Hot-Wire Foam Cutting Exposure Assessment During Theatrical Staging

Submitted to:

International Alliance of Theatrical Stage Employees

Local 891

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EXECUTIVE SUMMARY

Aura Health and Safety Corporation (Aura) was retained by the International Alliance of Theatrical Stage Employees (IATSE) to conduct an exposure assessment of workers involved in the hot-wire foam cutting process for theatrical staging. The assessment evaluated worker exposure to the inhalation of fumes released from the pyrolysis of Expanded Polystyrene (EPS), containing styrene, benzene, toluene, ethylbenzene, xylene (BTEX), and compared the results with the WorkSafeBC Occupational Exposure Limits.

The exposure assessment was conducted by Aura research students at two sites on separate days, with full-shift sampling performed at a set-design warehouse (site A), and task-based sampling performed at a prop-design warehouse (site B). At each site, two workers involved in hot-wire foam cutting were assigned for personal monitoring, alongside an area sample. A total of 8 samples were submitted to an American Industrial Hygiene Associated (AIHA) accredited laboratory for analysis for both styrene and BTEX (NIOSH Method 1501).

The results from the exposure assessment indicated that the concentrations were all below the analytical Limit of Detection, which suggests that hot-wire foam cutting workers and bystanders were not at risk of exceeding WorkSafeBC Occupational Exposure Limits (only applicable to workers in settings similar to ones performed in the exposure assessment).

It is recommended that additional sampling be performed during varied environmental conditions and volumes of foam cutting in order to attain enough exposure data to perform statistical analysis common in the practice of industrial hygiene.

TABLE OF CONTENTS

LIST OF TABLES

1 INTRODUCTION

1.1 Hot Wire Foam Cutting

Hot-wire foam cutting is a commonly used sculpting technique involved in the designing and building of sets for the film industry. Workers use electrically heated metal wires (typically nichrome wire) to cut polystyrene-based (known as Expanded Polystyrene) foam blocks into form-factors required by the production. Although workers may choose to use different heat settings, depending on how quickly they wish to cut, temperatures of the wire can reach more than 400°C (Aitchison, Brooks, Bain, & Pons, 2009). Not only does this pose a physical hazard to the workers working with the cutting equipment, but the high temperatures could also release hazardous decomposition products into the air that may pose a health risk when foam is cut.

While a range of commercial foam products exist, their composition is largely comprised of polystyrene, with a small percentage of the product consisting of brominated flame retardants and pentane. Polystyrene itself is a polymer of the aromatic monomer styrene. Once the foam is cut, the heat can cause the blocks to off-gas volatile organic compounds (VOCs) such as benzene, toluene, ethylbenzene, xylene (BTEX) and styrene into the air. The purpose of this project was to assess worker exposure to VOCs, more specifically the inhalation of BTEX and styrene.

1.2 Styrene

Styrene is a colourless liquid that produces a sweet smell at low concentrations (National Centre for Biotechnology Information, 2017). It is used primarily to produce polystyrene, and by extension, Expanded Polystyrene (EPS) including foam blocks that are used in the film industry. According to the International Agency for Research on Cancer (IARC) (1994), styrene is classified as Group 2B, *possibly carcinogenic to humans*, with some research suggesting carcinogenicity in mice and occupational exposures associated with developing cancer in white blood cells and stem cells. Symptoms resulting from inhalation of styrene include tiredness, slowed reaction time and problems with balance (Agency for Toxic Substances & Disease Registry, 2012).

Given that polystyrene is created from the polymerization of styrene monomers, the most likely decomposition product released into the air during hot-wire foam cutting is styrene. Results from a research study examining polystyrene decomposition products also indicated that styrene was found in the highest concentration compared to other decomposition products emitted from the pyrolysis of polystyrene in air at 300°C (Shapi & Hesso, 1990).

1.3 Benzene, Toluene, Ethylbenzene, and Xylene

Benzene, toluene, ethylbenzene and xylene are a group of Volatile Organic Compounds (VOCs) that readily become vapours at room temperature. Each of the BTEX chemicals are also present in the styrene production process, either as the primary component or intermediate by-product (James & Castor, 2012). Findings from Shapi & Hesso (1990) indicate that a significant amount of benzene, toluene, and ethylbenzene are released due to styrene pyrolysis.

Benzene is an aromatic hydrocarbon that is classified by IARC as Group 1, *carcinogenic to humans* (2012). Exposure to benzene is linked to non-lymphocytic leukemia with associations to other lymphocytic cancers. Out of the BTEX substance group, benzene causes the most adverse health effects, with its occupational exposure limit orders of magnitude lower than the other hydrocarbons. Excess benzene inhalation can result in symptoms of drowsiness, dizziness, and headaches, all of which can affect the safety of individuals working in the area (Centers for Disease Control and Prevention, 2013).

Ethylbenzene is another aromatic hydrocarbon, which, like benzene, emits an odour similar to gasoline. In addition, it is also the primary ingredient used in the production of styrene, where it accounts for 85% of

commercial production (James & Castor, 2012). IARC has classified ethylbenzene as Group 2B, possibly *carcinogenic to humans*; while there is limited evidence of carcinogenicity in humans, animal exposure to ethylbenzene has been associated with lung, liver and kidney cancers (2000). Symptoms resulting from exposure to ethylbenzene in the air may cause eye irritation and high concentrations may cause irritation to mucous membranes (Toxnet Toxicology Data Network, 2016).

Toluene, like benzene and ethylbenzene, is released from the pyrolysis of styrene. While not classified as a carcinogen by IARC, inhalation of toluene can lead to symptoms of headaches, dizziness, or unconsciousness (Agency for Toxic Substances & Disease Registry, 2014). Furthermore, toluene is known to cause reproductive health effects such as premature delivery, intrauterine growth retardation and congenital malformations (Donald, Hooper, & Hopenhayn-Rich, 1991).Toluene is also noted to be released in a higher relative-proportion compared to other compounds in the BTEX group (Shapi & Hesso, 1990).

Xylene is similarly released in low concentrations as ethylbenzene when styrene undergoes pyrolysis (Shapi & Hesso, 1990). Inhalation may cause irritation and throat, including symptoms of headaches, dizziness and confusion. Along with toluene, IARC classifies xylene as non-carcinogenic to humans (Canadian Centre for Occupational Health and Safety, 2017).

