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Silica dust in the workplace / 工作場所的矽塵

This guidance advises PCBUs of the risks of respirable crystalline silica dust and how to control them and protect their workers.

本指南是為企事業經營管理人員提供建議，助其瞭解吸入結晶矽塵的風險和控制方法並保護員工的健康安全。

Silicosis is a progressive and deadly disease that causes fibrosis of the lungs from the inhalation of respirable crystalline silica (RCS) dust.

As a PCBU, you have a duty to eliminate, or use controls to minimise worker exposure to the hazard of, and risks from, RCS dust.

矽肺病是一種慢性發展和致命的疾病，通過吸入結晶矽塵引起肺部纖維化。

任何企事業經營管理人員都有責任採取控制措施，消除或最大限度地減少員工接觸結晶矽塵的危險。

Respirable crystalline silica dust / 可吸入結晶矽塵

Silica is a natural substance found in concrete, bricks, rocks, stone (including artificial or engineered stone found in composite kitchen benchtops), sand and clay. RCS dust is created when materials containing silica are cut, ground, drilled, sanded, polished or otherwise disturbed. RCS particles are extremely small; they can't always be seen with the naked eye.

矽是一種天然物質，存在於混凝土、磚塊、岩石(包括人造或合成石質廚房檯面)、沙子和黏土中。當含有矽的材料被切割、研磨、鑽孔、打磨、拋光或以其它方式被攪動時，會產生可吸入的矽塵。矽塵的顆粒非常小，肉眼通常看不到。

How workers can be exposed to RCS dust / 員工接觸可吸入矽塵的途徑

Workers in the following industries or who work with the following materials are most at risk of being exposed to RCS dust:

- quarrying
- roading
- foundries
- construction: concrete, stone, bricks, mortar, fibre cement products
- manufacturing of concrete, bricks and tiles
- kitchen benchtop manufacturing (natural and engineered stone), finishing and fitting
- abrasive blasting

- monumental masonry work
- mining
- concrete drilling, cutting, grinding, fettling, mixing, handling, dry shovelling, tunnelling.

以下行業的員工或使用以下材料的員工最有可能接觸可吸入的矽塵：

- 採石；
- 築路；
- 翻砂；
- 建築：混凝土、石材、磚、砂漿、纖維水泥製品；
- 混凝土、磚瓦和瓷磚生產；
- (天然和人造石)廚房檯面生產、切割、研磨或拋光；
- 噴砂處理；
- 大型碑石工程；
- 採礦；
- 混凝土鑽孔、切割、研磨、修補、攪拌、搬運、鐵鍬鏟動乾粉、開鑿通道。

Health effects of exposure to RCS dust / 接觸可吸入結晶矽塵對健康的影響

Workers may develop the following lung diseases from breathing in RCS dust:

- **Silicosis:** scarring of lung tissue resulting in shortness of breath. May continue to develop even after exposure to RCS dust has stopped. **The effects of silicosis are permanent.** There are three types of silicosis:
 - **acute silicosis:** may occur after exposure of less than a year to very large amounts of RCS dust
 - **accelerated silicosis:** may occur after exposure to large amounts of RCS dust over a shorter period of time, typically 3 to 10 years. Has been seen in workers from the artificial/engineered stone kitchen benchtop industry
 - **chronic silicosis:** typically results from exposure to RCS dust over more than 20 years.
- **Lung cancer:** may occur in workers exposed to high levels of RCS dust over a long period of time.
- **Chronic obstructive pulmonary disease (COPD):** a chronic lung condition that can lead to breathing difficulties such as emphysema in workers exposed to high levels of RCS dust over a long period of time.

There is some evidence that exposure to RCS dust may also cause kidney disease.

員工接觸可吸入結晶矽塵可罹患以下肺部疾病：

- **矽肺病：**肺組織癒痕導致呼吸短促。即使停止接觸結晶矽塵後，病情也可能會繼續發展。矽肺病的影響是永久性的。矽肺病有三種類型：
 - **急性矽肺病：**過度接觸可吸入結晶矽塵不到一年後而致病者；
 - **加速型矽肺病：**過度接觸可吸入結晶矽塵3–10年後而致病者。常見於從事人造/合成石質廚房檯面的行業員工。
 - **慢性矽肺病：**接觸可吸入結晶矽塵超過20年的典型結果。
- **肺癌：**可發生在長期過度接觸可吸入結晶矽塵的員工身上。
- **慢性阻塞性肺病(COPD)：**慢性肺病可導致呼吸困難，諸如發生在長期過度接觸可吸入結晶矽塵的員工罹患的肺氣腫。

有證據表明，接觸可吸入結晶矽塵也可能導致腎臟疾病。

Your responsibilities as a PCBU / 企事業經營管理人員的職責

As a PCBU, you **must** ensure the health and safety of workers and that others are not put at risk from your work.

