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31 SEMANA de la SALUD OCUPACIONAL
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Faster Decisions with Real-Time Silica Monitoring: The Gilian® Dustlight Solution

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Sensidyne, LP

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Silica Exposure

Occupational Exposure

Millions of workers are occupationally exposed to Silica on a regular basis. Amongst the most at risk are construction workers, heavy equipment operators and plasterers or dry wall workers.

Silica Exposure

Global Concern Over Silica

- At least 227 million workers are employed in high risk industries worldwide
  - Over 1 million children working in these industries
- Exposed people are often the most vulnerable, disadvantaged and medically underserved
- Respirable crystalline silica (RCS) particles has been classified as an occupational airborne particulate of worldwide concern

Silica Exposure

Global Concern Over Silica

Asia Statistics

- In 2017, the regional incidence of silicosis were as follows:
  - East Asia 15,980
  - Southeast Asia 656
  - Central Asia 18
  - South Asia 2823
- The region of East Asia had the highest overall age-standardized incidence rates (ASIR) of 0.78 per 100,000.
- The regional incidents in Asia in 2017 are all higher than those reported in 1990.
- At a national level, the highest increase in average annual percentage change in ASIR was noted to be in Singapore, and globally the highest number of incident cases were in China (9066) and India (1464).

Silica Exposure

Global Concern Over Silica

International Example: India

- Estimated that over 10 million workers are exposed to silica dust
- Most of these exposures occur in construction and mining/quarrying
- Prevalence of silicosis can range widely in high-risk industries
- 3.5 % - 54.6% occurrence in high-risk work groups

Silica Exposure

Global Concern Over Silica

International Example: South Africa

The South African mining industry, particularly in gold, coal, and platinum mines, has been identified as a high-risk sector for silicosis due to extensive dust exposure during mining activities.

The disease often remains asymptomatic for years, making early detection and intervention challenging.

Silica Exposure

Global Concern Over Silica

South American Statistics

- Brazil: Silicosis remains the most prevalent pneumoconiosis in the country.
    - One study of semi-precious stone miners found a silicosis prevalence of 37%.
    - Another study involving amethyst miners revealed a prevalence of 37%.
    - Research on stone carvers found an alarming prevalence of 53.7%, with dust concentrations exceeding safe limits in most workplaces.
    - Silicosis mortality peaked in 2006 but has declined since, although not among the elderly or informal workers.
- Chile: In 2019, Chile had one of the highest age-standardized rates of silicosis prevalence globally, with a rate of 16.289 per 100,000 people.
- Peru: A 2008 study found that 26% of a group of 840 miners had silicosis. The region has a high number of mining workers exposed to silica at high altitudes.
- Paraguay: In 2019, Paraguay also had a high age-standardized rate of Disability-Adjusted Life Years (DALYs) from silicosis compared to other countries

Risk Assessment

How do you know which employees are being exposed?

Risk assessment includes:

- Hazard Assessment – identify anything that may cause harm
  - Perform Personnel Monitoring
  - Perform Area Monitoring
  - Review Objective Data
- Risk – determine the severity and likelihood that exposure to a hazard will cause injury or disease
  - Frequency of Exposure
  - Duration of Exposure
  - Concentration Present Compared to the OEL
- What actions can prevent/mitigate exposures to the hazard
  - Develop a Program
  - Utilize the Hierarchy of Controls
  - Continuous Improvement

Risk Assessment

Occupational Exposure Limits

- Occupational exposure limits (OELs) help to assess and communicate risk
- An OEL is an acceptable upper limit of exposure
- Sampling requires testing with pumps and analyzing samples at a laboratory
  - Laboratories offer the proper analysis
  - Must use size-selective devices (i.e. Respirable 4µm results to compare to an OEL)
- Rule of thumb: If you see dust, there is likely respirable dust and you have a problem!!!

