Crystalline Silica Procedures

1.0 Introduction

Silica (SiO2) is the second most common mineral in the earth's crust and is a major component of sand, rock and mineral ores. Silica exists in several forms, of which crystalline silica is of most concern. The best known and most abundant type of crystalline silica is quartz. Other forms of crystalline silica include cristobalite, tridymite and tripoli. Crystalline silica (in a respirable form) is a designated substance as per Ontario Regulation 490/09 under the Occupational Health and Safety Act.

Crystalline silica is the primary component of many building materials, such as brick, rock, stone, granite, sandstone, concrete, concrete block, cement, mortar, etc. Silica has also been found as a filler material in insulation. Exposure to airborne silica can occur when these building materials are disturbed or turned into powder:

- Abrasive blasting (if the abrasive contains silica and/or if the material being blasted contains silica)
- Chipping, hammering, crushing, loading, hauling, dumping, and drilling of rock
- Sawing, hammering, drilling, grinding, chipping, or demolition of concrete or masonry structures
- Dry sweeping or pressurized air blowing of concrete, rock or sand dust
- Road construction
- Sweeping, cleaning, and dismantling equipment
- Tunnelling, excavation, and earth moving of soils with high silica content.

The following procedures were developed following the Ministry of Labour, Immigration, Training and Skills Development (MLITSD) Guidelines for Silica on Construction Projects, November 2022.

For the purpose of this document, the term "silica" is used to refer to crystalline silica in a respirable form unless otherwise specified.

Hazards Summary

The prolonged inhalation of respirable dust containing crystalline silica may result in silicosis, a disease characterized by progressive fibrosis of the lungs. Crystalline silica may be harmful following high exposure levels received over a period of time, ranging from a few weeks to years or after long-term exposures to lower levels. There are three main types of silicosis: chronic (simple or complicated), accelerated and acute.

During construction and maintenance activities, every reasonable effort will be made to prevent silica-containing dust from migrating into occupied areas. If visible dust is observed in occupied spaces, workers are to report concerns to their supervisor. Appropriate cleaning and remediation measures to prevent reoccurrence will be undertaken. While such occurrences should be minimized, brief or incidental exposure to silica-containing dust is not expected to pose a significant health risk to building occupants. It is also important to note that silica is a naturally occurring mineral that is commonly present in the environment, including in natural settings such as beaches and sandy soils.

Scope

This procedure applies to all buildings, structures, machinery and equipment owned, occupied or operated by the University of Toronto at all campuses and other locations. It applies to all employees and students at the University, to occupants of University buildings and to external organizations who may come into contact with or cause silica to become airborne in University buildings.

2.0 Responsibilities

Supervisors/Management/Principle Investigators

- Consider substituting silica with a less hazardous substance
- Develop, document, and implement appropriate measures and precautions; consult with Environmental Health and Safety (EHS) as needed.
- Ensure workers are aware of the hazards of crystalline silica and are provided appropriate training.
- Ensure Designated Substance Assessments (DSAs) and Job Safety Analysis (JSA) is completed where necessary. Contact EHS for assistance if needed.
- Ensure controls identified in the DSA, JSA, and silica procedures are followed.
- Ensure that workers authorized to conduct any silica work receive appropriate training in silica procedures.
- Provide equipment, personal protective equipment (PPE), training or other resources as identified by the DSA, JSA, and silica procedures.
    - Train workers on safe work practices including the use of respiratory protection
    - Ensure equipment is maintained (e.g., including cleaning or replacing HEPA filters)
    - Implement thorough housekeeping procedures to control dust (wet methods, HEPA – filtered vacuuming)
- Ensure DSA, JSA and silica procedures are readily available to applicable workers.
- Ensure that contractors are notified of any designated substances that have been identified by the DSA.
- Ensure that contractors hired to perform any silica works are provided with a copy of this procedure and will comply with this procedure.

Workers

- Identify situations where silica procedures, a DSA, and a JSA are needed.
- Review applicable silica procedures and JSA prior to beginning the job.
- Follow safety procedures and use equipment and/or wear PPE as defined in the silica procedures and JSA.
- Report the absence of or defect in any equipment or protective device of which the worker is aware and which may endanger himself, herself or another worker.
- Participate in the development of the DSA and JSA if requested.
- Bring to the attention of their supervisor any new conditions that may negatively impact the process or lead to an unsafe work environment.
- Ensure hoarding and tarping in place, secured and small gaps are sealed, sticky mats located at the entrance of the construction site, if additional cleaning required, etc. If additional measures needed, notify your supervisor and work with the Project/Property Manager on improvements.

