Module 19: Silica Exposure
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arc wash machine. As he leaned over the metal cross bar to turn the handle of the circuit breaker switch of the side electrical panel, the co-worker in the next booth heard a scream. The co-worker ran for assistance, finding a supervisor who called for help. The Coroner's findings verified severe burns on both hands, indicating the flow of current through the chest area of the body. For approximately three to four months before the fatality occurred, the main power switch (toggle switch) of the Miller 1500 was not working properly. Two weeks prior to the incident, an operator at Booth #1 received a serious shock when trying to turn on the machine. He was reaching over the angle iron cross bar to turn the machine on when he received a "whole body shock." In addition, the operator reported that there was a spark between the frame which the part rested in and a hoist. The fatality was caused by contact with voltage current that was able to travel through the victim, from the disconnect switch handle on the machine to the metal crossbar behind the machine. The handle was "hot" with voltage current due to an electrical fault in the machine. The fault would usually cause an electrical circuit interruption (circuit breaker or fuse), but the ground wires not being connected prevented this safety device from working.

Lesson Summary

- In the arc welding process, an electric current is passed through the welding rod and is forced to jump—or arc—across a gap. The heat produced through this process is intense enough to perform welding and cutting operations. Most of the precautions and safe practices specified by OSHA are common to oxy-fuel gas welding, but there are certain requirements that are unique to arc welding. Electric shock is one of the most serious and immediate risks facing a worker while arc welding.
- Resistance welding utilizes pressure and heat that is generated in the pieces to be welded using resistance to an electric current. All personnel who are required to perform resistance welding must be properly trained and judged to be competent before they perform any tasks. While resistance welding, workers should ensure that all equipment is installed by a qualified electrician. All machines must have disconnecting switches or circuit breakers that are located at or near the machine. Thermal protection switches must also be provided for all ignitron tubes used in resistance welding equipment.

Module 19: Silica Exposure

Module Description

OSHA estimates 2.3 million American workers are exposed to respirable crystalline silica within their job site or manufacturing plant. Over 80% of the workers that are exposed to silica dust are in the construction industry. Crystalline Silica has been linked to several medical conditions and even death to workers exposed to the deadly dust. Exposure to respirable crystalline silica is a health concern for exposed workers. The

Occupational Safety and Health Administration (OSHA) recently updated the silica standard to increase the protection of workers through:

- Exposure identification sampling
- Medical evaluations
- Continued medical surveillance
- Lower Permissible Exposure Limit (PEL)
- Specific guideline for common construction tasks
- Requiring a silica exposure control program
- Addressing appropriate hazard exposure control

Module Learning Objectives

At the conclusion of this module, students will be able to:

- Identify materials which contain silica
- Understand the health hazards of respirable crystalline silica
- Explain the OSHA regulation on respirable crystalline silica for construction
- Be informed of the key provisions of the OSHA Construction standard 29 CFR 1926.1153
- Describe the federal guidance for medical surveillance
- Analyze exposure control techniques to protecting general industry workers from silica exposure
- Recognize the health hazards related to over exposure to respirable crystalline silica
- Identify the cause of lung tissue damage
- Understand the three major development stages of silicosis
- Explain the basic symptoms of silicosis

Lesson 1: The Issue

Lesson Focus

At the end of this lesson, students will be able to:

- Describe silica and its hazards
- Explain silica exposure limits
- Identify the tasks that create respirable crystalline silica
- Describe the available exposure assessment options
- Describe the available exposure control options
- Explain proper hazard communication
- Describe the necessary housekeeping when silica is exposed

Silica

A molecule of silica is made up of two of the most abundant elements on the earth: it contains two oxygen atoms and one silicon atom. The bonded molecules, when lined up in a repeatable pattern, are referred to as “crystalline silica”. There are 3 identified forms of silica in the OSHA standard:

- Quartz
- Cristobalite
- Tridymite

Respirable crystalline silica refers to a very small, breathable particle of hazardous crystalline silica in the air that is linked to lung cancer, silicosis, chronic obstructive pulmonary disease, and kidney disease. It could consist of any of the three forms of silica listed above (quartz, cristobalite, and tridymite). The International Organization for Standardization (ISO) has published a regulation called Air Quality-Particle Size Fraction Definitions for Health-Related Sampling (ISO 7708:1995). These very small particles are at least 100 times smaller than ordinary sand you might find on beaches and playgrounds.

