



GUIDE ON WORKERS' HEALTH PROTECTION

THROUGH THE GOOD HANDLING AND USE OF
CRYSTALLINE SILICA DUST
AND PRODUCTS CONTAINING IT



THE PURPOSE OF THIS GUIDE IS TO PROVIDE GUIDANCE AND INFORMATION
TO EMPLOYERS AND EMPLOYEES WHO MIGHT BE EXPOSED TO RESPIRABLE
SILICA DUST IN THE COURSE OF PERFORMING THEIR DUTIES AT WORK



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1. WHY THE GUIDE?

This guide is as a result of the commitment of Government to significantly reduce the prevalence of Silicosis by 2015 and to totally eliminate Silicosis in workplaces by 2030 in line with the International Labour Organisation (ILO) and the World Health Organisation's (WHO) Global Programme for the Elimination of Silicosis.

In 2009 the study was commissioned to determine the level of exposure of workers to silica dust in the non-mining sectors in South Africa. Based on the findings of the limited study, it was concluded that there is a significant problem with regard to silica dust exposure primarily in the following industries in SA:

- Sandstone
- Ceramics
- Refractory
- Foundry.

In 2010 inspections were conducted in the above-mentioned industries and it was found that there were challenges with compliance to reduce the exposure of workers to respirable crystalline silica dust.

2. PURPOSE OF THIS GUIDE

To provide guidance and information to employers and employees who might be exposed to respirable silica dust in the course of performance of their duties at work. The Regulations for Hazardous Chemicals Substances emphasises that employees should be protected against potential health effects caused by occupational exposure to hazardous chemical substances, of which respirable silica dust is one of them. Therefore efforts should be focused on minimising and controlling potential personal exposure to respirable crystalline silica in the workplace.

3. RESPIRABLE CRYSTALLINE SILICA

Crystalline silica is one of the major components of soil, rock, sand, granite and many other minerals found in the earth's crust. It is also a major constituent of construction materials such as bricks, tiles and concrete. Hence, crystalline silica is of great economic importance.

There are three major types of free crystalline silica used in the industry:



Loose, powdery dust on site 1, Day 2

- Quartz (the most common)
- Cristobalite
- Tridymite.

Quartz, cristobalite and tridymite when cut, drilled or ground all produce a respirable particle size, and exposure to these particles can occur during many work tasks including sandblasting, quarrying, brick cutting, glass manufacturing, tunneling, foundry work, stone working, ceramic manufacturing and construction activities. Respirable crystalline silica dust is one of the most aggressive, lung damaging dusts that can be encountered in the workplace.

Historically, respirable crystalline silica dust has been responsible for a huge burden of occupational ill-health with countless deaths from silicosis and silicotuberculosis. However, the health risks associated with exposure to crystalline silica dust can be controlled and, by using appropriate measures, reduced or eliminated completely. It is just a matter of assessing the risk and taking appropriate control measures.

4. OCCUPATIONAL EXPOSURE TO RESPIRABLE CRYSTALLINE SILICA (RCS)

Occupational exposure to respirable crystalline silica can occur in any workplace situation where airborne dust, containing a proportion of respirable crystalline silica, is generated. Respirable dust particles are so small that they cannot be seen with the naked eye. Once airborne, respirable dust takes a very long time to settle. A single release of dust into the workplace air can lead to significant occupational exposure. In situations whereby there is no air circulation or ventilation is inadequate, respirable dust may remain airborne in the workplace for days.

5. TYPES OF INDUSTRIES WHERE SILICA DUST MIGHT BE PRODUCED OR HANDLED

5.1. Foundry industry

The foundry industry produces shaped metal by pouring molten metal into moulds and allowing it to cool. There are two major sources of exposure:

- Refractory material is used to line the furnaces, and high silica-content bricks are used in the structure. A major source of exposure occurs during the removal or repair of these refractory linings or repair and removal of the bricks
- Vigorous attrition of sand creates fine particles; major operations that can produce this attrition are shot blasting, reclaim, knock-off using hammers and fettling.

5.2. Ceramics industry

This industry uses silica principally as a structural ingredient of clay bodies and as a major constituent of ceramic glazes. The principal ceramic products containing silica include tableware and ornamental ware, sanitary ware, wall and floor tiles, bricks and roof tiles, etc.



5.3 Glass industry

Silicon dioxide is the principal glass forming oxide and thus silica sand is the major ingredient in all types of glass. The main glass products include packaging glass (bottles, jars, etc.), flat glass (mirrors, windscreens, etc.), glass fibre (for reinforcement, insulation), etc.

