Occupational Exposure to Respirable Crystalline Silica

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OSHA 6b Health Standards

- Significant Risk of Material Impairment
- Technological / Economic Feasibility
Timeline

• Previous PEL established in 1971
• NIOSH Criteria Document in 1974
  – REL of 50 ug/m³
• OSHA Special Emphasis Program in 1996
• Regulatory Agenda in 1997
• Proposed Rule issued September 12, 2013
• Public Hearings March 18 to April 4, 2015
• Final Rule issued March 25, 2016
• Compliance Dates:
  – Construction June 23, 2017
  – General Industry June 23, 2018
Workers and Industries Affected

- 2.3 million workers:
  - Construction: 2 million
  - GI/Maritime: 300,000
- 676,000 establishments
  - Construction: 600,000
  - GI/Maritime: 76,000
Health Effects

• Exposure to respirable crystalline silica has been linked to:
  • Silicosis
  • Lung cancer
  • Chronic obstructive pulmonary disease
  • Kidney disease

• Extensive epidemiologic evidence that lung cancer and silicosis occur at exposure levels below 100 µg/m³
OSHA estimates that once the effects of the rule are fully realized, it will prevent:

- More than 600 deaths per year
  - Lung cancer: 124
  - Silicosis and other non-cancer lung diseases: 325
  - End-stage kidney disease: 193
- More than 900 new silicosis cases per year
Industries and Operations with Exposures

- Construction
- Glass manufacturing
- Pottery products
- Structural clay products
- Concrete products
- Foundries
- Dental laboratories
- Paintings and coatings
- Jewelry production
- Refractory products
- Asphalt products
- Landscaping
- Ready-mix concrete
- Cut stone and stone products
- Abrasive blasting in:
  - Maritime work
  - Construction
  - General industry
- Refractory furnace installation and repair
- Railroads
- Hydraulic fracturing for gas and oil
New OSHA Silica Standards

- Two standards:
  - General Industry and Maritime
    - 29 CFR 1910.1053
  - Construction
    - 29 CFR 1926.1153
- Provisions are similar to other OSHA health standards
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</table>
General Industry/Maritime - Scope

• All occupational exposures to respirable crystalline silica are covered, unless objective data shows exposures remain below 25 µg/m³ as an 8-hr TWA under any foreseeable conditions.

• Agricultural operations and exposures resulting from processing of sorptive clays are not covered.

• General industry employers can follow the construction standard in some very limited circumstances.
Previous PEL

• Previous permissible exposure limits (PELs) were based on respirable dust levels using formulas:
  – General Industry: PEL = 10 / (% silica + 2)
    • ~ 0.10 mg/m³ for 100% silica
  – Construction: PEL = 250 / (% silica + 50)
    • ~ 0.250 mg/m³ for 100% silica
• Construction/Shipyard PELs based on obsolete particle count methods
  – In units of million particles per cubic foot
  – 1.0 mppcf = ~0.1 mg/m³
Permissible Exposure Limit (PEL)

- PEL = 50 µg/m³ as an 8-hour TWA
- 10 mg/m³
- % SiO₂ +2
- Action Level = 25 µg/m³ as an 8-hour TWA
Respirable Dust Levels (in mg/m³) required to comply with new PEL of 50 µg/m³ compared with previous General Industry and Construction PELs by Percent Silica Content of Dust

- **Final PEL (5 / %)**
- **Gen Industry PEL=(10/(%+2))**
- **Construction PEL=(25/(%+5))**

**Milligrams per Cubic Meter**

**Percent Silica Content**

[Graph showing the relationship between Respirable Dust Levels and Percent Silica Content]
Exposure Assessment

• Required if exposures may reasonably be expected to be at or above an action level of 25 µg/m³

• Exposures assessments can be done following:
  • The performance option
  • The scheduled monitoring option
Performance Option

• Exposures assessed using any combination of air monitoring data or objective data sufficient to accurately characterize employee exposure to respirable crystalline silica
Objective Data

• Includes air monitoring data from industry-wide surveys or calculations based on the composition of a substance
• Demonstrates employee exposure associated with a particular product or material or a specific process, task, or activity
• 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
Scheduled Monitoring Option

- Prescribes a schedule for performing initial and periodic personal monitoring
- If monitoring indicates:
  - Initial 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
Sampling and Analysis

