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OSHA's Silica Standard

After many years on the regulatory agenda, OSHA has finally issued a proposed rule regarding occupational exposure to silica. The proposed rule has been published in the Federal Register with the period of public comment extending until December 11, 2013. Hearings will be held in Washington in March, 2014. OSHA estimates that around 1.3 million workers are exposed to silica in the US and the proposed standard will save nearly 700 lives and prevent 1,600 new cases of silicosis each year.

Two of the most abundant elements on earth are silicon and oxygen; the combination of these two produces silicon dioxide (SiO_2) also known as silica. Exposure to respirable concentrations of the crystalline form of silica is associated with the development of a fibrotic lung disease called silicosis. The term "Respirable" refers to the fraction of particles that are small enough to go deep into the lungs where oxygen exchange takes place. These particles are under 10 microns in size and are at least 100 times smaller than ordinary sand grains.

Silica sand is used in many different products. Sand blasting is a common use since it is cheaper than alternatives that are less hazardous. Silica sand and silica flour are common filler materials in many products such as paints and plastics. Some other uses include:

- Abrasives (sand blasting) and polishing agents
- Extenders in paint, wood fillers, rubber, plastics, soaps
- Molding agent in foundries
- Raw material in concrete, bricks, tile, glass

Industries with potential silica exposure include:

- Quarrying & Mining
- Foundries
- Ceramics, Clay & Pottery
- Stone
- Glass
- Abrasives
- Agriculture
- Construction
- Electronics

The hallmark of silicosis is the presence of nodules in the lungs. These nodular lesions contain a central zone with extracellular silica particles surrounded by whorls of collagen and fibrotic tissue. Studies have also shown that silica can cause lung cancer. The ACGIH (American Conference of Governmental Industrial Hygienists) has established a TLV (Threshold Limit Value) of 0.025 mg/m^3 (milligrams per cubic meter of air) for respirable silica as an eight-hour time weighted average to prevent silicosis and lung cancer. Currently, the OSHA and MSHA PEL (Permissible Exposure Limit) for silica are dependent on the form of silica and the percentage of silica in the respirable dust fraction and follows the formula:

$$\frac{10\ mg/m^3}{\%\ Quartz + 2}$$

The PEL was adopted by OSHA in 1971, is out of date with the most recent studies and is difficult to understand. That was one of the major reasons for promulgation of the proposed silica standard. The proposed silica standard includes a new PEL of 0.050 mg/m^3 with an Action Level of 0.025 mg/m^3. These exposures limits will apply to general Industry, Construction and Shipyards.

The proposed General Industry standard (29 CFR 1910.1053)

requires employers to assess employee exposure to silica where employees are or may reasonably be exposed to silica above the Action Level. Breathing zone air samples on each shift, each job classification and in each work area are to be collected as part of the assessment. If monitoring has been done in the previous 12 months prior to the effective date of the standard, this data may be used to satisfy this requirement. If the initial monitoring indicates exposures below the Action Level, monitoring may be discontinued. If initial testing reveals exposures above the Action Level but below the PEL, exposure monitoring shall be done at least every 6 months. If exposures are above the PEL, monitoring will be done at least every 3 months. Monitoring at these frequencies will be continued until two consecutive measurements are taken that are below the Action Level. The standard also requires additional exposure monitoring whenever processes, equipment, personnel or work practices may reasonably be expected to result in new exposures that may be above the Action Level.

If silica monitoring reveals exposures above the PEL, the standard requires the establishment of regulated areas. There are two options. The first involves demarcating and limiting access. In addition, each employee entering the regulated area is to be provided with an appropriate respirator depending on the level of silica present. If worker's clothing in regulated areas can be grossly contaminated with dust, employers are to provide protective clothing such as coveralls or means for removal of the dust from the clothing that minimizes potential employee exposure to silica. The second control option for a regulated area involves developing a written access control plan which includes these same elements with the addition of designating a competent person to identify the regulated areas, means of notifying employees of these areas, provisions to protect employees at multi-employer worksites, and procedures for reviewing and updating the plan at least annually.

The standard also requires the use of engineering controls and work practice controls to maintain exposures below the PEL. If feasible engineering controls do not bring exposures below the PEL, they are still to be used to bring exposures as low as possible. The standard also requires that HEPA (High Efficiency Particulate) vacuums or wet methods be used to clean accumulations of silica. Compressed air, dry sweeping and dry brushing is not to be used to clean clothing, or surfaces contaminated with crystalline silica. The standard also prohibits employers from using employee rotation as a means of achieving compliance with the PEL.

