Report – Workplace Exposure Monitoring of Respirable Dust and Silica

28a Harley Crescent, Condell Park, NSW 2200

Report No. | J22-4777R1

Report Issue Date | 16 December 2022

Prepared For:

Elite Marble and Granite Furniture Pty Ltd
28a Harley Crescent
Condell Park, NSW 2200

SESA-Safety & Environmental Services Australia Pty Ltd

Telephone |+61 2 9822 8406
Email | info@sesa.com.au
Web | www.sesa.com.au
ABN | 27 133 203 933
Address | Unit 53/3 Kelso Cr, Moorebank NSW 2170
PO Box 841, Moorebank NSW 1875

CLIENT

Client | Elite Marble and Granite Furniture Pty Ltd

Client Contact | Rowena Huang

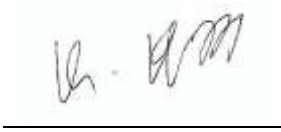
Client Address | 28a Harley Crescent, Condell Park, NSW 2200

SESA PROJECT PERSONNEL

Fieldwork & Report by | Kazeem Khatib

Position/Qualifications | Occupational Hygiene Technician

BSc Biological sciences

Signature 

Fieldwork and Report by | Brendan Egberts

Position/Qualifications | Occupational Hygiene Technician

BSc Chemical & Biomolecular Sciences

Signature 

Report Review/Approval by | Ibrahim Ech

Position/Qualifications | Certified Occupational Hygienist

BSc Biology
MSc Environmental Toxicology
Master of OHS Management
Grad. Cert. Occupational Hygiene

Signature 

Issue	Issue Date	Status/Comments	Author	Review/Approval
1	16 December 2022	Issued to the Client	Kazeem Khatib / Brendan Egberts	Ibrahim Ech

SESA
SAFETY & ENVIRONMENTAL SERVICES AUSTRALIA

Table of Contents

1.0 Overview 4
1.1 Instructions 4
1.2 Objectives 4
1.3 Background, Site & Process Description 4
1.4 Scope of Works 5
1.5 Evaluation Criteria 5
1.6 Findings 6
1.7 Conclusions and Recommendations 7
2.0 Hazard Identification 9
2.1 Dust 9
2.2 Respirable Crystalline Silica 10
3.0 Meaning of Key Terms 10
4.0 Sampling Plan 12
5.0 Methodology 12
5.1 Sampling and Analytical Methods 12
5.2 Exposure Criteria 12
6.0 Assessment 15
6.1 Measurement and Monitoring Data Summary 15
6.2 Site Photographic References 16
7.0 References 18
8.0 Statement of Limitations 19

Appendices

Appendix A – Certificate of Analysis 21

Figures

No table of figures entries found.

Tables

Table 1: Definition of Terms 10
Table 2: Personal Exposure Monitoring Results 15

1.0 Overview

1.1 Instructions

SESA – Safety & Environmental Services Australia Pty Ltd (SESA) was engaged by Elite Marble and Granite Furniture Pty Ltd (the Client) to undertake an Occupational Hygiene Exposure Assessment for respirable dust and respirable crystalline sillca (quartz) at their marble stone processing facility located at 28a Harley Crescent, Condell Park, NSW 2200 (the Site).

This project was requested by the client to measure the personal exposure of two (2) representative operators to respirable dust and respirable crystalline silica generated from the engineered stone benchtop processing activities and evaluate the health risk to operators based on comparison of the personal exposure results with applicable workplace exposure standards. The personal exposure results are also used to evaluate control measures adopted at the site regarding the exposure to those airborne contaminants in order to assist site management in protecting workers' health and compliance with legislative requirements.

The site inspection and exposure monitoring were undertaken under typical operating conditions on 24 November 2022.

Rowena Huang, Management Representative of Elite Marble and Granite Furniture Pty Ltd, provided initial job request and site information to SESA consultant and facilitated access throughout the assessment.

The report must be read entirely and is subject to the Statement of Limitation contained in Section 8.0.

For explanation of technical terms used in this report refer to Section 3.0 Meaning of Key Terms.

1.2 Objectives

The objectives of the assessment were to evaluate exposure of site operators to respirable crystalline sillca (quartz) by measuring the exposure to airborne contaminants within the breathing zone of representative operators and comparing with applicable workplace exposure standards (WESs) and the Australian Institute of Occupational Hygienists (AIOH) exposure guidelines where no WESs are available or for achieving best practice.

1.3 Background, Site & Process Description

The site assessed consists of a factory facility that processes engineered stone and marble for products such as kitchen benchtops. There were 2 operators working within the operating areas of the factory and an additional worker within the office.

The factory generally operates an 8-hour shift spanning from 8:00am to 4:30pm.

The sampling was conducted on the two (2) operators within the factory. The stone cutter was advised to be on site their whole shift spanning from 8:00am to 4:30pm. The stone mason was advised to only be on site for a portion of their shift (generally 4 hours) with the remained of work tasks undertaken in nearby glass processing facility. Note this exposure assessment only consider exposure for the operator with works conducted at the marble stone processing facility spanning from approximately 11:00am – 3:30pm.

SEGs for airborne dust and respirable crystalline silica

To facilitate the sampling and assessment of atmospheric contaminants, initial similar exposure groups (SEGs) are identified to represent the different working areas for respirable dust and crystalline silica.

The following SEGs are identified as associated with exposure to respirable dust and respirable crystalline silica (quartz and cristobalite) and were included in the sampling plan depending on the work area of the operators.

