



Health Surveillance – Silica (respirable crystalline)

A Guide for Medical Practitioners

Health surveillance is required to be provided by the employer, at no cost, to workers who are at risk of adverse health effects from exposure to a hazardous substance in the workplace. Health surveillance must be supervised by a medical practitioner who has been appointed by the employer.¹The appointed medical practitioner (AMP) must be trained to conduct health surveillance in relation to hazardous substances. Health surveillance aims to identify early changes or adverse health effects in order to enable prompt intervention to prevent irreversible changes or disease.

Legislated Radiological Screening

On 15 January 2021, legislation was passed for low dose CT scan (LDCT) to replace chest X-ray in Western Australia as the radiological screening test for occupational exposure to silica. This means that chest X-rays can no longer be used for this purpose.

Schedule 5.3 (OSH Amendment Regulations 2021)

Low dose high resolution computed tomography of the chest at less than 1 millisievert (mSv) equivalent dose for the entire study. The study must image the whole of each lung on inspiration at 1.5 mm slice thickness or less, without an interslice gap, and must include expiratory imaging. The images must be of adequate quality to detect subtle abnormalities, including ground glass opacities and small nodules.

Note: Supine views only; prone views are not required. No contrast should be used.

A standard diagnostic HRCT chest scan (2-5 mSv) is not suitable due to the higher radiation exposure.

Silicosis

This is an occupational lung disease caused by the inhalation of fine silica dust particles (also called respirable crystalline silica). Silicosis is a progressive disease which can remain asymptomatic for decades. There is no effective treatment even after cessation of exposure.

Hazardous silica dust is released into the air from drilling, chipping, cutting, grinding, sanding, polishing or crushing and screening natural rock and ore as in granite, sandstone, slate quarries and in mining. Similarly, workers are exposed to hazardous silica dust when products containing silica such as engineered stone, concrete, and masonry are drilled, chipped, cut, ground, sanded, polished or crushed.

¹ Note that this requirement does not apply currently to mining operations required to comply with the *Mines Safety and Inspection Act* (1994) and Regulations (1995).

The silica content in natural stone varies from 5% for marble, 20-40% for slate, 25-60% for granite and 70-90% for sandstone. Engineered stone contains 80-95% silica.

Silica exposure has historically been associated with **chronic silicosis** from exposure to relatively low levels of dust. Chronic silicosis, which develops slowly over decades (10-30 years), may become symptomatic towards the end of the worker's working life or after retirement. A small proportion of chronic silicosis may go on to develop complications of progressive massive fibrosis (PMF) and respiratory impairment.

In more recent times, the use of engineered stone products for kitchen and bathroom benchtops has led to the emergence of **accelerated silicosis** among workers (in their 30's, 40's and 50's) following work exposures of 5-10 years. Rapid progression from simple silicosis to complicated silicosis can occur with onset of progressive massive fibrosis resulting in respiratory failure and death.

Engineered stone, also known as artificial stone, is a composite material made up of silica held in a matrix with polymeric resin. Freshly fractured silica dust from engineered stone is also more reactive. As engineered stone is relatively easy to fabricate compared to the much harder granite (natural stone), far less training and skills are required.

Acute silicosis is rare. It is also known as silico-proteinosis in which alveoli fill with lipid and proteinaceous material. This condition is an acute illness that can occur after exposure to very high concentrations of silica dust resulting in severe symptoms within a few weeks to a few years of initial exposure. Clinically, there is progressive breathlessness, pleuritic chest pain, fever, cough, fatigue, weight loss and rapid progression to death from respiratory failure.

Pathology

Respirable crystalline silica particles (5 µm or less) penetrate deep within the lungs. When they reach the alveoli, the particles are ingested by macrophages. This induces proliferation of concentric fibrous tissue (often hyaline) surrounding birefringent silica particles, and the formation of tiny silicotic nodules. Fibrosis may progress to obliterate the lumen of respiratory bronchioles and pulmonary blood vessels. These nodules concentrate subpleurally and coalesce to form larger nodules and masses. Silica is also carried to the lymph nodes in the hilum. Enlargement and calcification of the lymph nodes can develop.

Associated conditions

Silicosis is associated with increased risk of:

- chronic bronchitis
- tuberculosis
- rheumatic disorders (rheumatoid arthritis, SLE)
- sarcoidosis
- lung cancer (silica is a Group 1 carcinogen in humans (IARC)).

Spirometry

Spirometry should be performed by trained personnel using a spirometer that is calibrated and maintained in line with TSANZ or ATS guidelines. Requirements include:

- at least 3 acceptable manoeuvres
- two largest FVC values are within 0.15L of each other
- two largest FEV₁ values are within 0.15L of each other
- maximal continuous expiration for ≥ 6 seconds.

Spirometry print-outs, including flow-volume graphs, must be available for submission to DMIRS with the health surveillance notification form.

Radiological Imaging

Chest X-rays are no longer required as they are not sensitive enough to detect silicosis nor associated early changes. A low dose CT high resolution chest scan (LDCT) with a dose limit of 1 mSv or less, provides an image quality sufficient to detect silicosis and early changes. No contrast should be used. A standard diagnostic HRCT chest scan (2-5 mSv) is not suitable as an occupational screening test due to the higher radiation exposure.

A LDCT is to be repeated at 2 to 5 yearly intervals depending on the specified Category. It is important that radiation exposures are kept as low as possible. The LDCT scan must be read by a radiologist with expertise in reading such scans. In addition to the standard report on the scan, the modified Kusaka ICOERD classification must be included together with the dose length product (DLP) for the scan. The conversion factor for dose length product (DLP) to mSv for chest CT scan is 0.014.