2 OCCUPATIONAL EXPOSURE LIMITS

WorkSafeBC sets Occupational Exposure Limits (OELs) for protection of worker health in Part 5 of the *Occupational Health and Safety Regulation* (OHSR). Section 5.48 of the OHSR contains the Table of OELs for Chemical and Biological Substances (Table of Exposure Limits for Chemicals and Biological Substances). OELs for benzene, toluene, ethylbenzene, xylene and styrene are provided in Table 1, below. OELs can be designated as full-shift (8-hour) time weighted averages (TWA) or 15-minute short-term exposure limits (STEL). The 8-hour TWA represents an airborne concentration which it is believed that nearly all workers can be exposed to for 8-hours a day, 40-hours a week, without adverse health effects. The STEL represents a shorter duration exposure concentration up to a maximum of 15-minutes.

In addition, Section 5.50 of the OHSR contains the TWA limit factors for work periods beyond the 8-hour TWA limit. The allowable exposure limit decreases at increasing shift lengths beyond 8-hours. For work shifts more than 8 hours long but less than 10 hours, the recommended TWA limits should be multiplied by a factor of 0.7.

Table 1. WorkSafeBC Occupational Exposure Limits for BTEX and Styrene

Substance	TWA	STEL	Notation
Styrene – Monomer [100-42-5]	50 ppm	75 ppm	2B
Benzene [71-43-2]	0.5 ppm	2.5 ppm	Skin; 1
Toluene [108-88-3] Revised 2007; 2008	20 ppm	-	R
Ethyl Benzene [100-41-4] Revised 2011	20 ppm	-	2B
Xylene [1330-20-7] (o, m & p isomers) [95-47-6; 108-38-3; 106-42-3]	100 ppm	150 ppm	

Notes:

mg/m^3	Milligrams per meter cubed
ppm	Parts per million
TWA	Time Weighted Average – 8 Hour Occupational Exposure Limit
STEL	Short Term Exposure Limit - 15 Minute Occupational Exposure Limit
1	IARC: Carcinogenic to Humans
2B	IARC: Possibly Carcinogenic to Humans
Skin	Skin Absorption Exposure
R	Adverse Reproductive Effects

3 BACKGROUND

Site A: Set Design Stage

The volume of hot-wire foam cutting required largely depends on stage and prop requirements of the upcoming production scene. On the day of the exposure assessment, two workers were involved in the hot-wire cutting of foam blocks into smaller sheets throughout their 10-hour shift. According to the department manager, the production at the time required very few foam designs, which meant the amount of hot-wire foam cutting was also low.

The hot-wire foam cutting process performed by the two workers first involves attaching metal plates over the foam blocks to act as a guide for the desired shape of the cut. Once the metal plates are nailed into the blocks, the workers each grip on one end of a wooden handle connected by an approximately 1.7-meter-long nichrome wire. The wire is then attached to a transformer that is adjusted to 130 volts, with a current of 20 amps; this heats up the wire to a temperature that the workers use to cut the foam blocks. The workers then stand on opposite ends of the foam block, and slowly bring down the heated wire onto the foam blocks using the metal plates as guides. Each cut usually takes no longer than 1-2 minutes before the foam block is cut and the metal plates are either readjusted for another cut or the cutting is done altogether. Given that only a low volume of foam blocks required hot-wire cutting, the activity was largely sparse and spread out between design, sanding, melting and other non-foam cutting activities throughout the entire work shift.

Site B: Prop-Design Warehouse

Hot-wire foam cutting at site B is also dependent on the number of props that need to be sculpted, but in relation to site A, the volume of hot-wire foam cutting is much lower. In contrast to site A, a task-based assessment of two workers conducting hot-wire foam cutting was performed over an hour period. During this period, the workers were continuously cutting foam rather than stopping intermittently to perform other tasks.

The hot-wire foam cutting process set-up involves the workers moving blocks of foam across a fixed hot-wire on top of a workbench. This is done to cut the foam blocks into smaller sheets, rather than specific shapes required by the workers in site A. The nichrome wire itself was approximately 1.5-meter-long, and heated by a transformer set to 170 volts. The workers stood on either ends of the work bench and pushed/guided the blocks across the stationary wire. There was minimal down-time between finishing the cutting of a foam block and the start of the next foam cut.

4 METHODOLOGY

Two industrial hygiene students from the Master of Science in Occupational & Environmental Hygiene program at the University of British Columbia conducted the exposure assessment for this project on June 9, 2017 (Site A) and July 14, 2017 (Site B).

4.1 Site A: Set-Design Stage

The first round of hot-wire foam cutting exposure assessment was conducted on a production based in Vancouver. Hot-wire cutting is one of the processes that took place in a large warehouse stage dedicated to foam prop sculpting.

The sampling strategy incorporated the use of both personal and area monitoring for the assessment of BTEX and styrene exposures among workers in the warehouse. Both exposure assessments were conducted following the National Institute of Occupational Safety and Health (NIOSH) Method 1501(modified for extended shift length).

A total of six samples were collected for this assessment: four personal and two area samples. For personal monitoring, two workers were selected and each was equipped with two low-flow sampling pumps attached to their waists. Sampling media attached to flexible tubing and the pumps, included coconut shell charcoal sorbent tubes placed in the breathing zone of the workers for duration of the shift. For area sampling, an unobtrusive central location covering a 5-meter radius of hot-wire foam cutting activity was selected. A sampling head was placed on a tripod at an approximate 1.5-meter height. The proximity to the hot-wire foam cutting reflects the exposures where other bystander workers might be exposed, especially those not involved in the hot-wire foam cutting process.

For each of the samples, the sampling pump flow rate was set to 0.050 L/min for a duration of 560-570 minutes, for a total of 28-32 Litres of sample volume. A Drycal Defender 520 primary calibrator was used for both pre- and post-flow rate verifications. For quality control, two field blanks were collected for identifying potential sources of contamination. Other environmental factors such as temperature and relative humidity were also recorded.

For the analysis of the samples, SGS Galson Laboratories in East Syracuse, New York, USA followed NIOSH Method 1501 and used Gas Chromatography and Flame Ionization Detector analysis to determine BTEX and styrene concentrations.

4.2 Site B: Prop-Design Warehouse

The second round of hot-wire foam cutting exposure assessment was conducted in a warehouse for a business dedicated to designing theatre/film props.

For this exposure assessment, a total of six samples were also collected, involving four personal and two area samples, with two additional field blanks. The monitoring process was identical to the previous site, with adjustments made to the area monitor proximity and flow rate/sampling duration. For area sampling, the sampling heads were set on a tripod approximately two meters away, in closer proximity to the hot-wire cutting process. This was done in part to reflect the proximity of other workers.

