CDPH
California Department of Public Health

A MODERN EPIDEMIC OF AN ANCIENT DISEASE: SILICOSIS AMONG ENGINEERED STONE FABRICATORS

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Acknowledgments

CDPH
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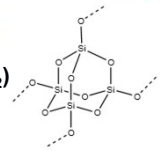
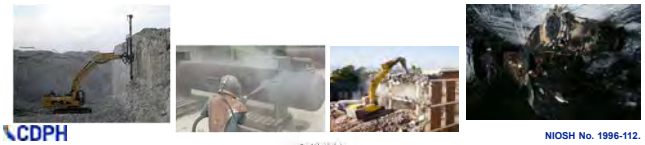
Silica

- Respirable crystalline silicon dioxide (SiO_2)
  - Quartz = 10% of earth's crust
- Rock, concrete, masonry, silica sand
- Drilling, cutting, sandblasting, demolition, mining





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NIOSH No. 1996-112.

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Respirable Crystalline Silica (RCS)

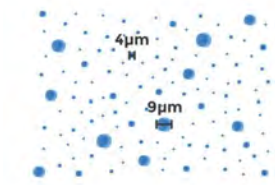
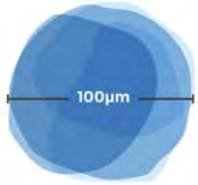


Table Salt



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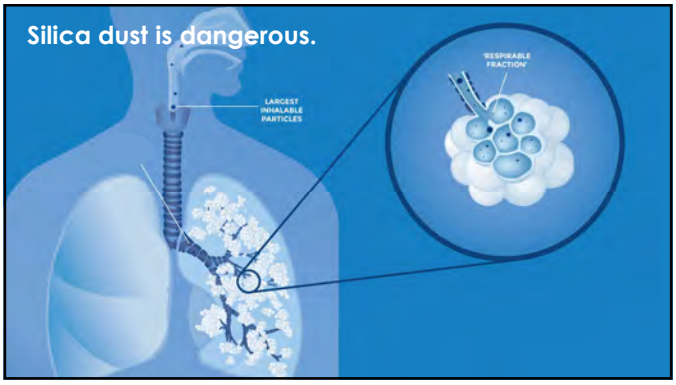
Silica dust is dangerous.



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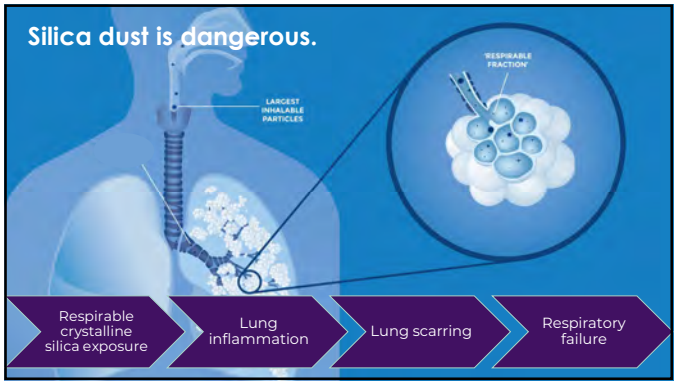

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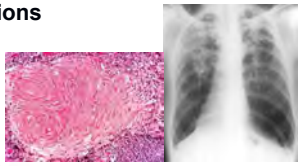
Health Effects of Silica

- Silicosis
  - Chronic = after 10+ years, lower concentrations
  - Accelerated = after 5-10 years, higher concentrations
  - Acute = after weeks to years, highest concentrations
- Mycobacterial, fungal infections
- Lung cancer, COPD
- Autoimmune disease
- Chronic kidney disease



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Hawks Nest Tunnel Disaster, 1930s

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Engineered Stone and Silica

- Silicosis is a **severe, incurable** lung disease caused by inhaling silica dust particles.
- Engineered stone (artificial stone, quartz), material used for kitchen countertops, contains **especially high levels of silica (>90%).**
- Workers who **cut and grind engineered stone** (stone fabricators) can be exposed to **hazardous levels of silica dust**.