After melting raw material, there is no crystalline silica any more. Glass is an amorphous material.

5.4 Brick manufacture and heavy clay

Bricks are made from soft sedimentary rocks – clays, marls, shales and mudstones – that are prepared by being crushed ground and mixed with water before being moulded, extruded, faced and shaped. The clay used for bricks contains up to 40% of free silica. Highest exposures are found at clay preparation such as milling, transporting and screening, during facing of bricks and during de-hacking where silica dust from facings, frogs or from loose surface materials is made airborne.

Where coal and clinker residues are incorporated into the clays, these also contain RCS.

5.6 Sandblasting/abrasive blasting companies

Sandblasting is the operation of cleaning or preparing a surface by propelling abrasive material against it. This is mainly carried out to smoothen and remove surface contaminants or to roughen the surface, and also to strip dirt, rust and paint from the surface of the object. In most cases siliceous sand is used as an abrasive in cleaning metal surfaces before finishing the operation. Dust levels are very high in sandblasting.

5.7 Construction companies

Construction workers, particularly those that are involved in the cutting, grinding, or drilling of concrete, brick and stone, can be exposed to excessive amounts of RCS.

5.8 Sandstone companies

Sandstone is a sedimentary rock composed mainly of quartz. It is usually mined in quarries. These blocks are then handed to sandstone sawyers who cut the sandstone blocks into cubes which are then taken for surface grinding, polishing, edge cutting or trimming. During the process of sawing, surface grinding, polishing, edge cutting or trimming/carving, high levels of dust are released. If the stone contains silica, workers are at risk of contracting silicosis.



6. HEALTH EFFECTS OF RESPIRABLE CRYSTALLINE SILICA (RCS)

When considering dust, three dust fractions are of main concern: the inhalable, thoracic and respirable dust fractions. However, for crystalline silica, the respirable dust fraction is the most important due to its potential health effects in humans.

It is also important to note that the occupational exposure limit values for crystalline silica apply to the respirable dust fraction. This dust fraction corresponds to the proportion of an airborne contaminant, which penetrates to the pulmonary alveolar (gas exchange) region of the lungs. The Occupational Exposure Limit for respirable silica dust is 0,1mg/m³.

People at work are rarely exposed to pure crystalline silica. The dust they breathe in at the workplace is usually composed of a mixture of crystalline silica and other materials.

The response of individuals is likely to depend on the following:

- Smoking habits
- The duration of exposure and intensity of the work
- The physiological make up
- The nature and crystalline silica content of the dust
- Dust fraction.

7. THE MAIN ADVERSE EFFECTS ASSOCIATED WITH RCS ARE:

7.1 Silicosis

It is a form of a lung disease resulting from occupational exposure to silica dust over a period of years. It causes slowly progressive fibrosis of the lungs, impairment of lung disease and a tendency to tuberculosis of the lungs.

There are three types of silicosis, namely:

- Acute
- Accelerated
- Chronic.

Acute and accelerated silicosis usually occur where the worker is exposed to high concentrations of fine respirable crystalline silica particles. Chronic silicosis is the most common form of silicosis and the fibrotic changes in the lungs are seen after ten to thirty years of exposure to dusts that contain 18-30% crystalline silica.

Silicosis can progress even after a person is no longer exposed to the dust, causing severe shortness of breath years later. The more years of exposure to dust, the greater the risk of the disease. Because there is no effective treatment for silicosis, prevention through exposure control is essential.



7.2 Pulmonary tuberculosis

Interstitial pulmonary fibrosis (IPF) is characterised by the replacement of normal lung tissue with fibrous tissue (fibrosis). There are over 150 different interstitial lung diseases that can cause IPF. IPF causes stiffness or scarring of the tissue in between the air sacs (alveoli) and vessels of the lungs. This stiffness reduces the ability of the alveoli to expand and take in adequate amounts of oxygen, leading to shortness of breath and eventually respiratory failure. IPF is irreversible.

7.3 Chronic Obstructive Pulmonary Disease (COPD)

It is a disease in which the airways and tiny air sacs (alveoli) inside the lungs are partially obstructed or destroyed. The result is difficulty in breathing. There are varying degrees of this illness, and different names for them, but it all comes back to damaged airways and air sacs. This disease occurs when a person breathes in lung irritants of some kind: smoke, chemicals, pollution, and dust. COPD includes Emphysema and Chronic Bronchitis.

