

3-22-2017

# Reduction of Airborne Silica Concentration Using a Novel Sand Coating Technology

Elizabeth Rains Lloyd

University of South Florida, [erains@mail.usf.edu](mailto:erains@mail.usf.edu)

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Reduction of Airborne Silica Concentration Using a Novel Sand Coating Technology

by

Elizabeth Rains Lloyd

A thesis submitted in partial fulfillment  
of the requirements for the degree of  
Master of Science in Public Health  
Department of Industrial Hygiene  
College of Public Health  
University of South Florida

Co-Major Professor: Steven Mlynarek, Ph.D.  
Co-Major Professor: Thomas Bernard, Ph.D.  
Yehia Hammad, Sc.D.

Date of Approval:  
March 10, 2017

Keywords: Occupational Silica Exposure, Novel Sand Coating Technology, Reduced Exposure

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## **Dedication**

This thesis is dedicated to my husband, Gregory Lloyd. Without your love, patience, and support, I would not have successfully completed this part of my adventure. Thank you for enduring my educational endeavor whilst undertaking additional hair-brained schemes with me.

## **Acknowledgements**

A great deal of gratitude must be bestowed on Dr. Steven Mlynarek, for supporting me throughout my time at the university and for encouraging me to persevere. When I wanted to give-up, his guidance and support helped me to see my education through to the end. I also owe gratitude to Drs. Thomas Bernard, Yehia Hammad, and John Smyth for educating and inspiring me. I would like to thank Autumn Dent for acting as my editor-in-chief and serving as my grammar guru. I must also thank the company which developed the novel sand coating technology for allowing me the ability to participate in this research. I would also like to extend my gratitude to those I had the pleasure of working with over the course of this research.

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## **List of Abbreviations and Acronyms**

ACGIH <sup>®</sup>	American Conference of Governmental Industrial Hygienists
AIHA <sup>®</sup>	American Industrial Hygiene Association
AL	Action Level
COPD	Chronic Obstructive Pulmonary Disease
DOL	Department of Labor
FT	Feet
IARC	International Agency for Cancer Research
L	Liter(s)
lbs/ton	Pounds per Ton
mg/m <sup>3</sup>	Milligrams per Cubic Meter of Air
µg/m <sup>3</sup>	Micrograms per Cubic Meter of Air
µm	Micrometer
mph	Miles per Hour
NIOSH	National Institutes for Occupational Safety and Health
NMAM	NIOSH Manual of Analytical Methods
OEL	Occupational Exposure Limit



OSHA	Occupational Safety and Health Administration
PBZ	Personal Breathing Zone
PEL	Permissible Exposure Limit
PPE	Personal Protective Equipment
R&D	Research and Development
TLV	Threshold Limit Value
TWA	Time Weighted Average
SiO <sub>2</sub>	Silicon Dioxide
US	United States
WHO	World Health Organization

## **Abstract**

The health effects of silica and the connection to occupational exposure has been known for years. In March of 2016, the Occupational Safety and Health Administration (OSHA) of the Department of Labor (DOL) published a new standard meant to reduce workers' exposure to silica. The standard update was set forth to further protect workers; OSHA estimates this revision will prevent more than 600 silica-related deaths each year.

A key feature of the updated OSHA standard emphasizes the use of engineering controls and work practices in certain industries. Material handling of industrial sand is a known cause of silica overexposure in many industries. A novel sand coating technology designed as an engineering control has been tested to reduce worker exposure to airborne silica. This study looked at whether the airborne silica concentrations could be reduced by applying this technology. Area air samples were collected for baseline samples along with coated samples, which were analyzed for respirable dust. The percent reduction was calculated to determine if the coating was able to reduce the airborne silica concentration.

This study found that the application of the coating was able to reduce the airborne silica concentration, but the reduction did not meet the benchmark of 80% as set forth for the study. Additional studies to refine application and dosage of the sand coating may result in meeting this benchmark in future studies. Study limitations include small sample size and the truncated sampling time period for some of the samples collected, along with meteorological and site conditions.

## **Introduction**

Silica or silicon dioxide ( $\text{SiO}_2$ ) is a naturally occurring compound found on earth. Silica is a basic component of sand, soil, and other materials found in nature. The most common forms of silica include quartz, cristobalite, and tridymite (OSHA, 2002). The main route of exposure to respirable silica is through inhalation, causing adverse health effects. Silicosis, lung cancer, chronic obstructive pulmonary disease (COPD), and kidney disease have been linked to silica exposures (NIOSH, 2016). The International Agency for Cancer Research (IARC) has classified silica as a Group 1 carcinogen – “carcinogenic to humans” (IARC, 1997). Silicosis is a lung disease that can be characterized by the inhalation of particulate matter containing silica that is deposited deep into the lungs. The respirable fraction is important when studying exposure to particulate matter. This portion is made up of particles that are up to  $10\ \mu\text{m}$  in aerodynamic diameter and that can settle deep into lung tissue (Dahmann, 2008). Once this particulate matter has been deposited into the lung tissue, the body does not have the ability to expel or remove the material; this material ultimately damages the lung tissue.

There are three types of silicosis that can be developed, dependent upon the airborne concentration of respirable silica to which an individual is exposed. Chronic silicosis often occurs 10 or more years after exposure to a low concentration over a greater length of time. Accelerated silicosis can occur between five to 10 years after the first exposure. Acute silicosis is often brought on by exposure to high concentrations of respirable silica and can manifest as early as four to five weeks from exposure (WHO, 2000).

The general population may be exposed to silica; however, the exposures of greatest concern are those of an occupational nature. The US National Institute for Occupational Safety and Health (NIOSH) estimated that about 1.7 million United States (US) workers are potentially exposed to respirable crystalline silica (NIOSH, 2016). Exposures can occur, but are not limited to when workers cut, grind, drill, saw, or crush materials such as rock, concrete, or sand. Workers in a large variety of industries have the potential to be exposed to silica, including individuals working in mining, construction, foundry operations, and those in the oil and gas industry. Onshore drilling and extraction activities employed by the oil and gas sector fall within the jurisdiction of OSHA. In recent years, OSHA has seen a decrease in silica exposure levels within some high-risk construction industries. Hydraulic fracturing employs a solid material called a proppant, which is injected into wells to hold open fissures underground to recover hydrocarbons (JOEH, 2013). With continued growth of industries such as the oil and gas sector and their use of silica-containing sand as a proppant, the risk of silica exposure must be considered when conducting these operations, as well as the mining, material handling, and transport of this sand (JOEH, 2013).

In order to further protect the workforce, OSHA amended the existing standards for occupational exposure to respirable silica (OSHA, 2016). The standard was published in March 2016 and will be phased in over five years, beginning in June 2017. The new standard reduced the permissible exposure limit (PEL) for workers from a calculated value based on the silica content of the sand to a total of  $50 \mu\text{g}/\text{m}^3$ , or  $0.05 \text{ mg}/\text{m}^3$  of dust, averaged over an eight-hour shift. The previous standard calculated the time weighted average (TWA) concentration for the OSHA PEL of respirable dust containing less than 1% silica, the percentage of silica in the sample was determined by dividing the quartz results for each sample by amount of respirable

dust and multiplying by 100. A PEL was previously calculated for each sample using the formula for general industry:  $10\text{mg}/\text{m}^3 \div (\% \text{SiO}_2 + 2)$ . This value was determined to be outdated and inadequate for protecting workers' health. The agency determined that occupational exposure to respirable crystalline silica at the previous PELs would still result in a significant risk of developing or dying from silica related diseases and that compliance with a  $50 \mu\text{g}/\text{m}^3$  PEL would substantially reduce that risk (OSHA, 2016). This new limit will still carry hazards, but OSHA determined compliance with the new PEL to be the lowest level that can reasonably be achieved through use of engineering controls and work practices in most affected operations (OSHA, 2016). The American Conference of Governmental Industrial Hygienists (ACGIH<sup>®</sup>) Threshold Limit Values (TLVs<sup>®</sup>) (Current Edition) recommends an even lower exposure limit of  $25 \mu\text{g}/\text{m}^3$ . The OSHA PEL is currently enforceable as a governmental regulation while the ACGIH<sup>®</sup> TLVs<sup>®</sup> are recommended practices.

In addition to the reduced PEL, the update to the standard also includes added requirements, including monitoring and medical surveillance requirements when exposure levels may exceed the action level (AL) for 30 or more days in a year. Once the standard has been implemented, employers will be responsible for training workers about the dangers of respirable crystalline silica exposure and how to limit these potential exposures. If measured exposures reach or exceed the AL of  $25 \mu\text{g}/\text{m}^3$  ( $0.025 \text{mg}/\text{m}^3$ ) as an eight hour TWA for more than 30 days, medical surveillance including pulmonary function testing and chest x-rays must be made available to employees every three years. Medical records from employees must then be maintained for the necessary number of years, including medical examinations used to determine employees' ability to wear respiratory protection. OSHA employers covered by the general industry and maritime standard have until June 2018 to comply with most requirements. Industry

responsible for hydraulic fracturing must comply by June 2018 for all provisions except engineering controls, which has a compliance date of June 2021 (OSHA, 2016).

Dust suppression techniques have been utilized in the past to minimize worker exposure to dust, including respirable crystalline silica. Techniques have included the use of equipment with integrated exhaust shrouds or water to reduce the airborne dust. There are applications where the use of water is an acceptable method for dust suppression, but in some cases the addition of water may not be feasible. When water is not an option, water soluble additives can be utilized as dust suppressing agents. A previous study published in the Journal of Occupational and Environmental Hygiene examined the use of a water soluble additive when cutting concrete. The article by Summers et al. (2015), determined that the additive had a practical application for reducing respirable dust when water was in short supply. There are additional situations where the use of water as a suppressant technology may not be advised. The novel sand coating that was examined in this research was developed to reduce the potential exposure risk to respirable crystalline silica in the oil and gas sector. Material handling operations for the industrial sands, which are used in the oil and gas sector are one of the largest exposure potentials for respirable crystalline silica. Product development for the coating focused on the ability to reduce the airborne concentrations of respirable silica without affecting the functionality of the sand or introducing additional environmental or health and safety concerns.

The purpose of this study was to examine if a novel sand coating technology could reduce the airborne silica concentration when applied to silica sand. Area air samples were collected to determine if an 80% reduction of airborne silica concentration was achieved.

The University of South Florida's Institutional Review Board (IRB) determined this study did not constitute research under their definition, since no human subjects were studied. A copy of this determination can be found in Appendix A.

## **Literature Review**

### **Assessment of Exposure in Epidemiological Studies: The Example of Silica Dust**

Occupational exposure to respirable crystalline silica is a well-established hazard. IARC has labelled silica as a human carcinogen, and ranks it among the more recurrent occupational exposures to an environmental carcinogen, just below tobacco smoke and ambient UV light (Kauppinen et al., 2000). Dahmann et al states that silica dust is so prevalent in industrial settings that baseline exposure cannot be avoided (Dahmann, 2008). The review published in the Journal of Exposure Science and Environmental Epidemiology (2008) looked at the specific methodologies used to assess exposure in several studies. This study was considered to be a high priority in regards to estimating exposures and controlling potential risks, since uncertainties in exposure assessment may have serious implications on workers' health. Previous studies have looked at dust as an agent; however, re-assessment was necessary since there were differences in the measuring devices used, the different sampling strategies used across countries, industries, and overtime (Dahmann, 2008).

This exposure assessment was conducted to develop a comprehensive exposure metric for respirable crystalline silica. Information was used to construct a database in regards to exposure situations in order to improve the risk estimation and to decrease uncertainties in the exposure assessment. The study stated that the two important considerations when looking at the exposure assessment were the occupational setting and the mineral characteristics of the silica (Dahmann, 2008).



## **Occupational Exposure to Respirable Crystalline Silica During Hydraulic Fracturing**

With the emergence of hydraulic fracturing (“fracking”), workers continue to join the oil and gas industry. The process of fracking involves the injection of large volumes of water and proppant, along with smaller amounts of treatment chemicals, into a well in order to fracture rock formations (Esswein, 2013). The fracturing of the rock formations allows for the extraction of hydrocarbons from a petroleum-bearing reservoir. The use of the proppant serves to hold the fractures open to increase the efficient collection of the hydrocarbon materials (Esswein, 2013). Aluminum pellets, man-made ceramics, and silica sand can be used as a proppant during the fracking process. Most commonly, fracking employs sand, referred to as “frac sand”. The crystalline silica content in the “frac sand” introduces an exposure risk to the oil and gas workers, as well as any workers responsible for the material handling prior to use, such as members of the mining or transport sectors.