Risk Assessment

History of Exposure Limits

- Previous permissible exposure limits (PELs) are formulas that many find hard to understand
- Construction/shipyard PELs are obsolete particle count limits
- General industry formula PEL is about equal to 100 µg/m3; Construction/shipyard formulas are about 250 µg/m3
- Previous PELs do not adequately protect workers
- Extensive epidemiologic evidence that lung cancer and silicosis occur at exposure levels below 100 µg/m3

Various Respirable Crystalline Silica Rules

Several International Standards and Rules:

- United States has a permissible exposure limit of 0.05 mg/m3, and an action limit of 0.025 mg/m3.
- Canada has a permissible exposure limit of 0.025 mg/m3 for respirable silica.
- Colombia, Costa Rica and Mexico follow ACGIH, so TLV-TWA for Silica α-quartz and Cristobalite is 0.025 mg/m3.
- Brazil calculates Silica % first, but also uses the value is 0.025 mg/m3 for a standard.
- Argentina has separate standards for Silica Quartz at 0.025 mg/m3, and Cristobalite at 0.05 mg/m3.
- Perú has a limit 0.05 mg/m3 by regulation D.S. 015-2005-SA
- South Africa has a limit 0.05 – 0.10 mg/m3

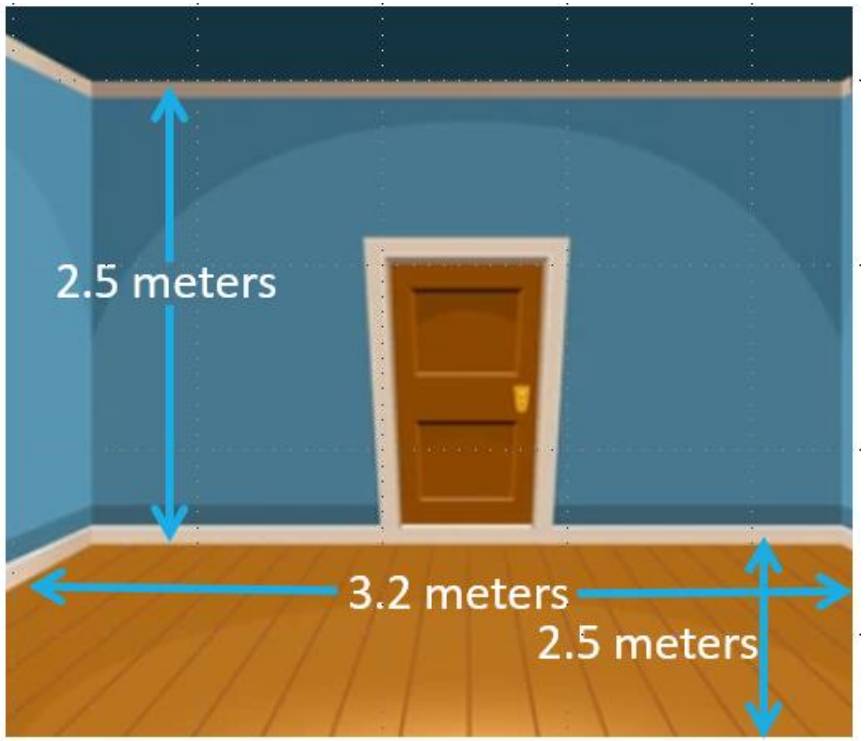
Risk Assessment

Silica PEL Perspective

1,000 µg in the air of this room = 50 µg/m^3

500 µg in the air of this room = 25 µg/m3

500 µg of silica in each small pile adjacent U.S. Dime.



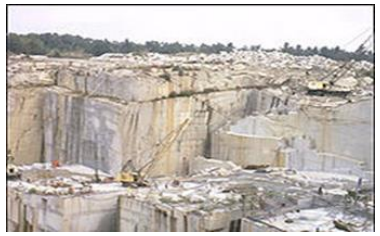
20 cubic meters of air

Industries Where Exposures Occur

Industries Where Exposures Occur

Industries and Operations with Exposures

- Mining/Quarry Work
- Construction
- Pottery products/Ceramics
- Glass manufacturing
- Structural clay products
- Concrete products
- Foundries
- Dental laboratories
- Paintings and coatings
- Jewelry production
- Refractory products

