OSHA®

Occupational Safety and Health Administration

www.osha.gov

Small Entity Compliance Guide

for the Respirable Crystalline Silica Standard for Construction

OSHA 3902-07R 2017

www.osha.gov

Occupational Safety and Health Act of 1970

"To assure safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health."

This information will be made available to sensory-impaired individuals upon request. Voice phone: (202) 693-1999; teletypewriter (TTY) number: 1-877-889-5627.

This publication provides a general overview of a particular standards-related topic. This publication does not alter or determine compliance responsibilities which are set forth in OSHA standards and the *Occupational Safety and Health Act.* Moreover, because interpretations and enforcement policy may change over time, for additional guidance on OSHA compliance requirements the reader should consult current administrative interpretations and decisions by the Occupational Safety and Health Review Commission and the courts.

Cover photo courtesy of OSHA, International Masonry Institute.

Small Entity Compliance Guide

for the Respirable Crystalline Silica Standard for Construction

Occupational Safety and Health Administration
U.S. Department of Labor

OSHA 3902-07R 2017

This guidance document provides an overview of OSHA's Respirable Crystalline Silica Standard for Construction. It is advisory in nature and informational in content. It is not a standard or regulation, and it neither creates new legal obligations nor alters existing obligations created by the Occupational Safety and Health Administration (OSHA) standards or the *Occupational Safety and Health Act of 1970* (OSH Act). Pursuant to the OSH Act, employers must comply with safety and health standards and regulations issued and enforced either by OSHA or by an OSHA-approved state plan. In addition, the Act's General Duty Clause, Section 5(a)(1), requires employers to provide their workers with a workplace free from recognized hazards that are causing or likely to cause death or serious physical harm.

In addition, Section 11(c)(1) of the Act provides that "No person shall discharge or in any manner discriminate against any employee because such employee has filed any complaint or instituted or caused to be instituted any proceeding under or related to this Act or has testified or is about to testify in any such proceeding or because of the exercise by such employee on behalf of himself or others of any right afforded by this Act." Reprisal or discrimination against an employee for reporting an incident, injury, or workplace violation, for participating in medical surveillance, or because of the results of medical surveillance would constitute a violation of Section 11(c) of the OSH Act.

TABLE OF CONTENTS

INTRODUCTION

This guide is intended to help small businesses understand and comply with the Occupational Safety and Health Administration's (OSHA) Respirable Crystalline Silica standard for Construction. Workers exposed to respirable crystalline silica are at increased risk of developing serious adverse health effects including silicosis, lung cancer, chronic obstructive pulmonary disease, and kidney disease. This guide describes the steps that employers are required to take to protect employees in construction from the hazards associated with exposure to respirable crystalline silica. Employers in industries other than construction should refer to the small entity compliance guide for occupational exposure to respirable crystalline silica in general industry and maritime.

What is Respirable Crystalline Silica?

Crystalline silica is a common mineral found in many naturally occurring and man-made materials used at construction sites. Materials like sand, concrete, brick, block, stone and mortar contain crystalline silica. Amorphous silica, such as silica gel, is not crystalline silica.

Respirable crystalline silica – very small particles typically at least 100 times smaller than ordinary sand found on beaches or playgrounds – is generated by high-energy operations like cutting, sawing, grinding, drilling and crushing stone, rock, concrete, brick, block and mortar, or when abrasive blasting with sand.

This document provides guidance only, and does not alter or determine compliance responsibilities, which are laid out in OSHA standards and the *Occupational Safety and Health Act*. This guide does not replace the official respirable crystalline silica standard for construction. The employer must refer to the standard to ensure that it is in compliance. Moreover, because interpretations and enforcement policy may change over time, for additional guidance on OSHA compliance requirements the reader should consult current administrative interpretations and decisions by the Occupational Safety and Health Review Commission and the courts.

Overview of the Standard and Guide

This guide is divided into sections that correspond to the major provisions (paragraphs) of the silica standard for construction. Each section describes the provision and gives additional details to help employers better understand the requirements of the standard.

The first step for an employer is to determine if the standard applies to its work. If its work is covered by the standard, an employer has two options for limiting employee exposure to respirable crystalline silica:

- Specified exposure control methods; or
- Alternative exposure control methods.

Employers who choose the specified exposure controls option must fully and properly implement protections for the tasks or equipment listed in Table 1 of the standard. Employers who fully and properly implement the controls in Table 1 do not have to assess employees' silica exposure levels or keep employee exposures at or below the permissible exposure limit (PEL).

Employers who follow alternative exposure control methods must:

- Determine the levels of respirable crystalline silica that employees are exposed to;
- Limit employee exposures to a PEL of 50 micrograms per cubic meter of air (50 $\mu g/m^3$) as an 8-hour time-weighted average (TWA);
- Use engineering and work practice controls, to the extent feasible, to limit employee exposures to the PEL, and supplement the controls with respiratory protection when necessary.
- Keep records of employee exposure to respirable crystalline silica.

All employers covered by the standard must:

- Provide respiratory protection when required;
- Restrict housekeeping practices that expose employees to respirable crystalline silica where feasible alternatives are available;
- Establish and implement a written exposure control plan, including designating a competent person;
- Offer medical exams to employees who will be required to wear a respirator under the standard for 30 or more days a year;
- Communicate hazards and train employees; and
- Keep records of medical examinations.

See the roadmap listed below for more information.

Roadmap for Meeting the Requirements of the Respirable Crystalline Silica Standard

1. Determine if the silica standard applies to your employees.

Could employees be exposed to respirable crystalline silica at or above 25 µg/m^3 as an 8-hour TWA under any foreseeable conditions, including the failure of engineering controls, while performing construction activities?

No: No further action is required under the silica standard.
Yes: Choose to comply with the standard using either the:

- Specified exposure control methods in Table 1, or
- The alternative methods of compliance

2. Determine what additional requirements you must meet under the standard, based on the compliance method you are following.

	Must the Employer Follow this Requirement?	
Requirement	**If Fully and Properly Implementing Table 1**	**If Following Alternative Exposure Controls**
PEL	**No**	**Yes**
Exposure Assessment	**No**	**Yes,** when exposures are reasonably expected to be above the action level.
Methods of Compliance	**No**	**Yes**
Respiratory Protection	**Yes,** if respirator use is required by Table 1	**Yes,** if respirator use is required to reduce exposures to the PEL
Housekeeping	**Yes**	**Yes**
Written Exposure Control Plan	**Yes**	**Yes**
Medical surveillance	**Yes,** for employees who must wear a respirator under the silica standard for 30 or more days a year.	
Communication of Hazards	**Yes**	**Yes**
Recordkeeping	**Yes,** for any employees who are getting medical examinations	**Yes,** for exposure assessments and for any employees who are getting medical examinations

SCOPE – PARAGRAPH (A) OF THE STANDARD

The standard applies to all occupational exposures to respirable crystalline silica in construction work, except where employee exposure will remain below 25 µg/m^3 as an 8-hour TWA under any foreseeable conditions. Exposures to respirable crystalline silica occur when the following tools are used on concrete, brick, block, stone, mortar, and other materials that contain crystalline silica:

- Stationary masonry saws;
- Handheld power saws;
- Walk-behind saws;
- Drivable saws;
- Rig-mounted core saws or drills;
- Handheld and stand-mounted drills (including impact and rotary hammer drills);
- Dowel drilling rigs;
- Vehicle-mounted drilling rigs;
- Jackhammers and handheld powered chipping tools;
- Handheld grinders;
- Walk-behind milling machines and floor grinders;
- Drivable milling machines;
- Crushing machines; and
- Heavy equipment and utility vehicles when used to abrade or fracture silica-containing materials (such as hoe-ramming or rock ripping) or during demolition activities, and for tasks such as grading and excavating.

Exposures to respirable crystalline silica also occur during tunneling operations and during abrasive blasting when sand or other blasting agents containing crystalline silica are used, or when abrasive blasting is performed on substrates that contain crystalline silica, such as concrete.

Where Employee Exposure Will Remain Below 25 µg/m^3 as an 8-Hour TWA

The standard does not apply where employee exposure will remain below 25 µg/m^3 as an 8-hour TWA under any foreseeable conditions. The phrase "any foreseeable conditions" refers to situations that can reasonably be anticipated. OSHA considers failure of engineering controls to be a situation that is reasonably foreseeable. Although engineering controls are usually a reliable means for controlling employee exposures, equipment does occasionally fail. Thus, the standard applies where exposures below 25 µg/m^3 as an 8-hour TWA are expected or achieved, but only because engineering controls are being used to limit exposures.

Employee exposure can reasonably be anticipated to remain below 25 µg/m^3 as an 8-hour TWA when performing certain tasks that involve only minimal exposure to respirable crystalline silica. Such tasks include:

- Mixing concrete for post holes;
- Pouring concrete footers, slab foundation, and foundation walls; and
- Removing concrete formwork.

When these tasks are performed in isolation from tasks that generate significant exposures to respirable crystalline silica, the standard does not apply. These examples are not exclusive, and there may be other tasks that involve exposure under 25 µg/m^3 as an 8-hour TWA under any foreseeable conditions.

Some employees in the construction sector perform tasks involving occasional, brief exposures to respirable crystalline silica that are incidental to their primary work. These workers include carpenters, plumbers, and electricians who occasionally drill holes in concrete or masonry or perform other tasks that involve exposure to respirable crystalline silica. Where employees perform tasks that involve exposure to respirable crystalline silica for a very short period of time, exposures for many tasks will be below 25 μg/m^3 as an 8-hour TWA. For example, for hole drillers using hand-held drills, if the duration of exposure is 15 minutes or less, the 8-hour TWA exposure can reasonably be anticipated to remain under the 25 μg/m^3 threshold (assuming no exposure for the remainder of the shift), and the standard would not apply.

This exception for situations where exposures are not likely to present significant risk to workers allows employers to focus their resources on exposures of greater occupational health concern.

DEFINITIONS – PARAGRAPH (B) OF THE STANDARD

Definitions are included in the standard to describe the meaning of terms used. Some of these terms are further explained as follows:

Action level means an airborne concentration of 25 µg/m^3 calculated as an 8-hour TWA. Exposures at or above the action level trigger requirements for exposure assessment.

Competent person means an individual who is capable of identifying existing and foreseeable respirable crystalline silica hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them. The competent person must have the knowledge and ability necessary to implement the written exposure control plan required under the standard.

Employee exposure means the exposure to airborne respirable crystalline silica that would occur if the employee were not using a respirator.

High-efficiency particulate air (HEPA) filter means a filter that is at least 99.97 percent efficient in removing mono-dispersed particles of 0.3 micrometers in diameter. HEPA-filtered vacuuming is an example of a housekeeping method that minimizes employee exposure to respirable crystalline silica, and some Table 1 tasks require HEPA-filtered vacuuming.

Objective data means information, such as air monitoring data from industry-wide surveys or calculations based on the composition of a substance, demonstrating employee exposure to respirable crystalline silica associated with a particular product or material or a specific process, task, or activity. The data must reflect workplace conditions closely resembling or with a higher exposure potential than the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operations.

Physician or other licensed health care professional [PLHCP] is an individual whose legally permitted scope of practice (*i.e.*, license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the particular health care services required by this standard.

Specialist means an American Board Certified Specialist in Pulmonary Disease or an American Board Certified Specialist in Occupational Medicine.

SPECIFIED EXPOSURE CONTROL METHODS – PARAGRAPH (C) OF THE STANDARD

The silica standard for construction provides a flexible approach for construction employers to achieve compliance. The standard includes Table 1, which lists 18 common tasks using various types of tools or equipment found at construction sites. For each employee engaged in a task in Table 1, employers who choose to follow the Table for that task are required to fully and properly implement the engineering controls, work practices, and respiratory protection specified in Table 1. Employers who comply with Table 1 are not required to conduct exposure assessments or comply with a PEL for those employees.

Employees engaged in the Table 1 task means the equipment operator; helpers, laborers and other employees who are assisting with the task; or any other

employee responsible for completing the task. For example, an employee operating a walk-behind saw and another employee helping the operator guide the saw are both engaged in the task. An employee operating a jackhammer would be engaged in the task, but another employee directing traffic near the employee jackhammering would not be engaged in the task. When Table 1 requires respiratory protection, employers must provide respirators to all employees engaged in the task. Employers must describe procedures for restricting access of employees not engaged in the task as part of its *Written Exposure Control Plan*.

Fully and properly implemented means that controls are in place, are properly operated and maintained, and employees understand how to use them. Several factors required for full and proper implementation of controls are listed in the discussion for each Table 1 entry below. The presence of large amounts of visible dust generally indicates that controls are not fully and properly implemented. A small amount of dust can be expected from equipment that is operating as intended by the manufacturer; however, a noticeable increase in dust generation during the task is a sign that the dust controls are not operating correctly. The difference between the small amounts of dust generated when control measures are working properly and the large amount of dust generated during tasks when control measures are not used or not operated effectively is easily observed. When this happens, prompt corrective actions are required.

As part of full and proper implementation, many Table 1 tasks require the employer to operate and maintain tools according to manufacturers' instructions for minimizing dust emissions. Manufacturer's instructions for minimizing dust can include:

- Water flow rates,
- Vacuum equipment air flow rate and capacity,
- Rotation of the blade (speed, direction),
- Maintaining and changing blades, and
- Frequency for changing water.

See sections on *Water Delivery Systems* and *Dust Collection Systems* for more information about the use of controls for respirable crystalline silica.

Several entries in Table 1 have requirements for the use of **respiratory protection with a minimum "assigned protection factor" (APF)**. Paragraph (d)(3)(i)(A) of the Respiratory Protection standard (29 CFR 1910.134) includes a table that can be used to determine the type or class of respirator that will provide employees with a particular APF, and it can help employers determine the type of respirator that would meet the required minimum APF specified by Table 1. Employers have the flexibility to provide a more protective respirator to those employees who request one or require the employees to use a more protective respirator. See section on *Determining Task Duration and Requirements for Respirator Use* for information on how to measure task duration to determine respiratory protection requirements for employees doing one or more Table 1 task.

Description of Table 1 Entries

This section lists each Table 1 entry and explains the requirement for that entry.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(i) Stationary masonry saws	Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None

Stationary masonry saws must be equipped with an integrated water delivery system (commercially developed specifically for the type of tool in use) that continuously feeds water to the blade. The water delivery system usually includes a nozzle for spraying water attached near the blade that is connected to a water basin by a hose and pump. The tool must be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions. Stationary masonry saws equipped with an integrated system for blade cooling also suppress dust and meet the requirements of Table 1.

Full and proper implementation of water controls on stationary masonry saws requires the employer to ensure that:

- An adequate supply of water for dust suppression is used;
- The spray nozzle is working properly to apply water at the point of dust generation;
- The spray nozzle is not clogged or damaged; and
- All hoses and connections are intact.

Table 1 does not specify a minimum flow rate; however, water must be applied at the flow rates specified by the manufacturer.

When using a stationary masonry saw indoors or in an enclosed space (areas where airborne dust can buildup, such as a structure with a roof and three walls), employers must provide additional exhaust as needed to minimize the accumulation of visible airborne dust.

See the section on *Indoors or Enclosed Areas* for more information.

Respiratory protection is not required for work with stationary masonry saws regardless of task duration.

Worker cutting masonry block on a stationary masonry saw equipped with integrated water delivery system that continuously feeds water to the blade. Note water supply hose attached to top of shroud around blade.

Photo courtesy of OSHA, International Masonry Institute. The equipment shown in this picture is for illustrative purposes only and is not intended as an endorsement by OSHA of this company, its products or services.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(ii) Handheld power saws (any blade diameter)	Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • When used outdoors. • When used indoors or in an enclosed area.	None APF 10	APF 10 APF 10

Handheld power saws with any blade diameter must be equipped with an integrated water delivery system (commercially developed specifically for the type of tool in use) that continuously feeds water to the blade. The water delivery system usually includes a nozzle for spraying water attached near the blade that is connected to a water basin via a hose and pump. The tool must be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions. Handheld power saws equipped with an integrated water delivery system for blade cooling also suppress dusts and meet the requirements of Table 1.

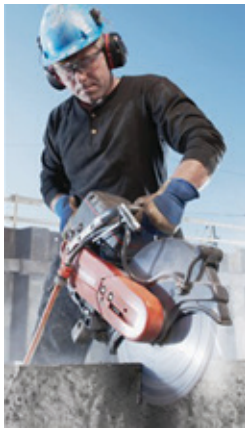
Full and proper implementation of water controls on handheld power saws requires the employer to ensure that:

- An adequate supply of water for dust suppression is used;
- The spray nozzle is working properly to apply water at the point of dust generation;
- The spray nozzle is not clogged or damaged;
- All hoses and connections are intact.

Table 1 does not specify a minimum flow rate; however, water must be applied at the flow rate specified by the manufacturer.

When working with handheld power saws of any blade diameter, respiratory protection with a minimum APF of 10 is required for work done outdoors for more than four hours per shift and for work done indoors, or in an enclosed location, regardless of task duration.

When using a handheld saw indoors or in enclosed spaces (areas where airborne dust can buildup, such as a structure with a roof and three walls), employers must provide additional exhaust, as needed to minimize the accumulation of visible airborne dust. See the section on *Indoors or Enclosed Areas* for more information.



A worker cutting a concrete block using a handheld masonry saw with an integrated water delivery system.

Photo courtesy Husqvarna. The equipment shown in this picture is for illustrative purposes only and is not intended as an endorsement by OSHA of this company, its products or services.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(iii) Handheld power saws for cutting fiber-cement board (with blade diameter of 8 inches or less)	For tasks performed outdoors only: • Use saw equipped with commercially available dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency.	None	None

Specialty handheld power saws for cutting fiber-cement board (with a blade diameter of 8 inches or less) must be equipped with commercially available dust collection systems and a filter with a 99 percent or greater efficiency. The saws must be operated and maintained in accordance with the manufacturer's instructions to minimize dust emissions, and provide the air flow rate recommended by the manufacturer or greater. When employers are complying with Table 1, the saws must only be used outdoors.

Full and proper implementation of dust collection systems on handheld power saws for cutting fiber-cement board requires the employer to ensure that:

- The shroud or cowling is intact and installed in accordance with the manufacturer's instructions;
- The hose connecting the tool to the vacuum is intact and without kinks or tight bends;
- The filter(s) on the vacuum are cleaned or changed in accordance with the manufacturer's instructions to prevent clogging; and
- The dust collection bags are emptied to avoid overfilling.

Respiratory protection is not required for work outdoors with specialty handheld power saws while cutting fiber-cement board regardless of task duration.

Worker cutting fiber-cement board outdoors using a handheld power saw and dust collection system. The dust collection system consists of the shroud on the saw, hose, and dust collector positioned between the saw horses.

Photo courtesy of NIOSH.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(iv) Walk-behind saws	Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • When used outdoors. • When used indoors or in an enclosed area.	None APF 10	None APF 10

Walk-behind saws must be equipped with an integrated water delivery system (commercially developed specifically for the type of tool in use) that continuously feeds water to the blade. The tool must be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions. Full and proper implementation of water controls on walk-behind saws requires the employer to ensure that:

- An adequate supply of water for dust suppression is used;
- The spray nozzles are working properly to apply water at the point of dust generation;
- The spray nozzles are not clogged or damaged; and
- All hoses and connections are intact.

Table 1 does not specify a minimum flow rate; however, water must be applied at the flow rate specified by the manufacturer.

Walk-behind saws used to cut roads and cut pavement are most commonly used outdoors, though they can also be used indoors to cut concrete floors. When using walk-behind saws indoors or in enclosed areas (areas where airborne dust can buildup, such as a structure with a roof and three walls), employers must provide additional exhaust, as needed to minimize the accumulation of visible airborne dust. See the section on *Indoors or Enclosed Areas* for more information.

When working outdoors, respiratory protection is not required for work with walk-behind saws regardless of task duration. When working indoors, or in an enclosed location, respiratory protection with a minimum APF of 10 is required regardless of task duration.

Worker using a walk-behind saw with an integrated water delivery system to cut asphalt roadway.

Photo courtesy of OSHA.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica			
Equipment/Task	**Engineering and Work Practice Control Methods**	**Required Respiratory Protection and Minimum Assigned Protection Factor (APF)**	
		≤ 4 hours/shift	**> 4 hours/shift**
(v) Drivable saws	For tasks performed outdoors only: • Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None

Drivable saws used to cut silica-containing materials (such as concrete, asphalt, granite and terrazzo) must be equipped with an integrated water delivery system (commercially developed specifically for the type of tool in use) that continuously feeds water to the blade and must be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions. Employers following Table 1 must only allow the saws to be used outdoors.

Full and proper implementation of water controls on drivable saws requires the employer to ensure that:

- An adequate supply of water for dust suppression is used;
- The spray nozzles produce a pattern that applies water at the point of dust generation;
- The spray nozzles are not clogged or damaged; and
- All hoses and connections are intact.

Respiratory protection is not required for work with drivable saws regardless of task duration.

Worker cutting a groove in concrete roadway with drivable saw using integrated water delivery system.

Photo courtesy of Husquvarna. The equipment shown in this picture is for illustrative purposes only and is not intended as an endorsement by OSHA of this company, its products or services.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(vi) Rig-mounted core saws or drills	• Use tool equipped with integrated water delivery system that supplies water to cutting surface. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None

Rig-mounted core saws or drills must be equipped with an integrated water delivery system (commercially developed specifically for the type of tool in use) that supplies water to the cutting surface, and must be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions.

Full and proper implementation of water controls on rig-mounted core saws or drills requires the employer to ensure that:

- An adequate supply of water for dust suppression is used;
- The spray nozzles produce a pattern that applies water at the point of dust generation;
- The spray nozzles are not clogged or damaged; and
- All hoses and connections are intact.

When using rig-mounted core saws or drills indoors or in enclosed areas (areas where airborne dust can buildup, such as a structure with a roof and three walls), employers must provide additional exhaust, as needed to minimize the accumulation of visible airborne dust. See the section on *Indoors or Enclosed Areas* for more information.

Respiratory protection is not required for work with rig-mounted core saws or drills regardless of task duration.

A rig-mounted core drill with an integrated water delivery system.

