

# OSHA's Crystalline Silica Rule for Construction

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## Continuing Education Credits

This program has been approved for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement of any material of construction or any method or manner of handling, using or distributing or dealing in any material or product by the AIA/CES, MCAA or ACI/TCA.

Questions related to specific materials, methods and services will be addressed at the conclusion of this presentation.



## Learning Objectives

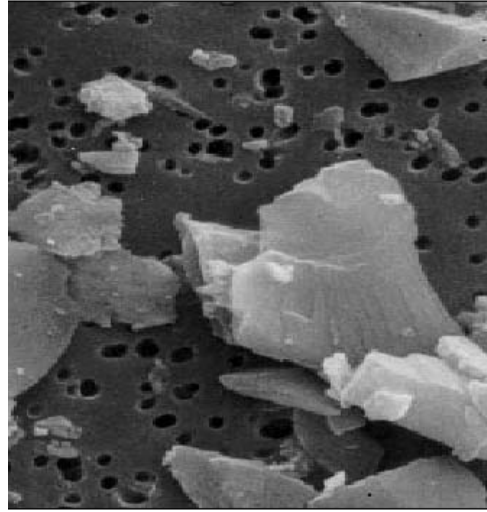
Upon completing this program, the participant should be able to:

1. Analyze compliance requirements for the new OSHA Crystalline Silica Rule
2. Review concrete construction workplace Safety
3. Explore ways to obtain enhanced productivity
4. Examine concrete workers that are more productive and comfortable with the new silica rule



## What is Crystalline Silica?

- Very jagged micro sized crystallized glass type shards (Quartz, Cristobalite, Tridymite) The most common element on the earth's surface.
- Extremely dangerous to lungs, Eventually fatal to humans upon continued, extended, uncontrolled ingestion.
- Sand + Heat = Glass = small micro bits = Crystalline Silica.
- Micro silica glass shards respiratory system tissue cutters



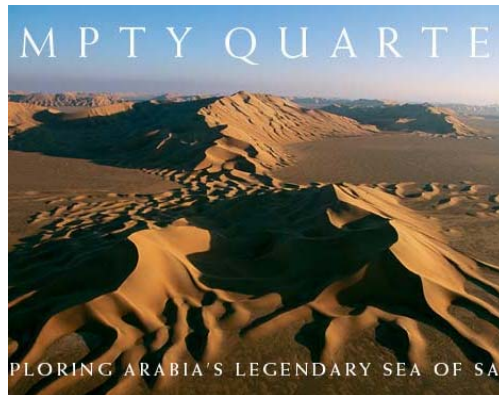
Electron microscope image

## Silica containing building materials

Construction Sand / Concrete Sand must have jagged-roughhewn surfaces for bonding and joining for solidification and strength.

Saudi Arabia has to import all their construction / concrete sand due to Arabian Desert sand being too smooth. Native Saudi sand will not adequately bond in concrete and cement mixtures due to the winds through eons of time in the desert sweeping each sand grain surface against each other creating smooth surfaces - micro ball bearings.

Best Silica sands in America are in the upper Midwest and Great Lakes Region.



Picture courtesy of National Geographic, Washington, DC, USA

## Micrograms

- Micron – About the size of a single particle of fine milled flour.
- Gram – Small metric unit of weight measure. Gold measured in grams.
- Microgram – 1,000,000ug of a gram
- Permissible exposure limit (PEL) for respirable Crystalline Silica is 50 micrograms per cubic meter of air, averaged over an 8 hour shift.
- Measured by special analytical instruments.

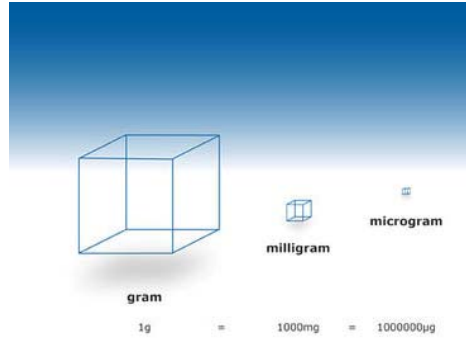


Photo courtesy of The University of Waikato, Hamilton, New Zealand

## Micrograms – cont'd

- New OSHA Crystalline Silica Rule for Construction and related industries requires employers to use engineering and administrative controls to limit worker exposure to the PEL.
- Final Rule – Document Citation 81 FR 16285 – Ongoing litigation.
- New Construction Standard (29 CFR 1926.1153) effective 06-23-2016, comply by 09-23-2017.
- General Industry – Concrete product producers, etc. (29 CFR 1910.1053) takes effect, 06-23-2016, comply 09-23-2017.