The source of the silica dust is commonly drilling, crushing, cutting, or grinding rocks such as quartz (the most common surface material by volume to make up the earth’s crust). However, silica can be found in brick, mortar, concrete, slate, granite, tile, sand-blasting sand, and filter media as well. Activities such as abrasive blasting with sand; sawing brick or concrete; sanding or drilling into concrete walls; grinding mortar; manufacturing brick, concrete blocks, stone countertops, or ceramic products; and cutting or crushing stone can result in worker exposures to respirable crystalline silica dust.

Over-Exposure to Silica

Over-exposure to respirable crystalline silica has been linked to several health diseases and conditions, such as, but not limited to:

- Lung Cancer
- Chronic Obstructive Pulmonary Disease (COPD)
- Chronic Kidney Disease (CKD)
- Silicosis

Lung Cancer

When silica is inhaled, especially when accompanied by smoking, there is a higher risk for workers to develop lung cancer than either factor alone. The American Cancer Society reports that over 100 studies conducted have shown there is “strong consistent evidence that silica exposure increases lung cancer risks (American Cancer Society, 2013).

Chronic Obstructive Pulmonary Disease (COPD)

COPD is a progressive and mostly irreversible airflow obstruction condition that mostly afflicts cigarette smokers. However, a report done in the United Kingdom identifies the relationship of increased cases of COPD in non-smoking individuals that are exposed to silica at work (British Medical Bulletin, 2012).

Chronic Kidney Disease (CKD)

Though the sample size was small, the US National Library of Medicine National Institutes of Health noted in a 2011 report that there is "a positive relationship between occupational silica exposure and CKD" (NCBI, 2011). Additionally, the report states exposure to silica may also be associated with earlier stages of kidney disease.

Silicosis

Silicosis is a lung disease that is related to chronic exposure or even acute exposures at a very high level of silica. Workers who develop silicosis have such severe lung damage that they experience fever, coughing, shortness of breath, occasional bluish skin at the ear lobes or lips, chronic fatigue, and loss of appetite.

Silicosis causes these symptoms by generating a chronic inflammatory reaction in the lungs. This disease is known to indirectly kill lung tissue: when the body's immune response cells, called macrophages, try to dissolve the silica dust, they instead become weighted down with the respirable crystalline silica and sink into the lung tissue where they die. The alveoli (air sacs) in the lungs are damaged or scarred as a result of this process. Workers can eventually become sick and die as a result of these symptoms.

There are 3 major stages in the development of silicosis:

1. **Chronic** (> 10 years of mild over-exposure of respirable crystalline silica)
2. **Accelerated** (5-10 years of moderate over-exposure of respirable crystalline silica)
3. **Acute** (up to 3 years of heavy over-exposure of respirable crystalline silica)

Workers that have silica exposure and exhibit signs for silicosis should seek medical attention.

Silica Exposure Limits

Exposure Limits and Specific Construction Task Identified in Task 1 of the Standard

OSHA has revised its Silica standard to reflect the current research which showed the previous standard wasn't protective enough for workers. The new regulation is

expressed in the amount of silica that a worker can be exposed over an 8-hour time weighted average (TWA). This limit is called the Permissible Exposure Limit (PEL) and it has been lowered to 50 micrograms of respirable crystalline silica per cubic meter of air (µg/m3). At the action level of 25 µg/m3 averaged over an 8-hour day, the employer must act to reduce the exposure to the worker.

To calculate the TWA for exposure, the employer must use the following calculation:

TWA= ((T1 x C1) + (T2 x C2) + …… (Tn x Cn))/8

In this equation, C is the concentration of silica for any period of time (T1, T2, etc.) during which the concentration of the silica is constant.