A study published in the Journal of Occupational and Environmental Hygiene (JOEH) by Esswein, et al (2013) described the previously uncharacterized occupational exposures to respirable crystalline silica for oil and gas workers during fracking activities. During this study, 111 personal breathing zone (PBZ) samples were collected across 11 sites to evaluate exposures to respirable crystalline silica. Full-shift samples at all 11 sites exceeded the exposure criteria (OSHA calculated PEL, NIOSH REL, and /or ACGIH TLV). Based on the data, it was determined that an occupational exposure to respirable crystalline silica exists during fracking activities. Using the data collected in the study, dust generation points were identified for the work activities, as well as from the sites themselves. Recommendations for controls were given in the study including material substitution (when feasible), engineering controls including modifications to

the sand handling machinery, administrative controls, and the use of personal protective equipment (PPE).

The novel sand coating technology was developed to reduce the potential exposure risk to respirable crystalline silica when handling and working around sand that has been coated. Additionally the coating should not affect the functionality of the sand or introduce additional environmental or health and safety concerns. According to the patent filed in March 2015, the material was developed to provide surface protection in order to “[reduce] the generation of dust/fumes from the proppant caused by abrasion and impingement during transportation and conveyance, particularly pneumatic transfer.” The patent claims that not only does this coating improve the recovery of oil and gas, but that additional desirable effects allows for users of the coated proppant to be in compliance with applicable regulatory standards. The patent states that the coating can reduce the airborne silica concentration by 70%. In addition to worker safety issues, the patent claims that the coating will not adversely impact the environment, and can be considered as “sustainable” and “green” in reference to being environmentally friendly. A confidential product Safety Data Sheet was provided to confirm the claims that there are no additional hazards arising from the use of the coating; a copy can be found in Appendix B.

## Methods

Sampling activities were conducted during material handling operations at a barge loading site in the state of Missouri. Five monitoring areas were sampled over four days in May 2016. Sample locations are shown in Figure 1 and an aerial view of the site is found in Figure 2 below. 40/70 (210  $\mu\text{m}$  - 420  $\mu\text{m}$ ) mesh sand was brought in by truck, loaded onto conveyor belts, and transferred into a barge. The coating was applied at the plant location using five spray nozzles for a targeted coating rate of 2.8 lbs/ton. The spray was applied directly to the sand as it traveled down the conveyor to the truck loading area. The sand was not mechanically mixed at the time of application, but was allowed to agitate as it traveled over the conveyor systems, loaded into trucks, and transported to the barge loading site. A single round of deliveries could range from as few as five trucks to as many as twenty-five but was typically around ten. Once the trucks were unloaded, they returned to the plant to receive another load of sand. Round trip delivery time for the trucks could vary from one and a half hours to four hours.

Full-shift (typically 8 hour) area air samples were collected from the five monitoring areas. Each monitoring area was sampled for respirable silica using GilAir personal sampling pumps (Sensidyne, LP, St. Petersburg, FL) connected to pre-weighted, 5- $\mu\text{m}$  polyvinyl chloride filters in three-piece, 37 mm sampling cassettes (provided by SGS Galson Laboratories, East Syracuse, NY). The respirable fractions were captured using aluminum cyclones (provided by SGS Galson Laboratories, East Syracuse, NY). Sampling trains were calibrated in-line to the recommended flow rate for respirable particulate using an aluminum cyclone at 2.5 L/min and post-calibrated with a Dry Cal Defender 510- M (Bios International, Bulter Park, NJ). Cyclones

and cassettes were affixed to a stationary tripod approximately four to five feet off the ground, to mimic the height of a workers' breathing zone.

All samples were submitted to an AIHA<sup>®</sup>- accredited laboratory, and analyzed according to the NIOSH Manual of Analytical Methods (NMAM) method 0600, for gravimetric analysis of respirable silica, NMAM method 7500 and a modified OSHA ID-142, X-ray diffraction analysis for crystalline silica (quartz, cristobalite, and tridymite). For the purpose of this research only the quartz concentrations were examined as part of the study.

The study had an assigned benchmark of an 80% airborne reduction of respirable silica, this benchmark was not derived by any methodical designation, rather was set forth by the potential consumer of the coating technology. Because the samples collected were area samples, the results cannot directly be compared to the OSHA PEL for any regulatory standpoint; the values are relevant to studying the potential protective properties of the coating.

## Weather

A handheld Kestrel 5400 WBGT Heat Stress Tracker (Nielsen-Kellerman Co., Minneapolis, MN) was used to record environmental parameters including temperature, relative humidity, barometric pressure, and estimated wind speed for each day sampled and is provided in Table I.

<b>Table I: Average Meteorological Data for Days Sampled</b>				
<b>Environmental Conditions</b>	<b>Temperature (°F)</b>	<b>Relative humidity (%)</b>	<b>Barometric pressure (inHg)</b>	<b>Estimated wind speed (mph)</b>
Sampling Day 1	58.9	55	29.84	7
Sampling Day 2	59.7	76	29.81	7
Sampling Day 3	70.0	44	29.77	7
Sampling Day 4	61.0	72	29.64	2

Overcast site conditions were observed during Sampling Day 1. Light and sporadic rain showers occurred for the first half of the day. Winds originated predominantly from the east and northeast at an estimated seven miles per hour (mph). This sampling activity was conducted as baseline sampling - no sand coating was applied to the materials sampled during this day.

During Sampling Day 2, the winds originated predominantly from the north and northeast, with speeds around seven mph. Sampling Day 3 included winds originating

predominantly from the north and northeast, with speeds around seven mph. Coating was applied during these two days of the sampling period.

During Sampling Day 4 the winds were originating predominantly from the North, with speeds around two mph. Overcast skies with light and sporadic rain was observed during the sampling period. This concluded as baseline sampling - no sand coating was applied to the materials sampled during this day.

### Site Diagram

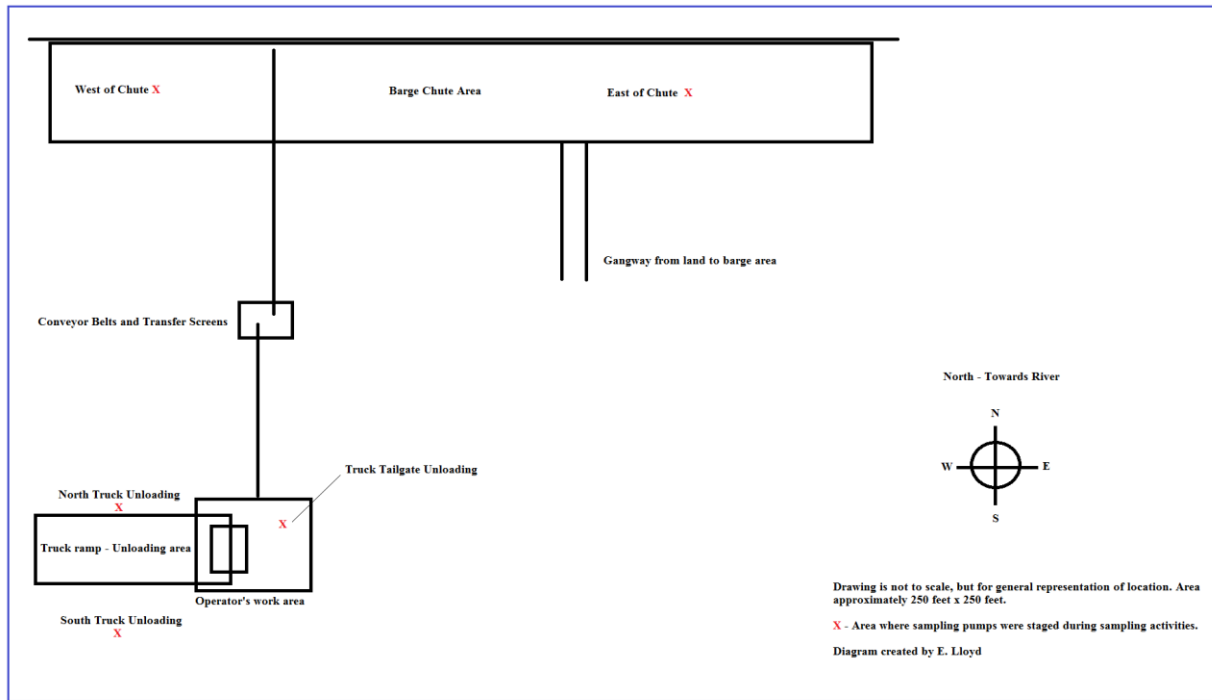


Figure 1: Site Schematic for area air sample locations



Figure 2: View of site – North facing

## Results

The analytical result provided by the laboratory and the calculated percent reduction of airborne silica are presented in the tables below.

<b>Table II: Respirable Silica Area Sampling Results Quartz Concentration NIOSH Method 0600/7500 &amp; OSHA ID 142</b>				
<b>Date</b>	<b>Sample ID</b>	<b>Sample Location</b>	<b>Coated (mg/m<sup>3</sup>)</b>	<b>Uncoated (mg/m<sup>3</sup>)</b>
<b>Sampling Day 1</b>	<b>976916</b>	North Truck Loading Area		0.052
	<b>976926</b>	On Barge, East of Chute Area		<0.0044
	<b>976946</b>	On Barge, West of Chute Area		0.049
	<b>976838</b>	South Truck Loading Area		0.25
	<b>976949</b>	Truck Tailgate Loading Area		0.073
<b>Sampling Day 2</b>	<b>976935</b>	North Truck Loading Area	0.02	
	<b>976950</b>	On Barge, East of Chute Area	0.017	
	<b>976952</b>	On Barge, West of Chute Area	0.066	
	<b>976957</b>	South Truck Loading Area	0.062	
	<b>976937</b>	Truck Tailgate Loading Area	0.13	
<b>Sampling Day 3</b>	<b>976940</b>	North Truck Loading Area	0.066	
	<b>976948</b>	On Barge, East of Chute Area	0.084	
	<b>976956</b>	On Barge, West of Chute Area	<0.0044	
	<b>976951</b>	South Truck Loading Area	0.18	
	<b>976947</b>	Truck Tailgate Loading Area	0.0071	



**Table II: Respirable Silica Area Sampling Results Quartz Concentration NIOSH Method 0600/7500 & OSHA ID 142 (Continued)**

Date	Sample ID	Sample Location	Coated (mg/m <sup>3</sup> )	Uncoated (mg/m <sup>3</sup> )
Sampling Day 4	976954	North Truck Loading Area		0.19*
	976958	On Barge, East of Chute Area		<0.013*
	976953	On Barge, West of Chute Area		0.072*
	976955	South Truck Loading Area		0.2*
	976934	Truck Tailgate Loading Area		0.25*

Lab results provided by Galson Laboratories that contain "<" were found to have a sample concentration that was at least below the indicated level of detection (LOD). For the purposes of reporting data, the concentration were reported as the value determined to be the LOD and calculations were based on that value.

\*: Denotes sampling volumes that were below the recommended minimum sampling of 400 liters for the NIOSH method 7500.

Table III: Percent Reduction of Respirable Silica when Handling Coated Sand							
	Coated			Uncoated			
Site Location	Min (mg/m <sup>3</sup> )	Max (mg/m <sup>3</sup> )	Average (mg/m <sup>3</sup> )	Min (mg/m <sup>3</sup> )	Max (mg/m <sup>3</sup> )	Average (mg/m <sup>3</sup> )	Percent Reduction
North Truck Loading Area	0.02	0.066	0.043	0.052	0.19	0.121	64%
On Barge, East of Chute Area	0.017	0.084	0.0505	<0.0044	<0.013	0.0087	-480%
On Barge, West of Chute Area	<0.0044	0.066	0.0352	0.049	0.072	0.0605	42%
South Truck Loading Area	0.062	0.18	0.121	0.2	0.25	0.225	46%
Truck Tailgate Loading Area	0.0071	0.13	0.06855	0.073	0.25	0.1615	58%
Average for All Locations	0.0221	0.1052	<b>0.06365</b>	0.07568	0.155	<b>0.11534</b>	45%
Average Excluding East of Chute data	0.023375	0.1105	<b>0.0669375</b>	0.0935	0.1905	<b>0.142</b>	53%

Lab results provided by Galson Laboratories that contain "<" were found to have a sample concentration that was at least below the indicated level of detection (LOD). For the purposes of reporting data, the concentration were reported as the value determined to be the LOD and calculations were based on that value.

-: Denotes an increase in the Respirable Crystalline Silica concentrations measured (values shown in red).

### Percent Reduction of Respirable Silica

An overall percent reduction of 45% for airborne respirable silica was observed when averaging results for all locations when handling the coated sand as compared to the baseline (Table III). The sample concentrations were averaged at each location for both the coated and the uncoated samples. These averaged values were used to calculate a percent reduction of respirable silica.

Excluding the “On Barge, East of Chute Area”, the individual locations ranged from a percent reduction of 42% at the “On Barge West of Chute Area” to 64% at the “North Truck Loading Area”. The “On Barge, East of Chute Area” was the only area to show an increase in the amount of respirable silica captured on the days in which the coated sand was handled (increase of 480%). Excluding the “On Barge, East of Chute Area”, an overall reduction of 53% was observed when handling the coated sand.

