OSHA 2016 Silica Rule

Impact and Control Methods for Crystalline Silica

Jeff Reese
Jeffrey.reese@libertymutual.com

Liberty Mutual INSURANCE

Objectives

- -History
- -Lung Physiology
- -Why Change
- -Rule Change and Key Provisions
- -Exposure Assessment
- -Written Plan
- -Sample Methods
- -Medical Surv
- -Engineering Control Tech.

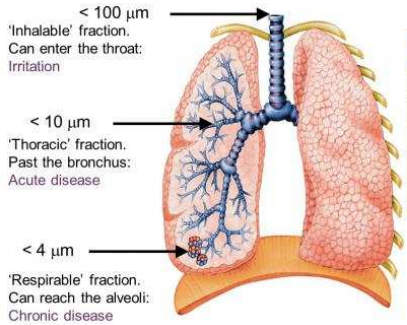
Brief History of Crystalline Silica Exposures

- Hippocrates - lung disease in quarry workers.
- Ramazini (1700's) – lung disease in stone cutters
- U.S. Public Health Service 1917- sand blasters and foundry workers to be at high risk of silicosis.
- **Hawk's Nest Tunnel Tragedy**: The Gauley Dam and Tunnel Project required the excavation of a 3-mile long tunnel to carry the New River through the Gauley Mountain. This project cost as many as 2,000 workers their lives and focused public attention on silicosis in America.

Liberty Mutual Insurance 3

Silica Related Lung Impairment and Lung Physiology

- Lung Physiology
  - Lungs have alveolar *surface area* available for gas exchange ranging between 75 to 100 square meters.
  - 5.8 liters of blood flow/minute in lungs.
  - Cell turn over every 28 days in lungs.

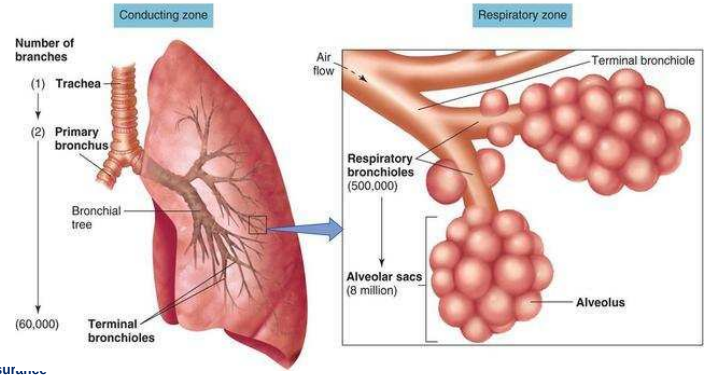


Latin prefix w/ meter	Measure as an exponent	Measure as a number	Common Expression
Terameter	10^{12}	1,000,000,000,000	One Trillion
Gigameter	10^{9}	1,000,000,000	One Billion
Megameter	10^{6}	1,000,000	One Million
Kilometer	10^{3}	1,000	One Thousand
METER	$\mathbf{10^{1}}$	**1**	**One**
Millimeter	10^{-3}	0.001	One Thousandth
Micrometer	10^{-6}	0.000001	One Millionth
Nanometer	10^{-9}	0.000000001	One Billionth
Picometer	10^{-12}	0.000000000001	One Trillionth

Liberty Mutual Insurance 4

Silicosis and Silica Related Lung Impairment

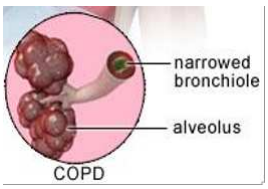
- Mechanism of disease
  - Macrophages / Fibroblasts
  - Lung damage in the deep lung – alveolar region
  - Reduced ability to exchange oxygen
  - Fibrotic lung disease
  - Other Lung Disease. TB



Liberty Mutual Insurance 5

Why Did OSHA Adopt a New Rule for Respirable Crystalline Silica?

- Prior to the update, OSHA's Permissible Exposure Limits for crystalline silica were more than 45 years old.
- Strong evidence showed that the previous PEL for crystalline silica did not adequately protect worker health.
  - Since the current exposure limits were adopted, respirable crystalline silica exposure has been found to cause lung cancer and kidney disease at the exposure levels previously permitted by the standards.
- Exposure to respirable crystalline silica has been linked to:
  - Silicosis
  - Lung cancer
  - Chronic obstructive pulmonary disease (COPD)
  - Kidney disease



Liberty Mutual Insurance 6

Why Did OSHA Adopt a New Rule for Respirable Crystalline Silica?