For the sampling process, both BTEX and styrene exposures were sampled for a period of 47-62 minutes to reflect the continuous hot-wire foam cutting process. For BTEX exposures, the sampling flow rate was increased from 0.050 L/min to 0.200 L/min in order to reach the desired sample volume, given the shorter sample duration.

5 RESULTS

5.1 Observations

The work volume at site A was noted to be typical for a production period that did not require many foam-based props. However, according to the department manager, during periods where large volumes of foam cutting is required, both the number of workers simultaneously performing hot-wire foam cutting and the duration of the cutting would be significantly higher. For site B, the amount of foam cutting required is usually low, and in most instances, there would not be more than two people performing hot-wire foam cutting at a given time. The amount of hot-wire foam cutting on the day of the assessment was considered higher than usual. Observations were made in each of the two facilities as indicated by Table 2.

Table 2. Site Observations

	Site A	Site B
Warehouse Features		
• Ventilation	• Building-wide ventilation system • Smoke rose towards the ceiling • Large interior space	• Natural ventilation from outdoors from large doors and ceiling openings • Susceptible to outdoor wind conditions • Irregular flow conditions evident from smoke travel • Large open space
• Proximity to other workers	• Close proximity to other foam workers in the area	• Close proximity to other workers near the benches and other machinery
• Proximity to other materials	• No materials/volatile compounds outside of HILTE glue	• Containers stored nearby containing latex, silicone rubber, paints, glue, but also organic solvents
Hot-Wire Cutting		
• Foam Manufacturer	• Plasti-Fab EPS Product Solutions	• Mansonville Plastics LTD
• Set-Up	• Manual handles for wire • Transformers set to 130 volts	• Fixed wire positioning between two clamps

	• Metal plates attached to ends of foam blocks for precision cuts • Vertical cuts	• Transformer set to 175 volts • Horizontal Cuts
• Visual	• Smoke released when wire contacts foam • Large volume of smoke released once blocks fully cut and separated	• Smoke released when wire contacts foam • Large volume of smoke released once blocks fully cut and separated
• Odour	• Smoke released evident smell	• Smoke released strong smell
Worker		
• Personal Protective Equipment (PPE)	• One worker wore a N95 dust mask • One worker did not wear anything	• One worker wore a full face elastomeric respirator with P100/organic vapour cartridges • One worker wore full helmet with powered air purifying respirator (PAPR)

5.2 Monitoring Results

5.2.1 Sites A and B: Set- and Prop-Design Warehouse Foam Cutting

All measured styrene and BTEX exposures, as well as all area samples were below their respective analytical limits of detection (LOD). These results are shown in Appendix I.

6 DISCUSSION

The exposure assessments conducted at site A and site B intended to look at exposures to styrene and BTEX as a result of hot-wire foam cutting. While both personal and area monitoring were performed at the site, the sampling approaches were slightly different.

The sampling conducted at site A was used to examine the full-shift exposures of hot-wire foam cutting workers dedicated to set and prop design for a show production. Therefore, the findings would reflect worker exposures to a full 10-hour shift and best represent actual exposures throughout the work day. The sampling conducted at site B relied on a task-based assessment approach, where exposure monitoring was conducted for only a one-hour period during continuous foam cutting. Task-based sampling can be used to extrapolate a full-shift exposure when given the total amount of time the work task is performed over the shift length.

Exposure levels attained from both site A and B did not result in significant differences, and samples from both sites yielded results that were all below the analytical Limit of Detection (LOD). These findings would suggest that, under the conditions during this assessment, worker exposures to these chemicals are not at a significant risk of reaching the applicable OELs, including those adjusted for extended shift length of 10-hours.

With regards to exploring possible explanations for these findings, factors such as building ventilation, may play a significant role in reducing exposures from hot-wire foam cutting. For site A, this was likely very relevant, as the warehouse had an active ventilation system that was circulating the air and drawing it upwards. Smoke that was released from the hot-wire foam cutting process was visibly travelling towards the ceiling before it could spread elsewhere, where bystander workers might be. As a result, the area sample is even more unlikely to detect significant concentrations of styrene or BTEX compared to the personal samples. For site B, the ventilation system was noticeably worse, since it relied on passive ventilation from open bay doors and ceiling frame openings to the outside environment. The circulation of air, as shown by the smoke released from the hot-wire foam cutting, was far more variable and changed depending on outdoor conditions. This meant the smoke dispersed into a wider area surrounding the foam cutting process, and it would be expected that bystander worker exposures would be higher. Nevertheless, the area samples at both sites indicated non-detect levels.

In terms of the personal sampling results, the non-detect values from site A could also possibly be attributed to the intermittent and brief periods of hot-wire foam cutting throughout the entire shift. While work shifts are longer than the usual 8-hour period, the amount of cumulative hot-wire foam cutting performed on the day of the assessment was no more than two total hours. According to the workers performing the hot-wire foam cutting, there are work days where foam cutting is done in much greater volume and longer duration, with more than two workers cutting simultaneously. This suggests that exposures could be higher and the day of the site visit may not necessarily reflect typical exposures during a period where large volumes of foam are needed for set design. With that in mind, the results from site B suggests that continuous exposure also yielded non-detect levels, which may simply suggest that overall exposures to styrene and BTEX are insignificant in relation to the OELs.

It is also important to note, that while site B would likely yield higher exposure concentrations, both workers performing the hot-wire foam cutting used respiratory equipment to protect against inhaling released fumes. In addition, this would also prevent the smelling of strong odours released from hot-wire foam cutting, which was only noticeable at site B. Other observations at site B include the presence of solvent products stored in sealed buckets. However, neither the field blank or active samples detected any significant levels of VOCs which suggests that the presence of other products in the environment would not have had any effect on the assessment.

7 LIMITATIONS

The greatest limitation to this exposure assessment was the number of monitoring opportunities available. Throughout an approximate four-month period, only site A and site B were available for exposure monitoring for single day assessments. While every attempt was made to acquire more sampling opportunities, obstacles largely involved a lack of hot-wire foam cutting needed for production and low volunteer rates from prospective sites and productions. Consequently, the lack of monitoring opportunities and exposure data makes it difficult to draw concrete conclusions on the actual exposures of hot-wire foam cutting, as a more robust data set would be required for such conclusions.