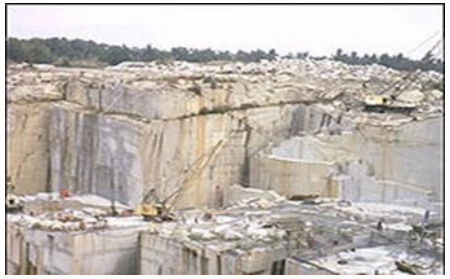


- Asphalt products
- Agriculture/Landscaping
- Tunneling
- Cut stone and stone products
- Abrasive blasting in:
  - Maritime work
  - Construction
  - General industry
- Furnace installation and repair
- Railroads
- Shipyards
- Hydraulic fracturing for gas and oil

Industries Where Exposures Occur

Some Tasks With Airborne Exposure

Industries	Job Tasks
Manufacturing	Abrasive blasting, glass making, making soaps & detergents
Agriculture	Disturbing soil (i.e. plowing, harvesting)
Ceramics	Manufacturing clay, pottery
Construction	Sandblasting, rock drilling, masonry work, jack hammering, tunneling
Foundry work	Grinding, molding, shaking, core room
Mining	Cutting stone, drilling through rock
Railroad	Setting/laying track
Shipbuilding	Abrasive blasting
Stone cutting	Sawing, abrasive blasting, chipping, grinding



Measuring Exposure To Silica

Measuring Exposure To Silica

Why Measure The Concentration Of Silica?

- To prevent disease and protect people from silica by identifying where the exposure is highest
- To determine how much silica is actually present and ensure a safe and healthy workplace
- To evaluate the controls by demonstrating which ones work best
- To improve the health and productivity of the workforce

Measuring Exposure To Silica

Collection of Samples for Compliance

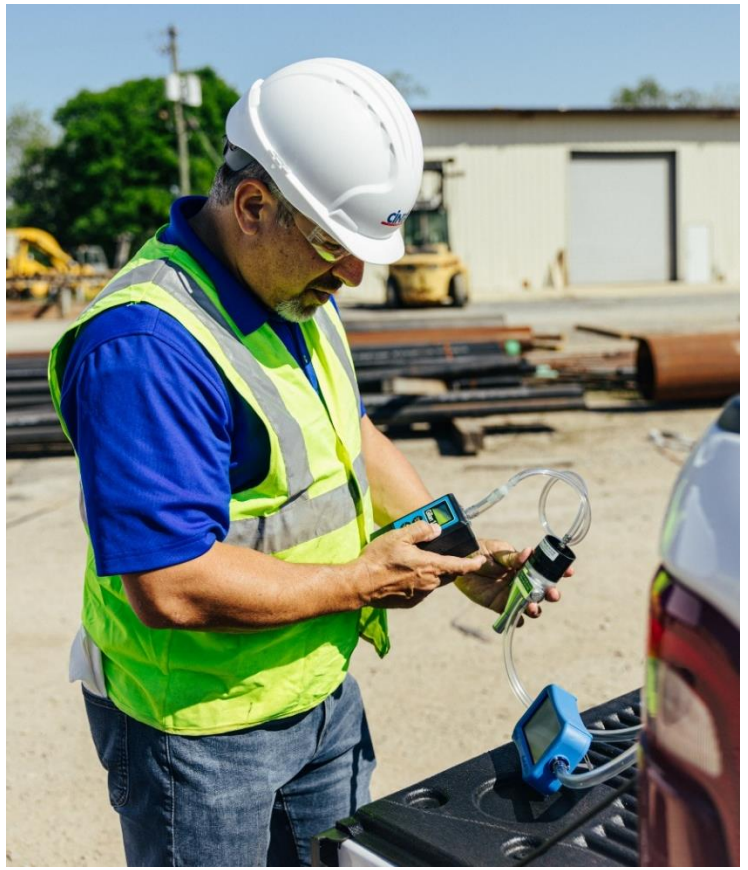
- Dust particles from the air are pulled into a sampling device using a pump and collected onto a filter
- The smaller sized respirable particles must be separated from the larger particles when measuring exposures using a size-selective device
- Various Cyclones or personal impactors may be utilized
- Need to take multiple samples due to variability in work environments