- **Stone cutting – SEG1**
- Worker tasks include the operation of automated wet cutting saw machines
- **Stone mason – SEG2**
- Worker tasks inlude the operation of automated wet cutting saw machines

1.4 Scope of Works

The scope of work for this project required SESA occupational hygiene consultant to perform the following:

- Review information provided by the Client regarding the manufacturing operations
- Identify a practical sampling strategy and methods based on the requirements of the client to enable undertaking a personal exposure assessment of specific atmospheric contaminants associated with the process within the breathing zone of representative operators
- Assess in consultation with site representative the operational areas for optimum representation of sample collection with considerations of workers' similar exposure groups (SEGs), work areas, processes and plant
- Perform personal monitoring of respirable dust and respirable crystalline sillica (quartz)
- Record observations made during the sampling period
- Arrange analysis of samples by a NATA accredited laboratory
- Provide electronic copy of this report which includes the methodology used, data collected, interpretation of results and conclusions and recommendations.

1.5 Evaluation Criteria

Based on NSW Work Health and Safety Regulation 2017, Safe Work Australia Workplace Exposure Standards (SWA WESs) and the Australian Institute of Occupational Hygienists (AIOH) recommended exposure criteria, the following evaluation criteria are used in this project:

Respirable dust, respirable crystalline silica

- Respirable Dust (not otherwise specified): 1 mg/m^3 (AIOH 8-hour Time Weighted Average (TWA))
- Respirable Crystalline silica (quartz and cristobalite): 0.05 mg/m^3 8-hour TWA (SWA WES, AIOH) and 0.025 mg/m^3 8 hour TWA action level (50% of the WES)

For airborne contaminants, where direct comparison with the exposure standard is made to evaluate worker's exposure a minimum of three (3) randomly collected samples per SEG are required with all samples results being below 10% of the WES to assume that the exposure standard is not exceeded. If the WES is exceeded at any stage or the exposure results exceeded 10% of the WES then control measures would be required to ensure the personal exposure is maintained below 10% of the WES. In any other case, more samples (additional 6 samples per SEG or more) would be required to enable statistical analysis to establish that the WES is not exceeded and that the exposure meet WHS legislative compliance.

Where a single sample is collected under fully confirmed worst case scenario conditions then comparison with 50% of the WES may be made to evaluate worker's exposure to account for sampling and analytical errors that may account for up to 50%. If uncertain that worst case scenario conditions prevailed during the sampling, the action level in this case should be 10% of the WES at which control measures must be introduced to ensure the WES is not exceeded at any time. This is also considered best industry practice and to ensure WHS legislative compliance.

1.6 Findings

1.6.1 Observations

On the day of the site inspection, the following were noted:

- The factory consisted of four general working areas: Stone cutting, polishing benches, the stone mason area and the office. Each operator is required to wear a half-face respirator during machine operation with a P2 and/or P3 filter noted to the half-face respirator with a protection factor of 10
- The dust-generating operations within the manufacturing area mainly involves cutting, grinding and polishing of engineered stone/marble slabs. The only operations conducted on the day of testing were the wet stone cutting machine with some short water grinder (handheld), and hand polishing (wet/handheld) tasks advised to be undertaken
- Visible dust was noted to be present on the floor throughout all areas of the facility. A layer of dry visible dust was noted on the floor around the automated wet stone cutter (GMM) prior to operation. During operation, the majority of the visible dust generated was observed to be wet and mixed in water. No extraction ventilation was also noted around the stone-cutting machine. The automated saw machine (GMM) is operated in a wet process with water to help reduce the generation of airborne dust. The water flows with particulates on the concrete floor and flows to a carved channel into the drain. At the main saw machine, it was noted that the operator (Stone cutting, Allen Lu) programs the saw at the control panel with the operator being in close proximity to the cutting area
- Small fans were noted to be blowing air from behind the wet stone-cutting machine in the direction of the machine operator. Some ventilation was also provided through the front roller door and through the back roller door when raised later in the workshift
- The slab polishing section involves the use of handheld wet grinders to polish the slab and the slab edge. During this process, the slab is at arm's distance from the operator and the wet grinder is constantly dispersing water
- The machines noted to not be in operation were the Denver machine and the marmo meccanica wet polishing machine.

1.6.2 Sampling Results and Discussion

The summary of the personal exposure sampling results for the respirable dust and respirable crystalline silica are presented in Section 5.0 Assessment. The laboratory certificate of analysis of the samples collected is included in Appendix A.

Respirable dust and respirable crystalline silica by SEG

Stone cutting – SEG 1:

- Allen Lu (0.010 mg/m^3) **reached 20%** of the SWA 8-hour TWA exposure standard for **respirable crystalline silica** – Quartz (0.05 mg/m^3).
- Allen Lu (0.13 mg/m^3) **reached 13%** of the AIOH 8-hour exposure guideline for **respirable dust** (1.0 mg/m^3).

Stone mason – SEG 2:

- Viet Mai (0.010 mg/m^3) **reached 20%** of the SWA 8-hour TWA exposure standard for **respirable crystalline silica** – Quartz (0.05 mg/m^3).
- Viet Mai (0.27 mg/m^3) **reached 27%** of the AIOH 8-hour exposure guideline for **respirable dust** (1.0 mg/m^3).

1.7 Conclusions and Recommendations

Under the conditions prevailed on the day of site visit and based on the results recorded and observations made at the Site for this project, SESA made the following conclusions and recommendations:

Respirable Dust (All SEGs)

The exposure of both Allen Lu (SEG1 – Stone Cutting) and Viet Mai (SEG2 – Stone mason) to respirable dust was between 13% – 27% of the AIOH 8-hour exposure guideline (1.0 mg/m^3). The health risk to operators is considered **Low to Moderate** for exposure to respirable dust (excluding silica or any other dust hazardous content). A P3 half-face respirator (currently used onsite) with a protection factor of 10 is considered acceptable for worker protection for the exposure levels measured.