In terms of the sampling strategy, the limitations mentioned above meant that it was only possible to conduct convenience sampling rather than random sampling or worst-case sampling. The days of monitoring and the workers selected for the personal monitoring were all selected based on availability, rather than random selection. The volume of hot-wire foam cutting was also subject to the needs of the production, and it would not have reflected a worst-case scenario where all workers were performing hot-wire foam cutting throughout the entire shift. These factors make it difficult to generalize the findings to other workers and workplaces.

Another limitation of the sampling strategy is the reliance on a stationary area monitor to simulate the bystander worker exposures in the area. For both site A and site B assessments, the surrounding area near the hot-wire foam cutting process was never saturated or at a homogenous exposure level. For site A, this was likely due to the active ventilation system, but for site B, the passive ventilation system meant that the

direction of smoke released would regularly change. In site A, it would also be uncharacteristic for a worker to be working in a fixed area for the entirety of the shift.

This exposure assessment also prioritized examining exposures to styrene and BTEX due to the literature suggesting that they are in the highest concentrations, but it is also possible that other chemicals could be released in to the air when foam is cut. These include the possible presence of pentane and brominated flame retardants, which are listed in the Safety Data Sheets for the foam products. However, since the exposure assessment did not examine what the temperatures of the wires were specifically heated to, potential exposures to other decomposition products were not evaluated.

8 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings from this exposure assessment the following conclusions and recommendations are made:

- The results suggest that the hot-wire foam cutting workers and nearby bystanders are not at a risk of over exposure to fume generated by this task under conditions similar to those present during this assessment.
- It should be stated that even if exposure levels are well below applicable OELs, odour thresholds may be breached, hence presenting a nuisance, or perception of a health hazard, to workers.
- It is recommended that additional sampling be performed during varied environmental conditions and volumes of foam cutting in order to attain enough exposure data to perform statistical analysis common in the practice of industrial hygiene.

9 CLOSURE

This report has been prepared for the exclusive use of IATSE. No other warranty, expressed or implied, is made. Any use that a third party makes of this report, or any reliance on or decisions to be made based upon it, are the responsibility of such third parties. Aura accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. Please see Aura's Statement of Limitations included in Appendix V.

Yours truly,

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Appendix I – Results

Site A: Prop Design Stage Foam Cutting

Table 1. Styrene Exposure Concentrations

Sample ID	Date (MM/DD/YY)	Sampled Volume (L)	Sample Type	Concentration (ppm)
1AS	06/09/17	30.44	Worker A	< 0.16
1BS	06/09/17	32.41	Worker B	< 0.15
1CS	06/09/17	28.70	Area	< 0.17
1FBS	06/09/17	N/A	Field Blank	Non-Detect

Table 2. Benzene Exposure Concentrations

Sample ID	Date (MM/DD/YY)	Sampled Volume (L)	Sample Type	Concentration (ppm)
1ABA	06/09/17	28.42	Worker A	< 0.02
1BBA	06/09/17	28.74	Worker B	< 0.02
1CBA	06/09/17	28.14	Area	< 0.02
1FBBA	06/09/17	N/A	Field Blank	Non-Detect

Table 3. Ethylbenzene Exposure Concentrations

Sample ID	Date (MM/DD/YY)	Sampled Volume (L)	Sample Type	Concentration (ppm)
1ABA	06/09/17	28.42	Worker A	< 0.04
1BBA	06/09/17	28.74	Worker B	< 0.04
1CBA	06/09/17	28.14	Area	< 0.04
1FBBA	06/09/17	N/A	Field Blank	Non-Detect

Table 4. Toluene Exposure Concentrations

Sample ID	Date (MM/DD/YY)	Sampled Volume (L)	Sample Type	Concentration (ppm)

1ABA	06/09/17	28.42	Worker A	< 0.05
1BBA	06/09/17	28.74	Worker B	< 0.05
1CBA	06/09/17	28.14	Area	< 0.05
1FBBA	06/09/17	N/A	Field Blank	Non-Detect

Table 5. Xylene Exposure Concentrations

Sample ID	Date (MM/DD/YY)	Sampled Volume (L)	Sample Type	Concentration (ppm)
1ABA	06/09/17	28.42	Worker A	< 0.12
1BBA	06/09/17	28.74	Worker B	< 0.12
1CBA	06/09/17	28.14	Area	< 0.12
1FBBA	06/09/17	N/A	Field Blank	Non-Detect

Site B: Warehouse Foam Cutting

Table 6. Styrene Exposure Concentrations

Sample ID	Date (MM/DD/YY)	Sampled Volume (L)	Sample Type	Concentration (ppm)
STY1	07/14/17	2.43	Worker A	< 2.1
STY2	07/14/17	2.52	Worker B	< 2.0
STY3	07/14/17	3.23	Area	< 1.5
STYFB	07/14/17	N/A	Field Blank	Non-Detect

Table 7. Benzene Exposure Concentrations

Sample ID	Date (MM/DD/YY)	Sampled Volume (L)	Sample Type	Concentration (ppm)
BTEX1	07/14/17	9.38	Worker A	< 0.07
BTEX2	07/14/17	9.82	Worker B	< 0.06
BTEX3	07/14/17	12.31	Area	< 0.05

BTEXFB	07/14/17	N/A	Field Blank	Non-Detect

Table 8. Ethylbenzene Exposure Concentrations

Sample ID	Date (MM/DD/YY)	Sampled Volume (L)	Sample Type	Concentration (ppm)
BTEX1	07/14/17	9.38	Worker A	< 0.1
BTEX2	07/14/17	9.82	Worker B	< 0.1
BTEX3	07/14/17	12.31	Area	< 0.1
BTEXFB	07/14/17	N/A	Field Blank	Non-Detect

Table 9. Toluene Exposure Concentrations

Sample ID	Date (MM/DD/YY)	Sampled Volume (L)	Sample Type	Concentration (ppm)
BTEX1	07/14/17	9.38	Worker A	< 0.1
BTEX2	07/14/17	9.82	Worker B	< 0.1
BTEX3	07/14/17	12.31	Area	< 0.1
BTEXFB	07/14/17	N/A	Field Blank	Non-Detect

Table 10. Xylene Exposure Concentrations

Sample ID	Date (MM/DD/YY)	Sampled Volume (L)	Sample Type	Concentration (ppm)
BTEX1	07/14/17	9.38	Worker A	< 0.37
BTEX2	07/14/17	9.82	Worker B	< 0.36
BTEX3	07/14/17	12.31	Area	< 0.28
BTEXFB	07/14/17	N/A	Field Blank	Non-Detect

Notes:

mg/m^3	Milligrams per meter cubed
ppm	Parts per million
N/A	No volume sampled

Appendix II – Field Photographs

Photo 1 – Site A. Nichrome wires attached to wooden handles act as foam cutting instrument. The warehouse is actively ventilated from the ceiling.

