Silica Exposure Control Plan

1.1 OBJECTIVES

Employers have a duty to protect their employees, students and the general public from silica exposure on projects. This duty extends to all personnel working on a project who may or may not be directly involved with any operations that work with Silica

For the purposes of this guideline, silica dust refers to crystalline silica in a respirable[1] form.

1.2 HAZARD IDENTIFICATION

Silica is the second most common mineral in the earth's crust and is a major component of sand, rock and mineral ores. The best known and most abundant type of crystalline silica is quartz.

The dust produced from cement and concrete finishing is referred to as crystalline silica. Silica exists in many forms of which crystalline silica is of the most concern. There are varying amounts of silica in cement, determined primarily by the type of aggregate used.

Exposure to crystalline silica can result in both respiratory and non-respiratory health effects. Of the respiratory effects, silicosis is one of the most documented occupational diseases. Silica is a designated substance[2] and, as such, there are precautions that the employer must take when there is a risk of silica exposure on a work site.

Throughout this ECP, silica dust will be used when referring to silica (crystalline, quartz).

1.3 SILICA IN MAINTAINENCE

In construction and maintenance, employee exposure to silica dust is of particular concern because silica is the primary component of many construction materials. Some commonly used construction materials containing silica include:

- abrasives used for blasting
- brick, refractory brick
- concrete, concrete block, cement, mortar
- granite, sandstone, quartzite, slate
- granite
- mineral deposits
- rock and stone
- sand, fill dirt, top soil
- asphalt containing rock or stone.

[1] "Respirable" means that size fraction of the airborne particulate deposited in the gas-exchange region of the respiratory tract and collected during air sampling with a particle size-selective device that,

(a) meets the American Conference of Governmental Industrial Hygienists (ACGIH) particle size-selective criteria, and

(b) has the cut point of 4 microns at 50 per cent collective efficiency.

[2] Designated Substance is one that is deemed to be carcinogenic by the ACGIH or IARC and is identified by either A1 or A2 (ACGIH), or 1, 2A or 2B (IARC)

Many maintenance activities can generate airborne silica-containing dust. In maintenance abrasive blasting generates the most dust. Other activities that generate airborne dust include:

- chipping, hammering, and drilling of rock
- crushing, loading, hauling, and dumping of rock
- sawing, hammering, drilling, grinding, and chipping of concrete or masonry structures
- demolition of concrete and masonry structures
- clean-up activities such as dry sweeping or pressurized air blowing of concrete, rock, or sand dust
- road construction
- sweeping, cleaning, and dismantling equipment
- hand mixing of concrete
- excavation and earth moving of soils with high silica content.

1.4 EXPOSURE LIMITS

The BC assigned exposure limit (ACGIH (TLV_TWA)) for crystalline silica (quartz) (2003) is 0.05 mg/m3 ([3R])[3]. Silica also contains an A2 designation (suspected human carcinogen) as listed by the IARC (International Agency for Research on Cancer).

Studies show that when maintenance work tasks such as those listed above, are conducted without using effective engineering controls, workers are exposed to airborne silica at levels well in excess of this exposure limit.

For designated substances such as crystalline silica, Section 5.57 of the OH&S regulation requires the employer to eliminate exposure where possible through methods such as substitution or process changes. If it is not practicable to do so, the employer must implement an Exposure Control Plan to maintain workers' exposure as low as reasonably achievable below the exposure limit. An Exposure Control Plan (ECP) describes the employer's strategy for minimizing worker exposure as low as reasonably achievable below the exposure limit and includes risk identification, assessment and control information from which the strategy is founded. Section 5.54 of the OH&S regulation outlines the required elements for the ECP.

It is known that if we protect workers from excessive exposure to silica dust we also protect them from excessive exposure to the total dust generated from the operation.

2 RESPONSIBILITIES

2.1 GENERAL

Due to the significant risk posed by respirable silica, it is imperative that all personnel involved in operations that could potentially create silica dust take specific action to ensure that, as much as possible, a hazard is not created for themselves, their co-workers or the general public.

[3] Respirable particle mass concentration

The release of respirable silica into the local environment in such quantities as to pose a significant hazard to unsuspecting employees or civilians, both at or near the workplace,

must be avoided. Specific notification measures are detailed in this document, but efforts should be made to limit exposure to anyone not able to adequately protect themselves.

Care must also be taken to ensure that silica is not introduced into the physical environment, such as storm drains, by using methods of dust control that capture rather than disperse the dust (vacuum instead of blow/sweep/rinse).

2.2 THE EMPLOYER IS RESPONSIBLE FOR:

1. Coordinating the work with the person in charge and other stakeholders to ensure a safe work environment. This includes notifying the Principal or Teacher in Charge (TIC) on site, either actual or potential, of the presence of crystalline silica on site and the safety requirements required while on site.
2. Providing a job-specific safe work procedure for each project to deal with the hazards and risks associated with concrete finishing operations
3. A periodic review of the effectiveness of the ECP, which may require air sampling of worker exposure levels to crystalline silica when there are significant changes in exposure conditions during non-standard work practices
4. Ensuring that personal protective equipment is readily available and used and mechanical ventilation equipment is provided and used where deemed necessary
5. Ensuring supervisors and employees are educated and trained to an acceptable level of competency
6. Maintaining records of training, fit-test results, crew talks, and inspections

2.3 THE SUPERVISOR IS RESPONSIBLE FOR:

1. Providing adequate instruction to workers on the hazards associated with cement or concrete finishing and on the precautions specified in the job-specific plan covering hazards at the location
2. Selecting and implementing the appropriate control measures
3. Ensuring that workers using respirators have been properly fit-tested and that the results are recorded. The fit-test and results recording is generally done by the designated person on site
4. Directing the work in a manner that ensures the risk to employees is minimized and adequately controlled
5. Liaising with the person in charge and other stakeholders to ensure a safe work environment