Photo courtesy of Hilti. The equipment shown in this picture is for illustrative purposes only and is not intended as an endorsement by OSHA of this company, its products or services.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(vii) Handheld and stand-mounted drills (including impact and rotary hammer drills)	• Use drill equipped with commercially available shroud or cowling with dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. • Use a HEPA-filtered vacuum when cleaning holes.	None	None

Handheld and stand-mounted drills (including impact and rotary hammer drills). Handheld and stand-mounted drills must be equipped with a commercially available shroud or cowling with a dust collection system that provides at least the minimum air flow recommended by the manufacturer. The dust collection system must include a filter cleaning mechanism and be equipped with a filter with 99 percent or greater efficiency. In addition, the tool must be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions.

Full and proper implementation of dust collection systems on handheld drills requires the employer to ensure that:

- The shroud or cowling is intact and installed in accordance with the manufacturer's instructions;

Worker drilling into concrete with a rotary hammer equipped with shroud and dust collection system. Note the shroud around drill bit, silver and black hose, and dust collector are attached conveniently to the drill.

Photo courtesy of DeWalt. The equipment shown in this picture is for illustrative purposes only and is not intended as an endorsement by OSHA of this company, its products or services.

- The hose connecting the tool to the vacuum is intact and without kinks or tight bends;
- The filter(s) on the vacuum are cleaned or changed in accordance with the manufacturer's instructions; and
- The dust collection bags are emptied to avoid overfilling.

A HEPA-filtered vacuum must be used when cleaning holes. Compressed air can be used to clean holes when used in conjunction with a HEPA-filtered vacuum to capture the dust or a hole cleaning kit designed for use with compressed air.

When using handheld and stand-mounted drills indoors or in enclosed areas (areas where airborne dust can buildup, such as a structure with a roof and three walls), employers must provide additional exhaust, as needed to minimize the accumulation of visible airborne dust. See the section on *Indoors or Enclosed Areas* for more information.

Respiratory protection is not required when using handheld or stand-mounted drills equipped with a dust collection system, including for overhead drilling, regardless of task duration.

Worker is drilling horizontal holes in a concrete wall using two stand-mounted drills, each equipped with a dust collector. Note the shrouds around drill bits, black hose, and dust collector are attached to the stand.

Photo courtesy of David Rempel, University of California, San Francisco.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica			
Equipment/Task	**Engineering and Work Practice Control Methods**	**Required Respiratory Protection and Minimum Assigned Protection Factor (APF)**	
		≤ 4 hours/shift	**> 4 hours/shift**
(viii) Dowel drilling rigs for concrete	For tasks performed outdoors only: • Use shroud around drill bit with a dust collection system. Dust collector must have a filter with 99% or greater efficiency and a filter-cleaning mechanism. • Use a HEPA-filtered vacuum when cleaning holes.	APF 10	APF 10

Dowel drills for concrete (*i.e.*, gang drills) are drills equipped with multiple drill bits that are used to drill several holes at the same time. Dowel drills must be equipped with a shroud around the drill bit and a dust collection system that has a filter with 99 percent or greater efficiency. The dust collection equipment must be equipped with a filter cleaning mechanism. Employers following Table 1 must allow dowel drilling rigs to only be used outdoors.

Full and proper implementation of dust collection systems on dowel drilling rigs requires the employer to ensure that:

- The shroud is intact and installed in accordance with the manufacturer's instructions;
- The hose connecting the tool to the vacuum is intact and without kinks or tight bends;
- The filter(s) on the vacuum are cleaned or changed in accordance with the manufacturer's instructions; and
- The dust collection bags are emptied to avoid overfilling.

A HEPA-filtered vacuum must be used when cleaning holes. Compressed air can be used to clean holes when used in conjunction with a HEPA-filtered vacuum to capture the dust or a hole cleaning kit designed for use with compressed air.

Respiratory protection with a minimum APF of 10 is required for all work with dowel drilling rigs for concrete regardless of task duration.

Worker drilling horizontal holes in concrete slab with a dowel drilling rig. The shroud surrounds the drill steel where it enters the concrete and the dust collector is the canister on the right. Worker is wearing respiratory protection.

Photo courtesy of NIOSH.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(ix) Vehicle-mounted drilling rigs for rock and concrete	Use dust collection system with close capture hood or shroud around drill bit with a low-flow water spray to wet the dust at the discharge point from the dust collector.	None	None
	OR		
	Operate from within an enclosed cab and use water for dust suppression on drill bit.	None	None

Vehicle-mounted rock and concrete drilling rigs must be equipped with a dust collection system with a close capture hood or shroud around the drill bit, and a low-flow water spray to wet the dust discharged from the dust collector. This combination of local exhaust ventilation (LEV) and water application controls dust at all emission points that can contribute to the operator's and other employees' exposures.

Employers also have the option to have the drill operator work within an enclosed cab and, when necessary, apply water at the drill bit, as described above, to reduce exposures to other employees in the area. See the section on *Enclosed Cabs* for more information on how to make sure cabs meet the requirements of Table 1.

Full and proper implementation of dust collection systems on vehicle-mounted drilling rigs requires the employer to ensure that:

- The shroud or hood is intact and installed in accordance with the manufacturer's instructions;
- The hose connecting the tool to the vacuum is intact and without kinks or tight bends;
- The filter(s) on the vacuum are cleaned or changed in accordance with the manufacturer's instructions; and
- The dust collection bags are emptied to avoid overfilling.

Full and proper implementation of water controls on vehicle-mounted drilling rigs requires the employer to ensure that:

Vehicle-mounted drilling rig using water on the drill bit. The enclosed operator's cab is on the right.

Photo courtesy of NIOSH.

- An adequate supply of water for dust suppression is used;
- The spray nozzles are working properly and produce a pattern that applies water on the discharge point from the dust collector;
- The spray nozzles are not clogged or damaged; and
- All hoses and connections are intact.

Respiratory protection is not required for work with vehicle-mounted drilling rigs regardless of task duration.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(x) Jackhammers and handheld powered chipping tools	Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact.		
	• When used outdoors. • When used indoors or in an enclosed area.	None APF 10	APF 10 APF 10
	OR		
	Use tool equipped with commercially available shroud and dust collection system.		
	Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.		
	Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.		
	• When used outdoors. • When used indoors or in an enclosed area.	None APF 10	APF 10 APF 10

Jackhammers and handheld powered chipping tools must be operated using either a water delivery system that supplies a continuous stream or spray of water at the point of impact, or a tool equipped with a commercially available shroud and vacuum dust collection system. Jackhammers and other handheld powered chipping tools must be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions.

If using the shroud and dust collection system, the vacuum dust collection system must provide at least the air flow recommended by the tool manufacturer, and have a filter with 99 percent or greater efficiency and a filter cleaning mechanism.

The water delivery system is not required to be integrated or mounted on the tool; it can be assembled and installed by the employer. However, it must deliver a continuous stream or spray of water at the point of impact.

Full and proper implementation of water controls on jackhammers and other handheld powered chipping tools requires the employer to ensure that:

- An adequate supply of water for dust suppression is used;
- The water sprays are working properly and produce a pattern that applies water at the point of dust generation;
- The spray nozzles are not clogged or damaged; and
- All hoses and connections are intact.

Acceptable water delivery systems include direct connections to fixed water lines or portable water tank systems. These water delivery systems can be operated by one worker or could require a second worker to supply the water at the point of impact.

Full and proper implementation of dust collection systems requires the employer to ensure that:

- The shroud is intact and installed in accordance with the manufacturer's instructions;
- The hose connecting the tool to the vacuum is intact and without kinks or tight bends;
- The filter(s) on the vacuum are cleaned or changed in accordance with the manufacturer's instructions; and
- The dust collection bags are emptied to avoid overfilling.

Respiratory protection with an APF of 10 is required when the task is done outdoors for more than four hours per shift, or when the task is done indoors or in an enclosed location regardless of task duration.

When working indoors or in an enclosed space (areas where airborne dust can buildup, such as a structure with a roof and three walls), employers must provide additional exhaust, as needed to minimize the accumulation of visible airborne dust. See the section on *Indoors or Enclosed Areas* for more information.

Jackhammer equipped with water spray delivery system to control dust. The water nozzle is mounted on the jackhammer frame just to the right of the chisel. Note the wet concrete on left from the water spray.

Photo courtesy of CPWR, Norman Zuckerman.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(xi) Handheld grinders for mortar removal (i.e., tuckpointing)	Use grinder equipped with commercially available shroud and dust collection system. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	APF 10	APF 25

Handheld grinders for mortar removal (i.e., tuckpointing). Tuckpointing involves removing deteriorating mortar from between bricks using a handheld grinder and replacing it with fresh mortar.

The handheld grinders must be equipped with a commercially available shroud and dust collection system and operated and maintained in accordance with manufacturer's instructions to minimize dust emissions. The dust collection system must provide at least 25 cfm of air flow per inch of wheel diameter and have a filter that has a 99 percent or greater efficiency and either a cyclonic pre-separator or a filter-cleaning mechanism. Cyclonic pre-separators and filter-cleaning mechanisms improve the suction of dust collection systems by preventing debris from building up on the filter.

Full and proper implementation of dust collection systems on handheld grinders requires the employer to ensure that:

- The shroud is intact, encloses most of the grinding blade, and is installed in accordance with the manufacturer's instructions;
- The hose connecting the tool to the vacuum is intact and without kinks or tight bends;
- The filter(s) on the vacuum are cleaned or changed in accordance with the manufacturer's instructions;
- The dust collection bags are emptied to avoid overfilling;
- The blade is kept flush against the surface whenever possible; and
- The tool is operated against the direction of blade rotation, whenever practical.

When using handheld grinders for mortar removal indoors or in enclosed areas (areas where airborne dust can buildup, such as a structure with a roof and three walls), employers must provide additional exhaust if needed to minimize the accumulation of visible airborne dust. See the section on *Indoors or Enclosed Areas* for more information on how to determine when those work situations apply.

Respiratory protection with a minimum APF of 10 is required for work with handheld grinders for mortar removal lasting four hours or less in a shift. Respiratory protection with a minimum APF of 25 is required for work lasting more than four hours per shift.

Worker grinding mortar from between bricks with a handheld grinder equipped with a shroud and dust collection system. In addition, worker is using respiratory protection.

Photo courtesy of OSHA, International Masonry Institute.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(xii) Handheld grinders for uses other than mortar removal	For tasks performed outdoors only: Use grinder equipped with integrated water delivery system that continuously feeds water to the grinding surface. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. OR Use grinder equipped with commercially available shroud and dust collection system. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	None	None
	• When used outdoors. • When used indoors or in an enclosed area.	None None	None APF 10

Handheld grinders may also be used for tasks other than mortar removal, such as to remove thin layers of concrete and surface coatings. Two control options may be used: (1) A grinder equipped with an integrated water delivery system (commercially developed specifically for the type of tool in use) that continuously feeds water to the grinding surface operated for outdoor work only; and (2) a dust collector equipped with a commercially available shroud and dust collection system with the same features as the dust collection system used for mortar removal for outdoor and indoor work. The dust collector must be rated to provide 25 cfm or greater air flow per inch of wheel diameter, have a filter with a 99 percent or greater efficiency, and a cyclonic pre-separator or filter-cleaning mechanism. Cyclonic pre-separators and filter-cleaning

mechanisms improve the suction of dust collection systems by preventing debris from building up on the filter. The grinder and both controls must be operated and maintained in accordance with manufacturer's instructions to minimize dust emissions.

The integrated water delivery system can be a free-flowing water system designed for blade cooling as well as manufacturers' systems designed for dust suppression alone. This option applies only when grinders are used outdoors.

Full and proper implementation of water controls on grinders requires the employer to ensure that:

- An adequate supply of water for dust suppression is used;
- The spray nozzles are working properly and produce a pattern that applies water at the point of dust generation;
- The spray nozzles are not clogged or damaged; and
- All hoses and connections are intact.

Handheld grinders equipped with dust collection systems may be used outdoors or indoors. Full and proper implementation of dust collection systems on handheld grinders requires the employer to ensure that:

- The shroud is intact and installed in accordance with the manufacturer's instructions;
- The hose connecting the tool to the vacuum is intact and without kinks or tight bends;
- The filter(s) on the vacuum are cleaned or changed in accordance with the manufacturer's instructions; and
- The dust collection bags are emptied to avoid overfilling.

Respiratory protection is not required when water-based dust suppression systems are used regardless of task duration. When dust collection systems are used, respiratory protection with a minimum APF of 10 is required only when engaged in a task indoors or in an enclosed location for more than four hours per shift.

When using handheld grinders indoors or in enclosed areas (areas where airborne dust can buildup, such as a structure with a roof and three walls), employers must provide additional exhaust as needed to minimize the accumulation of visible airborne dust. See the section on *Indoors or Enclosed Areas* for more information.

Worker grinding concrete floor with grinder attached to dust collector (background).

Photo courtesy of the University of Washington.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(xiii) Walk-behind milling machines and floor grinders	Use machine equipped with integrated water delivery system that continuously feeds water to the cutting surface. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
	OR		
	Use machine equipped with dust collection system recommended by the manufacturer. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide the air flow recommended by the manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. When used indoors or in an enclosed area, use a HEPA-filtered vacuum to remove loose dust in between passes.	None	None

Two control options may be used when using **walk-behind milling machines and floor grinders**. Regardless of control option used, the tool must also be operated and maintained in accordance with manufacturer's instructions for minimizing dust emissions.

Option one is to use an integrated water delivery system (commercially developed specifically for the type of tool in use) that continuously feeds water to the cutting surface. Table 1 does not specify a minimum flow rate; however, water must be applied at flow rates specified by the manufacturer.

Full and proper implementation of water controls on walk-behind milling machines and floor grinders requires the employer to ensure that:

- An adequate supply of water for dust suppression is used;

- The spray nozzles are working properly and produce a pattern that applies water at the point of dust generation;
- The spray nozzles are not clogged or damaged; and
- All hoses and connections are intact.

Option two is to use a dust collection system recommended by the manufacturer of the milling machine or floor grinder and a filter with 99 percent or greater efficiency and a filter-cleaning mechanism. The dust collection system used must be capable of maintaining the air flow recommended by the manufacturer.

Full and proper implementation of dust collection systems on walk-behind milling machines and floor grinders requires the employer to ensure that:

- The hose connecting the tool to the vacuum is intact and without kinks or tight bends;
- The filter(s) on the vacuum are cleaned or changed in accordance with the manufacturer's instructions to prevent clogging; and
- The dust collection bags are emptied to avoid overfilling.

When using a dust collector system indoors or in enclosed areas (areas where airborne dust can buildup, such as a structure with a roof and three walls), loose dust must be cleaned with a HEPA-filtered vacuum in between passes of the milling machine or floor grinder to prevent the loose dust from being re-suspended. Removing loose dust with a HEPA vacuum also maximizes vacuum suction by improving the seal between the machine and floor. For indoor and enclosed spaces, employers must provide additional ventilation as needed to minimize the accumulation of visible airborne dust. See the section on *Indoors or Enclosed Areas* for more information.

Respiratory protection is not required for work with walk-behind milling machines and floor grinders regardless of task duration.

Worker milling granite floor indoors with milling machine and dust collection system (background).

Photo courtesy of OSHA.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica			
Equipment/Task	**Engineering and Work Practice Control Methods**	**Required Respiratory Protection and Minimum Assigned Protection Factor (APF)**	
		≤ 4 hours/shift	**> 4 hours/shift**
(xiv) Small drivable milling machines (less than half-lane)	Use a machine equipped with supplemental water sprays designed to suppress dust. Water must be combined with a surfactant. Operate and maintain machine to minimize dust emissions.	None	None

Small drivable milling machines must be used with supplemental water sprays designed to suppress dust and must be operated and maintained to minimize dust emissions. The water used must be combined with a surfactant.

Full and proper implementation of water controls on small drivable milling machines requires the employer to ensure that:

- An adequate supply of water for dust suppression is used;
- The spray nozzles are working properly and produce a pattern that applies water at the point of dust generation;
- The spray nozzles are not clogged or damaged; and
- All hoses and connections are intact.

When using small drivable milling machines indoors or in enclosed areas (areas where airborne dust can buildup, such as a structure with a roof and three walls), the employer must provide additional exhaust as needed to prevent the accumulation of visible airborne dust. *See* the section on *Indoors or Enclosed Areas* for more information on how to determine when those work situations apply.

Respiratory protection is not required for work with small drivable milling machines (less than half-lane) regardless of task duration.

Milling machine milling asphalt road and loading debris into haul truck.

U.S. Air Force photo, Beth Holliker. The equipment shown in this picture is for illustrative purposes only and is not intended as an endorsement by OSHA of this company, its products or services.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(xv) Large drivable milling machines (half-lane and larger)	For cuts of any depth on asphalt only: Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. Operate and maintain machine to minimize dust emissions.	None	None
	For cuts of four inches in depth or less on any substrate: Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. Operate and maintain machine to minimize dust emissions.	None	None
	OR Use a machine equipped with supplemental water spray designed to suppress dust. Water must be combined with a surfactant. Operate and maintain machine to minimize dust emissions.	None	None

Employers whose employees operate large (one-half lane or wider) milling machines have two control options for cuts of four inches in depth or less on any substrate and one control option for cuts of any depth on asphalt. When using any of the control options, the machine must be operated and maintained to minimize dust emissions.

The two control options for making cuts of four inches or less on any combination of roadway material (asphalt and concrete), are to: (1) use a machine equipped with exhaust ventilation on the drum enclosure and supplemental water sprays designed to suppress dust; or (2) use a machine equipped with a supplemental water spray, combined with a surfactant, designed to suppress dust.

When making cuts of any depth on roadway material containing asphalt only, the only control option is to use a machine equipped with exhaust ventilation on the drum enclosure and supplemental water sprays designed to suppress dust.

Respiratory protection is not required for work with large drivable milling machines (half-lane or larger) regardless of task duration.

Milling machine milling asphalt road and loading debris into a haul truck.

Photo courtesy of NIOSH. The equipment shown in this picture is for illustrative purposes only and is not intended as an endorsement by OSHA of this company, its products or services.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica			
Equipment/Task	**Engineering and Work Practice Control Methods**	**Required Respiratory Protection and Minimum Assigned Protection Factor (APF)**	
		≤ 4 hours/shift	**> 4 hours/shift**
(xvi) Crushing machines	Use equipment designed to deliver water spray or mist for dust suppression at crusher and other points where dust is generated (e.g., hoppers, conveyers, sieves/sizing or vibrating components, and discharge points). Operate and maintain machine in accordance with manufacturer's instructions to minimize dust emissions. Use a ventilated booth that provides fresh, climate-controlled air to the operator, or a remote control station.	None	None

When using **crushing machines**, employers must provide workers with a remote control station or ventilated booth that provides fresh, climate-controlled air to the operator. Water sprays or mists must be used for dust suppression at the crusher and other points where dust is generated (*e.g.*, at hoppers, conveyors, sieves/sizing or vibrating components, and discharge points). See the section on *Enclosed Cabs* for more information on how to make sure enclosures meet the requirements of the rule. Table 1 also requires that the machine be operated and maintained according to the manufactures instructions to minimize dust emissions.

The water spray systems can be installed so that they can be activated by remote control. To prevent airborne dust from being generated, full and proper implementation of controls requires that:

- Nozzles are located upstream of dust generation points and positioned to thoroughly wet the material;
- The volume and size of droplets is adequate to sufficiently wet the material (optimal droplet size is between 10 and 150 µm); and
- Spray nozzles are located far enough from the target area to provide complete water coverage but not so far that the water is carried away by wind.

Respiratory protection is not required for crusher operators regardless of task duration.

Crushing machine being loaded with construction debris by an excavator

Photo courtesy of Screen Machine Industries. The equipment shown in this picture is for illustrative purposes only and is not intended as an endorsement by OSHA of this company, its products or services.

Heavy equipment and utility vehicles include a variety of wheeled or tracked vehicles, ranging in size from large heavy construction equipment, such as bulldozers, scrapers, loaders, cranes and road graders, to smaller and medium-sized utility vehicles, such as tractors, bobcats and backhoes with attached tools. Table 1 has two entries for heavy equipment and utility vehicles based on the types of tasks performed with that equipment.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(xvii) Heavy equipment and utility vehicles used to abrade or fracture silica-containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials	Operate equipment from within an enclosed cab. When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions.	None None	None None

The next Table 1 entry is **heavy equipment and utility vehicles used to abrade or fracture silica-containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials.** These include activities such as fracturing or abrading rock and soil; demolishing concrete or masonry structures; and loading, dumping, and removing demolition debris.

The operator must be in an enclosed cab. Modern heavy equipment already comes equipped with enclosed, filtered cabs that meet the requirements of Table 1. See the section on *Enclosed Cabs* for more information on how to make sure that the cab meets the requirements of the rule. When other employees are engaged in the task, water, dust suppressants, or both must also be applied as necessary to minimize dust emissions.

Respiratory protection is not required for heavy equipment operators and laborers who assist heavy equipment operators during demolition activities involving silica-containing materials or activities where silica-containing materials are abraded or fractured, regardless of the duration of the task.

NOTE: When the operator exits the enclosed cab and is no longer actively preforming the task, the operator is considered to have stopped the task. However, if other abrading, fracturing, or demolition work is performed by other heavy equipment and utility vehicles in the area while an operator is outside the cab, that operator is considered to be an employee "engaged in the task" and must be protected by the application of water and/or dust suppressants.

Excavator equipped with an enclosed cab and hoe-ram demolishing a concrete wall.

Photo courtesy of CPWR.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(xviii) Heavy equipment and utility vehicles for tasks such as grading and excavating but not including demolishing, abrading, or fracturing silica-containing materials	Apply water and/or dust suppressants as necessary to minimize dust emissions.	None	None
	OR		
	When the equipment operator is the only employee engaged in the task, operate equipment from within an enclosed cab.	None	None

Heavy equipment and utility vehicles used for tasks such as grading and excavating do not involve demolition or the fracturing or abrading of silica. Tasks include earthmoving, grading, and excavating; other activities such as moving, loading, and dumping soil and rock; and dumping and grading of ballast in the railroad industry, which is generally subject to OSHA's Construction standards.

Employers have two control options when the operator is the only employee engaged in the task and one option when employees other than the operator are engaged in the task. The first option requires the equipment operator to operate the equipment within an enclosed cab when the operator is the only employee in the area. Most heavy equipment already comes equipped with enclosed, filtered cabs that meet the requirements of Table 1. See the section on *Enclosed Cabs* for more information on how to make sure that the cab meets the requirements of the rule.

