Practices Found to be Useful in Controlling Employee Exposures to Respirable Crystalline Silica While Performing Construction Work

Developed by the

Construction Industry Silica Task Force

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Concrete Sawing and Drilling Association
American Subcontractors Association
Associated Builders and Contractors

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ACKNOWLEDGEMENTS

This document is based on existing research and recommended practices from the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA) and other organizations recognized for their knowledge about minimizing employee exposures to airborne respirable crystalline silica while performing construction work. The Construction Industry Silica Task Force is an ad hoc industry group organized for purposes of exploring practical and cost effective alternatives to a draft proposed standard put forth by OSHA to regulate workplace exposures to crystalline silica.

The Task Force thanks the following individuals for their participation in the development of this document:

The Task Force also worked in cooperation with OSHA and NIOSH to develop these alternatives and we gratefully acknowledge the assistance of former Assistant Secretary John Henshaw, and NIOSH Director John Howard in this effort.

FOREWORD

Construction companies and their trade associations have a sincere concern for the well being of their employees and all other individuals affected by their work activities. To the extent that construction work results in exposure to respirable crystalline silica at levels that present a significant risk of harm, construction companies and their trade associations are committed to identifying and implementing appropriate corrective measures.

Although the exposure levels at which the health risks from crystalline silica become significant remain uncertain, there is general agreement on the need for measures that would assist the industry in consistently complying with the current permissible exposure limit (PEL) established by OSHA. This document represents the efforts of construction trade associations to recommend measures that have been used by construction companies across the country to control exposures to crystalline silica in a practical and cost-effective manner.

This document is the product of an extensive review of engineering controls and work practices for controlling exposures to crystalline silica in the construction industry. In preparing this document, the Task Force identified 24 of the most commonly performed tasks in the construction industry that, depending on how they are performed, have the potential for generating airborne exposures in excess of OSHA's PEL. The Task Force then developed recommendations for the use of various engineering controls, work practices and personal protective equipment (PPE) during the performance of the 24 specific tasks. Based on a body of limited but growing field data, we believe the recommended measures represent a practical and effective means of achieving compliance with the OSHA PEL and, in some

cases, reducing exposures well below the OSHA PEL. However, there remains a significant amount of scientific uncertainty about the relative risks of health effects associated with exposure to crystalline silica and the kinds of work that present those risks. Thus the work herein is a work in progress and the efficacy of the control measures needs to be further evaluated and validated. We will, therefore, continue to perform sampling using these recommended measures and work with the product and equipment manufacturers to design and develop new methods to limit exposure to crystalline silica while performing construction work.

Control measures are generally thought to be more effective when the individuals responsible for their implementation understand the nature of the risk, how it is controlled by the selected control measures, and whether the selected control measures are being used as intended. Accordingly, the Task Force developed training recommendations and encourages all contractors to review the effectiveness of their silica construction safety education programs to ensure they adequately address these issues. In communicating the nature of the risk, the Task Force believes workers should be reminded of the significant adverse impact of smoking tobacco products.

The Construction Industry Silica Task Force is confident that these recommendations will significantly reduce workplace exposure to crystalline silica and significantly improve workplace safety. We look forward to working with OSHA, NIOSH and others in the industry to achieve that goal.

I. SCOPE AND APPLICATION

This document applies to all workplaces that engage in the following construction operations: Cutting, sanding, drilling, crushing, grinding, milling, sawing, scabbling, scraping, mixing, jack-hammering, or excavating materials that contain crystalline silica. Such materials include, but are not limited to, concrete, brick, block, mortar, rock, and soils.

II. PERMISSIBLE EXPOSURE LIMIT (PEL)

Construction employers are required to ensure that no employee is exposed to an airborne concentration of respirable crystalline silica (e.g., quartz, tridymite, cristobalite) greater than the OSHA permissible exposure limit (PEL).

The most common form of crystalline silica found in the workplace is quartz. The current OSHA PEL for workplace exposure to quartz in construction is approximately 100 micrograms (0.1 milligrams) of crystalline silica per cubic meter (ug/m3) on an 8-hour time weighted average (TWA). The actual PEL is for the airborne concentration of the respirable dust containing quartz is established by the following formula found in the Mineral Dust Table in 29 C.F.R. 1926.55:

$$\frac{250 \text{ mppcf}}{\%SiO_2+5} \quad \text{OR} \quad \frac{10 \text{ mg/m}^3}{\%SiO_2+2}$$

where mppcf stands for millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques. The term "$\%SiO_2$"represents the percentage of quartz determined from airborne samples, except in those instances in which other methods have been shown to be applicable.