2.4 THE EMPLOYEE IS RESPONSIBLE FOR:

1. Using the assigned protective equipment in an effective and safe manner
2. Setting up the operation in accordance with the site-specific plan

3. Following established work procedures as directed by the supervisor
4. Ensuring that they are fit tested and that a fit evaluation is conducted routinely to ensure the mask is still fitting properly as prescribed by the manufacturer
5. Reporting any unsafe conditions or acts to the supervisor

3 RISK ASSESSMENT

3.1 A POTENTIALLY DANGEROUS HAZARD - SILICA

The prolonged inhalation of respirable dust containing crystalline silica may result in silicosis, a disease characterized by progressive scarring and damage to the lungs. A pneumoconiosis (lung disease caused by the inhalation of dust), silicosis is marked by shortness of breath and impaired lung function which may give rise to complications that can result in death. The development and the severity of silicosis depends on the airborne concentration of silica dust to which a worker is exposed and the duration of exposure.

The International Agency for Research on Cancer (IARC) has concluded that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans and has classified these forms of silica as Group 1 carcinogens. In addition, the American Conference of Governmental Industrial Hygienists (ACGIH) has classified quartz as a suspected human carcinogen with an A2 classification

Crystalline silica may be harmful following high exposure levels received over a period, ranging from a few weeks to years or after long-term exposures to lower levels. There is no medical treatment available for silicosis. There are three major types of silicosis: chronic, accelerated, and acute.

Workers who are continually exposed to environments where significant levels of Silica dust are being generated should take proactive measures by visiting their physician annually for a routine checkup and to discuss any abnormal symptoms that may be a result of exposure.

The worker has the responsibility and the obligation to be the first line of defense against the possible side effects of Silica dust.

3.2 SILICOSIS

3.2.1 CHRONIC SILICOSIS

Chronic silicosis is most common. Symptoms may not appear for a long time, usually more than 10 years, and may progress and worsen over a period of many years. Chronic silicosis may be either a simple or a complicated type.

The effects of silicosis can continue to develop even after the exposure ceases and they are irreversible. In addition, the progression of lung fibrosis can also lead to the development of lung cancer

3.2.2 ACCELERATED SILICOSIS

Accelerated silicosis is almost the same as chronic silicosis. However, it develops more quickly and the lung scars show up sooner. Accelerated silicosis can develop when exposure to large

amounts of silica dust occurs over a short time period. Nodules may appear on a chest x-ray five years after the first exposure to silica dust and the disease can quickly worsen.

3.2.3 ACUTE SILICOSIS

Acute silicosis is a lung disease that develops rapidly. As few as 8 to 18 months may elapse from the time of first exposure to the onset of symptoms, which include progressive shortness of breath, fever, cough and weight loss. There is a rapid progression of respiratory failure usually resulting in death within one or two years.

4 EXPOSURE CONTROL MEASURES

4.1 GENERAL

Studies show that when construction work tasks, such as those previously listed, are conducted without using effective exposure control measures, workers are exposed to airborne silica at levels well in excess of the exposure limit for silica. Studies show that work activities conducted both indoors and outdoors can result in excessive worker exposure to silica and so under both conditions control measures must be implemented.

In addition, public areas, either inside or outside the work zone, can become hazardous as a result of silica dust producing operations.

In order for silica to be a hazard, silica-containing dust particles that are small enough to be inhaled (IE: respirable) must get into the air. Respirable dust at the level of the exposure limit cannot be seen by the human eye and so an absence of visible dust does not indicate that exposure limits are not being exceeded. The strategy for controlling the silica hazard can be broken down into four basic approaches:

1. Eliminate the need to perform work which generates silica dust
2. Prevent silica dust from getting into the workplace air: control at the source
3. Dilute silica dust present in the air
4. Provide protection to workers to protect them from excessive exposure to silica dust.

Workers generating Silica dust must be aware of the potential risks associated with the hazard they are creating to those in the area they are working. Workers must ensure that all reasonable steps are taken to minimize the risk of exposure to co-workers and the general public.

4.2 TRAINING

Training is an important component in preventing worker exposure to silica. Each firm has an obligation to designate a person or persons who are responsible for conducting training with regards to silica. This person is responsible to ensure all topics relating to silica are covered off in sufficient detail to ensure there is a solid understanding of the hazards, risks and methods used to minimize the risk of silica dust.

Control methods, measures and procedures can only be as effective as the workers carrying them out. It is therefore essential for training to cover the following:

1. WHMIS training
2. the hazards of silica, including health effects and symptom recognition and reporting,
3. the recognition of typical operations producing silica
4. engineering controls
5. personal hygiene
6. respirator requirements
7. work measures and procedures
8. the use, care, maintenance, cleaning and disposal of personal respiratory protective equipment
9. care and consideration of others in and around the area they are working in

Instruction and training should be provided by a competent person. This could be the employer or someone hired by the employer. A competent person is defined as a person who:

1. is qualified because of his/her knowledge, training and experience to organize the work and its performance
2. is familiar with the provisions of the WorkSafe BC Act and the regulations that apply to the work; and
3. has knowledge of any potential health and safety hazards in the workplace

The health and safety representative or the representative of a joint health and safety committee should be advised about when and where the training and instruction is to be carried out.

4.3 CONTROL MEASURE HIERARCHY

To eliminate or reduce worker exposure to harmful silica dust it is essential to implement effective control measures. For example, local exhaust ventilation controls are intended to control concrete dust at it source while administrative controls may be selected to ensure that work activities are coordinated so that unprotected workers are instructed about the dusty work and restricted from entering these work locations. It will often be necessary to select a combination of control measures to effectively manage worker exposure.