Photo 2 – Site A. Foam blocks are cut into thin sheets. The wire is held taut by the workers and brought down against a metal plate guide.

Photo 3 – Site A. Area sample station with sampling heads placed on top of tripod. The position is 3-meters away from the hot-wire foam cutting process

Photo 4 – Site B. Workers cut a foam block into thin sheets with a fixed hot-wire. Both workers wear additional PPE when hot-wire foam cutting. Sampling heads at breathing zones are circled in red.

Photo 5 – Site B. Visible fumes are released as hot-wire cuts across foam block.

Photo 6 – Site B. Foam cutting warehouse is passively ventilated by open bay doors and ceiling openings with the outdoor environment.

Appendix III – Site A Laboratory Results

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DOH ELAP #11626
AIHA-LAP #100324

Account# 30522

Login# L409613

Dear Ms. Kajbafzadeh:

Enclosed are the analytical results for the samples received by our laboratory on June 14, 2017. 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 in the accreditations section under the "about Galson" tab.

Please contact Charlene Moser 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

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.

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LABORATORY ANALYSIS REPORT

Client : Aura Health and Safety
Site : NS

Date Sampled : 09-JUN-17
Date Received : 14-JUN-17

Account No.: 30522
Login No. : L409613

Date Analyzed : 15-JUN-17 - 17-JUN-17
Report ID : 1002372

Client ID : 1ABA **Lab ID : L409613-1** **Air Volume : 28.42 L**
Date Sampled : 06/09/17 **Date Analyzed : 06/15/17**

Parameter	LOQ ug	Front ug	Back ug	Total ug	Conc mg/m3	ppm
Benzene	2	<2	<2	<2	<0.07	<0.02
Ethylbenzene	5	<5	<5	<5	<0.2	<0.04
Toluene	5	<5	<5	<5	<0.2	<0.05
Xylene	15	<15	<15	<15	<0.53	<0.12

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

Collection Media: 226-01 Submitted by: SAB Approved by: NKP
Date : 20-JUN-17 NYS DOH # : 11626 Supervisor: KLD QC by: NDC

< -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 LOQ-Limit of Quantitation

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Client : Aura Health and Safety
Site : NS

Date Sampled : 09-JUN-17
Date Received : 14-JUN-17

Account No.: 30522
Login No. : L409613

Date Analyzed : 15-JUN-17 - 17-JUN-17
Report ID : 1002372

Client ID : 1BBA **Lab ID : L409613-2** **Air Volume : 28.74 L**
Date Sampled : 06/09/17 **Date Analyzed : 06/15/17**

Parameter	LOQ ug	Front ug	Back ug	Total ug	Conc mg/m3	ppm
Benzene	2	<2	<2	<2	<0.07	<0.02
Ethylbenzene	5	<5	<5	<5	<0.2	<0.04
Toluene	5	<5	<5	<5	<0.2	<0.05
Xylene	15	<15	<15	<15	<0.53	<0.12

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

Collection Media: 226-01 Submitted by: SAB Approved by: NKP
Date : 20-JUN-17 NYS DOH # : 11626 Supervisor: KLD QC by: NDC

< -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 LOQ-Limit of Quantitation

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Client : Aura Health and Safety
Site : NS

Date Sampled : 09-JUN-17
Date Received : 14-JUN-17

Account No.: 30522
Login No. : L409613

Date Analyzed : 15-JUN-17 - 17-JUN-17
Report ID : 1002372

Client ID : 1CBA **Lab ID : L409613-3** **Air Volume : 28.14 L**
Date Sampled : 06/09/17 **Date Analyzed : 06/16/17**

Parameter	LOQ ug	Front ug	Back ug	Total ug	Conc mg/m3	ppm
Benzene	2	<2	<2	<2	<0.07	<0.02
Ethylbenzene	5	<5	<5	<5	<0.2	<0.04
Toluene	5	<5	<5	<5	<0.2	<0.05
Xylene	15	<15	<15	<15	<0.54	<0.12

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

Collection Media: 226-01 Submitted by: SAB Approved by: NKP
Date : 20-JUN-17 NYS DOH # : 11626 Supervisor: KLD QC by: NDC

< -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 LOQ-Limit of Quantitation

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Client : Aura Health and Safety
Site : NS

Date Sampled : 09-JUN-17
Date Received : 14-JUN-17

Account No.: 30522
Login No. : L409613

Date Analyzed : 15-JUN-17 - 17-JUN-17
Report ID : 1002372

Client ID : 1FBBA **Lab ID : L409613-4** **Air Volume : NA**
Date Sampled : 06/09/17 **Date Analyzed : 06/16/17**

Parameter	LOQ ug	Front ug	Back ug	Total ug	Conc mg/m3	ppm
Benzene	2	<2	<2	<2	NA	NA
Ethylbenzene	5	<5	<5	<5	NA	NA
Toluene	5	<5	<5	<5	NA	NA
Xylene	15	<15	<15	<15	NA	NA

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

Collection Media: 226-01 Submitted by: SAB Approved by: NKP
Date : 20-JUN-17 NYS DOH # : 11626 Supervisor: KLD QC by: NDC

< -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 LOQ-Limit of Quantitation

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Client : Aura Health and Safety
Site : NS

Date Sampled : 09-JUN-17
Date Received : 14-JUN-17

Account No.: 30522
Login No. : L409613

Date Analyzed : 17-JUN-17
Report ID : 1002102

Styrene

Sample ID	Lab ID	Air Vol liter	Front ug	Back ug	Total ug	Conc mg/m3	ppm
1AS	L409613-5	30.44	<20	<20	<21	<0.70	<0.16
1BS	L409613-6	32.41	<20	<20	<21	<0.66	<0.15
1CS	L409613-7	28.7	<20	<20	<21	<0.74	<0.17
1FBS	L409613-8	NA	<20	<20	<21	NA	NA

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

Level of quantitation: 20. ug
Analytical Method : mod. OSHA 89; GC/FID
OSHA PEL : 100 ppm (TWA)
Collection Media : 226-73

Submitted by: MRH
Approved by : KLD
Date : 19-JUN-17
Supervisor: KLD

NYS DOH # : 11626
QC by: NDC

< -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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Client Name : Aura Health and Safety
Site :

Date Sampled : 09-JUN-17
Date Received: 14-JUN-17
Date Analyzed: 15-JUN-17 - 17-JUN-17

Account No.: 30522
Login No. : L409613

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 preceeding 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.

