CMPA

Dust Management Guideline

Issue 1

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1. *Overview*

This Dust Management Guideline together with the CMPA's Work Safely Reference Manual aims to support members in meeting the requirements of the Victorian Occupational Health and Safety Act 2004 and the Victorian Environment Protection Act 1970.

In doing so, the CMPA endeavours to:

- Provide members with appropriate management practices required to minimise potential health risks or environmental impacts associated with airborne dust arising from extractive industry operations
- Assist members in establishing and maintaining a Work Plan that defines operational activity so as to obtain and sustain an Extractive Industry Work Authority

2. *Scope*

This Dust Management Guideline covers the health risks and environmental impacts and their associated controls from both a workplace and a community perspective.

3. *Relevant Legislation and Resource Materials*

Relevant Legislation

- Victorian Occupational Health and Safety Act 2004
- Victorian Occupational Health and Safety Regulations 2007
- Victorian Environment Protection Act 1970
- Environment Protection Authority Victoria (EPA) - Protocol for Environmental Management, State Environment Protection Policy (air quality management) Mining and Extractive Industries, Publication 1191, December 2007
- Environment Protection Authority Victoria (EPA) Policy for Air Quality Management (SEPP-AQM)
- Mineral Resources (Sustainable Development) Act 1990
- Mineral Resources (Sustainable Development) (Extractive Industries) Regulations 2010

References and Guidance Materials;

- Safe Work Australia - Preparation of Safety Data Sheets for Hazardous Chemicals Code of Practice
- Safe Work Australia - Baseline Health Monitoring before starting work in a Crystalline Silica Process
- Safe Work Australia - Health monitoring for exposure to hazardous chemicals guide for persons conducting a business or undertaking
- Australian Institute of Occupational Hygienists - Dusts not otherwise specified and Occupational Health Issues, Position Paper 2014
- Australian Institute of Occupational Hygienists - Respirable Crystalline Silica and Occupational Health Issues, Position Paper February 2009
- Environment Australia - Best Practice Environmental Mining – Dust Control
- Environmental Defender's Office Ltd (NSW) Technical Fact Sheet: Air Quality – Dust Monitoring Aggregates Levy Sustainability Fund (ALSF) Information Gateway http://www.sustainableaggregates.com/index.html
- Reynolds Soil Technologies (RST) http://www.rstsolutions.com.au
- Canadian Centre for Occupational Health and Safety http://www.ccohs.ca
- HB203:2006, Environmental risk management – Principles and process (EPA pub. 1321.2).

Note: Attachment F details Guidance Materials for the Sampling, Monitoring and Analysis of Dust.

4. *Introduction to Dust*

Dust Definition

Dust is a generic term used to describe fine particles that are suspended in the atmosphere. Dust comes from a wide variety of sources, including soil, vegetation (pollens and fungi), sea salt, fossil fuel combustion, burning of biomass, and industrial activities.

Within the quarry industry, asides from dust arising from surface soil, dust is generated through the mechanical disintegration of solids, i.e. drilling, blasting and crushing of hard rock.

Uncontrolled dust is known as an airborne contaminant and can be hazardous to both personal health and the environment.

Dust Measurement, Weight & Classification

Dust particles are generally measured in microns/micrometers using the symbol µm:

- **1 millimeter (mm) = 1000 microns**
- **A human hair is approximately 50 microns**
- **Respirable dust is invisible being less than 7 microns**

Dust particles are generally weighed as milligrams (mg) or micro grams using the symbol µg:

- **1000 grams = 1 kilogram**
- **1000 milligrams = 1 gram**
- **1000 micrograms = 1 milligram**

From an environmental perspective dust is typically classified as follows:

- Total Suspended Particles (TSP) typically refers to particles 50µm (0.05mm diameter) in size or less
- Particulate Matter (PM) 10 refers to particles 10µm (0.01mm) in size or less.
- **Particulate Matter (PM) 2.5 refers to particles 2.5µm (0.0025mm) in size or less**

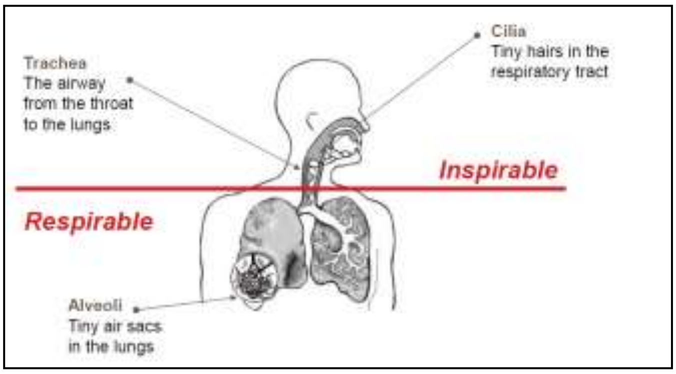
From an occupation perspective dust is typically classified as follows:

Inhalable/Inspirable Dust, Visible Dust, Nuisance Dust

- **Dust particles below 100 microns that are trapped in the nose, throat, and upper respiratory tract.**

Respirable Dust (Invisible Dust):

- **Dust particles small enough (0.2 - 7 microns) to penetrate past the upper respiratory tract and deep into the lungs.**



Respirable Crystalline Silica Dust (RCSD)

Quartz is one of the most abundant minerals, and as a major constituent in many rocks it is an important rock-forming mineral. Quartz is a hard mineral composed of silicon dioxide, SiO2, and is found widely in igneous, metamorphic and sedimentary rocks and typically occurs as colourless or white hexagonal prisms.