The second option requires the application of water and/or dust suppressants as necessary to minimize dust emissions. Water must be applied at rates sufficient to minimize release of visible dust. The following scenarios are examples of when the employer must use water and/or dust suppressants as necessary to minimize dust emissions: (1) equipment for grading and excavating is not equipped with enclosed, pressurized cabs or (2) employees other than the operator are engaged in the task. If water or dust suppressants are applied as necessary to minimize visible dust, the employer need not provide an enclosed, filtered cab for the operator.

Respiratory protection is not required for work with heavy equipment when it is operated from within an enclosed cab, or when water or other dust suppressants are used, regardless of task duration.

Earthmoving using a dozer equipped with enclosed operator cab.

Photo courtesy of NIOSH.

Water Delivery Systems

Integrated water delivery systems are required for several types of equipment in Table 1. Integrated water systems must be developed specifically for the type of tool in use so they will apply water at the appropriate dust emission points based on tool configuration and do not interfere with other tool components or safety devices. Water systems designed for blade cooling also suppress dust and meet the requirements for Table 1.

The water must be applied at flow rates sufficient to minimize release of visible dust. Effective control of the dust depends on factors such as dust particle size, dust particle velocity, spray nozzle size and location, use of surfactants or other binders, and environmental factors (water hardness, humidity, weather, etc.), all of which must be considered when using wet methods. The appropriate water flow rates for controlling silica dust emissions can vary; therefore, it is necessary to follow manufacturers' instructions when determining the required flow rate for dust suppression systems on a given worksite.

Any slurry generated when using water to suppress dust should be cleaned up to limit secondary exposure to silica dust when the slurry dries following procedures described in the employer's *Written Exposure Control Plan*.

When working in cold temperatures, where there is a risk of water freezing, additional work practices such as insulating drums, wrapping drums with gutter heat tape or adding environmentally-friendly antifreeze additives to water may be needed.

Dust Collection Systems

Commercially available dust collection systems (*i.e.*, LEV) are required for several types of equipment in Table 1. This requirement ensures that employers use equipment that is designed to effectively capture dust generated by the tool being used and does not introduce new hazards such as obstructing or interfering with safety mechanisms.

The "commercially available" limitation is meant only to eliminate on-site improvisations of equipment by the employer. Employers can use products that are made by aftermarket manufacturers (someone other than the original tool manufacturer) that are intended to fit the make and model of the tool. This includes custom-designed products made to meet the particular needs and specifications of the employer purchasing the product. These systems are designed to work effectively with the equipment and not introduce new hazards such as obstructing or interfering with safety mechanisms. When employers use methods other than commercially available systems for dust suppression, they must conduct exposure assessments and comply with the PEL.

Some Table 1 entries for dust collection systems specify use of cyclonic pre-separators and filter cleaning mechanisms to prevent buildup of debris on filters that result in less dust capture. A cyclonic pre-separator collects large debris before the air reaches the filters. A filter cleaning mechanism prevents the need for manually cleaning filters to prevent buildup of debris (caking). Some vacuums are equipped with a gauge indicating filter pressure or an equivalent device (*e.g.*, timer to periodically pulse the filter) to help employees in determining when it is time to run a filter cleaning cycle.

Indoors or Enclosed Areas

Several Table 1 entries refer to tasks performed "outdoors" or "indoors or in an enclosed area." Indoors or in an enclosed areas mean areas where airborne dust can build up unless additional exhaust is used. For example, a work area with only a roof that does not affect the dispersal of dust

would not be considered enclosed; however, an open-top structure with three walls and limited air movement or a roof that does limit dispersal would be considered enclosed.

Sufficient air circulation in enclosed or indoor environments is important to ensure the effectiveness of the control strategies and to prevent the accumulation of airborne dust. Employers following Table 1 are required to provide a means of exhaust as needed to minimize the accumulation of visible airborne dust for tasks performed indoors or in enclosed areas. The means of exhaust necessary could include: the use of portable fans (box fans, floor fans, axial fans), portable ventilation systems, or other systems that increase air movement and assist in the removal and dispersion of airborne dust. To be effective, the ventilation must be set up so that movements of employees during work, or the opening of doors and windows, will not negatively affect the airflow.

Enclosed Cabs

Enclosed cabs or booths are specified for rock drilling, crushers, and heavy equipment. Employers must ensure that the enclosed cab or booth is:

- Maintained as free as practicable from settled dust;
- Has door seals and closing mechanisms that work properly;
- Has gaskets and seals that are in good condition and work properly;
- Is under positive pressure maintained through continuous delivery of filtered air;
- Has intake air that is filtered through a pre-filter that is 95% efficient in the 0.3-10.0 µm range (*e.g.*, MERV-16 or better); and
- Has heating and cooling capabilities.

The controls for enclosed cabs lower the potential for dust to be re-suspended inside the cab or enter the enclosed cab or booth. They also ensure that the filtered air provided to the employee does not contain silica particles and that the working conditions in the cab are comfortable so that employees are less likely to open windows and be exposed.

The procedures for maintaining and cleaning the cab or booth, and for frequent and regular inspections of the cabs and booths, must be addressed through the employer's *Written Exposure Control Plan* and *Competent Person* requirements described below.

Determining Task Duration and Requirements for Respirator Use

Respirator requirements in Table 1 are divided by task duration:

- "Less than or equal to four hours/shift" and,
- "Greater than four hours/shift".

Each of the following scenarios is considered a "shift" for purposes of determining the maximum amount of time that an employee may spend on Table 1 tasks without respiratory protection:

- A standard 8-hour work period;
- A day with a break between work periods (*e.g.*, four hours on, two hours off, four hours on);
- Work periods longer than eight hours;
- Double shifts within a single day;
- A work period spanning two calendar days (*e.g.*, 8 p.m. until 4 a.m.).

Task duration time starts when the operator begins using the tool, and continues to be counted until he or she completes the task. This time includes intermittent breaks in tool usage and clean-up. However, tasks that are performed multiple times per day, during distinct time periods, should be counted as separate tasks, and times should be combined.

The requirement to provide respirators is based on the anticipated duration of the task. Employers must make a good-faith judgment

of the task's anticipated duration over the work shift, whether performed continuously or intermittently, based on previous experience and all other available information.

Examples of Determining Task Durations

1. Tasks with intermittent breaks. An employee cuts and places bricks, one at a time, for four hours consecutively and then spends 30 minutes cleaning up the saw and emptying slurry or dust collectors. All four hours spent cutting and laying bricks along with the 30 minutes for clean-up count for a total task duration of four and a half hours.
2. Tasks with distinct time periods. An employee cuts multiple bricks for 15 minutes, lays bricks for two hours before returning to cut more bricks for another 30 minutes. The total task duration is 45 minutes

If an employer estimates that an employee will perform a single task for four hours or less during a single shift, then the employer must ensure that the employee uses whichever respirator, if any, is specified in the "≤ 4 hr/shift" column in Table 1. If an employer estimates that the task will take more than four hours, then the employer must ensure that the employee uses any respiratory protection specified in the "> 4 hr/shift" column in Table 1, during the entire task, not just during the time beyond the first four hours that the task is performed.

If an employer anticipates that a task will take four hours or less, but unforeseen difficulties will extend the task duration beyond four hours, the employer is required to provide the listed respiratory protection as soon as it becomes evident that the duration of the task may exceed the 4-hour limit, measured from the beginning of the task.

Where an employee performs more than one task in Table 1 during the course of a shift, and the total duration of all tasks combined is less than four hours, the required respiratory protection for each task is the respiratory protection specified in the less than four hours per shift column. If the total duration of all Table 1 tasks combined is more than four hours per shift, the required respiratory protection for each task is the respiratory protection specified in the more than four hours per shift column. As was discussed for single tasks, if multiple tasks are estimated to last less than 4 hours, but it becomes evident that the tasks will take more than four hours total, the employer must reexamine respiratory protection requirements and immediately provide a respirator, when required.

Examples of Respiratory Protection Requirements for Single Tasks in Table 1

1. An employer anticipates that it will take an employee 3 hours to cut concrete walls using a handheld power saw (outdoors). No respiratory protection is required.
2. An employer anticipates that it will take an employee 5 hours to demolish an asphalt road using a jackhammer (outdoors). The employer must provide a respirator with an APF of 10 and ensure that the employee wears it for the entire duration of the task.
3. An employer anticipates that it will take an employee 3 hours to grind a concrete floor (indoors) and, therefore, determines that respiratory protection is not required under Table 1. However, at two hours, the employer determines that it will take more than 4 hours to complete the task. The employer must provide a respirator with an APF of 10 at that time and ensure that the employee wears it for the remaining duration of the task.

Examples of Respiratory Protection Requirements for Employees who do more than one Table 1 Task

1. An employer anticipates that an employee will use a handheld grinder on a concrete wall outdoors for 3 hours and then use a chipping hammer outdoors for 2 hours (total Table 1 task duration of 5 hours per shift). The employer looks in the "> 4 hour/shift" column for each task to determine that no respiratory protection is required during use of the handheld grinder outdoors, but a respirator with an APF of 10 is required during use of the chipping hammer outdoors.
2. An employer anticipates that an employee will use a stationary masonry saw to cut bricks for 1 hour and use a handheld power saw to cut concrete indoors for 1 hour over the course of a shift (total Table 1 task duration of two hours per shift). The employer looks in the "≤ 4 hour/shift" column for each task to determine that no respiratory protection is required during use of the stationary masonry saw, but a respirator with an APF of 10 is required during use of the handheld power saw indoors.
3. An employer anticipates that an employee will drive a half-lane milling machine for 4 hours and then operate a walk-behind milling machine equipped with an integrated water delivery system for 4 hours (total Table 1 task duration of 8 hours). The employer looks in the "> 4 hour/shift" column for each task to determine that no respiratory protection is required for either task.

ALTERNATIVE EXPOSURE CONTROL METHODS – PARAGRAPH (D) OF THE STANDARD

Employers that conduct tasks not listed in Table 1 or do not fully and properly implement the engineering controls, work practices, and respiratory protection described in Table 1 of the specified exposure control methods approach must follow the alternative exposure control methods approach. The alternative exposure control methods approach involves assessing employee exposure to respirable crystalline silica, and limiting exposure to the PEL using feasible engineering and work practice control methods, and respiratory protection when necessary. Each of the three components of alternative exposure control methods – the PEL, exposure assessment, and methods of compliance – is explained below.

Permissible Exposure Limit (PEL)

Employers complying with the alternative exposure control methods must ensure that their employees' exposures to respirable crystalline silica do not exceed the PEL, which is 50 µg/m^3 as an 8-hour TWA. This means that over the course of any 8-hour work shift, exposures can fluctuate, but the average exposure to respirable crystalline silica cannot exceed 50 µg/m^3. The PEL applies to the three forms of respirable crystalline silica that are covered by the standard: quartz, cristobalite, and trydimite. Quartz is by far the most common form of crystalline silica found at construction workplaces, and in most cases, quartz will be the only form of respirable crystalline silica analyzed in air samples used to measure employee exposures.

Exposure Assessment

Construction employers following alternative exposure control methods must assess the 8-hour TWA exposure for each employee who is or may reasonably be expected to be exposed to respirable crystalline silica at or above the action level of 25 µg/m^3 as an 8-hour TWA. The purposes of assessing employee exposures include: identifying where exposures are occurring; helping the employer select control methods and make sure those methods are effective; preventing employees from being exposed above the PEL; providing employees with information about their exposure levels; and allowing the employer to give the PLHCP performing medical examinations information about employee exposures.

Calculation of TWA Exposures

Both the PEL and the action level are expressed as TWA exposures. TWA measurements account for variable exposure levels over the course of a work shift by averaging periods of higher and lower exposures. The TWA exposure for an 8-hour work shift is calculated using a simple formula:

TWA = (Ca Ta + Cb Tb . . . Cn Tn) ÷ 8

Where:

TWA is the time-weighted average exposure for the work shift

C is the concentration during any period of time (T) where the concentration remains constant; and

T is the duration in hours of the exposure at the concentration (C)

For example, assume that an employee is exposed to respirable crystalline silica in an 8-hour workday as follows:

Two hours exposure at 100 µg/m^3
Two hours exposure at 50 µg/m^3
Four hours exposure at 10 µg/m^3

Entering this information in the formula, we get:

(2 x 100 + 2 x 50 + 4 x 10) ÷ 8 = 42.5 µg/m^3

Because 42.5 µg/m^3 is higher than 25 µg/m^3, this employee's TWA exposure would be above the action level, but below the PEL of 50 µg/m^3.

Employers can choose between two options for assessing exposures:

- The performance option; or
- The scheduled monitoring option.

Performance Option. The performance option gives employers flexibility to determine the 8-hour TWA exposure for each employee based on any combination of air monitoring data or objective data that can accurately characterize employee exposures to respirable crystalline silica.

Air monitoring data are any results of air monitoring (analyzed according to the procedures and requirements in Appendix A) that the employer has done to meet the requirements of the standard.

Objective data is information that demonstrates employee exposure to respirable crystalline silica associated with a particular product or material or a specific process, task, or activity. The data must reflect workplace conditions that closely resemble or could result in higher exposures than the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operations.

Examples of objective data are information such as:

- Air monitoring data from industry-wide surveys;
- Calculations based on the composition of a substance;
- Area sampling results and exposure mapping profile approaches; and
- Historical air monitoring data collected by the employer.

Employers choosing the performance option must:

- Conduct the exposure assessment before work begins;
- Reassess exposures whenever a change in production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or higher exposures at or above the action level, or when the employer has any reason to believe that new or additional exposures at or above the action level have occurred;
- Be able to demonstrate that employee exposures have been accurately characterized; and
- Make sure that the exposure assessment reflects the exposures of employees on each shift, for each job classification, in each work area.

Examples of Using Objective Data to Conduct Exposure Assessments under the Performance Option

1. Industry-wide surveys of typical tasks or operations, which include well-documented procedures for measuring exposures and methods for controlling dust, could be used by employers to characterize employee exposures where employees perform tasks consistent with those described in the survey.
2. Employers can use direct-reading instruments to measure real-time levels of respirable dust in the air. If the employer has information on the percentage of respirable crystalline silica in that dust (for example, from the analysis of a bulk sample or information from a safety data sheet), he or she can then calculate the level of respirable crystalline silica in air.
3. Historical air monitoring data collected by the employer could be used to assess employee exposures if the employer can show that the data were collected during work operations and conditions that are consistent with the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operations.

The performance option may be especially useful when measuring employee exposures is challenging, such as when tasks are conducted for short durations of time or performed under different weather conditions.

The performance option gives employers flexibility for characterizing the exposures of all employees. For example, instead of conducting air monitoring on two employees who perform the same job on different shifts, the employer could determine that there are no differences in exposure between those two employees, and characterize the exposure of the second employee based on the air monitoring results of the first employee.

Under the performance option, employers can characterize employee exposure within a range to account for exposure variability. Employers can also use that option to show that exposures exceed the PEL by a certain level, such as less than 10 times the PEL, after using all feasible controls. The employer would then know that he or she must provide respiratory protection with an APF of at least 10, as well as medical surveillance for employees required to wear a respirator under the silica standard for 30 or more days per year.

Scheduled Monitoring Option. The scheduled monitoring option lets employers know when and how often they must perform exposure monitoring to measure employee exposures. When following the scheduled monitoring option, employers must make sure that:

- Results represent the employee's TWA exposure to respirable crystalline silica over an eight-hour workday;
- Samples are collected from the employee's breathing zone; and
- Samples are collected outside respirators so that they represent the exposure that would occur without the use of the respirator.

OSHA intends for employers using the scheduled monitoring option to conduct initial monitoring as soon as work begins so that they are aware of exposure levels and where control measures are needed.

Under the scheduled monitoring option, just as under the performance option, employers must correctly characterize each employee's exposure to respirable crystalline silica.

Exposure monitoring must include, at a minimum, one full-shift sample taken for each job function in each job classification, in each work area, and on each shift. Characterizing each employee's exposure may involve monitoring all exposed employees or a smaller number of employees whose exposures can then represent those of other employees.

Representative sampling involves monitoring the employee or employees reasonably expected to have the highest exposure to respirable crystalline silica (for example, the employee closest to an exposure source). This exposure is then assigned to the other employees in the group who perform the same tasks on the same shift and in the same work area.

Representative monitoring is allowed when several employees perform the same job on the same shift and under the same conditions.

How Often Employers Must Monitor under the Scheduled Monitoring Option. Under the scheduled monitoring option, how often monitoring must be done depends on the results of initial monitoring and, thereafter, any required further monitoring, as follows:

- If the initial monitoring indicates that employee exposures are below the action level, no further monitoring is required.
- If the most recent exposure monitoring reveals employee exposures at or above the action level but at or below the PEL, the employer must repeat monitoring within six months of the most recent monitoring.

- If the most recent exposure monitoring reveals employee exposures above the PEL, the employer must repeat monitoring within three months of the most recent monitoring.
- When two non-initial monitoring results taken consecutively, at least 7 days apart but within 6 months of each other, are below the action level, employers may stop monitoring for employees represented by those results, as long as no changes occur that could reasonably be expected to result in new or additional exposures at or above the action level.

Reassessment of Exposures. The employer must reassess exposures whenever a change in production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or additional exposures to respirable crystalline silica at or above the action level, or when the employer has any reason to believe that new or additional exposures at or above the action level have occurred. For example, reassessment would be required when a task performed in an open, outdoor location is moved to an enclosed or confined space, because the change in conditions could reasonably be expected to result in higher exposures to respirable crystalline silica.

Employers do not have to conduct additional monitoring simply because a change has occurred, so long as the change is not reasonably expected to result in new or additional exposures to respirable crystalline silica at or above the action level. For example, reassessment is not required when a task is moved from an indoor to an outdoor location, or when a product is replaced with another product that has lower crystalline silica content in the same process.

Methods of Sample Analysis (Appendix A of the Standard). Appendix A of the silica standard lists laboratory procedures for measuring respirable crystalline silica in air samples. Employers must make sure that all air samples taken to meet the requirements of the silica standard are analyzed by a laboratory that follows the procedures in Appendix A. If employers hire an outside laboratory to do the analyses for respirable crystalline silica, they can rely on a statement from that laboratory that it follows Appendix A. For example, the laboratory could indicate that it analyzes samples according to Appendix A of the standard in the laboratory report or on its website.

Employee Notification. Employers must notify each affected employee of the results of the exposure assessment within 5 working days of completing it. "Affected" means all employees whose exposures were assessed, including employees whose exposures were represented by other employees' exposure measurements, and those whose exposure assessments were based on objective data. The 5-day period for notification starts when:

- An employer following the performance option finishes the exposure assessment; or
- An employer following the scheduled monitoring approach receives the laboratory results.

Employers must either notify each employee in writing or post the results in a location that all affected employees can access. In cases where an employee might have moved onto another job or jobsite, the assessment results could be included with the employees' final paycheck.

Exposures can be characterized and reported as a range (for example, between the action level and the PEL), but must reflect exposures that would occur if the employee were not using a respirator.

When an exposure assessment reveals exposures above the PEL, the written notification must also describe the corrective action the employer is taking to reduce employee exposures to or below the PEL. Corrective actions include engineering controls. However, if engineering controls are not feasible or the employer needs more than 5 days to identify the right engineering

controls, respiratory protection is the corrective action that would be described in the written notification.

Observation of Monitoring. The employer must let affected employees or their designated representatives observe any air monitoring of employee exposure to respirable crystalline silica. When observation of monitoring requires entry into an area where use of protective clothing or equipment, such as a respirator, is required, the employer must provide the observer with that protective clothing or equipment. The employer must provide the protective clothing and equipment at no cost, and make sure that the observer uses such clothing or equipment.

However, if the observer does not need to enter an area requiring the use of protective clothing or equipment in order to effectively observe monitoring (for example, if monitoring can be viewed from outside the hazardous areas), no protective clothing or equipment would be needed.

Methods of Compliance

Employers following alternative exposure control methods must comply with the methods of compliance requirements of the standard. The methods of compliance section of the standard requires employers to protect employees following the hierarchy of controls, which relies on engineering and work practice controls for reducing exposures and allows for respirator use, in addition to those controls, only when feasible engineering controls cannot reduce exposures to acceptable levels. The methods of compliance section also cross-references other OSHA standards that apply to abrasive blasting.

Engineering and Work Practice Controls. Employers must use engineering and work practice controls to reduce and keep employee exposure to respirable crystalline silica to or below the PEL of 50 μg/m^3, unless the employer can demonstrate that such controls are not feasible. If feasible engineering and work practice controls are not able to reduce employee exposures to or below the PEL, employers must still use feasible controls to reduce exposures to the lowest possible level and then use respiratory protection along with those controls.

The main types of engineering controls for silica are wet methods and local exhaust ventilation. Wet methods involve applying water or foam at the point of dust generation to keep dust from getting into the air. An example is an integrated water delivery system on a stationary masonry saw. Local exhaust ventilation removes dust by capturing it at or near the point where it is created. An example is a dust collector for a handheld grinder.

Another engineering control is isolation. Isolation separates employees from the dust source by containing the dust or isolating employees. An example is a properly ventilated cab on heavy equipment.

Work practice controls involve performing a task in a way that reduces the likelihood or levels of exposure. Work practice controls are often used with engineering controls to protect employees. Employees must know the appropriate work practices for maximizing the effectiveness of controls and minimizing exposures. Examples of work practice controls include:

- Inspecting and maintaining controls to prevent or fix malfunctions that would result in increased exposures;
- Making sure that nozzles spray water at the point of dust generation for wet method controls;

- Making sure that hoses are not kinked on a tool used with a dust collector;
- Wetting down silica dust before sweeping it up; and
- Scheduling work so that tasks that involve high exposures are performed when no other employees are in the area.

Reducing exposures through the primary use of engineering and work practice controls is known as the hierarchy of controls, and it is a long-standing OSHA policy. Advantages of engineering controls are that they:

- Control crystalline silica-containing dust particles at the source, thus minimizing exposures to all persons in the surrounding work area;
- Are reliable, predictable, and provide consistent levels of protection to a large number of employees;
- Can be monitored; and
- Are less prone to human error than the use of personal protective equipment.