Where exposures are above the PEL, the standard requires the use of appropriate respiratory protection and implementation of a Respiratory Protection Program.

The standard also requires a medical surveillance program for employees who may be exposed above the PEL for more than 30 days per year. This consists of a baseline examination within 30 days of assignment and every three years after that. The medical surveillance program includes a work history, a chest X-ray, a pulmonary function test, TB test and any other tests deemed appropriate by the medical provider.

Training provisions of the standard include Hazard Communications and the health effects of silica. Other training requirements include:

- Operations in the workplace that may result in exposure to silica
- Specific procedures and practices to limit exposure
- The contents of the OSHA silica standard
- The purpose and description of the medical surveillance program

The standard also requires employers to keep records of exposure monitoring, medical surveillance and employee training.

The proposed silica standard in construction (29 CFR 1926.1053) has the same general provisions as the general industry standard with exception that employers do not need to do the exposure monitoring if the employers implements the work practices, engineering controls and use respiratory protection as outlined for specific work practices listed. As an example if an employee uses a jack hammer with a continuous supply of water to the point of impact or a shroud with a HEPA dust collection system for less than 4 hours per day, no respiratory protection is required. If the same controls are in place and an employee uses the jack hammer for more than 4 hours per day, then a half face respirator with a protection factor of 10 is required.

Some of the minor details in the proposed silica standards may change slightly as a result of the public hearings but it is anticipated that the overall final regulations will not change significantly. For now, employers should review the new standards and identify areas and operations that potentially expose employees to silica. If exposure monitoring has been conducted and levels will be above the new silica Action Level or PEL, controls should be implemented to reduce exposure. Employers should also evaluate how the new training, medical evaluation and respiratory protection provisions of the standards will fit into existing company safety programs.

Respiratory Protection

Ideally, engineering controls or substitution of a hazardous chemical with one less hazardous should be used to control exposures to airborne hazards in the workplace. In cases where controls are impractical or do not reduce exposures to acceptable levels, respirators must be used to control employees exposures. Employers need to have an understanding of the benefits and limitations of respiratory protection and how to establish a Respiratory Protection Program.

The first step in implementing a Respiratory Protection Program requires the evaluation of the need for respiratory protection in the first place. This involves conducting a risk assessment to identify the respiratory hazards in the workplace. The assessment should include:

- Identification of chemicals in each area or operation as well as the physical form of the chemicals-solids, liquids or gases
- Determine if liquids and solids give off vapors, dusts or mists
- Identify if oxygen deficient atmospheres exist in the work place

Once the airborne hazards are identified, the extent of the hazard must be determined. This involves identifying the concentrations of the hazards and comparing the levels found with acceptable exposure limits. Air monitoring is used to measure worker exposures. Personal samples collected in the breathing zone of workers provide the best estimate of occupational exposure levels. When samples are collected, it is important to relate the exposures to work variability from day to day. Factors to consider include:

- Was sampling conducted under normal operations or on a worst case basis?
- Are exposures constant throughout the shift or do certain processes expose employees to high concentrations for short periods?
- Which employees and how many samples need to be collected to give the best representation of exposure?

The best way to sample in most situations involves worst case conditions. This involves collecting samples from employees performing operations for the longest period of time or with the highest potential exposure. For highly hazardous operations or in cases of unknown exposures such as confined space entry, chemical spills or firefighting, the highest level of respiratory protection is required involving supplied air respirators and SCBAs (self-contained breathing apparatus).

Now that the respiratory hazards have been identified and the concentrations of the hazards have been determined, appropriate respirators are selected. There are two types of respirators depending on the type of hazards. These are air- purifying respirators and air supplied respirators. Air-purifying respirators remove gases, vapors and particulate matter through filters or cartridges. Specific types of filters and cartridges are available depending on the air-borne hazards. The simplest type of respirator are filtering face-piece respirators also called dust masks. They incorporate particulate filtration in the mask itself. There are tight-fitting respirators that can be either half mask or full face-piece. The full-face-piece respirators are required when there are airborne hazards that also affect the eyes. Various types of cartridges are available depending on the hazards. Powered air-purifying respirators (PAPRs) have a hood or helmet with either a tight fitting face-piece or a loose fitting face-piece. PAPRs use a battery powered blower to push air through the cartridges and into the face-piece. This makes breathing easier by eliminating the force required to inhale air through filters or cartridges.