If an employee is exposed to quartz for more than 8 hours in a work day, the employee's allowable exposure, as a time weighted average (TWA) for that day, must be limited so that the total daily exposure does not exceed the equivalent of the 8-hour TWA established by the formula.

III. METHODS OF COMPLIANCE

(1) **Compliance hierarchy.** (i) Construction employers are required to implement engineering controls and work practices to reduce and maintain employee exposures to or below the PEL. (ii) When feasible engineering controls and work practices are not sufficient to reduce employee exposure to or below the PEL, the employer must supplement them with the use of respiratory protection in accordance with the requirements of OSHA's Respiratory Protection Standard, 29 CFR 1926.103.

(2) **Engineering Controls**

The use of properly designed engineering controls is generally thought to be the most reliable approach for controlling dust from crystalline silica-containing materials. The contractor should review the project to determine which, if any, engineering controls are technologically feasible for each project.

The following are some of the engineering controls that can be used to control dust generation from work with masonry and concrete materials:

- Work with architects, engineers and manufacturers to reduce the amount of cutting
- Natural ventilation
- Local exhaust systems
- Shrouds, HEPA filters, fans, ventilation systems and other specialty equipment that can be used to suppress dust (such as cabs, enclosures or isolation systems)
- Dust suppression systems
- Dust collection systems
- Wet systems or methods

(3) **Work Practices or Administrative Controls**

The following are some of the work practices that can be used to control dust generation from work with masonry and concrete materials:

- A comprehensive hazard communication program, incorporating a silica-based training program with appropriate emphasis on silica hazards, silica-specific control measures, and compliance with instructions accompanying manufacturers' materials and equipment

- Positioning the worker upwind of the work
- Job rotation and creative scheduling
- The employee must follow good personal hygiene and housekeeping practices, which include:
  - Not smoking tobacco products; use of tobacco products has been shown to increase the risk of illness from exposure to airborne crystalline silica.
  - Avoiding, to the extent practical, activities that would contribute significantly to an employee's exposure to airborne respirable crystalline silica.
  - Prohibiting the use of compressed air to clean up respirable crystalline silica dust.

(4) Personal Protective Equipment (PPE) – General

If the contractor/employer determines that engineering controls and administrative controls will not adequately protect the workers, personal protective equipment (PPE) must be used. The need for PPE should be evaluated for each work classification relative to an assessment of the site hazards.

(5) Implementation and Employee Compliance

To have an effective exposure control program for crystalline silica, employers must i) establish work rules designed to ensure compliance with the applicable requirements; ii) adequately communicate those work rules to its employees; and iii) take effective actions to enforce the rules when violations are discovered.

IV. GENERIC TASK-BASED GUIDANCE FOR SPECIFIC COMMONLY PERFORMED TASKS

This section provides suggestions for engineering controls, work practices and personal protective equipment found to be effective in eliminating or controlling employee exposures to respirable crystalline silica while performing common

construction tasks. Based on a body of limited but growing field data, we believe the recommended measures represent a practical and effective means of achieving compliance with the OSHA PEL and, in some cases, reducing exposures well below the OSHA PEL. However, we know that there is more work to be done to evaluate and further validate these measures and control workplace exposures to crystalline silica. The column for recommended work practices is limited to those work practices viewed as unique to the task or operation and does not repeat those work practices that are generally viewed as uniformly applicable to virtually all tasks, such as: appropriate training, implementing an effective Hazard Communication Program, etc.

A. Abrasive Blasting

OSHA has already established standards for abrasive blasting work requiring ventilation (29 C.F.R. 1926.57) and respiratory protection (29 C.F.R. 1926.103). In the case of abrasive blasting operations, it is recommended that the employer provide a Type CE, pressure demand or positive-pressure, abrasive blasting respirator (APF of 1000 or 2000). Other engineering controls which may limit exposure are:

- Using alternative materials.
- Wet suppression systems
- Exhaust ventilation

B. Cutting Clay Masonry Units (brick) – The following controls apply to employees cutting clay masonry units during a full work shift and does not apply to occasional cutting limited to 90 minutes total time[1]

Operation/Task	Control Measures	Respiratory Protection
Cutting clay masonry units – (Using stationary or portable saws)	Wet Method: Continuously apply stream or spray at the cutting point.	Not Required [2]
	OR Dry Method: Enclose saw within a ventilated enclosure operated with a minimum face velocity of 250 feet-per-minute. Saw blade must be contained entirely within the booth and exhaust must be directed away from other workers or fed to a dust collector with a HEPA filtration system.	100 series filtering face piece (disposable dust mask) or ½ Face respirator with 100 series filters

Additional control measures for consideration: Ventilation (natural and mechanical), dust collection methods, architectural design, use special-shaped products, job rotation, and demarcation of specific cutting areas.