Here is a sample breakdown of concentrations for an 8-hour shift:

- 3 hours at 100 µg/m3
- 2 hours at 10 µg/m3
- 5 hours at 50 µg/m3

The calculation would go as follows:

TWA= ((3 x 100) + (2 x 10) + (5 x 50))/8 = 71.25 µg/m3

This would be above the PEL, so the employer must take steps to lower the exposure.

Stationary masonry saws

- Use a saw that is equipped with an integrated water delivery system with constant feed
- Operate per the operations and maintenance (O&M) manual to minimize dust emissions
- If the above precautions are taken, no respiratory protection needed

Handheld power saw (any diameter)

- Use a saw that is equipped with an integrated water delivery system with constant feed
- Operate per the Operations and Maintenance (O&M) manual to minimize dust emissions.
- When used outdoors for:
  - Less than 4 hours/shift, no respirator is needed
  - More than 4 hours/shift, a respirator with a minimum assigned protection factor (APF) of 10 should be worn
- When used indoors or in enclosed areas for:
  - Less than 4 hours/shift, a respirator with APF 10 should be worn

- More than 4 hours/shift, a respirator with APF 10 should be worn

Handheld power saws for cutting fiber-cement board (with blade diameter of 8" or less)

- Use saw equipped with commercially available dust collection system
- Use as outlined in O&M
- Ensure 99% or greater dust collection efficiency
- If the above precautions are taken, no respiratory protection needed

Walk-behind saws

- Use a saw that is equipped with an integrated water delivery system with constant feed
- Operate as outlined in O&M to minimize dust emissions
- When used outdoors, no respirator is needed
- When used indoors or enclosed areas, a respirator with APF 10 should be worn.

Drivable saws

- Use a saw that is equipped with an integrated water delivery system with constant feed
- Operate per O&M to minimize dust emissions
- If the above precautions are taken, no respiratory protection needed

Rig-mounted core saws or drills

- Use a saw that is equipped with an integrated water delivery system with constant feed
- Operate per O&M to minimize dust emissions
- If the above precautions are taken, no respiratory protection needed

Handheld and stand-mounted drills (including impact and rotary hammer drills)

- Use a saw that is equipped with a shroud or cowling with dust collection capabilities
- Operate per O&M to minimize dust emissions
- Use a HEPA-filtered vacuum when cleaning holes
- A dust collector must be provided with a filter with 99% or greater efficiency and a filter-cleaning mechanism
- If the above precautions are taken, no respiratory protection needed

Dowel drilling for concrete

- Use a shroud around the drill bit with a dust collection system

- The dust collector must have a filter with 99% or greater efficiency and a filter-cleaning mechanism
- Use a HEPA-filtered vacuum when cleaning holes
- Wear a respirator with APF 10

Vehicle-mounted drilling rigs for rock and concrete

- Use a dust collection system with a close capture hood or shroud around drill bit that employs a low-flow water spray to wet the dust at the discharge point form the dust collector, OR
- Operate from within an enclosed cab and use water for dust suppression on the drill bit
- If the above precautions are taken, no respiratory protection needed

Jackhammers and handheld powered chipping tools

- Use a tool with a continuous stream or spray of water at the point of impact, OR
- Use a tool with a commercially available shroud and dust collection system
- Operate per O&M to minimize dust emissions
- The dust collector must be provided with a filter with 99% or greater efficiency and a filter-cleaning mechanism
- When used outdoors for:
  - Less than 4 hours/shift, no respirator is needed
  - More than 4 hours/shift, respirator with APF 10 must be worn
- When used indoors or in enclosed areas, a respirator with APF 10 must be worn

Handheld grinders for mortar removal (i.e., tuckpointing)

- Use a grinder equipped with a commercially available shroud and dust collection system
- Operate per O&M to minimize dust emissions
- The dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter
- A filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism should be used
- For work less than 4 hours/shift, use a respirator with APF 10
- For work more than 4 hours/shift, use respirator with an APF 25

Handheld grinders for uses other than mortar removal

- Use grinder equipped with commercially available shroud and dust collection system
- Operate per O&M to minimize dust emissions
- The dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter

- Use a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism
- When used outdoors, no respirator is needed
- When used indoors or in enclosed areas:
    - For less than 4 hours/shift, no respirator is needed
    - For more than 4 hours/shift, use a respirator with APF 10

Walk-behind milling machines and floor grinders

- Operate per O&M to minimize dust emissions
- Use a Hepa-filtered vacuum when used indoors or enclosed areas to remove loose dust in between passes
- A dust collector must be provided with a filter with 99% or greater efficiency and a filter-cleaning mechanism
- If the above precautions are taken, no respiratory protection needed

Small drivable milling machines (less than half-lane)

- Operate per O&M to minimize dust emissions
- Use a machine equipped with supplemental water sprays designed to suppress dust. Water must be combined with a surfactant.
- When the above precautions are taken, no respiratory protection needed

Large drivable milling machine (half-lane and lager)

- For cutting less than 4 inches in depth on any substrate:
    - Use a machine equipped with supplemental water sprays designed to suppress dust; you may additionally use exhaust ventilation on the drum enclosure
    - If only using the supplemental water spray, it must be combined with a surfactant
- For cutting more than 4 inches in depth (for asphalt only):
    - Use machine with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust
    - Operate and maintain machine to minimize dust emissions

Crushing machines

- Use equipment that is designed to spray or mist for dust suppression at crusher and other points where dust is generated
- Operate per O&M to minimize dust emissions
- Use a ventilated booth that provides fresh, climate-controlled air to the operator, or a remote-control station
- If the above precautions are taken, no respiratory protection needed

Heavy equipment and utility vehicles used to abrade or fracture 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

Heavy equipment and utility vehicles for tasks such as grading and excavating

- Apply water and/or dust suppression as necessary to minimize dust emissions
- When the equipment operator is the only employee engaged in the task, operate equipment from within an enclosed cab

Abrasive Blasting

Blasting substrates containing silica is regulated as an extremely high hazard task.

Common Silica-Producing Tools and their Controls

Handheld Grinders for Mortar Removal (Tuckpointing) and Other Tasks

Using a grinder to remove mortar while tuckpointing can generate respirable crystalline silica dust, which can irreversibly damage the lungs. The most effective engineering control method to protect workers is to use a vacuum dust collection system (VDCS) which sucks the dust out of the air at the point of work. The grinder and VDCS must be operated and maintained in accordance with the manufacturers' instructions. A VDCS works best when employees are properly trained and use good work practices, including:

- Keeping the vacuum hose clear and free of debris, kinks, and tight bends.
- Following the equipment manufacturer's direction on how to reduce dust buildup on the filter.
- Changing vacuum-collection bags as needed.
- Setting a regular schedule for maintenance and filter cleaning of the grinder and VDCS.
- Avoiding exposure to dust when changing vacuum bags and cleaning or replacing air filters.

Unless there is a ventilation system that effectively captures the dust cloud, *do not* use compressed air or blowers to clean dust from surfaces or clothing. This can increase the risk of exposure to silica. Instead, use a HEPA filter-equipped vacuum or by wet methods.

In addition to using a VDCS, workers should use respiratory protection with a minimum assigned protection factor (APF) of 10 when using the grinder for four hours or less per shift, and an APF of 25 when using it for more than four hours per shift.

Grinders equipped with an integrated water delivery system can be used to control dust when cutting, grinding, or polishing granite, concrete, or other materials containing crystalline silica. Note that where wet methods are employed, *electrical hazards are of particular concern*.

Handheld, Stationary, and Drivable Power Saws

Similar to grinders, power saws used to cut stone, concrete, and masonry can generate respirable crystalline silica dust. The most effective control method for avoiding the hazards posed by silica when using power saws is the **wet cutting method**, in which water is applied continuously to the saw blade. A vacuum dust collection system (VDCS) may also be used.

Many handheld power saws come equipped with an **integrated water delivery system** designed to cool the blade by directing a continuous stream of water onto the blade where it wets the material being cut and reduces the amount of dust generated. The water can be supplied either by a pressurized container or by a constant water supply such as a hose. Water flow rates must be sufficient to minimize the release of visible dust.