Respirable Crystalline Silica – Quartz (All SEGs)

The exposure of both Allen Lu (SEG1 – Stone Cutting) and Viet Mai (SEG2 – Stone mason) to respirable crystalline silica (Quartz) was 20% of the SWA 8-hour TWA (0.05 mg/m^3). The health risk to operators is considered **Low to Moderate** for exposure to respirable crystalline silica (Quartz) if no respiratory protection is worn. A P3 half-face respirator (currently used onsite) with a protection factor of 10 is considered acceptable for worker protection for the exposure levels measured.

Overall Recommendations

- Further monitoring is recommended to be undertaken over varying atmospheric conditions and various work shifts to ensure no exceedance of the exposure standard occurs. Where direct comparison with the exposure standard is made to evaluate worker's exposure, a minimum of three (3) randomly collected samples per SEG are required with all samples results being below 10% of the WES to assume that the exposure standard is not exceeded
- Although the risk to the operators is considered low to moderate, the exposure could vary due to the tasks assigned to the operators on the day and the length of exposure. Elevated silica concentrations could be encountered around the wet processes and would likely be due to the fine mist carrying respirable silica becoming airborne or the wet dust generated around those locations becoming dry and airborne before being removed. It is advised that the following recommendations are put into consideration to account for these variations in workplace exposure to increase worker safety.
- The substitution and replacement of existing products with a lower silica content should be considered and implemented where appropriate
- Implement a housekeeping program to ensure all areas including the factory, warehouse, offices and amenities identified with settled dust are wet/dry HEPA vacuumed (H-Class) at an increased frequency which ensures clean surfaces at all times. Allow for use of an adequate number of water feeds to prevent visible dust during the process and that adequate water pressure is maintained (0.5 L/min or as specified by the manufacturer)
- Ensure no dry sweeping methods, such as using brooms, or using compresed air to clean up accumulated dust is undertaken. These methods can recirculate silica dust into the air presenting the risk of re-exposure. The use of household vacuum cleaners are not designed for use with hazardous dusts and should never be used where silica dust is or may be present, even if they are fitted with a HEPA filter. Ensure that are vacuuming of dust is completed using an industrial M- or H- class rated cauum cleaner
- It is recommended that a structure is built around the stone-cutting machine to isolate the silica dust generating activity form other workers. The machine area should be enclosed on all 4 sides by 1.8 m height automated doors that opens when not in cutting operation. This is to reduce dust generation throughout the facility and to protect workers from increased dust levels
- The use of a local extraction ventilation system in polishing operations may be beneficial in reducing the accumulation of generated particulates
- Respiratory protection in the form of a P2/P3 half-face respirator shall continue to be used in all operational areas until suitable control measures higher in the hierarchy are implemented

- To reduce the uncertainty associated with variations of exposure conditions, SESA recommends using P2 respiratory protection for operators exposed to airborne dust above 10% of the relevant Safe Work Australia workplace exposure standards or AIOH exposure guidelines in order to minimise the risk of operators' exposure to these contaminants
- When respiratory protection is chosen as a control measure, operators who are required to use respiratory protection equipment (RPE) should be given adequate training in the selection and correct use of such equipment (eg. be clean shaven to ensure proper fitting), and also be informed about potential health hazards of exposure to relevant airborne contaminants. Respiratory protection must be selected, maintained and fit-tested as specified by AS1715 and AS1716. As a general rule, Personal Protective Equipment is considered the least effective/reliable and should be used as a "last line of defence". Initial control measures should focus on eliminating or minimizing the dust hazard, and not just using PPE to protect workers from the hazard
- To reduce the exposure to contaminated work clothing on and off-site, it is recommended that workers bring a clean pair of clothes to change into before they leave the site each shift. It is also recommended that workers are provided with a laundry service for dusty work clothes and PPE so they are not taken home for washing
- Alternatively, the use of coveralls is more appropriate for all operators working in dusty areas within the factory so they do not contaminate their clothing with silica dust. At the end of a task, where the operator is covered in dust, it is important to safely remove dust from clothing, shoes and skin by H-Class HEPA vacuuming and washing (eg. in a commercially available dust removal booth). Exposure to dust will continue if the dust on clothing and skin is not controlled. Ensure no compressed air is used to blow dust. Cross-contamination to other non-contaminated areas is also likely to occur if the dust is not fully removed
- Where installed, engage a competent person to check the effectiveness of the local extraction ventilation systems regularly to ensure they are properly configured and well maintained and keep maintenance records
- Ensure regular maintenance checks of all water suppression tools are complemented, and ensure that all tools and attachments are specifically designed by the manufacturer for use with water attachments with appropriate ingress protection (IP)
- Undertake exposure monitoring following the introduction of any new controls, or when modifications are introduced into the process as well as regularly (eg. 6 monthly) to ensure that control measures are working and effective
- Undertake health surveillance for operators exposed to respirable crystalline silica as required by the work health and safety legislation.

2.0 Hazard Identification

2.1 Dust

According to AIOH (2016) position paper literature sources, dust usually comprises solid particles formed by crushing or other mechanical forces on a parent material, which are generally greater than 0.5 microns (µm) in particle size, usually in the size range from about 1 to 100 µm in diameter, and they settle slowly under the influence of gravity. The AIOH (2016) position paper considered dust derived from such workplace processes or tasks as vehicle traffic, blasting, crushing, grinding, milling, drilling, demolition, shovelling, conveying, screening, bagging, sweeping, sieving, riffling, calcining, drying and handling of dry finely divided materials (e.g. powders), or working with objects that have surfaces contaminated with such dusts. These are often associated with mineral dust exposures in the tunnelling, mineral extraction and processing industries, as well as in agriculture and some chemical manufacturing and shaping processes involving polymers.