[1] MCAGC
[2] 152.

C. Cutting concrete masonry units (CMU) - The following controls apply to employees cutting concrete masonry units during a full work shift and does not apply to occasional cutting limited to 90 minutes total time[3]

Operation/Task	Control Measures	Respiratory Protection
Cutting CMU – (Using stationary or portable saws)	Wet Method: Continuously apply stream or spray at the cutting point.	Not Required [4]
	OR Dry Method: Enclose saw within a ventilated enclosure operated with a minimum face velocity of 250 feet-per-minute. Saw blade must be contained entirely within the booth and exhaust must be directed away from other workers or fed to a dust collector with a HEPA filtration system.	100 series disposable respirators or ½ Face respirator with 100 series filters

Additional control measures for consideration: Ventilation (natural and mechanical), dust collection methods, architectural design, use special-shaped products, job rotation, and demarcation of specific cutting areas

[3] MCAGC
[4] (134& 136), (160), (174) and (179)

D. Cutting Stone- The following controls apply to employees cutting stone during a full work shift and does not apply to occasional cutting limited to 90 minutes total time[5]

Operation/Task	Control Measures	Respiratory Protection
Cutting Stone (Pre-cast and Natural) (Using stationary or portable saws)	Wet Method: Continuously apply stream or spray at the cutting point.	Not Required [6]
	OR Dry Method: Enclose saw within a ventilated enclosure operated with a minimum face velocity of 250 feet-per-minute. Saw blade must be contained entirely within the booth and exhaust must be directed away from other workers or fed to a dust collector with a HEPA filtration system.	100 series disposable respirators or ½ Face respirator with 100 series filters

Additional control measures for consideration: Ventilation (natural and mechanical), dust collection methods, architectural design, use special-shaped products, job rotation, and demarcation of specific cutting areas

[5] MCAGC
[6] (155)

E. Mixing Concrete, Grout and Mortar

Operation/Task	Control Measures	Respiratory Protection
Mixing Concrete, Grout or Mortar	Natural ventilation and demarcation of mixing areas	Not Required [7]

F. Tuck Pointing

Operation/Task	Control Measures	Respiratory Protection
Tuck Pointing	The following control measures may be useful in reducing exposure levels but will not be adequate to reliably reduce exposures below the PEL. Ventilation Natural Mechanical Dust collection/vacuum Shroud Gauge / Guide for Equipment Wet methods	These types of respiratory protection will be necessary to provide adequate protection in the absence of the previous control methods. Full face respirator with 100 series filter or Supplied air respirator

[7] (127), (137 & 145), (151), (156), (158), (172 & 173), (175), (178 & 180) and (182-189).

G. Concrete Cutting

Operation/Task	Control Measures	Respiratory Protection
Outdoor Slab Sawing	Use water-fed system that delivers water continuously at the cut point with natural ventilation OR Early entry sawing	Not Required [8]
Indoor Slab Sawing	Use water-fed system that delivers water continuously at the cut point with natural ventilation.	100 series filtering face piece respirator [9]
	Or Mechanical ventilation (fans).	100 series filtering face piece respirator
	Or Early entry sawing.	100 series filtering face piece respirator
Outdoor Wire Sawing w/ remote *Indoor Wire Sawing* *Outdoor Wire Sawing w/o remote*	Use water-fed system that delivers water continuously on wire, operated via remote control with natural ventilation.	Not Required [10]
Outdoor Wall Sawing	Use water-fed system that delivers water continuously on blade with natural ventilation. OR Remote Control	Not Required [11]
Indoor Wall Sawing--	Use water-fed system that delivers water continuously on blade, operated via remote control with natural ventilation.	100 series filtering face piece respirator

[8] (78) and (190-192)
[9] (77) and (171)
[10] (114, 115, 116, & 117)
[11] (34 & 146)

Outdoor Hand Sawing	Use water-fed system that delivers water continuously on blade with natural ventilation.	Not Required [12]
	OR Use vacuum system at point of operation with natural ventilation.	Not Required [13]
Indoor Hand Sawing	Use water-fed system that delivers water continuously on blade with natural ventilation.	100 series filtering face piece respirator

H. Core Drilling

Operation/Task	Control Measures	Respiration Protection
Core Drilling	Use water-fed system that delivers water continuously at the cut point with natural ventilation	Not Required [14]
	OR Dry Method: Use vacuum system at point of operation with natural ventilation.	None OR 100 series filtering face piece respirators [a]
Hand Held tools with core drilling bits	Use water-fed system that delivers water continuously at the cut point with natural ventilation	None OR 100 series filtering face piece respirators [a]
	OR Use vacuum system at point of operation with natural ventilation.	None OR 100 series filtering face piece respirators [a]