Under the hierarchy of controls, respirators can be another effective way to protect employees. However, respirators may be less practical or effective than engineering controls for the following reasons:

- They must be selected for each worker, fitted, occasionally refitted, and regularly maintained (including replacing filters and other parts as necessary).
- Employees have to consistently and correctly use properly fitted respirators but may resist wearing them because respirators can be uncomfortable, especially in hot weather.
- Respirators may put a physical strain on employees' bodies, as a result of the respirator's weight and because they increase breathing resistance. Employees with some health conditions cannot wear respirators because the physical strain of wearing the respirator increases their risk of illness, injury, and even death.
- Respirators can create safety concerns because they interfere with workers' ability to hear, see, smell, and communicate.
- Respirators only protect the employees wearing them.

Even when engineering and work practice controls cannot reduce exposure levels to or below the PEL, those controls must be used to reduce exposures as low as possible. This reduction in exposure levels benefits employees by reducing the required protection factor of the respirator, and thus increasing the choices of respirators that can be used. For example, if feasible engineering controls reduce exposures from 50 times to less than 10 times the PEL, employers could provide approved half-mask respirators with an APF of 10 that may be lighter and easier to use compared to full-facepiece respirators.

Abrasive Blasting. In addition to complying with requirements to use engineering controls and work practices according to the hierarchy of controls, construction employers that conduct abrasive blasting operations using crystalline silica-containing blasting agents or conduct abrasive blasting on structures that contain crystalline silica must also comply with other relevant standards, such as the ventilation standard for construction (29 CFR 1926.57), which contains requirements for ventilation and personal protective equipment, including respirators. This is simply a cross-reference to other standards that construction employers must comply with when conducting abrasive blasting.

RESPIRATORY PROTECTION – PARAGRAPH (E) OF THE STANDARD

Employers must provide employees with appropriate respirators where required by the silica standard. The respirators must comply with requirements of the silica standard and with OSHA's Respiratory Protection standard (29 CFR 1910.134).

Employers who follow the specified exposure control methods listed in Table 1 must provide respiratory protection where required by Table 1. Employers who follow alternative exposure control methods must provide respiratory protection:

- Where exposures exceed the PEL during periods necessary to install or implement feasible engineering and work practice controls;
- Where exposures exceed the PEL during tasks, such as some maintenance and repair tasks, for which engineering and work practice controls are not feasible;
- During tasks in which the employer has implemented all feasible engineering and work practice controls but exposures remain above the PEL.

Where respirator use is required, employers must implement a respiratory protection program in accordance with the respiratory protection standard. The respiratory protection program ensures that respirators are properly used in the workplace and are effective in protecting employees. See the *Small Entity Compliance Guide for the Respiratory Protection Standard* for information on the requirements of that standard.

If an employer following the specified exposure control methods fully and properly implements the engineering controls, work practices, and respiratory protection required in Table 1, the employer will be considered to be in compliance with the requirements of the silica standard and the respiratory protection standard for identifying and evaluating respiratory hazards and providing each employee with an appropriate respirator.

Employers following Table 1 must comply with all other requirements of the Respiratory Protection standard.

Voluntary Use of Respirators

Employers may provide respirators at the request of employees or let employees use their own respirators when respirators are not required under the silica standard. See the *Small Entity Compliance Guide for the Respiratory Protection Standard* for information about employer responsibilities when employees voluntarily wear respirators.

HOUSEKEEPING – PARAGRAPH (F) OF THE STANDARD

The respirable crystalline silica standard requires all construction employers covered by the standard, including those who fully and properly implement the control methods specified in Table 1, to avoid certain housekeeping practices. When cleaning up dust that could contribute to employee exposure to respirable crystalline silica, employers must:

- Not allow dry brushing or dry sweeping, unless methods such as wet sweeping and HEPA-filtered vacuuming are not feasible;
- Not allow cleaning of surfaces or clothing with compressed air, unless the compressed air is used together with a ventilation system that effectively captures the dust cloud or no other cleaning method is feasible.

Cleaning methods such as dry sweeping, dry brushing, and use of compressed air can cause respirable crystalline silica dust to get into the air and be inhaled by employees. Therefore, the silica standard limits the use of these cleaning methods to prevent unnecessary exposures to employees. Employers are required to use other cleaning methods such as wet sweeping and HEPA-filtered vacuums, whenever feasible, because such methods reduce employee exposures by preventing silica-containing dust from getting into the air.

Feasibility of Cleaning Methods

In a very limited number of cases, cleaning methods such as wet sweeping or HEPA-filtered vacuums may not be safe or effective. When wet methods or HEPA-filtered vacuuming would not be effective, would cause damage, or would create a hazard in the workplace, the employer is not required to use these cleaning methods. However, even in cases where one of those cleaning methods may not be safe or effective, employers could often use another acceptable method for cleaning. For example, if it is not feasible to wet sweep a wood floor because water would damage the wood or cause mold growth, a HEPA-filtered vacuum could be used for cleaning. Therefore, situations in which no acceptable cleaning methods can be used are expected to be very rare.

In those rare cases where the employer needs to use cleaning methods such as dry sweeping, dry brushing, or compressed air, the employer must be able to show why cleaning methods that decrease employee exposures are not feasible.

When Employers Must Follow Housekeeping Practices

The housekeeping requirements in the silica standard apply only where cleaning "could contribute to employee exposure to respirable crystalline silica". This phrase clarifies that employers have to follow the housekeeping requirements of the silica standard only where employees could be exposed to the very small (respirable) crystalline silica particles created by high-energy tasks such as drilling, cutting, grinding, or crushing crystalline-silica-containing materials. Employers are not required to follow these housekeeping requirements when cleaning ordinary soil, large debris, and non-silica-containing materials, such as sawdust.

WRITTEN EXPOSURE CONTROL PLAN – PARAGRAPH (G) OF THE STANDARD

All employers covered by the standard, including employers who fully and properly implement the specified exposure controls in Table 1, must develop and implement a written exposure control plan. Written exposure control plans describe workplace exposures and ways to reduce those exposures, such as engineering controls, work practices, housekeeping methods, and restricting access to areas where high exposures occur. The plans improve employee protections by making sure that employers identify all exposures and controls to prevent overexposures. Such plans are also useful for letting employees know what kind of protections they should expect to see on the job.

What Must be Included in a Written Exposure Control Plan

Below is a list of what the employer must include in each section of the written exposure control plan, with general examples of the types of information that could be included and sample entries for the use of a stationary masonry saws for cutting bricks.

The plan must include a description of workplace tasks involving exposures to respirable crystalline silica. Employers must list all tasks that employees perform that could expose them to respirable crystalline silica dust. This section could also describe the equipment used and factors that affect exposures, such as types of silica-containing materials handled in those tasks (concrete or tile), weather conditions (wind or humidity), soil types (clay versus rock), and if tasks are done outdoors versus indoors or in enclosed locations.

Example: Cutting bricks using a stationary masonry saw outdoors.

The plan must include a description of engineering controls, work practices, and respiratory protection used to limit employee exposure to respirable crystalline silica for each task. For each task that employees perform, employers must describe types of controls used, like a dust collector with manufacturer's recommended air flow and a filter with 99 percent efficiency, effective work practices, as in checking that water nozzles are not plugged, and if required, appropriate respiratory protection, like a respirator with an APF of 10. Employers could also describe signs that controls are not working effectively, such as an increase in visible dust or no water being delivered to the saw blade.

This section of the written exposure control plan is especially important for construction employers who use controls in Table 1, because they are not required to measure exposures to make sure that controls are working. Therefore, including information such as manufacturer's instructions for operating and maintaining tools to decrease dust, when possible, demonstrates that the employer has a complete understanding of those instructions and is using them to control dust. Describing those instructions in the written exposure control plans also lets employees know what the employer needs to do to protect them.

Example: When cutting bricks using a stationary masonry saw, Table 1 will be fully and properly implemented, including using a saw with an integrated water delivery system that delivers a steady stream of water to the cutting blade. The saw operator will make sure that enough water for the saw is available before starting to cut, and that a steady stream of water can be seen while cutting. The operator will change water, when needed, to maintain flow of water to the blade.

Use the stationary masonry saw in accordance with manufacturer's instructions to minimize the release of visible dust. Inspect dust controls daily to make sure they are functioning properly. Stop work and adjust controls if you see an increase in visible dust.

Respiratory protection is not required.

The plan must include a description of the housekeeping methods used to limit employee exposure to respirable crystalline silica. While employees are cleaning, dust can become airborne and expose them to silica. In this part of the written exposure control plan, employers must list acceptable cleaning methods that will be used to prevent employees from being exposed and any protections that are needed if certain cleaning methods have to be used.

The *Housekeeping* section of the standard requires that when cleaning up dust that can contribute to employee exposures to respirable crystalline silica, employers must:

- Not allow cleaning by dry brushing and sweeping, unless methods such as wet sweeping and HEPA-filtered vacuuming are not feasible;
- Not allow cleaning of surfaces or clothing with compressed air, unless the compressed air is used together with a ventilation system that effectively captures the dust cloud or no other cleaning method is feasible.

This section of the written plan would include cleaning methods that are acceptable (*e.g.*, wet sweeping), cleaning methods that are unacceptable because acceptable cleaning methods are feasible (*e.g.*, dry sweeping), and special instructions (*e.g.*, use local exhaust ventilation if compressed air must be used). Hygiene-related subjects, such as not using compressed air to clean clothing, could also be addressed in this section of the written exposure control plan.

Example: Slurry generated by the saw will be cleaned up before it dries using a wet vacuum. When emptying the vacuum, the slurry will be transferred into a plastic bag and placed inside a container for disposal. The container will be sealed to prevent the release of dust back into the work space.

Never sweep or use compressed air on dried slurry. If slurry dries, immediately wet it down and clean it up with the wet vacuum.

The plan must include a description of the procedures used to restrict access to work areas, when necessary, to limit the number of employees exposed to respirable crystalline silica and the levels to which they are exposed, including exposures generated by other employers or self-employed workers. This section of the plan must describe how the employer restricts access to prevent exposures, such as:

- Scheduling certain tasks when others are not around,
- Telling employees to stay out of areas where dust is generated,
- Moving employees to an area where they are not exposed to dust, or
- Posting warning signs.

Employers following the alternative exposure control methods approach must restrict access where an exposure assessment shows that exposures are above the PEL. When following Table 1, employers must restrict

access when employees are engaged in tasks that require respirator use under Table 1. For example, if an employer following Table 1 has an employee who is jackhammering for more than four hours and is therefore wearing a respirator, the employer or the competent person must make sure that an employee directing traffic (not engaged in the task), is positioned away and upwind from the employee who is jackhammering.

The employer or competent person must also restrict access, when needed, for exposures generated by another employer or self-employed person. Such a situation might occur if the other employer of self-employed person is conducting a task that generates clearly visible dust.

Example: When the controls on a stationary masonry saw are fully and properly implemented, access does not need to be restricted to decrease other employees' exposure to respirable crystalline silica.

The competent person can use traffic cones or barrier tape to restrict access if needed for other reasons such as safety concerns.

Yearly Review of Written Exposure Control Plans

The respirable crystalline silica standard requires employers to review and evaluate the effectiveness of the written exposure control plan at least once a year and update it as necessary. A yearly review is needed to make sure that all information in the plan is up-to-date. For example, the employer might have bought a new type of equipment or asked employees to conduct a new task involving exposure, and that information needs to be described in the written plan.

Availability of the Written Exposure Control Plan

Employers must allow the written exposure control plan to be viewed or copied by each employee covered by the standard, their designated representative, and representatives from OSHA or NIOSH, upon request. Making the written exposure control plan available to employees and their designated representatives empowers and protects employees by letting them and their representatives know the silica hazards the employer identified and controls for those hazards. This allows employees and representatives to question employers if controls are not fully and properly implemented or maintained. Likewise, making written exposure control plans readily available to OSHA or NIOSH allows them to verify that employee protections are effective. If OSHA inspects a workplace, the OSHA Compliance Safety and Health Officer will ask to see the employer's written exposure control plan.

Sample Written Exposure Control Plans

To help employers develop written exposure control plans, a sample plan is included below. This sample shows an easy-to-use format that can be changed to address the specific tasks performed by each employee. The sample plan meets the requirements of the standard and contains the level of detail that OSHA considers useful for employers in helping them protect their employees. As the sample shows, the plan can contain useful information without being long or complicated.

The Center for Construction Research and Training (CPWR) has a tool to help employers develop written exposure control plans that is available at www.silica-safe.org. Unions, trade associations or professional groups may offer sample written exposure control plans or other assistance to employers, which might be helpful, especially if written exposure control plans are tailored to a particular type of construction work performed. Although such general guidance may be helpful, employers must make sure that any plan they use is tailored to address all the information required by the standard and all tasks, tools, and controls used by the employer.

Some sample plans might call for more information than is required by the silica standard (for example, information about exposure assessments, medical surveillance, and training). Employers can include this information in the plan if it is useful to them, but they are not required to do so under the silica standard.

Employers can also develop a comprehensive plan that includes all equipment, materials, tasks, and conditions for the jobs they perform. Doing so will greatly reduce the need to update the written plan for each new job or jobsite for the many construction employers who use the same equipment to perform the same tasks at many locations.

Sample Written Exposure Control Plan

Company:
John Doe Renovators

Person Completing the Plan, Title:
John Doe, Owner

Description of Task:
Demolishing concrete and tile floors inside homes or public buildings using a jackhammer.

Control Description
Controls:

- Use jackhammer equipped with the appropriate, commercially available shroud and a vacuum dust collection system with the flow rate recommended by the jackhammer manufacturer, a filter that is at least 99 percent efficient, and a filter cleaning mechanism.
- Use a portable fan to exhaust air and prevent the buildup of dust.

Work practices:

- Check shrouds and hoses to make sure they are not damaged before starting work.
- Make sure the hoses do not become kinked or bent while working.
- Use switch on vacuum to activate filter cleaning at the frequency recommended by the manufacturer.
- Replace vacuum bags as needed to prevent overfilling.
- Use the jackhammer and vacuum controls according to manufacturer's instructions for reducing the release of visible dust.
- If visible dust increases, check controls and adjust as needed.

Respiratory protection:

- Use respirator with APF of 10 the entire time the task is being performed.
- See the written respiratory protection program for information on selection, training and fit testing requirements, in addition to proper use instructions for respirators (for example, being clean shaven when using a respirator that seals against the face).

Housekeeping:

- Dust containing silica on work surfaces and equipment must be cleaned up using wet methods or a HEPA-filtered vacuum.
- Do not use compressed air or dry sweeping for removing dust and debris containing silica from work surfaces.
- Dispose of used vacuum bags in a container and keep the container sealed.

Procedures Used to Restrict Access to Work Areas:
Schedule the work so that only employees who are engaged in the task (the jackhammer operator and employees helping the operator) are in the area.

Competent Person Requirements

The employer must designate a competent person to frequently and regularly inspect job sites, materials, and equipment to implement the written exposure control plan. A competent person is someone who:

- Can identify existing and foreseeable respirable crystalline silica hazards;
- Is authorized to promptly eliminate or minimize silica hazards; and
- Has the knowledge and ability to implement the written exposure control plan.

The employer can designate any of his or her employees to be a competent person if the employee is qualified, including the employee who does the work on a jobsite. For example, employees who go to jobsites alone can be designated a competent person if they know how to properly implement controls on the tools they use, can recognize if the controls are not working, and can correct the non-working control.

The standard does not require specific training for a competent person. The employer is responsible for determining what training is necessary to provide the knowledge and ability for his or her competent person to implement the written exposure control plan.

The training will depend on the types of work done, and in some cases, successfully completing training required under the silica standard and OSHA's Hazard Communication standard will be enough. In other cases, additional training may be needed. For example, a competent person at a small residential construction company might only need training on controls for power tools that they do not typically use to do their own tasks, so that they could help other employees with questions about or problems with dust controls on those tools. In contrast, a competent person for heavy equipment tasks may require more specialized training in heavy equipment inspection or in recognizing different soil types to determine if exposures might be a concern.

MEDICAL SURVEILLANCE – PARAGRAPH (H) OF THE STANDARD

Medical surveillance is intended to: (1) identify respirable crystalline silica-related diseases so that employees with those diseases can take actions to protect their health; (2) determine if an employee has any condition, such as a lung disease, that might make him or her more sensitive to respirable crystalline silica exposure; and (3) determine the employee's fitness to use respirators.

The standard specifies which employees must be offered medical surveillance, when and how often the examinations must offered, and the tests that make up medical examinations. The standard also specifies the information that the employer must give to the physician or other licensed health care professional (PLHCP) who conducts the examinations and the information that the employer must ensure that the PLHCP provides to the employee and employer.

All medical examinations and procedures required by the standard must be performed by a PLHCP. Medical surveillance must be provided at no cost to employees, and at a reasonable time and place. If getting the medical examination requires the employee to travel away from the worksite, the employer is required to cover the cost of travel. The employer must also pay employees for time spent traveling and taking medical examinations.

Which Employees Must be Offered Medical Surveillance

Employers must make an initial or periodic medical examination available to employees who will be required by the silica standard to wear a respirator for 30 or more days per year in the upcoming year (the next 365 days). If the employee is required to wear a respirator at any time during a day, that counts as one day of respirator use.

An employer will be able to estimate how often respirator use will be required by the standard in the upcoming year based on the types of tasks that the employee will perform, as well as how long and how often those tasks are performed. Respirator use with past employers does not count toward the 30-day threshold.

When unexpected circumstances result in employees being required to wear respirators more frequently than first expected, employers must make medical surveillance available as soon as it becomes apparent that the employee will be required by the silica standard to wear a respirator for 30 or more days in the upcoming year.

Frequency of Medical Examinations

Employers must offer medical examinations:

- Within 30 days of initial assignment (the day the employee starts working in a job/task in which he or she will be required by the silica standard to wear a respirator for 30 or more days per year), unless the employee has had an examination that meets the requirements of the silica standard within the last three years.
- Every three years from the employee's last examination that met the requirements of the silica standard, or more frequently if recommended by the PLHCP, if the employee will continue to perform tasks that require respirator use under the silica standard for 30 or more days per year.

A PLHCP might recommend more frequent medical examinations based on factors such as high exposure levels or a medical finding such as an X-ray suggesting silicosis.

Employers must make sure that employees receive a dated copy of the PLHCP's written medical opinion for the employer, and the employee can present that opinion to a

new employer as proof of a current medical examination. Employers can determine when they must offer an employee the next periodic medical examination based on the examination date on the written medical opinion.

Medical Evaluation Requirements under the Respiratory Protection Standard

Employees who are required to wear respirators must receive medical evaluations required by the respiratory protection standard before they are fit tested for a respirator or wear a respirator in the workplace. The medical evaluation for the respiratory protection standard can be combined with the medical examination for silica, and employers could have the PLHCP conduct both the evaluation for respirator use and examination for silica at the same time. They could also have employees evaluated for respirator use before they wear a respirator and then offer the silica examination later, according to the required time limits of the silica standard.

Also note that under the respiratory protection standard, employers are required to provide another medical evaluation if employees report medical signs or symptoms related to the ability to wear a respirator.

(see 29 CFR 1910.134, Respiratory Protection, and OSHA's *Small Entity Compliance Guide for the Respiratory Protection Standard*, Publication #3384).

Tests that Must be Included in the Examination

An initial medical examination provided under the silica standard must consist of:

- A medical and work history that focuses on: past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system; any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (for example, shortness of breath, cough, wheezing); history of tuberculosis; and smoking status and history;
- A physical examination that focuses on the respiratory system;
- A digital or film chest X-ray interpreted according to the International Labour Office (ILO) International Classification of Radiographs of Pneumoconioses by a National Institute for Occupational Safety and Health (NIOSH)-certified B Reader (this involves a certified physician reading the X-ray according to certain procedures to determine if it shows signs of diseases such as silicosis);
- A lung function (spirometry) test that includes forced vital capacity (the total amount of air that is forcefully blown out after taking a full breath), forced expiratory volume in one second (the amount of air forcefully blown out in the first second), and FEV_1/FVC ratio (the speed of air that is forcefully blown out), administered by a spirometry technician with a current certificate from a NIOSH-approved spirometry course;
- Testing for latent tuberculosis infection;
- Any other tests deemed appropriate (medically necessary and related to respirable crystalline silica exposure) by the PLHCP.

Periodic examinations include all these tests, with the exception of testing for latent tuberculosis, which is required only for the initial examination.

Employees who must be offered medical surveillance are at risk of developing respirable crystalline silica-related diseases, and the required tests are the minimum tests needed to look for those diseases. More tests may also be needed to address an employee's medical complaint or a finding related to respirable crystalline silica exposure, such as

abnormal lung function. The standard gives the PLHCP the flexibility to order additional tests he or she deems appropriate. Employers must make those tests ordered by the PLHCP available to the employee.

Information the Employer Must Provide to the PLHCP

The employer must ensure that the examining PLHCP has a copy of the standard and must provide the PLHCP with:

- A description of the employee's past, current, and future duties as they relate to respirable crystalline silica exposure;
- The employee's past, current, and future levels of exposure to respirable crystalline silica (if the employer does not have information on the employee's past or current exposure level because they are following Table 1 and are not required to measure exposures, the employer can indicate if the employee is likely exposed at or above the PEL, based on required respirator use under Table 1);
- A description of any personal protective equipment used, or to be used, by the employee, including when and for how long the employee has used or will use that equipment; and
- Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.

The PLHCP needs this information to evaluate the employee's health in relation to assigned duties and fitness to use personal protective equipment, such as respirators. The information provided to the PLHCP includes only that within the control of the employer; the employer is not required to obtain information from past employers.

The PLHCP's Written Medical Report for the Employee

The employer must ensure that the PLHCP explains the results of the medical examination to the employee and gives the employee a written medical report within 30 days of each medical examination performed. Only the employee receives the written medical report, and the employer does not receive a copy of this report. The report must contain:

- A description of the medical examination results, including any medical condition(s) that would place the employee at increased risk of material impairment of health from exposure to respirable crystalline silica (any health condition that might make the employee more sensitive to exposure). The report must also describe any medical conditions that require further evaluation or treatment;
- Any recommended limitations on the employee's use of respirators;
- Any recommended limitations on respirable crystalline silica exposure; and
- A statement that the employee should be examined by a specialist if the B-reader classifies the chest X-ray provided under the silica standard as 1/0 or higher (X-ray evidence of silicosis in employees exposed to respirable crystalline silica), or if the PLHCP otherwise recommends referral to a specialist.