## **Discussion**

The samples examined in this study were area air samples only, and thereby cannot be used to determine personal exposure or regulatory compliance. Area air samples cannot be compared to the regulatory standards, but may be used as illustrative values when looking at the performance of the coating. In previous studies it has been thought that personal samples are of greater experimental value than area samples (Dahmann, 2008). This was in large part because of the respirable dust concentration in the PBZ, and the considerably lower suction rates of personal samplers than that of the area samplers. In recent studies it has been noted that if the same standards are followed for area sampling that are employed during personal sampling, the personal samples cannot be considered to have more significance than area samples (Dahmann, 2008). The data collected in this study may provide an initial overview of potential risk reduction for respirable silica, but it must be noted that future research would be necessary to accurately portray specific benefits to worker protection. The research was conducted to compare baseline concentration data to the concentrations of coated samples in order to examine the airborne silica reduction capacity of the coating as tested.

### **Potential Influencing Factors**

Several factors may have caused the sampling results to appear unrepresentative of typical exposures, including the predominant wind direction on sampling days preventing capture of particulates on the cassette media, along with the rainy conditions on Sampling Day 1. The lack of documentation of the coated sand deliveries and the gas blower usage to remove

sand from the lid of the barge on Sampling Day 2 – 4, that may have resulted in higher levels of particulates, and lower than recommended sample volume collected due to a shorter period of loading on Sampling Day 4.

Percent reduction calculations were completed for all locations and also calculated excluding the data from the “On Barge, East of Chute Area” due to concerns of unrepresentative data. The data collected from “On Barge, East of Chute Area” was not typical of the overall results. With the wind originating from the east, it is likely that the particulate matter was carried away from sampling equipment and not captured on the sampling media, resulting in lower or undetected sample concentrations during the uncoated sampling days. This low baseline concentration would not provide representative data when compared to the coated samples. While the monitoring stations were stationary, the wind speed and direction varied throughout the course of the sampling and these conditions may have influenced the amount of particulate collected during sampling. It should also be noted that rainy conditions will decrease the levels of particulates suspended in the air and may not be representative of sampling occurring during dry conditions.

The application process used to apply the sand coating for the field sampling was different from the application process previously used in the research and development (R&D) phase. Inadequate mixing and coating of the sand with the novel sand coating technology may have diminished the coating’s ability to reduce the airborne silica concentration. The original application was designed to use five spray nozzles at the plant with a targeted coating rate of 2.8 lbs/ton via spray nozzles. An issue with the location of one spray nozzle required that nozzle to be shut down around 11:00 am on Sampling Day 2, and the coating was applied with only four nozzles for the remaining application. The sand was not mechanically mixed at the time of

application; however during the R&D phase, the coating was mixed to ensure coating on all sides. During Sampling Day 3, the coating system was only run intermittently. The coating system was started when the conveyors belt were started up and was turned off once the belts were shut down. The coating application may not have been evenly distributed to the outside of the sand and may not have presented optimal dust suppression during sand handling as a result. It was not well documented at the plant load out area which trucks received the coating during the first deliveries of the Sampling Day 2 and 3. Since the trucks were loaded at the plant and travelled almost 45 minutes to unload at the barge site, the order in which the trucks were loaded and unloaded may potentially have changed during transit. The possibility that uncoated sand were unloaded during the coated sand sampling period could not be eliminated without specific documentation.

During all sampling days, with the exception of Sampling Day 1, the barge lid was cleaned of excess sand debris. The activities used to clean the barge lid included the use of a high powered blower to remove the sand debris. Visible dust was observed being blown off the barge lid, with some of the emissions carried back to the area where the sampling equipment was located. This visible emissions observed may have resulted in higher than normal results on those days.

The sample duration was truncated on Sampling Day 4 due to the limited deliveries that occurred during this day. The typical duration for deliveries extend over an 8 hour work shift, on this day the delivery duration was approximately two hours, which was not representative in terms of length of the sampling period. Concentrations from short interval sampling may overestimate the total shift exposure, as it does not account for the periods of zero or low

exposures (Dahmann, 2008). The NMAM for 7500 recommends a minimum of 400 liters (L) be collected during the sampling period; the minimum volumes were not collected during Sampling Day 4 activities. The low sample volumes collected increases the chances of non-detection for respirable silica particulates, as observed in this area on Sampling Day 4.

### **Study Limitations**

This study was limited due to small sample size and the truncated sampling time period for some of the samples collected. Observed factors that may have influenced the data collected during the study include weather, wind direction and speed, and the coating application method.

It should be noted that results of sampling at this site location may not correspond to the exposures at other locations; this data was dependent on the site configuration, equipment, and weather conditions at the time of sampling. The area sampling results in this study are not indicative of personal samples or other potential situations or environments.

### **Future Research**

Although the use of the sand coating did show a reduction in the concentration of airborne silica, it did not meet the 80% reduction assigned for this study. Refinement of the application process for the coating may be a primary factor for not meeting the assigned benchmark. Application of the coating as it was studied in the R&D phase, so that the coating is thoroughly applied to the sand and mixed in order to ensure even distribution would need to be studied. Application of the coating in the field in same manner in which it was tested in the laboratory may illustrate reduction in future research. Additional future research - including the collection of

additional samples and the collection of personal samples - may offer a more accurate idea of the ability of the coating to reduce airborne silica.



## **Conclusion**

Based on the comparison between the uncoated and coated area air samples collected during this study, the novel sand coating technology was able to show a 45% reduction of airborne silica concentration. The results achieved during this study did not meet the benchmark of 80% set forth for this study, but did illustrate that with more research which could include technical improvements to the product and refinement to the application process, the desired reduction values may be possible.

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**Appendix A:**

**IRB Determination Letter**



RESEARCH INTEGRITY AND COMPLIANCE  
Institutional Review Boards, FWA No. 00001669  
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799  
(813) 974-3638 • FAX (813) 974-7091

1/12/2017

Elizabeth Lloyd  
Environmental and Occupational Health  
Tampa, FL 33612

**RE: Not Human Subjects Research Determination**

IRB#: Pro00028921

Title: Reduction of Airborne Silica Concentration Using a Novel Sand Coating Technology

Dear Mrs. Lloyd:

The Institutional Review Board (IRB) has reviewed your application and determined the activities do not meet the definition of human subjects research. Therefore, this project is not under the purview of the USF IRB and approval is not required. If the scope of your project changes in the future, please contact the IRB for further guidance.

All research activities, regardless of the level of IRB oversight, must be conducted in a manner that is consistent with the ethical principles of your profession. Please note that there may be requirements under the HIPAA Privacy Rule that apply to the information/data you will utilize. For further information, please contact a HIPAA Program administrator at 813-974-5638.

We appreciate your dedication to the ethical conduct of research at the University of South Florida. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

A handwritten signature in blue ink that reads "Vjorgensen MD". The signature is written in a cursive style.

E. Verena Jorgensen, M.D., Chairperson  
USF Institutional Review Board

**Appendix B:**

**Safety Data Sheet**

# SAFETY DATA SHEET

## 1. Identification

**Product identifier** Novel Sand Coating Technology

### Other means of identification

**Product Code** N/A

**Recommended use** Coating agent for sand.

**Recommended restrictions** None known.

### Manufacturer/Importer/Supplier/Distributor information

#### Manufacturer

**Company name** Proprietary Company

**Address**

**Telephone** Proprietary Information

**E-mail** Proprietary Information

**Emergency phone number** Proprietary Information

## 2. Hazard(s) identification

**Physical hazards** Not classified.

**Health hazards** Not classified.

**Environmental hazards** Not classified.

**OSHA defined hazards** Not classified.

### Label elements

**Hazard symbol** None.

**Signal word** None.

**Hazard statement** The mixture does not meet the criteria for classification.

### Precautionary statement

**Prevention** Observe good industrial hygiene practices.

**Response** Wash hands after handling.

**Storage** Store away from incompatible materials.

**Disposal** Dispose of waste and residues in accordance with local authority requirements.

**Hazard(s) not otherwise classified (HNOC)** None known.

**Supplemental information** None.

## 3. Composition/information on ingredients

### Mixtures

Chemical name	Common name and synonyms	CAS number	%
Aliphatic Alcohol		56-81-5	50 - < 95
Aqueous Attrition Resistant Agent		Proprietary	5 - < 50

\*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

## 4. First-aid measures

**Inhalation** Move to fresh air. Call a physician if symptoms develop or persist.

Material name: Novel Sand Coating Technology  
Version #: 05 Revision date: 06-03-2016 Issue date: 01-08-2016

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<b>Skin contact</b>	Wash off with soap and water. Get medical attention if irritation develops and persists. Take off contaminated clothing and wash before reuse.
<b>Eye contact</b>	Rinse with water. Get medical attention if irritation develops and persists.
<b>Ingestion</b>	Rinse mouth. Get medical attention if symptoms occur.
<b>Most important symptoms/effects, acute and delayed</b>	Headache. Irritation of eyes and mucous membranes. Nausea, vomiting. Skin irritation.
<b>Indication of immediate medical attention and special treatment needed</b>	Treat symptomatically.
<b>General information</b>	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

## 5. Fire-fighting measures

<b>Suitable extinguishing media</b>	Alcohol resistant foam. Water fog. Dry chemical powder. Carbon dioxide (CO <sub>2</sub> ).
<b>Unsuitable extinguishing media</b>	Do not use water jet as an extinguisher, as this will spread the fire.
<b>Specific hazards arising from the chemical</b>	During fire, gases hazardous to health may be formed.
<b>Special protective equipment and precautions for firefighters</b>	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
<b>Fire fighting equipment/instructions</b>	Move containers from fire area if you can do so without risk.
<b>Specific methods</b>	Use standard fire-fighting procedures and consider the hazards of other involved materials.

## 6. Accidental release measures

<b>Personal precautions, protective equipment and emergency procedures</b>	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep out of low areas. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. For personal protection, see section 8 of the SDS.
<b>Methods and materials for containment and cleaning up</b>	Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Use water spray to reduce vapors or divert vapor cloud drift. Prevent entry into waterways, sewer, basements or confined areas. Following product recovery, flush area with water.  Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.  Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
<b>Environmental precautions</b>	Avoid discharge into drains, water courses or onto the ground.

## 7. Handling and storage

<b>Precautions for safe handling</b>	Avoid prolonged exposure. Observe good industrial hygiene practices.
<b>Conditions for safe storage, including any incompatibilities</b>	Store in original tightly closed container. Store away from incompatible materials (see Section 10 of the SDS).

## 8. Exposure controls/personal protection

### Occupational exposure limits

#### US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Aliphatic Alcohol (CAS 56-81-5)	PEL	5 mg/m <sup>3</sup>	Respirable fraction.
		15 mg/m <sup>3</sup>	Total dust.

<b>Biological limit values</b>	No biological exposure limits noted for the ingredient(s).
<b>Appropriate engineering controls</b>	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.
<b>Individual protection measures, such as personal protective equipment</b>	
<b>Eye/face protection</b>	Avoid contact with eyes. Wear safety glasses with side shields (or goggles).



<b>Skin protection</b>	
<b>Hand protection</b>	Wear appropriate chemical resistant gloves.
<b>Other</b>	Wear appropriate chemical resistant clothing.
<b>Respiratory protection</b>	In case of insufficient ventilation, wear suitable respiratory equipment.
<b>Thermal hazards</b>	Wear appropriate thermal protective clothing, when necessary.
<b>General hygiene considerations</b>	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

## 9. Physical and chemical properties

<b>Appearance</b>	Colorless to Light Amber Liquid.
<b>Physical state</b>	Liquid.
<b>Form</b>	Liquid.
<b>Color</b>	Colorless to Light Amber
<b>Odor</b>	Minimal.
<b>Odor threshold</b>	Not available.
<b>pH</b>	7 - 7.5
<b>Melting point/freezing point</b>	Not available.
<b>Initial boiling point and boiling range</b>	Not available.
<b>Flash point</b>	> 350 °F (> 177 °C)
<b>Evaporation rate</b>	Not available.
<b>Flammability (solid, gas)</b>	Not available.
<b>Upper/lower flammability or explosive limits</b>	
<b>Flammability limit - lower (%)</b>	Not available.
<b>Flammability limit - upper (%)</b>	Not available.
<b>Explosive limit - lower (%)</b>	Not available.
<b>Explosive limit - upper (%)</b>	Not available.
<b>Vapor pressure</b>	Not available.
<b>Vapor density</b>	Not available.
<b>Relative density</b>	Not available.
<b>Solubility(ies)</b>	
<b>Solubility (water)</b>	Complete.
<b>Partition coefficient (n-octanol/water)</b>	Not available.
<b>Auto-ignition temperature</b>	Not available.
<b>Decomposition temperature</b>	Not available.
<b>Viscosity</b>	60 - 90 cP
<b>Viscosity temperature</b>	77 °F (25 °C)
<b>Other information</b>	
<b>Density</b>	9.59 - 10.35 lb/gal
<b>Density temperature</b>	77 °F (25 °C)
<b>Specific gravity</b>	1.15 - 1.24
<b>Specific gravity temperature</b>	77 °F (25 °C)

## 10. Stability and reactivity

<b>Reactivity</b>	The product is stable and non-reactive under normal conditions of use, storage and transport.
<b>Chemical stability</b>	Material is stable under normal conditions.