Controls should be selected in accordance with the following hierarchy:

1. Elimination or replacement
2. Engineering controls
3. Administrative Controls
4. Respirators and Personal Protective Equipment

Safe work procedures are the means of disseminating the control measures to be used on a work site. It is necessary to review each site to ensure that the control measures) selected are suitable to reducing the hazard.

Medical Surveillance, although not a control measure, forms an integral part of the overall risk assessment and can be used to ensure the chosen control measures) are effective. Section 5 discusses the practical application of these measures.

Appendix A offers guidance on the selection of controls for various tasks associated with concrete finishing.

4.4 SELECTING CONTROL MEASURES

Selection of the control measure depends of the specifics of the operation. In some cases, LEV is more effective at controlling exposure (IE: during grinding operations) than wetting methods. In a different application wetting may be more effective (IE: during cutting operations) than LEV.

When determining the control measure that will be employed during concrete finishing operations use the control hierarchy as a guide to preferred methods. Elimination is more preferred than engineering controls and so on.

Always consider the work to be performed before selecting a control measure. It may be found that, for certain work locations, a particular control measure may not be suitable. In these types of situations, the choice of control measure must be selected with the requirement to minimize risk to workers involved in the task with attention given to the surrounding environment as much as is practical.

The use of water and large volume exhaust fans for silica dust control are methods that should be looked at in terms of the surrounding area and not just the work area. Efforts should be taken, as much as is practical, to ensure that by removing the hazard from one area another area will not become potentially hazardous or contaminated.

If a control measure is found to be not practical another method which produces similar risk reduction results must be employed with the goal of keeping the level of respirable silica below 0.05 mg/m3.

As much as is possible silica dust should not be allowed to circulate freely in areas where proper controls have not been implemented. All efforts must be made by the employer to ensure adequate controls are in place prior to work commencing.

4.5 ELIMINATION OR REPLACEMENT

When possible, avoid the need to perform work which generates silica dust. It may be that construction formwork methods which eliminate the need for cutting, grinding or drilling of concrete can be selected during the planning phase of the project. Removing larger chunks is another method to reduce the amount of silica dust produced.

One alternative is the use of surface applications which minimize or reduce the amount of concrete grinding or simply covering imperfections instead of removing them. Discussing this issue with the architect can result in safer alternatives.

4.6 ENGINEERING CONTROLS

These controls include those technologies or methods which control the dust at its source such as Local Exhaust Ventilation (LEV) and wetting methods. Dust controls are available for many types of dust generating equipment and if used properly, significantly reduce the

amount of silica dust released into the workplace. Engineering controls also include general dilution ventilation however for dust generating processes this method is not as effective as LEV and also clean-up becomes problematic. It may also be difficult to find a reliable source of water on a work site which suggests that LEV may be the only option available for dust control.

4.6.1 LOCAL EXHAUST VENTILATION (LEV)

General – Of all the dust-generating activities that may be present on a construction site, the highest exposure levels to silica are often associated with the preparation of concrete surfaces using a hand-held grinder. Furthermore, site observations and conversations with construction industry professionals indicate that the grinding of concrete surfaces is common to most commercial structures that use concrete as a building material. Therefore, a high priority needs to be placed on the development and widespread use of engineering controls for reducing silica exposures during surface grinding.

With respect to surface grinding, the use of LEV has been shown to reduce respirable dust exposures by up to 95% which indicates that for these type of work operations, local exhaust ventilation appears to be an effective method for reducing silica dust exposures.

one study confirmed that during concrete grinding that without the use of LEV respirable crystalline silica levels were a mean of 8.7 times the ACGIH TLV[4] of 0.05mg/m3. Other studies have measured airborne silica levels well in excess of this. Using LEV the average respirable crystalline silica levels were 1.14 times the ACGIH TLV.

The air flow of the mechanical ventilation system should be at least 50 cubic feet per minute per square foot of face area (0.25 m3/s per square meter of face area).

Below are some general points to consider when using LEV;

- Whenever possible, use vacuum attachment systems to capture and control the dust at its source. Dust controls are available for many types of dust generating equipment and if used properly, significantly reduce the amount of silica dust released into the workplace (See Appendix A)
- Always use the dust control system and keep it well maintained
- Specify the vacuum systems which are approved for use during concrete grinding as well as the exhaust capabilities of this equipment in your firms ECP for concrete grinding
- Specify the decision logic your firm will use to select dust control measures. Be specific about those circumstances during which your workers will not be able to employ engineering controls
- Operate grinding wheels at the manufacturers recommended rpm. Operating in excess of this can generate significantly higher airborne dust levels
- Retrofit shrouds or exhaust cowlings for corner grinding. Use low rpm speeds on a well-maintained vacuum with high cfm and water lift
- Consider diamond stones which allow for the use of a more efficient suction casing on the grinder which uses a brush design around the cutter

[4] Threshold Limit Value

- Use industrial purpose vacuum units which are designed to filter the fine silica dust and prevent it from being discharged.
- Consider vacuum units equipped with an automatic cleaning feature.
- Follow safe work procedures for the cleaning of vacuum filters.
- Consider the use of general ventilation in circumstances when local exhaust and wetting methods cannot be used to control the dust

Vacuums and Shrouds – Both vacuums and shrouds are both integral parts to the LEV system. The vacuum should be equipped with a means of connecting to the grinding shroud, a hose which is capable of carrying the silica dust from the grinding shroud to a receptacle and a HEPA[5] filter which will clean the air as it moves out of the vacuum.

Shrouds should cover the grinding wheel completely allowing for a seal between the working surface and the shroud. Figure 1 shows an example of a hand held grinder with a shroud and a vacuum connection for LEV.