If this service is not available in your regional area, there is scope for the worker to undertake the screening in a facility that has this capability within 3-6 months of the date of referral. A full dose HRCT and/or chest X-ray are not acceptable substitutes if the radiology provider cannot provide a low dose CT scan service.

HEALTH SURVEILLANCE

Portability of health surveillance is important for continuity. It is also important to prevent overly frequent screening when changing employment or AMP. The worker must be provided with a copy of the health surveillance forms including the LDCT report. The worker must take their previous health surveillance records to their next health surveillance appointment.

A. Special Category: Engineered stone

Engineered stone workers have a higher risk of silicosis – in particular those whose work exposures were for periods prior to 2020 when dust controls and respiratory protection may have been inadequate. Silicosis in the engineered stone industry has occurred after shorter exposures in the younger working age groups.

Health surveillance requirements (Category A)

- Annual health surveillance and spirometry with **2-yearly LDCT**.
- For those workers who are already enrolled in the health surveillance system, with 2 or more years of exposure, and who have not had a previous screening LDCT, a baseline LDCT must be done with their next health surveillance.
- Workers new to the industry are required to have a baseline health surveillance and spirometry but not an LDCT unless clinically indicated (AMP decision) or there is prior exposure to silica dust.
- Workers leaving the industry must have a health surveillance and LDCT on exit, unless the last health surveillance and LDCT were within the last 2 years.

B. General Category: Miscellaneous industries (natural stone)

All other silica exposure (predominantly natural stone) has been grouped into a General Category. This includes stonemasonry (natural stone) and other processing of natural stone, the construction industry (e.g. concrete cutting, shotcreting, tunnelling, demolition), foundry work, abrasive blasting, fire assay lab (ore sample crushing) and other industries (quarrying, mining).

Health surveillance requirements (Category B)

- Annual health surveillance and spirometry with **5-yearly LDCT**.
- For those workers who are already enrolled in the health surveillance system, with 5 or more years of exposure, and who have not had a previous screening LDCT, a baseline LDCT must be done with their next health surveillance.
- Workers new to the industry are required to have a baseline health surveillance and spirometry but not an LDCT unless clinically indicated (AMP decision) or there is prior exposure to silica dust.
- Workers leaving the industry must have a health surveillance and LDCT on exit, unless the previous health surveillance and LDCT were within the last 2 years.

Appointed Medical Practitioner – role and duties

The AMP's role is defined by health surveillance requirements including communications with the worker, the employer and the regulatory authority for the safety and health of the worker.

AMP

- Use the DMIRS [health surveillance questionnaire/notification form](#) to provide as much information as possible to enable a comprehensive risk assessment of the worker.
- Determine whether the worker may continue to work with silica dust.
- Remove workers with confirmed silicosis from silica work.
- Determine whether referral to a respiratory physician is necessary:
 - to confirm the diagnosis of silicosis
 - to clarify the significance and work-relatedness of other CT abnormalities.
- In complex cases, take advice from the respiratory physician.

AMP and worker

- Inform the worker of the AMP's requirement to notify and provide results to WorkSafe.
- Inform and explain results of health surveillance to the worker.
- Counsel the worker to stop smoking.
- Encourage good hygiene practices (wash/shower before eating or going home).
- Reinforce safe work practices including consistent use of respiratory protective equipment (RPE) and being clean shaven.
- Enquire into existing controls in the workplace for dust suppression (including wet work)
- If removal from silica work is required, inform the worker (and employer)
- Non-work related findings (spirometry or LDCT) requiring attention are to be forwarded to the worker and their GP to address.

AMP and employer

- Provide employer with health surveillance outcome and any recommendations for remedial action to improve safety and health in the workplace.
- Inform the employer when referral to a respiratory physician is indicated.
- The employer is responsible for the cost of the initial respiratory physician assessment and report where the lung condition is considered likely to be silica-related from current work exposures.
- Inform employer when removal of worker is required.
- The employer should consider availability of alternative work that does not expose the worker further to silica dust.

Note: The role of the AMP is limited to health surveillance within the provisions of the OSH legislation. Similarly, the initial role of the respiratory physician is limited to assisting to clarify the diagnosis and significance of chest CT abnormalities. When a work-related lung disease has been confirmed, it is recommended that the worker take advice from their treating medical practitioners and specialists in relation to workers' compensation. WorkCover is the authority administering the Workers' Compensation and Injury Management legislation.

DMIRS notifications

- All health surveillance results are to be notified to DMIRS on the [Silica – Health surveillance notification form](#).
- Silicosis cases are to be reported by the AMP promptly to DMIRS.
- Email the completed health surveillance questionnaire/notification form, spirometry print-out and LDCT report to safety@dmirs.wa.gov.au
- Forward the respiratory physician report when available.

Note: Incomplete forms will be returned by WorkSafe.

DMIRS contact

- Call 1300 136 237 to speak to the Occupational Physician or Inspector
- Alternatively send request by email to safety@dmirs.wa.gov.au

References

- [Occupational Safety and Health Regulations 1996](#)
- [Health Surveillance – Information, Guides and Forms](#) (DMIRS)
- [Fact sheet for workers. Silicosis claims in the engineered stone benchtop industry](#) (WorkCover WA, 2020)
- [Health monitoring for registered medical practitioners guide](#) (Safe Work Australia, 2020)
- Kusaka Y., Hering K.G., Parker, J.E. (2005). *International Classification of HRCT for Occupational and Environmental Respiratory Diseases*. Springer, Japan.
- Standardization of Spirometry 2019 Update. An official American Thoracic Society and European Respiratory Society Technical Statement, *American Journal Respiratory Critical Care Medicine*, Vol. 200 (8): e70-e88, 2019.
- Thoracic Society of Australia & New Zealand (2017), *Standards for the delivery of spirometry for coal mine workers*.