Measuring Exposure To Silica

Sampling Strategies – Personnel Monitoring

Silica Sampling Best Practices

- Draw a large enough sample to obtain a maximum limit of detection of 12.5 micrograms per cubic meter (i.e. 25% of 50 micrograms per cubic meter).
- Use the analysis by XRD or IR as described in the six listed methods.
- Observe the cyclone flow rate specification for meeting the appropriate size selection curve (i.e. 50% at 4 microns).
- Use a constant flow control pump that will keep the flow rate at +/- 5% of set flow.
- A medium flow cyclone can meet the detecting limit in an 8 hour sample and still be comfortable to wear.



Measuring Exposure To Silica

Sampling Strategies – Personnel Monitoring

Choosing the Right Cyclone

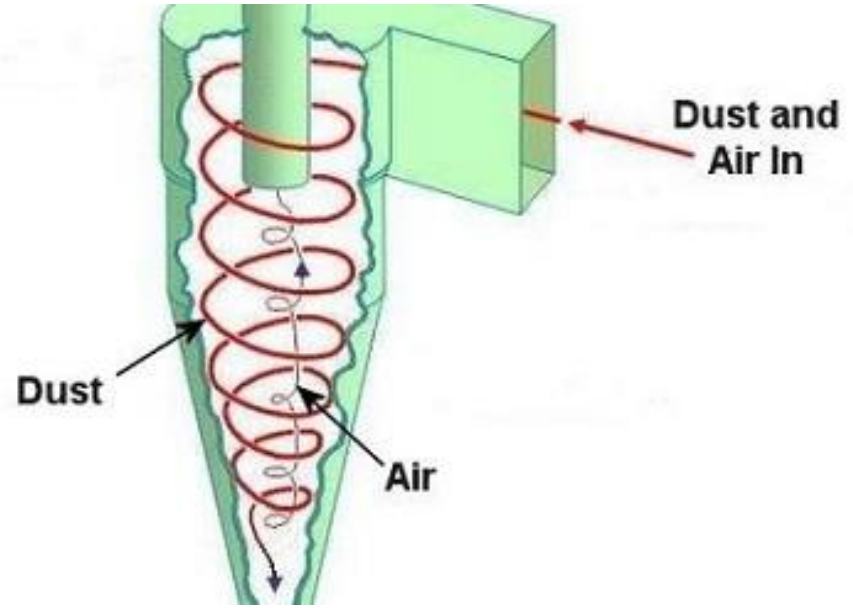
- Cyclones with various flow rates and media sizes are available for numerous applications
    - Consider how visibly dusty is the process or environment
    - How long do you need to sample (i.e. task less than 1 hr)
    - Consider the diameter and pore size of the filter
    - Know the back pressure capability of the pump
    - Is your media pre-weighed
    - Is your filter media pre-loaded into cassettes
    - Know the manufacturer's flow rate specification for the device selected
- Some cyclones can independently measure thoracic and respirable fraction, and have a unique flow rate for each

Measuring Exposure To Silica

Sampling Strategies – Personnel Monitoring

Cyclone Mechanics

- Centrifugal force spins dust particles to inverted cone base
- Heavy particles drop out into a grit pot
- Lighter (respirable) particles are pulled up on to the filter medium



Measuring Exposure To Silica

Sampling Strategies – Personnel, Task & Area Monitoring

Sampling Methods For Silica

- Compliance sampling requires the pump to be worn for the entire duration of the work shift for TWA personal monitoring
  - Results can be compared to occupational exposure limits
  - OELs are often the basis for assessing risk, making recommendations, and instituting controls
- Short Term or task sampling may be helpful in some cases
  - Ensure that the minimum volume is collected
  - Higher flow rates may be required
  - Used to validate controls
- Area sampling may be helpful in some cases
  - Real-time monitoring for particulates

Measuring Exposure To Silica

Real-time monitoring for particulates

What is a Dust Meter / Nephelometer?