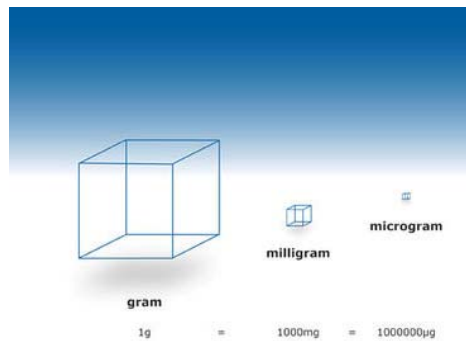


Photo courtesy of The University of Waikato, Hamilton, New Zealand

## Action Level of exposure

Trigger for concern and awareness of abatement that leads to the Permissible Exposure Limit (PEL)

A concentration of airborne respirable Crystalline Silica of 25 ug/m<sup>3</sup> as calculated on an 8 hour Time Weighted Average (TWA)



## Crystalline Silica Permissible Exposure Limit (PEL)

An airborne concentration of respirable Crystalline Silica in excess of 50 ug/m<sup>3</sup> on an 8 hour Time Weighted Average (TWA)



## Atomic Absorption Spectrophotometer

### Micro sized particle measurement machine

Micrograms and smaller – Atomic size particles, (parts per million) – How machine measures / detects:

Spectrophotometer uses flame/heat to bring elements of liquid sample into suspension. Then machine measures heated atomic particles of sample in suspension using light spectrum absorption sensors (eyes). Machine then digitally calculates parts per million of various elements in sample. Measured sample amounts are compared to parameters to detect adverse amount of elements.

Silica is an element. Most common element on crust of earth's surface.

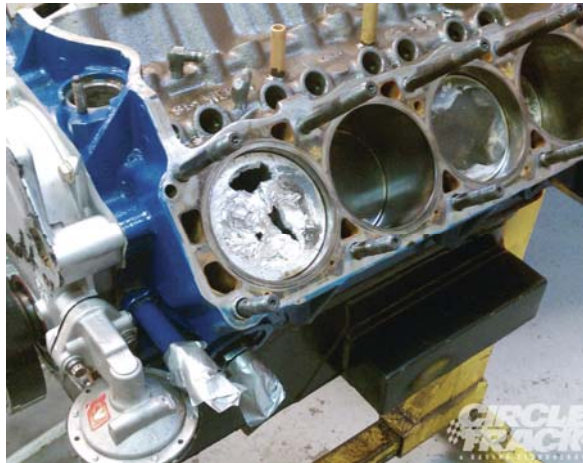
Atomic Absorption Spectrophotometer detects silica and other elements (Iron, Copper, etc.) in fluids – engine oils, transmission fluids, differential fluids, axle fluids, transfer case fluids, gear box oils, hydraulic fluids, cooling fluids, machine tool cutting/cooling fluids, chemicals.



United States Atomic Absorption Spectrophotometer makers – Perkins-Elmer, Varian Associates, et.al.

Historically industry culture was concerned about Crystalline Silica ingestion in equipment and equipment component failure.

Long term health affects of Crystalline Silica were not considered and identified. Similar to Asbestos and Atomic radiation exposure - contamination.





## Crystalline Silica Lungs

Transformation of healthy lung tissue into scars by Crystalline Silica ingestion, leading to early death, cancer, etc.

No reversal / no return.

Once lungs are damaged – are always damaged.

Unlike healing of the lung tissue from total withdrawal of cigarette / cigar / cannabis smoking

You cannot heal Silica damaged lungs.

Don Evans will expand into this medical area in the second segment.



## Human applications – workers on construction jobsites and in concrete materials plants

Concern for Crystalline Silica exposure.

Acute and chronic exposure considerations

1. Sawing – Masonry, Concrete
2. Cutting – Concrete, Stone work
3. Drilling – Concrete, Masonry
4. Breaking – Concrete – Jackhammers, Excavators, Recycling equipment, etc.
5. Demolition – Concrete - Masonry



## Human applications – cont'd

6. Chipping – Roadway profiling
7. Milling – Smoothing concrete floors
8. Forming – Footers, Walls, Towers, Silos, Columns, Chimneys
9. Excavating – Earthmoving (Caliche soils, sandstone, sand, slag = Crystalline Silica)
10. Crushing – Materials production, Sand & Gravel, Lime, Slag, etc.



