	8/10/2016	Assay N566	260	min	Styrene	mod. NIOSH 1501; GC/FID BADGE	
LW1420	8/10/2016	Assay N566	15	min	Styrene	mod. NIOSH 1501; GC/FID BADGE	
LW1641	8/10/2016	Assay N566	16	min	Styrene	mod. NIOSH 1501; GC/FID BADGE	
LW0582	8/10/2016	Assay N566	15	min	Styrene	mod. NIOSH 1501; GC/FID BADGE	
LW0284	8/10/2016	Assay N566	15	min	Styrene	mod. NIOSH 1501; GC/FID BADGE	

☒ ^ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.

Chain of Custody	Print Name / Signature	Date	Time		Print Name / Signature	Date	Time
Relinquished By:	Kim Henry <b>SIGNED ELECTRONICALLY</b>	8/11/2016	08:42	Received By:	Zachary King 	8/15/16	9:34
Relinquished By:				Received By:			

Samples received after 3pm will be considered as next day's business.

Online COC No. : 112491

Prep No. :

Account No. : 13625

Finalized : 8/11/2016 11:44:16 AM

All services are rendered in accordance with the applicable SGS General Conditions of Service accessible via: <http://www.sgs.com/en/Terms-and-Conditions.aspx>