7.4 Emphysema

It occurs as more and more of the walls between air sacs get destroyed. Instead of having lots of little sacs, the sacs break up and what is left are fewer larger sacs. These bigger sacs have less surface area for the exchange of oxygen and carbon dioxide than the tiny ones. Poor exchange of oxygen and carbon dioxide causes shortness of breath.

7.5 Chronic bronchitis

It happens when the airways are inflamed and thickened. More of the cells in the airways are making mucus, so the result is a habitual cough and difficult breathing.

8. WHAT DOES THE LAW SAY?

Section 8 of the Occupational Health and Safety Act, Act No. 85 of 1993, as amended, places the onus on the employer to provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees. Section 14 (c) further requires the employee to cooperate with the employer's precautionary measures.

The Hazardous Chemical Substance Regulations clearly outline the measures to be taken by the employer as well as the duties of the exposed. Therefore risk management requires the employer and the employee, to look at the risks that arise in the workplace and then putting sensible health and safety measures in place to control them.



9. RISK ASSESSMENT

Risk assessment is the process of evaluating the risks to workers' safety and health from workplace hazards. It is a systematic examination of all aspects of work that considers:

- What could cause injury/diseases or harm
- Analysis and evaluation of the risks associated with the identified hazard
- Whether the hazards could be eliminated and, if not, what preventive or protective measures are, or should be, in place to control the risks.

There are five recommended steps to risk assessment:

- Identify the hazards
- Decide who might be harmed and how
- Evaluate the risks and decide on precaution
- Record your findings and implement them
- Review your assessment and update if necessary.

10. AIR MONITORING

The only way to quantify the amount of respirable crystalline silica present in the workplace's atmosphere is to perform sampling of the air and analysis of the dust collected; Occupational exposure assessment is the process of measuring or estimating the intensity, frequency and duration of human contact with such contaminants. The sampling shall be carried out by an approved inspection authority or by a person whose ability to do the measurements is verified by an approved inspection authority.

There are two types of measurements that are commonly used:

- Personal
- Static.

Both types of measurements can be used jointly as they are complementary.

11. GENERAL PREVENTION PRINCIPLES

The hierarchy of control must be considered when preventive measures are taken:

- Avoiding risks
- Evaluating the risks which cannot be controlled
- Combating the risks at source
- Replacing the dangerous by the non-dangerous or less dangerous
- Developing a coherent overall prevention policy
- Giving collective protective measures priority over individual protective measures
- Giving appropriate information, instruction and training to the workers
- Providing competent supervision.

In the context where crystalline silica is handled in the workplace, examples of practical application

of the above principles are:

- Substitution: replace a dust generating process with a process generating less dust (e.g. use of wet process instead of dry process, or an automated process instead of manual process)
- Provision of engineering controls: e.g. extraction ducts, isolation techniques
- Good housekeeping practices
- Work pattern: establish safe working procedures, job rotation
- Personal protective equipment: provide protective clothing and respiratory protective equipment
- Education: provide health and safety training to the workers.

12. HEALTH SURVEILLANCE

Health surveillance is about putting in place systematic, regular and appropriate procedures to detect early signs of work-related ill health among employees exposed to certain health risks, and acting on the results.

The benefits of health surveillance are that it can:

- Provide information so that harmful health effects are detected at an early stage, thereby protecting employees and confirming whether they are still fit to do the work
- Check that control measures are working well by giving feedback or risk assessments, suggesting where further action might be needed
- Provide data, by means of the health records, to detect and evaluate health risks
- Provide an opportunity to train and instruct employees further in safe and healthy working practices, for example, the correct wearing and usage of PPE.

13. MEDICAL SURVEILLANCE

It includes the following:

13.1 Pre-placement, baseline medical screening

The pre-placement medical history should include the following:

- a. A medical and occupational history, with emphasis on the respiratory system
- b. A physical examination, with emphasis on the respiratory system
- c. Pulmonary function test (PFT) - using a spirometer, is the most common of the pulmonary function tests, measuring lung function, specifically the measurement of the amount (volume) and/or speed (flow) of air that can be inhaled and exhaled
- d. A baseline chest x-ray
- e. A respiratory health questionnaire.

13.2 Periodic medical screening

According to the requirement of the Hazardous Chemical Substance Regulations, all employees at risk for exposure to silica dust must have the following examinations every two years, or at intervals specified by an occupational medical practitioner for the duration of their employment:

- a. An occupational medical history, with emphasis on any exposures during the previous years
- b. A pulmonary function test (PFT) – using a spirometer, is the most common of the pulmonary function tests, measuring lung function, specifically the measurement of the amount (volume) and/or speed (flow) of air that can be inhaled and exhaled
- c. A respiratory health questionnaire
- d. A physical medical examination (with emphasis on the respiratory tract) should be pursued if the occupational medical history indicates a possible health problem which may be adversely affected by the work or the work environment
- e. A chest x-ray.