The American Conference of Governmental Industrial Hygienists (ACGIH, 2013) define low toxicity particles as being "not cytotoxic, genotoxic, or otherwise chemically reactive with lung tissue, and do not emit ionizing radiation, cause immune sensitisation, or cause toxic effects other than by inflammation or the mechanism of 'lung overload'." To classify dusts as being 'free from toxic materials' requires analysis of the dusts to determine that such toxics are less than the prescribed level.

The AIOH (2016) focused on the prevention of health effects due to respirable and inhalable 'Dust NOS', which is insoluble or poorly soluble in water, of inherently low toxicity and free from toxic impurities, and which does not have a listed applicable workplace exposure standard (WES). Low content crystalline silica mineral dust is the most common example of Dust NOS, deriving from rock and soil and being ubiquitous, arising from vehicle traffic, drilling, blasting, crushing, grinding, screening and other such activities. Natural organic dusts free of harmful bacteria or biological toxins and synthetic organic dusts such as polymers may also fit into this classification.

There are other papers published by AIOH that deal specifically with some dusts that fall outside this classification of 'free from toxic materials', such as respirable crystalline silica, asbestos and dusts and fumes containing toxins such as lead. Safe Work Australia has listed a number of dusts that have a WES based on the original ACGIH® general 'Nuisance Particulates' limit of 10 mg/m^3 for total dust. These include: aluminium (metal dust & oxide); barium sulphate; calcium carbonate (limestone & marble); calcium silicate; calcium sulphate (gypsum & plaster of Paris); cellulose (paper fibre); diatomaceous earth (uncalcined); emery (dust); kaolin; magnesite; magnesium oxide (fume); pentaerythritol; perlite dust; Portland cement; rouge dust; silica gel; silicon; silicon.

Safe Work Australia (SWA, 2013b) Guidance on the Interpretation of Workplace Exposure Standards for Airborne Contaminants recommends that "Where no specific exposure standard has been assigned and the substance is both of inherently low toxicity and free from toxic impurities, exposure to dusts should be maintained below 10 mg/m^3, measured as inhalable dust (8 hour TWA)." While there are workplace exposure standards (WESs) for the various components of dust, such as respirable crystalline silica, and dusts and fumes containing toxins, such as lead, there are no specific WESs for inhalable and respirable substances that are insoluble or poorly soluble in water, of inherently low toxicity and free from toxic impurities, although most State jurisdictions do promulgate limit values for these.

The AIOH (2016) states "there are still information gaps for health aspects of dust of both inherently low toxicity and free from toxic impurities. However, workers may be susceptible to a number of dust-related respiratory diseases from excessive exposure, including inflammatory reaction in the lung, resulting in chronic obstructive pulmonary disease (COPD) caused by both the respirable and inhalable dust fractions. Workers can certainly experience physical irritation of the eyes, nose and throat, due primarily to high levels of the inhalable fraction of low toxicity dusts".

Due to a number of physical variables, including aerodynamic particle size distribution and particle surface area in the dust cloud, the AIOH (2016) recommended that two 'Dust NOS' trigger values (expressed as 8-hour TWAs) be adopted to protect workers from potentially serious health effects due to insoluble or poorly water-soluble dusts of inherently low toxicity and free from toxic impurities, for which there is no other applicable WES specified:

- 5 mg/m^3 for the inhalable fraction (measured in accordance with Australian Standard method, AS3640); and

- 1 mg/m^3 for the respirable fraction (measured in accordance with Australian Standard method, AS 2985).

These AIOH recommended trigger values are not exposure standards but rather indicate breathing zone exposure concentrations at which consideration should be given to implementing reasonably practicable exposure controls.

2.2 Respirable Crystalline Silica

Large bio-accumulated loads of crystalline silica in the lung substance (or lung parenchyma) can cause a build-up of connective tissue, which is termed silicosis, a specific form of pneumoconiosis. Silicosis is an irreversible and progressive condition.

Early silicosis may have no untoward effects. However, severe forms can result in poor gas exchange, difficulty in breathing and death. Evidence suggests crystalline silica interacts with other respiratory hazards, like tobacco smoke, to cause airway diseases. Silicosis virtually always requires prolonged exposure to substantial airborne quantities of respirable crystalline free silica. Four clinical patterns of diffuse lung disease may be seen with silicosis: simple nodular silicosis, progressive massive fibrosis, accelerated silicosis, and acute silicosis or silicoproteinosis.

Several work-related exposure studies indicate the crystalline silica is a potential human carcinogen, but provide little support that work-related silica exposure is a direct acting cancer initiator.

However, there is strong evidence people with many forms of pulmonary fibrosis, including silicosis, have a major risk of developing lung cancer. A number of epidemiological studies from around the world have shown an increased risk for lung cancer among workers exposed to silica. In 1997, the International Agency for Research on Cancer (IARC) made the following evaluation: crystalline silica inhaled in the form of quartz or cristobalite from work-related sources is carcinogenic to humans (Group 1). IARC also noted that not all studies were consistent, and the carcinogenic potential of silica might be affected by the physical properties of the silica particles.