• OSHA Method 142
  – Dorr-Oliver Cyclone at 1.7 LPM
  – Analysis using X-Ray Diffraction

• NIOSH Method 7500
  – Higgens Dewell Cyclone: 2.2 L/min;
  – Aluminum Cyclone: 2.5 L/min
Appendix A – Methods of Sample Analysis

• Employers must ensure that samples are analyzed by a laboratory that follows the procedures in Appendix A
• Appendix A specifies methods of sample analysis
  • Allows for use of OSHA, NIOSH, or MSHA methods
  • Analysis must be conducted by accredited laboratories that follow specified quality control procedures
# Detection Limits in Air

With an Analytical LOD of 10 µg

<table>
<thead>
<tr>
<th>Sample Duration</th>
<th>Air Volume*</th>
<th>Detection Limit</th>
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</thead>
<tbody>
<tr>
<td>480 minutes</td>
<td>816 Liters</td>
<td>12 µg/m³</td>
</tr>
<tr>
<td>360 minutes</td>
<td>612 Liters</td>
<td>16 µg/m³</td>
</tr>
<tr>
<td>240 minutes</td>
<td>408 Liters</td>
<td>24 µg/m³</td>
</tr>
<tr>
<td>120 minutes</td>
<td>204 Liters</td>
<td>49 µg/m³</td>
</tr>
<tr>
<td>30 minutes</td>
<td>51 Liters</td>
<td>196 µg/m³</td>
</tr>
</tbody>
</table>

* For air sample at flowrate of 1.7 LPM, the rate used for a standard nylon cyclone. (OSHA Method ID-142)
Regulated Areas

• General Industry and Maritime Standards
• Required where exposures can reasonably be expected to exceed the PEL
• Must be demarcated in any manner that limits workers in the area
• Must post warning signs at entrances
• Respirator use required
Methods of Compliance – Hierarchy of Controls

• Employers can use any engineering or work practice controls to limit exposures to the PEL

• Respirators permitted where PEL cannot be achieved with engineering and work practice controls
Dust Controls

• Wet Methods
  – Water fed tools
  – Misting systems

• Local Exhaust Ventilation
  – Industrial vacuums
  – Dust extractors
Wet Methods

Grinding stone without engineering controls

Polishing stone using water to control the dust
Vacuum Dust Collectors

Grinding without engineering controls

Grinding using a vacuum dust collector
Written Exposure Control Plan (General Industry/Maritime)

The written control plan must describe:

• Tasks involving exposure to respirable crystalline silica
• Engineering controls, work practices, and respiratory protection for each task
• Housekeeping measures used to limit exposure
Respiratory Protection

• Must comply with 29 CFR 1910.134
• Respirators required for exposures above the PEL:
  • While installing or implementing controls or work practices
  • For tasks where controls or work practices are not feasible
  • When feasible controls cannot reduce exposures to the PEL
  • While in a regulated area (General Industry/Maritime)
Housekeeping

• When it can contribute to exposure, employers must not allow:
  • Dry sweeping or brushing
  • Use of compressed air for cleaning surfaces or clothing, unless it is used with ventilation to capture the dust
• Those methods can be used if no other methods like HEPA vacuums, wet sweeping, or use of ventilation with compressed air are feasible
Medical Surveillance (General Industry/Maritime)

• Employers must offer medical examinations to workers who will be exposed above the action level for 30 or more days a year
• Employers must offer examinations every three years to workers who continue to be exposed above the trigger
• Exam includes medical and work history, physical exam, chest X-ray, and pulmonary function test (TB test on initial exam only)
Medical Opinion

• Worker receives *report* with detailed medical findings, any work restrictions, and recommendations concerning any further evaluation or treatment.

• Employer receives an *opinion* that only describes limitations on respirator use, and if the worker gives written consent, recommendations on:
  • Limitations on exposure to respirable crystalline silica, and/or
  • Examination by a specialist
Communication of Hazards

• Employers required to comply with hazard communication standard (HCS) (29 CFR 1910.1200)
• Address: Cancer, lung effects, immune system effects, and kidney effects as part of HCS
• Train workers on health hazards, tasks resulting in exposure, workplace protections, and medical surveillance.
Recordkeeping

• Must maintain records per 29 CFR 1910.1020 for:
  • Air monitoring data
  • Objective data
  • Medical records
General Industry/Maritime – Compliance Dates

Employers must comply with all requirements of the standard by June 23, 2018, except:

• Employers must comply with the action level trigger for medical surveillance by June 23, 2020. (The PEL is the trigger from June 23, 2018 through June 23, 2020.)