The PLHCP's Written Medical Opinion for the Employer

The employer must get a written medical opinion from the PLHCP within 30 days of the medical examination. The written opinion must contain only the following information:

- The date of the examination;
- A statement that the examination has met the requirements of the silica standard; and
- Any recommended limitations on the employee's use of respirators.

If the employee gives written authorization, the written medical opinion to the employer must also contain one or both of the following:

- Any recommended limitations on the employee's exposure to respirable crystalline silica;
- A statement that the employee should be examined by a specialist if the B reader classifies the chest X-ray provided under the silica standard as 1/0 or higher (X-ray evidence of silicosis in employees exposed to respirable crystalline silica), or if the PLHCP otherwise recommends referral to a specialist.

The purpose of the employee written authorization requirement is to enhance employee privacy and encourage employees to participate in medical surveillance by minimizing fears about retaliation or discrimination based on medical findings.

Employers must make sure that each employee receives a copy of the written medical opinion within 30 days of each medical examination. The PLHCP can give a copy of the opinion directly to the employee, so long as the time deadline is met. As indicated above, employees can show this opinion to future employers as proof that medical surveillance requirements under the silica standard are current.

Sample Medical Forms in Appendix B of the Standard

Appendix B contains guidelines for PLHCPs and blank sample forms for the medical report for the employee, the medical opinion for the employer, and an authorization form to allow limitations on respirable crystalline silica exposure or recommendations for a specialist examination to be reported to the employer. Employers must make sure that PLHCPs who will conduct medical examinations required by the silica standard have a copy of the standard, including Appendix B. The purpose of Appendix B is to give PLHCPs medical information and guidance to help them conduct medical examinations that meet the requirements of the silica standard.

Examples of completed forms are included in this guide. Sample Form 1 is a sample of the written medical report that the PLHCP provides to the employee. The employer does not receive a copy of the written medical report. Sample Form 2 is a sample of the written medical opinion that the PLHCP provides to the employer. The PLHCP indicates the type of examination and recommendations on use of a respirator. If the employee signs the written authorization (Sample Form 3) allowing the PLHCP to release further information to the employer, the PLHCP must include any recommend limitations on exposure to respirable crystalline silica and/or any referral to a specialist.

Sample Form 1: Written Medical Report for Employee

EMPLOYEE NAME: Joe Smith **DATE OF EXAMINATION**: June 1, 2017

TYPE OF EXAMINATION:
[x] Initial examination [ ] Periodic examination [ ] Specialist examination
[ ] Other: _____

RESULTS OF MEDICAL EXAMINATION:

Physical Examination –	[x] Normal	[ ] Abnormal (see below)	[ ] Not performed
Chest X-Ray –	[x] Normal	[ ] Abnormal (see below)	[ ] Not performed
Breathing Test (Spirometry) –	[ ] Normal	[x] Abnormal (see below)	[ ] Not performed
Test for Tuberculosis –	[x] Normal	[ ] Abnormal (see below)	[ ] Not performed
Other:_____	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed

Results reported as abnormal: Breathing test (Spirometry) shows an obstructive pattern.

---

[x] Your health may be at increased risk from exposure to respirable crystalline silica due to the following:
Continued unprotected exposure to respirable crystalline silica may further damage your lungs.

RECOMMENDATIONS:
[ ] No limitations on respirator use
[x] Recommended limitations on use of respirator: A powered air purifying respirator (PAPR) is the only type of respirator you can safely wear. A PAPR will give you higher protection from silica exposure and will decrease strain on your heart and lungs.
[x] Recommended limitations on exposure to respirable crystalline silica: Ideally, you may want to consider a position that doesn't involve exposure to substances hazardous to your lungs, such as respirable crystalline silica. If that is not possible, be sure to always wear a respirator when needed to protect your lungs.

Dates for recommended limitations, if applicable: Indefinitely unless otherwise indicated by a specialist.

[x] I recommend that you be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine

[x] Other recommendations*: See your personal physician about the mole on your neck

---

Your next periodic examination for silica exposure should be in: [ ] 3 years [x] Other: 1 year, June 1, 2018

Examining Provider: Dr. Jones Date: June 1, 2017
(signature)
Provider Name: Dr. Jones Health Clinic
Office Address: 1111 Main Street, Washington, DC Office Phone: 123-456-7890

*These findings may not be related to respirable crystalline silica exposure or may not be work-related, and therefore may not be covered by the employer. These findings may necessitate follow-up and treatment by your personal physician.

Respirable Crystalline Silica standard (§ 1910.1053 or 1926.1153)

Sample Form 2: Written Medical Opinion for Employer

EMPLOYER: John Doe Renovations

EMPLOYEE NAME: Joe Smith **DATE OF EXAMINATION:** June 1, 2017

TYPE OF EXAMINATION:
[x] Initial examination [ ] Periodic examination [ ] Specialist examination
[ ] Other: _____

USE OF RESPIRATOR:
[ ] No limitations on respirator use
[x] Recommended limitations on use of respirator: A powered air purifying respirator (PAPR) is the only type of respirator Mr. Smith can safely wear.

Dates for recommended limitations, if applicable: Indefinitely, unless otherwise recommended by specialist

---

The employee has provided written authorization for disclosure of the following to the employer (if applicable):

[x] This employee should be examined by an American Board Certified Specialist in Pulmonary Disease or Occupational Medicine
[ ] Recommended limitations on exposure to respirable crystalline silica:_____
_____

Dates for exposure limitations noted above: _____ (MM/DD/YYYY) to _____ (MM/DD/YYYY)

NEXT PERIODIC EVALUATION: [ ] 3 years [x] Other: 1 year, June 1, 2018

Examining Provider: Dr. Jones (signature) Date: June 1, 2017
Provider Name: Dr. Jones Health Clinic Provider's specialty: None, general practitioner

Office Address: 1111 Main Street, Washington, DC Office Phone: 123-456-7890

[x] I attest that the results have been explained to the employee.

The following is required to be checked by the Physician or other Licensed Health Care Professional (PLHCP):
[x] I attest that this medical examination has met the requirements of the medical surveillance section of the OSHA Respirable Crystalline Silica standard (§ 1910.1053(h) or 1926.1153(h)).

Sample Form 3: Authorization for Crystalline Silica Opinion to Employer

This medical examination for exposure to crystalline silica could reveal a medical condition that results in recommendations for (1) limitations on respirator use, (2) limitations on exposure to crystalline silica, or (3) examination by a specialist in pulmonary disease or occupational medicine. Recommended limitations on respirator use will be included in the written opinion to the employer. If you want your employer to know about limitations on crystalline silica exposure or recommendations for a specialist examination, you will need to give authorization for the written opinion to the employer to include one or both of those recommendations.

I hereby authorize the opinion to the employer to contain the following information, if relevant (please check all that apply):

☐ Recommendations for limitations on crystalline silica exposure

☒ Recommendation for a specialist examination

OR

☐ I do not authorize the opinion to the employer to contain anything other than recommended limitations on respirator use.

Please read and initial:

X I understand that if I do not authorize my employer to receive the recommendation for specialist examination, the employer will not be responsible for arranging and covering costs of a specialist examination under the OSHA standard for respirable crystalline silica.

Joe Smith
Name (printed)

Joe Smith
Signature

June 1, 2017
Date

Additional Examinations by a Specialist

The employer must make the specialist examination available within 30 days of receiving the written medical opinion that includes the PLHCP's recommendation for a specialist examination. The specialists must be either an American Board Certified Specialist in Pulmonary Disease or an American Board Certified Specialist in Occupational Medicine.

The employer must ensure the specialist:

- Receives the same information that the employer is required to provide the PLHCP (*see* above);
- Explains the results of the medical examination to the employee and provides each employee with a written medical report within 30 days of the examination; and
- Provides the employer a written medical opinion within 30 days of the examination.

The specialist's written medical report to the employee must contain the following information:

- A description of the medical examination results, including any medical condition(s) that may make an employee more sensitive to respirable crystalline silica exposure and any medical conditions that require further evaluation or treatment;
- Any recommended limitations on the employee's use of respirators; and
- Any recommended limitations on respirable crystalline silica exposure.

The specialist's written medical opinion for the employer must include only the following:

- The date of the examination; and
- Any recommended limitations on the employee's use of respirators.

If the employee gives written authorization, the written opinion to the employer must also contain any recommended limitations on the employee's exposure to respirable crystalline silica.

COMMUNICATION OF HAZARDS – PARAGRAPH (l) OF THE STANDARD

Employers must train and inform employees covered by the silica standard about respirable crystalline silica hazards and the methods the employer uses to limit their exposures to those hazards. Employers must cover the cost of training and must pay employees for the time spent in training.

OSHA's Hazard Communication Standard

Employers must also comply with OSHA's Hazard Communication standard (HCS) (29 CFR 1910.1200). HCS requires employers to inform employees about hazardous chemicals in the workplace, such as respirable crystalline silica, through their written hazard communication programs. Written hazard communication programs must describe how requirements for container labels, safety data sheets (SDSs), and employee training will be met. As part of their hazard communication program for respirable crystalline silica, employers must address at least these health hazards: cancer, lung effects, immune system effects, and kidney effects.

Under the HCS, employers must:

- Inform employees about the general requirements of HCS, as well as where and how they can view the written hazard communication program, lists of hazardous chemicals, and SDSs.
- Train employees on how the presence or release of hazardous chemicals in the work area is detected; in the case of respirable crystalline silica, this could include methods the employer uses to measure exposures, such as air sampling or objective data. If employers are using Table 1, they can train employees to recognize that an increase in visible dust is a sign that a control may not be working properly.
- Train employees on the details of the workplace-specific hazard communication program developed by the employer, such as container labels, the workplace labeling system, SDSs (including the order in which the information is presented), and how employees can get and use hazard information.

See OSHA's *HAZARD COMMUNICATION: Small Entity Compliance Guide for Employers that Use Hazardous Chemicals [OSHA Publication #3695]* for more information on preparing a written hazard communication program and employer requirements for labeling, SDSs, and training.

Training Topics

The employer must ensure that employees trained under the silica standard can demonstrate knowledge and understanding of at least:

1. Health hazards associated with respirable crystalline silica exposure. For respirable crystalline silica, the health hazards include: cancer, lung effects, immune system effects, and kidney effects.
2. Specific workplace tasks that could expose employees to respirable crystalline silica. Examples include those listed in Table 1, such as using a stationary masonry saw to cut crystalline silica-containing materials.
3. Specific measures the employer is implementing to protect employees from respirable crystalline silica exposure, including engineering controls, work practices, and respirators to be used.

This training must be specific for the task that each employee performs. For example, employees who operate tools with built-in controls, such as saws with integrated water delivery systems, would need to demonstrate knowledge and understanding of:

- The full and proper use of the controls on those tools; and
- Signs that controls may not be functioning properly.

Laborers who do not operate equipment but are engaged in a task by helping the tool operator would only need to demonstrate knowledge and understanding of:

- The general types of controls used in the workplace, such as water or vacuum controls and how to recognize if those controls are not working properly; and
- Work practices they perform as part of helping the tool operator, such as appropriate clean-up of respirable crystalline silica dust accumulations.

4. The contents of the respirable crystalline silica standard. This would involve a description of the standard's requirements.

5. The identity of the competent person designated by the employer. This could be as simple as announcing who the competent person is at the beginning of a work shift.

6. The purpose and a description of the medical surveillance program required under the standard. Topics that employers could communicate to their employees as part of this training include:

   - That employers must offer medical examinations to employees who are required to wear a respirator under the silica standard for 30 or more days a year;
   - That employers must offer medical examinations at no cost to the employee, including additional silica-related tests or specialist examinations recommended by the physician or other licensed health care professional;
   - The types of tests included in the medical examinations;
   - Symptoms associated with respirable crystalline silica-related diseases;
   - Information that must be included in the written medical report to the employee versus the written medical opinion for the employer;
   - Information that must not be included in written medical opinion to the employer without written authorization from the employee (recommendations for limitations on exposures to silica and for specialist referrals);
   - The importance of keeping a copy of the written medical opinion to the employer as proof of a current medical examination to avoid unnecessary testing; and
   - That employers cannot retaliate or discriminate against employees for participating in medical surveillance.

The employer is not required to provide all required training if an employee is already able to demonstrate knowledge and understanding of training topics such as health hazards, the contents of the silica standard, or medical surveillance requirements. However, some site-specific or employer-specific training is always necessary, such as training on specific tasks that could result in exposures in that workplace, specific controls or work practices that the employer is using, and the identity of the competent person.

When Employees Must be Trained

Employees must be trained at the time they are assigned to a position involving exposure to respirable crystalline silica.

Additional training must be provided as often as necessary to ensure that employees know and understand respirable crystalline silica hazards and the protections available in their workplace. Examples of when additional training would be required include:

- When the employer asks an employee to perform a task that is new to that employee;
- When the employer introduces new protections (for example, an employer who was having employees use a handheld grinder with wet method controls decides to have employees use a handheld grinder with a dust collection system); or
- When an employee is working in a manner that suggests he or she has forgotten what was learned in training.

Training Methods

The silica standard does not require the employer to use any particular method for training employees. Employers could use hands-on training, videotapes, slide presentations, classroom instruction, informal discussions during safety meetings, written materials, or any combination of these methods to train employees.

In order for employees to demonstrate knowledge and understanding of the training subjects, training must be done in a manner and language that employees understand. This may mean, for example, providing materials, instruction, or assistance in Spanish rather than English for Spanish-speaking employees who do not understand English, and using methods other than printed reading materials if the employee is not able to read.

To ensure that employees understand the material presented during training, it is critical that trainees have the opportunity to ask questions and receive answers if they do not fully understand the material that is presented to them. When videotape presentations or computer-based programs are used, this requirement may be met by having a qualified trainer available to address questions after the presentation, or providing a telephone hotline so that trainees will have direct access to a qualified trainer.

Employers can determine if employees know and understand the training topics through discussion of the required training subjects, written tests, or oral quizzes.

Making a Copy of the Standard Available

Employers must make a copy of the respirable crystalline silica standard available at no cost to each employee covered by the standard. This could simply involve allowing employees to view a printed or electronic copy in a reasonable location.

RECORDKEEPING – PARAGRAPH (J) OF THE STANDARD

Records can demonstrate employer compliance with the standard, and can assist in diagnosing and identifying workplace-related illnesses. Therefore, employers are required to make and keep accurate records of air monitoring data and objective data used to assess employee exposures to respirable crystalline silica under the standard, as well as records of medical surveillance provided under the standard.

Air Monitoring Data

Employers must make and keep an accurate record of all air monitoring performed to comply with the standard. The record must indicate:

- The date of the measurement for each sample taken;
- The task monitored;
- Sampling and analytical methods used;
- The number, duration, and results of samples taken;
- The identity of the laboratory that performed the analysis;
- The type of personal protective equipment used (*e.g.*, type of respirators worn); and
- The name, social security number, and job classification of all employees represented by the monitoring, indicating which employees were actually monitored.

Objective Data

When an employer relies on objective data to comply with the silica standard, the employer must make and keep an accurate record of the objective data. The record must include at least:

- The crystalline silica-containing material in question;
- The source of the objective data;
- The testing protocol and results of testing;
- A description of the process, task, or activity on which the objective data were based; and
- Any other data relevant to the process, task, activity, material, or exposures on which the objective data are based.

Medical Surveillance

The employer must make and keep an accurate record for each employee provided medical surveillance under the standard. The record must include the following information about the employee:

- Name and social security number;
- A copy of the PLHCPs' and specialists' written opinions; and
- A copy of the information that the employer is required to provide to the PLHCPs and specialists (*i.e.*, a description of the employee's former, current, and anticipated duties as they relate to crystalline silica exposure; a description of the employee's former, current, and anticipated respirable crystalline silica exposure levels; a description of the personal protective equipment used by the employee; and information from previous employment-related medical examinations that is currently within the control of the employer).

Keeping and Making Medical Records Available

Exposure and medical records must be kept and made available to employees, their representatives, and OSHA in accordance with OSHA's access to employee exposure and medical records regulation.

OSHA's Access to Employee Exposure and Medical Records Regulation

A separate OSHA regulation (29 CFR 1910.1020, Access to Employee Exposure and Medical Records) addresses requirements for maintaining exposure and medical records. In general, exposure records (including air monitoring and objective data) must be kept for at least 30 years, and medical records must be kept for at least the duration of employment plus 30 years. It is necessary to keep these records for extended periods because silica-related diseases such as cancer often cannot be detected until several decades after exposure. However, if an employee works for an employer for less than one year, the employer does not have to keep the medical records after employment ends, as long as the employer gives those records to the employee.

DATES – PARAGRAPH (K) OF THE STANDARD

Construction employers must comply with all requirements of the standard by September 23, 2017 (delayed from June 23, 2017), except the requirement to use laboratories that analyze respirable crystalline silica samples according to the procedures in Appendix A, which will be enforced beginning on June 23, 2018. That means that as of September 23, 2017, employers must either fully and properly implement Table 1 requirements or implement alternative exposure control measures, and comply with requirements for respiratory protection, housekeeping, medical surveillance, hazard communication and training, and recordkeeping. Prior to September 23, 2017, the previous PEL (a formula that is approximately equivalent to 250 µg/m^3 of respirable crystalline silica as an 8-hour TWA) remains in effect.

Take steps now to ensure the requirements can be met by the compliance dates.

1. Implement specified exposure control methods in Table 1.
2. Complete exposure assessments needed to select appropriate engineering controls and respiratory protection for tasks not in Table 1.
3. Set up respiratory protection programs where required.
4. Get appropriate equipment, controls, and respirators.
5. Arrange for medical surveillance.
6. Take actions such as the following to meet all other requirements:
   a. Determine appropriate housekeeping methods.
   b. Prepare a written exposure control plan.
   c. Set up a training program.
   d. Set up a recordkeeping system.

APPENDIX I: OSHA RESPIRABLE CRYSTALLINE SILICA STANDARD FOR CONSTRUCTION

§1926.1153 Respirable crystalline silica.

(a) *Scope and application*. This section applies to all occupational exposures to respirable crystalline silica in construction work, except where employee exposure will remain below 25 micrograms per cubic meter of air (25 µg/m^3) as an 8-hour time-weighted average (TWA) under any foreseeable conditions.

(b) *Definitions*. For the purposes of this section the following definitions apply:

Action level means a concentration of airborne respirable crystalline silica of 25 µg/m^3, calculated as an 8-hour TWA.

Assistant Secretary means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

Director means the Director of the National Institute for Occupational Safety and Health (NIOSH), U.S. Department of Health and Human Services, or designee.

Competent person means an individual who is capable of identifying existing and foreseeable respirable crystalline silica hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them. The competent person must have the knowledge and ability necessary to fulfill the responsibilities set forth in paragraph (g) of this section.

Employee exposure means the exposure to airborne respirable crystalline silica that would occur if the employee were not using a respirator.

High-efficiency particulate air [HEPA] filter means a filter that is at least 99.97 percent efficient in removing mono-dispersed particles of 0.3 micrometers in diameter.

Objective data means information, such as air monitoring data from industry-wide surveys or calculations based on the composition of a substance, demonstrating employee exposure to respirable crystalline silica associated with a particular product or material or a specific process, task, or activity. The data must reflect workplace conditions closely resembling or with a higher exposure potential than the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operations.

Physician or other licensed health care professional [PLHCP] means an individual whose legally permitted scope of practice (*i.e.*, license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the particular health care services required by paragraph (h) of this section.

Respirable crystalline silica means quartz, cristobalite, and/or tridymite contained in airborne particles that are determined to be respirable by a sampling device designed to meet the characteristics for respirable-particle-size-selective samplers specified in the International Organization for Standardization (ISO) 7708:1995: Air Quality – Particle Size Fraction Definitions for Health-Related Sampling.

Specialist means an American Board Certified Specialist in Pulmonary Disease or an American Board Certified Specialist in Occupational Medicine.

This section means this respirable crystalline silica standard, 29 CFR 1926.1153.

(c) Specified exposure control methods. (1) For each employee engaged in a task identified on Table 1, the employer shall fully and properly implement the engineering

controls, work practices, and respiratory protection specified for the task in Table 1, unless the employer assesses and limits the exposure of the employee to respirable crystalline silica in accordance with paragraph (d) of this section.