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Photo credit: Earl Dotter

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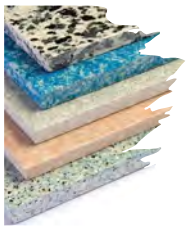
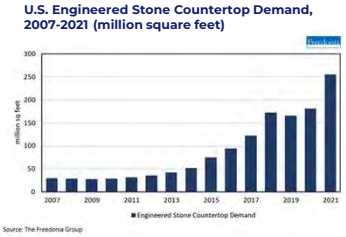
Engineered Stone: Growing Demand





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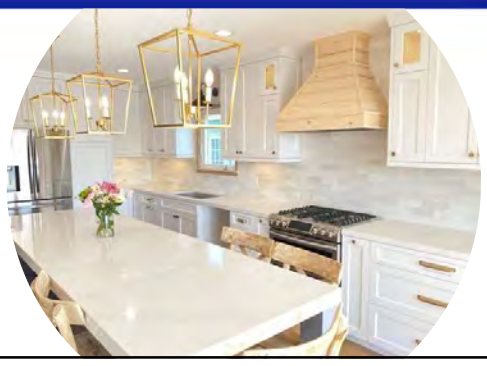

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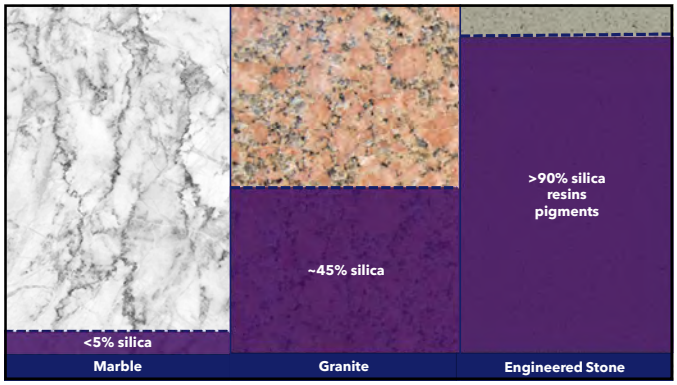

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Dry Cutting is Hazardous

- Generates high silica exposures
- Associated with disease
- Can occur in workshop and onsite during installation

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Salamon et al. *JOEH* 2021.
Hoy et al. *OEM* 2023.

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Silicosis Related to Engineered Stone

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California Index Case

- 37-year-old man hospitalized with silicosis in 2017

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California Index Case

- 37-year-old man hospitalized with silicosis in 2017
  - **2004-2013:** Worked at a countertop fabrication shop

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California Index Case

- 37-year-old man hospitalized with silicosis in 2017
  - **2004-2013:** Worked at a countertop fabrication shop
  - **2013:** Diagnosed with silicosis

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California Index Case

- **37-year-old man hospitalized with silicosis in 2017**
  - **2004-2013:** Worked at a countertop fabrication shop
  - **2013:** Diagnosed with silicosis
  - **2014-2017:** Worsening symptoms, lung function

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California Index Case

- **37-year-old man hospitalized with silicosis in 2017**
  - **2004-2013:** Worked at a countertop fabrication shop
  - **2013:** Diagnosed with silicosis
  - **2014-2017:** Worsening symptoms, lung function
  - **2018:** Ineligible for lung transplant, died of silicosis

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Workplace Investigation

Hospital discharge records

Investigation with Cal/OSHA

All were Hispanic men in their 30s at diagnosis. Two cases were fatal.

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Rose, Heinzerling, et al. *MMWR.* 2019.

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Workforce Screening

Silicosis by chest X-ray = 12%

Median age of cases detected by screening was 37.

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Heinzerling et al. *AJRCCM.* 2021.

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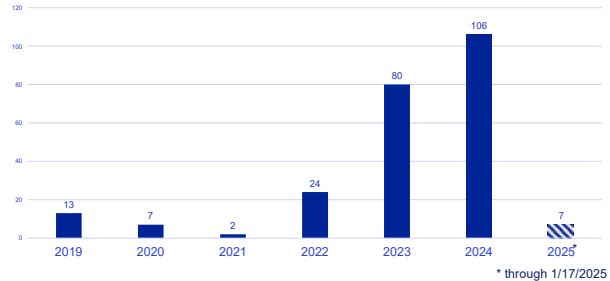
Cases Increasing in California



