RESPIRABLE CRYSTALLINE SILICA

Presented by:

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Arizona Division of Occupational Safety and Health
This presentation contains a summary of OSHA requirements found in 29 CFR 1910.1053 AND 29 CFR 1926.1153.

This presentation does not include or address all requirements of the standards.

Please refer to the OSHA standards for all requirements.
Effective Dates

Construction Industry
6/23/2017
9/23/2017

General Industry and Maritime
6/23/2018
6/23/2021 for hydraulic fracturing engineering controls.
Avoid Confusion

You can’t begin to understand the standard until you understand what respirable crystalline silica is.
What is Silica?

Chemistry 101a

Silicon - The element Silicon (Si)
Silica

- Silicon dioxide - $\text{SiO}_2$.
- Found in quartz, cristobalite and tridymite in a crystalline form.
**Silicates**

- Compounds containing silica, oxygen plus other elements.
- Cement, silicon carbide, garnet.
Silicone

• Polysiloxanes – polymers.
• Found in rubber, caulks, etc.
Silica
Silicates and Silicone
Cement and Concrete

This is cement, a calcium silicate material containing very low concentrations of crystalline silica 0-0.1% typical.

This is concrete, a hard material made with cement, and crystalline silica-containing rock and sand.
What is Crystalline?

Silica can occur in crystalline and amorphous states. Amorphous silica does not pose the same hazards as crystalline silica and is not addressed by this standard.

Crystalline materials have a highly ordered structure – amorphous solids do not have an ordered structure.
Crystalline and Amorphous Examples

Both are pure carbon but the diamond is crystalline the coal is amorphous.
Crystalline  Amorphous
Amorphous
Amorphous

- Glass
- Fiberglass
- Glazes
- Silica gel
- Mineral wool
- Slag abrasive blasting media
- Semiconductor products
- Fulgurite
What is Respirable?

CEN$^1$ Definition:

The mass fraction of inhaled particles penetrating to the unciliated airways.

i.e. can get into lower reaches of the lung.

$^1$ European Committee for Standardization
OSHA Definition:

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.
What Is Needed for Exposure?

• Presence of crystalline silica.
• Presence of small respirable particles or activity that generates respirable particles.
• Respirable particles must become airborne.
Action Level and Permissible Exposure Limit

• Action Level – 25 µg/M³
• PEL – 50 µg/M³
Exposure Assessments

• Performance Option – Air sampling and objective data to determine exposure.

• Scheduled Monitoring.
Exposure Assessment Frequency

• If below Action Level – no more monitoring.

• If above Action Level but below PEL – repeat within 6 months.

Assumes no changes in tasks, duration or potential exposures.
Exposure Assessment Frequency

• If above PEL – repeat within 3 months.

• If exposures were above the Action Level but now assessment shows below Action Level...

Assumes no changes in tasks, duration or potential exposures.
...Repeat monitoring within 6 months until 2 consecutive measurements, taken at least 7 days apart show exposures below the Action Level in order to discontinue monitoring.

Assumes no changes in tasks, duration or potential exposures.
Exposure Assessment Reporting

Results of exposure monitoring must be provided to employees within 5 or 15 working days after completion of assessment.

- Construction – 5 days
- General Industry – 15 days
Regulated Areas 1910.1053

- Any work area where exposures can reasonably be expected to exceed the PEL shall be established as a Regulated Area.

- Area must be demarcated and signs must be posted at all entrances.

- Access to area must be limited to authorized people.

- Must provide respirators and ensure use in area.
Methods of Compliance - Written Exposure Control Plan

Plan must include:

- Description of tasks involving exposure to silica.

- Description of engineering controls, work practices and respiratory protection used to limit exposure to silica.
Written Exposure Control Plan

• Description of housekeeping measures to limit employee exposure to silica.

• Review plan at least annually and update if necessary.

• Plan must be made available to employees and OSHA.

• 1926 – Competent Person
Methods of Compliance - 1926.1153(c) Table 1

Follow **all** engineering controls, work practices and respiratory protection requirements in Table 1 to be considered in compliance with standard. No exposure assessment is required if all Table 1 requirements are followed.
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- When used outdoors  
- When used indoors or in an enclosed area | None | 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 |
| (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 |
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| (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                                                                       |
| (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                                                                       |
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| (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 | ≤ 4 hours/shift | >4 hours/shift |
| (x) 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 |
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| (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 | ≤ 4 hours/shift | >4 hours/shift |
| | | None | None |
| (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  
  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 | APF 10 |
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| (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                                                                                           | ≤ 4 hours/shift: None  
>4 hours/shift: None                                                                                                                                         |
| (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  
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  
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                                                                                           | ≤ 4 hours/shift: None  
>4 hours/shift: 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                                                                                             | ≤ 4 hours/shift: None  
>4 hours/shift: None                                                                                                                                         |
| (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                                                                                          | ≤ 4 hours/shift: None  
>4 hours/shift: 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                                                                                                           | ≤ 4 hours/shift: None  
>4 hours/shift: None                                                                                                                                         |
Table 1 Requirements