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(i) Stationary masonry saws	Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
(ii) Handheld power saws (any blade diameter)	Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • When used outdoors. • When used indoors or in an enclosed area.	None APF 10	APF 10 APF 10
(iii) Handheld power saws for cutting fiber-cement board (with blade diameter of 8 inches or less)	For tasks performed outdoors only: Use saw equipped with commercially available dust collection system. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency.	None	None

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(iv) Walk-behind saws	Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • When used outdoors. • When used indoors or in an enclosed area.	None APF 10	None APF 10
(v) Drivable saws	For tasks performed outdoors only: Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
(vi) Rig-mounted core saws or drills	Use tool equipped with integrated water delivery system that supplies water to cutting surface. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
(vii) Handheld and stand-mounted drills (including impact and rotary hammer drills)	Use drill equipped with commercially available shroud or cowling with dust collection system. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. Use a HEPA-filtered vacuum when cleaning holes.	None	None

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(viii) Dowel drilling rigs for concrete	For tasks performed outdoors only: Use shroud around drill bit with a dust collection system. Dust collector must have a filter with 99% or greater efficiency and a filter-cleaning mechanism. Use a HEPA-filtered vacuum when cleaning holes.	APF 10	APF 10
(ix) Vehicle-mounted drilling rigs for rock and concrete	Use dust collection system with close capture hood or shroud around drill bit with a low-flow water spray to wet the dust at the discharge point from the dust collector. OR Operate from within an enclosed cab and use water for dust suppression on drill bit.	None None	None None
(x) Jackhammers and handheld powered chipping tools	Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact. • When used outdoors. • When used indoors or in an enclosed area. OR Use tool equipped with commercially available shroud and dust collection system. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. • When used outdoors. • When used indoors or in an enclosed area.	None APF 10 None APF 10	APF 10 APF 10 APF 10 APF 10

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(xi) Handheld grinders for mortar removal (i.e., tuckpointing)	Use grinder equipped with commercially available shroud and dust collection system. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	APF 10	APF 25
(xii) Handheld grinders for uses other than mortar removal	For tasks performed outdoors only: Use grinder equipped with integrated water delivery system that continuously feeds water to the grinding surface. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. OR Use grinder equipped with commercially available shroud and dust collection system. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism. • When used outdoors. • When used indoors or in an enclosed area.	None None None	None None APF 10

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(xiii) Walk-behind milling machines and floor grinders	Use machine equipped with integrated water delivery system that continuously feeds water to the cutting surface. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
	OR		
	Use machine equipped with dust collection system recommended by the manufacturer. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide the air flow recommended by the manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. When used indoors or in an enclosed area, use a HEPA-filtered vacuum to remove loose dust in between passes.	None	None
(xiv) Small drivable milling machines (less than half-lane)	Use a machine equipped with supplemental water sprays designed to suppress dust. Water must be combined with a surfactant. Operate and maintain machine to minimize dust emissions.	None	None

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(xv) Large drivable milling machines (half-lane and larger)	For cuts of any depth on asphalt only: Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. Operate and maintain machine to minimize dust emissions.	None	None
	For cuts of four inches in depth or less on any substrate: Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. Operate and maintain machine to minimize dust emissions.	None	None
	OR Use a machine equipped with supplemental water spray designed to suppress dust. Water must be combined with a surfactant. Operate and maintain machine to minimize dust emissions.	None	None
(xvi) Crushing machines	Use equipment designed to deliver water spray or mist for dust suppression at crusher and other points where dust is generated (e.g., hoppers, conveyers, sieves/sizing or vibrating components, and discharge points). Operate and maintain machine in accordance with manufacturer's instructions to minimize dust emissions. Use a ventilated booth that provides fresh, climate-controlled air to the operator, or a remote control station.	None	None

TABLE 1: Specified Exposure Control Methods When Working with Materials Containing Crystalline Silica

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	> 4 hours/shift
(xvii) Heavy equipment and utility vehicles used to abrade or fracture silica-containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials	Operate equipment from within an enclosed cab. When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions.	None None	None None
(xviii) Heavy equipment and utility vehicles for tasks such as grading and excavating but not including: demolishing, abrading, or fracturing silica-containing materials	Apply water and/or dust suppressants as necessary to minimize dust emissions. OR When the equipment operator is the only employee engaged in the task, operate equipment from within an enclosed cab.	None None	None None

(2) When implementing the control measures specified in Table 1, each employer shall:

(i) For tasks performed indoors or in enclosed areas, provide a means of exhaust as needed to minimize the accumulation of visible airborne dust;

(ii) For tasks performed using wet methods, apply water at flow rates sufficient to minimize release of visible dust;

(iii) For measures implemented that include an enclosed cab or booth, ensure that the enclosed cab or booth:

(A) Is maintained as free as practicable from settled dust;

(B) Has door seals and closing mechanisms that work properly;

(C) Has gaskets and seals that are in good condition and working properly;

(D) Is under positive pressure maintained through continuous delivery of fresh air;

(E) Has intake air that is filtered through a filter that is 95% efficient in the 0.3-10.0 μm range (*e.g.*, MERV-16 or better); and

(F) Has heating and cooling capabilities.

(3) Where an employee performs more than one task on Table 1 during the course of a shift, and the total duration of all tasks combined is more than four hours, the required respiratory protection for each task is the respiratory protection specified for more than four hours per shift. If the total duration of all tasks on Table 1 combined is less than four hours, the required respiratory protection for each task is the respiratory protection specified for less than four hours per shift.

(d) *Alternative exposure control methods.* For tasks not listed in Table 1, or where the employer does not fully and properly implement the engineering controls, work practices, and respiratory protection described in Table 1:

(1) *Permissible exposure limit (PEL)*. The employer shall ensure that no employee is exposed to an airborne concentration of respirable crystalline silica in excess of 50 μg/m^3, calculated as an 8-hour TWA.

(2) *Exposure assessment*—(i) *General*. The employer shall assess the exposure of each employee who is or may reasonably be expected to be exposed to respirable crystalline silica at or above the action level in accordance with either the performance option in paragraph (d)(2)(ii) or the scheduled monitoring option in paragraph (d)(2)(iii) of this section.

(ii) *Performance option*. The employer shall assess the 8-hour TWA exposure for each employee on the basis of any combination of air monitoring data or objective data sufficient to accurately characterize employee exposures to respirable crystalline silica.

(iii) *Scheduled monitoring option*. (A) The employer shall perform initial monitoring to assess the 8-hour TWA exposure for each employee on the basis of one or more personal breathing zone air samples that reflect the exposures of employees on each shift, for each job classification, in each work area. Where several employees perform the same tasks on the same shift and in the same work area, the employer may sample a representative fraction of these employees in order to meet this requirement. In representative sampling, the employer shall sample the employee(s) who are expected to have the highest exposure to respirable crystalline silica.

(B) If initial monitoring indicates that employee exposures are below the action level, the employer may discontinue monitoring for those employees whose exposures are represented by such monitoring.

(C) Where the most recent exposure monitoring indicates that employee exposures are at or above the action level but at or below the PEL, the employer shall repeat such monitoring within six months of the most recent monitoring.

(D) Where the most recent exposure monitoring indicates that employee exposures are above the PEL, the employer shall repeat such monitoring within three months of the most recent monitoring.

(E) Where the most recent (non-initial) exposure monitoring indicates that employee exposures are below the action level, the employer shall repeat such monitoring within six months of the most recent monitoring until two consecutive measurements, taken seven or more days apart, are below the action level, at which time the employer may discontinue monitoring for those employees whose exposures are represented by such monitoring, except as otherwise provided in paragraph (d)(2)(iv) of this section.

(iv) *Reassessment of exposures*. The employer shall reassess exposures whenever a change in the production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or additional exposures at or above the action level, or when the employer has any reason to believe that new or additional exposures at or above the action level have occurred.

(v) *Methods of sample analysis*. The employer shall ensure that all samples taken to satisfy the monitoring requirements of paragraph (d)(2) of this section are evaluated by a laboratory that analyzes air samples for respirable crystalline silica in accordance with the procedures in Appendix A to this section.

(vi) *Employee notification of assessment results*. (A) Within five working days after completing an exposure assessment in accordance with paragraph (d)(2) of this section, the employer shall individually notify each affected employee in writing of the results of that assessment or post the results in an appropriate location accessible to all affected employees.

(B) Whenever an exposure assessment indicates that employee exposure is above the PEL, the employer shall describe in the written notification the corrective action being taken to reduce employee exposure to or below the PEL.

(vii) *Observation of monitoring*. (A) Where air monitoring is performed to comply with the requirements of this section, the employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to respirable crystalline silica.

(B) When observation of monitoring requires entry into an area where the use of protective clothing or equipment is required for any workplace hazard, the employer shall provide the observer with protective clothing and equipment at no cost and shall ensure that the observer uses such clothing and equipment.

(3) *Methods of compliance*—(i) *Engineering and work practice controls*. The employer shall use engineering and work practice controls to reduce and maintain employee exposure to respirable crystalline silica to or below the PEL, unless the employer can demonstrate that such controls are not feasible. Wherever such feasible engineering and work practice controls are not sufficient to reduce employee exposure to or below the PEL, the employer shall nonetheless use them to reduce employee exposure to the lowest feasible level and shall supplement them with the use of respiratory protection that complies with the requirements of paragraph (e) of this section.

(ii) *Abrasive blasting*. In addition to the requirements of paragraph (d)(3)(i) of this section, the employer shall comply with other OSHA standards, when applicable, such as 29 CFR 1926.57 (Ventilation), where abrasive blasting is conducted using crystalline silica-containing blasting agents, or where abrasive blasting is conducted on substrates that contain crystalline silica.

(e) *Respiratory protection*—(1) General. Where respiratory protection is required by this section, the employer must provide each employee an appropriate respirator that complies with the requirements of this paragraph and 29 CFR 1910.134. Respiratory protection is required:

(i) Where specified by Table 1 of paragraph (c) of this section; or

(ii) For tasks not listed in Table 1, or where the employer does not fully and properly implement the engineering controls, work practices, and respiratory protection described in Table 1:

(A) Where exposures exceed the PEL during periods necessary to install or implement feasible engineering and work practice controls;

(B) Where exposures exceed the PEL during tasks, such as certain maintenance and repair tasks, for which engineering and work practice controls are not feasible; and

(C) During tasks for which an employer has implemented all feasible engineering and work practice controls and such controls are not sufficient to reduce exposures to or below the PEL.

(2) *Respiratory protection program*. Where respirator use is required by this section, the employer shall institute a respiratory protection program in accordance with 29 CFR 1910.134.

(3) *Specified exposure control methods*. For the tasks listed in Table 1 in paragraph (c) of this section, if the employer fully and properly implements the engineering controls, work practices, and respiratory protection described in Table 1, the employer shall be considered to be in compliance with paragraph (e)(1) of this section and the requirements for selection of respirators in 29 CFR 1910.134(d)(1)(iii) and (d)(3) with regard to exposure to respirable crystalline silica.

(f) *Housekeeping*. (1) The employer shall not allow dry sweeping or dry brushing where such activity could contribute to employee exposure to respirable crystalline silica unless wet sweeping, HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure are not feasible.

(2) The employer shall not allow compressed air to be used to clean clothing or surfaces where such activity could contribute to employee exposure to respirable crystalline silica unless:

(i) The compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air; or

(ii) No alternative method is feasible.

(g) *Written exposure control plan*. (1) The employer shall establish and implement a written exposure control plan that contains at least the following elements:

(i) A description of the tasks in the workplace that involve exposure to respirable crystalline silica;

(ii) A description of the engineering controls, work practices, and respiratory protection used to limit employee exposure to respirable crystalline silica for each task;

(iii) A description of the housekeeping measures used to limit employee exposure to respirable crystalline silica; and

(iv) A description of the procedures used to restrict access to work areas, when necessary, to minimize the number of employees exposed to respirable crystalline silica and their level of exposure, including exposures generated by other employers or sole proprietors.

(2) The employer shall review and evaluate the effectiveness of the written exposure control plan at least annually and update it as necessary.

(3) The employer shall make the written exposure control plan readily available for examination and copying, upon request, to each employee covered by this section, their designated representatives, the Assistant Secretary and the Director.

(4) The employer shall designate a competent person to make frequent and regular inspections of job sites, materials, and equipment to implement the written exposure control plan.

(h) *Medical surveillance*—(1) *General*. (i) The employer shall make medical surveillance available at no cost to the employee, and at a reasonable time and place, for each employee who will be required under this section to use a respirator for 30 or more days per year.

(ii) The employer shall ensure that all medical examinations and procedures required by this section are performed by a PLHCP as defined in paragraph (b) of this section.

(2) *Initial examination*. The employer shall make available an initial (baseline) medical examination within 30 days after initial assignment, unless the employee has received a medical examination that meets the requirements of this section within the last three years. The examination shall consist of:

(i) A medical and work history, with emphasis on: past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system; any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (*e.g.*, shortness of breath, cough, wheezing); history of tuberculosis; and smoking status and history;

(ii) A physical examination with special emphasis on the respiratory system;

(iii) A chest X-ray (a single posteroanterior radiographic projection or radiograph of the chest at full inspiration recorded on either film (no less than 14 x 17 inches and no more than 16 x 17 inches) or digital radiography systems), interpreted and classified according to the International Labour Office (ILO) International Classification of Radiographs of Pneumoconioses by a NIOSH-certified B Reader;

(iv) A pulmonary function test to include forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1) and FEV_1/FVC ratio, administered by a spirometry technician with a current certificate from a NIOSH-approved spirometry course;

(v) Testing for latent tuberculosis infection; and

(vi) Any other tests deemed appropriate by the PLHCP.

(3) *Periodic examinations*. The employer shall make available medical examinations that include the procedures described in paragraph (h)(2) of this section (except paragraph (h)(2)(v)) at least every three years, or more frequently if recommended by the PLHCP.

(4) *Information provided to the PLHCP*. The employer shall ensure that the examining PLHCP has a copy of this standard, and shall provide the PLHCP with the following information:

(i) A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;

(ii) The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica;

(iii) A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and

(iv) Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.

(5) *PLHCP's written medical report for the employee*. The employer shall ensure that the PLHCP explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of each medical examination performed. The written report shall contain:

(i) A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;

(ii) Any recommended limitations on the employee's use of respirators;

(iii) Any recommended limitations on the employee's exposure to respirable crystalline silica; and

(iv) A statement that the employee should be examined by a specialist (pursuant to paragraph (h)(7) of this section) if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP.

(6) *PLHCP's written medical opinion for the employer*. (i) The employer shall obtain a written medical opinion from the PLHCP within 30 days of the medical examination. The written opinion shall contain only the following:

(A) The date of the examination;

(B) A statement that the examination has met the requirements of this section; and

(C) Any recommended limitations on the employee's use of respirators.

(ii) If the employee provides written authorization, the written opinion shall also contain either or both of the following:

(A) Any recommended limitations on the employee's exposure to respirable crystalline silica;

(B) A statement that the employee should be examined by a specialist (pursuant to paragraph (h)(7) of this section) if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP.

(iii) The employer shall ensure that each employee receives a copy of the written medical opinion described in paragraph (h)(6)(i) and (ii) of this section within 30 days of each medical examination performed.

(7) *Additional examinations*. (i) If the PLHCP's written medical opinion indicates that an employee should be examined by a specialist, the employer shall make available a medical examination by a specialist within 30 days after receiving the PLHCP's written opinion.

(ii) The employer shall ensure that the examining specialist is provided with all of the information that the employer is obligated to provide to the PLHCP in accordance with paragraph (h)(4) of this section.

(iii) The employer shall ensure that the specialist explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of the examination. The written report shall meet the requirements of paragraph (h)(5) (except paragraph (h)(5)(iv)) of this section.

(iv) The employer shall obtain a written opinion from the specialist within 30 days of the medical examination. The written opinion shall meet the requirements of paragraph (h)(6) (except paragraph (h)(6)(i)(B) and (ii)(B)) of this section.

(i) *Communication of respirable crystalline silica hazards to employees—(1) Hazard communication*. The employer shall include respirable crystalline silica in the program established to comply with the hazard communication standard (HCS) (29 CFR 1910.1200). The employer shall ensure that each employee has access to labels on containers of crystalline silica and safety data sheets, and is trained in accordance with the provisions of HCS and paragraph (i)(2) of this section. The employer shall ensure that at least the following hazards are addressed: Cancer, lung effects, immune system effects, and kidney effects.

(2) *Employee information and training*. (i) The employer shall ensure that each employee covered by this section can demonstrate knowledge and understanding of at least the following:

(A) The health hazards associated with exposure to respirable crystalline silica;

(B) Specific tasks in the workplace that could result in exposure to respirable crystalline silica;

(C) Specific measures the employer has implemented to protect employees from exposure to respirable crystalline silica, including engineering controls, work practices, and respirators to be used;

(D) The contents of this section;

(E) The identity of the competent person designated by the employer in accordance with paragraph (g)(4) of this section; and

(F) The purpose and a description of the medical surveillance program required by paragraph (h) of this section.

(ii) The employer shall make a copy of this section readily available without cost to each employee covered by this section.

(j) *Recordkeeping*—(1) Air monitoring data. (i) The employer shall make and maintain an accurate record of all exposure measurements taken to assess employee exposure to respirable crystalline silica, as prescribed in paragraph (d)(2) of this section.

(ii) This record shall include at least the following information:

(A) The date of measurement for each sample taken;

(B) The task monitored;

(C) Sampling and analytical methods used;

(D) Number, duration, and results of samples taken;

(E) Identity of the laboratory that performed the analysis;

(F) Type of personal protective equipment, such as respirators, worn by the employees monitored; and

(G) Name, social security number, and job classification of all employees represented by the monitoring, indicating which employees were actually monitored.

(iii) The employer shall ensure that exposure records are maintained and made available in accordance with 29 CFR 1910.1020.

(2) *Objective data*. (i) The employer shall make and maintain an accurate record of all objective data relied upon to comply with the requirements of this section.

(ii) This record shall include at least the following information:

(A) The crystalline silica-containing material in question;

(B) The source of the objective data;

(C) The testing protocol and results of testing;

(D) A description of the process, task, or activity on which the objective data were based; and

(E) Other data relevant to the process, task, activity, material, or exposures on which the objective data were based.

(iii) The employer shall ensure that objective data are maintained and made available in accordance with 29 CFR 1910.1020.

(3) *Medical surveillance*. (i) The employer shall make and maintain an accurate record for each employee covered by medical surveillance under paragraph (h) of this section.

(ii) The record shall include the following information about the employee:

(A) Name and social security number;

(B) A copy of the PLHCPs' and specialists' written medical opinions; and

(C) A copy of the information provided to the PLHCPs and specialists.

(iii) The employer shall ensure that medical records are maintained and made available in accordance with 29 CFR 1910.1020.

(k) *Dates*. (1) This section shall become effective June 23, 2016.

(2) All obligations of this section, except requirements for methods of sample analysis in paragraph (d)(2)(v), shall commence June 23, 2017.

(3) Requirements for methods of sample analysis in paragraph (d)(2)(v) of this section commence June 23, 2018.

Appendix A to § 1926.1153 – Methods of Sample Analysis.

This appendix specifies the procedures for analyzing air samples for respirable crystalline silica, as well as the quality control procedures that employers must ensure that laboratories use when performing an analysis required under 29 CFR 1926.1153 (d)(2)(v). Employers must ensure that such a laboratory:

1. Evaluates all samples using the procedures specified in one of the following analytical methods: OSHA ID-142; NMAM 7500; NMAM 7602; NMAM 7603; MSHA P-2; or MSHA P-7;

2. Is accredited to ANS/ISO/IEC Standard 17025:2005 with respect to crystalline silica analyses by a body that is compliant with ISO/IEC Standard 17011:2004 for implementation of quality assessment programs;

3. Uses the most current National Institute of Standards and Technology (NIST) or NIST traceable standards for instrument calibration or instrument calibration verification;

4. Implements an internal quality control (QC) program that evaluates analytical uncertainty and provides employers with estimates of sampling and analytical error;

5. Characterizes the sample material by identifying polymorphs of respirable crystalline silica present, identifies the presence of any interfering compounds that might affect the analysis, and makes any corrections necessary in order to obtain accurate sample analysis; and

6. Analyzes quantitatively for crystalline silica only after confirming that the sample matrix is free of uncorrectable analytical interferences, corrects for analytical interferences, and uses a method that meets the following performance specifications:

6.1 Each day that samples are analyzed, performs instrument calibration checks with standards that bracket the sample concentrations;

6.2 Uses five or more calibration standard levels to prepare calibration curves and ensures that standards are distributed through the calibration range in a manner that accurately reflects the underlying calibration curve; and

6.3 Optimizes methods and instruments to obtain a quantitative limit of detection that represents a value no higher than 25 percent of the PEL based on sample air volume.

Appendix B to § 1926.1153 – Medical Surveillance Guidelines.

Introduction

The purpose of this Appendix is to provide medical information and recommendations to aid physicians and other licensed health care professionals (PLHCPs) regarding compliance with the medical surveillance provisions of the respirable crystalline silica standard (29 CFR 1926.1153). Appendix B is for informational and guidance purposes only and none of the statements in Appendix B should be construed as imposing a mandatory requirement on employers that is not otherwise imposed by the standard.

Medical screening and surveillance allow for early identification of exposure-related health effects in individual employee and groups of employees, so that actions can be taken to both avoid further exposure and prevent or address adverse health outcomes. Silica-related diseases can be fatal, encompass a variety of target organs, and may have public health consequences when considering the increased risk of a latent tuberculosis (TB) infection becoming active. Thus, medical surveillance of silica-exposed employees requires that PLHCPs have a thorough knowledge of silica-related health effects.

This Appendix is divided into seven sections. Section 1 reviews silica-related diseases, medical responses, and public health responses. Section 2 outlines the components of the medical surveillance program for employees exposed to silica. Section 3 describes the roles and responsibilities of the PLHCP implementing the program and of other medical specialists and public health professionals. Section 4 provides a discussion of considerations, including confidentiality. Section 5 provides a list of additional resources and Section 6 lists references. Section 7 provides sample forms for the written medical report for the employee, the written medical opinion for the employer and the written authorization.

1. Recognition of Silica-related Diseases.

1.1. Overview. The term "silica" refers specifically to the compound silicon dioxide (SiO_2). Silica is a major component of sand, rock, and mineral ores. Exposure to fine (respirable size) particles of crystalline forms of silica is associated with adverse health effects, such as silicosis, lung cancer, chronic obstructive pulmonary disease (COPD), and activation of latent TB infections. Exposure to respirable crystalline silica can occur in industry settings such as foundries, abrasive blasting operations, paint manufacturing, glass and concrete product manufacturing, brick making, china and pottery manufacturing, manufacturing of plumbing fixtures, and many construction activities including highway repair, masonry, concrete work, rock drilling, and tuck-pointing. New uses of silica continue to emerge. These include countertop manufacturing, finishing, and installation (Kramer et al. 2012; OSHA 2015) and hydraulic fracturing in the oil and gas industry (OSHA 2012).

Silicosis is an irreversible, often disabling, and sometimes fatal fibrotic lung disease. Progression of silicosis can occur despite removal from further exposure. Diagnosis of silicosis requires a history of exposure to silica and radiologic findings characteristic of silica exposure. Three different presentations of silicosis (chronic, accelerated, and acute) have been defined. Accelerated and acute silicosis are much less common than chronic silicosis. However, it is critical to recognize all cases of accelerated and acute silicosis because these are life-threatening illnesses and because they are caused by substantial overexposures to respirable crystalline silica. Although any case of silicosis indicates a breakdown in prevention, a case of acute or accelerated silicosis implies current high exposure and a very marked breakdown in prevention.

In addition to silicosis, employees exposed to respirable crystalline silica, especially those with accelerated or acute silicosis, are at increased risks of contracting active TB and other infections (ATS 1997; Rees and Murray 2007). Exposure to respirable crystalline silica also increases an employee's risk of developing lung cancer, and the higher the cumulative exposure, the higher the risk (Steenland et al. 2001; Steenland and Ward 2014). Symptoms for these diseases and other respirable crystalline silica-related diseases are discussed below.