<b>Possibility of hazardous reactions</b>	No dangerous reaction known under conditions of normal use.
<b>Conditions to avoid</b>	Avoid temperatures exceeding the flash point. Contact with incompatible materials.
<b>Incompatible materials</b>	Strong oxidizing agents.
<b>Hazardous decomposition products</b>	Carbon oxides. Irritating and/or toxic fumes and gases may be emitted upon the products decomposition.

## 11. Toxicological information

### Information on likely routes of exposure

<b>Inhalation</b>	Not classified. Prolonged inhalation may be harmful.
<b>Skin contact</b>	Not classified. Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis.
<b>Eye contact</b>	Not classified. Direct contact with eyes may cause temporary irritation.
<b>Ingestion</b>	Not classified. May cause discomfort if swallowed.
<b>Symptoms related to the physical, chemical and toxicological characteristics</b>	Headache. Nausea, vomiting. Skin irritation. Irritation of eyes and mucous membranes.

### Information on toxicological effects

<b>Acute toxicity</b>	Not available.
<b>Skin corrosion/irritation</b>	Not classified. Prolonged skin contact may cause temporary irritation.
<b>Serious eye damage/eye irritation</b>	Not classified. Direct contact with eyes may cause temporary irritation.

### Respiratory or skin sensitization

<b>Respiratory sensitization</b>	Not classified.
<b>Skin sensitization</b>	Not classified.

**Germ cell mutagenicity** Not classified. No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

**Carcinogenicity** This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

### IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

### OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

### US. National Toxicology Program (NTP) Report on Carcinogens

Not listed.

**Reproductive toxicity** Not classified. This product is not expected to cause reproductive or developmental effects.

**Specific target organ toxicity - single exposure** Not classified.

**Specific target organ toxicity - repeated exposure** Not classified.

**Aspiration hazard** Not classified.

**Chronic effects** Prolonged exposure may cause chronic effects.

## 12. Ecological information

**Ecotoxicity** The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Components	Species	Test Results
Aliphatic Alcohol (CAS 56-81-5)		
<b>Aquatic</b>		
Fish	LC50 Rainbow trout, donaldson trout (Oncorhynchus mykiss)	51000 - 57000 mg/l, 96 hours

\* Estimates for product may be based on additional component data not shown.

**Persistence and degradability** No data is available on the degradability of this product.

<b>Bioaccumulative potential</b>	No data available.
<b>Partition coefficient n-octanol / water (log Kow)</b>	
Aliphatic Alcohol	-1.76
<b>Mobility in soil</b>	No data available.
<b>Other adverse effects</b>	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

### 13. Disposal considerations

<b>Disposal instructions</b>	Collect and reclaim or dispose in sealed containers at licensed waste disposal site.
<b>Local disposal regulations</b>	Dispose in accordance with all applicable regulations.
<b>Hazardous waste code</b>	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
<b>Waste from residues / unused products</b>	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
<b>Contaminated packaging</b>	Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

### 14. Transport information

<b>DOT</b>	Not regulated as dangerous goods.
<b>IATA</b>	Not regulated as dangerous goods.
<b>IMDG</b>	Not regulated as dangerous goods.
<b>Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code</b>	Not available.

### 15. Regulatory information

<b>US federal regulations</b>	All components are on the U.S. EPA TSCA Inventory List. This product is not known to be a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
<b>TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)</b>	Not regulated.
<b>CERCLA Hazardous Substance List (40 CFR 302.4)</b>	Not listed.
<b>SARA 304 Emergency release notification</b>	Not regulated.
<b>OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)</b>	Not regulated.
<b>Superfund Amendments and Reauthorization Act of 1986 (SARA)</b>	
<b>Hazard categories</b>	Immediate Hazard - No Delayed Hazard - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No
<b>SARA 302 Extremely hazardous substance</b>	Not listed.
<b>SARA 311/312 Hazardous chemical</b>	No
<b>SARA 313 (TRI reporting)</b>	Not regulated.
<b>Other federal regulations</b>	
<b>Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List</b>	Not regulated.

**Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)**

Not regulated.

**Safe Drinking Water Act (SDWA)** Not regulated.**FEMA Priority Substances Respiratory Health and Safety in the Flavor Manufacturing Workplace**

Aliphatic Alcohol (CAS 56-81-5)

Other Flavoring Substances with OSHA PEL's

**US state regulations****US. California Controlled Substances. CA Department of Justice (California Health and Safety Code Section 11100)**

Not listed.

**US. Massachusetts RTK - Substance List**

Aliphatic Alcohol (CAS 56-81-5)

**US. New Jersey Worker and Community Right-to-Know Act**

Aliphatic Alcohol (CAS 56-81-5)

**US. Pennsylvania Worker and Community Right-to-Know Law**

Aliphatic Alcohol (CAS 56-81-5)

**US. Rhode Island RTK**

Not regulated.

**US. California Proposition 65**

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins.

**International Inventories**

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

\*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

**16. Other information, including date of preparation or last revision****Issue date** 01-08-2016**Revision date** 06-03-2016**Version #** 05**HMIS® ratings** Health: 1  
Flammability: 1  
Physical hazard: 0  
Personal protection: X**NFPA ratings** Health: 1  
Flammability: 1  
Instability: 0**Disclaimer** The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.Material name:  
Version #: 05 Revision date: 06-03-2016 Issue date: 01-08-2016SDS US  
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**Revision information**

Physical & Chemical Properties: Multiple Properties  
Toxicological Information: Toxicological Data

## **Appendix C:**

### **List of Equipment and Instrumentation**

2 piece 37 mm diameter 5- $\mu$ m PVC Membrane Filter Sampling Cassette

3 piece 37 mm diameter 5- $\mu$ m PVC Membrane Filter Sampling Cassette

Aluminum Cyclone and Calibration Chamber

Bios DryCal Defender 510-M primary calibrator

Serial Number: 127807

Gilian GilAir-5 Air Sampling Pump

Pump Number: PG679

Gilian GilAir-5 Air Sampling Pump

Pump Number: PG541

Gilian GilAir-5 Air Sampling Pump

Pump Number: PG667

Gilian GilAir-5 Air Sampling Pump

Pump Number: PG727

Gilian GilAir-5 Air Sampling Pump

Pump Number: PG744

Gilian GilAir-5 Air Sampling Pump

Pump Number: PG1515

Gilian GilAir-5 Air Sampling Pump

Pump Number: PG658

Gilian GilAir-5 Air Sampling Pump

Pump Number: PG726

Gilian GilAir-5 Air Sampling Pump

Pump Number: PG176

Gilian GilAir-5 Air Sampling Pump  
Pump Number: PG256

Gilian GilAir-5 Air Sampling Pump  
Pump Number: PG679

Gilian GilAir-5 Air Sampling Pump  
Pump Number: PG249

Nielsen-Kellerman Kestrel 5400 Heat Stress Tracker  
SKU family: 0854

Stationary Sampling Tripods

TSI DustTrak DRX Aerosol Monitor 8533  
Serial Number: 8533153303

Tygon tubing and Cassette holders

**Appendix D:**

**Air Monitoring Data**



## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/16/16
Area Name	Barge Unloading	Pump #	PG667
Title	North Truck Unloading Area	Cyclone #	CY1584
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976916
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.14	mg/m <sup>3</sup>	
Quartz	0.052	mg/m <sup>3</sup>	
Cristobalite	<0.0048	mg/m <sup>3</sup>	
Tridymite	<0.019	mg/m <sup>3</sup>	
Calculated PEL	0.26	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.50
End Flow Rate (l/min)				AVG (l/min)	2.57
Average Flow rate for sampling period (l/min)			2.54		
Start Time	9:54 am	End time	4:42 pm	Total sampling time (mins)	408
Volume Collected (liters)			1036.3		

WEATHER INFORMATION			
Wind Direction	East - SE- SW	Wind velocity (mph)	7 mph
Temperature (F)	58.9-59.4 F	Humidity	55%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/16/16
Area Name	Barge Unloading	Pump #	PG727
Title	On Barge, East of Chute	Cyclone #	CY2089
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____ x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976926
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	<0.044	mg/m <sup>3</sup>	
Quartz	<0.0044	mg/m <sup>3</sup>	
Cristobalite	<0.0044	mg/m <sup>3</sup>	
Tridymite	<0.018	mg/m <sup>3</sup>	
Calculated PEL	5.0	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.50
End Flow Rate (l/min)				AVG (l/min)	2.54
Average Flow rate for sampling period (l/min)			2.52		
Start Time	9:15 am	End time	4:48 pm	Total sampling time (mins)	453
Volume Collected (liters)			1141.6		

WEATHER INFORMATION			
Wind Direction	East - SE- SW	Wind velocity (mph)	7 mph
Temperature (F)	58.9-59.4 F	Humidity	55%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/16/16
Area Name	Barge Unloading	Pump #	PG679
Title	On Barge, West of Chute	Cyclone #	CY220
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976946
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.15	mg/m <sup>3</sup>	
Quartz	0.049	mg/m <sup>3</sup>	
Cristobalite	<0.0048	mg/m <sup>3</sup>	
Tridymite	<0.019	mg/m <sup>3</sup>	
Calculated PEL	0.29	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.50
End Flow Rate (l/min)				AVG (l/min)	2.52
Average Flow rate for sampling period (l/min)			2.51		
Start Time	10:00 am	End time	4:55 pm	Total sampling time (mins)	415
Volume Collected (liters)			1041.7		

WEATHER INFORMATION			
Wind Direction	East - SE-SW	Wind velocity (mph)	7 mph
Temperature (F)	58.9-59.4 F	Humidity	55%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/16/16
Area Name	Barge Unloading	Pump #	PG726
Title	South Truck Unloading Area	Cyclone #	CY2088
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976838
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.66	mg/m <sup>3</sup>	
Quartz	0.25	mg/m <sup>3</sup>	
Cristobalite	<0.0053	mg/m <sup>3</sup>	
Tridymite	<0.021	mg/m <sup>3</sup>	
Calculated PEL	0.25	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA						
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015	
Calibrator Serial #	127807					
Starting Flow rate (l/min)				AVG (l/min)	2.43	
End Flow Rate (l/min)				AVG (l/min)	2.21	
Average Flow rate for sampling period (l/min)			2.32			
Start Time	9:52 am	End time	4:38 pm	Total sampling time (mins)	406	
Volume Collected (liters)			941.9			

WEATHER INFORMATION			
Wind Direction	East - SE- SW	Wind velocity (mph)	7 mph
Temperature (F)	58.9-59.4 F	Humidity	55%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/16/16
Area Name	Barge Unloading	Pump #	PG249
Title	Truck Tailgate Unloading Area	Cyclone #	CY1972
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List SEG Name if routine		List GROUP/TASK if task specific	
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976949
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.23	mg/m <sup>3</sup>	
Quartz	0.073	mg/m <sup>3</sup>	
Cristobalite	<0.0047	mg/m <sup>3</sup>	
Tridymite	<0.019	mg/m <sup>3</sup>	
Calculated PEL	0.29	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.50
End Flow Rate (l/min)				AVG (l/min)	2.30
Average Flow rate for sampling period (l/min)			2.40		
Start Time	9:11 am	End time	4:32 pm	Total sampling time (mins)	441
Volume Collected (liters)			1058.4		

WEATHER INFORMATION			
Wind Direction	East - SE- SW	Wind velocity (mph)	7 mph
Temperature (F)	58.9-59.4 F	Humidity	55%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/16/16
Area Name	Barge Unloading	Pump #	PG256
Title	North Truck Unloading Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972303
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	0.38	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.00
End Flow Rate (l/min)				AVG (l/min)	2.05
Average Flow rate for sampling period (l/min)			2.03		
Start Time	9:54 am	End time	4:45 pm	Total sampling time (mins)	411
Volume Collected (liters)			834.3		

WEATHER INFORMATION			
Wind Direction	East - SE- SW	Wind velocity (mph)	7 mph
Temperature (F)	58.9-59.4 F	Humidity	55%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/16/16
Area Name	Barge Unloading	Pump #	PG658
Title	On Barge, East of Chute Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972282
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	<0.051	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA						
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015	
Calibrator Serial #	127807					
Starting Flow rate (l/min)				AVG (l/min)	2.20	
End Flow Rate (l/min)				AVG (l/min)	2.10	
Average Flow rate for sampling period (l/min)			2.15			
Start Time	9:15 am	End time	4:47 pm	Total sampling time (mins)	452	
Volume Collected (liters)			971.8			

WEATHER INFORMATION			
Wind Direction	East - SE- SW	Wind velocity (mph)	7 mph
Temperature (F)	58.9-59.4 F	Humidity	55%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/16/16
Area Name	Barge Unloading	Pump #	PG744
Title	On Barge - West of Chute Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972280
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	0.72	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.00
End Flow Rate (l/min)				AVG (l/min)	2.03
Average Flow rate for sampling period (l/min)			2.01		
Start Time	10:00 am	End time	4:52 pm	Total sampling time (mins)	412
Volume Collected (liters)			828.1		