13.3 Exit medical

This is a final medical examination done before an employee leaves employment or is transferred to a different operation of job category where exposure is different from the previous job. It includes the following:

- a) A pulmonary function test (PFT) – using a spirometer
- b) A respiratory health questionnaire
- c) A physical medical examination (with emphasis on the respiratory)
- d) A chest x-ray.

An exit medical certificate is then issued.

14. RECORDS

- All medical records shall be kept for a minimum period of 30 years and if the employer ceases activities, all those records shall be handed over or forwarded by registered post to the relevant Chief Director of Provincial Operation of the Department
- All records of assessments and air monitoring shall be kept for a minimum period of 30 years.

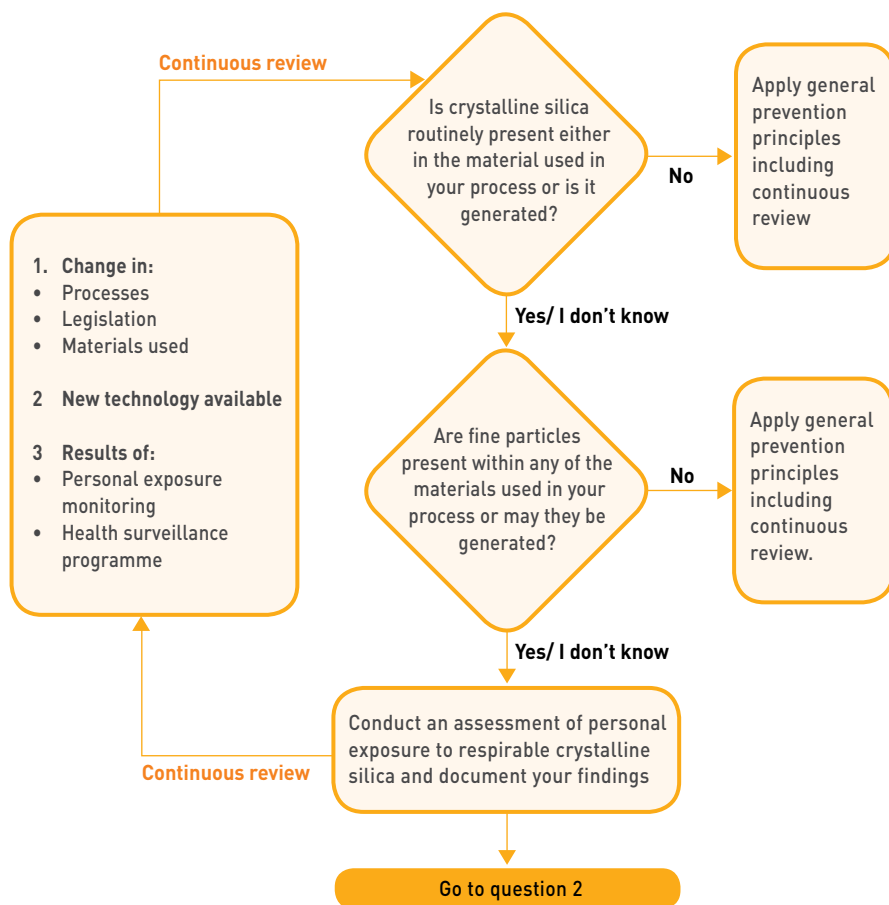


15. RISK MANAGEMENT – WHAT DO I NEED TO DO?

The following are basic risk management techniques that should be applied to workplace situations where employees may be exposed to respirable crystalline silica.

