December 12, 2017

Clemson University
310 Klugh Avenue
Clemson, South Carolina 29634

Attn: Mr. W. Robert Newberry, IV
E-mail: wnewber@clemson.edu

Re: Employee Exposure Monitoring – Respirable Dust with Crystalline Silica
Clemson University
Lightsey Bridge II, Apt. 16I – Drywall Repair
Clemson, South Carolina
Terracon Project No. 86127158-118

Dear Mr. Newberry:

Terracon Consultants, Inc. (Terracon) is pleased to present the results of the personal exposure monitoring conducted at the above-referenced project site. This monitoring was conducted in general conformance with our in general accordance with our Master Service Agreement with Clemson University.

PROJECT OVERVIEW

Introduction

This report presents the results of personal exposure monitoring conducted during manual sanding of joint compound at the Lightsey Bridge II apartments located on the Clemson University Campus in Clemson, South Carolina. Terracon conducted personal exposure monitoring to evaluate airborne concentrations of respirable dust with crystalline silica during the sanding process.

Clemson University is currently preparing an apartment for occupancy. Work involves repairing damaged drywall throughout the two-bedroom apartment. Terracon understands that Clemson's Health and Safety department requested that Terracon conduct personal exposure monitoring to evaluate employee exposures to respirable dust and crystalline silica during the process.

Standard of Care

This occupational silica exposure monitoring was conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under

similar conditions in the same locale. Terracon did not attempt to identify every potential exposure or hazard present. The results, findings, conclusions and recommendations expressed in this report are based on conditions observed during our sampling. Many factors, such as weather conditions, building occupancy, ventilation patterns and seasonal variations in fungal concentrations, can affect the conditions observed.

The information contained in this report should not be relied upon to represent conditions that existed prior to or after this sampling. Terracon does not warrant the services of regulatory agencies, laboratories or other third parties supplying information that may have been used in the preparation of this report. In the event any changes in nature or location of processes, materials, or other conditions as outlined in this report are observed, the conclusions contained in this report cannot be considered valid unless the changes are reviewed and the conclusions of this report are modified or verified in writing by the industrial hygienist.

Regulatory Overview

OSHA regulates exposure to silica under 29 CFR 1926.1153 - Respirable Crystalline Silica. OSHA has recently updated the silica standards and the updated construction standard now lists the permissible exposure limits (PEL) for silica dust as 50 micrograms per cubic meter of air ($\mu g/m^3$) for an 8-hour time weighted average (TWA) with an Action Level (AL) of 25 $\mu g/m^3$.

If the initial assessment is below the AL then no further action need be done. If the samples are between the AL and the PEL then the sampling must continue at 6 month intervals until engineering controls decrease the exposure below the AL for two consecutive measurements, taken seven or more days apart.

If the sample results exceed the PEL, then the sampling must continue at 3-month intervals until two consecutive measurements, taken seven or more days apart, are below the action level. Employees need to be enrolled in a medical surveillance program and specific engineering controls need to be implemented and documented to reduce exposures. Respirators can be used only if all other means fail to reduce the exposures below the PEL. Additional provisions are required under the silica standards and should be referenced.

OSHA regulates exposure to respirable dusts under 29 CFR 1910.1000 – Table Z-3 Mineral Dusts. The PEL listed for respirable dust is 5,000 $\mu g/m^3$ for an 8-hour TWA.

FIELD ACTIVITIES

Methods

Terracon conducted personal monitoring for a work shift during which sanding operations were conducted (approximately 4 hours) on October 31, 2017. For respirable dust with crystalline silica

monitoring, sampling pumps were pre and post-calibrated onsite using a TSI 4146 primary calibrator. Pumps were calibrated to 2.0 LPM with pre-weighed PVC filters (5-µm) in a Parallel Particle Impactor (PPI) sampler. The collection efficiency of this device meets the standards set forth by ACGIH/ISO/CEN for a respirable curve operated at a flow rate of 2.0 LPM.

The sample media cassettes were placed on the employees' shoulders within their breathing zones or at the breathing zone height for the area sample. Terracon was onsite for the duration of the process. Pumps were periodically checked throughout the sampling period to ensure that they were running. Observations were also made during sample collection activities. As employees ended their shifts, Terracon collected the sampling pumps. The samples and field blank collected as part of this project were submitted under standard chain-of-custody to Scientific Analytical Institute Inc. (SAI) Laboratories, an American Industrial Hygiene Association (AIHA) accredited laboratory in Greensboro, North Carolina for sample analysis of respirable dust and airborne crystalline silica by NIOSH 0600/ Modified from NIOSH Method 7500 & OSHA ID-142.

Daily Field Activities and Observations

Lightsey Bridge II, Apartment 16I is a two-bedroom apartment. On the day prior, Clemson maintenance staff applied Pro-Form Brand joint compound on walls and ceilings requiring repair in the apartment. The application task was not monitored as the joint compound was premixed and applied wet. On October 31, 2017, the following staff members were selected for personal exposure monitoring during sanding operations:

- Mr. Al Drexler, Paint Shop; and,
- Mr. Dennis Sanders, Paint Shop.