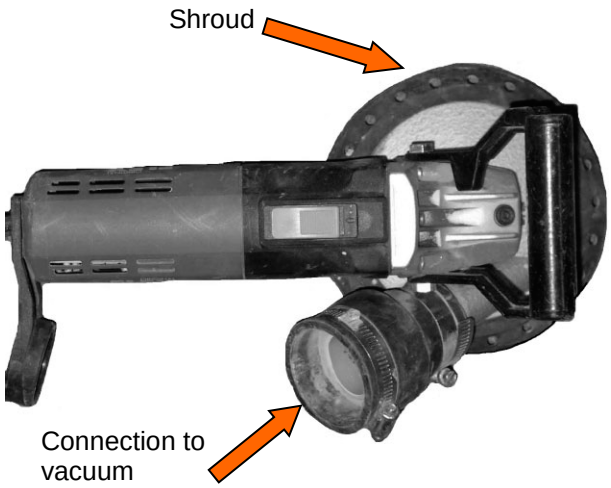

Figure 1 Hand held grinder, shroud and vacuum connection

For new vacuum equipment new to the market, they should be evaluated in a controlled area to ensure they will meet the minimum requirements of efficiency prior to being deployed to a job site. Such items to be aware of are reliability, ease of use and maintenance requirements as well as its ability to integrate with current grinding equipment.

4.6.2 WETTING METHODS

Like LEV control, wetting methods[6] will, if used in accordance with accepted work practices, significantly reduce dust levels. Along with LEV wet methods should be considered a priority control measure. For wetting, consideration should be taken to selecting appropriate equipment to apply the water. Care should be taken to ensure that the silica dust is not spread

[5] High Efficiency Particulate Arrestant.

[6] Water spray can effectively reduce exposure levels, but is not feasible in many applications because water can result in material discoloration and expansion, building damage and wastewater disposal problems. Use of water spray control also presents potential safety hazards, which include electrocution, slipping and potentially hypothermia.

over an area larger than required. Pressure and flow rate of water are important considerations.

If there is too much pressure silica dust will be dispersed over a wider area. Likewise if there is too much water flowing, the silica may be transported further than required thus making recovery more difficult.

Many of the tools used in concrete finishing can be fitted with wetting attachments. For example, specialized grinders are available which are equipped with a fitting allowing the

connection of a water supply. The flow of water can be regulated to suit the type of material being worked on. These grinders generally have smaller grinding surfaces for use in confined areas such as window casements. Figure 2 shows an example of a hand held wet grinder.

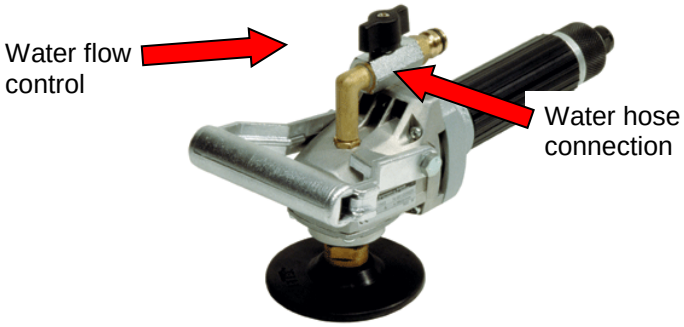

Figure 2 Hand held wet grinder

4.6.3 BARRIERS, ENCLOSURES AND ABATEMENT SYSTEMS

These control methods are used primarily to keep personal out of an area, as in the case of barriers, or contain the hazard to a certain area, as in the case of enclosures, or to remove silica dust from large areas, such as parkades, as in the case of abatement systems.

Barriers and partial enclosures are used to separate the work area from the rest of the project, and in some cases, to prevent silica exposure to other workers not directly involved in the operation. Partial enclosures can also prevent or reduce the dispersion of silica into the surrounding work area and environment. Barriers should only be used where partial enclosures are not practicable.

The use of full enclosures are not generally required for concrete finishing operations unless there is evidence suggesting that fugitive silica emissions would pose an unacceptable hazard to personnel not involved in the work which is generating the silica hazard or if there is a risk to civilians within proximity to the work site.

It should be noted that workers inside of enclosures have an increased exposure risk to silica. This method only limits exposure for workers outside of the enclosure

Ropes or barriers do not prevent the release of contaminated dust or other contaminants into the environment. However, they can be used to restrict access of workers who are not adequately protected with proper PPE, and prevent the entry of workers not directly involved in the operation.

Figure 3 Enclosure

Partial enclosures allow some level of emission to the atmosphere outside of the enclosure. Full enclosures are used to close off work areas where there is a high amount of silica dust being generated such as when finishing parkades. Both of these types of enclosures are locally produced, generally built out of readily available construction materials such as plastic sheeting or tarps. They may have an exhaust system in the form of fans or simply natural air flow if it is of sufficient force. Figure 3 shows an example of a manufactured system using floor to ceiling adjustable poles and sheet poly.

When it is important to fully isolate a work area during dust producing activity, abatement systems may be required. These systems are comprised of a sealed covering (air-lock) at each entrance to the work area, a pre-filter, a HEPA filter, a containment system and an exhaust system. Figure 4 shows and example of an abatement system.

The covering is usually fitted with a means of access/egress which may produce a negative pressure seal meaning that no air can escape when the covering is opened.

The exhaust system consists of a vacuum and a HEPA filter. There may be a fan at the opposite end of the system which creates a flow of air in the direction of the vacuum. An abatement system prevents any silica dust from moving into areas where there is little or not protection available to workers in those areas.