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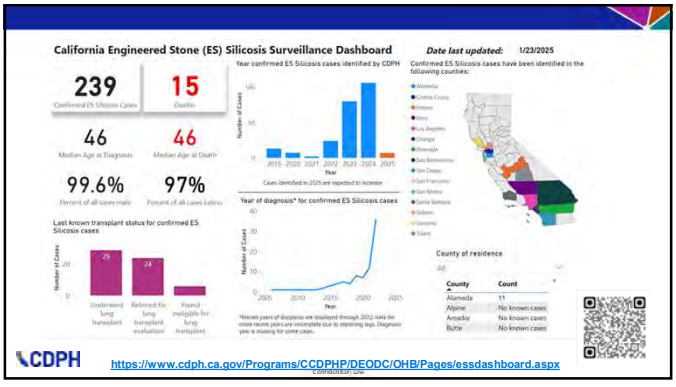

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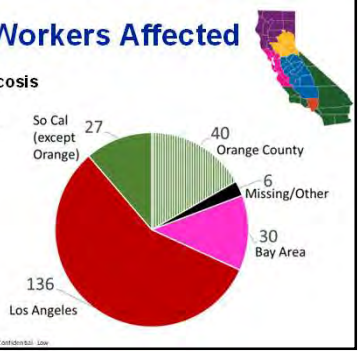
Young Immigrant Workers Affected

- **239 fabrication workers with silicosis**
  - Many in their 30s and 40s
  - Immigrants from Latin America
  - Often under/uninsured
- At least **15 deaths**
- At least **29 lung transplants**



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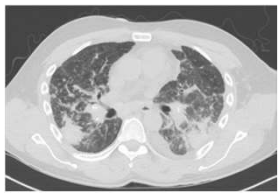
Advanced Disease

Simple: 61%

Complicated: 38%



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Fazio et al. *JAMA Int Med.* 2023;183(9):991-998.

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Substitution

- **Select products with lower or no silica content**
- Natural: marble, granite, wood
- Manufactured: ceramic, porcelain, concrete
- New engineered stone products

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Elimination

- **July 2024:** ban on engineered stone in Australia
  - Manufacture
  - Supply
  - Processing
  - installation

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Safe Work Australia, 2024

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Cal/OSHA's Silica Standard, CCR Title 8, Section 5204

Mike Wilson
Senior Safety Engineer
Cal/OSHA Research and Standards

State Compensation Insurance Fund
February 28, 2025

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Hazards of Artificial Stone

2020, Wu et. al.

- 18 patients with artificial stone-associated silicosis
  - Median exposure duration of 6 years.
  - 22% experience rapid deterioration in 6 to 12 months
  - 40% required lung transplant
  - 28% died
- 63 patients with natural stone-associated silicosis
  - Median exposure duration of 30 years
  - 3% required lung transplant
  - No deaths

Wu N, et al. Artificial stone-associated silicosis in China: A prospective comparison with natural stone-associated silicosis. *Respirology* (2020) 25, 518–524. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7187561/.

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Widespread Non-compliance found in the 2019-2020 SEP

- 72% of countertop employers in violation of section 5204.
- Only 5% of workers received required medical exam.
- Only 45% of workers reported using wet methods.

Photo: Federal OSHA

Surasi K, et al. (2022). *Am J Ind Med*. 65:701-707 https://pubmed.ncbi.nlm.nih.gov/35899403/.

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Cal/OSHA Silicosis Projections under the Pre-Existing Silica Regulation

Based on 2019 findings; silicosis rate of 12% to 21% in the industry; and silicosis fatality rate of 19% in the industry—Cal/OSHA estimates:*

Of ~4000** workers in California, about 1,000 (25%) are likely exposed over the PEL of 50 µg/m^3.

* After a median of 15 years of exposure.
** The number of countertop workers might be as high as 11,000 (CDPH, MMWR 2018).

Photo: Federal OSHA

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Cal/OSHA Silicosis Projections under the Pre-Existing Silica Regulation

- Between 500 and 800 of these 4,000 workers could develop silicosis.
- Between 95 and 150 of these workers with silicosis could die of pulmonary fibrosis and respiratory failure, absent a lung transplant.

Photo: CDC

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2024 Silica ETS Inspections as of Feb 18, 2025

92 silica inspections opened since 12/29/23. Of these:

- 72 silica inspections closed.
- 67 (93%) with violations of 5204 and others.
- 22 of 92 (24%) shops issued 34 Orders Prohibiting Use (OPUs). Shop or equipment shut-down.