• Hydraulic fracturing operations in the oil and gas industry must implement engineering controls to limit exposures to the new PEL by June 23, 2021.
Construction Standard

(a) Scope
(b) Definitions
(c) Specified exposure control methods
   OR
(d) Alternative exposure control methods
   (1) PEL
   (2) Exposure Assessment
   (3) Methods of Compliance
(e) Respiratory protection
(f) Housekeeping
(g) Written exposure control plan
(h) Medical surveillance
(i) Communication of silica hazards
(j) Recordkeeping
(k) Dates
Construction – Scope

• All occupational exposures to respirable crystalline silica are covered, unless employee exposure will remain below an action level of 25 μg/m³ as an 8-hr TWA under any foreseeable conditions.
Construction – Specified 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
  - Conduct exposure assessments for employees engaged in those tasks
<table>
<thead>
<tr>
<th>Equipment / Task</th>
<th>Engineering and Work Practice Control Methods</th>
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<tr>
<td>Stationary masonry saws</td>
<td>Use saw equipped with integrated water delivery system that continuously feeds water to the blade.</td>
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<tr>
<td></td>
<td>Operate and maintain tool in accordance with manufacturer’s instructions to minimize dust emissions.</td>
</tr>
<tr>
<td>Required Respiratory Protection and Minimum APF</td>
<td>≤ 4 hr/shift</td>
</tr>
<tr>
<td>None</td>
<td>None</td>
</tr>
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<td>Equipment / Task</td>
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<td>-----------------</td>
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</tbody>
</table>
| 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 manufacturers’ instruction to minimize dust.  
- When used outdoors  
- When used indoors or in an enclosed area | None APF 10 | APF 10 APF 10 |
List of Table 1 Entries

- 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 (i.e. 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
Stationary Masonry Saw
Handheld Power Saw
Rotary Hammer
Jackhammer use without engineering controls

Jackhammer use with water spray to control dust
Handheld Grinder used for Mortar Removal
Heavy Equipment – Demolition
Fully and Properly Implementing Controls Specified on Table 1

• Presence of controls is not sufficient.
• Employers are required to ensure that:
  • Controls are present and maintained
  • Employees understand the proper use of those controls and use them accordingly
Respiratory Protection Requirements on Table 1

• Respirators required where exposures above the PEL are likely to persist despite full and proper implementation of the specified engineering and work practice controls

• Where respirators required, must be used by all employees engaged in the task for entire duration of the task

• Provisions specify how to determine when respirators are required for an employee engaged in more than one task
Written Exposure Control Plan (Construction)

The plan must describe:

• Tasks involving exposure to respirable crystalline silica
• Engineering controls, work practices, and respiratory protection for each task
• Housekeeping measures used to limit exposure
• Procedures used to restrict access, when necessary to limit exposures
Competent Person (Construction)

• Construction employers must designate a competent person to implement the written exposure control plan

• *Competent person* is an individual capable of identifying existing and foreseeable respirable crystalline silica hazards, who has authorization to take prompt corrective measures

• Makes frequent and regular inspection of job sites, materials, and equipment
Medical Surveillance
(Construction)

• 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 to workers who continue to be exposed above the trigger
• Exam includes medical and work history, physical exam, chest X-ray, and pulmonary function test (TB test on initial exam only)
Compliance Dates (Construction)

• Employers must comply with all requirements (except methods of sample analysis) by June 23, 2017

• Compliance with methods of sample analysis required by June 23, 2018
Enforcement

• Compliance Directive
  – Currently under internal review
• Construction: Focus on full and proper implementation of Table 1 controls
• General Industry and Construction Alternative Exposure controls: Similar to current enforcement of health standards
Guidance and Outreach

- Silica Rulemaking Webpage: www.osha.gov/silica
  - Fact sheets
  - FAQs
  - Video
- Appendix B – Medical Surveillance Guidelines
Other Guidance Materials

• NIOSH Silica Safety and Health Topics
  – https://www.cdc.gov/niosh/topics/silica/
• CPWR Silica Safe Website
  – http://www.silica-safe.org/
Thank You!
Questions?