

Silica and the lung

Crystalline silica is a common mineral found in most rocks, sands and clays. It is present in things like concrete, bricks, mortar, pavers, tiles, cement sheeting, natural stone products and engineered stone slabs. There are three forms of crystalline silica: quartz, cristobalite and tridymite.

Material	Amount of crystalline silica (quartz)
Engineered stone	Up to 95 per cent
Sandstone	70–90 per cent
Concrete, mortar	25–70 per cent
Brick	Up to 30 per cent
Granite	20–45 per cent
Fibre cement sheets	10–30 per cent
Demolition dust	3–4 per cent
Marble	2 per cent

Table 1: Typical concentrations of crystalline silica in commonly used materials^{1,2}.

Crystalline silica is hazardous to health

Very fine silica particles can be breathed deep into the lungs and cause damage, as shown in Figure 1. These fine silica particles are called respirable crystalline silica.

Repeated exposure to high levels of these fine crystalline silica particles can cause a variety of diseases that mostly affect the respiratory system.

Our lungs have ways to remove some of the dust we breathe in, such as coughing or bringing up phlegm. However, the fine particles can become trapped and cause irritation. In response, immune system cells called macrophages unsuccessfully try to clear the dust particles by engulfing and dissolving them. This can cause the macrophages to die, triggering inflammation and scar tissue formation.

As more silica dust is breathed in, more scar tissue forms—it can become harder to breathe and disease can develop.

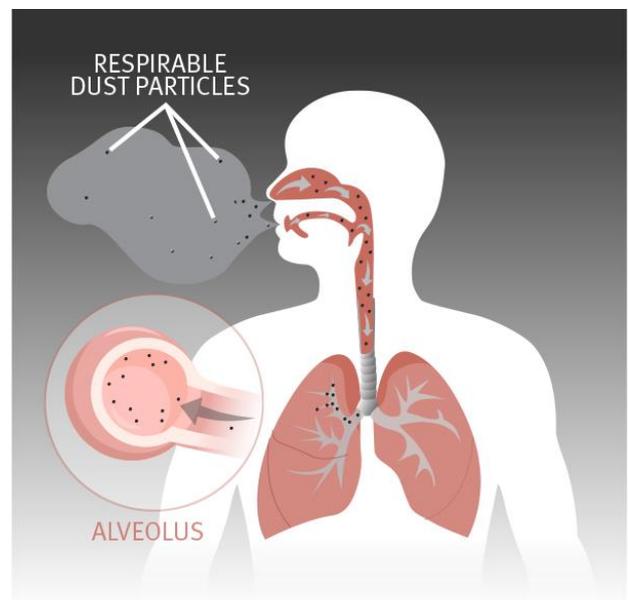


Figure 1: Very fine crystalline silica dust particles can be breathed into the deepest parts of the lung and cause irreversible damage. (Image courtesy DNRM 2019³)

¹ Control of Exposure to Silica Dust (2013) United Kingdom Health and Safety Executive, sourced at <http://www.hse.gov.uk/pubns/indg463.pdf>

² Crystalline silica and silicosis (2019) Safe Work Australia, sourced at <https://www.safeworkaustralia.gov.au/silica>

³ Queensland Government, Department of Natural Resources and Mines 2019, webpage <https://www.dnrme.qld.gov.au/miners-health-matters/what-is-cwp>

Diseases caused by breathing in silica dust

Silicosis: incurable lung tissue scarring that stops oxygen being absorbed and can lead to disability or death. Simple silicosis involves formation of small spots of scar tissue (nodules), usually without symptoms. Complicated silicosis involves formation of large areas of scar tissue called progressive massive fibrosis. There are three types of silicosis.

- **Acute silicosis:** is very rare and results from very large amounts of exposure to silica over a very short time (less than one year, may be weeks or months)
- **Accelerated silicosis:** results from short term exposure to large amounts of silica (1 to 10 years exposure)—this was once rare but is now being seen in engineered stone benchtop workers.
- **Chronic silicosis:** results from long term exposure (10+ years of exposure) to low levels of silica.

Chronic bronchitis: inflammation of the airways causing persistent coughing.

Emphysema: destruction of lung tissue which impairs lung function.

Lung cancer: uncontrolled growth of abnormal cells within one or both lungs. Smokers are at higher risk.

Chronic kidney disease: a decline in kidney function that may require dialysis if severe.

Scleroderma: an autoimmune disease of the connective tissue causing scar tissue formation in the skin, joints and other organs.