Supplied air respirators don't filter out contaminants. They supply clean breathing air to the face-piece of the respirator. Supplied air respirators can be loose fitting helmets and hoods or tight fitting face-pieces. Air can be supplied through airlines to the respirator from a source outside the work area or from a pressurized air cylinder the user carries (SCBA). Air supplied respirators are required for highly hazardous atmospheres and in the following situations:

- No approved cartridges are available
- Operations involving highly toxic chemicals
- During abrasive blasting (sand blasting)
- When escaping from a hazardous environment
- In oxygen deficient atmospheres
- In situations that are IDLH (Immediately Dangerous to Life and Health)

Choosing the correct respirator requires multiplication of the

respirator assigned protection factor with the PEL (Permissible Exposure Limit). This provides a maximum use concentration when wearing the respirator. Some respirator assigned protection factors are:

- Half-mask air purifying- 10
- Full-face piece air purifying- 50
- Half-mask PAPR- 50
- Full-face piece PAPR- 1000
- Helmet/Hood/Loose Fitting PAPR- 25
- Half-mask supplied air/ continuous flow- 50
- Full-mask supplied air/ continuous flow- 1000

(Consult OSHA's Respiratory Protection Standard for more assigned protection factors.)

Maximum Use Concentration Example- Employee with exposure to xylene at 300 ppm (PEL for xylene 100 ppm). Maximum use concentration for a half-mask air purifying respirator is 10 x 100 ppm= 1000 ppm. In this case since the employee is exposed to xylene at 300 ppm which is below the 1000 ppm maximum use concentration the respirator is acceptable as long as the right type of cartridge is selected. The service life of cartridges depends on the environmental conditions such as temperature and humidity, the contaminant concentration, breathing rate and cartridge capacity. Respirator manufacturers have technical data, information and tools for choosing the right cartridge for a given situation and should be consulted for assistance.

Use of a respirator can place an additional stress on the employee. If the employee has existing heart or respiratory impairment, this additional burden may put the employee at risk. Medical evaluations are required to assess these risks taking into account the employee's health, the type of respirator they will be using, the airborne hazards they may be exposed to, the expected physical work effort, temperatures and humidity that may be encountered as well as additional personal protective equipment that may be worn. OSHA required that medical evaluations be conducted by a medical provider. Questionnaires and/or medical examinations are used to perform these assessments.

Respirators are only effective if they fit properly. Respirators with tight fitting seals must seal properly with the face. To accommodate different face sizes employers should provide a number of respirator options in various sizes. Two types of fit testing are used to ensure the respirators seal with the face. Qualitative fit testing involves a pass/fail test relying on the employee detecting a test agent such as isomayl acetate (banana oil) or irritant smoke leaking through the respirator seal. Quantitative fit testing involves using sensors to detect leakage of an agent through the mask seal with a resulting numerical fit factor. Fit testing is required before respirator use and at least annually. Fit testing should also be performed whenever employees use different respirators or have changes that may affect respirator fit. Facial hair can interfere with the respirator seal. Employees cannot have facial hair that interferes with the seal. PAPRs or air supplied respirators with loose fitting hoods may be required in these situations.

An important part of a Respiratory Protection Program involves employee training. If employees don't know how to use and maintain respirators properly or don't understand the limitations of their respirators, they put themselves in danger. Training should include:

- Why the respirator is required
- The capabilities and limitation of the respirators
- Use of respirators in emergency situations
- How to inspect, put on, remove and use the respirators
- Procedures for cleaning, maintaining and storing respirators
- Recognition of medical signs and symptoms that may limit or prevent effective use of the respirator
- Requirements of the OSHA Respiratory Protection Standard

Training needs to be conducted before respirators are used and should be done annually or whenever deficiencies are noted that indicate a need for more training.

In some situations, where exposures to particulates are below exposure limits, employees may still want to use dust masks. In these situations, the employer can provide dust masks to employees without implementing a Respiratory Protection Program as long as the employer provides employees with a copy of Appendix D of the Respiratory Protection Standard (29 CFR 1910.134). Medical evaluations and respirator fit testing are not required. If any other type of respirator is used in the work place even on a voluntary basis, OSHA requires that a full Respiratory Protection Program with medical evaluations and fit testing be implemented.

OSHA requires that all these elements be documented in a written Respiratory Protection Program. Program elements include:

- Respirator selection
- Medical evaluations
- Fit testing
- Use of respirators
- Maintenance and care of respirators

- Breathing air quality and use for air supplied respirators
- Training
- Program evaluation

The program should include roles and responsibilities of management, supervisors and employees under the program.

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