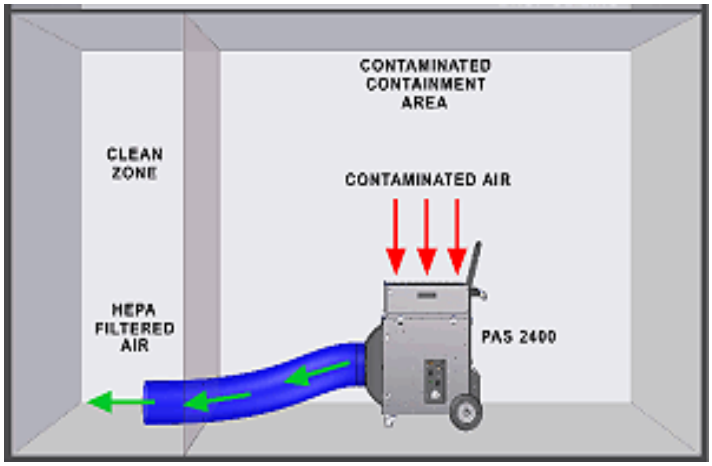

Figure 4 Abatement system

Filters are cleaned at regular intervals dependent on how much dust is being filtered by the system. Generally, once per day is sufficient but the system should be checked for effectiveness periodically during use.

Above all else, reduction of risk is the guiding principal for use of full enclosures. It is important to recognize that even with good air movement in the enclosure; workers will be exposed to high silica dust levels. Respirators must be selected after a determination of the effectiveness of the ventilation system at moving dust away from the worker and out of the enclosure. In most cases, a full-face respirator equipped with HEPA cartridges will be required. A PAPR or air supplied respirator may be required in some circumstances.

4.7 ADMINISTRATIVE CONTROLS

Work Planning & Practice controls are those activities that take place which are not directly involved with the work (e.g. concrete grinding) but are, never the less, potentially capable of impacting the overall exposure a worker may experience. Some of these activities are listed below.

4.7.1 WORK SCHEDULING, PLANNING & COORDINATION

In order for any control measures to be effective, workers must know and understand them and, most importantly, follow them.

1. Coordination amongst all involved parties
2. Provision of work scheduling which would have concrete grinding operations conducted at a time when there are minimal personnel on site
3. Work procedures specifically designed for the operation being conducted
4. Warning signs should be posted in sufficient numbers to warn of the silica hazard. There should be a sign, at least, at each entrance to the work area. The signs should display the following information in large, clearly visible letters:
    - There is a silica dust hazard
    - Access to the work area is restricted to authorized persons
    - If respirators must be worn in the work area (IE: window liner installers, window installers, plumbers working near cement finishing)

    Other points to consider are as follows;

    - Recognize when silica dust may be generated and plan ahead to eliminate or control the dust at the source. Awareness and planning are key to prevention of silicosis
    - Post warning signs to mark boundaries of work areas contaminated with silica dust
    - Wear disposable or washable protective clothes at the worksite
    - Ensure that training programs teach workers and supervisors how to properly use and maintain the tools and equipment so that they achieve maximum benefit from the controls
    - Whenever possible, plan work so that concrete grinding can be completed when the concrete is still wet. Dust release can be significantly reduced
    - Follow good housekeeping work practices. For example, use vacuums with high-efficiency particulate air (HEPA) filters, or use wet sweeping

4.7.2 PERSONAL HYGIENE

Hygiene practices are on-the-job activities that protect workers from breathing silica dust which is introduced into the air from contaminated surfaces and work clothing and equipment. Silica can also accumulate on the hands, clothing and hair. From there it can be disturbed, re-suspended in air and inhaled. It is therefore important to follow good work and hygiene practices whenever silica is present.

Workers should therefore be able to wash and shower at the end of each shift. As these facilities are likely not to be available on site it is important that effective controls are in place to limit significant contamination. There should be no smoking, eating, drinking or chewing in contaminated areas and lunches should be stored in an uncontaminated area.

It must be stressed to all workers that lunch and rest areas are off limits to anyone who is working either directly or indirectly in concrete finishing operations. Personal cleaning procedures as defined by company SOP must be completed prior to entering common areas. This also applies to public areas not directly associated with the work site.

If common areas are contained within the work zone (IE: a parkade) where cement finishing is taking place than enclosures must be erected to ensure that Silica dust does not enter these common areas.

4.7.3 SITE CLEAN-UP

Good housekeeping is important wherever silica dust is generated. Containers of silica-containing waste should be kept tightly covered to prevent dust from becoming airborne. Surfaces should be kept clean by washing down with water or vacuuming with a vacuum equipped with a high-efficiency particulate air (HEPA) filter. Where water is being used it is important to note the transient nature of liquids.

By using water, the hazard is potentially being shifted from one area to another. The goal with water use is to apply sufficient quantities to minimize the dust hazard but not so much as to create a flow of Silica away from the work area. If water is used the hose should be equipped with a spray nozzle which will allow the worker to control the flow easily. The wet Silica dust (Silica slurry) should be shoveled into coverable containers which, when full, can be stored in a designated area for later disposal.

Cleaning with compressed air or dry sweeping should be avoided. If dry sweeping cannot be avoided, use of Absorbal, or a similar product, will help to limit the degree that the silica dust becomes airborne. The following points should be considered regarding site clean-up;

- Clean-up after each operation should be done to prevent dust containing silica from spreading
- Compressed air or dry sweeping should be avoided when cleaning a work area
- Compressed air should not be used for removing dust from clothing
- Workers exposed to silica should be provided with or have access to washing facilities equipped with clean water, soap, and individual towels
- Silica dust on personal protective clothing and equipment should be removed by damp wiping or HEPA vacuuming
- Contaminated personal protective clothing and equipment should be handled with care to prevent disturbing the silica dust and the generation of airborne silica dust. Workers should be encouraged to launder work clothing after each shift of dusty work. Contaminated clothing should be bagged for safe transportation prior to leaving the work site.