When employing the wet cutting method, the saw must be operated and maintained in accordance with the manufacturer's instructions. In particular, be sure to:

- Check that hoses are securely connected and are not cracked or broken.
- Adjust nozzles so that water goes to the blade and wets the cutting area.
- Inspect the saw blade before use to be sure it is in good condition and does not show excessive wear.
- Clean up any slurry produced to prevent it from drying and releasing silica dust into the air.

Stationary masonry saws may come equipped with a water basin that holds several gallons of water and recirculates it through a nozzle that directs a continuous stream onto the blade. In addition to the maintenance and safety checks listed above, for a stationary masonry saw be sure to also replace the basin water when it gets gritty or begins to silt up with dust. Instead of a basin, a drivable saw will have a built-in water tank or will be supplied by a hose.

If the wet cutting method is not sufficient to reduce silica exposure from stationary masonry saws, extra ventilation or a means of exhaust may be needed. This can be supplied by exhaust trunks, portable exhaust fans, air ducts, or other mechanical means of ventilation.

Note that countertops, whether of natural or engineered stone, often contain high levels of silica. Because countertops undergo both cutting and grinding, they can easily release this silica into the air, which can be dangerous to workers. Special care should

be taken when working with countertops to prevent this hazard. Here are some possible controls:

- Use water spraying systems and remote-controlled tools at the impact site where a saw or grinder generates dust.
- Large bridge or gantry-like saws usually use water sprays and can be remote-controlled for dust control and cooling.
- Hand-held angle grinders can be modified to deliver water to the point of contact with the stone.
- Wet-edge milling machines or stone routers can replace dry grinders in shops. They provide a clean edge profile with a diamond wheel.
- Use hand tools (e.g., drills, masonry saws, grinders) equipped with a shroud and a vacuum with a high efficiency particulate air (HEPA)-filter when wet methods are not practicable.
- Install LEV systems at fixed locations to capture dust at its point of origin.
- Use a combination of both water and ventilation controls, if necessary.

Jackhammers

The use of a jackhammer or handheld power chipping tool to break or demolish concrete, stone, masonry, or other silica-containing materials can generate dangerous silica dust. When jackhammering, wetting must occur with a continuous stream or spray of water at the point where the jackhammer's tip strikes the surface material. Employers may use manual spraying or water- spray systems. Under either approach, water must be applied at a flow rate sufficient to minimize the release of visible dust. Only wetting the surface is not sufficient. Continuous water application either streamed or sprayed at the point where the jackhammer or handheld powered chipping tool breaks the surface is necessary because as the tool breaks through the surface, dry materials below are disturbed, which can produce dust.

One option for applying water when jackhammering is to have one worker direct a stream or spray of water at the impact point while another worker operates the jackhammer or powered chipping tool. A portable sprayer with a nozzle can be used for this job. Spray nozzles aimed at the tip of the tool on jackhammers and handheld powered chipping tools can also lower silica exposures. Existing equipment can be retrofitted with such nozzles.

Drills

The use of handheld and stand-mounted drills, impact and rotary hammer drills, and similar tools used to drill holes in concrete, masonry, or other silica-containing materials can generate respirable crystalline silica dust. The best engineering control for avoiding this hazard is the vacuum dust collection system (VDCS), similar to that used for grinding machines and saws. A VDCS encloses a drill in a commercially available shroud or cowling with a vacuum attached to capture the silica dust as it is generated around the drill bit.

When using a VDCS with a drill, be sure to:

- Keep the vacuum hose clear and free of debris, kinks, and tight bends.
- Activate any non-automatic filter-cleaning mechanism as needed to reduce dust buildup on the filter.
- Change vacuum-collection bags as needed.
- Set a schedule for filter cleaning and maintenance.
- Avoid exposure to dust when changing vacuum bags and cleaning or replacing air filters.