- A Dust Meter/Nephelometer is an analytical instrument used to measure airborne dust levels in real time.
- It works by measuring the light-scattering coefficient of aerosols drawn into a darkened chamber.
- Instruments incorporate a Laser light source.
- Some have interchangeable Inlet Heads for various fractional sizes
- Can be an extremely useful tool for screening and validating controls, is lightweight, reliable and quite sensitive.

NOTE – Dust Meters and Nephelometers do NOT distinguish Silica from Other Particulates

Measuring Exposure To Silica

Real-time vs. Traditional Sampling for Particulates

The Challenge with Traditional Sampling

- Incomplete picture – TWA sampling misses short-term spikes
- Delayed response – Lab analysis can takes days or weeks
- High cost – Media, lab fees, and consultant time add up
- Regulatory pressure – Must prove control measures are effective

Measuring Exposure To Silica

Real-time vs. Traditional Sampling for Particulates

Why Real-Time Monitoring Matters

- Immediate visibility into airborne particulate levels
- Validate controls and define safe zones in real time
- Correct issues without waiting for lab results
- OSHA accepts under performance option (1910.1053 - RCS) as a supplement to traditional gravimetric and speciated sampling.

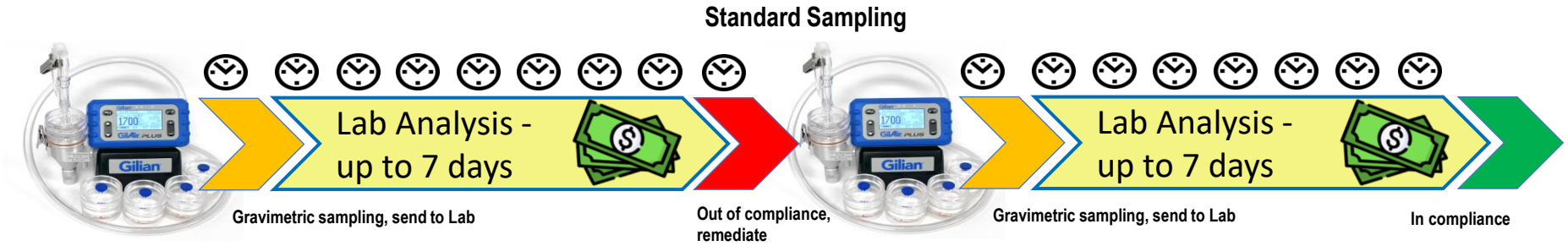
Note: Real-time monitoring does NOT replace standard gravimetric/speciated sampling methods. However, the Gilian Dustlight is an effective compliment to save time and costs.

Measuring Exposure To Silica

Real-time vs. Traditional Sampling for Particulates

Compliance and Data Confidence

- Meets criteria for OSHA objective data
- Complements gravimetric sampling – less time & lab costs
- Identify high-exposure tasks – screening & area monitoring
- Prove effectiveness and define zones – validate & delineate



Potentially:
50% less cost.
41% less time.

Note: additional sampling cycles may be needed to meet the new OSHA standard. Instant real-time exposure data speeds corrective action.

Measuring Exposure To Silica

Real-time vs. Traditional Sampling for Particulates

Gilian Dustlight – Wearable, Powerful, Simple

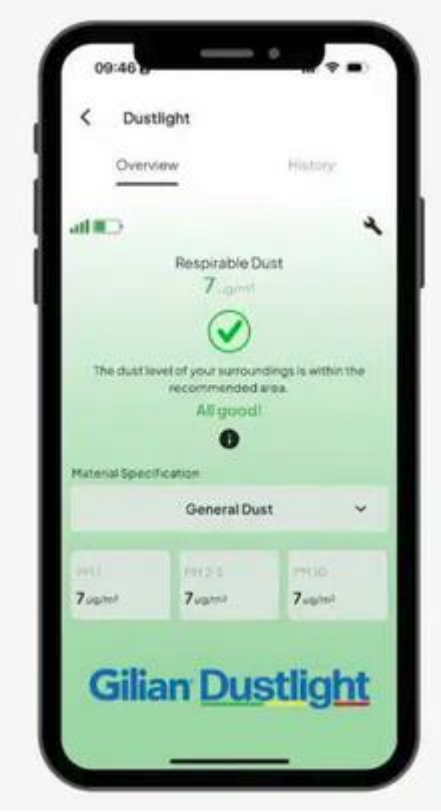
- Compact, rugged, lightweight (149g)
- Worn in breathing zone using Klick Fast mount system
- One-button operation
- Battery life up to 40 hrs. in ECO mode