WEATHER INFORMATION			
Wind Direction	East - SE- SW	Wind velocity (mph)	7 mph
Temperature (F)	58.9-59.4 F	Humidity	55%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016



## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/16/16
Area Name	Barge Unloading	Pump #	PG176
Title	South Truck Unloading Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972270
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	2.1	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.00
End Flow Rate (l/min)				AVG (l/min)	1.99
Average Flow rate for sampling period (l/min)			1.99		
Start Time	9:52am	End time	4:36 pm	Total sampling time (mins)	404
Volume Collected (liters)			806.4		

WEATHER INFORMATION			
Wind Direction	East - SE	Wind velocity (mph)	7 mph
Temperature (F)	58.9-59.4 F	Humidity	55%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/16/16
Area Name	Barge Unloading	Pump #	PG1515
Title	Truck Tailgate Unloading Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972278
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	0.53	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA						
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015	
Calibrator Serial #	127807					
Starting Flow rate (l/min)				AVG (l/min)	2.00	
End Flow Rate (l/min)				AVG (l/min)	2.05	
Average Flow rate for sampling period (l/min)			2.03			
Start Time	9:11 am	End time	4:29 pm	Total sampling time (mins)	438	
Volume Collected (liters)			889.1			

WEATHER INFORMATION			
Wind Direction	East - SE- SW	Wind velocity (mph)	7 mph
Temperature (F)	58.9-59.4 F	Humidity	55%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/18/16
Area Name	Barge Unloading	Pump #	PG667
Title	North Truck Unloading Area	Cyclone #	CY1584
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____ x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976935
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.064	mg/m <sup>3</sup>	
Quartz	0.020	mg/m <sup>3</sup>	
Cristobalite	<0.0057	mg/m <sup>3</sup>	
Tridymite	<0.023	mg/m <sup>3</sup>	
Calculated PEL	0.30	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.49
End Flow Rate (l/min)				AVG (l/min)	2.41
Average Flow rate for sampling period (l/min)			2.45		
Start Time	9:52 am	End time	3:54 pm	Total sampling time (mins)	361
Volume Collected (liters)			884.5		

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7-8 mph
Temperature (F)	59.7- 70F	Humidity	76%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/18/16
Area Name	Barge Unloading	Pump #	PG679
Title	On Barge, East of Chute Area	Cyclone #	CY2088
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976950
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	<0.060	mg/m <sup>3</sup>	
Quartz	0.017	mg/m <sup>3</sup>	
Cristobalite	<0.0060	mg/m <sup>3</sup>	
Tridymite	<0.024	mg/m <sup>3</sup>	
Calculated PEL	0.098	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.49
End Flow Rate (l/min)				AVG (l/min)	2.19
Average Flow rate for sampling period (l/min)			2.34		
Start Time	9:43 am	End time	3:42 pm	Total sampling time (mins)	357
Volume Collected (liters)			835.38		

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7-8 mph
Temperature (F)	59.7- 70F	Humidity	76%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/18/16
Area Name	Barge Unloading	Pump #	PG541
Title	On Barge, West of Chute Area	Cyclone #	CY2146
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976952
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.16	mg/m <sup>3</sup>	
Quartz	0.066	mg/m <sup>3</sup>	
Cristobalite	<0.0058	mg/m <sup>3</sup>	
Tridymite	<0.023	mg/m <sup>3</sup>	
Calculated PEL	0.23	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA						
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015	
Calibrator Serial #	127807					
Starting Flow rate (l/min)				AVG (l/min)	2.48	
End Flow Rate (l/min)				AVG (l/min)	2.37	
Average Flow rate for sampling period (l/min)			2.43			
Start Time	9:42 am	End time	3:37 pm	Total sampling time (mins)	354	
Volume Collected (liters)			860.2			

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7-8 mph
Temperature (F)	59.7- 70F	Humidity	76%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/18/16
Area Name	Barge Unloading	Pump #	PG727
Title	South Truck Unloading Area	Cyclone #	CY2089
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976957
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.23	mg/m <sup>3</sup>	
Quartz	0.062	mg/m <sup>3</sup>	
Cristobalite	<0.0054	mg/m <sup>3</sup>	
Tridymite	<0.022	mg/m <sup>3</sup>	
Calculated PEL	0.34	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.53
End Flow Rate (l/min)				AVG (l/min)	2.47
Average Flow rate for sampling period (l/min)			2.50		
Start Time	9:52 am	End time	4:01 pm	Total sampling time (mins)	368
Volume Collected (liters)			920.0		

WEATHER INFORMATION			
Wind Direction	N/E	Wind velocity (mph)	7-8 mph
Temperature (F)	59.7- 70F	Humidity	76%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/18/16
Area Name	Barge Unloading	Pump #	PG249
Title	Truck Tailgate Unloading Area	Cyclone #	CY1972
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976937
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.40	mg/m <sup>3</sup>	
Quartz	0.13	mg/m <sup>3</sup>	
Cristobalite	<0.0056	mg/m <sup>3</sup>	
Tridymite	<0.022	mg/m <sup>3</sup>	
Calculated PEL	0.29	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.52
End Flow Rate (l/min)				AVG (l/min)	2.45
Average Flow rate for sampling period (l/min)			2.49		
Start Time	9:51 am	End time	3:50 pm	Total sampling time (mins)	360
Volume Collected (liters)			896.4		

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7-8 mph
Temperature (F)	59.7- 70F	Humidity	76%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016



## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/18/16
Area Name	Barge Unloading	Pump #	PG176
Title	North Truck Unloading Area	Cyclone #	
<b>Denote whether Routine TWA Monitoring or Task Specific Monitoring</b>			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
<b>List GROUP/TASK if task specific</b>			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972314
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	0.40	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	1.99
End Flow Rate (l/min)				AVG (l/min)	2.05
Average Flow rate for sampling period (l/min)			2.02		
Start Time	9:52 am	End time	3:57 pm	Total sampling time (mins)	365
Volume Collected (liters)			737.3		

WEATHER INFORMATION			
Wind Direction		Wind velocity (mph)	
Temperature (F)		Humidity	

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016



## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/18/16
Area Name	Barge Unloading	Pump #	PG1515
Title	On Barge, East of Chute Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972274
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	0.30	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.03
End Flow Rate (l/min)				AVG (l/min)	1.98
Average Flow rate for sampling period (l/min)			2.00		
Start Time	9:43 am	End time	3:45 pm	Total sampling time (mins)	361
Volume Collected (liters)			723.8		

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7-8 mph
Temperature (F)	59.7- 70F	Humidity	76%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/18/16
Area Name	Barge Unloading	Pump #	PG744
Title	On Barge - West of Chute Area	Cyclone #	
<b>Denote whether Routine TWA Monitoring or Task Specific Monitoring</b>			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
<b>List GROUP/TASK if task specific</b>			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972302
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	1.3	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.02
End Flow Rate (l/min)				AVG (l/min)	2.02
Average Flow rate for sampling period (l/min)			2.02		
Start Time	9:42 am	End time	3:35 pm	Total sampling time (mins)	352
Volume Collected (liters)			711.0		

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7-8 mph
Temperature (F)	59.7- 70F	Humidity	76%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/18/16
Area Name	Barge Unloading	Pump #	PG658
Title	South Truck Unloading Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972293
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	2.3	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA						
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015	
Calibrator Serial #	127807					
Starting Flow rate (l/min)				AVG (l/min)	2.05	
End Flow Rate (l/min)				AVG (l/min)	2.05	
Average Flow rate for sampling period (l/min)			2.05			
Start Time	9:52am	End time	3:59 pm	Total sampling time (mins)	366	
Volume Collected (liters)			750.3			

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7-8 mph
Temperature (F)	59.7- 70F	Humidity	76%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/18/16
Area Name	Barge Unloading	Pump #	PG256
Title	Truck Tailgate Unloading Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____ x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972306
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	4.1	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA						
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015	
Calibrator Serial #	127807					
Starting Flow rate (l/min)				AVG (l/min)	2.02	
End Flow Rate (l/min)				AVG (l/min)	2.02	
Average Flow rate for sampling period (l/min)			2.02			
Start Time	12:14 pm	End time	3:48 pm	Total sampling time (mins)	214	
Volume Collected (liters)			432.3			

WEATHER INFORMATION			
Wind Direction	N/E	Wind velocity (mph)	7-8 mph
Temperature (F)	59.7- 70F	Humidity	76%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/19/16
Area Name	Barge Unloading	Pump #	PG679
Title	North Truck Unloading Area	Cyclone #	CY2088
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____ x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976940
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.22	mg/m <sup>3</sup>	
Quartz	0.066	mg/m <sup>3</sup>	
Cristobalite	<0.0045	mg/m <sup>3</sup>	
Tridymite	<0.018	mg/m <sup>3</sup>	
Calculated PEL	0.31	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA						
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015	
Calibrator Serial #	127807					
Starting Flow rate (l/min)				AVG (l/min)	2.50	
End Flow Rate (l/min)				AVG (l/min)	2.43	
Average Flow rate for sampling period (l/min)			2.47			
Start Time	10:13 am	End time	5:44 pm	Total sampling time (mins)	450	
Volume Collected (liters)			1109.3			

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7 mph
Temperature (F)	70F	Humidity	44%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/19/16
Area Name	Barge Unloading	Pump #	PG727
Title	On Barge, East of Chute	Cyclone #	CY2089
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976948
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.29	mg/m <sup>3</sup>	
Quartz	0.084	mg/m <sup>3</sup>	
Cristobalite	<0.0045	mg/m <sup>3</sup>	
Tridymite	<0.018	mg/m <sup>3</sup>	
Calculated PEL	0.29	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.48
End Flow Rate (l/min)				AVG (l/min)	2.48
Average Flow rate for sampling period (l/min)			2.48		
Start Time	10:13 am	End time	5:44 pm	Total sampling time (mins)	450
Volume Collected (liters)			1116.0		

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7 mph
Temperature (F)	70F	Humidity	44%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/19/16
Area Name	Barge Unloading	Pump #	PG667
Title	On Barge, West of Chute Area	Cyclone #	CY1584
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976956
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	<0.044	mg/m <sup>3</sup>	
Quartz	<0.0044	mg/m <sup>3</sup>	
Cristobalite	<0.0044	mg/m <sup>3</sup>	
Tridymite	<0.018	mg/m <sup>3</sup>	
Calculated PEL	5.0	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA						
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015	
Calibrator Serial #	127807					
Starting Flow rate (l/min)				AVG (l/min)	2.52	
End Flow Rate (l/min)				AVG (l/min)	2.49	
Average Flow rate for sampling period (l/min)			2.51			
Start Time	10:13 am	End time	5:44 pm	Total sampling time (mins)	450	
Volume Collected (liters)			1129.5			

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7 mph
Temperature (F)	70F	Humidity	44%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/19/16
Area Name	Barge Unloading	Pump #	PG541
Title	South Truck Unloading Area	Cyclone #	CY2146
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976951
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.55	mg/m <sup>3</sup>	
Quartz	0.18	mg/m <sup>3</sup>	
Cristobalite	<0.0044	mg/m <sup>3</sup>	
Tridymite	<0.017	mg/m <sup>3</sup>	
Calculated PEL	0.29	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.51
End Flow Rate (l/min)				AVG (l/min)	2.57
Average Flow rate for sampling period (l/min)			2.54		
Start Time	10:13 am	End time	5:44 pm	Total sampling time (mins)	450
Volume Collected (liters)			1143.0		

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7 mph
Temperature (F)	70F	Humidity	44%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016



## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/19/16
Area Name	Barge Unloading	Pump #	PG249
Title	Truck Tailgate Unloading Area	Cyclone #	CY1973
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5- $\mu$ m PVC cassette	Assigned Number	976947
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	<0.045	mg/m <sup>3</sup>	
Quartz	0.0071	mg/m <sup>3</sup>	
Cristobalite	<0.0045	mg/m <sup>3</sup>	
Tridymite	<0.018	mg/m <sup>3</sup>	
Calculated PEL	0.098	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA						
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015	
Calibrator Serial #	127807					
Starting Flow rate (l/min)				AVG (l/min)	2.48	
End Flow Rate (l/min)				AVG (l/min)	2.46	
Average Flow rate for sampling period (l/min)			2.47			
Start Time	10:13 am	End time	5:44 pm	Total sampling time (mins)	450	
Volume Collected (liters)			1111.5			

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7 mph
Temperature (F)	70F	Humidity	44%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/19/16
Area Name	Barge Unloading	Pump #	PG658
Title	North Truck Unloading Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972283
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	1.1	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	1.99
End Flow Rate (l/min)				AVG (l/min)	2.02
Average Flow rate for sampling period (l/min)			2.01		
Start Time	10:13 am	End time	5:44 pm	Total sampling time (mins)	450
Volume Collected (liters)			904.5		