I. Selective Surface Grinding

Operation/Task	Control Measures	Respiratory Protection
Selective Surface Grinding	Use water-fed system that delivers water continuously at the cut point with natural ventilation	100 series filtering face piece respirators [a]

[a] If supported by data.
[12] 1998 BOHS Conference, London Final Published 3/10/99 (84-87 & 97-100)
[13] 1998 BOHS Conference, London Final Published 3/10/99 (88,89, 95 &96)
[14] Id 8

	OR Use vacuum system at point of operation with natural ventilation.	Not Required [15]

[15] AOEH Vol 17(7) Pg. 457-461 (218)

J. Selective Demolition

Operation/Task	Control Measures	Respiratory Protection
Concrete Breaking Hydraulic hammer Or hydraulic breaker	Use natural ventilation	Not Required [16]
Jackhammer	Use natural ventilation	100 series filtering face piece respirators
Indoor demolition robot with hammer	Use dust suppression system and remote control.	Half- faced respirator with dual cartridge -- 100 Series
Outside demolition with hammer	Use dust suppression system, remote control, natural ventilation	Not Required
Equipment with hammer	Use natural ventilation	Not Required
Load and haul, mechanical devices	Use natural ventilation, and enclosed cab when feasible.	Not Required [17]

[16] (79)
[17] 233-122C NIOSH (101 & 105) and (106,108 & 149)

V. DETERMINING THE APPROPRIATE CONTROL MEASURES

A silica exposure assessment should include the following elements:

- A list of tasks the employees will perform, which may result in employee exposure to respirable crystalline silica
- A list of engineering and administrative controls and necessary respiratory protection equipment used by the employer to reduce exposures for each task identified
- A determination that the measures used by the employer are adequate

Given the dynamic nature of a construction site, it is generally recognized that obtaining timely and representative site-specific exposure monitoring for the tasks being performed is often impractical if not infeasible. Generally, the results of exposure monitoring would not be available until after operations involving the monitored exposure have been completed. Therefore, the employer would not be in a position to make use of the monitoring results to determine appropriate control measures for that task. In other cases, the workplace conditions in construction worksites vary to such a great extent that it would be difficult to accurately characterize employee exposure from one day to the next. For example, an employee may work: outdoors on a dry, windy day on day one; outdoors on a calm, humid day on day two; and in an enclosed environment on day three. Personal monitoring for crystalline exposure on a given day is not likely to accurately reflect these changing conditions.

Despite these challenges, the employer needs to have an objective basis for concluding that the control measures it is using are adequate to limit workplace exposures to respirable crystalline silica from exceeding the PEL though a combination of historical data (obtained by the employer through its prior work, or obtained from NIOSH, OSHA, the state consultation service, another government agency or industry association), objective data (from a manufacturer or a published scientific study), or site-specific employee exposure monitoring.

NOTE: If certain tasks are of very limited duration, such as a few cuts of brick or block or using a hammer to drill anchor holes, exposure assessments should not be necessary. However, appropriate engineering and administrative controls are recommended, where appropriate, to protect workers and ensure compliance with the PEL.

When exposure monitoring is performed, the employer should ensure that all samples are: 1) collected in accordance with the procedures specified in sampling methods for respirable crystalline silica published by OSHA and/or NIOSH; and 2) analyzed by a certified/ compliant laboratory (see DEFINITIONS Section) in accordance with the protocol for respirable crystalline silica published by OSHA and/or NIOSH.

It is also recommended that when testing is performed, the NIOSH-approved protocol In Appendix A be applied.

VI. RESPIRATORY PROTECTION

Respiratory protection for airborne crystalline silica will normally require the use of particulate air filters, specifically NIOSH Series-100 filters. This type of filter can be found with either elastomeric respirators with canister shapes filters or filtering face piece respirators (disposable respirators). Whether respiratory protection is required or voluntary, the OSHA Respiratory Protection Standard, 29 C.F.R. 1926.103 applies to both types of respirators.

A. Required Use

OSHA does not require an employer to provide or require the use of respirators when employee exposures to crystalline silica do not exceed the PEL. Where engineering controls and work practices are inadequate to prevent workplace exposures to airborne crystalline silica from exceeding the PEL, respiratory protection is required in accordance with OSHA's Respiratory Protection Standard, 29 C.F.R. 1926.103, which incorporates 29 C.F.R. 1910.134

by reference. This includes periods when engineering controls and work practices are being installed, repaired, or implemented.

NOTE: Respirators should be seen as the last level of control and are not to be used as a substitute for feasible controls that will significantly mitigate or control the dust at the source.