Crushing Machines

Using crushing machines at construction sites to reduce the size of large rocks, concrete, or construction rubble can generate respirable crystalline silica dust. The use of water sprays or mists for dust suppression at the points where dust is generated (for example, hoppers, conveyers, sieves, vibrating components, and discharge points) can control dust exposures when operating crushers. In addition, operator isolation through the use of a remote-control station or ventilated booth that provides fresh, climate-controlled air to the operator must also be used to control exposure when operating crushers at construction sites.

Wet spray methods can greatly reduce the silica exposure levels of operators and laborers who work near crushers, tending the equipment, removing jammed material from hoppers, picking debris out of the material stream, and performing other tasks. The crusher must be operated and maintained in accordance with the manufacturer's instructions to minimize dust emissions. Make sure to:

- Locate nozzles upstream of dust generation points.
- Position nozzles to thoroughly wet the material.
- Ensure the volume and size of droplets is adequate to sufficiently wet the material (optimal droplet size is between 10 and 150 µm).
- Ensure nozzles provide complete water coverage but are not so far that the water is carried away by wind.

Operator isolation for crushing machines includes using either an enclosed booth or a remote-control station. Operators using crushing machines with enclosed cabs can limit their silica exposure by staying inside the cab during crushing operations. The enclosed cab must:

- Be well-sealed and well-ventilated using positive pressure.
- Have door jambs, window grooves, power-line entries and other joints that work properly and are tightly sealed.
- Have heating and air conditioning so that operators can keep windows and doors closed.

- Use an intake air filter with a minimum MERV-16 rating (at least 95 percent in the 0.3-10.0 µm range).
- Be kept free from settled dust by regular cleaning and maintenance to prevent dust from becoming airborne inside the enclosed booth.

An alternative method for operator isolation is to use a remote-control station located a sufficient distance upwind to limit exposure to silica containing dust.

Exposure Assessment Options

Employers that either do not perform the tasks listed in the previous section or choose to use another form of exposure control must evaluate the worksite for silica exposure. For the employer to know the actual employee exposure level to respirable crystalline silica, they will have to do worksite assessment. There are two options of assessments allowed under the silica standard: the performance option or the scheduled monitoring option.

Performance Option

The performance option is the more flexible of the two accepted assessment methods. Objective air monitoring data collected from an employer, a manufacturer, an industry-wide survey, or various professional associations is utilized to profile the work environment. This data must be an accurate depiction of the working conditions of the worksite in terms of the concentration, duration, types of materials, environmental conditions, etc. Below are some examples OSHA provides of acceptable sources for objective data (OSHA, 2018):

- Calculations based on substance composition
- Area sampling exposure mapping based on results
- Historical data for air monitoring by the employer
- Air monitoring data that reflects the workplace from industry-wide surveys
-

Air monitoring must be done in accordance with Appendix A of the OSHA standard, which lists laboratory procedures for measuring the quality of air. A statement from the approved laboratory detailing the level of silica at the most representative location of the worker's environment will be acceptable to OSHA.

If the employer chooses to use the performance option, then the following must occur:

- Exposure assessment must be done prior to the commencement or assignment of work
- Reassessment of exposure must be done if there is a change in the process, product, or hazard control equipment that is expected to increase the exposure
- The employer must prove that the assessment was accurate
- The employer must ensure that the exposure assessment reflects the exposure for each job classification and every shift.

Scheduled Monitoring Option

The scheduled monitoring option involves testing employees for exposure levels and should commence as soon as the work begins. Exposed employees are given air-sampling devices to wear at their breathing zones for a full shift. Another technique is to use a stationary air sampling meter, which is positioned in a place that represents the highest concentrations of silica exposure for several employees in a regulated area.

The employer can discontinue monitoring if the initial employee monitoring is below the action level. If the most recent sampling event is at or above the action level, but below the PEL, then the sampling must be repeated within a 6-month period. However, if the most recent sampling reveals exposure above the PEL, then it must be repeated within 3 months.