Monitoring for silica and dust exposure was performed during the sanding and clean-up of drywall repair operations. Sanding was conducted using 3M brand all-purpose medium-grit sanding sponges. No mechanical sanding occurred. Cleanup of the dust was performed using damp rags and a five-gallon capacity Shop-Vac brand vacuum cleaner, Model H87S600CR. This vacuum contained a collection filter bag and a cartridge filter. Neither filter is a high-efficiency particulate air (HEPA) filter.

Hand sanding and clean-up lasted for 218 minutes. No other tasks were scheduled for the day that could cause silica exposure. Representative photographs are attached to give a visual understanding of the areas requiring sanding.

During the sanding and clean-up activities the employees were wearing a 3M 8511 filtering facepiece. These were used on a voluntary basis; therefore, these respirators were not fit tested to the employee. Aside from the vacuum cleaner and damp rags, no other engineering controls were used.

RESULTS

Task based personal exposure monitoring concentrations for respirable dust ranged from 850 to 1,600 µg/m^3. Additionally, the laboratory detected silica as alpha quartz and results ranged from 17 to 18 µg/m^3. Cristobalite or tridymite were not detected. The results of personal TWA exposure monitoring results are provided in Table 1 below. The results are reported as TWA exposures/concentrations based upon the duration of monitoring. Laboratory results are attached.

Table 1. Respirable Dust with Crystalline Silica

Employee	Sample ID	Duration of Monitoring (Minutes)	Sample Volume (L)	Respirable Dust TWA (µg/m^3)	Silica (Alpha Quartz, Cristobalite, Tridymite) TWA (µg/m^3)
Al Drexler	1	218	436	850	17
Dennis Sanders	2	217	434	1,600	18

The OSHA PEL is an 8-hour TWA. Since the task lasted, and was monitored for, 218 minutes with no additional exposure to silica for the day; the 8-hour TWA was calculated using zero exposure for the un-sampled period to compare to the OSHA PEL. Although one could assume some respirable dust exposure for the remainder of the work day, it may be considered negligible and, therefore, respirable dust was also calculated similarly. Table 2 below provides the calculated 8-hour TWA.

Table 2. Respirable Dust with Crystalline Silica – Calculated Exposure

Employee	Calculated 8-hour TWA Respirable Dust (µg/m^3)	Calculated 8-Hour TWA Silica TWA (µg/m^3)
Al Drexler	390	7.7
Dennis Sanders	720	8.1
OSHA PEL **OSHA AL**	**5,000** **None**	**50** **25**

CONCLUSIONS AND RECOMMENDATIONS

Respirable dust and silica were below the OSHA PEL and AL for the period and tasks sampled. Terracon recommends additional monitoring be conducted when any change in the process, raw materials, equipment, personnel, work practices, or control methods may result in new or additional exposures to respirable dust or crystalline silica.

Notify monitored employees in writing of their sample results. This report constitutes an exposure record as defined under 29 CFR 1910.1020, Access to Employee Exposure and Medical Records. Therefore, Clemson University should preserve and maintain this report for at least 30 years [29 CFR 1910.1020(d)(1)(ii)].

CLOSING

Terracon appreciates the opportunity to provide these services to you. If we can provide additional environmental, occupational health, or safety-related services, please contact us.

Sincerely,
Terracon Consultants, Inc.

Jeffrey A. Gurrie
Senior Industrial Hygienist

Ben Hestir, P.E.
Staff Industrial Hygienist

Attachments: General Photographs
Laboratory Results

General Photographs



Photo #1 Living Room –General understanding on sanding efforts.



Photo #2 Living Room –General understanding on sanding efforts.



Photo #3 Living Room –General understanding on sanding efforts.



Photo #4 Kitchen –General understanding on sanding efforts.

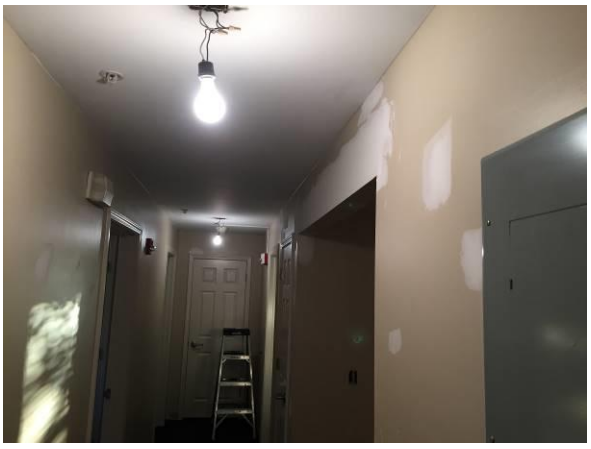


Photo #5 Hallway –General understanding on sanding efforts.