4.7.4 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment includes protective clothing and respirators which have been designated for use in silica hazard areas. The purpose of protective clothing is to prevent the contamination of street clothing and the transport of silica-containing materials from the workplace. Clothing that is contaminated with silica dust should not therefore be worn home without cleaning.

Workers working directly or indirectly in areas where Silica dust is present should be supplied with coveralls or protective clothing (i.e. Tyvek suits) to be worn during their time in the hazardous area. These suits should be dealt with as detailed in section 4.6.3.

In most cases engineering controls and work practices cannot lower the concentration of silica to non-hazardous levels and workers must wear respirators for added protection. For example, concrete finishing respirators must be worn in all cases as control measures are not effective enough to control silica to less than 0.05mg/m3.

When respirators (RPE)[7]are required, a respirator program must be implemented. It must include written procedures for the selection, use, care and maintenance of personal respiratory protection equipment. Workers must be instructed and trained on the care and use of personal protective equipment before using it.

Some workers may have a medical condition that causes them to have difficulty breathing when wearing a respirator. Such workers should not be assigned to do work that requires a respirator if they have written medical proof of their condition.

4.7.5 Respirator Selection

Where respirators are provided, they should be appropriate in the circumstances for the type and the concentration of airborne silica. Respirators should be selected in accordance with the U.S. National Institute for Occupational Safety and Health (NIOSH) assigned protection factors (APF).

Table 1 in Appendix A describes the type of respirator required when working with silica. See Appendix B for a list of selection criteria for RPE.

4.7.6 Use, Care, and Maintenance of Respirators

The following general use, care, and maintenance procedures should be followed whenever respirators are required;

- respirators should be used and maintained in accordance with the manufacturer's specifications
- proper seal of respirators should be checked prior to each use
- storage of respirators should be in a convenient, clean and sanitary location and stored in a manner that does not subject them to damage or distortion
- respirators assigned for the exclusive use of one worker, should be cleaned, disinfected and inspected after each shift
- respirators used by more than one worker, should be cleaned, disinfected and inspected after each use
- any respirator parts that are damaged or that have deteriorated should be replaced before the respirator is used

[7] Respirator Protective Equipment

- workers are to be clean shaved in preparation for the use of respirators. Moustaches and side burns should be trimmed and beards are not recommended and, in fact, may not be allowed by some companies

For additional information on the use, care, and maintenance of respirators, please refer to CSA standard Z94.4-02.

Ideally respirators should be assigned for the exclusive use of one worker. But before a decision is made for a respirator to be shared by more than one worker, the following factors should be considered;

- the fit of the equipment
- the health and safety risk to the worker that would be caused by non-exclusive use of the equipment
- any undue economic hardship to the employer that would be caused by exclusive use of the equipment.

Respirators with a tight-fitting facepiece must be fitted to the worker in such a way that there is an effective seal between the equipment and the worker‘s face. Each worker must be fit-tested for each type of respirator to be worn.

4.8 SAFE WORK PROCEDURES

The development of Safe Work Procedures (SWP) is critical to the initial and continued safety of a task. SWP are the culmination of the ECP and must be developed in a way to ensure that all hazards and risks are identified and effective control measures are employed. Refer to Section 5.2 for more details.

4.9 MEDICAL SURVEILLANCE

Even with appropriate measures to control silica, some workers may still be affected. For this reason, periodic medical examinations are important for determining if the control measures in place are effective and if workers are suffering from any of the effects of silica exposure. This is known as medical surveillance, and can be considered to be a method of early detection and prevention of silicosis.

Medical surveillance can be used as both a preventive and remedial measure. By providing regular medical examinations and clinical tests on workers exposed to silica, early signs or symptoms of disease can be detected. The examining physician can then alert the worker, the employer and the joint health and safety committee to exposure problems in the workplace that might otherwise go unrecognized. This should ensure that remedial steps will be taken.

Workers working with silica on a regular basis should have pre-placement medical examinations that include chest X-rays and pulmonary function tests, followed by periodic medical examinations. The frequency of the periodic examination will depend on the intensity and length of exposure to silica and shall be decided by the examining physician. It need not be the same for all workers but shall be done at least once every two years. See Appendix C for further details.

Workers should be encouraged to report signs and symptoms which may be associated with excessive exposure to silica dust.

It should be noted that this program is not required by the OH&S Regulation; however, it is recommended that such a program be implemented by all employers making it a condition of employment. Employers could also pay for the required examinations of workers on an ongoing basis or as required.

5 SAFE WORK PROCEDURE

5.1 GENERAL

Protective measures and procedures must be implemented when conducting concrete grinding and other operations which generate silica dust. Specific measures and procedures will depend on factors such as the type and scope of work, work location, practicability of using engineering controls, proximity to occupied work locations. It is important to assess the work to be conducted in order to determine which control method(s) would be appropriate.

This should be done ideally before any work begins and a safe work procedure developed which describes the control methods to be used, lists the tools/equipment/materials

required for the job and provides direction to workers. The work procedure should include control measures for each task to be conducted.

5.2 DEVELOPMENT OF SAFE WORK PROCEDURES

It is important to note that this document, or any section in it, is not a Safe Work Procedure (SWP) but rather serves as a guide to developing safe work procedures. SWP are site and likely task specific.

Supervisors or designate for each employer whose work activity generate silica dust must complete a site specific work plan which includes written task specific work procedures which will be followed during the work. These SWP must have the following information as a minimum;

1. Responsibilities of the employer and employee
2. A plan for how the work will be executed.
3. Tools and Equipment required for the work
4. The step-by-step work procedure for each task including control measures
5. Personal Protective Equipment required

It is recommended that employers develop a risk assessment tool for this purpose. Safe work procedures can be developed for many of the routine tasks performed and customized as required during work planning.