1.2. Chronic Silicosis. Chronic silicosis is the most common presentation of silicosis and usually occurs after at least 10 years of exposure to respirable crystalline silica. The clinical presentation of chronic silicosis is:

1.2.1. Symptoms - shortness of breath and cough, although employees may not notice any symptoms early in the disease. Constitutional symptoms, such as fever, loss of appetite and fatigue, may indicate other diseases associated with silica exposure, such as TB infection or lung cancer. Employees with these symptoms should immediately receive further evaluation and treatment.

1.2.2. Physical Examination - may be normal or disclose dry rales or rhonchi on lung auscultation.

1.2.3. Spirometry - may be normal or may show only a mild restrictive or obstructive pattern.

1.2.4. Chest X-ray - classic findings are small, rounded opacities in the upper lung fields bilaterally. However, small irregular opacities and opacities in other lung areas can also occur. Rarely, "eggshell calcifications" in the hilar and mediastinal lymph nodes are seen.

1.2.5. Clinical Course - chronic silicosis in most cases is a slowly progressive disease. Under the respirable crystalline silica standard, the PLHCP is to recommend that employees with a 1/0 category X-ray be referred to an American Board Certified Specialist in Pulmonary Disease or Occupational Medicine. The PLHCP and/or Specialist should counsel employees regarding work practices and personal habits that could affect employees' respiratory health.

1.3. Accelerated Silicosis. Accelerated silicosis generally occurs within 5-10 years of exposure and results from high levels of exposure to respirable crystalline silica. The clinical presentation of accelerated silicosis is:

1.3.1. Symptoms - shortness of breath, cough, and sometimes sputum production. Employees with exposure to respirable crystalline silica, and especially those with accelerated silicosis, are at high risk for activation of TB infections, atypical mycobacterial infections, and fungal superinfections. Constitutional symptoms, such as fever, weight loss, hemoptysis (coughing up blood), and fatigue may herald one of these infections or the onset of lung cancer.

1.3.2. Physical Examination - rales, rhonchi, or other abnormal lung findings in relation to illnesses present. Clubbing of the digits, signs of heart failure, and cor pulmonale may be present in severe lung disease.

1.3.3. Spirometry - restrictive or mixed restrictive/obstructive pattern.

1.3.4. Chest X-ray - small rounded and/or irregular opacities bilaterally. Large opacities and lung abscesses may indicate infections, lung cancer, or progression to complicated silicosis, also termed progressive massive fibrosis.

1.3.5. Clinical Course - accelerated silicosis has a rapid, severe course. Under the respirable crystalline silica standard, the PLHCP can recommend referral to a Board Certified Specialist in either Pulmonary Disease or Occupational Medicine, as deemed appropriate, and referral to a Specialist is recommended whenever the diagnosis of accelerated silicosis is being considered.

1.4. Acute Silicosis. Acute silicosis is a rare disease caused by inhalation of extremely high levels of respirable crystalline silica particles. The pathology is similar to alveolar proteinosis with lipoproteinaceous material accumulating in the alveoli. Acute silicosis develops rapidly, often, within a few months to less than 2 years of exposure, and is almost always fatal. The clinical presentation of acute silicosis is as follows:

1.4.1. Symptoms - sudden, progressive, and severe shortness of breath. Constitutional symptoms are frequently present and include fever, weight loss, fatigue, productive cough, hemoptysis (coughing up blood), and pleuritic chest pain.

1.4.2. Physical Examination - dyspnea at rest, cyanosis, decreased breath sounds, inspiratory rales, clubbing of the digits, and fever.

1.4.3. Spirometry - restrictive or mixed restrictive/obstructive pattern.

1.4.4. Chest X-ray - diffuse haziness of the lungs bilaterally early in the disease. As the disease progresses, the "ground glass" appearance of interstitial fibrosis will appear.

1.4.5. Clinical Course - employees with acute silicosis are at especially high risk of TB activation, nontuberculous mycobacterial infections, and fungal superinfections. Acute silicosis is immediately life-threatening. The employee should be urgently referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for evaluation and treatment. Although any case of silicosis indicates a breakdown in prevention, a case of acute or accelerated silicosis implies a profoundly high level of silica exposure and may mean that other employees are currently exposed to dangerous levels of silica.

1.5. COPD. COPD, including chronic bronchitis and emphysema, has been documented in silica-exposed employees, including those who do not develop silicosis. Periodic spirometry tests are performed to evaluate each employee for progressive changes consistent with the development of COPD. In addition to evaluating spirometry results of individual employees over time, PLHCPs may want to be aware of general trends in spirometry results for groups of employees from the same workplace to identify possible problems that might exist at that workplace. (See Section 2 of this Appendix on Medical Surveillance for further discussion.) Heart disease may develop secondary to lung diseases such as COPD. A recent study by Liu et al. 2014 noted a significant exposure-response trend between cumulative silica exposure and heart disease deaths, primarily due to pulmonary heart disease, such as cor pulmonale.

1.6. Renal and Immune System. Silica exposure has been associated with several types of kidney disease, including glomerulonephritis, nephrotic syndrome, and end stage renal disease requiring dialysis. Silica exposure has also been associated with other autoimmune conditions, including progressive systemic sclerosis, systemic lupus erythematosus, and rheumatoid arthritis. Studies note an association between employees with silicosis and serologic

markers for autoimmune diseases, including antinuclear antibodies, rheumatoid factor, and immune complexes (Jalloul and Banks 2007; Shtraichman et al. 2015).

1.7. TB and Other Infections. Silica-exposed employees with latent TB are 3 to 30 times more likely to develop active pulmonary TB infection (ATS 1997; Rees and Murray 2007). Although respirable crystalline silica exposure does not cause TB infection, individuals with latent TB infection are at increased risk for activation of disease if they have higher levels of respirable crystalline silica exposure, greater profusion of radiographic abnormalities, or a diagnosis of silicosis. Demographic characteristics, such as immigration from some countries, are associated with increased rates of latent TB infection. PLHCPs can review the latest Centers for Disease Control and Prevention (CDC) information on TB incidence rates and high risk populations online (See Section 5 of this Appendix). Additionally, silica-exposed employees are at increased risk for contracting nontuberculous mycobacterial infections, including Mycobacterium avium-intracellulare and Mycobacterium kansaii.

1.8. Lung Cancer. The National Toxicology Program has listed respirable crystalline silica as a known human carcinogen since 2000 (NTP 2014). The International Agency for Research on Cancer (2012) has also classified silica as Group 1 (carcinogenic to humans). Several studies have indicated that the risk of lung cancer from exposure to respirable crystalline silica and smoking is greater than additive (Brown 2009; Liu et al. 2013). Employees should be counseled on smoking cessation.

2. Medical Surveillance.

PLHCPs who manage silica medical surveillance programs should have a thorough understanding of the many silica-related diseases and health effects outlined in Section 1 of this Appendix. At each clinical encounter, the PLHCP should consider silica-related health outcomes, with particular vigilance for acute and accelerated silicosis. In this Section, the required components of medical surveillance under the respirable crystalline silica standard are reviewed, along with additional guidance and recommendations for PLHCPs performing medical surveillance examinations for silica-exposed employees.

2.1. History.

2.1.1. The respirable crystalline silica standard requires the following: A medical and work history, with emphasis on: past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system; any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (*e.g.*, shortness of breath, cough, wheezing); history of TB; and smoking status and history.

2.1.2. Further, the employer must provide the PLHCP with the following information:

2.1.2.1. A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;

2.1.2.2. The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica;

2.1.2.3. A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and

2.1.2.4. Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.

2.1.3. Additional guidance and recommendations: A history is particularly important both in the initial evaluation and in periodic examinations. Information on past and current medical conditions

(particularly a history of kidney disease, cardiac disease, connective tissue disease, and other immune diseases), medications, hospitalizations and surgeries may uncover health risks, such as immune suppression, that could put an employee at increased health risk from exposure to silica. This information is important when counseling the employee on risks and safe work practices related to silica exposure.

2.2. Physical Examination.

2.2.1. The respirable crystalline silica standard requires the following: A physical examination, with special emphasis on the respiratory system. The physical examination must be performed at the initial examination and every three years thereafter.

2.2.2. Additional guidance and recommendations: Elements of the physical examination that can assist the PHLCP include: an examination of the cardiac system, an extremity examination (for clubbing, cyanosis, edema, or joint abnormalities), and an examination of other pertinent organ systems identified during the history.

2.3. TB Testing.

2.3.1. The respirable crystalline silica standard requires the following: Baseline testing for TB on initial examination.

2.3.2. Additional guidance and recommendations:

2.3.2.1. Current CDC guidelines (See Section 5 of this Appendix) should be followed for the application and interpretation of Tuberculin skin tests (TST). The interpretation and documentation of TST reactions should be performed within 48 to 72 hours of administration by trained PLHCPs.

2.3.2.2. PLHCPs may use alternative TB tests, such as interferon-release assays (IGRAs), if sensitivity and specificity are comparable to TST (Mazurek et al. 2010; Slater et al. 2013). PLHCPs can consult the current CDC guidelines for acceptable tests for latent TB infection.

2.3.2.3. The silica standard allows the PLHCP to order additional tests or test at a greater frequency than required by the standard, if deemed appropriate. Therefore, PLHCPs might perform periodic (*e.g.*, annual) TB testing as appropriate, based on employees' risk factors. For example, according to the American Thoracic Society (ATS), the diagnosis of silicosis or exposure to silica for 25 years or more are indications for annual TB testing (ATS 1997). PLHCPs should consult the current CDC guidance on risk factors for TB (See Section 5 of this Appendix).

2.3.2.4. Employees with positive TB tests and those with indeterminate test results should be referred to the appropriate agency or specialist, depending on the test results and clinical picture. Agencies, such as local public health departments, or specialists, such as a pulmonary or infectious disease specialist, may be the appropriate referral. Active TB is a nationally notifiable disease. PLHCPs should be aware of the reporting requirements for their region. All States have TB Control Offices that can be contacted for further information. (See Section 5 of this Appendix for links to CDC's TB resources and State TB Control Offices.)

2.3.2.5. The following public health principles are key to TB control in the U.S. (ATS-CDC-IDSA 2005):

(1) Prompt detection and reporting of persons who have contracted active TB;

(2) Prevention of TB spread to close contacts of active TB cases;

(3) Prevention of active TB in people with latent TB through targeted testing and treatment; and

(4) Identification of settings at high risk for TB transmission so that appropriate infection-control measures can be implemented.

2.4. Pulmonary Function Testing.

2.4.1. The respirable crystalline silica standard requires the following: Pulmonary function testing must be performed on the initial examination and every three years thereafter. The required pulmonary function test is spirometry and must include forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and FEV_1/FVC ratio. Testing must be administered by a spirometry technician with a current certificate from a National Institute for Occupational Health and Safety (NIOSH)-approved spirometry course.

2.4.2. Additional guidance and recommendations: Spirometry provides information about individual respiratory status and can be used to track an employee's respiratory status over time or as a surveillance tool to follow individual and group respiratory function. For quality results, the ATS and the American College of Occupational and Environmental Medicine (ACOEM) recommend use of the third National Health and Nutrition Examination Survey (NHANES III) values, and ATS publishes recommendations for spirometry equipment (Miller et al. 2005; Townsend 2011; Redlich et al. 2014). OSHA's publication, Spirometry Testing in Occupational Health Programs: Best Practices for Healthcare Professionals, provides helpful guidance (See Section 5 of this Appendix). Abnormal spirometry results may warrant further clinical evaluation and possible recommendations for limitations on the employee's exposure to respirable crystalline silica.

2.5. Chest X-ray.

2.5.1. The respirable crystalline silica standard requires the following: A single posteroanterior (PA) radiographic projection or radiograph of the chest at full inspiration recorded on either film (no less than 14 x 17 inches and no more than 16 x 17 inches) or digital radiography systems. A chest X-ray must be performed on the initial examination and every three years thereafter. The chest X-ray must be interpreted and classified according to the International Labour Office (ILO) International Classification of Radiographs of Pneumoconioses by a NIOSH-certified B Reader.

Chest radiography is necessary to diagnose silicosis, monitor the progression of silicosis, and identify associated conditions such as TB. If the B reading indicates small opacities in a profusion of 1/0 or higher, the employee is to receive a recommendation for referral to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine.

2.5.2. Additional guidance and recommendations: Medical imaging has largely transitioned from conventional film-based radiography to digital radiography systems. The ILO Guidelines for the Classification of Pneumoconioses has historically provided film-based chest radiography as a referent standard for comparison to individual exams. However, in 2011, the ILO revised the guidelines to include a digital set of referent standards that were derived from the prior film-based standards. To assist in assuring that digitally-acquired radiographs are at least as safe and effective as film radiographs, NIOSH has prepared guidelines, based upon accepted contemporary professional recommendations (See Section 5 of this Appendix). Current research from Laney et al. 2011 and Halldin et al. 2014 validate the use of the ILO digital referent images. Both studies conclude that the results of pneumoconiosis classification using digital references are comparable to film-based ILO classifications. Current ILO guidance on radiography for pneumoconioses and B-reading should be reviewed by the PLHCP periodically, as needed, on the ILO or NIOSH websites (See Section 5 of this Appendix).

2.6. Other Testing. Under the respirable crystalline silica standards, the PLHCP has the option of ordering additional testing he or she deems appropriate. Additional tests can be ordered on a case-by-case basis depending on individual signs or symptoms and clinical judgment. For example, if an employee reports a history of abnormal kidney function tests, the PLHCP may want to order a baseline renal function tests (*e.g.*, serum creatinine and urinalysis). As indicated above, the PLHCP may order annual TB testing for silica-exposed employees who are at high risk of developing active TB infections. Additional tests that PLHCPs may order based on findings of medical examinations include, but is not limited to, chest computerized tomography (CT) scan for lung cancer or COPD, testing for immunologic diseases, and cardiac testing for pulmonary-related heart disease, such as cor pulmonale.

3. Roles and Responsibilities.

3.1. PLHCP. The PLHCP designation refers to "an individual whose legally permitted scope of practice (*i.e.*, license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the particular health care services required" by the respirable crystalline silica standard. The legally permitted scope of practice for the PLHCP is determined by each State. PLHCPs who perform clinical services for a silica medical surveillance program should have a thorough knowledge of respirable crystalline silica-related diseases and symptoms. Suspected cases of silicosis, advanced COPD, or other respiratory conditions causing impairment should be promptly referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine.

Once the medical surveillance examination is completed, the employer must ensure that the PLHCP explains to the employee the results of the medical examination and provides the employee with a written medical report within 30 days of the examination. The written medical report must contain a statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment. In addition, the PLHCP's written medical report must include any recommended limitations on the employee's use of respirators, any recommended limitations on the employee's exposure to respirable crystalline silica, and a statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational medicine if the chest X-ray is classified as 1/0 or higher by the B Reader, or if referral to a Specialist is otherwise deemed appropriate by the PLHCP.

The PLHCP should discuss all findings and test results and any recommendations regarding the employee's health, worksite safety and health practices, and medical referrals for further evaluation, if indicated. In addition, it is suggested that the PLHCP offer to provide the employee with a complete copy of their examination and test results, as some employees may want this information for their own records or to provide to their personal physician or a future PLHCP. Employees are entitled to access their medical records.

Under the respirable crystalline silica standard, the employer must ensure that the PLHCP provides the employer with a written medical opinion within 30 days of the employee examination, and that the employee also gets a copy of the written medical opinion for the employer within 30 days. The PLHCP may choose to directly provide the employee a copy of the written medical opinion. This can be particularly helpful to employees, such as construction employees, who may change employers frequently. The written medical opinion can

be used by the employee as proof of up-to-date medical surveillance. The following lists the elements of the written medical report for the employee and written medical opinion for the employer. (Sample forms for the written medical report for the employee, the written medical opinion for the employer, and the written authorization are provided in Section 7 of this Appendix.)

3.1.1. The written medical report for the employee must include the following information:

3.1.1.1. A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;

3.1.1.2. Any recommended limitations upon the employee's use of a respirator;

3.1.1.3. Any recommended limitations on the employee's exposure to respirable crystalline silica; and

3.1.1.4. A statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine, where the standard requires or where the PLHCP has determined such a referral is necessary. The standard requires referral to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for a chest X-ray B reading indicating small opacities in a profusion of 1/0 or higher, or if the PHLCP determines that referral to a Specialist is necessary for other silica-related findings.

3.1.2. The PLHCP's written medical opinion for the employer must include only the following information:

3.1.2.1. The date of the examination;

3.1.2.2. A statement that the examination has met the requirements of this section; and

3.1.2.3. Any recommended limitations on the employee's use of respirators.

3.1.2.4. If the employee provides the PLHCP with written authorization, the written opinion for the employer shall also contain either or both of the following:

(1) Any recommended limitations on the employee's exposure to respirable crystalline silica; and

(2) A statement that the employee should be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine if the chest X-ray provided in accordance with this section is classified as 1/0 or higher by the B Reader, or if referral to a Specialist is otherwise deemed appropriate.

3.1.2.5. In addition to the above referral for abnormal chest X-ray, the PLHCP may refer an employee to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for other findings of concern during the medical surveillance examination if these findings are potentially related to silica exposure.

3.1.2.6. Although the respirable crystalline silica standard requires the employer to ensure that the PLHCP explains the results of the medical examination to the employee, the standard does not mandate how this should be done. The written medical opinion for the employer could contain a statement that the PLHCP has explained the results of the medical examination to the employee.

3.2. Medical Specialists. The silica standard requires that all employees with chest X-ray B readings of 1/0 or higher be referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine. If the employee has given written authorization for the employer to be informed, then the employer shall make available a medical examination by a Specialist within 30 days after receiving the PLHCP's written medical opinion.

3.2.1. The employer must provide the following information to the Board Certified Specialist in Pulmonary Disease or Occupational Medicine:

3.2.1.1. A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;

3.2.1.2. The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica;

3.2.1.3. A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used or will use that equipment; and

3.2.1.4. Information from records of employment-related medical examinations previously provided to the employee and currently within the control of the employer.

3.2.2. The PLHCP should make certain that, with written authorization from the employee, the Board Certified Specialist in Pulmonary Disease or Occupational Medicine has any other pertinent medical and occupational information necessary for the specialist's evaluation of the employee's condition.

3.2.3. Once the Board Certified Specialist in Pulmonary Disease or Occupational Medicine has evaluated the employee, the employer must ensure that the Specialist explains to the employee the results of the medical examination and provides the employee with a written medical report within 30 days of the examination. The employer must also ensure that the Specialist provides the employer with a written medical opinion within 30 days of the employee examination. (Sample forms for the written medical report for the employee, the written medical opinion for the employer and the written authorization are provided in Section 7 of this Appendix.)

3.2.4. The Specialist's written medical report for the employee must include the following information:

3.2.4.1. A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;

3.2.4.2. Any recommended limitations upon the employee's use of a respirator; and

3.2.4.3. Any recommended limitations on the employee's exposure to respirable crystalline silica.

3.2.5. The Specialist's written medical opinion for the employer must include the following information:

3.2.5.1. The date of the examination; and

3.2.5.2. Any recommended limitations on the employee's use of respirators.

3.2.5.3. If the employee provides the Board Certified Specialist in Pulmonary Disease or Occupational Medicine with written authorization, the written medical opinion for the employer shall also contain any recommended limitations on the employee's exposure to respirable crystalline silica.

3.2.5.4. Although the respirable crystalline silica standard requires the employer to ensure that the Board Certified Specialist in Pulmonary Disease or Occupational Medicine explains the results of the medical examination to the employee, the standard does not mandate how this should be done. The written medical opinion for the employer could contain a statement that the Specialist has explained the results of the medical examination to the employee.

3.2.6. After evaluating the employee, the Board Certified Specialist in Pulmonary Disease or Occupational Medicine

should provide feedback to the PLHCP as appropriate, depending on the reason for the referral. OSHA believes that because the PLHCP has the primary relationship with the employer and employee, the Specialist may want to communicate his or her findings to the PLHCP and have the PLHCP simply update the original medical report for the employee and medical opinion for the employer. This is permitted under the standard, so long as all requirements and time deadlines are met.

3.3. Public Health Professionals. PLHCPs might refer employees or consult with public health professionals as a result of silica medical surveillance. For instance, if individual cases of active TB are identified, public health professionals from state or local health departments may assist in diagnosis and treatment of individual cases and may evaluate other potentially affected persons, including coworkers. Because silica-exposed employees are at increased risk of progression from latent to active TB, treatment of latent infection is recommended. The diagnosis of active TB, acute or accelerated silicosis, or other silica-related diseases and infections should serve as sentinel events suggesting high levels of exposure to silica and may require consultation with the appropriate public health agencies to investigate potentially similarly exposed coworkers to assess for disease clusters. These agencies include local or state health departments or OSHA. In addition, NIOSH can provide assistance upon request through their Health Hazard Evaluation program. (See Section 5 of this Appendix)

4. Confidentiality and Other Considerations.

The information that is provided from the PLHCP to the employee and employer under the medical surveillance section of OSHA's respirable crystalline silica standard differs from that of medical surveillance requirements in previous OSHA standards. The standard requires two separate written communications, a written medical report for the employee and a written medical opinion for the employer. The confidentiality requirements for the written medical opinion are more stringent than in past standards. For example, the information the PLHCP can (and must) include in his or her written medical opinion for the employer is limited to: the date of the examination, a statement that the examination has met the requirements of this section, and any recommended limitations on the employee's use of respirators. If the employee provides written authorization for the disclosure of any limitations on the employee's exposure to respirable crystalline silica, then the PLHCP can (and must) include that information in the written medical opinion for the employer as well. Likewise, with the employee's written authorization, the PLHCP can (and must) disclose the PLHCP's referral recommendation (if any) as part of the written medical opinion for the employer. However, the opinion to the employer must not include information regarding recommended limitations on the employee's exposure to respirable crystalline silica or any referral recommendations without the employee's written authorization.

The standard also places limitations on the information that the Board Certified Specialist in Pulmonary Disease or Occupational Medicine can provide to the employer without the employee's written authorization. The Specialist's written medical opinion for the employer, like the PLHCP's opinion, is limited to (and must contain): the date of the examination and any recommended limitations on the employee's use of respirators. If the employee provides written authorization, the written medical opinion can (and must) also contain any limitations on the employee's exposure to respirable crystalline silica.