Unit	Gram Equivalents	Exp. Form
Kilogram (kg)	1000.0 g	10^{3} g
Gram (g)	1.0 g	1 g
Milligram (mg)	0.001 g	10^{-3} g
Microgram (µg)	0.000,001 g	10^{-6} g
Nanogram (ng)	0.000,000,001 g	10^{-9} g
Picogram (pg)	0.000,000,000,001 g	10^{-12} g
Femtogram (fg)	0.000,000,000,000,001 g	10^{-15} g

epidemiologic evidence revealed that lung cancer and silicosis occur at exposure levels below 0.1 mg/m3. 1/10,000 of a gram – Roughly equal to 1 paperclip in a volume of 150'x150'x 15'high

Liberty Mutual Insurance 7

Previous OSHA PELs Did Not Adequately Protect Workers

- Many found the calculated PEL method for silica confusing.
- If a sample contained 100% crystalline silica, as quartz, the calculated PEL in General Industry & Maritime resulted in a PEL of ~0.1 mg/m3 as an 8-hour TWA.

Previous $PEL_{(General\ Industry)}$ *in* $mg/m^3 = \frac{10}{\%silica + 2} = \frac{10}{100+2} = 0.098 \sim$ **0.1 mg/m³**

This calculated PEL was then compared to the respirable particulate concentration of the sample.

$$\text{Respirable Dust PEL} = \frac{10\ mg/m^3}{(\%quartz + 2(\%cristobalite) + 2)}$$

Liberty Mutual Insurance 8

Previous OSHA PELs Did Not Adequately Protect Workers

Cristobalite	<0.014	mg/cu m
Quartz	0.37	mg/cu m
Respirable Dust	0.66	mg/cu m

TWA Silica Exposure Calculation For Multiple & Polymorph Samples Based On The OSHA Method*

TWA Exposure For: **(Position)**

Sample #	Quartz conc.	Cristobalite conc.	Tridymite Conc.	Resp. Dust Conc.	Minutes
1.	0.370	0.014	0.00	0.66	424
2.	0.000	0.000	0.00	0	0

	% Silica	% Cristobalite	% Tridymite
1.	56.1	2.1	0.0
2.	N/A	N/A	N/A

Minutes of Exposure = 600 Minutes Sampled = 424 TWA Dust Conc.= 0.66

8 Hr. TWA Dust = 0.83

TWA % Quartz = 56.1

TWA % Cristobalite = 2.1 *Please refer to the Discussion section of this report for the formulas used.

TWA % Tridymite = 0.0

TWA PEL = 0.16 mg/m3 This exposure is: 514 % of the PEL

Example here is 56% Quartz - 1,480% of TLV

Liberty Mutual Insurance 9

Previous OSHA PELs Did Not Adequately Protect Workers

- Construction PEL used an obsolete particle count limit.
- If a sample contained 100% crystalline silica, as quartz, the calculation resulted in a PEL of ~0.24 mg/m^3 as an 8-hour TWA.

Previous PEL$_{(Construction)}$ *in mppcf* = $\frac{250}{\%\text{silica} + 5} = \frac{250}{100+5}$ = 2.3809 = **2.4 mppcf**

To convert from MPPCF to mg/m3 = $\frac{mppcf}{10} = \frac{2.4}{10}$ = **0.24 mg/m^3**



Lib 10

Key Provisions of Crystalline Silica Standard

Old Rule approximately

.24 mg/m3 for Construction

.1 mg/m3 for General Industry

New rule

50 micrograms/m3 or .05 mg/m3

With an action level of .025 mg/m3

NOTE: ACGIH TLV for Crystalline Silica, as quartz = **0.025 mg/m3 as 8-hour TWA**