3.0 Meaning of Key Terms

Table 1: *Definition of Terms*

Term	Definition/Explanation
Airborne or atmospheric contaminant:	means a contaminant in the form of a fume, mist, gas, vapour or dust, and includes microorganisms. An airborne contaminant of this type is a potentially harmful substance that is either not naturally in the air or is present in an unnaturally high concentration and to which workers may be exposed in their working environment.
Breathing zone:	means a hemisphere of 300 mm radius extending in front of a person's face and measured from the midpoint of an imaginary line joining the ears.
Exposure standard:	means Workplace Exposure Standard (WES) (also known as occupational exposure limit (OEL)) for Airborne Contaminants. It is the airborne concentration of a particular substance or mixture that must not be exceeded at any time. The exposure standard can be of three forms: - 8-hour time-weighted average (8-hour TWA) - peak limitation (peak) - short term exposure limit (STEL). For airborne dust the peak and STEL are not assigned.
Field blank:	means a blank filter that undergoes the same handling as the sample filter, generally including conditioning and, often, loading into the samplers or transport containers, as well as transportation between laboratory and sampling site, but without being exposed to sampling.
Respirable dust:	means the dust fraction consisting of those airborne particles which are taken in through the nose or mouth during breathing and which has been so defined in ISO 7708 as the percentage of respirable matter collected by a device conforming to a sampling efficiency curve. The particle sizes of respirable dust are up to 10 microns.

Protection Factor (PF):	AS/NZS 1715:2009 defines protection factor as "a measure of the degree of protection afforded by the respirator, defined as the ratio of the concentration of contaminant outside the respirator to that inside the respirator" For example, a protection factor of 10 would mean that the air inside the respirator is 10 times cleaner than that of the air outside the respirator. <u>Protection Factor of up to 10</u> • Use a replaceable P1(mechanically generated particulates only), P2 or P3 filter in a half face respirator • Use a P1 or P2 disposable respirator <u>Protection Factor of up to 50</u> • Use a P2 filter in a full-face respirator • Use a P3 filter in PAPR with any head covering <u>Protection Factor of up to 100</u> • Use a P3 filter in a full facepiece <u>Protection Factor of 100+</u> • Use P3 Powered Air Purifying Respirator (PAPR) in a full facepiece.
STEL	Short term exposure limit. A short-term exposure limit is the time-weighted maximum average airborne concentration of a particular substance permitted over a 15-minute period. Some substances or mixtures can cause intolerable irritation or other acute effects upon brief exposure, although the primary toxic effects may occur with long term exposure through accumulation of the substance or mixture in the body or through gradual health impairment with repeated exposures.
TWA	8-hour time-weighted average. An eight-hour time-weighted average exposure standards is the average airborne concentration of a particular substance permitted over an eight-hour working day and a 5-day working week. These are the most common types of exposure standards. It is preferable to keep exposure limits continually below the 8-hour TWA exposure standard. However, during periods of continuous daily exposure to an airborne contaminant, the 8-hour TWA exposure standard allows short term excursions above the exposure standard provided they are compensated for by extended periods of exposure below the standard during the working day.
SEGs	SEGs means similar exposure group. SEGs are used to identify a group of workers who have the same general exposure to risks. This can include: • similarity and frequency of the tasks performed • the types of materials and processes used to complete tasks • similarity of the way tasks is performed.
Silica:	means a silicon dioxide, a naturally occurring widely abundant mineral that forms the major component of most rocks and soils. soils. Respirable crystalline silica is found in dust generated from mechanical abrasion of natural stone, man-made stones and concrete. Crystalline silica dust particles which are small enough to penetrate deep into the lung are termed respirable. Respirable crystalline silica may cause lung damage. The non-crystalline form of silica does not cause this kind of lung damage. The various forms of crystalline silica are: α-quartz, β-quartz, α-tridymite, β-tridymite, α-cristobalite, β-cristobalite, keatite, coesite, stishovite, and moganite (NIOSH, 2002). The most abundant form of silica is α-quartz, and the term quartz is often used in place of the general term crystalline silica.

4.0 Sampling Plan

Based on the Client's requirements and the review of Safety Data Sheet (SDSs) for the raw materials, the following sampling plan was developed.

Stone cutting (SEG1):

- Respirable dust (including respirable quartz), covering > 60% of the shift-length operations

Stone mason (SEG2):

- Respirable dust (including respirable quartz), covering > 60% of the shift-length operations

5.0 Methodology

5.1 Sampling and Analytical Methods

Respirable dust and respirable crystalline silica

Respirable dust samples (including quartz) were collected using sampling pumps, fitted with a respirable sampling heads in accordance with Australian Standard AS2985 - 2009 "Workplace Atmosphere – Method for Sampling and Gravimetric Determination of Respirable Dust". The air sampling pumps were set to a flow rate of 3 L/min, and drawn through a pre-weighed 25 mm filter within a respirable cyclone cassette.

Both air sampling pumps and field calibrator were initially calibrated against a primary source.

Calibration was also performed prior to and at the completion of the sampling period to ensure the flow rate is within ±10%. The average flow rate was obtained for calculating the total air volume (in litres) for each sample based on the sampling time in minutes.

The pre-weighed filters/samples were provided by the NATA accredited laboratory and were returned for analysis. Analysis for respirable Dust is determined gravimetrically. The method involves drawing a metered volume of contaminated air through the surface of a pre-weighed filter and then re-weighing the filter to determine the respirable dust weight.

Results obtained for Respirable Dust are expressed in milligrams of dust per filter and then calculated based on the sample volume and expressed in mg per cubic metre of air. The detection limit of the method is 0.04 mg/filter.

Fourier Transform InfraRed (FTIR) spectroscopy is used to analyse respirable crystalline silica (Quartz) in accordance with NIOSH Method 7603 and MPL Laboratories internal methodology and conforms to the Australian Standards. Results obtained for Respirable crystalline silica (Quartz) are expressed in milligrams of dust per cubic meter of air. The detection limit of the method for Respirable Quartz is 0.01mg/m^3.

5.2 Exposure Criteria

5.2.1 Respirable Dust Criteria

Safe Work Australia (SWA, 2018) Guidance on the Interpretation of Workplace Exposure Standards for Airborne Contaminants recommends that "Where no specific exposure standard has been assigned and the substance is both of inherently low toxicity and free from toxic impurities, exposure to dusts should be maintained below 10 mg/m^3.