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Enforcement Operations

Karen Smith, CIH, CSP
Cal/OSHA Senior Industrial Hygienist
May 2024

"I'm averaging about 10 citations per countertop inspection. Other CSHOs I have talked to are finding similar results. Even cutting wet, they are still over the PEL."

"By issuing OPUs without sampling we can stop the exposures immediately. We are also requiring a higher level of protection for those workers once the shops do reopen."

Photo: NIOSH, CDC

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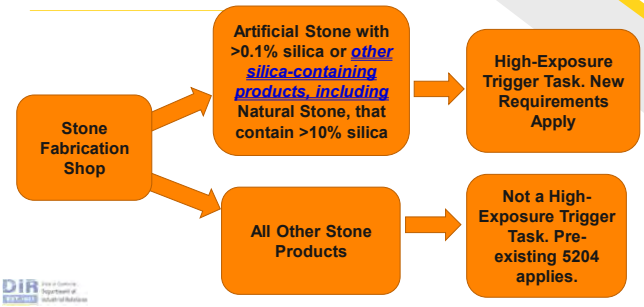
CCR Title 8, Section 5204



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Subsections in Section 5204

- (a) Scope and Application
- (b) Definitions
- (c) Permissible Exposure Limit
- (d) Exposure Assessment
- (e) Regulated Areas
- (f) Methods of Compliance
- (g) Imminent Hazards
- (h) Respiratory Protection
- (i) Housekeeping
- (j) Medical Surveillance
- (k) Medical Removal
- (l) Communication of Hazards
- (m) Reporting of Silicosis and Lung Cancer
- (n) Recordkeeping

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Subsections in Section 5204

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(f) Methods of Compliance

- Engineering and work practice controls required for HETTs, regardless of exposures, exposure assessments, or objective data.
- Wet methods required, as defined.
- Proper containment of dust, debris from HETTs.
- Clean up HETT dust, debris with wet methods or HEPA filter vacuum.
- HETT prohibitions on compressed air, dry sweeping, use of employee rotation, walking or moving through debris.
- Additions to the written exposure control plan.

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(g) Imminent Hazards

Violation of (f)(2) wet methods is a mandatory Order Prohibiting Use (OPU) by Cal/OSHA. Shop closed until hazards abated.

Violations respiratory protection (h); reporting of silicosis (m); and carcinogen reporting (5203) may be subject to OPU.

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(h) Respiratory Protection

Tight-fitting PAPR with APF 1000 required with HEPA, N100, R100 or P100 filter.

EXCEPTION 1: Less protective respirator allowed if exposures to RCS are <AL through rep air sampling by qualified person, at least once every 6 months.

EXCEPTION 2: Even less protective respirator allowed if above conditions are met, all employees participating in med surveillance, no silicosis or suspected cases. PLHCP can overrule.

Supplied-air respirator for workers with suspected silicosis, or per PLHCP.

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(h) Respiratory Protection

Why require respiratory protection when wet methods are also required?

- Studies from NIOSH and Dr. Jenny Houlroyd at Georgia Institute of Technology show that even with wet methods, RCS exposures can be very high.
- Water mist contains silica particles.
- Tools can misdirect the water stream, or have insufficient flow.
- Videos available at: Clean Air, Clean Water: Silicosis - November-December 2020 (stonemag.online)

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(j) Medical Surveillance

- Initial and periodic exams available at no cost, at reasonable time and place.
- Reporting requirements to employee, PLHCP and Cal/OSHA, CDPH.
- Referral to specialist if requested by PLHCP.
- Chest CT scan substituted for chest X-ray for the following:
  1. If requested by the PLHCP
  2. Suspected silicosis
  3. HETTs for at least 30 days each year

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(k) Medical Removal

(k)(1) Modify work or transfer employee, per PLHCP.

(k)(2) Earnings, seniority, benefits maintained for 6 months or until employee is able to return to work per PLHCP, or permanently unable to return to work.

(i)(3) If WC claim filed, wages continue for six months.

(k)(4) Wages, benefits may be reduced if income from other programs or other employer.

(k)(5) Independent Medical Review. Designated by employee; paid by employer; determination binding.