## Crystalline Silica sampling and analysis – who does?

Industrial Hygienists, Safety-Health workers, Private safety/health consultants, OSHA consultation sections, MSHA services sections, colleges and universities, National Institute for Occupational Safety and Health (NIOSH)

Atmospheric sampling and analysis of suspended Crystalline Silica element microgram particles with special pre-calibrated induction measuring instruments.



Dorr-Oliver Cyclone



## Engineering Controls

- Enclosed – positive pressure air conditioned, rollover protective structure cabs on equipment
- Water flows
- Water sprays
- Air exchange filtration systems
- Vacuum systems
- Partitions
- Cyclones
- Precipitators
- Positive pressure rooms / zones



Picture courtesy of Deere & Company, Moline, Illinois, USA

## Water flow controls Manufacturing Operations

- Stone Cutting / Milling
- Brick Cutting
- Block Cutting / Milling
- Slab Cutting/Milling
- Stone Engraving – Cemetery markers, stone signs, etc.



## Water Spray Systems

- Crushers
- Material Recycling Equipment
- Conveyors
- Transfer Stations
- Gravel stockpiling
- Demolition work



## Water Sprinklers and Mobile Water Spray Units for Crystalline Silica abatement

- Cement plant slag dumps
- Used foundry sand dumps
- Cement raw material processing – Lime production, etc.
- Recycling concrete road and building materials in crushing system
- Demolition – Ski slope snow making equipment that shoots water directly on rubble.



## Crystalline Silica Dust Abatement in Demolition Operations

Ski slope snowmaking equipment retrofitted with high water flow nozzle that shoots intense water mist on rubble and structure to control dust in suspension.



## Severe Crystalline Silica Dust Conditions in Demolition

Water spray can significantly reduce airborne Crystalline Silica dust.



Photo courtesy of Brandenburg Industrial Services Co., Chicago, Illinois

## Air Exchange Filtration Systems



## High Volume Systems

- Custom Engineered
- Stock Designs



Picture courtesy of Dustcontrol Inc., Wilmington, NC, USA

## Vacuum Systems

- Mobile
- Custom Designed
- Stock Units
- HEPA Filters – High efficiency particulate arresting.
- Removes 99.97% of particles that have a size of 0.3 microns.
- Random fibers
- Suggest “EPA certified” dust extractor
- EPA certified means no leakage
- Need “on-board automatic filter cleaning”