MSHA

Liberty Mutual Insurance 11

OSHA Standard Compliance Schedule

- Both standards contained in the final rule take effect on **June 23, 2016**, after which industries have **one to five years to comply with most requirements**, based on the following schedule:
  - ***General Industry and Maritime*** *(1910.1053)* - June 23, 2018, **two years after the effective date**.
  - ***Hydraulic Fracturing*** - June 23, 2018, two years after the effective date for all provisions except Engineering Controls, which have a compliance date of June 23, 2021, five years
  - ***Construction*** *(1926.1153)* - **June 23, 2017**, one year after the effective date.
  - **Construction - Methods of Sample Analysis (Appendix A)** required by June 23, 2018, two years

Liberty Mutual Insurance 12

Key Provisions of Crystalline Silica Standard

- Requires employers to:
  - **Utilize feasible Engineering Controls (such as water or ventilation) to reduce or limit worker exposure** to levels below the PEL;
  - Implement work practice controls and **supplement with respiratory protection (as a temporary control)**, where controls cannot adequately limit exposure;
  - Establish a regulated area. Demarcate, limit worker access and require use of respiratory protection when in regulated area.
  - Develop a written **Exposure Control Plan**;
  - Provide medical surveillance to highly exposed workers (when **above PEL for 30 or more days per year**); and
  - Train workers on silica risks and how to limit exposures.
  - Housekeeping

Elimination or Engineering Controls

Use of PPE

Liberty Mutual Insurance 13

Exemptions

- Excludes exposures where the employer has objective data demonstrating that employee exposures to respirable crystalline silica will remain below 0.025 mg/m^3, as an 8-hour TWA concentration, under any foreseeable conditions.

- Construction excludes things such as mixing mortar, pouring concrete footers and removing formwork.

**There are no requirements for use of protective clothing to address exposures to respirable crystalline silica in the Standard.

Liberty Mutual Insurance 14

Construction Standard – Specific Exposure Control Methods

- Table 1 in the construction standard matches 18 tasks with effective dust control methods and, in some cases, respirator requirements.
- Employers that fully and properly implement controls on Table 1 do not have to:
  - Comply with the PEL in any additional manner unless exposure conditions for a given process change
  - Conduct exposure assessments for employees engaged in those tasks

Tasks for Construction in Table 1

- Stationary masonry saws
- Handheld power saws
- Handheld power saws for fiber cement board
- Walk-behind saws
- Drivable saws
- Rig-mounted core saws or drills
- Handheld and stand-mounted drills
- Dowel drilling rigs for concrete
- Vehicle-mounted drilling rigs for rock and concrete
- Jackhammers and handheld powered chipping tools
- Handheld grinders for mortar removal (tuckpointing)
- Handheld grinders for other than mortar removal
- Walk-behind milling machines and floor grinders
- Small drivable milling machines
- Large drivable milling machines
- Crushing machines
- Heavy equipment and utility vehicles to abrade or fracture silica materials
- Heavy equipment and utility vehicles for grading and excavating

Liberty Mutual Insurance 15

Exposure Control Methods in Construction

In the Construction industry, employers can either follow a control method as listed in Table 1 or they can measure workers' silica exposures and determine which dust controls work best to limit exposures to the PEL.

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
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.	None	APF 10
	• When used indoors or in an enclosed area.	APF 10	APF 10

Liberty Mutual Insurance 16

Exposure Control Methods in Construction

Half mask/Dust mask
APF=10
Needs to be fit tested

Half mask (Elastomeric)
APF=10
Needs to be fit tested

Full facepiece (Elastomeric)
APF=50
Needs to be fit tested

Assigned Protection Factor

Exposure Control Methods in Construction

Exposure Control Methods in Construction

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

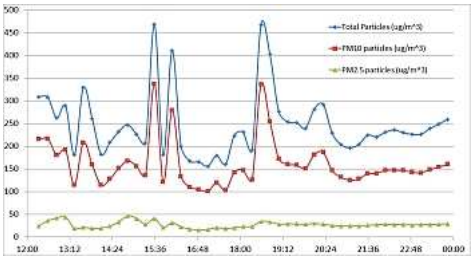
Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection and Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	>4 Hours/shift
(x) Jackhammers and handheld powered chipping tools	Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact.		
	•When used outdoors.	None	APF 10
	•When used indoors or in an enclosed area.	APF 10	APF 10
	OR		
	Use tool equipped with commercially available shroud and dust collection system.		
	•When used outdoors.	None	APF 10
	•When used indoors or in an enclosed area.	APF 10	APF 10

Exposure Assessment – General Industry & Construction

- Required to assess the exposure of each employee or similar exposure group who **is or may reasonably be expected to be** exposed to respirable crystalline silica **at or above the action level** using either:
  - **The Performance Option**

OR

  - **Scheduled Monitoring Option**



Liberty Mutual Insurance 19

Exposure Assessment - Performance Option

- Exposures assessed using any combination of **air monitoring data or objective data** sufficient to accurately characterize employee exposure to respirable crystalline silica.