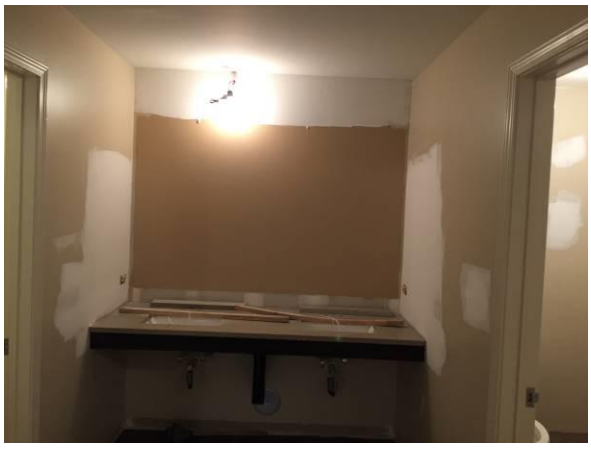


Photo #6 Bathroom –General understanding on sanding efforts.



Photo #7 Bathroom –General understanding on sanding efforts.



Photo #8 Bedroom –General understanding on sanding efforts.



Photo #9 Bedroom –General understanding on sanding efforts.



Photo #10 Bedroom –General understanding on sanding efforts.

Analytical Results

Analysis of Respirable Dust and Airborne Crystalline Silica

By X-Ray Diffraction (XRD)

NIOSH 0600 / Modified from NIOSH Method 7500 & OSHA ID-142

Client: Terracon Consultants, Inc.
72 Pointe Circle
Greenville, SC 29615

Attn: Jeffrey Gurrie

Project: Clemson – Lightsey Bridge 2 Unit 16I

Lab Order ID: 1723152
Date Received: 11/2/2017
Date Reported: 11/07/2017

Sample ID / *Lab Sample ID*	Description / *Lab Notes*	Air Volume (m^3)	Analyte	Analyte Detected	LOD (µg Analyte)	µg Analyte	CONCENTRATION µg/m^3
1	Al Drexler – 21193	0.436	Dust	N/A	50	370	850
			Alpha Quartz	Detected	5	7.6	17
1723152XDZ_1			Cristobalite	BDL	5	<5	<11
			Tridymite	BDL	10	<10	<23
			Total Silica	N/A	N/A	N/A	17
2	Dennis Sanders – 39317	0.434	Dust	N/A	50	690	1600
			Alpha Quartz	Detected	5	7.8	18
1723152XDZ_2			Cristobalite	BDL	5	<5	<12
			Tridymite	BDL	10	<10	<23
			Total Silica	N/A	N/A	N/A	18
3	Blank	0	Dust	N/A	50	<50	N/A
			Alpha Quartz	BDL	5	<5	N/A
1723152XDZ_3			Cristobalite	BDL	5	<5	N/A
			Tridymite	BDL	10	<10	N/A
			Total Silica	N/A	N/A	N/A	N/A

BDL: Below Detectable Limit

Ired Gulley
Analyst

Lab Director

Unless otherwise noted blank sample correction was not performed on analytical results. Scientific Analytical Institute participates in the AIHA IHPAT program. IHPAT Laboratory ID: 173190. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. Analytical uncertainty available upon request. Time-weighted average (TWA) calculations are based on customer supplied data and valid only for samples included in the specified TWA group

Scientific Analytical Institute, Inc.
4604 Dundas Drive Greensboro, NC 27407
Phone: 336.292.3888 Fax: 336.292.3313
www.sailab.com lab@sailab.com

Lab Use Only
Lab Order ID: 172352
Client Code: _____

Company Contact Information	
Company: Terracon Consultants, Inc.	Contact: Jeffrey Gurrie
Address: 72 Pointe Circle	Phone ☐:
Greenville, SC 29615	Fax ☐:
	Email ☒: jagurrie@terracon.com

Billing/Invoice Information	Turn Around Times^	
SAME ☒	90 Min. ☐	48 Hours ☐
Company:	3 Hours ☐	72 Hours ☒
Contact:	6 Hours ☐	96 Hours ☐
Address:	12 Hours ☐	120 Hours ☐
	24 Hours ☐	144+Hours ☐
	^TATs not available for certain test types	
PO Number:		
Project Name/Number: Clemson - Lightsey Bridge 2 Unit 161		

Industrial Hygiene Test Types	
Silica as Alpha Quartz*	☒
Silica as Cristobalite*	☐
Silica as Tridymite*	☐
Silica as Alpha Quartz, Cristobalite, Tridymite*	☐
Include Respirable Dust	☒
Silica Bulk*	☐
Bulk Phase ID/Whole Rock SAI Method H-SOP-003	☐
Total Dust NIOSH Method 0500	☐
Respirable Dust NIOSH Method 0600	☐
PCM NIOSH 7400 (Fibers)	☐
TEM NIOSH 7402 (Asbestos)	☐
Hexavalent Chromium (OSHA ID-215) (Note if from spray paint operations)	☐
Metals (NIOSH 7300) (Specify Metals Under Comments)	☐
Other _____	☐

**Modified NIOSH 7500/OSHA ID 142*

Sample ID #	Description/Location	Volume/Area	Comments (List Metals Here)
1	Al Drexler - 21193	436 L	
2	Dennis Sanders - 39317	434 L	
3	Blank	NA	

Accepted ☑
Rejected ☐

Total # of Samples 3

Relinquished by	Date/Time	Received by	Date/Time
	11/1/17	B Hulley 142	1010