Rheumatoid Arthritis: an autoimmune disease causing joint pain and swelling.

All silica-related diseases can be prevented using effective controls to stop or reduce the amount of silica dust in the workplace.

Symptoms of silicosis

Silicosis causes no symptoms in the early stages. It is possible to have silicosis and not realise.

The first symptoms are often shortness of breath, a cough, occasional chest pain, loss of appetite and tiredness. As the disease progresses the shortness of breath gets worse and can become permanent. In time the cough becomes more severe and persistent, the chest pain can worsen, weight loss can occur, and night sweats can be experienced.

In severe cases, respiratory failure may cause death.

People with silicosis are also more at risk of getting tuberculosis and lung cancer.

There is no cure for silicosis—prevention is the only option.

Provide health monitoring for high risk workers

Health monitoring is a system of ongoing health checks to identify ill health.

Health monitoring for workers exposed to silica dust primarily focuses on respiratory health.

A suitably experienced registered medical practitioner, such as an occupational physician, will provide the following screening tests as part of the health monitoring:

- demographic, medical and occupational history
- records of personal exposure
- standardised respiratory questionnaire
- standardised lung function tests such as spirometry (Figure 2), lung volumes and lung diffusion capacity
- chest X-ray or computed tomography (CT) scan (Figures 3-6).

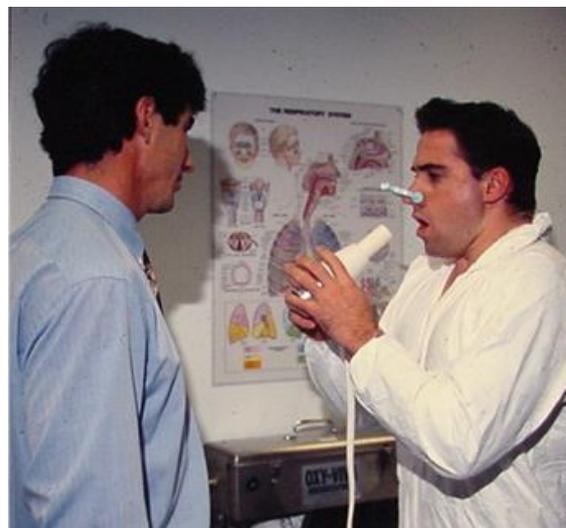


Figure 2: Lung function testing using spirometry.

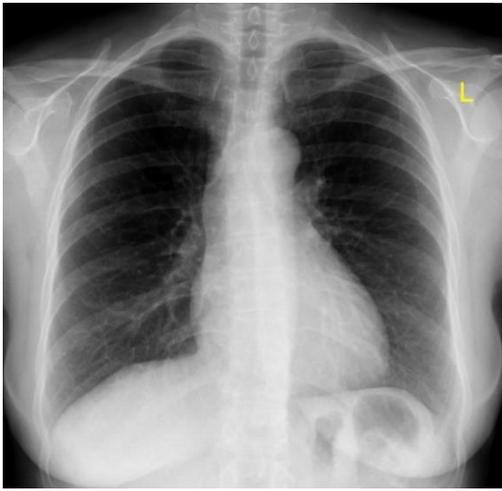


Figure 3: Chest X-ray showing healthy lungs in a 45-year old⁴.



Figure 4: Chest X-ray showing simple silicosis in a 55-year old with occupational exposure to silica dust⁵.



Figure 5: Chest X-ray showing silicosis with progressive massive fibrosis in a 45-year old stone mason⁶.

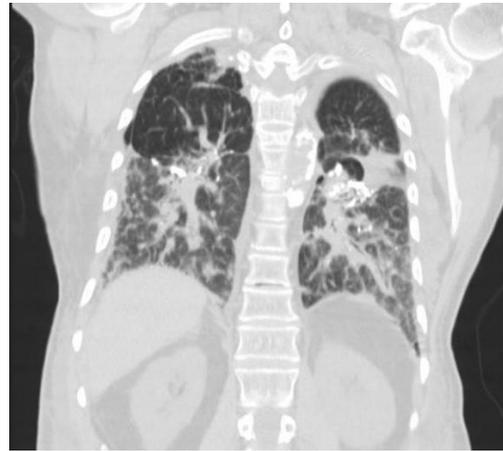


Figure 6: Chest CT scan showing silicosis with progressive massive fibrosis in a 64-year old former sand blaster⁷.