Before starting work using artificial/engineered stone, you must complete a risk assessment and review your controls.

You **must** eliminate risks that arise from your work so far as is reasonably practicable.¹

- When deciding how (control measures) to eliminate or minimise risks, you must identify when work tasks may create RCS dust.
- Give preference to effective control measures that protect many workers at the same time.
- Talk to your workers to get their views on which control measures to use.

企事業經營管理人員**必須**確保工作人員的健康和安全，並確保從事的工作不會對他人造成威脅。

在從事人造/合成石質工作之前，您**必須**完成風險評估並審查控制措施。

您**必須**在合理可行的範圍內消除工作中產生的風險。¹

- 在決定如何(通過控制措施)消除或降低風險時，您**必須**確定工作中可能產生可吸入結晶矽塵的時間段。
- 應優先考慮可同時保護眾多員工的有效控制措施。
- 與員工進行探討，瞭解他們對採用控制措施的看法。

To eliminate RCS / 盡量減少接觸矽塵

- Use alternative products (eg metallic shot, slag products or grit instead of sand for abrasive blasting).

If you can't eliminate risks, you must **minimise** them so far as is reasonably practicable.

- 使用替代產品(例如：噴砂時使用金屬噴砂、礦渣產品或粗砂，而不是細砂)。

如果無法消除風險，則**必須**在合理可行的範圍內**盡量減少**接觸矽塵。

To minimise exposure to RCS dust / 減少接觸可吸入結晶矽塵

Instead of using engineered stone, use materials with a lower silica content. Engineered stone has approximately 90% silica compared with natural stone like marble and limestone which have around 2% silica. For more information about managing risk, see: worksafe.govt.nz

使用含矽量較少的材料，替代合成石料。合成石料含約90%的矽，相比之下，天然石材(如：大理石和石灰石)僅含約為2%的矽。有關管理風險的更多資訊，請參閱：worksafe.govt.nz

WET-WORKING CONTROL MEASURES / 濕加工控制措施

Freshly exposed silica particle surfaces (created due to grinding, drilling, cutting etc) are more toxic than older weathered particle surfaces. Using water to suppress dust has the added benefit of speeding up the weathering process.

接觸新產生的矽顆粒表面(因研磨、鑽孔、切割等而產生)比接觸陳舊的風化顆粒表面更具毒性。用水抑制灰塵具有加速風化過程的額外好處。

DO	DON'T
Use water spray or misting systems to suppress dust. Keep the work material (eg concrete, engineered stone benchtops) wet while work is carried out on them (eg cutting, polishing, etc). Use on-tool water suppression systems to keep dust out of the air	Dry sweep work areas
Frequently hose down equipment and work areas with water	Use compressed air to blow away dust
可行	禁止
使用噴水或噴霧系統抑制灰塵。在切割、拋光時確保工作材料(例如：混凝土、廚房檯面合成石料)水濕狀態。使用噴水工具抑制空氣中的灰塵。	用掃帚清掃乾燥的工作區域；
經常用水沖洗設備和工作區域。	用壓縮空氣吹拂灰塵。

¹ 'So far as is reasonably practicable' means you first consider what is possible in your circumstances to ensure health and safety. You then consider what is reasonable to do in your circumstances. You need to achieve a result that provides the highest protection that is reasonably practicable in the circumstances.

¹ 「在合理可行的範圍內」意指首先要考慮所處環境是否可確保健康和 safety。然後需考慮所處環境可合理開展的工作。您需要在最高保護的合理可行環境中完成工作。

DUST CONTROL MEASURES / 防塵措施

- Use physical barriers or computer numerical control (CNC) machines to isolate work areas or tasks that generate dust.
- When purchasing equipment and machinery, look for dust control features and dust collection systems. For example, tools used for cutting, grinding or polishing concrete and masonry should provide water to the blade and/or be fitted with an on-tool extraction system. See: worksafe.govt.nz
- Ensure dust-generating equipment has a dust collection system with a filtered air supply to isolate the worker from the dust.
- Use an H-class HEPA-filtered vacuum cleaner in accordance with Standard AS60335-2-69. This includes when working at someone's home (eg to fit a bench). Workers should not use the household vacuum cleaner to remove dust.
- Seal dust waste bags and place them in the correct waste container.
- 使用物體隔離裝置或電腦數控機器隔離產生灰塵的工作區域。
- 購置設備和機器時，請查看防塵功能和集塵系統。例如：用於切割、研磨或拋光混凝土和磚石的工具應提供刀頭噴水裝置和/或為工具配備除塵系統。請瀏覽：worksafe.govt.nz
- 確保產生粉塵的設備帶有集塵和空氣過濾系統，使員工遠離灰塵。
- 使用符合AS60335-2-69標準的H級HEPA吸塵器。包括在住宅裝修廚房檯面時的工作。員工不應使用家用吸塵器收集灰塵。
- 密封灰塵袋並將其放入正確的廢物收集箱中。