5.3 WORK TASKS

Before a control measure is selected analysis of the tasks to be conducted should be done to ensure that the scope of work is defined and understood. The following list is not complete and is only meant to show tasks based on categories;

- Grinding
- Chipping
- Drilling
- Clean-up
- Mixing of concrete
- Other surfacing type operations which do not fall into one of the above categories

5.4 CONTROL MEASURES

5.4.1 HIERARCHY OF CONTROL

Controls methods serve to protect workers from harmful exposure to airborne contaminants. Refer to section 4.3 for details on the control hierarchy.

5.4.2 ASSESSING THE EFFECTIVENESS OF THE CONTROL MEASURE

Fortunately, much is known about the effectiveness of the engineering controls which are commercially available for concrete finishing. The 'silica control selection chart' in Appendix A was developed using published exposure information related to work with Silica.

Where employers choose to use non-conventional control methods, and information about their effectiveness is not known, Section 5.53 of the OH&S Regulation requires the employer to undertake air-sampling survey to ensure that the controls are effective. In the event that

measurement finds the threshold is exceeded than other control measures will have to be employed, implemented based on the hierarchy detailed in section 5.1.1 of the OH&S Regulation.

5.5 COMBINING PROTECTIVE MEASURES

Although LEV and wetting methods can be an effective control for reducing dust exposures during surface grinding, research studies show that by themselves they are not adequate to reduce worker exposure to safe levels. In some cases, both wetting and LEV may be appropriate. In most cases, administrative controls and PPE (including respirators) will be required to adequately protect workers. Due to the risk associated with silica dust, a thorough assessment of risk must be conducted and the applicable dust control measures must be employed prior to work commencing.

In most situations, there is a requirement to use PPE. As a minimum, respirators should be used by all persons directly involved in concrete finishing operations. Other PPE can be added as part of the control measure as required, always with the intention of reducing risk.

Appendix A offers guidance on the selection of controls for various tasks associated with concrete finishing.

5.6 DISPOSAL OF SILICA DUST

Silica dust should be collected at the end of each work day and disposed of in the onsite garbage receptacles which have been designated specifically for Silica dust. Care should be taken to ensure that the silica dust collected by LEV, wetting or other methods such as abatement systems is handled in a way so as to ensure it is not dispersed during collection.

Containers used to hold waste Silica dust should be of sufficient strength to ensure that they are not easily punctured. It is imperative that the hazard of Silica dust not be passed on to other persons who are likely involved in the disposal process such as dumpster truck drivers or workers in transfer stations or landfills.

If possible effort should be made to communicate the hazard of Silica dust to the various agencies involved in waste management to determine if they have specific protocols for dealing with Silica dust generated from concrete finishing operations. Education and communication are key to minimizing the risk associated with Silica dust and it should be noted that the requirement for education and communication does not necessarily end at the boundary of the work site.

Regardless of protocols or procedures that may be in place for the disposal of Silica dust, workers should be discouraged from simply dumping the Silica dust into garbage receptacles that are also used by other workers on site. This practice will result in exposure to personal that may not be aware of the associated risks. It is imperative that workers involved in concrete finishing operations realize that their responsibilities also include protection of their fellow workers from the hazards of Silica dust by preventing inadvertent exposure to those unprotected and likely unsuspecting workers.

APPENDIX A

SILICA CONTROL SELECTION CHART

The table below describes the applicable control measure to be taken for specific tasks relating to concrete finishing. The first column describes a task and the type of control (administrative, engineering) that is being used. The second column describes the control and the third column provides notes and the type of respirator that may be required while a worker is engaged in that task.

Task/Tool	Control Method	Notes (including respirator selection)
Grinding concrete surfaces such as walls or ceilings	LEV Barriers	▪ Local Exhaust Ventilation (LEV) attachments for concrete grinders are readily available for walls and floor grinders. Ensure the use of a properly sized HEPA vacuum system to achieve desired capture/control, to maintain adequate transport velocity and avoid settling and to minimize the duration between filter maintenance. ▪ Workers must wear half-mask filtering respirator equipped with N-, R, or P- series filter and 100% efficiency. ▪ Full-face filtering respirator equipped with N-, R, or P- series filter and 100% efficiency may be required when working in an enclosure.
Grinding concrete surfaces such as window casements	Wetting Barriers	▪ LEV equipped grinder is not usable due to space constraints ▪ Wet methods can be as effective as LEV when applied properly but can produce a slipping hazard. ▪ Water flow and RPM of grinder adjusted correctly for material being worked on

Task/Tool	Control Method	Notes (including respirator selection)
		▪ Workers must wear half-mask or full face-piece filtering respirator equipped with N-, R, or P- series filter and 100% efficiency.
Grinding concrete surfaces such as stairwells or elevator shafts when work involves stairs, angles, bevels.	LEV Abatement System[8][9][10] Barriers	▪ Local Exhaust Ventilation (LEV) attachments for concrete grinders are readily available although tend not to be effective when grinding surfaces which are not flat. ▪ Barrier or Enclosure systems may be required to restrict access to work area and/or restrict access to unprotected workers. Exhaust from abatement/enclosure system must be sufficient to create enough air flow to remove silica dust hazard ▪ Full-face filtering respirator equipped with N-, R, or P- series filter and 100% efficiency may be appropriate if effective mechanical ventilation is established. ▪ Full-facepiece supplied-air respirator operated in demand mode or half-mask or full-facepiece supplied air respirator operated in continuous-flow mode will be required when extensive grinding in enclosed locations (IE: parkade, stairwell) and effective general ventilation cannot be established.