Picture courtesy of Dustcontrol, Inc., Wilmington, NC, USA

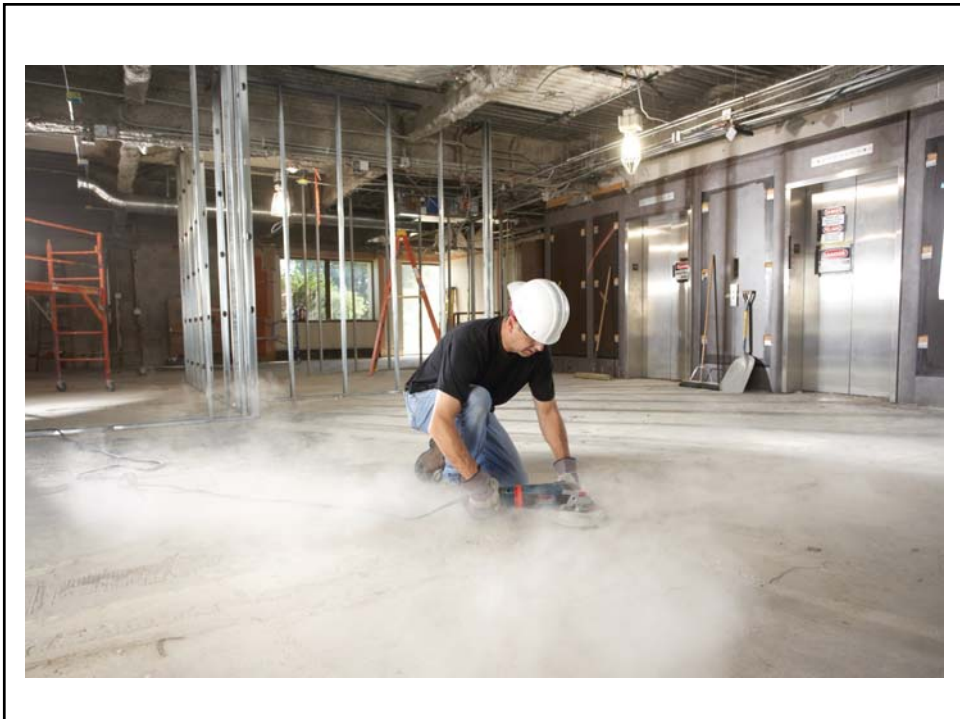
## Vacuum Systems

- Hand Held Mobile Units



Picture courtesy of Dustcontrol, Inc., Wilmington, NC, USA









## Vacuum Systems

- Custom Designed
- Stock



Picture Courtesy of Dustcontrol, Inc. Wilmington, NC

## Partitions

- Temporary
- Permanent



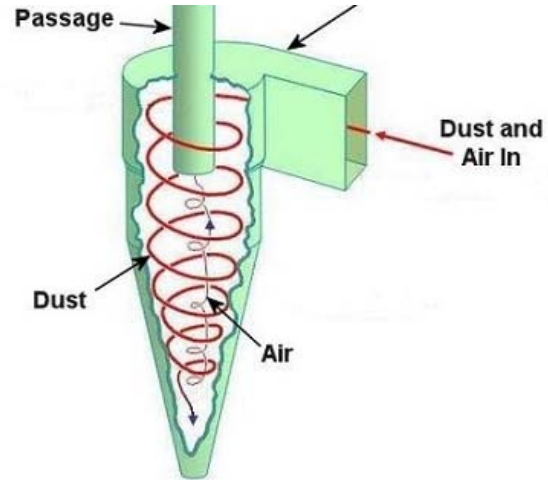
## Regulated Areas

- The employer must establish a regulated area wherever exposure is, or can be reasonably expected to be in excess of the PEL
- Demarcation of the area
- Signs
- Limited access



## Cyclones

Centrifugal force spins dust particles to inverted cone base



## Precipitators

- Custom Engineered Systems
- Stock Units
- Uses electricity on internal grids to remove dust particles
- Some use water flow on grids to remove dust particles



## Personal Protective Equipment - PPE

- Respirators – P 100 Mask Recommended – light / regular duty applications
- N 95 Mask – Not Good
- Single Strap Mask – Not Good
- P 100 Mask – One Size Fits All
- Abrasive Blasting – Air Fed Helmets – Special consideration
- Protective Clothing
- Hearing Protection



Picture courtesy of 3M Safety Products, Minneapolis, Minnesota

## Respirator types by material worked

- Check with vendor or maker – Technical considerations
- Sizing considerations
- Fit considerations – facial hair, facial landscape
- Physical considerations – lungs / nose / throat – Medical test/evaluation



Picture courtesy of 3M Safety Products, Minneapolis, Minnesota

## Air Fed Helmets and Special Respirator types

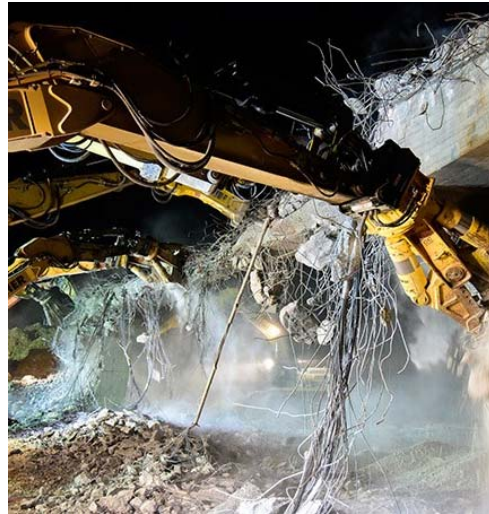
- Abrasive Blasting
- High volume cutting and drilling operations
- Intensive demolition work in confined spaces
- Intensive drilling and cutting in confined spaces and tunnels
- Working close to underground tunneling machines
- Shotcrete applications in water transmission, transportation and utility tunnels



Picture courtesy of 3M Safety Products, Minneapolis, Minnesota

## Enclosed positive pressure equipment cabs

Open rollover protective cabs - have operators wear suitable respirators and eye protection



Picture courtesy of Atlas Copco USA, Voorheesville, NY  
Atlas Copco Jaws – Concrete Bridge Demolition

### Most intense Crystalline Silica application – exposure - Abrasive Blasting

- Use air fed respirator
- Protective clothing
- Hearing protection
- Periodic breaks