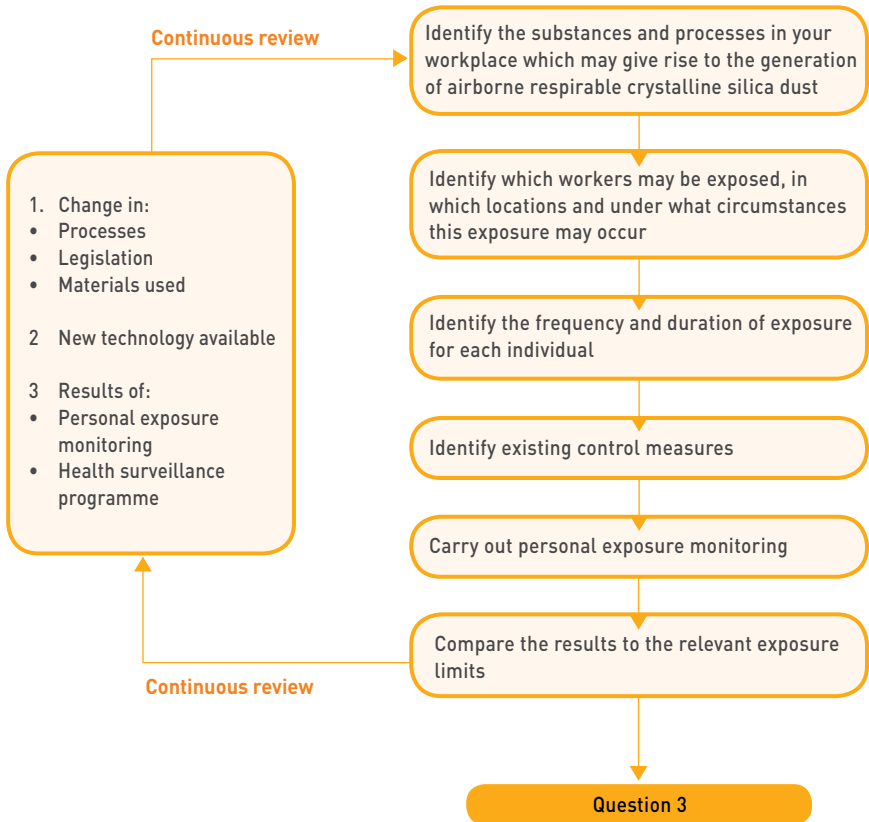
Question 1: How to determine whether employees are exposed to respirable crystalline silica in the workplace:

Figure 1: Initial assessment procedure



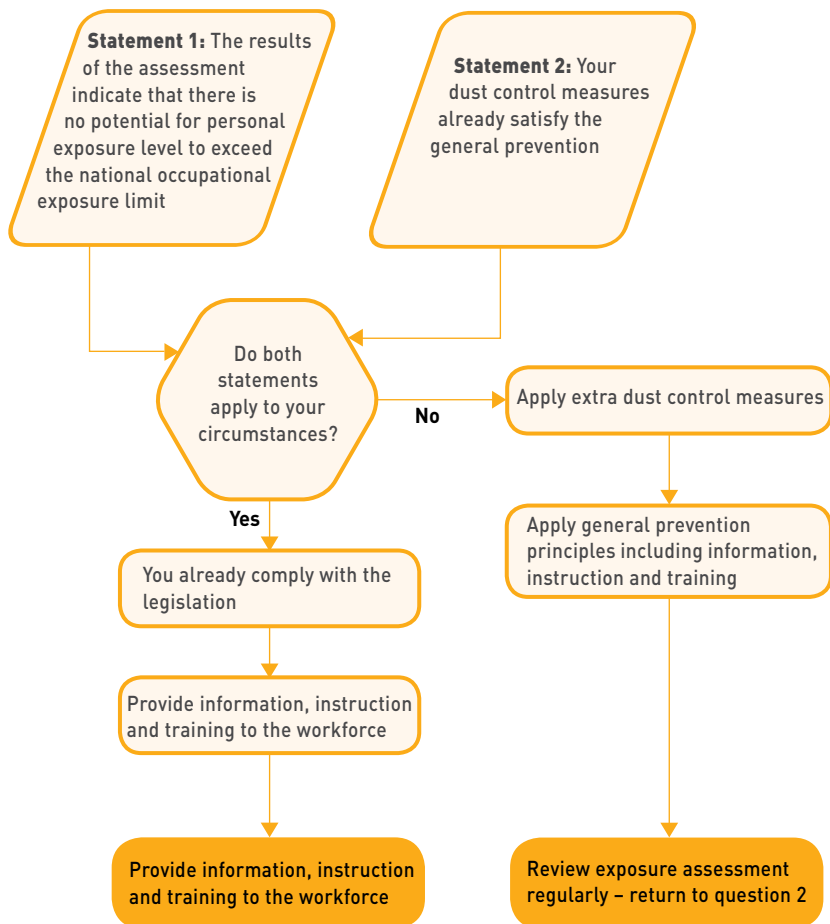
Question 2: How to conduct an assessment of personal exposure to respirable crystalline silica?

Figure 2: Assessment of personal exposure levels to respirable crystalline silica



Question 3: An exposure assessment has been conducted, what to do now?

Figure 3: Simple decision flow chart for control of exposure to respirable crystalline silica



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