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Subsections in Section 5204

(a) Scope and Application	(b) Definitions	(c) Permissible Exposure Limit	(d) Exposure Assessment
(e) Regulated Areas	(f) Methods of Compliance	(g) Imminent Hazards	(h) Respiratory Protection
(i) Housekeeping	(j) Medical Surveillance	(k) Medical Removal	(l) Communication of Hazards
	(m) Reporting of Silicosis and Lung Cancer	(n) Recordkeeping	

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Controlling Respirable Crystalline Silica Exposure

Meeting the Requirements of Cal/OSHA's Regulation, T8CCR5204

Colleen Cunanan, REHS
Industrial Hygiene
Consultant

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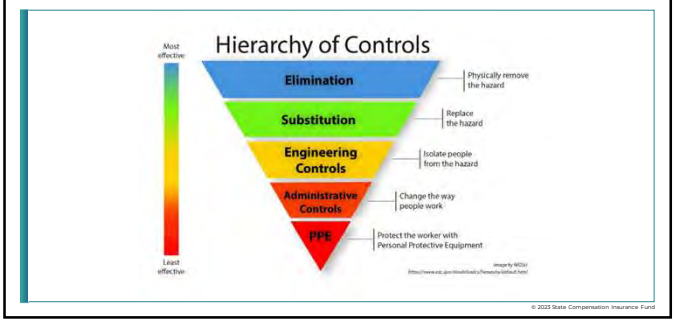
Hierarchy of Controls



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Substitution

High silica

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substance
Not applicable

3.2. Mixture: These products are composed of inorganic minerals that include crystalline silica (quartz and cristobalite), ceramic particles, polymers, metal powders, pigments, and additives. Certain products may contain titanium dioxide (0-5.0%), copper (0-2.0%) and/or nickel (0-0.5%). The Product composition varies based on the specific product.

Name	Synonyms	Product identifier	% *	GHS ingredient classification
Quartz	Quartz (SiO2) / Silica, crystalline, quartz / Crystalline silica, quartz / Silica, quartz / Silica, crystalline / Cristobalite	(CAS-No.) 14808-60-7 (CAS-No.) 14464-46-1	>87	Carc. 1A, H350 STOT RE 1, H372
Silicon	Silicon powder / Silicon (powder, amorphous)	(CAS-No.) 7440-21-3	<3	Comb. Dust
Titanium dioxide	C.I. 77891 / C.I. Pigment White 6 / Titanium oxide (TiO2) / CI 77891 / Titanium (IV) oxide / C.I. Pigment White 7 / Pigment White 6 / Titanium dioxide nanoparticles / TITANIUM DIOXIDE / Titanium-oxide	(CAS-No.) 13463-67-7	<5	Carc. 2, H351
Copper (in some Alloy Collection products)		(CAS-No.) 7440-50-8	<2	Not classified as hazardous
Nickel (in some Alloy Collection products)		(CAS-No.) 7440-02-0	<0.5	Carc. 2, H351 STOT RE, 1, H372 Skin Sens., 1, H317

Full text of H-phrases: see section 16

*Percentages are listed in weight-by-weight percentage (w/w%) for liquid and solid ingredients. Gas ingredients are listed in volume-by-volume percentage (v/v%).

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Substitution

Low silica

SECTION 3

Composition and information on ingredients

Mixture: NEOLITH is composed of a glassy matrix containing crystalline silica, alluminosilicates, zircon, and inorganic pigments. The crystalline silica content is less than 9%

IDENTIFIER	CAS	EC	CONCENTRATION	CLASSIFICATION
Crystalline Silica (SiO2) - Quartz	14808-60-7	238-878-4	0 - < 9%	STOT RE 1, H372 Carc. 1A, H350

Additional information:
Tests on the product have not detected either cristobalite or tridymite, which are the most siliceous and hazardous variants

Low Silica Product Lines: Neolith (<9%), Silestone Hybriq Q10 (<10%)

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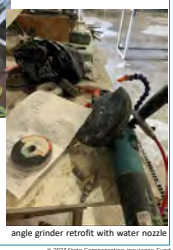
Engineering Controls – Wet Methods

Train workers on wet methods:

- Flow rates – measure to verify
- Use the right tool for the job
- Keep blades sharp
- Have a pre-work inspection
  - Electrical safety
  - Check for damage
  - Replace worn out pads and discs

wet polisher



angle grinder retrofit with water nozzle

****NEVER REMOVE GUARDS TO FIT DUST CONTROLS****

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Engineering Controls – Wet Methods

Experimental setup for wet operations using sheet flow wetting via a perforated water distribution manifold.