Once it has been determined that respirators are required, care must be taken to properly select, use and maintain the respiratory protection equipment. Both the nature of the air contaminant(s) and its/their exposure levels must be considered in properly selecting a respirator.

Before using a respirator, the employee must be trained in the proper selection, use and care of the respirator, and a qualified health care provider must determine the employee is medically fit to wear the respirator.

Under the OSHA standard, when respirators are necessary to protect the health of employees, or whenever an employer requires the use of respirators, the employer must have a written respiratory protection program that covers certain required worksite-specific procedures for respirator use. The basic elements that must be covered in a written respiratory protection program are as follows:

- Procedures for selecting respirators and ensuring their effectiveness through fit testing
- Medical evaluations of employees required to use respirators
- Procedures for cleaning, storing, repairing, discarding and maintaining respirators
- Training of employees
    - in respiratory hazards to which they are potentially exposed during routine and emergency situations
    - in the proper use of respirators, including limitations and proper maintenance
- Procedures for regularly evaluating the effectiveness of the program

The medical evaluation must be done by a physician or other licensed health care professional who uses the mandatory medical questionnaire (found in Appendix C of 1910.134) or an initial medical exam that obtains the same information contained in the medical questionnaire. Prior to giving the medical questionnaire, the health care provider must be given the following information:

- Type and weight of the respirator to be used by the employee
- Frequency and duration of respirator use
- Expected physical work effort
- Additional PPE worn
- Temperature and humidity extremes that may be encountered
- A copy of the applicable standard (1910.134)

The health care provider must submit a written report to the employer regarding the employee's ability to wear a respirator, any limitations on respirator use, the need for any further medical evaluations and a statement that the health care provider has given the employee the same written report as the employer.

B. Voluntary Use

The following are requirements of the voluntary use section of OSHA's respiratory protection standard, 29 CFR 1926.103. This section applies if an employee requests a respirator even though their exposures to airborne respirable crystalline silica do not exceed the PEL.

- The employer must determine that the employee's voluntary use will not create a hazard.
- The information provided in Appendix D of the section must be provided to the affected employee.
- An abbreviated respiratory protection program must be implemented which includes provisions for initial medical screening and training so that the worker can clean, store and maintain the respirator
- Unless the respirator is a filtering face-piece respirator (disposable respirator, etc.) a short program must be put together describing how the employer will meet these requirements

VII. HAZARD COMMUNICATION AND TRAINING

The employer must ensure that respirable crystalline silica is addressed under the hazard communication program required by 29 CFR 1926.59, including labels on containers, material safety data sheets (MSDS), and information and training covering:

a) The hazards of excessive exposure to silica -- Appendix A is an example of the information that can be provided during training;

b) Specific tasks that may generate significant amounts of silica (tuck pointing, abrasive blasting, guiniting, dry sawing, indoor sawing, rock drilling, jack hammering, stone cutting, chipping, mortar mixing, & demolition);

c) The types of measures used by the employer (e.g., the types of engineering controls, work practices, and respiratory protection) to limit exposure to crystalline silica on the jobsite.

d) Description of specific controls that will be used to reduce or mitigate silica dust, their proper use, and verifying they are operating properly. These include measures such as: wet suppression systems, dust suppression systems, early entry saws, dust collection systems, shrouds, HEPA filters, fans, performing certain tasks upwind or in segregated areas, job rotation, working with architects, engineers and manufacturers to limit cutting; and
e) Proper housekeeping and good hygiene practices.

While some aspects of the work are appropriately learned through on-the–job training, an appropriate level of training with respect to crystalline silica must be provided to each employee. Good training for jobs that are done on a day-to-day basis does not have to be repeated. This training must be updated when appropriate such as new equipment, changes in the assigned tasks, control measures or conditions that could result in an increase in the potential for exposure to crystalline silica of more than 50 percent. Refresher training should be required when employees are observed incorrectly following procedures or not in compliance with silica procedures. It is recommended that the employer document that the training has been completed by preparing a written record containing: (1) the name of the employee; (2) the date(s) of the training (3) a general description of the training, and (4) the signature of the trainer and trainee(s).

VIII. RECORDKEEPING

When required, employers must maintain the written respiratory protection program, medical evaluations and fit testing records [i) Name of employee; ii) Type of respirator; iii) Brand and size of respirator; iv) Most current fit test date; v) Fit test protocol used; and vi) Results of the fit test] required by OSHA's Respiratory Protection Program. Any exposure monitoring or medical records related to this exposure control program must be maintained and made available to the affected employees and their representatives in accordance with the access and confidentiality provisions in OSHA's Access to Employee Exposure and Medical Records Access Rule, 1910.1020, which is incorporated by reference into 29 C.F.R. 1926.33. Under that rule, employee exposure records must be kept for 30 years, and

employee medical records must be kept for the duration of employment plus an additional 30 years.