Air monitoring data from industry-wide IH assessments or calculations based on the composition of a substance.

Liberty Mutual Insurance 20

Scheduled Monitoring Option in the Workplace

- This option prescribes a schedule for performing initial and periodic personal monitoring.
- Must conduct initial exposure monitoring.
- If monitoring indicates:
  - Initial Exposure below the AL: no additional monitoring
  - Most recent at or above the AL: repeat within 6 months
  - Most recent above the PEL: repeat within 3 months
  - When two consecutive non-initial results, taken 7 or more days apart, are below the AL, monitoring can be discontinued
  - Reassess if circumstances change

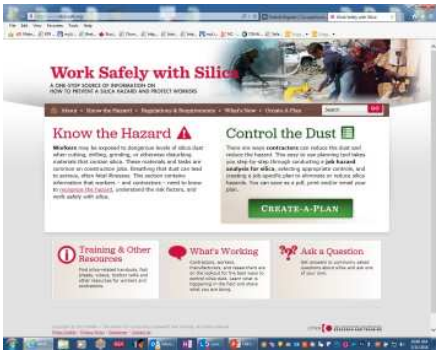
Implies - keep monitoring until exposure is below AL

Liberty Mutual Insurance 21

Written Exposure Control Plan

- The plan must describe:
  - Tasks involving exposure to respirable crystalline silica
  - Engineering controls,
  - work practices,
  - respiratory protection for each task
  - Housekeeping measures used to limit exposure
  - Procedures used to restrict access, when necessary to limit exposures

http://www.silica-safe.org/



Liberty Mutual Insurance 22

Construction – Competent Person Designation

Construction – Competent Person Designation

- OSHA defined "**competent person**" in this standard as:

*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 29 CFR 1926.1153(g)].*

Competent Person must make frequent and regular inspection

Appendix A – Methods of Sample Analysis

- *1926.1153 Appendix A* specifies the procedures for analyzing respirable crystalline silica air samples.
- Samples are collected using a size selected sampling device and flow rate including any of the following:
  - 10-mm nylon Dorr-Oliver operated at 1.7 L/min
  - SKC aluminum cyclone operated at 2.5 L/min
  - Higgins Dewell cyclone operated at 2.2 L/min
  - GK2.69 operated at 4.2 L/min

When the NPRM was issued, OSHA estimated that approx. 40 IH Labs in US meet the required analytical criteria.

Appendix B - Medical Surveillance

- Employers must offer medical examinations to workers who will be required to wear a respirator under the standard for 30 or more days a year.
- Employers must offer examinations every three years
- Exam includes
  - medical and work history,
  - physical exam,
  - chest X-ray, and
  - pulmonary function test (TB test on initial exam only)

Liberty Mutual Insurance 25

Concrete Slab Cutting

Water and Dust Extraction	No Dust Suppression Controls
▪ Walk-Behind Saw - Wet Saw Blade and vacuum	▸ Walk-Behind Concrete Saw with No Dust Controls