L409613 (Report ID: 1002372):
Benzene - Total ug corrected for a desorption efficiency of 100%.
Ethylbenzene - Total ug corrected for a desorption efficiency of 98%.
Toluene - Total ug corrected for a desorption efficiency of 97%.
Xylene - Total ug corrected for a desorption efficiency of 99%.
SOPs: GC-SOP-16(17), GC-SOP-8(20), GC-SOP-12(12)

L409613 (Report ID: 1002372):
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. Where N/A appears below, insufficient data is available to provide statistical accuracy and mean recovery values for the associated analyte.

Parameter	Accuracy	Mean Recovery
Benzene	+/-7.1%	94.9%
Ethylbenzene	+/-8.5%	99.7%
Toluene	+/-7.9%	98.3%

< -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

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Client Name : Aura Health and Safety
Site :

Date Sampled : 09-JUN-17
Date Received: 14-JUN-17
Date Analyzed: 15-JUN-17 - 17-JUN-17

Account No.: 30522
Login No. : L409613

Xylene	+/-7.9%	95.7%

Parameter	Method	PEL
Benzene	mod. NIOSH 1501; GC/FID	1 ppm (TWA)
Ethylbenzene	mod. NIOSH 1501; GC/FID	100 ppm (TWA)
Toluene	mod. NIOSH 1501/OSHA 111; GC/FID	200 ppm (TWA)
Xylene	mod. NIOSH 1501; GC/FID	100 ppm (TWA)

L409613 (Report ID: 1002102):
Total ug corrected for a desorption efficiency of 94%.
SOPs: GC-SOP-16(17), GC-SOP-8(20), GC-SOP-12(12)

L409613 (Report ID: 1002102):
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. Where N/A appears below, insufficient data is available to provide statistical accuracy and mean recovery values for the associated analyte.

Parameter	Accuracy	Mean Recovery
Styrene	+/-11%	104%

< -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

810168538021
Date:06/14/17
Shipper:FEDEX
Initials:CEM

Prep:UNKNOWN

L 409613

73

GALSON CHAIN OF CUSTODY

Comments: initially, we received a quote for the analysis of both BTEX and Acrylonitrile we only need the analysis of BTEX at this point. Thank you.

Sample ID * (Maximum of 20 Characters)	Date Sampled *	Collection Medium	~~Sample Volume~~ Sample Time Sample Area *	Liters Minutes in², cm², ft² *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
1ABA	June 9, 2017	Sm. Charcoal Tubes/226-01	28.42 L		BTEX; ~~Acrylonitrile~~	mod. NIOSH 1501; GC/FID	
1BBA	June 9, 2017	Sm. Charcoal Tubes/226-01	~~30.44~~ 28.74 L		BTEX; ~~Acrylonitrile~~	mod. NIOSH 1501; GC/FID	
1CBA	June 9, 2017	Sm. Charcoal Tubes/226-01	28.14 L		BTEX; ~~Acrylonitrile~~	mod. NIOSH 1501; GC/FID	
1FBBA	June 9, 2017	Sm. Charcoal Tubes/226-01 Field	Blank		BTEX; ~~Acrylonitrile~~	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX; ~~Acrylonitrile~~	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX; Acrylonitrile	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX; Acrylonitrile	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX; Acrylonitrile	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX; Acrylonitrile	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX; Acrylonitrile	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX; Acrylonitrile	mod. NIOSH 1501; GC/FID	

☐ ^ 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 :	Kiana Kasbafzadeh [signature]	June 13/2017	12:00pm	Received By :	Kris Stone [signature]	6/14/17	~~0919~~ KMS 0919
Relinquished By :	Raymond Wang [signature]	June 13/17	12pm	Received By :			

You must fill in these columns for any samples which you are submitting.

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

Online COC No. : 128662
Prep No. : PSY429627
Account No. : 30522
Draft : 6/7/2017 12:56:09 PM

SGS GALSON CHAIN OF CUSTODY

Comments :

Sample ID * (Maximum of 20 Characters)	Date Sampled *	Collection Medium	Sample Volume / Sample Time / Sample Area *	Liters / Minutes / in², cm², ft² *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
1AS	June 9/17	Anasorb CSC/226-73	SV	30.44L	Styrene	mod. OSHA 89; GC/FID	
1BS	June 9/17	Anasorb CSC/226-73	SV	32.41L	Styrene	mod. OSHA 89; GC/FID	
1CS	June 9/17	Anasorb CSC/226-73	SV	28.70L	Styrene	mod. OSHA 89; GC/FID	
1FBS	June 9/17	Anasorb CSC/226-73	NA	Field Blank	Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	

☐ ^ 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 :	Raymond Wang	Raymond Wang	June 13/17	12pm	Received By :	Kris Stone	Kris Stone	6/14/17	0919
Relinquished By :	Kiana Kajbafzadeh	Kiana Kajbafzadeh	June 13/17	12pm	Received By :				

*** You must fill in these columns for any samples which you are submitting.**

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

Online COC No. : 128662
Prep No. : PSY429627
Account No. : 30522
Draft : 6/7/2017 12:56:09 PM

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Appendix IV – Site B Laboratory Results

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Mr. Raymond Wang
Aura Health and Safety
3981 Kingsway
Unit B
Burnaby, BC V5H 1Y7
Canada

July 26, 2017

DOH ELAP #11626
AIHA-LAP #100324

Account# 30522

Login# L412957

Dear Mr. Wang:

Enclosed are the analytical results for the samples received by our laboratory on July 19, 2017. 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. When possible, non-IOM samples will be retained for 14 days following the date of this report (unless an extension is specifically requested). IOM samples are retained for 7 days.

Current Scopes of Accreditation can be viewed at www.galsonlabs.com in the accreditations section under the "about Galson" tab.

Please contact Charlene Moser 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

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.