Once an employer has taken a sampling that is below the action level (not counting the initial sampling), then 2 more consecutive samples should be taken 7 or more days apart from each other. If one of the 2 follow up samples exceed the action level, then the employer must follow the procedures as outlined in the Reassessment of Exposures section of the standard.
Employees must be notified, in writing or by a posting in a location where everyone can see, of the results of the silica exposure test results within 5 working days after the completion of either exposure assessment. The 5-day notification begins when:

- An employer receives the laboratory results of the scheduling monitoring test, or
- Following the completion of the performance option exposure assessment

Employees or the designated representative must be allowed to observe the air monitoring if requested. Anyone observing a scheduled monitoring assessment must be protected from silica exposure by engineering controls or personal protective equipment.

Exposure Control Options

Regardless of which exposure control method is used, all construction employers covered by the standard are required to:

- Establish and implement a written exposure control plan that identifies tasks that involve exposure and methods used to protect workers, including procedures to restrict access to work areas where high exposure may occur
- Designate a competent person to implement the written exposure control plan
- Restrict housekeeping practices that expose workers to silica, such as use of compressed air without a ventilation system to capture the dust and dry sweeping
- Offer medical exams—including chest X-rays and lung function tests—every three years for workers as required by the standard to some operations

Engineering controls are the most effective way to protect a worker from any hazard that cannot be completely eliminated. An engineering control is a physical device or mechanism that will protect workers from a hazard. The second-best way to protect a worker from a hazard is to define administrative controls (work rules). Finally, Personal Protective Equipment (PPE) is utilized when engineering and administrative controls are not sufficient to completely negate the hazard's effects. The following are examples of these three types of controls:

- Engineering Controls
  - Ventilation systems in cabs of vehicles
  - Wet cutting methods
  - Vacuums equipped with a 0.3-micron HEPA filter
- Administrative Controls
  - Policies and Procedures
  - Following Operations and Maintenance (O & M) manuals
  - Conducting Job Hazard Analysis (JHA)
  - Exposure Control Plan
- Personal Protective Equipment (PPE)
  - Hand protection
  - Eye and face protection
  - Respiratory protection
  - Gloves

The employer must comply with all regulations outlined in OSHA's construction ventilation standard 1926.57. Additionally, OSHA encourages the use of alternative substrates to replace silica when possible as an added engineering control. The use of a respirator is mandatory when doing repair task where engineering and work practices aren't feasible.

The employer must also develop and display a written exposure control plan that includes at least the following information:

- Description of the tasks in the workplace involving exposure to silica
- Description of engineering controls, work practices, and respiratory protection for each task
- Description of housekeeping measures
- Description of the signs that indicate the engineering or other exposure controls are not working effectively, such as increase of visible dust or no water being delivered on the blade of a handsaw
- Include manufacturer instruction for all tools and equipment that are being used per the Table 1 guidelines
- Annual review of plan for effectiveness and update the plan when necessary
- Written plan must be readily available to each employee covered by the section, their designated representative, the Assistant Secretary and the Director

Housekeeping is a term that refers to the condition of the work environment as a measure of cleanliness. Employees must avoid dry sweeping, brushing, or using compressed air to blow dust off of themselves or any surface. This practice will increase the exposure of silica to the worker and the surrounding workstations.

Medical evaluation

Workers who are required to wear respirators under the standard for 30 or more days a year must be given a medical evaluation. These examinations must be offered every 3 years and must contain tests for pulmonary functions, a chest x-ray, and a physical exam. This medical surveillance is intended to:

- Identify if there is any disease caused from exposure to respirable crystalline silica contracted by the worker, and take actions necessary to protect their health
- Determine if the work has any conditions that may make them or others sensitive to working around silica
- Determine if the worker is fit to wear a respirator

After the exam the worker will get a report detailing their health and the employer will receive a medical opinion as per the limitations, if any, to the worker as a result of the exam. All medical evaluations must be free to the employees and offered at a reasonable time and place. Medical records must be kept and made available in accordance to 29 CFR 1910.1020. The records must include:

- Air monitoring data
- Objective data
- Medical Records

Though silica sand in the respirable state can be very dangerous for the workers, it is controllable by engineering, administrative, and PPE. In some cases, the exposure to this dust can be eliminated by substitution methods. However, the employer must protect its workers from this known hazard through the methods outlined in the OSHA standard.