Due to a number of physical variables, including aerodynamic particle size distribution and particle surface area in the dust cloud, the Australian Institute of Occupational Hygienists (AIOH) recommends that two 'Dust NOS' (Not otherwise specified) trigger values (expressed as 8-hour TWA) be adopted to protect workers from potentially serious health effects due to insoluble or poorly water-soluble dusts of inherently low toxicity and free from toxic impurities, for which there is no other applicable exposure specified:

- 1 mg/m^3 for the respirable fraction (measured in accordance with Australian Standard method, AS 2985).

5.2.2 Respirable Crystalline Silica Criteria

Respirable crystalline silica (quartz) has a workplace exposure standard of 0.05 mg/m^3 averaged over eight hours. This is available from Internet based Hazardous Substances Information Database (HCIS) (http://hcis.safeworkaustralia.gov.au/ExposureStandards accessed 26/06/2020).

The ACGIH (American Conference of Governmental Industrial Hygienists) threshold limit value (TLV) for respirable crystalline silica (quartz) is 0.025mg/m^3.

Note that evaluation criteria adopted by Safe Work Australia (SWA) are regarded as workplace exposure standards (WES) which are mandatory and shall not be exceeded in any circumstances. Person Conducting a Business or Undertaking (PCBU) shall take necessary actions to ensure that SWA WESs are not exceeded at any time in order to achieve regulatory compliance.

Evaluation criteria endorsed by other non-governmental bodies (eg. AIOH and ACGIH) are considered as industry best practice and are not enforceable. Constantly and continuously maintaining workers' exposure below the industry best practice will ensure that workers' health risk of exposure to relevant airborne contaminants is minimised to as low as reasonably practicable.

Risks to health and safety from exposures to all hazardous chemicals must, so far as is reasonably practicable, be eliminated. The person conducting a business or undertaking must ensure that no person at the workplace is exposed to a substance above its exposure standard and must reduce exposures so far as is reasonably practicable.

5.2.3 Calculation of Shift Length Adjusted Exposure

For shifts lasting longer than eight hours the standard may need to be adjusted according to the time of the shift. (Brief and Scala method):

$$\textbf{Adjusted exposure standard (TWA)} = \frac{8 \times (24 - h) \times \text{Exposure Standard (8-hour TWA)}}{16 \times h}$$

Where h = length of shift in hours.

The work shift for factory operators and laboratory operators is generally of 8 hours duration. Therefore, adjustment of the exposure standard for airborne contaminants is not required.

5.2.4 Evaluation Criteria and Control Limits

As part of controlling the exposure to any chemical / dust hazards, most chemicals have a regulatory detection limit of 10-fold below the workplace exposure standard or occupational exposure limit (WES or OEL) and a control limit at 10% of the exposure standard as measured by personal exposure monitoring.

WES/OELs are usually defined as sharp boundaries that must not be exceeded, but the variability of exposure means that occasional high results occur even where the exposure is generally well controlled. It is assumed that a WES may be regarded as complied with if the probability of exposure exceeding the WES is <5%, always remembering that WHS laws requires that effective control measures are applied whether or not the WES is complied with.

The evaluation method has five steps.

1. Divide the workforce into similarly exposed groups (SEGs)
2. Take 3 representative personal exposure measurements from random workers in the SEG. If all three exposures are <0.1xWES, it can be assumed that the WES is complied with. If at this stage or any later one any result is >WES, the WES is not complied with
3. Do a group compliance test. Take at least 6 more samples from the SEG, at least 2 per worker from workers picked at random. Use all 9 (or more) samples to apply a test which establishes, with 70% confidence, that there is <5% probability of any random exposure in the SEG being >WES

4. Do an analysis of variance on the 9 (or more) results to establish whether the between - worker variance is >0.2 x total variance. If it is, then step 5 must be added
5. Analyse the 9 (or more) results to do an individual compliance test. There should be <20% probability that any individual in the SEG has >5% of exposures > WES. If the WES is not complied with, further control measures should be applied. If the WES is complied with, a periodic monitoring programme should be started, with frequency depending on the test results.

The calculations in Microsoft Excel HSTAT™ developed by AIHA is used for the statistical calculations.

Parameter statistics for chronic hazards - Upper Confidence Limit (Land's "Exact") (UCL) – we can be 95% sure that the arithmetic mean for this exposure profile is below this value.

Parameter Statistics Acute Hazards or Compliance - Upper Tolerance Limit (UTL) – we can be confident that 95% of exposures are below the UTL. If this value is greater than the OEL, we cannot be 95% certain that exposures will be less than the OEL 95% of the time.

Therefore, if only a single sample is collected to assess the exposure of one SEG then, to ensure that the exposure standard is not exceeded at any time the exposure should not exceed 10% of the exposure standard. Where the exposure monitoring can be confirmed to be done under worst case scenario conditions, comparing a single sample result with 50% of the exposure standard may be appropriate based on subjective and professional judgement and not based on statistical evaluation.