IX. DEFINITIONS

Accredited laboratory - A laboratory that is accredited to ISO Standard 17025 for the performance of crystalline silica analyses. The AIHA operates the Proficiency Analysis Testing (PAT) program or other similar round-robin testing program.

Amorphous silica: is a solid powder in which the molecules of silica attach to each other in random patterns. Pure amorphous silica does not cause silicosis.

Backhoe: Primary duties are to move, load and/or grade concrete dirt or sand to change existing conditions to meet new requirements of that site.

Breaker: Primary duties are to operate hydra-hammers and skid steer loaders with hammer attachments to demolish areas of concrete for a specific purpose. Concrete breaking is used to break out concrete that needs to be removed for plumbing trenches, patchwork repair, drive approaches, or any required concrete demolition.

Clay Masonry Unit: Brick or block made of clay or shale.

Concrete Masonry Unit: Brick or block made of concrete.

Core Drilling: Special drills powered by hydraulics, electricity, hi-cycle, or air are used with water to drill any diameter hole through concrete, brick, or other masonry type materials. Primarily, core drilling is used to drill precise sized holes for plumbing, electrical, HVAC installations, anchor bolts, dowel bars, and for concrete core samples.

Crystalline silica - a solid in which the molecules of silica attach to each other in repeating patterns that form a crystalline structure. Respirable crystalline silica has been identified as

the agent that causes silicosis. Crystalline silica is the basic component of quartz, granite rock and sand.

Hand Sawing: Handsaws are powered by gas, electricity, hydraulics, and hi-cycle with water used as a dust suppression system. Hand sawing is used when working in tight or inaccessible areas where conventional methods cannot be used. Handsaws are typically used to cut openings in concrete, brick and block for doors, windows, A/C units and other duct openings. Hand saws are also used for occasional wet or dry cutting of brick and block during new construction.

Jackhammer: Jackhammers are used to break out concrete.

Milligram (mg) – one thousandth of a gram (a unit of mass).

Permissible Exposure Limit (PEL) – a legally enforceable occupational exposure limit established by OSHA

PPM – Parts per million; the proportion (by volume or mass) of one substance per million parts of a mixture. When referring to air it is gas or vapor in volume; when referring to solids or liquids it is mass.

Silica – Also known as silicon dioxide, silica is the most common material in the earth's crust. It is a noncombustible, colorless, tasteless solid. There are two types of silica that occur naturally -- **Amorphous silica and Crystalline silica.**

Silicosis – a disabling, progressive and nonreversible disease involving scarring of lung tissue. The development of this scar tissue lessens the lung's ability to take in oxygen from the air. Symptoms of silicosis include severe cough, fatigue, loss of appetite, shortness of breath, chest pain and fever. Generally there are three types of silicosis: acute, accelerated and chronic. Contributing factors to silicosis are particle size and amount inhaled, smoking

of tobacco products, percentage of respirable silica, length of exposure and individual susceptibility.

Slab Sawing: Slab sawing or flat sawing is the most commonly used diamond cutting method. It is typically used to cut horizontal flat surfaces such as floors, bridge decks, and pavement. Slab saws are operated by fuel or electricity and feature a diamond blade with water that is mounted on a walk behind machine requiring one operator. Slab saws are typically used to provide expansion joints, remove damaged sections, clean and repair random cracks for repair and cut concrete sections for demolition purposes.

Tuck Pointing: Tuck pointing is the grinding out and replacement of existing mortar between masonry joints that is used at or near the surface of the masonry wall to restore integrity or improve appearance. Special saws with shrouds attached are typically used for this task.

TWA – The allowable Time-Weighted Average concentration for a normal 8-hour workday or 40-hour work week

Wall Sawing: This task is performed with special saws powered by hydraulics, electricity, hi-cycle, or air, which employ a circular blade on a track-mounted machine. The track is attached to a concrete surface such as a horizontal wall or steep incline that will not permit the use of slab saws. Wall sawing is typically specified to cut precise door, vent or window openings. A wall saw can also be operated with a remote control, which greatly reduces employee exposure to silica and other hazards.

Wire Sawing: This task is performed with special saws powered by hydraulics, electricity, hi-cycle and air. A wire saw is used to cut concrete when conventional methods cannot be used due to the location of the job or when the sections of concrete are larger than a concrete saw or drill can accommodate. The diamond-impregnated wire is wrapped around the concrete structure to cut it. Wire saws are used to remove pedestals, concrete structures, bridge columns, beams and machine foundations. This machine is usually remote controlled.