ADMINISTRATIVE CONTROL MEASURES / 防塵措施管理

- Set up exclusion zones with signs to mark the boundaries of work areas where RCS dust is created. The signs should warn workers about the hazards and specify the PPE to be used.
- Schedule potential high-exposure work for times when there are fewer workers and others around (eg breaks or after normal working hours).
- 設置帶有標誌的禁區，隔離產生可吸入結晶矽塵的工作區域。該標誌應提醒員工相關危險並具體指出應使用的個人防護裝備。
- 在人員較少的時間(例如：休息或正常工作時間之後)安排接觸粉塵較多的工作。

PERSONAL PROTECTIVE EQUIPMENT (PPE) / 個人防護裝備

- **PPE is the least effective control measure. It should not be the first or only control measure you consider.**
- PCBUs must provide PPE to workers unless another PCBU provides it or the worker genuinely and voluntarily chooses to provide their own PPE (and you are satisfied it is suitable).
- Seek expert advice when choosing PPE and consult with the workers who will be using it.
- 個人防護裝備是最基本的控制措施。不應將其視為首先考慮的或唯一的控制措施。
- 除非其它企事業經營管理人員提供個人防護裝備或員工自願選擇自己提供個人防護裝備(並您認為是合適的)。否則，企事業經營管理人員必須向員工提供個人防護裝備。
- 在選擇個人防護裝備時尋求專家建議，並諮詢將要使用這些裝備的員工。

Respiratory (breathing) protection / 呼吸保護措施

- A respirator may be half-face, full-face or a Powered Air Purifying Respirator (PAPR) (see pictures below). The type of respirator you choose will depend on the job and the levels of toxicity and concentration of RCS. Always choose a respirator that fully protects the worker, conforms with AS/NZS 1716 and is selected in accordance with Standard AS/NZS 1715.
- Carry out fit testing for each worker who will wear a respirator that requires a seal against the face.
- Provide information, training and instruction so workers can correctly use, wear, store and maintain their PPE.
- 防塵面罩可以是半罩式、全罩式或動力空氣淨化防塵面罩(見下圖)。您選擇的防塵面罩類型取決於工作以及可吸入結晶矽塵的毒性和濃度。始終選擇符合AS/NZS 1716標準並可全面保護員工的呼吸面罩，並根據AS/NZS 1715標準進行選擇。
- 對佩戴防塵面罩的員工進行佩戴測試，使面罩可以緊密配合面形。
- 提供資訊、培訓和指導，以便員工正確使用、佩戴、保存和保養他們的個人防護裝備。



FIGURE 1:
Re-usable half-face respirator (cartridge)

圖1:
可重複使用的半面罩呼吸器
(盒式)



FIGURE 2:
Full-face respirator (cartridge)

圖2:
全面罩呼吸器(盒式)



FIGURE 3:
Full-face powered respirator (cartridge)

圖3:
全面罩動力呼吸器(盒式)

Protective clothing and cleanliness / 防護服和清洗事項

- Ensure workers have overalls and gloves to wear at work. Workers should leave their dust-covered clothes at work to be cleaned. They should not wear them home.
- Ensure workers understand the importance of washing their hands before eating, drinking and smoking, and of washing up before they go home at the end of the day.
- Ensure washing facilities are provided.
- 確保員工在工作時穿戴防塵工作服和手套。員工應把防塵工作服留在工作場所進行清洗。他們不應在家中穿戴。
- 確保員工瞭解在進食、飲水和吸煙之前洗手，以及在工作結束、回家之前清洗的重要性。
- 確保提供清洗設施。

Exposure monitoring / 接觸程度監測

Exposure monitoring involves measuring and evaluating workers' exposure to a health hazard. It includes monitoring workplace conditions as well as biological monitoring.

- As a PCBU you **must**, so far as is reasonably practicable, monitor workplace conditions if exposure to a particular health risk warrants it.
- Exposure monitoring will confirm whether workers are exposed to RCS dust at potentially harmful levels and if your control measures are working properly.
- Exposure monitoring does not replace the need for control measures.
- You can engage an occupational hygienist from the New Zealand Occupational Hygiene Society: www.nzohs.org.nz or the Health and Safety Association of New Zealand (HASANZ) Register: <https://register.hasanz.org.nz> to measure RCS dust concentrations and help evaluate risks to worker health.
- Ask your workers for their views when making decisions about exposure monitoring.