- Indoors – use ventilation to minimize accumulations of visible airborne dust.
- Wet methods – apply sufficient water to minimize release of dust.
For enclosed cabs/booths:

- Properly working door seals and closing mechanisms.
- Seals and gaskets in good condition and working properly.
- Under positive pressure through delivery of fresh air.
- Intake air filtered through 95% efficient filter 0.3-10.0µm range (MERV-16).
- Has heating and cooling capabilities.
Respiratory Protection

• Compliance with 29 CFR 1910.134 (Respiratory Protection) is required.

• Minimum requirement is an air purifying respirator with an assigned protection factor of 10.

• Filtering facepiece (dust mask) is acceptable if NIOSH approved.
Housekeeping

• No dry sweeping or brushing unless wet sweeping and HEPA vacuuming is not feasible.

• No compressed air cleaning where such activity could contribute to employee exposure.
Medical Surveillance

- General Industry – required for employees exposed at or above Action Level for 30 days or more per year.

- Construction Industry – required for employees who are required to wear a respirator for 30 or more days per year.
Medical Surveillance

- Initial exam and periodic exams at least every three years or more frequently if recommended by physician.

- Each exam includes mandatory chest X-ray, TB test and pulmonary function test. Chest X-ray not at discretion of physician.
Medical Surveillance

- Pulmonary function test must be administered by technician with current certificate from a NIOSH approved spirometry course.

- Employer must pay for additional specialist examinations recommended by the physician.
Hazard Communication

Employee training on the following is mandatory:

• Health hazards associated with silica exposure.

• Specific tasks that can result in exposure to silica.
• Specific measures taken to protect employees from exposure to silica including engineering controls, work practices and respirators to be used.

• OSHA silica standard.

• Purpose and description of medical surveillance program.
Sampling Methods

Must collect respirable fraction of dust.

Two major types of size-selective sampling devices:

- Cyclones
- Particle impactors
Cyclones

Vortex separation - uses gravity and rotational effects to achieve particle separation.
Respirable particles exit to filter

Air Inlet

Dirty gas stream enters collector tangentially and gravity forces downward spiral

Centrifugal force sends particulate toward walls of collector

As the dirty gas stream is constrained within the smaller diameter cone, vortex reversal occurs and the gas stream travels back up the center of the collector and exhausts out the top. Fine particulate flowing near the center of the cyclone can be carried out with the exhaust gases.

COLLECTED DUST OUTLET
Particle Impactors

Larger (non-respirable) particles are separated from the air by inertial impaction. Smaller respirable particles continue onward to collection media.
Large particles will be captured by impaction. Smaller particles go around to get collected on filter.

**FIGURE 1.** Schematic of particles of different aerodynamic diameters trying to follow the flow of the air impinging on the impacting surface.
SKC PPI
SKC PPI

Disposable

Reloadable
# Table 1 Fails and Follies

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| (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:  
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|                                                          | -When used indoors or in an enclosed area: 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 airflow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency. | ≤ 4 hours/shift: None  
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</tr>
<tr>
<td></td>
<td>Use a machine equipped with supplemental water spray designed to suppress dust. Water must be combined with a surfactant</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Operate and maintain machine to minimize dust emissions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(xvi) Crushing machines</td>
<td>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)</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Operate and maintain machine in accordance with manufacturer's instructions to minimize dust emissions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(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</td>
<td>Operate equipment from within an enclosed cab</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>(xviii) Heavy equipment and utility vehicles for tasks such as grading and</td>
<td>Apply water and/or dust suppressants as necessary to minimize dust emissions</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Equipment/task</td>
<td>Engineering and work practice control methods</td>
<td>Required respiratory protection and minimum assigned protection factor (APF)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| (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) | ≤ 4 hours/shift: None  
>4 hours/shift: None                                                                 |
| (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 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  
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  
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 | ≤ 4 hours/shift: None  
>4 hours/shift: None                                                                 |
| (xviii) Heavy equipment and utility vehicles for tasks such as grading and excavating but not including: Demolishing, abrading, or fracturing silica-containing materials |                                                                                                                                                                                                                                           | ≤ 4 hours/shift: None  
>4 hours/shift: None                                                                 |
<table>
<thead>
<tr>
<th>Equipment/task</th>
<th>Engineering and work practice control methods</th>
<th>Required respiratory protection and minimum assigned protection factor (APF)</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
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<td>None</td>
</tr>
<tr>
<td>(xviii) Heavy equipment and utility vehicles for tasks such as grading and excavating but not including: Demolishing, abrading, or fracturing silica-containing materials</td>
<td>Use a ventilated booth that provides fresh, climate-controlled air to the operator, or a remote control station</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Operate equipment from within an enclosed cab</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Apply water and/or dust suppressants as necessary to minimize dust emissions OR</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>When the equipment operator is the only employee engaged in the task, operate equipment from within an enclosed cab</td>
<td>None</td>
</tr>
</tbody>
</table>
For enclosed cabs/booths:

• Properly working door seals and closing mechanisms.
• Seals and gaskets in good condition and working properly.
• Under positive pressure through delivery of fresh air.
• Intake air filtered through 95% efficient filter 0.3-10.0µm range (MERV-16).
• Has heating and cooling capabilities.
Retrofit Engineering Controls

- Dust shrouds and watering devices have been around for a while but not readily available.
- More manufacturers are jumping into the market.
- Many large manufacturers now have shrouds available.
- Many retail outlets starting to carry shrouds.
Dust Minimization Devices
Most Commonly Asked Question

What about drywall?
Sheetrock Issues

Does Sheetrock® (drywall) contain crystalline silica?

What about joint compound?
3. Composition/information on ingredients

<table>
<thead>
<tr>
<th>Chemical name</th>
<th>CAS number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium sulfate dihydrate (alternative CAS 10101-41-4)</td>
<td>13397-24-5</td>
<td>≥ 85</td>
</tr>
<tr>
<td>Cellulose</td>
<td>9004-34-6</td>
<td>&lt; 5</td>
</tr>
</tbody>
</table>

Composition comments

All concentrations are in percent by weight unless ingredient is a gas.

The gypsum used to manufacture these panels contains respirable crystalline silica ranging up to 0.56 percent by weight, depending on source, as indicated by bulk sampling methods. Industrial hygiene laboratory testing using both personal and area sampling measured no detectable respirable crystalline silica when cutting the product by “score and snap,” rotary saw, or circular saw. Good work practices which minimize the extent of dust generation should be followed, and actual employee exposure must be determined by workplace industrial hygiene testing.

4. First-aid measures

Inhalation

Dust irritates the respiratory system, and may cause coughing and difficulties in breathing. Move injured person into fresh air and keep person calm under observation. Get medical attention if symptoms persist.
# USG Joint Compound SDS

## 3. Composition/information on ingredients

<table>
<thead>
<tr>
<th>Mixtures</th>
<th>Chemical name</th>
<th>CAS number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Limestone</td>
<td>1317-65-3</td>
<td>&gt; 35</td>
</tr>
<tr>
<td></td>
<td>Attapulgite</td>
<td>12174-11-7</td>
<td>&lt; 5</td>
</tr>
<tr>
<td></td>
<td>Mica</td>
<td>12001-26-2</td>
<td>&lt; 5</td>
</tr>
<tr>
<td></td>
<td>Talc</td>
<td>14807-96-6</td>
<td>&lt; 5</td>
</tr>
</tbody>
</table>

### Composition comments

All concentrations are in percent by weight unless ingredient is a gas.

Raw materials in this product contain respirable crystalline silica as an impurity. The weight percent of respirable crystalline silica found in this product is < 0.7%. The OSHA PEL for respirable crystalline silica has been lowered to 0.05 mg/m3, effective June 23, 2016 with compliance dates of June 23, 2017 for construction and June 23, 2018 for general industry. Testing of this product and its constituents suggests that under normal conditions the expected use of this product will not result in exposure to respirable crystalline silica that exceeds the OSHA PEL. However, actual exposures to respirable crystalline silica on a given jobsite must be determined by workplace hygiene testing.
### 3. Composition/information on ingredients

#### Mixtures

<table>
<thead>
<tr>
<th>Chemical name</th>
<th>CAS number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limestone</td>
<td>1317-65-3</td>
<td>&gt; 60</td>
</tr>
<tr>
<td>Attapulgite</td>
<td>12174-11-7</td>
<td>&lt; 20</td>
</tr>
<tr>
<td>Mica</td>
<td>12001-26-2</td>
<td>&lt; 20</td>
</tr>
<tr>
<td>Starch</td>
<td>9005-25-8</td>
<td>&lt; 5</td>
</tr>
</tbody>
</table>

#### Impurities

<table>
<thead>
<tr>
<th>Chemical name</th>
<th>CAS number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystalline silica (Quartz)</td>
<td>14808-60-7</td>
<td>&lt; 1</td>
</tr>
</tbody>
</table>
Various manufacturers claim crystalline silica content ranging from <1% to 5% in gypsum board and joint compound products.
Questions?