APPENDIX A

NIOSH-RECOMMENDED DATA COLLECTION GUIDELINES

The following is a description of the data and information that should be collected when evaluating exposures to silica.

General Note: sampling strategy and the extent of documentation can vary based on the sampling goal and the question(s) that the sampling is intended to answer.

In comparison to general exposure monitoring to determine compliance, sampling performed to understand the contribution of a specific task to overall exposure generally involves collecting additional types of information. Similarly, sampling to evaluate the effectiveness of a control method or work practice generally involves supplemental documentation and exposure survey design. Several of the suggestions below (e.g., details on controls, duration of task) are examples of useful supplemental data elements for these purposes

Project Type – Residential, Highway/Bridge, Industrial/Commercial, Other

NAICS or (Standard Industrial Classification Code) if other than brick masonry work.

Project Purpose – New, Renovation, Demolition, Maintenance, Other

Trade – Finish Mason, Stone Mason, Laborer, Heavy Equipment Operator, Other

Task –

Abrasive Blasting

Tuck pointing

Brick and Block cutting:

Hand-held saws

Stationary saws

Cement, Mortar, or Grout Mixing

Clean-up

Concrete:

Drilling, Coring, Sawing, Breaking, Crack-Chasing, other

Concrete Surface Preparation:

Grinding walls; scarifying, sanding, or scabbling floors; sacking and patching; shot blasting, other

Demolition

Others as applicable

Tool (note make and model) - e.g., Wall saw, hand saw, table-mount saw, concrete mixer, jackhammer, grinder, etc.

Substrate/work surface – e.g. vertical brick wall with 25% edge work, horizontal cement floor, curved painted brick fence wall with no edge work, 5000 psi structural concrete, etc

Controls – None, water on tool, water by helper, wetting in advance, shroud on tool, hood, negative pressure enclosure, isolation, delayed re-entry, other

For water, note flow rate (can be measured with a watch and measuring cup or bucket)

For shroud on tool, note make and model of shroud and dust collector (e.g., vacuum cleaner make and model), type of filter and/or bag, capacity of bag or other collector, how often bag or other collector needed to be emptied, if possible note air flow and static pressure, if not use manufacturer's rating.

For controls, check age, condition and history of the system. (e.g., good condition as designed, needs maintenance, well below original specifications)

For negative pressure enclosure, note: size (LxWxH), make, model, filter type, and cfm rating of AFDs; number used; pressure differential (if measured) of enclosure

For isolation, note how this was accomplished and size of restricted area

For delayed re-entry note re-entry time and how this was determined

Photos are extremely useful for documenting control and work practice set ups.

Ventilation – None, natural, cooling fans, mechanical (dilution), don't know; flow rate if known, direction relative to job (e.g., across the wall, toward the work, etc.)

Number of other workers at the job performing the same task

Nearby Dust – Number of sources, distance, usually, sometimes, rarely/never, don't know. Provide a percentage estimate of the sampling time that was influenced by a nearby source.

Number of other potentially exposed workers on the site (NOTE: useful if collecting data on overall impact or scope)

Environment – Open air, partially enclosed (2-4 walls), enclosed, confined space, don't know

Sampler – Nylon cyclone, alum. Cyclone, 37mm cassette, direct reading, other, don't know

Air sample time on, time off, duration of air sample, flow rate of calibrated pump/sample train, sampling train leak test (yes/no), calibration method used, location/type of sample (personal breathing zone/area), pre and post weight of filters

If purpose of sampling is to target tasks or control effectiveness, collect information on:
-the duration of the task (or duration of control use) so that it can be compared to the sample duration.
-Was individual and task selected because he/she appeared to represent the worst case exposure of the group? Or was selection random or typical of the task or group? Describe the general exposure conditions during the sampling period: e.g., late delivery resulted in reduced number of blocks cut to 30% of normal, or sampling period included 3X more interior corner work (which is impediment to the shroud) than normal.
-Describe the experience of the worker sampled with the specific task (e.g., two years)
-Describe the experience of the worker with using the specific control or practice (e.g., is it the first time using the control? or years of experience?)

-Describe the training and information previously provided to the worker being sampled on the control or practice being evaluated.

Weather (temp, relative humidity, raining?)

PPE - respirator type, make and model, approval, filter type (e.g., N100), clothing, hard hat, eye/face protection

If respirator used: worker fitted, trained, medically cleared? Written program? Maintained and stored properly?

Method of Analysis, information on which lab performed the analysis, method number, any variations from the method.

Date of Exposure Assessment

Results, sample identification, mass of respirable dust collected, mass of respirable crystalline silica sampled (state form of silica – quartz, cristobalite, etc.), sample flow rate, sample duration time, volume of air sampled.