Measuring Exposure To Silica

Real-time vs. Traditional Sampling for Particulates

What It Measures (and Why It Matters)

- PM1, PM2.5, PM10, and Respirable Dust (PM4)
- Targets: silica, oil mist, welding fumes (and more)
- Meets ISO 7708 and OSHA standards for Respirable Fraction
- Thresholds configurable via mobile app



Measuring Exposure To Silica

Real-time vs. Traditional Sampling for Particulates

Empowering the Worker

- Traffic light system: Green / Yellow / Red
- Audible and visual alarms for exceedances
- Workers aware of exposure in real time
- Promotes accountability and safety culture

Safe Air Quality

Caution Advised

Dangerous Levels

Measuring Exposure To Silica

Real-time vs. Traditional Sampling for Particulates

Gilian Dustlight – Alarm System

- Multiple Alarm Settings: Audio and visual alerts when Action or Ceiling limits are exceeded
- Customizable Alarms: Set thresholds for STEL, TWA, Action, Ceiling, or user-defined limits
- Alarm Indicators:
  - Green to Yellow = Action Limit
  - Yellow to Red = Ceiling or TWA Limit
  - Audible beep reinforces visual alerts

Safe Air Quality

Caution Advised

Dangerous Levels

Measuring Exposure To Silica

Real-time vs. Traditional Sampling for Particulates

Gilian Dustlight – Design Technology

- Advanced Optical Particle Counter Technology
- Provides Instant and Time-Weighted Average (TWA) Concentrations of dust
- Calculates Concentrations for PM1, PM2.5, PM10 and Respirable (PM4)
- Graphs exposures over time

Respirable Dust Levels of Gilian Dustlight(red) and Grimm 11D (green) with the calibration dust mixture for mixed dusts configuration. Performed at the IGF Technical Centre in Germany

Measuring Exposure To Silica

Real-time vs. Traditional Sampling for Particulates

Software That Supports You

- Mobile App: Live data, CSV/PDF reports, settings
- Pro/Enterprise Plans: Cloud storage, advanced profiles
- Fleet management, alert history, centralized access
- TWA/STEL analysis across devices

Measuring Exposure To Silica

Real-time vs. Traditional Sampling for Particulates

Gilian Dustlight – Data Management Software

- Choose the Plan that Meets your Application Needs
- Activation of the Mobile App (Free from the App Store) is required to configure the Dustlight device.
- Professional and Enterprise plans require a paid subscription, unlocking advanced features.