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7 mph
Temperature (F)	70F	Humidity	44%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/19/16
Area Name	Barge Unloading	Pump #	PG1515
Title	On Barge, East of Chute Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972272
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	1.2	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA						
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015	
Calibrator Serial #	127807					
Starting Flow rate (l/min)				AVG (l/min)	1.92	
End Flow Rate (l/min)				AVG (l/min)	2.00	
Average Flow rate for sampling period (l/min)			2.00			
Start Time	10:13 am	End time	5:44 pm	Total sampling time (mins)	450	
Volume Collected (liters)			882.0			

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7 mph
Temperature (F)	70F	Humidity	44%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/19/16
Area Name	Barge Unloading	Pump #	PG744
Title	On Barge - West of Chute Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972275
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	<0.056	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	1.98
End Flow Rate (l/min)				AVG (l/min)	2.00
Average Flow rate for sampling period (l/min)			1.99		
Start Time	10:13 am	End time	5:44 pm	Total sampling time (mins)	450
Volume Collected (liters)			895.5		

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7 mph
Temperature (F)	70F	Humidity	44%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/19/16
Area Name	Barge Unloading	Pump #	PG256
Title	South Truck Unloading Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972271
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	1.5	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	1.96
End Flow Rate (l/min)				AVG (l/min)	1.98
Average Flow rate for sampling period (l/min)			1.97		
Start Time	10:13 am	End time	5:44 pm	Total sampling time (mins)	450
Volume Collected (liters)			886.5		

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7 mph
Temperature (F)	70F	Humidity	44%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/19/16
Area Name	Barge Unloading	Pump #	PG176
Title	Truck Tailgate Unloading Area	Cyclone #	
<b>Denote whether Routine TWA Monitoring or Task Specific Monitoring</b>			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
<b>List GROUP/TASK if task specific</b>			
Coated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972273
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	<0.056	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	1.96
End Flow Rate (l/min)				AVG (l/min)	1.98
Average Flow rate for sampling period (l/min)			1.97		
Start Time	10:13 am	End time	5:44 pm	Total sampling time (mins)	450
Volume Collected (liters)			886.5		

WEATHER INFORMATION			
Wind Direction	N/NE	Wind velocity (mph)	7 mph
Temperature (F)	70F	Humidity	44%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/20/16
Area Name	Barge Unloading	Pump #	PG667
Title	North Truck Unloading Area	Cyclone #	CY1584
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976954
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.47	mg/m <sup>3</sup>	
Quartz	0.19	mg/m <sup>3</sup>	
Cristobalite	<0.013	mg/m <sup>3</sup>	
Tridymite	<0.053	mg/m <sup>3</sup>	
Calculated PEL	0.23	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.55
End Flow Rate (l/min)				AVG (l/min)	2.54
Average Flow rate for sampling period (l/min)			2.55		
Start Time	7:18 am	End time	9:46am	Total sampling time (mins)	148
Volume Collected (liters)			377.4		

WEATHER INFORMATION			
Wind Direction	North	Wind velocity (mph)	2 mph
Temperature (F)	61 F	Humidity	71.9%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/20/16
Area Name	Barge Unloading	Pump #	PG541
Title	On Barge, East of Chute Area	Cyclone #	CY2146
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976958
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	<0.13	mg/m <sup>3</sup>	
Quartz	<0.013	mg/m <sup>3</sup>	
Cristobalite	<0.013	mg/m <sup>3</sup>	
Tridymite	<0.053	mg/m <sup>3</sup>	
Calculated PEL	5.0	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.55
End Flow Rate (l/min)				AVG (l/min)	2.49
Average Flow rate for sampling period (l/min)			2.53		
Start Time	7:30 am	End time	9:58 am	Total sampling time (mins)	148
Volume Collected (liters)			374.4		

WEATHER INFORMATION			
Wind Direction	North	Wind velocity (mph)	2 mph
Temperature (F)	61 F	Humidity	71.9%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016



## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/20/16
Area Name	Barge Unloading	Pump #	PG727
Title	On Barge, West of Chute Area	Cyclone #	CY2089
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring _____x		Task Specific Monitoring _____	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976953
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.20	mg/m <sup>3</sup>	
Quartz	0.072	mg/m <sup>3</sup>	
Cristobalite	<0.014	mg/m <sup>3</sup>	
Tridymite	<0.054	mg/m <sup>3</sup>	
Calculated PEL	0.26	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.52
End Flow Rate (l/min)				AVG (l/min)	2.49
Average Flow rate for sampling period (l/min)			2.51		
Start Time	7:30 am	End time	9:57 am	Total sampling time (mins)	147
Volume Collected (liters)			369.0		

WEATHER INFORMATION			
Wind Direction	North	Wind velocity (mph)	2 mph
Temperature (F)	61 F	Humidity	71.9%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/20/16
Area Name	Barge Unloading	Pump #	PG679
Title	South Truck Unloading Area	Cyclone #	CY2088
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5- $\mu$ m PVC cassette	Assigned Number	976955
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.52	mg/m <sup>3</sup>	
Quartz	0.20	mg/m <sup>3</sup>	
Cristobalite	<0.013	mg/m <sup>3</sup>	
Tridymite	<0.053	mg/m <sup>3</sup>	
Calculated PEL	0.24	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.56
End Flow Rate (l/min)				AVG (l/min)	2.52
Average Flow rate for sampling period (l/min)			2.54		
Start Time	7:18 am	End time	9:46 am	Total sampling time (mins)	148
Volume Collected (liters)			303.4		

WEATHER INFORMATION			
Wind Direction	North	Wind velocity (mph)	2 mph
Temperature (F)	61 F	Humidity	71.9%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/20/16
Area Name	Barge Unloading	Pump #	PG249
Title	Truck Tailgate Unloading Area	Cyclone #	CY1972
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	3 pc 37-mm, 5-µm PVC cassette	Assigned Number	976934
Analysis type	Respirable Dust	NIOSH method #	0600/7500 & ID 142
ANALYTES	Lab Results	Units	
Dust	0.65	mg/m <sup>3</sup>	
Quartz	0.25	mg/m <sup>3</sup>	
Cristobalite	<0.013	mg/m <sup>3</sup>	
Tridymite	<0.051	mg/m <sup>3</sup>	
Calculated PEL	0.25	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.50
End Flow Rate (l/min)				AVG (l/min)	2.82
Average Flow rate for sampling period (l/min)			2.66		
Start Time	7:18 am	End time	9:46 am	Total sampling time (mins)	148
Volume Collected (liters)			393.7		

WEATHER INFORMATION			
Wind Direction	North	Wind velocity (mph)	2 mph
Temperature (F)	61 F	Humidity	71.9%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/20/16
Area Name	Barge Unloading	Pump #	PG256
Title	North Truck Unloading Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/> x		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972269
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	1.2	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.05
End Flow Rate (l/min)				AVG (l/min)	2.03
Average Flow rate for sampling period (l/min)			2.04		
Start Time	7:18 am	End time	9:46 am	Total sampling time (mins)	148
Volume Collected (liters)			301.9		

WEATHER INFORMATION			
Wind Direction	North	Wind velocity (mph)	2 mph
Temperature (F)	61 F	Humidity	71.9%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/20/16
Area Name	Barge Unloading	Pump #	PG658
Title	On Barge, East of Chute Area	Cyclone #	
<b>Denote whether Routine TWA Monitoring or Task Specific Monitoring</b>			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
<b>List GROUP/TASK if task specific</b>			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972295
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	<0.16	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.07
End Flow Rate (l/min)				AVG (l/min)	2.08
Average Flow rate for sampling period (l/min)			2.08		
Start Time	7:30 am	End time	9:58 am	Total sampling time (mins)	148
Volume Collected (liters)			307.8		

WEATHER INFORMATION			
Wind Direction	North	Wind velocity (mph)	2 mph
Temperature (F)	61 F	Humidity	71.9%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET



MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/20/16
Area Name	Barge Unloading	Pump #	PG1515
Title	On Barge, West of Clute Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972267
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	0.53	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.06
End Flow Rate (l/min)				AVG (l/min)	2.06
Average Flow rate for sampling period (l/min)			2.06		
Start Time	7:30 am	End time	9:57 am	Total sampling time (mins)	147
Volume Collected (liters)			302.8		

WEATHER INFORMATION			
Wind Direction	North	Wind velocity (mph)	2 mph
Temperature (F)	61 F	Humidity	71.9%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/20/16
Area Name	Barge Unloading	Pump #	PG744
Title	South Truck Unloading Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972277
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	1.7	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.05
End Flow Rate (l/min)				AVG (l/min)	2.05
Average Flow rate for sampling period (l/min)			2.05		
Start Time	7:18 am	End time	9:46 am	Total sampling time (mins)	148
Volume Collected (liters)			303.4		

WEATHER INFORMATION			
Wind Direction	North	Wind velocity (mph)	2 mph
Temperature (F)	61 F	Humidity	71.0%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016

## AIR MONITORING DATA SHEET

MONITORING EVENT INFORMATION			
Site	Proprietary	Date	5/20/16
Area Name	Barge Unloading	Pump #	PG176
Title	Truck Tailgate Unloading Area	Cyclone #	
Denote whether Routine TWA Monitoring or Task Specific Monitoring			
Routine TWA Monitoring <input checked="" type="checkbox"/>		Task Specific Monitoring <input type="checkbox"/>	
List GROUP/TASK if task specific			
Uncoated Sand Samples			

SAMPLING MEDIA/ANALYSIS INFORMATION			
Sampling Media	2 pc 37-mm, 5-µm PVC cassette	Assigned Number	972276
Analysis type	Total Dust	NIOSH method #	0500
ANALYTES	Lab Results	Units	
Dust	2.3	mg/m <sup>3</sup>	

CALIBRATION and SAMPLING DATA					
Calibration Method/Instrument	Bios Defender 510-M			Date Calibrated	7/10/2015
Calibrator Serial #	127807				
Starting Flow rate (l/min)				AVG (l/min)	2.00
End Flow Rate (l/min)				AVG (l/min)	2.00
Average Flow rate for sampling period (l/min)			2.00		
Start Time	7:18 am	End time	9:46 am	Total sampling time (mins)	148
Volume Collected (liters)			296.0		

WEATHER INFORMATION			
Wind Direction	North	Wind velocity (mph)	2 mph
Temperature (F)	61 F	Humidity	71.9%

JOB TASK INFORMATION	
Job Task Description	Duration (mins)

Revision Date: May 1, 2016





Ms. Elizabeth Lloyd

June 07, 2016



DOH ELAP #11626  
AIHA-LAP #100324

Account# [REDACTED]

Login# [REDACTED]

Dear Ms. Lloyd:

Enclosed are the analytical results for the samples received by our laboratory on May 23, 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 John Bailey 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 cursive script that reads "Lisa Swab".

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

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Client :
Site :
Project No. :
Date Sampled : 16-MAY-16 - 20-MAY-16
Date Received : 23-MAY-16

Account No. :
Login No. :
Date Analysed : 27-MAY-16
Report ID : 938257

Total Dust

Table with 5 columns: Sample ID, Lab ID, Air Vol liter, Total mg, Conc mg/m3. Rows 972278 to 972277.

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

Level of quantitation: 0.050 mg
Analytical Method : mod. NIOSH 0500; Gravimetric
OSHA PEL : FNOR 15 mg/m3 (TWA)
Collection Media : PVC FW 37mm

Submitted by: DCB
Approved by : CRI
Date : 27-MAY-16 NYS DOH # : 11626
Supervisor: CRI 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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Client :
Site :
Project No. :
Date Sampled : 16-MAY-16 - 20-MAY-16
Date Received : 23-MAY-16

Account No. :
Login No. :
Date Analyzed : 27-MAY-16
Report ID : 938257

Total Dust

Table with 5 columns: Sample ID, Lab ID, Air Vol liter, Total mg, Conc mg/m3. Rows include sample IDs 972276 through 972297 with corresponding measurements.