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LABORATORY ANALYSIS REPORT

Client : Aura Health and Safety
Site : NS

Date Sampled : 14-JUL-17
Date Received : 19-JUL-17

Account No.: 30522
Login No. : L412957

Date Analyzed : 21-JUL-17 - 24-JUL-17
Report ID : 1008638

Client ID : BTEX1 **Lab ID : L412957-1** **Air Volume : 9.38 L**
Date Sampled : 07/14/17 **Date Analyzed : 07/21/17**

Parameter	LOQ ug	Front ug	Back ug	Total ug	Conc mg/m3	ppm
Benzene	2	<2	<2	<2	<0.2	<0.07
Ethylbenzene	5	<5	<5	<5	<0.5	<0.1
Toluene	5	<5	<5	<5	<0.5	<0.1
Xylene	15	<15	<15	<15	<1.6	<0.37

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

Collection Media: 226-01 Submitted by: ARE Approved by: NKP
Date : 26-JUL-17 NYS DOH # : 11626 Supervisor: KLD QC by: AMD

< -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 LOQ-Limit of Quantitation

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Client : Aura Health and Safety
Site : NS

Date Sampled : 14-JUL-17
Date Received : 19-JUL-17

Account No.: 30522
Login No. : L412957

Date Analyzed : 21-JUL-17 - 24-JUL-17
Report ID : 1008638

Client ID : BTEX2 **Lab ID : L412957-2** **Air Volume : 9.82 L**
Date Sampled : 07/14/17 **Date Analyzed : 07/21/17**

Parameter	LOQ ug	Front ug	Back ug	Total ug	Conc mg/m3	ppm
Benzene	2	<2	<2	<2	<0.2	<0.06
Ethylbenzene	5	<5	<5	<5	<0.5	<0.1
Toluene	5	<5	<5	<5	<0.5	<0.1
Xylene	15	<15	<15	<15	<1.5	<0.36

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

Collection Media: 226-01 Submitted by: ARE Approved by: NKP
Date : 26-JUL-17 NYS DOH # : 11626 Supervisor: KLD QC by: AMD

< -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 LOQ-Limit of Quantitation

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Client : Aura Health and Safety
Site : NS

Date Sampled : 14-JUL-17
Date Received : 19-JUL-17

Account No.: 30522
Login No. : L412957

Date Analyzed : 21-JUL-17 - 24-JUL-17
Report ID : 1008638

Client ID : BTEX3 **Lab ID : L412957-3** **Air Volume : 12.31 L**
Date Sampled : 07/14/17 **Date Analyzed : 07/21/17**

Parameter	LOQ ug	Front ug	Back ug	Total ug	Conc mg/m3	ppm
Benzene	2	<2	<2	<2	<0.2	<0.05
Ethylbenzene	5	<5	<5	<5	<0.4	<0.1
Toluene	5	<5	<5	<5	<0.4	<0.1
Xylene	15	<15	<15	<15	<1.2	<0.28

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

Collection Media: 226-01 Submitted by: ARE Approved by: NKP
Date : 26-JUL-17 NYS DOH # : 11626 Supervisor: KLD QC by: AMD

< -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 LOQ-Limit of Quantitation

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LABORATORY ANALYSIS REPORT

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Client : Aura Health and Safety
Site : NS

Date Sampled : 14-JUL-17
Date Received : 19-JUL-17

Account No.: 30522
Login No. : L412957

Date Analyzed : 21-JUL-17 - 24-JUL-17
Report ID : 1008638

Client ID : BTEXFB **Lab ID : L412957-4** **Air Volume : NA**
Date Sampled : 07/14/17 **Date Analyzed : 07/21/17**

Parameter	LOQ ug	Front ug	Back ug	Total ug	Conc mg/m3	ppm
Benzene	2	<2	<2	<2	NA	NA
Ethylbenzene	5	<5	<5	<5	NA	NA
Toluene	5	<5	<5	<5	NA	NA
Xylene	15	<15	<15	<15	NA	NA

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

Collection Media: 226-01 Submitted by: ARE Approved by: NKP
Date : 26-JUL-17 NYS DOH # : 11626 Supervisor: KLD QC by: AMD

< -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 LOQ-Limit of Quantitation

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LABORATORY ANALYSIS REPORT

Client : Aura Health and Safety
Site : NS

Date Sampled : 14-JUL-17
Date Received : 19-JUL-17

Account No.: 30522
Login No. : L412957

Date Analyzed : 24-JUL-17
Report ID : 1008847

Styrene

Sample ID	Lab ID	Air Vol liter	Front ug	Back ug	Total ug	Conc mg/m3	ppm
STY1	L412957-5	2.43	<20	<20	<21	<8.8	<2.1
STY2	L412957-6	2.52	<20	<20	<21	<8.4	<2.0
STY3	L412957-7	3.23	<20	<20	<21	<6.6	<1.5
STYFB	L412957-8	NA	<20	<20	<21	NA	NA

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

Level of quantitation: 20. ug
Analytical Method : mod. OSHA 89; GC/FID
OSHA PEL : 100 ppm (TWA)
Collection Media : 226-73

Submitted by: BDK
Approved by : NKP
Date : 26-JUL-17
Supervisor: KLD

NYS DOH # : 11626
QC by: AMD

< -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

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Client Name : Aura Health and Safety
Site :

Date Sampled : 14-JUL-17
Date Received: 19-JUL-17
Date Analyzed: 21-JUL-17 - 24-JUL-17

Account No.: 30522
Login No. : L412957

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 preceeding 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.

L412957 (Report ID: 1008638):
Benzene - Total ug corrected for a desorption efficiency of 100%.
Ethylbenzene - Total ug corrected for a desorption efficiency of 98%.
Toluene - Total ug corrected for a desorption efficiency of 97%.
Xylene - Total ug corrected for a desorption efficiency of 99%.
SOPs: GC-SOP-16(17), GC-SOP-8(20), GC-SOP-12(12)

L412957 (Report ID: 1008638):
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. Where N/A appears below, insufficient data is available to provide statistical accuracy and mean recovery values for the associated analyte.

Parameter	Accuracy	Mean Recovery
Benzene	+/-7.2%	94.7%
Ethylbenzene	+/-8.5%	99.7%
Toluene	+/-7.9%	98.3%

< -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

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

Client Name : Aura Health and Safety
Site :

Date Sampled : 14-JUL-17
Date Received: 19-JUL-17
Date Analyzed: 21-JUL-17 - 24-JUL-17

Account No.: 30522
Login No. : L412957

Xylene	+/-9%	95.8%

Parameter	Method	PEL
Benzene	mod. NIOSH 1501; GC/FID	1 ppm (TWA)
Ethylbenzene	mod. NIOSH 1501; GC/FID	100 ppm (TWA)
Toluene	mod. NIOSH 1501/OSHA 111; GC/FID	200 ppm (TWA)
Xylene	mod. NIOSH 1501; GC/FID	100 ppm (TWA)

L412957 (Report ID: 1008847):
Total ug corrected for a desorption efficiency of 94%.
SOPs: GC-SOP-16(17), GC-SOP-8(20), GC-SOP-12(12)

L412957 (Report ID: 1008847):
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. Where N/A appears below, insufficient data is available to provide statistical accuracy and mean recovery values for the associated analyte.