Liberty Mutual Insurance 26

Concrete Block Cutting

Water Used for Dust Suppression

- Water Suppression System on Saw Blade

No Dust Suppression Controls

- Dry Cutting of Concrete Block with PAPR

Liberty Mutual Insurance 27

Concrete Drilling

Dust Extraction - Ventilation

Ventilation System Surrounds Drill Bit

Liberty Mutual Insurance 28

Concrete Grinding

Grinding Concrete Using Dust Extraction - Ventilation

Grinding Concrete without Controls

Liberty Mutual Insurance 29

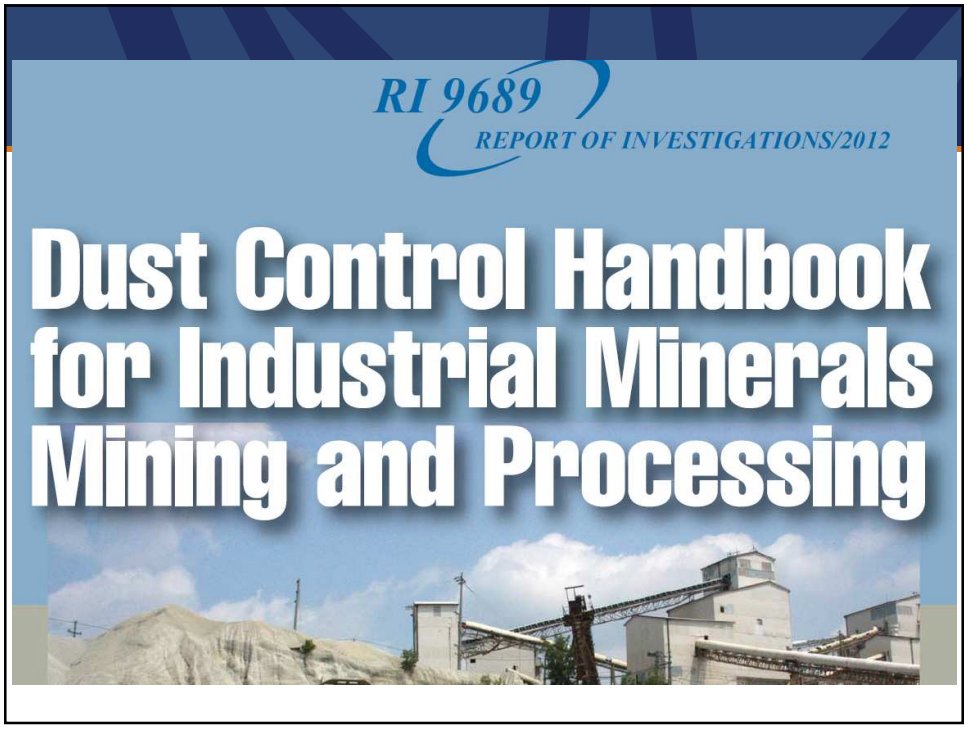
Grinding and Polishing Concrete Floors

Concrete Floor Grinding with Dust Extraction

LEV System to extract silica containing dust from grinding area.

Concrete Floor Grinding – No Dust Control

Liberty Mutual Insurance 30



Dust Suppression Methods

- Water mist used to Suppress Dust at Crusher Dump Zone

Dust Suppression Methods

- Water Misting Using Spray Nozzles on Rings

Liberty Mutual Insurance 33

Dust Suppression Methods

- Water Mist Suppresses Dust at Belt End (Material Drop Point)

Liberty Mutual Insurance 34

Haul Road Dust Control

- Water Truck Wetting Haul Road Out of Mine; may need to use chemical wetting agents or coatings (Surfactants, Emulsions, Polymers, or Sealants.)

Liberty Mutual Insurance 35

Dust Control in Crushing & Screening

- Bag Houses and Ventilation in Sand and Gravel Mine

Liberty Mutual Insurance 36

References / Resources

- OSHA Final Rule to Protect Workers from Crystalline Silica:
  - www.osha.gov/silica
  - This web page contains:
    - Regulatory Text for Construction Standard
    - Fact sheet on Construction
    - FAQs
    - Video
    - Appendix B – Medical Surveillance Guidelines for Construction
- NIOSH Silica Webpage:
  - http://www.cdc.gov/niosh/topics/silica/
- Health & Safety Executive (HSE):
  - http://www.hse.gov.uk/pubns/cis36.pdf

Liberty Mutual Insurance 37

Take Action!

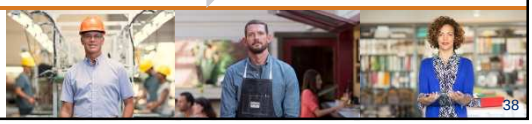
.05 mg/m3 PEL

.025 mg/m3 AL

Evaluate Tasks at your jobsites

Align Tasks with Controls

Develop a Written Exposure Control Plan/Designate a Competent Person



Liberty Mutual Insurance 38