Property Managers/Project Managers

- Identify situations where silica procedures are required and the classification of any silica work. Consult with EHS as needed.
- Ensure that DSAs are conducted where necessary and readily available.
- Ensure that contractors are notified of any designated substances that have been identified by the DSA.
- Ensure that contractors hired to perform any silica works are provided with a copy of this procedure and will comply with this procedure.

University Staff and Students

- Be familiar with and work in compliance with the requirements of the Crystalline Silica Procedures as it applies to their work.
- Abide by all access control restrictions posted on areas where silica-related work is taking place.
- Report any suspected (potential) silica dust contamination in their work or study area to their supervisor or academic contact immediately.

External Contractors

- Comply with the requirements of the Crystalline Silica Procedures.
- Ensure that all employees under their directions are properly trained in the hazards of silica and control procedures prior to conducting any silica work.
- Ensure warning signs are posted in the appropriate locations.
- Ensure appropriate control measures are in place (hoarding and tarping, sticky mats located at entrance, etc.).
- Clean up the work area and equipment after each operation to prevent dust containing silica from spreading which may include high-efficiency particulate air (HEPA) vacuuming, damp wiping and general housekeeping.

3.0 General Controls for Silica Hazards

In order for silica to be a hazard, silica-containing dust particles must be small enough to be inhaled (i.e., respirable size). To control the silica hazard, there are three basic approaches:

- Prevent silica dust from getting into the workplace air,
- Remove silica dust present in the air, and
- If present, prevent workers from inhaling the dust.

To avoid inhalation of respirable silica in the air, the following preventative control measures need to be implemented:

A. Engineering controls
B. Work practices and hygiene practices
C. Respirators and PPE
D. Training

A: Engineering Controls

Engineering controls are methods of designing or modifying equipment, ventilation systems, and processes to minimize the amount of substance that gets into the workplace air.

Consider the following elements prior to conducting the task:

- Can the silica be substituted for a less hazardous substance?
  - Example: silica sand used in abrasive blasting may be replaced by metal shot and grit, alumina, garnet, etc. It is important that when choosing non- silica containing abrasives to avoid choosing abrasives that may introduce new health hazards to the workplace.
- Can the processes be controlled/ modified to remove the hazard?
  - Example: Use wet methods (spray/misting of water) to reduce dust, particularly in cutting, grinding, and drilling operations).
- Can enclosures and/or isolation of the emission source be conducted to contain the silica?
  - Example: Dusty operations can be isolated by carrying them out in areas that are physically separated from non-dusty areas and keeping workers not involved in the operation out of the area. Alternatively, if the isolation is not effective, the process can be sealed off from the rest of the workplace with an enclosure.
- Can ventilation be installed to remove the airborne silica?

    - Example: Local exhaust ventilation is the most effective use of ventilation to remove dust at its source.
- Can equipment/tools be modified to control the hazard?
    - Example: Some dust-generating tools are equipped with dust collection systems to prevent dust from spreading or becoming airborne.

B: Work Practices and Hygiene Practices

The following work practices and hygiene practices should be followed while conducting any on-the-job activities related to silica to reduce exposure potential from contaminated surfaces and work areas:

- As silica can accumulate on the hands, clothing and hair, workers should be able to wash and shower at the end of each shift where silica is being handled.
- No eating, smoking, drinking, or chewing in contaminated areas.
- Lunches should be stored in an uncontaminated area.
- Follow good house-keeping practices wherever silica dust is generated.
- Surfaces should be kept clean by washing down with water or vacuuming with a vacuum equipped with a HEPA filter.
- Do not use compressed air or dry sweep to clean up silica-containing dust.

C: Personal Protective Equipment (PPE)

Personal protective equipment (PPE) includes protective clothing and respirators.

Protective Clothing: The purpose of using protective clothing is meant to prevent contamination of regular clothing and the transportation of silica-containing materials from the workplace. Clothing that is contaminated with silica dust should therefore not be worn home without cleaning. Where protective clothing is required, refer to the University of Toronto Protective Clothing standard, available online at www.ehs.utoronto.ca.

Respiratory Protection: Engineering controls and workplace practices can minimize airborne silica dust. However, there are situations where concentration of silica cannot be lowered to below the occupational exposure limit and workers must use respirators. The careful selection, training, use, care, and maintenance of respirators must be considered where respiratory protection is required. Where respirators are required, refer to the University of Toronto Respirator Standard and the Respiratory Protection program, available online at www.ehs.utoronto.ca. As a reminder, all workers who are required to use a respirator must receive training and must be fit-tested every two years.

Appendix 1 outlines required respirators depending on types of operations that may generate airborne silica dust.

D: Training

Training is important component in preventing worker exposure to silica. Therefore, minimum training requirements for workers handling or who may be exposed to silica include:

- WHMIS training
- Silica training (Evaluating the Hazard and Controlling Exposure)
- Respiratory protection training
- Asbestos training (Modules 1, 2a, 2b) – see discussion on “Insulation” in Section 5.