The PLHCP should discuss the implication of signing or not signing the authorization with the employee (in a manner and language that he or she understands) so that the employee can make an informed decision

regarding the written authorization and its consequences. The discussion should include the risk of ongoing silica exposure, personal risk factors, risk of disease progression, and possible health and economic consequences. For instance, written authorization is required for a PLHCP to advise an employer that an employee should be referred to a Board Certified Specialist in Pulmonary Disease or Occupational Medicine for evaluation of an abnormal chest X-ray (B-reading 1/0 or greater). If an employee does not sign an authorization, then the employer will not know and cannot facilitate the referral to a Specialist and is not required to pay for the Specialist's examination. In the rare case where an employee is diagnosed with acute or accelerated silicosis, co-workers are likely to be at significant risk of developing those diseases as a result of inadequate controls in the workplace. In this case, the PLHCP and/or Specialist should explain this concern to the affected employee and make a determined effort to obtain written authorization from the employee so that the PLHCP and/or Specialist can contact the employer.

Finally, without written authorization from the employee, the PLHCP and/or Board Certified Specialist in Pulmonary Disease or Occupational Medicine cannot provide feedback to an employer regarding control of workplace silica exposure, at least in relation to an individual employee. However, the regulation does not prohibit a PLHCP and/or Specialist from providing an employer with general recommendations regarding exposure controls and prevention programs in relation to silica exposure and silica-related illnesses, based on the information that the PLHCP receives from the employer such as employees' duties and exposure levels. Recommendations may include increased frequency of medical surveillance examinations, additional medical surveillance components, engineering and work practice controls, exposure monitoring and personal protective equipment. For instance, more frequent medical surveillance examinations may be a recommendation to employers for employees who do abrasive blasting with silica because of the high exposures associated with that operation.

ACOEM's Code of Ethics and discussion is a good resource to guide PLHCPs regarding the issues discussed in this section (See Section 5 of this Appendix).

5. Resources.

5.1. American College of Occupational and Environmental Medicine (ACOEM):

ACOEM Code of Ethics. Accessed at: http://www.acoem.org/codeofconduct.aspx

Raymond, L.W. and Wintermeyer, S. (2006) ACOEM evidenced-based statement on medical surveillance of silica-exposed workers: medical surveillance of workers exposed to crystalline silica. J Occup Environ Med, 48, 95-101.

5.2. Center for Disease Control and Prevention (CDC)

Tuberculosis webpage: http://www.cdc.gov/tb/default.htm

State TB Control Offices web page: http://www.cdc.gov/tb/links/tboffices.htm

Tuberculosis Laws and Policies webpage: http://www.cdc.gov/tb/programs/laws/default.htm

CDC. (2013). Latent Tuberculosis Infection: A Guide for Primary Health Care Providers. Accessed at: http://www.cdc.gov/tb/publications/ltbi/pdf/targetedltbi.pdf

5.3. International Labour Organization

International Labour Office (ILO). (2011) Guidelines for the use of the ILO International Classification of Radiographs of Pneumoconioses, Revised edition 2011. Occupational Safety and Health Series No. 22: http://www.ilo.org/safework/info/publications/WCMS_168260/lang--en/index.htm

5.4. National Institute of Occupational Safety and Health (NIOSH)

NIOSH B Reader Program webpage. (Information on interpretation of X-rays for silicosis and a list of certified B-readers). Accessed at: http://www.cdc.gov/niosh/topics/chestradiography/breader-info.html

NIOSH Guideline (2011). Application of Digital Radiography for the Detection and Classification of Pneumoconiosis. NIOSH publication number 2011-198. Accessed at: http://www.cdc.gov/niosh/docs/2011-198/

NIOSH Hazard Review (2002), Health Effects of Occupational Exposure to Respirable Crystalline Silica. NIOSH publication number 2002-129: Accessed at http://www.cdc.gov/niosh/docs/2002-129

NIOSH Health Hazard Evaluations Programs. (Information on the NIOSH Health Hazard Evaluation (HHE) program, how to request an HHE and how to look up an HHE report). Accessed at: http://www.cdc.gov/niosh/hhe

5.5. National Industrial Sand Association:

Occupational Health Program for Exposure to Crystalline Silica in the Industrial Sand Industry. National Industrial Sand Association, 2nd ed. 2010. Can be ordered at: http://www.sand.org/silica-occupational-health-program

5.6. Occupational Safety and Health Administration (OSHA)

Contacting OSHA: http://www.osha.gov/html/Feed_Back.html

OSHA's Clinicians webpage. (OSHA resources, regulations and links to help clinicians navigate OSHA's web site and aid clinicians in caring for workers.) Accessed at: http://www.osha.gov/dts/oom/clinicians

OSHA's Safety and Health Topics webpage on Silica. Accessed at: http://www.osha.gov/dsg/topics/silicacrystalline

OSHA (2013). Spirometry Testing in Occupational Health Programs: Best Practices for Healthcare Professionals. (OSHA 3637-03 2013). Accessed at: http://www.osha.gov/Publications/OSHA3637.pdf

OSHA/NIOSH (2011). Spirometry: OSHA/NIOSH Spirometry InfoSheet (OSHA 3415-1-11). (Provides guidance to employers). Accessed at http://www.osha.gov/Publications/osha3415.pdf

OSHA/NIOSH (2011) Spirometry: OSHA/NIOSH Spirometry Worker Info. (OSHA 3418-3-11). Accessed at http://www.osha.gov/Publications/osha3418.pdf

5.7. Other

Steenland, K. and Ward E. (2014). Silica: A lung carcinogen. CA Cancer J Clin, 64, 63-69. (This article reviews not only silica and lung cancer but also all the known silica-related health effects. Further, the authors provide guidance to clinicians on medical surveillance of silica-exposed workers and worker counselling on safety practices to minimize silica exposure.)

6. References.

American Thoracic Society (ATS). Medical Section of the American Lung Association (1997). Adverse effects of crystalline silica exposure. Am J Respir Crit Care Med, 155, 761-765.

American Thoracic Society (ATS), Centers for Disease Control (CDC), Infectious Diseases Society of America (IDSA) (2005). Controlling Tuberculosis in the United States. Morbidity and Mortality Weekly Report (MMWR), 54(RR12), 1-81. Accessed at: http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5412a1.htm

Brown, T. (2009). Silica exposure, smoking, silicosis and lung cancer – complex interactions. Occupational Medicine, 59, 89-95.

Halldin, C. N., Petsonk, E. L., and Laney, A. S. (2014). Validation of the International Labour Office digitized standard images for recognition and classification of radiographs of pneumoconiosis. Acad Radiol, 21,305-311.

International Agency for Research on Cancer. (2012). Monographs on the evaluation of carcinogenic risks to humans: Arsenic, Metals, Fibers, and Dusts Silica Dust, Crystalline, in the Form of Quartz or Cristobalite. A Review of Human Carcinogens. Volume 100 C. Geneva, Switzerland: World Health Organization.

Jalloul, A. S. and Banks D. E. (2007). Chapter 23. The health effects of silica exposure. In: Rom, W. N. and Markowitz, S. B. (Eds). Environmental and Occupational Medicine, 4th edition. Lippincott, Williams and Wilkins, Philadelphia, 365-387.

Kramer, M. R., Blanc, P. D., Fireman, E., Amital, A., Guber, A., Rahman, N. A., and Shitrit, D. (2012). Artifical stone silicosis: disease resurgence among artificial stone workers. Chest, 142, 419-424.

Laney, A. S., Petsonk, E. L., and Attfield, M. D. (2011). Intramodality and intermodality comparisons of storage phosphor computed radiography and conventional film-screen radiography in the recognition of small pneumonconiotic opacities. Chest, 140, 1574-1580.

Liu, Y., Steenland, K., Rong, Y., Hnizdo, E., Huang, X., Zhang, H., Shi, T., Sun, Y., Wu, T., and Chen, W. (2013). Exposure-response analysis and risk assessment for lung cancer in relationship to silica exposure: a 44-year cohort study of 34,018 workers. Am J Epi, 178,1424-1433.

Liu, Y., Rong, Y., Steenland, K., Christiani, D. C., Huang, X., Wu, T., and Chen, W. (2014). Long-term exposure to crystalline silica and risk of heart disease mortality. Epidemiology, 25, 689-696.

Mazurek, G. H., Jereb, J., Vernon, A., LoBue, P., Goldberg, S., Castro, K. (2010). Updated guidelines for using interferon gamma release assays to detect Mycobacterium tuberculosis infection – United States. Morbidity and Mortality Weekly Report (MMWR), 59(RR05), 1-25.

Miller, M. R., Hankinson, J., Brusasco, V., Burgos, F., Casaburi, R., Coates, A., Crapo, R., Enright, P., van der Grinten, C. P., Gustafsson, P., Jensen, R., Johnson, D. C., MacIntyre, N., McKay, R., Navajas, D., Pedersen, O. F., Pellegrino, R., Viegi, G., and Wanger, J. (2005).

American Thoracic Society/European Respiratory Society (ATS/ERS) Task Force: Standardisation of Spirometry. Eur Respir J, 26, 319-338.

National Toxicology Program (NTP) (2014). Report on Carcinogens, Thirteenth Edition. Silica, Crystalline (respirable Size). Research Triangle Park, NC: U.S. Department of Health and Human Services, Public Health Service. http://ntp.niehs.nih.gov/ntp/roc/content/profiles/silica.pdf

Occupational Safety and Health Administration/National Institute for Occupational Safety and Health (OSHA/NIOSH) (2012). Hazard Alert. Worker exposure to silica during hydraulic fracturing.

Occupational Safety and Health Administration/National Institute for Occupational Safety and Health (OSHA/NIOSH) (2015). Hazard alert. Worker exposure to silica during countertop manufacturing, finishing, and installation. (OSHA- HA-3768-2015).

Redlich, C. A., Tarlo, S. M., Hankinson, J. L., Townsend, M. C, Eschenbacher, W. L., Von Essen, S. G., Sigsgaard, T., Weissman, D. N. (2014). Official American Thoracic Society technical standards: spirometry in the occupational setting. Am J Respir Crit Care Med; 189, 984-994.

Rees, D. and Murray, J. (2007). Silica, silicosis and tuberculosis. Int J Tuberc Lung Dis, 11(5), 474-484.

Shtraichman, O., Blanc, P. D., Ollech, J. E., Fridel, L., Fuks, L., Fireman, E., and Kramer, M. R. (2015). Outbreak of autoimmune disease in silicosis linked to artificial stone. Occup Med, 65, 444-450.

Slater, M. L., Welland, G., Pai, M., Parsonnet, J., and Banaei, N. (2013). Challenges with QuantiFERON-TB gold assay for large-scale, routine screening of U.S. healthcare workers. Am J Respir Crit Care Med, 188,1005-1010.

Steenland, K., Mannetje, A., Boffetta, P., Stayner, L., Attfield, M., Chen, J., Dosemeci, M., DeKlerk, N., Hnizdo, E., Koskela, R., and Checkoway, H. (2001). International Agency for Research on Cancer. Pooled exposure-response analyses and risk assessment for lung cancer in 10 cohorts of silica-exposed workers: an IARC multicentre study. Cancer Causes Control,12(9):773-84.

Steenland, K. and Ward E. (2014). Silica: A lung carcinogen. CA Cancer J Clin, 64, 63-69.

Townsend, M. C. ACOEM Guidance Statement. (2011). Spirometry in the occupational health setting – 2011 Update. J Occup Environ Med, 53, 569-584.

7. Sample Forms.

Three sample forms are provided. The first is a sample written medical report for the employee. The second is a sample written medical opinion for the employer. And the third is a sample written authorization form that employees sign to clarify what information the employee is authorizing to be released to the employer.

WRITTEN MEDICAL REPORT FOR EMPLOYEE

EMPLOYEE NAME: _____ **DATE OF EXAMINATION**: _____

TYPE OF EXAMINATION:
[ ] Initial examination [ ] Periodic examination [ ] Specialist examination
[ ] Other: _____

RESULTS OF MEDICAL EXAMINATION:

Physical Examination –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Chest X-Ray –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Breathing Test (Spirometry) –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Test for Tuberculosis –	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed
Other:_____	[ ] Normal	[ ] Abnormal (see below)	[ ] Not performed

Results reported as abnormal: _____
_____

[ ] Your health may be at increased risk from exposure to respirable crystalline silica due to the following:
_____

RECOMMENDATIONS:
[ ] No limitations on respirator use
[ ] Recommended limitations on use of respirator: _____
[ ] Recommended limitations on exposure to respirable crystalline silica: _____
_____

Dates for recommended limitations, if applicable: _____ (MM/DD/YYYY) to _____ (MM/DD/YYYY)

[ ] I recommend that you be examined by a Board Certified Specialist in Pulmonary Disease or Occupational Medicine

[ ] Other recommendations*:
_____
_____

Your next periodic examination for silica exposure should be in: [ ] 3 years [ ] Other: _____ (MM/DD/YYYY)

Examining Provider: _____ (signature) Date: _____

Provider Name: _____

Office Address: _____ Office Phone: _____

*These findings may not be related to respirable crystalline silica exposure or may not be work-related, and therefore may not be covered by the employer. These findings may necessitate follow-up and treatment by your personal physician.

Respirable Crystalline Silica standard (§ 1910.1053 or 1926.1153)

WRITTEN MEDICAL OPINION FOR EMPLOYER

EMPLOYER: _____

EMPLOYEE NAME: _____ **DATE OF EXAMINATION:** _____

TYPE OF EXAMINATION:
[ ] Initial examination [ ] Periodic examination [ ] Specialist examination
[ ] Other: _____

USE OF RESPIRATOR:
[ ] No limitations on respirator use
[ ] Recommended limitations on use of respirator:_____

Dates for recommended limitations, if applicable: _____ to _____
MM/DD/YYYY MM/DD/YYYY

The employee has provided written authorization for disclosure of the following to the employer (if applicable):

[ ] This employee should be examined by an American Board Certified Specialist in Pulmonary Disease or Occupational Medicine
[ ] Recommended limitations on exposure to respirable crystalline silica:_____
_____

Dates for exposure limitations noted above: _____ to _____
MM/DD/YYYY MM/DD/YYYY

NEXT PERIODIC EVALUATION: [ ] 3 years [ ] Other: _____
MM/DD/YYYY

Examining Provider: _____ Date: _____
(signature)
Provider Name: _____ Provider's specialty:_____

Office Address: _____ Office Phone: _____

[ ] I attest that the results have been explained to the employee.

The following is required to be checked by the Physician or other Licensed Health Care Professional (PLHCP):
[ ] I attest that this medical examination has met the requirements of the medical surveillance section of the OSHA Respirable Crystalline Silica standard (§ 1910.1053(h) or 1926.1153(h)).

AUTHORIZATION FOR CRYSTALLINE SILICA OPINION TO EMPLOYER

This medical examination for exposure to crystalline silica could reveal a medical condition that results in recommendations for (1) limitations on respirator use, (2) limitations on exposure to crystalline silica, or (3) examination by a specialist in pulmonary disease or occupational medicine. Recommended limitations on respirator use will be included in the written opinion to the employer. If you want your employer to know about limitations on crystalline silica exposure or recommendations for a specialist examination, you will need to give authorization for the written opinion to the employer to include one or both of those recommendations.

I hereby authorize the opinion to the employer to contain the following information, if relevant (please check all that apply):

☐ Recommendations for limitations on crystalline silica exposure

☐ Recommendation for a specialist examination

OR

☐ I do not authorize the opinion to the employer to contain anything other than recommended limitations on respirator use.

Please read and initial:

___ I understand that if I do not authorize my employer to receive the recommendation for specialist examination, the employer will not be responsible for arranging and covering costs of a specialist examination.

_____
Name (printed)

_____ _____
Signature Date

WORKERS' RIGHTS

Under federal law, workers are entitled to working conditions that do not pose a risk of serious harm.

For more information on how to assure a safe and healthful workplace, see OSHA's Workers page.

OSHA ASSISTANCE, SERVICES AND PROGRAMS

OSHA has a great deal of information to assist employers in complying with their responsibilities under OSHA law. Several OSHA programs and services can help employers identify and correct job hazards, as well as improve their safety and health program.

Establishing a Safety and Health Program

Safety and health programs are systems that can substantially reduce the number and severity of workplace injuries and illnesses, while reducing costs to employers.

Visit www.osha.gov/shpguidelines for more information.

Compliance Assistance Specialists

OSHA Compliance assistance specialists can provide information to employers and workers about OSHA standards, short educational programs on specific hazards or OSHA rights and responsibilities, and information on additional compliance assistance resources.

Visit www.osha.gov/dcsp/compliance_assistance/cas.html or call 1-800-321-OSHA (6742) to contact your local OSHA office.

Free On-site Safety and Health Consultation Services for Small Business

OSHA's On-site Consultation Program offers free and confidential advice to small and medium-sized businesses in all states, with priority given to high-hazard worksites. On-site consultation services are separate from enforcement and do not result in penalties or citations.

For more information or to find the local On-site Consultation office in your state, visit www.osha.gov/consultation, or call 1-800-321-OSHA (6742).

Under the consultation program, certain exemplary employers may request participation in OSHA's **Safety and Health Achievement Recognition Program (SHARP)**. Worksites that receive SHARP recognition are exempt from programmed inspections during the period that the SHARP certification is valid.

Cooperative Programs

OSHA offers cooperative programs under which businesses, labor groups and other organizations can work cooperatively with OSHA. To find out more about any of the following programs, visit www.osha.gov/cooperativeprograms.

Strategic Partnerships and Alliances

The OSHA Strategic Partnerships (OSP) provide the opportunity for OSHA to partner with employers, workers, professional or trade associations, labor organizations, and/or other interested stakeholders. Through the Alliance Program, OSHA works with groups to develop compliance assistance tools and resources to share with workers and employers, and educate workers and employers about their rights and responsibilities.

Voluntary Protection Programs (VPP)

The VPP recognize employers and workers in private industry and federal agencies who have implemented effective safety and health management programs and maintain injury and illness rates below the national average for their respective industries.

Occupational Safety and Health Training Courses

The OSHA Training Institute partners with 27 OSHA Training Institute Education Centers at 42 locations throughout the United States to deliver courses on OSHA standards and occupational safety and health topics to thousands of students a year. For more information on training courses, visit www.osha.gov/otiec.

OSHA Educational Materials

OSHA has many types of educational materials to assist employers and workers in finding and preventing workplace hazards.

All OSHA publications are free at www.osha.gov/publications and www.osha.gov/ebooks. You can also call 1-800-321-OSHA (6742) to order publications.

Employers and safety and health professionals can sign-up for *QuickTakes*, OSHA's free, twice-monthly online newsletter with the latest news about OSHA initiatives and products to assist in finding and preventing workplace hazards. To sign up visit www.osha.gov/quicktakes.

OSHA REGIONAL OFFICES

Region I
Boston Regional Office
(CT*, ME*, MA, NH, RI, VT*)
JFK Federal Building, Room E340
Boston, MA 02203
(617) 565-9860 (617) 565-9827 Fax

Region II
New York Regional Office
(NJ*, NY*, PR*, VI*)
201 Varick Street, Room 670
New York, NY 10014
(212) 337-2378 (212) 337-2371 Fax

Region III
Philadelphia Regional Office
(DE, DC, MD*, PA, VA*, WV)
The Curtis Center
170 S. Independence Mall West
Suite 740 West
Philadelphia, PA 19106-3309
(215) 861-4900 (215) 861-4904 Fax

Region IV
Atlanta Regional Office
(AL, FL, GA, KY*, MS, NC*, SC*, TN*)
61 Forsyth Street, SW, Room 6T50
Atlanta, GA 30303
(678) 237-0400 (678) 237-0447 Fax

Region V
Chicago Regional Office
(IL*, IN*, MI*, MN*, OH, WI)
230 South Dearborn Street
Room 3244
Chicago, IL 60604
(312) 353-2220 (312) 353-7774 Fax

Region VI
Dallas Regional Office
(AR, LA, NM*, OK, TX)
525 Griffin Street, Room 602
Dallas, TX 75202
(972) 850-4145 (972) 850-4149 Fax
(972) 850-4150 FSO Fax

Region VII
Kansas City Regional Office
(IA*, KS, MO, NE)
Two Pershing Square Building
2300 Main Street, Suite 1010
Kansas City, MO 64108-2416
(816) 283-8745 (816) 283-0547 Fax

Region VIII
Denver Regional Office
(CO, MT, ND, SD, UT*, WY*)
Cesar Chavez Memorial Building
1244 Speer Boulevard, Suite 551
Denver, CO 80204
(720) 264-6550 (720) 264-6585 Fax

Region IX
San Francisco Regional Office
(AZ*, CA*, HI*, NV*, and American Samoa, Guam and the Northern Mariana Islands)
90 7th Street, Suite 18100
San Francisco, CA 94103
(415) 625-2547 (415) 625-2534 Fax

Region X
Seattle Regional Office
(AK*, ID, OR*, WA*)
300 Fifth Avenue, Suite 1280
Seattle, WA 98104
(206) 757-6700 (206) 757-6705 Fax

*These states and territories operate their own OSHA-approved job safety and health plans and cover state and local government employees as well as private sector employees. The Connecticut, Illinois, Maine, New Jersey, New York and Virgin Islands programs cover public employees only. (Private sector workers in these states are covered by Federal OSHA). States with approved programs must have standards that are identical to, or at least as effective as, the Federal OSHA standards.

Note: To get contact information for OSHA area offices, OSHA-approved state plans and OSHA consultation projects, please visit us online at www.osha.gov or call us at 1-800-321-OSHA (6742).

HOW TO CONTACT OSHA

For questions or to get information or advice, to report an emergency, fatality, inpatient hospitalization, amputation, or loss of an eye, or to file a confidential complaint, contact your nearest OSHA office, visit www.osha.gov or call OSHA at 1-800-321-OSHA (6742), TTY 1-877-889-5627.

For assistance, contact us.
We are OSHA. We can help.

OSHA®
www.osha.gov

U.S. Department of Labor

For more information:

OSHA® Occupational Safety and Health Administration

www.osha.gov (800) 321-OSHA (6742)