Ann Work Expo Health, Volume 61, Issue 6, July 2017, Pages 711–723, https://doi.org/10.1093/annweh/wxx040

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Engineering Controls – Wet Methods

Maintain your water filtration system

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Engineering Controls – Wet Methods

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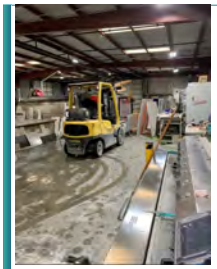
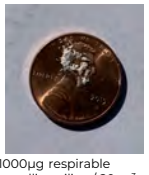
Administrative Controls – Housekeeping



Imminent hazard = shop closure



~1000µg respirable crystalline silica / 20 m^3 = 50µg/m^3

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Administrative Controls – Housekeeping

- Start with wide spray, then use a narrow, forceful stream
- Collect wastes in leak-tight containers or bags
- Hose down often
- Use respiratory protection
- Ensure proper footwear

ANY USE OF COMPRESSED AIR OR DRY CLEAN-UP OF WASTE IS PROHIBITED

Excellent housekeeping!

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Administrative Controls – Housekeeping

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Administrative Controls – Housekeeping

Don't forget the breakroom

Provide personal washing facilities, stocked with soap and disposable towels

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Administrative Controls – Regulated Area

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Administrative Controls – Employee Rotation PROHIBITED

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Administrative Controls – Procedures and Training

Train workers about:

- Health hazards of silica exposure
- Symptoms of exposure
- Workplace tasks with exposure
- Controls to reduce exposure for each task and how to use properly
- Purpose of medical surveillance

State Fund's Silica Exposure Control Plan template

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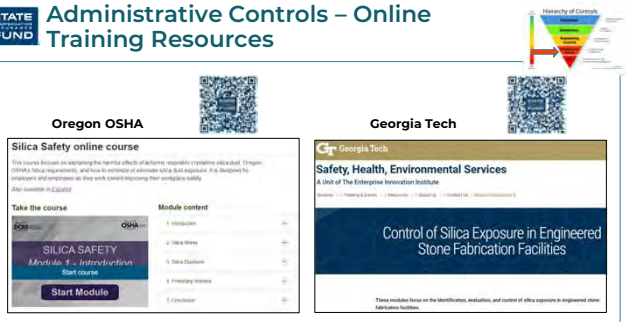
Administrative Controls – Online Training Resources



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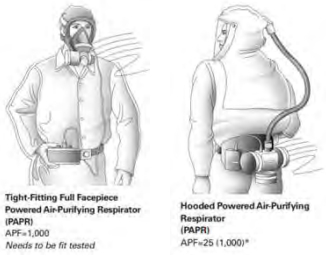
PPE – Respiratory Protection

PAPRs required:

- High-exposure trigger tasks
- Housekeeping after high-exposure tasks
- Clean-up or handling wastes
- Work within regulated area where high-exposure trigger tasks occur



Tight-Fitting Full Facepiece Powered Air-Purifying Respirator (PAPR)
APF=1,000
Needs to be fit tested

Hooded Powered Air-Purifying Respirator (PAPR)
APF=25 (1,000)*

Images courtesy of OSHA

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Additional Resources

- State Fund Loss Prevention/ Industrial Hygiene Services
  - SafetySupport@scif.com
- Cal/OSHA Consultation
- AIHA Consultants Listing/BGC Public Roster
- DIR.ca.gov/dosh
- CDPH/Occupational Health Branch
- SafeAtWorkCA.com

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Silicosis is 100% Preventable

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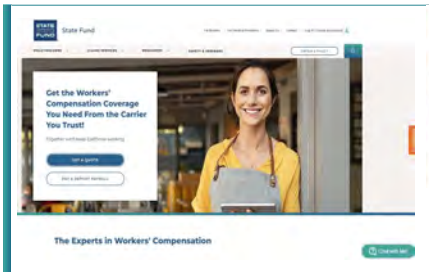
Need Workers' Compensation Insurance?



www.StateFundCA.com

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Thank You

For all your safety resources please visit
SafeAtWorkCA.com

For more information:
www.safeatworkca.com
www.statefundca.com

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