Supervisors who have workers handling or may be exposure to silica will also require:

- WHMIS training
- JSA training
- Silica training (Evaluating the Hazard and Controlling Exposure)

- Respiratory protection training
- Asbestos training (Modules 1, 3) – see discussion on "Insulation" in Section 5.

Contact your supervisor/manager or EHS should you have any questions regarding the training required for working with silica and/or silica-containing materials.

4.0 Classification of Work

Classification of work will assist in determining the appropriate respirators, measures, and procedures that should be followed to protect the worker from silica exposure. The MOL's Guidelines for Silica provides examples of tasks which are considered Type 1, Type 2, and Type 3 operations. Note that the MOL document is geared towards construction activities, but some activities listed do occur during regular maintenance activities. Note: silica work classification is different from asbestos work classifications (Type 1, 2, 3).

Type 1 Operations

- Drilling of holes in concrete or rock that is not part of a tunneling operation or road construction.
- Milling of asphalt from concrete highway pavement
- Charging mixers and hoppers with silica sand or silica flour
- Any other operation at a project that requires the handling of silica-containing material in a way that may result in a worker being exposed to airborne silica.
- Entry into a dry mortar removal or abrasive blasting area while airborne dust is visible for less than 15 minutes for inspection and/or sampling.

Type 2 Operations

- Removal of silica containing refractory materials with a jackhammer.
- The drilling of holes in concrete or rock that is part of a tunnelling or road construction.
- The use of a power tool to cut, grind, or polish concrete, masonry, terrazzo, or refractory materials.
- The use of a power tool to remove silica containing materials.
- Tunneling (operation of the tunnel boring machine, tunnel drilling, tunnel mesh installation)
- Tuckpoint and surface grinding.
- Dry mortar removal with an electric or pneumatic cutting device.
- Dry method dust cleanup from abrasive blasting operations.
- Entry into area where abrasive blasting is being carried out for more than 15 minutes.

Type 3 Operations

- Abrasive blasting with an abrasive that contains ≥1 per cent silica.
- Abrasive blasting of a material that contains ≥ 1 per cent silica.

Insulation

In addition, silica has been detected in small concentrations in cementitious layers of insulation. Due to the similarity of work procedures for silica and asbestos and for clarity in execution, the following procedures are recommended:

- Asbestos-containing insulation: Follow procedures for working with asbestos, per the University's Asbestos Management Program. The controls for asbestos are even more stringent and will protect workers from exposure to any silica that may be present.
- Non-asbestos-containing insulation containing visibly cementitious materials:
    - For minor repairs, regular maintenance/repairs, and other day-to-day operations, follow procedures for working with asbestos materials, per the University's Asbestos Control Program.

- For major renovations, contact the Facilities Services' Hazardous Construction Materials group (St. George). The insulation can be tested to confirm the presence of silica and work procedures will be developed based on the sampling result, type, and scale of work

5.0 General Procedures for Working with Silica

The following are general measures and procedures for working with silica. Workers and supervisors should refer to the JSAs, department procedures, etc. for specific measures.

5.1 General Measures and Procedures for Type 1, Type 2, and Type 3 Operations

General measures and procedures for all work with silica:

- Workers who see damaged silica-containing materials or other hazards not identified in the DSA or JSA should report it to their supervisor immediately.
- Polyethylene drop sheets should be laid on applicable work areas to help capture debris.
- Mist silica-containing materials with water (i.e., wet it) before handling where feasible.
- After the work is complete, clean-up the work area and equipment after each operation to prevent dust containing silica from spreading. This can include HEPA vacuuming, damp wiping and general housekeeping. Do not use compressed air or dry sweeping to clean the work area.
- Silica dust on personal protective clothing (i.e., Tyvek coveralls) and equipment should be removed by damp wiping or HEPA vacuuming. Do not use compressed air to remove dust from clothing.
- Contaminated personal protective clothing and equipment should be handled with care to prevent disturbing the silica dust and the generation of airborne silica dust.
- Double bag any debris and waste that may have silica. Damp wipe outside of the bag.
- Provide access to washing facilities. Wash hands, face, etc. prior to eating, smoking, and drinking.

5.2 Preparation of the Work Area

Signage

Warning signs should be posted to warn of the hazard. If it is an indoor operation, signs should be posted at each entrance to the work area.

The signs (indoors or outdoors) should display the following information in large, clearly visible letters:

1. There is a silica dust hazard.
2. Access to the work area is restricted to authorized persons.
3. Respirators must be worn in the work area.

Caution Silica Dust Hazard Authorized personnel only. Respiratory protection required to enter work area.