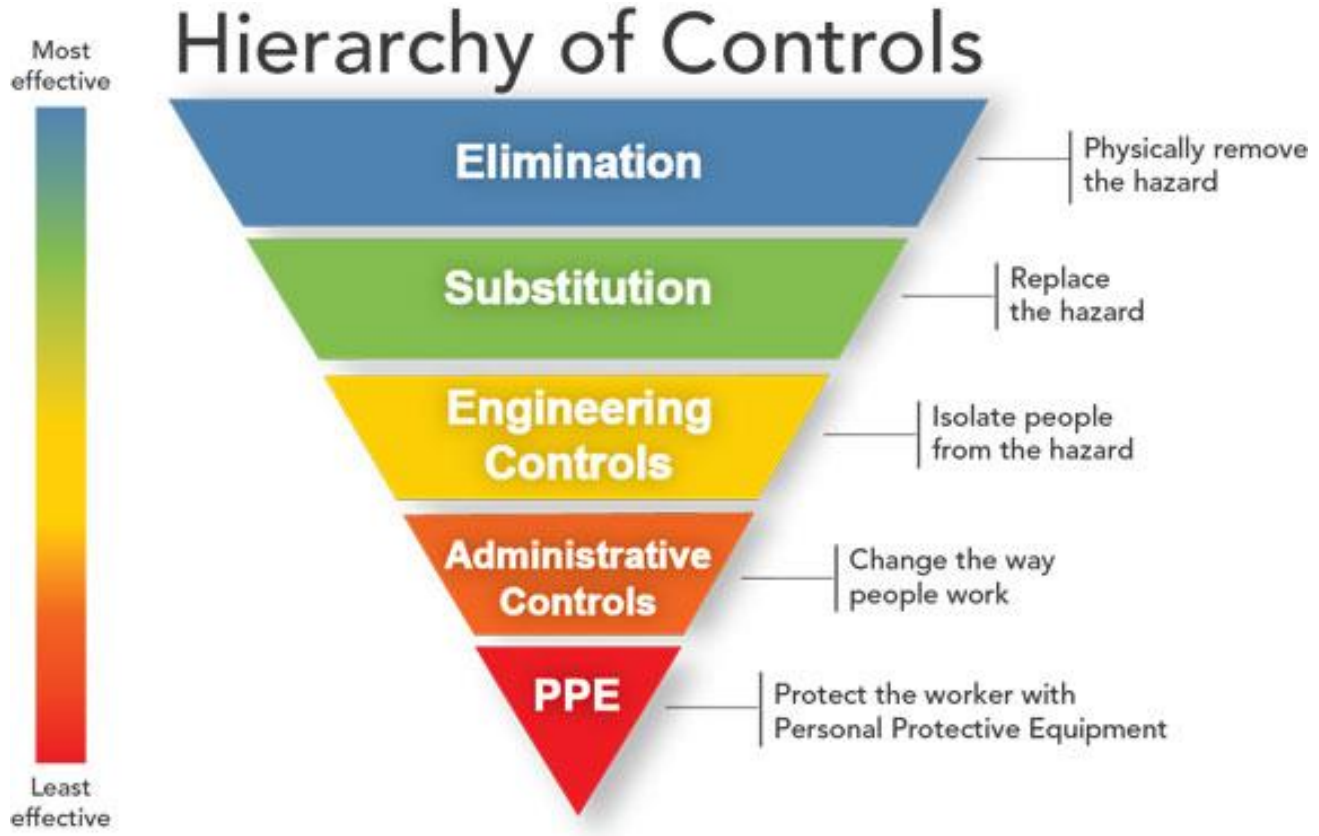
Feature	Basic (Free)	Professional*	Enterprise*	Description
Dustlight Mobile App Access	✓	✓	✓	Utilized with all Plans
General Dust Profile	✓	✓	✓	Dust mixture consists largely of crystalline dust containing quartz, crystalline silica
CSV Event File	✓	✓	✓	Respirable Dust, PM1, PM2.5, PM4, and PM10 data in 1 minute Intervals
Basic Event PDF	✓	✓	✓	Respirable Dust Only
Advanced Event PDF		✓	✓	Respirable Dust, PM1, PM2.5, PM4, PM10, TWA, Action Limit and STEL
Additional Substance Profiles		✓	✓	Welding Fumes, Oil Mist, Softwood
Cloud-Based Web Access		✓	✓	Storage, Device Management, Configuration, and STEL/TWA/ Exceedance Reporting
Advanced Data Analytics			✓	Trending, Reports, Queries
Fleet Management Tools			✓	Role Management, Hierarchies, Centralized Data Sharing

Preventing and Mitigating Exposures

Preventing and Mitigating Exposures

Hierarchy of Controls

- Elimination
- Substitution
- Engineering controls
  - Wet methods
  - Isolate the process
  - Isolate the worker
- Administrative Controls
- Personal protective equipment



Elimination or Substitution

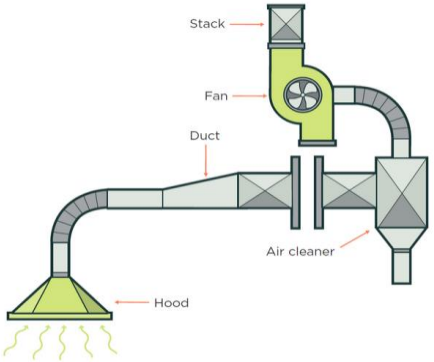
Sandblasting:

- Abrasive blasting with sand (sandblasting) used extensively to change surface properties materials
- Substitute other material for the sand, such as:
  - Walnut shells, metal beads, steel shot
  - Chemicals can be used to remove surface coatings
  - Be aware of the hazards of the chemical
- High pressure water
  - Used in bridge deck refurbishing

Engineering Controls

Change the process to reduce exposure:

- Retrofitting or purchasing equipment capable of wet or dry methods for cutting, sawing, etc.
- Enclosing the process to remove the worker from the hazard
  - Glove box for sandblasting
  - Covers on conveyor belts
  - Ventilation
  - Cabs for construction/mining equipment
- Visual dust emissions indicate that a control is needed
- Engineering controls (primarily wet methods) found to be the most cost-effective silica control strategy in developing and developed countries



Engineering Controls: Wet Methods

Wet methods can significantly reduce exposures, but require pre-planning:

- Cutting with saws equipped with water basin
- Drilling with water pump through the drill stem
- Grinding and hammering on pre-wetted surfaces
- Fogging or steaming to suppress dust in areas where dust is generated
- Wet spray misting is important to reduce exposure to smaller particles

Dry sawing concrete

Wet sawing concrete
Water is added at saw blade

Notice puddle at feet of wet saw operator. It contains the same amount of dust as seen in picture of dry saw operator. What happens to the dust when puddle dries?

Preventing and Mitigating Exposures

Administrative Controls

Recommend policies and procedures to:

- Perform routine housekeeping to reduce dust sources in the cab
- Prohibit dry sweeping and implement wet sweeping methods
- If services are available, institute a medical monitoring program
- Consider keeping doors and windows closed for worksite machinery
- Educate and train employees on the hazards of working with RCS
- What to do when the Gilian Dustlight alarms

Administrative Controls

Example of Work Practice Controls:

- Use of HEPA Vacuum or Wet Sweep versus Dry Sweeping

or

vs.

Preventing and Mitigating Exposures

Education & Training

It is important for employees to:

- Be informed of the hazards of working with silica
- Be able to recognize when the hazard is present
- Know how to prevent themselves from being exposed
- Know how to operate engineering controls
- Be familiar with required PPE and how to wear it

Personal Protective Equipment (PPE)

Respirators may be of immediate assistance

- Half-face
- Full-face
- Filtering face piece






Respirators are a good method to prevent exposure if engineering controls aren't in place, but they have limitations, including:

- Highly dependent on seal
    - Employees should be instructed on seal checks
- Require regular change-out
- Must be medically fit

Preventing and Mitigating Exposures

What can employers do?

Employers can:

- Regular Screening For Hazards
    - Utilize Direct Reading Instruments, such as the Gilian Dustlight, to monitor for changes in the airborne environment.
- Keep dust levels down
    - There are a several different ways of keeping dust levels down on your site, which will keep Silica particles from becoming airborne. Examples include wet cutting, vacuum dust collection systems, intense ventilation or hosing down work sites to keep Silica dust from forming.
- Stay informed
    - As every region has different rules and regulations around managing Silica exposure, it’s important to stay up to date with legal limits, testing methods and the latest data on how you can minimize risk.

What can employees do?

Employees can:

- Use all available screening tools, such as the Gilian Dustlight, to alert when hazardous environment is present.
- Use all available engineering controls such as blasting cabinets and local exhaust ventilation.
- Avoid using compressed air for cleaning surfaces.
- Use water sprays, wet methods (e.g. wet spray misting) for cutting, chipping, drilling, sawing, grinding, etc.
- Substitute non-crystalline silica blasting material.
- Use respirators approved for protection against silica; if sandblasting, use abrasive blasting respirators.
- Do not eat, drink or smoke near crystalline silica dust.
- Wash hands and face before eating, drinking or smoking away from exposure area.
- Quit smoking

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