接觸程度監測包括測量和評估員工接觸粉塵對健康造成的危害。其中包括監測工作場所的環境以及生物監測。

- 企事業經營管理人員在合理可行的範圍內，**必須**監測工作場所接觸粉塵的環境，是否對健康造成特定危害。
- 接觸程度監測將確認員工是否接觸對健康有潛在危害的可吸入結晶矽塵，以及您的控制措施是否正常發揮作用。
- 接觸程度監測不能取代控制措施。
- 您可以從紐西蘭職業衛生協會：www.nzohs.org.nz或者紐西蘭健康與安全協會的註冊機構：<https://register.hasanz.org.nz>聘請職業健康師，監測可吸入結晶矽塵濃度，並幫助評估對員工健康造成的風險。
- 在做出有關接觸監測的決策時，須徵詢員工的意見。

Health monitoring / 健康監測

Health monitoring involves testing workers to identify any changes in their health status because of exposure to hazards arising from their work.

- As a PCBU you must, so far as is reasonably practicable, monitor workers' health if exposure to a particular health risk warrants it.
- Provide health monitoring for all your workers who may be exposed to RCS dust. You can engage an occupational health practitioner from the New Zealand Occupational Health Nurses' Association: www.nzohna.org.nz from the HASANZ Register, and/or the Australian and New Zealand Society of Occupational Medicine: <https://anzsom.org.nz> to perform health monitoring.
- Monitoring should include:
 - collection of workers' demographic, medical and occupational histories
 - records of workers' exposure
 - a respiratory questionnaire
 - respiratory function tests
 - in some cases, chest x-ray or other radiological procedure.
- You must have workers' consent before you monitor their health.
- Ask your workers for their views when making decisions about health monitoring.

健康監測涉及檢測員工，以確定他們因接觸危害工作環境對其健康狀況造成的任何變化。

- 企業經營管理人員在合理可行的範圍內，必須監測工作場所接觸粉塵的情況是否對員工健康造成危害。
- 為可能接觸可吸入結晶矽塵的所有員工提供健康監測。您可以從紐西蘭職業健康護士協會：www.nzohna.org.nz和/或澳洲和紐西蘭職業醫學會：<https://anzsom.org.nz>聘請職業健康師，進行健康監測。
- 監測應包括：
 - 收集員工的種族、疾病和從業歷史；
 - 員工接觸粉塵的記錄；
 - 呼吸問卷調查；
 - 呼吸功能檢測；
 - 在某些情況下，採取胸部X光或其它透視措施。
- 在監測健康狀況之前，您必須征得員工的同意。
- 在做出有關健康監測的決策時，徵詢員工的意見。

Health monitoring for workers exposed to engineered stone / 接觸合成石料的員工健康監測

Due to the serious risk of developing accelerated silicosis in those working with engineered stone, an Occupational Medicine Specialist should be engaged to provide health monitoring advice and services.

由於使用合成石料的員工有加速型矽肺病的嚴重風險，應聘請職業醫學專家提供健康監測建議和服務。

Training / 培訓

- As a PCBU you must, so far as is reasonably practicable, ensure workers are supervised or trained to work healthily and safely.
- Provide your workers with information, training and instruction on the control measures (including the use and care of PPE) and the potential health risks of wearing PPE. For more information, see: worksafe.govt.nz
- Ask your workers for their views when deciding how to provide information and training.
- 為您的員工提供有關控制措施(包括個人防護裝備的使用和養護)以及佩戴防護裝備的潛在健康風險方面的資訊、培訓和指導。有關更多資訊，請瀏覽：worksafe.govt.nz
- 在做出有關提供資訊和培訓決策時，徵詢員工的意見。

More information / 更多資訊

Safety alert / 安全提示

[Accelerated silicosis](#)

[加速型矽肺病](#)

Fact sheets / 資料簡報

[Controlling dust with on-tool extraction](#)

[Respiratory Protective Equipment – advice for PCBU's](#)

[Workplace Exposure Standards \(WES\)](#)

[HASANZ Register](#)

[NZOHS](#)

[NZOHNA](#)

[ANZSOM](#)

[用吸塵工具控制粉塵](#)

[呼吸防護設備 – 為企事業經營管理人員提供的建議](#)

[工作場所接觸粉塵標準](#)

[紐西蘭健康與安全協會註冊機構](#)

[紐西蘭職業衛生協會](#)

[紐西蘭職業健康護士協會](#)

[澳洲和紐西蘭職業醫學會](#)