The generation of airborne silica-containing dust should be controlled with a mechanical ventilation system, wetting, or the use of a dust collection system. However, if it is determined that none of these methods are practical, workers may be provided with respirators (see Appendix 1: Respirator Requirements) to protect them from exposure.

For Type 2 operations, ropes and barriers should be set up to prevent personnel from entering the work area. Personnel working within 10 m of type 2 work should wear respiratory protection (Appendix 1).

First Aid

Eye: Irrigate immediately. If this dust contacts the eyes, immediately wash (irrigate) the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention if any discomfort continues.

Breathing: Fresh air. If a person breathes large amounts of this dust, move the exposed person to fresh air at once. Other measures are usually unnecessary. Unless symptoms persist, then seek medical attention. Symptoms include cough, dyspnea (breathing difficulty), wheezing; decreased pulmonary function, progressive respiratory symptoms (silicosis); irritation eyes; [potential occupational carcinogen]

Report all incidents immediately by completing an accident/incident eForm for Employees or eForm for Students, Contractor and Visitors report at Report an Incident - Environmental Health & Safety.

6.0 Specific Procedures for Working with Silica

Specific measures and procedures will depend on how the work is classified and the results of the University of Toronto's DSA and JSA completed for each situation where silica is handled. Supervisors/management/Principle investigators should develop, document, and implement appropriate specific measures and precautions for silica work or in conjunction with EHS.

7.0 Communication

When DSA and JSA are completed and the results indicate that silica procedures are required, the results and procedures must be communicated to all workers who are, or who will be, performing the job. Supervisors should ensure that workers are following the appropriate control procedures, training, and appropriate communication or warning signs have been posted.

Appendix 1: Respiratory Requirements

Operations	Respirator Required
Type 1 (> 0.05 to 0.50 mg/m3 of silica in the form of cristobalite and tridymite) (> 0.10 to 1.0 mg/m3 of silica in the form of quartz and tripoli) • The drilling of holes in concrete or rock that is not part of a tunnelling operation or road construction. • Milling of asphalt from concrete highway pavement. • Charging mixers and hoppers with silica sand or silica flour. • Any other operation at a project that requires the handling of silica-containing material in a way that may result in a worker being exposed to airborne silica. • Entry into a dry mortar removal or abrasive blasting area while airborne dust is visible for less than 15 minutes for inspection and/or sampling. • Working within 25 metres of an area where compressed air is being used to remove silica-containing dust outdoors.	**NIOSH APF* = 10** Half-mask particulate respirator with N-, R-, or P-series filter and 95, 99 or 100 per cent efficiency.
Type 2 *(> 0.50 to 2.5 mg/m^3 of silica in the form of cristobalite and tridymite)* *(> 1.0 to 5.0 mg/m^3 of silica in the form of quartz and tripoli)* • Removal of silica containing refractory materials with a jackhammer. • The drilling of holes in concrete or rock that is part of a tunnelling operation or road construction. • The use of a power tool to cut, grind, or polish concrete, masonry, terrazzo or refractory materials. • The use of a power tool to remove silica-containing materials. • The use of a power tool indoors to chip or break and remove concrete, masonry, stone, terrazzo or refractory materials. • Tunnelling (operation of the tunnel boring machine, tunnel drilling, and tunnel mesh installation). • Tuck-pointing and surface grinding. Dry method dust clean-up from abrasive blasting operations. • Dry mortar removal with an electric or pneumatic cutting device. • The use of compressed air outdoors for removing silica dust. • Entry into area where abrasive blasting is being carried out for more than 15 minutes.	**NIOSH APF = 50** Full-face piece air-purifying respirator with any 100-series particulate filter. Tight-fitting powered air-purifying respirator with any 100-series particulate filter. Full-face piece supplied-air respirator operated in demand mode. Half-mask or full-face piece supplied air respirator operated in continuous-flow mode.
Type 3 *(> 2.5 mg/m3 of silica in the form of cristobalite and tridymite)* *(> 5.0 mg/m3 of silica in the form of quartz and tripoli)* • Abrasive blasting with an abrasive that contains ≥ 1 per cent silica • Abrasive blasting of a material that contains ≥ 1 per cent silica	**NIOSH APF ≥ 1000** Type CE abrasive-blast supplied air respirator operated in a positive-pressure mode with a tight-fitting half-mask face piece. Type CE abrasive-blast supplied air respirator operated in a pressure-demand or positive

	pressure mode with a tight-fitting full-face piece.

Adapted from the Ministry of Labour Guideline for silica on Construction Projects, November 2022

***NIOSH APF = National Institute of Occupational Safety and Health Assigned Protection Factor**

Note: It is recommended that compressed air that is used to supply supplied air respirators meet the breathing air purity requirements of CSA Standard Z180.1-00. Where oil-lubricated compressor is used to supply breathing air, a continuous carbon monoxide monitor/alarm should be provided.