### Shotcrete Applications

Prolonged exposure  
to Crystalline Silica

- Respirator use
- Eye safety  
considerations
- Hearing protection





## Underground / confined concrete demolition and construction work

1. Use high volume fans
2. Constantly check atmosphere for Crystalline Silica content
3. Monitor Diesel emissions
4. Adequate lighting



## Administrative Controls

1. Analysis
2. Processes
3. Policies
4. Training
5. Understanding
6. Testing
7. Sampling
8. Inspection
9. Documentation



## Develop a written exposure plan

1. Federal and State OSHA consultation programs can assist you on this.
2. Independent safety/health professional consultants.
3. National Institute Occupational Safety and Health (NIOSH) representatives.
4. Certified Industrial Hygienists.
5. Colleges and universities.
6. OSHA Training Institutes.



## Provide medical exams to highly exposed workers

1. Baseline exams
2. Required for each worker who will be occupationally exposed to Silica at or above the action level for 30 or more days per year
3. Detailed requirements for a medical examination by a physician or other licensed health care professional
4. Possible referrals to specialist and/or follow-up exams
5. Limited information from physician to the employer
6. Respirator ability requirement
7. Exit exams



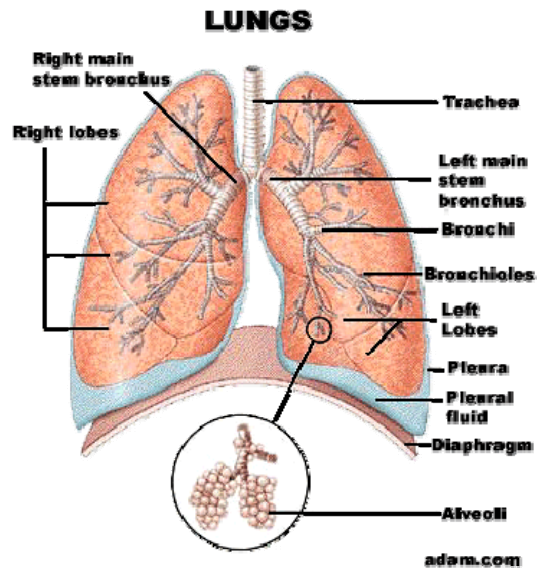
## Safety and health awareness training program on Crystalline Silica risks and how to limit exposure

1. Classroom training
2. Field training
3. Vendor training
4. OSHA Consultation and Training
5. Trade Associations (AGC, etc.)
6. Trade Unions (Operating Engineers, etc.)
7. Insurance Companies
8. Insurance Brokers
9. Worker compensation entities
10. Colleges and universities
11. Private safety and health consultants



## Provide workers information about lung health

1. American Lung Association
2. American Cancer Society



## Crystalline Silica written safety/health training program

- Develop a written safety/health training program on Crystalline Silica exposure/abatement.
- Have workers, read, understand and sign-off on it. Most important is understanding.



## Training

- Train potential and actual exposed workers on Crystalline Silica hazards.
- Develop within your specific construction jobsite safety/health program a section on Crystalline Silica exposure potential and abatement procedures/processes.
- Use as a tailgate safety/health training session and have workers sign off on this training acknowledging that they understand and will abide by this program.



## Training

Instruct workers in their native language so that they will understand the risks and solutions for crystalline silica exposure.



## Training

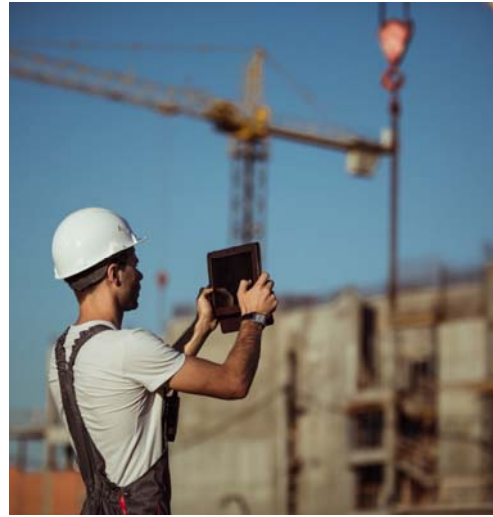
Make sure your workers understand the risks and control methods for Crystalline Silica exposure. Everybody going home healthy, safe and happy.





## Procedures

Walk your jobsites on a regular basis to detect exposure risks and abatement needs.



## Procedures

Contact a competent Industrial Hygienist to measure and report Crystalline Silica levels that are suspect to you. Contact your state's OSHA workplace safety and health consultation program for recommendations and advice.