6.0 Assessment

6.1 Measurement and Monitoring Data Summary

Respirable dust and respirable crystalline silica

Table 2: *Personal Exposure Monitoring Results*

Employee Name / Sample Location / Notes	Sample ID	Time on / off Sampling Time (minutes) Sample Volume Respirable (m^3)	Calculated Concentration(mg/m^3)	
			Resp. Dust	Quartz
Personal Exposure Sample Allen Lu (Stone cutting-SEG 1)	RSESA10	10:06am-03:04m 298 895	0.13	0.010
Personal Exposure Sample Viet Mai (Stone mason-SEG 2)	RSESA9	10:47am-03:20pm 273 811	0.27	0.010
Field Blank	RSESA11	NA	NA	NA
SWA WES (8-hour TWA)			**NA**	**0.05**
AIOH Exposure Guideline (8-hour TWA)			**1**	**0.05**
Action level (50% of SWA WES or AIOH exposure guideline)			**0.5**	**0.025**
Target level (10% of SWA WES or AIOH exposure guideline)			**0.1**	**0.005**
Colour Legend	**≥100% SWA WES Risk Level: Very High**	**≥ 50% SWA WES Risk Level: High**	**≥ 10% SWA WES Risk Level: Moderate**	**< 10% SWA WES Risk Level: Low**
Respiratory Protection Required for exposure assessed by only one sampling event	**Protection Factor (PF) 10 or greater Required: Half face P2/P3 Respirator Full Face P2/P3 Respirator**	**Protection Factor 10 Required Half face P2/P3 Respirator**	**Protection Factor 10 Recommended: Half Face P2/P3 Respirator**	**Respirator not required**

6.2 Site Photographic References

Photograph 1: Sawing machine (Front) – prior to sawing where water and particulates are cleaned off prior to transport in warehouse.

Photograph 2: Sawing machine dust build up prior to machine operation.

Photograph 3: Saw cutter – machine operated close to operator.

Photograph 4: Polishing and hand grinding area.

Photograph 5: Hand grinding machine.

Photograph 6: Overview of warehouse area

Photograph 5: Half face mask advised to be used. (P2 filter noted)

Photograph 6: Half face mask in use. (P3 filter noted)

7.0 References

- NSW Work Health & Safety Act 2011 (WHS Act)
- NSW Work Health and Safety Regulation 2017 (WHS Regulation)
- Safe Work Australia Workplace Exposure Standards for Airborne Contaminants
- Guidance on the Interpretation of Workplace Exposure Standards for Airborne Contaminants 2013
- American Conference of Governmental Industrial Hygienist Threshold Limit Values (2018)
- AIOH position paper: Dust Not Otherwise Specified (Dust NOS) and occupational health issues
- AIOH position paper: Adjustment of Workplace Exposure Standards for Extended Work Shifts
- Safework NSW WHS code of practice: How to manage work health and safety risks (2019)
- Safework NSW WHS code of practice: Managing risks of hazardous chemicals in the workplace (2020)
- Safework NSW code of practice: Managing the risks of respirable crystalline silica from engineered stone in the workplace (2022)

8.0 Statement of Limitations

This report and the associated services performed by SESA-Safety & Environmental Services Australia (SESA) are in accordance with the scope of services set out in the contract between SESA and the Client. The scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

SESA derived the data in this report primarily from visual inspections, examination of available records, interviews with individuals with information about the site, and if requested, limited samples collection and analysis made on the dates indicated. In preparing this report, SESA has relied upon, and presumed accurate, certain information (or absence thereof) provided by government authorities, the Client and others identified herein. Except as otherwise stated in the report, SESA has not attempted to verify the accuracy or completeness of any such information.

Limitations also apply to analytical methods used in the identification of substances (or parameters). These limitations may be due to non-homogenous material being sampled (i.e. the sample to be analysed may not be representative), low concentrations, the presence of 'masking' agents and the restrictions of the approved analytical technique. As such, non-statistically significant sampling results can only be interpreted as 'indicative' and not used for quantitative assessments.

No warranty, undertaking, or guarantee, whether expressed or implied, is made with respect to the data reported or to the findings, observations, conclusions and recommendations expressed in this report. Furthermore, such data, findings, observations, conclusions and recommendations are based solely upon existence at the time of the investigation. The passage of time, manifestation of latent conditions or impacts of future events (e.g. changes in legislation, scientific knowledge, land uses, etc) may require further investigation at the site with subsequent data analysis and re-evaluation of the findings, observations, conclusions and recommendations expressed in this report.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between SESA and the Client. SESA accepts no liability or responsibility whatsoever and expressly disclaims any responsibility for or in respect of any use of or reliance upon this report by any third party or parties. It is the responsibility of the Client to accept if the Client so chooses any recommendations contained within and implement them in an appropriate, suitable and timely manner.

SESA-Safety & Environmental Services Australia Pty Ltd

Appendices

Appendix A – Certificate of Analysis

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207
16-18 Hayden Court Myaree WA 6154
ph +61 8 9317 2505 fax +61 8 9317 4163
lab@mpl.com.au
www.mpl.com.au

Certificate of Analysis PDL0174

Client Details

Client	Safety & Environmental Services Australia
Contact	Brendan Egberts
Address	53/3 Kelso Cres, MOOREBANK, NSW, 2170

Sample Details

Your Reference	J22-4777
Number of Samples	2 Air, 1 Filter
Date Samples Received	05/12/2022
Date Samples Registered	05/12/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date Results Requested by	12/12/2022
Date of Issue	12/12/2022

Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Authorisation Details

Results Approved By	Thomas Edwards, OHL Supervisor Todd Lee, Group Operations Manager
Laboratory Manager	Michael Kubiak

Certificate of Analysis PDL0174

Samples in this Report

Envirolab ID	Sample ID	Matrix	Date Sampled	Date Received
PDL0174-01	RSESA9	Air	24/11/2022	05/12/2022
PDL0174-02	RSESA10	Air	24/11/2022	05/12/2022
PDL0174-03	RSESA11 (FB)	Filter	24/11/2022	05/12/2022

Sample Information

Sample ID	Filter ID	Flow Rate (L/min)	Time Sampled (min)	Air Volume (m3)
RSESA9	RSESA9	[NA]	[NA]	0.8950
RSESA10	RSESA10	[NA]	[NA]	0.8110
RSESA11 (FB)	RSESA11	[NA]	[NA]	[NA]