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

Level of quantitation: 0.050 mg
Analytical Method : mod. NIOSH 0500; Gravimetric
OSHA PEL : FNOR 15 mg/m3 (TWA)
Collection Media : PVC FW 37mm
Submitted by: DCB
Approved by : CRI
Date : 27-MAY-16
Supervisor: CRI
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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Client : [REDACTED]  
Site : [REDACTED]  
Project No. : [REDACTED]  
Date Sampled : 16-MAY-16 - 20-MAY-16  
Date Received : 23-MAY-16

Account No.: [REDACTED]  
Login No. : [REDACTED]  
Date Analyzed : 03-JUN-16 - 06-JUN-16  
Report ID : 940461

Silica: Quartz, Cristobalite, Tridymite

Sample ID	Lab ID	Analyte	%
BRL01051616	[REDACTED]-57	Quartz	100
		Cristobalite	<0.24
		Tridymite	<0.97
BRL01051816	[REDACTED]-58	Quartz	100
		Cristobalite	<0.24
		Tridymite	<0.96
BRL01051916	[REDACTED]-59	Quartz	100
		Cristobalite	<0.25
		Tridymite	<0.99

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

Level of quantitation: Q:0.25% C:0.25% T:1.0%	Submitted: SPR
Analytical Method : mod. NIOSH 7500/mod. OSHA ID-142; XRD	Approved : CMR
OSHA PEL : NA	Date : 07-JUN-16
Collection Media : Bulk	Supervisor: KKK
	NYS DOH #: 11626
	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



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Project No. : [REDACTED]  
Date Sampled : 16-MAY-16 - 20-MAY-16  
Date Received : 23-MAY-16

Account No. : [REDACTED]  
Login No. : [REDACTED]  
Date Analyzed : 03-JUN-16 - 06-JUN-16  
Report ID : 940461

Silica: Quartz, Cristobalite, Tridymite

Sample ID	Lab ID	Analyte	%
BRL01052016	[REDACTED]-60	Quartz	94
		Cristobalite	<0.24
		Tridymite	<0.97

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

Level of quantitation: Q:0.25% C:0.25% T:1.0%      Submitted: SPR  
Analytical Method : mod. NIOSH 7500/mod. OSHA ID-142; XRD      Approved : CMR  
OSHA PEL : NA      Date : 07-JUN-16      NYS DOH #: 11626  
Collection Media : Bulk      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



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Date Received : 23-MAY-16

Account No. :
Login No. :
Date Analyzed : 24-MAY-16 - 27-MAY-16
Report ID : 938254

Respirable Dust and Crystalline Silica: Quarts, Cristobalite, Tridymite

Table with 8 columns: Sample ID, Lab ID, Analyte, Air Vol (l), mg, %, mg/m3, Dust PEL mg/m3. Rows include data for samples 976946, 976926, and 976949.

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

Level of quantitation: Dust 0.050mg Q:0.0050mg C:0.0050mg T:0.020mg
Analytical Method : mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD
OSHA PEL : see 1910.1000 (Table Z-3)
Collection Media : PVC PW 37mm

Submitted: DCE/PAH/BTM/SPR
Approved : CRI/AJD/KRK
Date : 31-MAY-16 NYS DOH #: 11626
Supervisor: KRK/CRI 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



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Date Received : 23-MAY-16

Account No. :
Login No. :
Date Analyzed : 24-MAY-16 - 27-MAY-16
Report ID : 938254

Respirable Dust and Crystalline Silica: Quartz, Cristobalite, Tridymite

Table with 8 columns: Sample ID, Lab ID, Analyte, Air Vol (l), mg, %, mg/m3, Dust PEL (mg/m3). Rows include sample IDs 976916, 976838, and 976950 with their respective analyte results.

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

Level of quantitation: Dust 0.050mg Q:0.0050mg C:0.0050mg T:0.020mg
Analytical Method : mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD
OSHA PEL : see 1910.1000 (Table Z-3)
Collection Media : PVC PW 37mm

Submitted: DCB/PAH/BTM/SPR
Approved : CRI/AJD/KRK
Date : 31-MAY-16 NYS DOH #: 11626
Supervisor: KRK/CRI 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



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Login No. :
Date Analyzed : 24-MAY-16 - 27-MAY-16
Report ID : 938254

Respirable Dust and Crystalline Silica: Quartz, Cristobalite, Tridymite

Table with 8 columns: Sample ID, Lab ID, Analyte, Air Vol (l), mg, #, mg/m3, Dust PEL (mg/m3). Rows include data for samples 976952, 976957, and 976935.

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

Level of quantitation: Dust 0.050mg Q:0.0050mg C:0.0050mg T:0.020mg
Analytical Method : mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD
OSHA PEL : see 1910.1000 (Table Z-3)
Collection Media : PVC FW 37mm

Submitted: DCB/PAH/BTM/SPR
Approved : CRI/AJD/KRK
Date : 31-MAY-16 NYS DOH #: 11626
Supervisor: KRK/CRI 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





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Account No. :
Login No. :
Date Analyzed : 24-MAY-16 - 27-MAY-16
Report ID : 938254

Respirable Dust and Crystalline Silica: Quarts, Cristobalite, Tridymite

Table with 8 columns: Sample ID, Lab ID, Analyte, Air Vol (l), mg, #, mg/m3, Dust PEL mg/m3. Rows include data for samples 976937, 976956, and 976940.

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

Level of quantitation: Dust 0.050mg Q:0.0050mg C:0.0050mg T:0.020mg
Analytical Method : mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD
OSHA PEL : see 1910.1000 (Table Z-3)
Collection Media : PVC PW 37mm
Submitted: DCE/PAH/BTM/SPR
Approved : CRI/AJD/KRK
Date : 31-MAY-16 NYS DOH #: 11626
Supervisor: KRK/CRI 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



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Account No.:
Login No.:
Date Analyzed : 24-MAY-16 - 27-MAY-16
Report ID : 938254

Respirable Dust and Crystalline Silica: Quarts, Cristobalite, Tridymite

Table with 8 columns: Sample ID, Lab ID, Analyte, Air Vol (l), mg, %, mg/m3, Dust PEL (mg/m3). Rows include sample IDs 976948, 976947, and 976951 with their respective analyte results.

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

Level of quantitation: Dust 0.050mg Q:0.0050mg C:0.0050mg T:0.020mg
Analytical Method : mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD
OSHA PEL : see 1910.1000 (Table Z-3)
Collection Media : PVC PW 37mm
Submitted: DCB/PAH/BTM/SPR
Approved : CRI/AJD/KRK
Date : 31-MAY-16
Supervisor: KRK/CRI
NYS DOH #: 11626
QC by : TUB

< -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



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Date Sampled : 16-MAY-16 - 20-MAY-16
Date Received : 23-MAY-16

Account No.:
Login No.:
Date Analyzed : 24-MAY-16 - 27-MAY-16
Report ID : 938254

Respirable Dust and Crystalline Silica: Quartz, Cristobalite, Tridymite

Table with 8 columns: Sample ID, Lab ID, Analyte, Air Vol (l), mg, #, mg/m3, Dust PEL mg/m3. Rows include data for samples 976934, 976953, and 976958.

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

Level of quantitation: Dust 0.050mg Q:0.0050mg C:0.0050mg T:0.020mg
Analytical Method : mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD
OSHA PEL : see 1910.1000 (Table Z-3)
Collection Media : PVC PW 37mm
Submitted: DCB/PAH/BTM/SPR
Approved : CRI/AJD/KRK
Date : 31-MAY-16 NYS DOH #: 11626
Supervisor: KRK/CRI 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



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Date Received : 23-MAY-16

Account No. :
Login No. :
Date Analyzed : 24-MAY-16 - 27-MAY-16
Report ID : 938254

Respirable Dust and Crystalline Silica: Quartz, Cristobalite, Tridymite

Table with 8 columns: Sample ID, Lab ID, Analyte, Air Vol (l), mg, %, mg/m3, Dust PEL mg/m3. Rows include data for samples 976954, 976955, and 976942.

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

Level of quantitation: Dust 0.050mg Q:0.0050mg C:0.0050mg T:0.020mg
Analytical Method : mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD
OSHA PEL : see 1910.1000 (Table Z-3)
Collection Media : PVC FW 37mm

< -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



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Date Received : 23-MAY-16

Account No. :
Login No. :
Date Analyzed : 24-MAY-16 - 27-MAY-16
Report ID : 938254

Respirable Dust and Crystalline Silica: Quartz, Cristobalite, Tridymite

Table with 8 columns: Sample ID, Lab ID, Analyte, Air Vol (l), mg, %, mg/m3, Dust PEL (mg/m3). Rows include sample IDs 976941, 976921, and 976925 with various analyte results.

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

Level of quantitation: Dust 0.050mg Q:0.0050mg C:0.0050mg T:0.020mg
Analytical Method : mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD
OSHA PEL : see 1910.1000 (Table Z-3)
Collection Media : PVC FW 37mm

Submitted: DCB/PAH/BTM/SPR
Approved : CRI/AJD/KRK
Date : 31-MAY-16
Supervisor: KRK/CRI
NYS DOH #: 11626
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



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Project No. :
Date Sampled : 16-MAY-16 - 20-MAY-16
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Account No.:
Login No.:
Date Analyzed : 24-MAY-16 - 27-MAY-16
Report ID : 938254

Respirable Dust and Crystalline Silica: Quartz, Cristobalite, Tridymite

Table with 8 columns: Sample ID, Lab ID, Analyte, Air Vol l, mg, %, mg/m3, Dust PEL mg/m3. Rows include sample IDs 976992, 976999, and 976928 with various analyte results.

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

Level of quantitation: Dust 0.050mg Q:0.0050mg C:0.0050mg T:0.020mg
Analytical Method : mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD
OSHA PEL : see 1910.1000 (Table Z-9)
Collection Media : PVC PW 37mm

Submitted: DCB/PAH/BTM/SPR
Approved : CRI/AJD/KRK
Date : 31-MAY-16 NYS DOH #: 11626
Supervisor: KRK/CRI 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 ANALYSIS REPORT

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

Client :
Site :
Project No. :
Date Sampled : 16-MAY-16 - 20-MAY-16
Date Received : 23-MAY-16

Account No.:
Login No. :
Date Analyzed : 24-MAY-16 - 27-MAY-16
Report ID : 938254

Respirable Dust and Crystalline Silica: Quartz, Cristobalite, Tridymite

Table with 8 columns: Sample ID, Lab ID, Analyte, Air Vol (l), mg, %, mg/m3, Dust PEL mg/m3. Row 1: 976938, [redacted]-28, Dust, NA, <0.050, ND, NA, NA. Row 2: Quartz, NA, <0.0050, ND, NA, NA. Row 3: Cristobalite, NA, <0.0050, ND, NA, NA. Row 4: Tridymite, NA, <0.020, ND, NA, NA.

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

Level of quantitation: Dust 0.050mg Q:0.0050mg C:0.0050mg T:0.020mg Submitted: DCB/PAH/BTM/SPR
Analytical Method : mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD Approved : CRI/AJD/KRK
OSHA PEL : see 1910.1000 (Table Z-3) Date : 31-MAY-16 NYS DOH #: 11626
Collection Media : PVC BW 37mm Supervisor: KRK/CRI 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

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

Client Name : ██████████  
 Site : ██████████  
 Project No. : ██████████  
 Date Sampled : 16-MAY-16 - 20-MAY-16 Account No. : ██████████  
 Date Received: 23-MAY-16 Login No. : ██████████  
 Date Analyzed: 24-MAY-16 - 06-JUN-16

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.

██████████ (Report ID: 938257):  
 SOPs: GRAV-SOP-5(15), 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 SOP(s) referenced in this report and does not account for any uncertainty associated with the sampling process.  
 PNOR = Particulates Not Otherwise Regulated.

██████████ (Report ID: 940461):  
 SOPs: ix-calibrate(11), ix-xrdbulkprep(21), ix-xrdreview(13), ix-xrdstdprep(25)  
 Bulk silica results are considered approximate, per OSHA ID-142 section 3.6.  
 Level of quantitation varies with actual sample mass used for preparation.

██████████ (Report ID: 938254):  
 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 SOP(s) referenced in this report and does not account for any uncertainty associated with the sampling process.  
 SOPs: GRAV-SOP-5(15), GRAV-SOP-6(15), ix-calibrate(11), ix-xrdprep(25), ix-xrdreview(13),

<	-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

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

Client Name : ██████████  
 Site : ██████████  
 Project No. : ██████████  
 Date Sampled : 16-MAY-16 - 20-MAY-16 Account No.: ██████████  
 Date Received: 23-MAY-16 Login No. : ██████████  
 Date Analyzed: 24-MAY-16 - 06-JUN-16

██████████ (Report ID: 938254):  
 1x-xrdstdprep(25)

██████████ -8,12-13,15 (Report ID: 938254):  
 The Secondary Quartz angle is used for Quartz mass determination.

██████████ (Report ID: 938254):  
 The NIOSH 7500 minimum recommended sampling volume is 400 liters.  
 We perform a quantitative secondary angle confirmation on all Quartz results greater than 0.025 mg.  
 Secondary angle quantitative confirmation is not possible below 0.025 mg.  
 We were able to confirm Quartz in sample L375863-9 and L375863-17 qualitatively using the secondary angle.

██████████ -6,14 (Report ID: 938254):  
 PEL is based on maximum possible percent Quartz.