## Procedures

For clarification and detailed interpretation of the new OSHA Crystalline Silica standard and for on-site visual interventions, inspections and recommendations, contact your state's OSHA safety and health consultation section.

These services are free.



## Resources

OSHA's new Crystalline Silica Web Page

[www.osha.gov](http://www.osha.gov)

- The final rule and preamble comments
- Summaries and fact sheets
- CPWR ([silica-safe.org](http://silica-safe.org))



## World of Concrete 2017 Show Factoid

Frank Lloyd Wright's favorite building material was reinforced concrete.



Photo courtesy Frank Lloyd Wright Archives



## Crystalline Silica Health Risks

Protecting the Health of Workers

Don Evans



## Crystalline Silica

- Introduction
  - Dying is always an option
  - Anatomy & physiology of the respiratory system
  - Effects of silica on the lungs
  - Determining the risks
  - Preventing the unwanted

## Crystalline Silica

- Crystalline silica can be fatal
  - It is a miserable way to die
  - You will slowly suffocate over a long period of time
  - Common diseases include
    - Pneumoconiosis
    - Black lung disease

## Crystalline Silica

- Chemical identification
  - Si
  - It is the most common element in the earth's crust
  - Widely used in a variety of applications
    - Paints
    - Glass
    - Cement
    - Chemicals

## Crystalline Silica

- Anatomy & physiology of the respiratory system
  - The nose & mouth
    - Lined with mucus membranes
    - Nose hair to trap large particles
    - The superior and inferior turbinates
    - The trachea

## Crystalline Silica

- A & P Continued
  - Cilia
  - Bronchus
  - Bronchioles
  - Alveolus (plural)

## Crystalline Silica

- Effects of silica on the lungs
  - Microscopic lacerations of the alveoli
  - Formation of scar tissue
    - Creation of fibroids
    - Non-detectable until ~1cm in size
    - Now observable on a radio graph (x-ray)
  - Scar tissue & fibroids prevent the exchange of gasses in the lung tissue
    - Oxygen and Carbon dioxide

## Crystalline Silica

- Effects continued:
  - The body will be starved for O<sub>2</sub>
  - The condition is irreversible
    - Bronchio-dialators may provide temporary relief early on
  - Medical oxygen may be necessary as the disease progresses

## Crystalline Silica

- Determining the risks
  - It is the employer's responsibility to perform a risk assessment
    - Employees should know the risks of the jobs they are expected to perform
  - What forms of protection will be utilized to prevent over exposure
    - Wet methods
    - HEPA vacuum, etc.



## Crystalline Silica

- Risks Continued:
  - How much silica exposure is too much
    - The new standard specifies 50 ug/m<sup>3</sup>
    - The action level is 25 ug/m<sup>3</sup>
    - This is ~ 20% of the old standard

## Crystalline Silica

- Risks Continued
  - A worker who is diagnosed with silicosis, pneumoconiosis or black lung disease will become an enormous liability to an employer's workman's compensation program
    - Employers can be required to place additional funds in their reserve account to cover these long term expenditures

## Crystalline Silica

- Preventing the unwanted
  - It starts with a good workplace risk assessment
    - Identify the hazards and then design a good prevention strategy
  - If your prevention strategy involves respiratory protection, consult 29 CFR 1910.134 Respiratory Protection

## Crystalline Silica

- Prevention Continued:
  - You will need to comply with the regulation before putting workers in respirators
  - N95's may look like dust masks, but they are classed as respirators and require fit testing per the manufacturers instructions

## Crystalline Silica

- Prevention is a synonym for safety
  - The standard is not designed to intimidate or harass
  - It is all about preventing unwanted, unplanned and undesired medical problems that at the least may be an inconvenience, and at worst may cause a workers death

## Crystalline Silica

- Summary
  - No one goes to work to die on the job
    - Employers are responsible to provide a work environment that has either eliminated or addressed the hazards
  - Knowing how the body works can be a real asset in knowing what to do to protect yourself
  - Silica is a known hazard that can be life threatening

## Crystalline Silica

- Summary Continued:
  - Know the risks and how to deal with them
  - Don't take protection for granted
    - Ask the FDNY what happened after 9/11

## Crystalline Silica

- The forgoing presentation is based on the most recent information available
- It is not intended to be all inclusive
- It is the employer's responsibility to protect workers on the job
- OSHA provides consultation services in all states and territories of the United States.

Thank You!

This concludes the Continuing Education Program.

Any Questions?

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