Certificate of Analysis PDL0174

Respirable Dust (Air)

Envirolab ID	Units	PQL	PDL0174-01	PDL0174-02
Your Reference			RSESA9	RSESA10
Date Sampled			24/11/2022	24/11/2022
Dust	mg/m3	0.10	0.13	0.27

Certificate of Analysis PDL0174

Respirable Dust (Filter)

Envirolab ID	Units	PQL	PDL0174-03
Your Reference			RSESA11 (FB)
Date Sampled			24/11/2022
Dust	mg	0.040	<0.040

Certificate of Analysis PDL0174

Respirable Crystalline Silica (Air)

Envirolab ID	Units	PQL	PDL0174-01	PDL0174-02
Your Reference			RSESA9	RSESA10
Date Sampled			24/11/2022	24/11/2022
a-Quartz	mg/m3		0.010	0.010

Respirable Crystalline Silica (Filter)

Envirolab ID	Units	PQL	PDL0174-03
Your Reference			RSESA11 (FB)
Date Sampled			24/11/2022
a-Quartz	µg/sample	5.0	<5.0

Method Summary

Method ID	Methodology Summary
DUST-004_QTZ	Respirable Quartz (and/or Cristobalite) is determined after ashing, redeposition and FTIR determination. The Quartz exposure standard is 50µg/m3, therefore where sampling follows MDHS 101 guidelines and at least 500L of air is sampled, this is equivalent to a dust weight of 25µg/filter. The estimated measurement uncertainty for the laboratory analysis of Quartz is 40% at 25µg at 95% confidence limit (i.e. statistically the true value lies between 15-35µg / filter (30 – 70 µg/m3) at 95% confidence). The estimated measurement uncertainty was determined during method validation.
INORG-100_RESP	Gravimetric determination of Respirable dust as pre AS2985.

Result Definitions

Identifier	Description
NR	Not reported
NEPM	National Environment Protection Measure
NS	Not specified
LCS	Laboratory Control Sample
RPD	Relative Percent Difference
>	Greater than
<	Less than
PQL	Practical Quantitation Limit
INS	Insufficient sample for this test
NA	Test not required
NT	Not tested
DOL	Samples rejected due to particulate overload (air filters only)
RFD	Samples rejected due to filter damage (air filters only)
RUD	Samples rejected due to uneven deposition (air filters only)
##	Indicates a laboratory acceptance criteria outlier, for further details, see Result Comments and/or QC Comments

Quality Control Definitions

Blank

This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, and is determined by processing solvents and reagents in exactly the same manner as for samples.

Surrogate Spike

Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

LCS (Laboratory Control Sample)

This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Matrix Spike

A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

Duplicate

This is the complete duplicate analysis of a sample from the process batch. The sample selected should be one where the analyte concentration is easily measurable.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria. Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for Physical and Aggregate Tests are not applicable. For VOCs in water samples, three vials are required for duplicate or spike analysis.

General Acceptance Criteria (GAC) - Analyte specific criteria applies for some analytes and is reflected in QC recovery tables.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% - see ELN-P05 QAQC tables for details (available on request); <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase. Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was typically insufficient in order to satisfy laboratory QA/QC protocols.

Miscellaneous Information

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached. We have taken the sampling date as being the date received at the laboratory.

Two significant figures are reported for the majority of tests and with a high degree of confidence, for results <10*PQL, the second significant figure may be in doubt i.e. has a relatively high degree of uncertainty and is provided for information only.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS where sediment/solids are included by default.

Urine Analysis - The BEI values listed are taken from the 2022 edition of *TLVs and BEIs Threshold Limits by ACGIH*.

Air volume measurements are not covered by Envirolab's NATA accreditation.

Data Quality Assessment Summary PDL0174

Client Details

Client	Safety & Environmental Services Australia
Your Reference	J22-4777
Date Issued	12/12/2022

Recommended Holding Time Compliance

No recommended holding time exceedances

Quality Control and QC Frequency

QC Type	Compliant	Details
Blank	Yes	No Outliers
LCS	Yes	No Outliers
Duplicates	Yes	No Outliers
Matrix Spike	Yes	No Outliers
Surrogates / Extracted Internal Standards	Yes	No Outliers
QC Frequency	Yes	No Outliers

Surrogates/Extracted Internal Standards, Duplicates and/or Matrix Spikes are not always relevant/applicable to certain analyses and matrices. Therefore, said QC measures are deemed compliant in these situations by default. See Laboratory Acceptance Criteria for more information

Data Quality Assessment Summary PDL0174

Recommended Holding Time Compliance

Analysis	Sample Number(s)	Date Sampled	Date Extracted	Date Analysed	Compliant
Gravimetric Dust | Air	1-2	24/11/2022	08/12/2022	08/12/2022	Yes
Gravimetric Dust | Filter	3	24/11/2022	08/12/2022	08/12/2022	Yes
Quartz | Air	1-2	24/11/2022	08/12/2022	09/12/2022	Yes
Quartz | Filter	3	24/11/2022	08/12/2022	09/12/2022	Yes

Quality Control PDL0174

DUST-004_QTZ | Respirable Crystalline Silica (Filter) | Batch BDL0900

Analyte	Units	PQL	Blank	DUP1 BDL0900-DUP1# Samp | QC | RPD %	DUP2 BDL0900-DUP2# Samp | QC | RPD %	LCS %
a-Quartz	µg/sample	5.0	<5.0	<5.0 | <5.0 | [NA]	<5.0 | <5.0 | [NA]	96.7

The QC reported was not specifically part of this workorder but formed part of the QC process batch.