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

Parameter	Accuracy	Mean Recovery
Primary Quartz	+/-11.8%	98.1%
Secondary Quartz	+/-13.5%	92.2%
Cristobalite	+/-11.9%	96.1%
Tridymite	+/-16.3%	100%

<	-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

783167205197  
 Date: 05/23/16  
 Shipper: FEDEX  
 Initials: SK  
 Prep: UNKNOWN

LSON

CHAIN OF CUSTODY

78-80

<b>Turn Around Time (TAT):</b> (surcharge) <input checked="" type="checkbox"/> Standard 0% <input type="checkbox"/> 4 Business Days 35% <input type="checkbox"/> 3 Business Days 50% <input type="checkbox"/> 2 Business Days 75% <input type="checkbox"/> Next Day by 6pm 100% <input type="checkbox"/> Next Day by Noon 150% <input type="checkbox"/> Same Day 200%		You may edit and complete this COC electronically by logging in to your Client Portal account at <a href="https://portal.galsonlabs.com/">https://portal.galsonlabs.com/</a>							
<input checked="" type="checkbox"/> Samples submitted using the FreePumpLoan™ Program <input type="checkbox"/> Samples submitted using the FreeSamplingBadges™ Program		Client Acct No.: [REDACTED] Report To: Ms. Elizabeth Lloyd Invoice To: [REDACTED] Company Name: [REDACTED] Address 1: [REDACTED] Address 2: [REDACTED] City, State Zip: [REDACTED] Phone No.: [REDACTED] Cell No.: [REDACTED] Email reports to: [REDACTED] Comments: [REDACTED]							
Online COC No.: 107553		Payment info.: <input type="checkbox"/> I will call SGS Galson to provide credit card info <input type="checkbox"/> Card on File (enter the last five digits on the line below)							
Comments: Please analyze the low volumes.		State Sampled: MO Please indicate which OEL(s) this data will be used for: <input type="checkbox"/> OSHA PEL <input type="checkbox"/> ACGIH TLV <input type="checkbox"/> MSHA <input type="checkbox"/> Cal OSHA <input type="checkbox"/> IAQ: _____ <input type="checkbox"/> Other: _____ Specify Limit(s) Specify Other							
Site Name: [REDACTED]		Project: [REDACTED]							
Sampled By: E Lloyd		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 *	Filters Minutes in <sup>3</sup> , cm <sup>3</sup> , ft <sup>3</sup> *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)		
976946	5/16/16	3pc 37mm PW PVC	415 mins	1041.7 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD			
<input 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	Time
Relinquished By:		E Lloyd		5/20/16	2pm	Zachary King		5/23/16	9:13
Relinquished 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.: 107553 Prep No.: PTX381326 Account No.: [REDACTED] Draft: 5/11/2016 4:08:19 PM			



GALSON

CHAIN OF CUSTODY

Comments :

Sample ID * (Maximum of 20 Characters)	Date Sampled *	Collection Medium	Sample Volume Sample Time Sample Area *	Liters Minutes in <sup>3</sup> , cm <sup>3</sup> , ft <sup>3</sup> *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
976926	5/16/16	3pc 37mm PW PVC	453 mins	1141.6 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976949	5/16/16	3pc 37mm PW PVC	441 mins	1058.4 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976916	5/16/16	3pc 37mm PW PVC	408 mins	1036.3 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976838	5/16/16	3pc 37mm PW PVC	406 mins	941.9 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976950	5/18/16	3pc 37mm PW PVC	357 mins	835.4 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976952	5/18/16	3pc 37mm PW PVC	354 mins	860.2 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	

^ 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:	E Lloyd	E Lloyd	5/20/16	2pm	Received By:	Zachary King	5/20/16	9:17
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. : 107553  
Prep No. : PTX381326  
Account No. : [Redacted]  
Draft : 5/17/2016 4:08:19 PM



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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>3</sup> , cm <sup>3</sup> , ft <sup>3</sup> *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
976957	5/18/16	3pc 37mm PW PVC	368 mins	920.0 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976935	5/18/16	3pc 37mm PW PVC	361 mins	884.5 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976937	5/18/16	3pc 37mm PW PVC	450 mins	<del>877.5</del> 896.4 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976956	5/19/16 SR	3pc 37mm PW PVC	450 mins	1129.5 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976940	5/19/16 SR	3pc 37mm PW PVC	450 mins	1109.3 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976948	5/19/16 SR	3pc 37mm PW PVC	450 mins	1116.0 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	

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Chain of Custody	Print Name / Signature		Date	Time	Received By :	Print Name / Signature	Date	Time
Relinquished By :	Elloyd	Elloyd	5/20/16	2pm	Received By :	Zachary King	5/23/16	9:17
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. : 107553  
Prep No. : PTX381326  
Account No. :   
Draft : 5/19/2016 4:08:19 PM



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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>3</sup> , cm <sup>3</sup> , ft <sup>3</sup> *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
976947	5/19/16	3pc 37mm PW PVC	450 mins	1111.5 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976951	5/19/16	3pc 37mm PW PVC	450 mins	1143.0 liter	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976934	5/20/16	3pc 37mm PW PVC	148mins	393.7 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976953	5/20/16	3pc 37mm PW PVC	148 mins	369 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976958	5/20/16	3pc 37mm PW PVC	148 mins	374.4 liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976954	5/20/16	3pc 37mm PW PVC	148 mins	377.4 liter	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	

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Chain of Custody	Print Name / Signature		Date	Time	Print Name / Signature		Date	Time
Relinquished By:	E Lloyd	E Lloyd	5/20/16	2pm	Received By:	Zachary King	5/20/16	9:13
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. : 107553  
Prep No. : BTX281326  
Account No. : [Redacted]  
Draft : 5/11/2016 4:08:19 PM



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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>3</sup> , cm <sup>3</sup> , ft <sup>3</sup> *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
976955	5/20/16	3pc 37mm PW PVC	144 mins	375.9 Liters	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976942	5/20/16	3pc 37mm PW PVC	Blank	Blank	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976941	5/20/16	3pc 37mm PW PVC	Blank	Blank	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976921	5/20/16	3pc 37mm PW PVC	Blank	Blank	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976925	5/20/16	3pc 37mm PW PVC	Blank	Blank	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976932	5/18/16	3pc 37mm PW PVC	Blank	Blank	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	

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Chain of Custody	Print Name / Signature		Date	Time	Print Name / Signature		Date	Time
Relinquished By:	Ellaya	Edmond	5/20/16	2 PM	Received By:	Zachary King	5/23/16	9:13
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.: 107553  
 Prep No.: PTX381326  
 Account No.: [Redacted]  
 Draft: 5/17/2016 4:08:19 PM





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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>3</sup> , cm <sup>3</sup> , ft <sup>3</sup> *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
976939	5/18/16	3pc 37mm PW PVC	Blank	Blank	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976928	5/19/16	3pc 37mm PW PVC	Blank	Blank	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
976938	5/19/16	3pc 37mm PW PVC	Blank	Blank	Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm PW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm PW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm PW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	

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Chain of Custody	Print Name / Signature		Date	Time	Received By:	Print Name / Signature		Date	Time
Relinquished By:	E Lloyd	E Lloyd	5/20/16	2 PM	Received By:	Zachary King	[Signature]	5/23/16	9:13
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.: 107553  
 Prep No.: PTX381326  
 Account No.: [Redacted]  
 Draft: 5/17/2016 4:08:19 PM

*Attn: [Signature] ORR*



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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>3</sup> , cm <sup>3</sup> , ft <sup>3</sup> *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
		3pc 37mm PW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm PW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm PW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm PW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm PW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm PW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	

^ 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 : <b>Zachary King</b>	5/25/16	9:13
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.

Blank COC

Online COC No. : 107553  
 Prep No. : PTX381326  
 Account No. :   
 Draft : 5/11/2016 4:08:19 PM





GALSON

CHAIN OF CUSTODY

Comments :

Sample ID * (Maximum of 20 Characters)	Date Sampled *	Collection Medium	Sample Volume Sample Time Sample Area *	Liters Minutes in <sup>3</sup> , cm <sup>3</sup> , ft <sup>3</sup> *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
		3pc 37mm FW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm FW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm FW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm FW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm FW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm FW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	

^ 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	Received By:	Print Name / Signature	Date	Time
Relinquished By:				Received By: Zachary King		5/23/16	9:13
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. : 107553  
 Prep No. : PTX381326  
 Account No. :   
 Draft : 5/17/2016 4:08:19 PM

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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', cm', ft' *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
		3pc 37mm PW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
		3pc 37mm PW PVC			Silica, crystalline quartz, cristobalite, & tridymite (with respirable dust)	mod. NIOSH 0600/7500/mod. OSHA ID-142; Grav./XRD	
972278	5/16/16	2pc 37mm PW PVC	438 mins	889.1 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972270	5/16/16	2pc 37mm PW PVC	404 mins	806.4 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972282	5/16/16	2pc 37mm PW PVC	452 mins	971.8 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972303	5/16/16	2pc 37mm PW PVC	411 mins	834.3 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972280	5/16/16	2pc 37mm PW PVC	412 mins	828.1 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972314	5/18/16	2pc 37mm PW PVC	365 mins	737.8 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972293	5/18/16	2pc 37mm PW PVC	366 mins	750.3 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972306	5/18/16	2pc 37mm PW PVC	214 mins	432.3 liter	Dust, Total	mod. NIOSH 0500; Gravimetric	

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Chain of Custody	Print Name / Signature	Date	Time	Print Name / Signature	Date	Time
Relinquished By:	<i>E. Lloyd</i>	5/20/16	2 pm	Received By: Zachary King	5/23/16	9:13
Relinquished By:	<i>E. Lloyd</i>			Received By:		

\* You must fill in these columns for any samples which you are submitting.  
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Online COC No. : 107553  
Prep No. : 077381326  
Account No. :   
Draft : 5/11/2016 4:08:19 PM



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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>3</sup> , cm <sup>3</sup> , ft <sup>3</sup> *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
972274	5/18/16	2pc 37mm PW PVC	361 mins	723.8 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972302	5/18/16	2pc 37mm PW PVC	352 mins	711.0 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972272	5/19/16	2pc 37mm PW PVC	450 mins	882 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972283	5/19/16	2pc 37mm PW PVC	450 mins	904.5 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972271	5/19/16	2pc 37mm PW PVC	450 mins	886.5 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972275	5/19/16	2pc 37mm PW PVC	450 mins	895.5 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972273	5/19/16	2pc 37mm PW PVC	450 mins	886.5 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972271	5/20/16	2pc 37mm PW PVC	148 mins	303.4 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972276	5/20/16	2pc 37mm PW PVC	148 mins	296 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972267	5/20/16	2pc 37mm PW PVC	147 mins	302.8 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972295	5/20/16	2pc 37mm PW PVC	148 mins	307.8 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	

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Chain of Custody	Print Name / Signature		Date	Time	Print Name / Signature		Date	Time
Relinquished By:	E Lloyd	E Lloyd	5/20/16	2 pm	Received By:	Zachary King	5/23/16	9:13
Relinquished By:					Received By:			

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

Online COC No. : 107553  
Prep No. : BTX381326  
Account No. : [Redacted]  
Draft : 5/11/2016 4:08:19 PM



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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>3</sup> , cm <sup>3</sup> , ft <sup>3</sup> *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
972269	5/20/16	2pc 37mm PW PVC	148mins	301.9 liters	Dust, Total	mod. NIOSH 0500; Gravimetric	
972268	5/16/16	2pc 37mm PW PVC	Blank	Blank	Dust, Total	mod. NIOSH 0500; Gravimetric	
972284	5/16/16	2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
972285	5/18/16	2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
972299	5/18/16	2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
972313	5/19/16	2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
972312	5/19/16	2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
972279	5/20/16	2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
972297	5/20/16	2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	

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Chain of Custody	Print Name / Signature		Date	Time	Print Name / Signature		Date	Time
Relinquished By:	Elloyd	Elloyd	5/20/16	2pm	Received By:	Zachary King	5/23/16	9:12
Relinquished By:					Received By:			

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

Online COC No. : 107553  
Prep No. : PTX381326  
Account No. : [Redacted]  
Draft : 6/17/2016 4:08:19 PM



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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>3</sup> , cm <sup>3</sup> , ft <sup>3</sup> *	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	

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Chain of Custody	Print Name / Signature	Date	Time	Print Name / Signature	Date	Time
Relinquished By :				Received By : Zachary King	5/23/16	9:13
Relinquished By :				Received By :		

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Online COC No. : 107553  
Prep No. : EY381326  
Account No. :   
Draft : 5/11/2016 4:08:19 PM

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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.)
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
		2pc 37mm PW PVC			Dust, Total	mod. NIOSH 0500; Gravimetric	
BRLO1051616	5-16-16	Bulk sand			Bulk sand <sup>per</sup>	7000-7000	
BRLO2051816	5-18-16	↓			Bulk sand	7000	
BRLO3051916	5-19-16	↓			Bulk sand	7000	
BRLO4052016	5-20-16	↓			Bulk sand	7000	
						per client 00513116	

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Chain of Custody	Print Name / Signature		Date	Time	Print Name / Signature		Date	Time
Relinquished By:	Elloyd	Elloyd	5/20/16	2pm	Received By:	Zachary King	5/23/16	9:13
Relinquished By:					Received By:			

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Online COC No. : 107553  
Prep No. : BTY281326  
Account No. : [Redacted]  
Draft : 5/11/2016 4:08:19 PM