Hazard Communication

Employers must comply with the 29 CFR 1910.1200 Subpart Z hazard communication standard. This standard is commonly referred to as “the right to know” rule for chemical exposure. Workers must be aware of the hazards related to the handling, storage, and use of chemicals in or around their work environment. Under the silica standard employers must address:

- Cancer hazards
- Lung effects
- Immune system effects
- Kidney effects

Under the hazard communication standard each component of a workplace must have:

- Labelling of primary and secondary containment of chemicals
- A written hazard communication program
- An administrator for the hazard communication program
- Training on the chemicals that the workers are exposed to the workplace
- Instructions on how to interpret the Safety Data Sheets (SDS)
- Knowledge of what task will produce over-exposure to chemicals

Workers must be trained on the following topics regarding respirable silica dust exposure:

- How the presence or release of silica is detected and analyzed
- Objective data or Air Monitoring Sampling
- How a visible increase in dust concentration indicates that the work exposure control practice in inadequate
- The details of workplace-specific SDS information, signage, container labels, emergency procedures, and written exposure control plan
- Work practices that will reduce or increase the exposure to silica dust
- Housekeeping techniques designed to reduce or eliminate the workplace exposure to silica

If workers are ever found to be working in a manner that suggests they have forgotten their initial training, they must be retrained on the hazards of silica.

Acceptable training methods are as follows, but not limited to:

- Hands-on training
- Webinars
- Videotapes
- Slide presentations
- Classroom instruction
- Seminars
- Written material
- Any combination of training delivery systems

Lesson Summary

- A molecule of silica is made up of two of the most abundant elements on the earth: it contains two oxygen atoms and one silicon atom. The bonded molecules, when lined up in a repeatable pattern, are referred to as “crystalline silica”. There are 3 identified forms of silica in the OSHA standard: Quartz, Cristobalite, and Tridymite.

- Respirable crystalline silica refers to a very small, breathable particle of hazardous crystalline silica in the air that is linked to lung cancer, silicosis, chronic obstructive pulmonary disease, and kidney disease. It could consist of any of the three forms of silica listed above (quartz, cristobalite, and tridymite).
- Over-exposure to respirable crystalline silica has been linked to several health diseases and conditions, such as, but not limited to: Lung Cancer, Chronic, Obstructive Pulmonary Disease (COPD), Chronic Kidney Disease (CKD), and Silicosis.
- Tools that commonly produce respirable silica include grinders, saws, jackhammers, drills, and crushing machines.
- Employers that either do not perform the tasks listed in the previous section or choose to use another form of exposure control must evaluate the worksite for silica exposure. For the employer to know the actual employee exposure level to respirable crystalline silica, they will have to do worksite assessment. There are two options of assessments allowed under the silica standard: the performance option or the scheduled monitoring option.
- Engineering controls are the most effective way to protect a worker from any hazard that cannot be completely eliminated. An engineering control is a physical device or mechanism that will protect workers from a hazard. The second-best way to protect a worker from a hazard is to define administrative controls (work rules). Finally, Personal Protective Equipment (PPE) is utilized when engineering and administrative controls are not sufficient to completely negate the hazard's effects.
- Employers must comply with the 29 CFR 1910.1200 Subpart Z hazard communication standard. This standard is commonly referred to as "the right to know" rule for chemical exposure. Workers must be aware of the hazards related to the handling, storage, and use of chemicals in or around their work environment.

Module 20: Lead Exposure

Module Description

Lead is a very toxic substance. People who are exposed to lead or lead compounds may become ill or even die due to lead poisoning. Our bodies remove lead from our systems at a slow rate, so inhaling even small doses of lead for a prolonged period of time can result in lead poisoning. Workers who are required to work at or near sites that are contaminated with lead are at a greater risk of lead poisoning.

This module is designed for workers who work in areas where the hazard of lead exposure exists. The module focuses on the health risks associated with exposure to lead and how workers can protect themselves against lead.

Revision #1
Created 24 April 2024 20:43:24 by Dale Bergman
Updated 24 April 2024 20:44:16 by Dale Bergman