[8] Ensure system is rated for the overall area size it will be employed in. The area should be measured in cubic feet or meters. Additional fans and vacuums may be required to ensure that the required air flow is attained.
[9] HEPA filters should be checked routinely throughout the work shift to ensure they are not clogged with silica dust. Filters should be cleaned daily or more often as required.
[10] Silica dust collected in containment unit should be placed in plastic garbage bags and disposed of in the onsite garbage bin.

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Task/Tool	Control Method	Notes (including respirator selection)
Grinding concrete surfaces such as parkade walls or floors	LEV Systems Enclosure/Abatement System Barriers General Mechanical Ventilation	▪ LEV available and effective for wall and floor grinders. ▪ Portable Shot Blaster available for floor grinding which is equipped with dust control. ▪ If enclosure/abatement system used mechanical ventilation must be sufficient to create enough air flow to remove silica dust hazard. ▪ Workers must wear half-mask or full-face-piece filtering respirator equipped with N-, R, or P- series filter and 100% efficiency when effective LEV or wetting methods used.
Grinding Concrete Surfaces (DRY)	Implement administrative and PPE controls to manage/limit worker exposure/ contamination	• Dry grinding when engineering controls cannot be used or are not practical • Full-face filtering respirator equipped with N-, R, or P- series filter with 100% efficiency may be required when working in outdoor locations or other locations with good general ventilation. • Full-facepiece supplied-air respirator operated in demand mode or half-mask or full-facepiece supplied air respirator operated in continuous-flow mode when extensive grinding in enclosed locations (e.g. parkade, stairwell) with poor general ventilation and LEV not effective.
Chip Hammering or Drilling	Wet methods may need to be supplemented with a	• Workers must wear half-mask or full-face-piece filtering respirator equipped with N-, R, or P- series

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Task/Tool	Control Method	Notes (including respirator selection)
Concrete or Cement	barrier or enclosure system when work is extensive and large amounts of material will be removed.	filter and 100% efficiency when effective LEV or wetting methods used. • Full enclosure may be required when large area and/or volume of concrete to be removed. ▪ Barriers or partial enclosure may be permitted when work activity is of limited duration and coordination can arranged to ensure that unprotected workers are well removed from the active work area. ▪ Full-facepiece supplied-air respirator operated in demand mode or half-mask or full-facepiece supplied air respirator operated in continuous-flow mode when extensive drilling or chip hammering in enclosed locations (IE: parkade, stairwell) with poor general ventilation and LEV/wet methods not effective.
Jack hammering to break out concrete (open indoor areas)	Wetting concrete and rubble Barriers to restrict access to work area EV Full enclosure if large area adjacent to occupied areas and unable to adequately wet material.	▪ Workers must wear full-face filtering respirator equipped with N-, R, or P-series filter and 100% efficiency when effective wetting methods are used.
Cutting concrete wall/floor	Saw equipped with wetting controls (a water flow rate of 0.5 gallons/minute is	▪ Workers must wear half-mask or full-face filtering respirator equipped with N-, R, or P- series filter and

Task/Tool	Control Method	Notes (including respirator selection)
	recommended minimum). Other means of effective wetting of material during work Barrier/Enclosure systems is work is extensive in occupied worksite.	100% efficiency when effective wetting methods are used. ▪ Full-facepiece supplied-air respirator operated in demand mode or half-mask or full-facepiece supplied air respirator operated in continuous-flow mode may be required when cutting in enclosed locations (IE: parkade, stairwell) with poor general ventilation and the work is extensive and wetting controls cannot be established.
Brick mortar restoration, handheld grinders and routers (mortar rake)	Wetting or LEV Methods Barriers A mortar rake removes larger chunks and procedures less respirable dust than a grinder.	▪ Vacuum attachments methods need to be used in accordance with established work procedures. One study suggests that ventilating the enclosing shroud at a rate of 20-25 cfm per inch of wheel or blade diameter is required to minimize dust generation. The shroud needs to be maintained flush with the wall. ▪ Workers must wear half-mask or full-face filtering respirator equipped with N-, R, or P- series filter and 100% efficiency when effective LEV or wetting methods are used. ▪ Tight-fitting powered air-purifying respirator with a high-efficiency filter when in outdoor locations and effective general ventilation available. ▪ Full-facepiece supplied-air respirator operated in demand mode or half-mask or full-facepiece supplied air respirator operated in continuous-flow mode may be required when extensive grinding in enclosed locations with poor general

Task/Tool	Control Method	Notes (including respirator selection)
		ventilation and LEV and wetting controls cannot be established.
Brick mortar restoration, handheld angle grinder	Wetting or LEV Methods. Barriers	▪ Recommended at least 20-25 cfm per inch of grinder wheel when used to remove mortar from between bricks. ▪ Electric shock hazard when using wet methods needs to be assessed and controlled. Pneumatic grinders may be a viable option. ▪ Workers must wear half-mask or full-face filtering respirator equipped with N-, R, or P- series filter and 100% efficiency when effective LEV or wetting methods are used. ▪ Full-facepiece supplied-air respirator operated in demand mode or half-mask or full-facepiece supplied air respirator operated in continuous-flow mode may be required when extensive grinding in enclosed locations with poor general ventilation and LEV and wetting controls cannot be established.
Clean-up Vacuum bag/filter changing Maintenance of LEV	Vacuum or wetting General ventilation Barriers (e.g. Stairwell during clean-up activity)	▪ Workers must wear half-mask or full-facepiece filtering respirator equipped with N-, R, or P- series filter and 100% efficiency. ▪ A safe work procedure should be available to provide direction for these tasks.

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