APPENDIX B - HAZARD COMMUNICATION PROGRAM
HEALTH AND SAFETY TRAINING BACKGROUNDER – CRYSTALLINE SILICA

A. Crystalline Silica – The Chemical

Crystalline silica and amorphous silica are two forms of the chemical compound, silicon dioxide (SiO_2). Crystalline silica comes in several forms. The most common form of crystalline silica is quartz, which is the largest single component of the earth's crust. It is the primary component of sand and is a common component of soil and rocks. The other forms of crystalline silica are known as cristobalite and tridymite.

B. Sources of Crystalline Silica

Workers in a variety of industries have a potential for exposure to crystalline silica exposure, primarily quartz. Crystalline silica is the basic building block of many construction materials (concrete, brick, mortar and stone) and is widely used in a broad variety of construction and maintenance activities.

C. Safety Hazards

Crystalline silica, like other solid materials, is an abrasive material that can cause mechanical irritation of eyes and skin and suitable eye and skin protection must be worn where appropriate.

D. Health Hazards

Not all crystalline silica poses a health hazard, but only the very fine particles that can be inhaled into the lungs. The larger particles are filtered out by your nose and never reach the lungs. The very fine particles are called "respirable" particles. In terms of numbers, the individual respirable particles have a maximum diameter of less than 10 microns, which is approximately $1/5^{th}$ the thickness of a human hair, and cannot be seen by the naked eye. The smallest particle size that can be seen by the naked eye is 40 microns.

The fact that someone is exposed to respirable crystalline silica does not mean they will develop adverse health effects. In general, adverse health effects result from chronic inhalation (day after day for extended periods of time) to dust containing a significant concentration of respirable crystalline silica over many years. Smoking and other factors may increase the risk of adverse health effects. The proper use of a respirator that filters out respirable silica from the air inhaled by the worker should eliminate the risk.

a. Silicosis

The primary health risk posed by the chronic inhalation of respirable crystalline silica is a disease known as silicosis (also known as "diffuse nodular pulmonary fibrosis"), which is a nonreversible, potentially disabling and sometimes fatal lung

disease. It is caused by overexposure of the lungs to respirable crystalline silica, which is inhaled and deposited in the lungs over a period of many years. The microscopic particles of crystalline silica can cause scar tissue to form in the lungs, which reduces the lungs' ability to extract oxygen from the air. The symptoms of silicosis include shortness of breath, severe cough and weakness. There are three types of silicosis:

Simple Chronic Silicosis, which results from long-term exposure (more than 20 years) to low amounts of silica dust;

Accelerated Silicosis, which occurs after exposure to larger amounts of silica over a shorter period of time (5-15 years); and,

Acute Silicosis, which results from short-term exposure (1-5 years) to very large amounts of silica.

The primary external factors that influence the risk of contracting silicosis are: the concentration of respirable crystalline silica in the airborne dust inhaled by the worker, the amount of time the worker inhales that dust each day, and the number of days the worker inhales that dust. Other factors that may affect the risk are inhalation of other dusts, smoking, and personal health factors.

b. Other Pulmonary Illnesses

As silicosis progresses, it may interfere with the body's natural abilities to kill infectious organisms, leading to other respiratory infections.

c. Lung cancer

While the science remains uncertain, there are a number of studies indicating that chronic inhalation of crystalline silica may cause lung cancer, or may cause silicosis, which then leads to lung cancer. Based on that research, the International Agency for Research on Cancer (IARC) has classified crystalline silica as a human carcinogen.

E. Current Regulations and Recommendations on Exposure Levels

The current OSHA PEL for construction is approximately 100 ug/m3 for an 8 hour time weighted average. The actual PEL is for the airborne concentration of the respirable dust containing quartz is established by the following formula found in the Mineral Dust Table in 29 C.F.R. 1926.55:

$$\frac{250 \quad \text{mppcf}}{\%\ SiO2+5}$$

where mppcf stands for millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques. The term "% SiO2" represents the percentage of quartz determined from airborne samples, except in those instances in which other methods have been shown to be applicable.

F. Recommended Work Practices

All work should be performed in a way that minimizes the creation of airborne dusts, especially those that contain or may contain respirable crystalline silica. For example, cutting tasks (or dust generating tasks) should be performed with wet methods or by shrouding the point of operation with a local exhaust ventilation or vacuum system to the extent practical. Other types of controls include: Wet systems, dust suppression systems, dust collection systems, local exhaust systems, shrouds, HEPA filters, fans, ventilation systems and other specialty equipment that can be used to suppress dust, natural ventilation, having the employee work upwind from the work, not allowing use of compressed air for cleaning purposes, good personal hygiene and working with architects and engineers to reduce the amount of cutting.