Parameter	Accuracy	Mean Recovery
Styrene	+/-11%	104%

< -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

810171276123
Date:07/19/17
Shipper:FEDEX
Initials:CEM
Prep:UNKNOWN

L412957

87

GALSON CHAIN OF CUSTODY

Turn Around Time (TAT):	(surcharge)
☐ Standard	0%
☐ 4 Business Days	35%
☐ 3 Business Days	50%
☐ 2 Business Days	75%
☐ Next Day by 6pm	100%
☐ Next Day by Noon	150%
☐ Same Day	200%

☑ Samples submitted using the FreePumpLoan™ Program

☐ Samples submitted using the FreeSamplingBadges™ Program

You may edit and complete this COC electronically by logging in to your Client Portal account at https://portal.galsonlabs.com/

Client Acct No.: 30522

Original Prep No.: PSY433051

CS Rep: NTORMEY

Online COC No.: 130202

Report To :	Mr. Raymond Wang
Company Name :	Aura Health and Safety
Address 1 :	3981 Kingsway
Address 2 :	Unit B
City, State Zip :	Burnaby, BC V5H 1Y7
Country :	Canada
Phone No. :	604 - 715 - 8866
Cell No. :	
Email reports to :	raymond.wang@aurahealthsafety.com
Email EDD to :	raymond.wang@aurahealthsafety.com
Comments :	

Invoice To :	Ms. Mona Shum
Company Name :	Aura Health and Safety
Address 1 :	3981 Kingsway
Address 2 :	Unit B
City, State Zip :	Burnaby, BC V5H 1Y7
Country :	Canada
Phone No. :	778 - 242 - 8138
Email Address :	mona.shum@aurahealthsafety.com
Comments :	
P.O. No. :	
Payment info. :	☐ I will call SGS Galson to provide credit card info ☐ Card on File (enter the last five digits on the line below)

Comments :

State Sampled :

Please indicate which OEL(s) this data will be used for :
☐ OSHA PEL ☐ ACGIH TLV ☐ MSHA ☐ Cal OSHA
☐ IAQ : _____ (Specify Limit(s)) ☐ Other : _____ (Specify Other)

Site Name :

Project :

Sampled By :

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 in², cm², ft² *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
		Sm. Charcoal Tubes/226-01			BTEX	mod. NIOSH 1501; GC/FID	

☐ ^ 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 :					Received By :	Kris Stone	Kris Stone	7/19/17	0913
Relinquished By :					Received By :				

*** You must fill in these columns for any samples which you are submitting.**

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

Online COC No. : 130202
Prep No. : PSY433051
Account No. : 30522
Draft : 6/29/2017 2:59:11 PM

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

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SGS GALSON **CHAIN OF CUSTODY**

Comments :

Sample ID * (Maximum of 20 Characters)	Date Sampled *	Collection Medium	Sample Volume / Sample Time / Sample Area *	Liters / Minutes / in², cm², ft² *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
BTEX1	July 14, 2017	Sm. Charcoal Tubes/226-01	SV	9.38L	BTEX	mod. NIOSH 1501; GC/FID	
BTEX2	↓	Sm. Charcoal Tubes/226-01	SV	9.82L	BTEX	mod. NIOSH 1501; GC/FID	
BTEX3	↓	Sm. Charcoal Tubes/226-01	SV	12.31L	BTEX	mod. NIOSH 1501; GC/FID	
BTEXFB	↓	Sm. Charcoal Tubes/226-01	SV	Field Blank	BTEX	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX	mod. NIOSH 1501; GC/FID	
		Sm. Charcoal Tubes/226-01			BTEX	mod. NIOSH 1501; GC/FID	

☐ ^ 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 :	Raymond Wang / [signature]	July 17, 2017	2pm	Received By :	Kris Stone / Kris Stone	7/19/17	0913
Relinquished By :				Received By :			

*** You must fill in these columns for any samples which you are submitting.**

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

Online COC No. : 130202
Prep No. : PSY433051
Account No. : 30522
Draft : 6/29/2017 2:59:11 PM

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SGS GALSON CHAIN OF CUSTODY

Comments :

Sample ID * (Maximum of 20 Characters)	Date Sampled *	Collection Medium	Sample Volume / Sample Time / Sample Area *	Liters / Minutes / in², cm², ft² *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
STY1	July 14, 2017	Anasorb CSC/226-73	SV	2.43L	Styrene	mod. OSHA 89; GC/FID	
STY2	↓	Anasorb CSC/226-73	SV	2.52L	Styrene	mod. OSHA 89; GC/FID	
STY3	↓	Anasorb CSC/226-73	SV	3.23L	Styrene	mod. OSHA 89; GC/FID	
STYFB	↓	Anasorb CSC/226-73	SV	Field Blank	Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	
		Anasorb CSC/226-73			Styrene	mod. OSHA 89; GC/FID	

☐ ^ 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 :	Raymond Wang	Raymond Wang	July 17, 2017	2 pm	Received By :	Kris Stone	Kris Stone	7/19/17	0913
Relinquished By :					Received By :				

*** You must fill in these columns for any samples which you are submitting.**

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

Online COC No. : 130202
Prep No. : PSY433051
Account No. : 30522
Draft : 6/29/2017 2:59:11 PM

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Appendix V – Statement of Limitations

STATEMENT OF LIMITATIONS

The work performed in this report was carried out in accordance with the Standard Terms of Conditions made part of our contract. The conclusions presented herein are based solely upon the scope of services and time and budgetary limitations described by this contract.

The report has been prepared in accordance with generally accepted industrial hygiene and/or health and safety practices. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of our contract and included in this report.

The research performed herein relies on information supplied by others, such as the International Alliance of Theatrical Stage Employees. No attempt has been made to independently verify the accuracy of such information, unless specifically noted in our report. The possibility remains that unexpected environmental conditions may be encountered at the site in locations not specifically investigated.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it are the responsibility of such third parties. Aura Health and Safety accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.