Health monitoring requirements

People conducting businesses or undertakings must provide health monitoring to workers if they:

- carry out ongoing work using, handling, generating or storing products containing crystalline silica
- there is *significant risk to the worker's health* because of exposure to crystalline silica.

Guidance on determining if there is significant risk can be found in [Health Monitoring for Exposure to Hazardous Chemicals Guide for Persons Conducting a Business or Undertaking](#). (SWA 2013⁸)

Case reports

The case reports below are of construction and manufacturing workers in the United States of America. More information is available at www.cdc.gov/niosh/topics/silica

Case one: Stone benchtop fabrication

A 37-year old man developed silicosis with progressive massive fibrosis. He was a non-smoker and had worked for 10 years polishing, laminating and fabricating engineered stone benchtops. He is now dependent on oxygen to breathe and may undergo a lung transplant.

⁴ Case courtesy of Dr Henry Knipe, Radiopaedia.org. From the case <<https://radiopaedia.org/cases/normal-chest-x-ray-1?lang=gb>>.

⁵ Case courtesy of Dr Hani Salam, Radiopaedia.org. From the case <<https://radiopaedia.org/cases/simple-silicosis?lang=gb>>.

⁶ Case courtesy of Dr Bruno Di Muzio, Radiopaedia.org. From the

case < <https://radiopaedia.org/cases/progressive-massive-fibrosis-silicosis?lang=gb>>.

⁷ Case courtesy of Dr Paulo A Noronha, Radiopaedia.org. From the case < <https://radiopaedia.org/cases/silicosis-with-progressive-massive-fibrosis-3?lang=gb>>.

⁸ Safe Work Australia, February 2013 - Health Monitoring for Exposure to Hazardous Chemicals: guide for persons conducting a business or undertaking

Case two: Rock drilling

A 47-year-old man was diagnosed with severe silicosis after working 22 years as a rock driller. He was diagnosed after he was brought to a hospital with respiratory failure and right heart failure and was put on a ventilator, but died. His autopsy confirmed advanced silicosis. Before this worker's diagnosis, he had never seen a doctor and had never had a chest X-ray. The drills he used were equipped with dust controls, but they were routinely inoperable.

Case three: Tunneling

A 69-year old man died of silicosis after working two years as a tunnel construction worker and 40 years as a nurse. He had been a smoker for most of his life and was exposed to silica during his employment in tunnel construction.

Prevent workers breathing in silica dust

Uncontrolled dry processing of materials containing crystalline silica is prohibited. This means silica dust must be captured or suppressed (usually with water) when cutting, grinding, sanding, polishing, drilling and mixing materials containing crystalline silica.

Stop or reduce the amount of silica dust being produced

Some methods include:

- Use vacuum extraction with hand-held power tools. Make sure the vacuum or dust extractor is properly rated: H-class for stone benchtop fabrication and installation, M or H-class for general construction and H-class for other industries.
- Use water to suppress dust on tools specifically designed for that purpose.

Stop workers breathing in silica dust

- Use barriers to isolate workers from dust producing activities.
- Use HEPA filtered air-conditioning systems in fixed and mobile plant operator cabins.

Don't create secondary sources of silica dust

- Clean up dust using low pressure water, wet mopping, wet wiping or an appropriately rated vacuum cleaner (H-class for stone benchtop fabrication and installation, M or H-class for general construction and H-class for other industries).
- Keep silica dust wet (as a slurry) and clean up regularly to prevent it drying out.

More information

Call 1300 362 128 or download:

- [Managing respirable crystalline silica dust exposure in the construction industry - Information for employers](#)
 - [Managing respirable crystalline silica dust exposure in the construction industry - Information for workers](#)
 - [Managing respirable crystalline silica dust exposure in the stone benchtop industry Code of Practice 2019](#)
 - [Managing respirable dust hazards in coal-fired power stations Code of Practice 2018](#)
 - [Selecting the right portable extractor or industrial vacuum cleaner for hazardous dust](#)
 - [Fit-testing requirements for tight-fitting respirators](#)
 - [Crystalline Silica – Hazardous chemicals requiring health monitoring Hazardous. Safe Work Australia.](#)
 - [Health Monitoring for Exposure to Hazardous Chemicals Guide for Persons Conducting a Business or Undertaking. Safe Work Australia.](#)
- [Controlling airborne contaminants at work: A guide to local exhaust ventilation \(LEV\). United Kingdom Health and Safety Executive.](#)



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