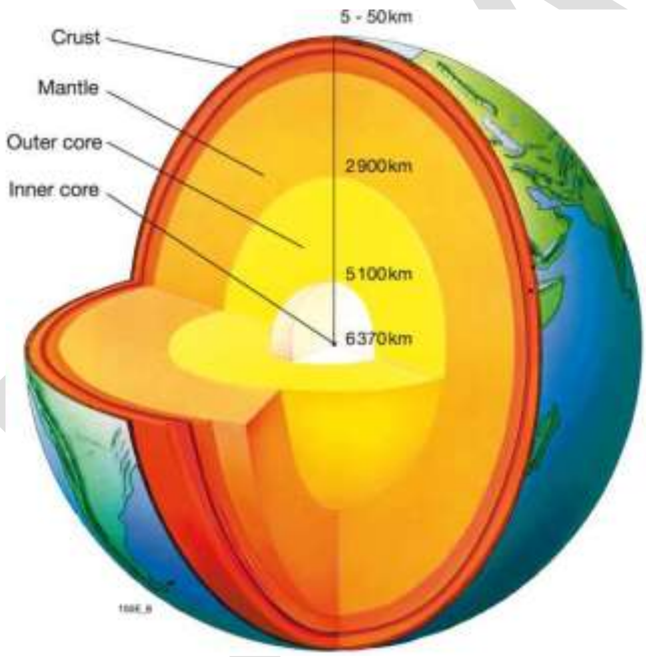
It is estimated that about 12% of the mass of the Earth's crust is made of quartz.

There are Non-Crystalline and Crystalline forms of Silicon Dioxide. Crystalline Silica is also known as Free Silica.

Crystalline Silica when broken up (e.g. crushed), generates dust particles which are small enough to penetrate deep into the lung. These particles are deemed respirable.

Respirable Crystalline Silica may cause lung damage. The non-crystalline form of silica (amorphous) does not cause this kind of lung damage.

Respirable Crystalline Silica Dust (RCSD) is generally defined as a rock source with greater than 1% quartz content.



Source Diercke International Atlas

Rocks are often classified both by their quartz content and by their silica content.

Quartz is one form of silica, SiO_2, but the terms "quartz content" and "silica content" have a very different meaning:

- Quartz content means the relative content of the mineral quartz in a rock.
- Silica content means the relative content of SiO_2 in the total chemical composition of a rock or a mineral.

Silica is the chemical component present in all silicate materials

Quartz is a mineral with a particular composition and crystal structure that represents the surplus SiO_2 that is left over after all other silicate minerals have captured their share of the available silica during the formation process. For example, a rock that is entirely made of Albite, a Feldspar, has 0% quartz content, but contains 77.3% silica (weight percent).

Common Rock Sources Containing Quartz

The largest amount of quartz is contained in igneous rocks, in particular in granitoids, granites and related rock. Volcanic rocks have very low quartz content or are void of it.

Very high concentrations of quartz can be found in certain sedimentary rocks like sandstone, as well as in alluvial and marine sands.

Metamorphic rocks also show large variations in quartz content. The quartz content often reflects the mineral composition of the precursor rock. The total amount of quartz present in metamorphic rocks is lower than in igneous but higher than in sedimentary rocks.

Rock and Product Quartz Content	
Basalt	< 1.0%
Scoria	0.5 - 2.0%
Clay	20 - 30%
Granite	25 - 40%
Hornfels	35 - 60%
Siltstone	45%
Sandstone	>80%
Sand	>90%
Fly Ash	up to 30 %
Portland Cement	> 1% and varies

Example of Quartzite Rock

Determination of Quartz Content

The quartz or silica content of rock is determined by conducting a Petrographic Analysis of representative samples of the rock source within the quarry.

A Petrographic Analysis is an in depth investigation of the chemical and physical features of a particular rock sample and is conducted by a Petrographer within a Mineralogy Laboratory and outlines the mineral content and the textural relationships within the rock sample.

A Petrographic Analysis can be conducted using a scanning electron microscope (SEM) to characterize the fracture surfaces from microstructures of the rock samples or doing X-ray diffraction (XRD) to identify exact mineral assemblages of a rock.

A Petrographic Analysis is used for both quality and health & safety objectives, e.g. assuring the rock source will meet its required quality specification, and identifying the quantity expressed in percentage, of the quartz present in the rock source.

The Petrographic Analysis must be relevant to the rock source being extracted. As a quarry extracts material from different locations the characteristic of the rock may change and another Petrographic Analysis may be required to verify quartz content.

A copy of the Petrographic Analysis should be forward to the Occupational Hygienist who conducts the dust monitoring.

Identification : Psammopelitic hornfels

Description :

The sample consisted of about 1 kg of clean, hard, robust, angular fragments (intermediate diameters about 6 to 12 mm) of finely crystalline, metamorphic rock. When a subsample was sorted it was seen to consist of 94% dark grey, unweathered fragments of hornfels, 3% dark grey fragments of hornfels with joint surface controlled brown, limonitic staining attributable to quite slight weathering and 3% light grey aplite (felsic microgranite).

A thin section was prepared to permit detailed examination in transmitted polarised light of 17 random fragments. An approximate average mineralogical composition of the aggregate, expressed in volume percent and based on a brief count of 100 widely spaced observation points falling within the sectioned random fragments, is :

34%	quartz
42%	biotite mica
19%	muscovite mica
3%	chlorite
2%	feldspar
<1%	opaque grains (probably ilmenite and magnetite)
trace	sulphide
trace	limonite
trace	other minerals (tourmaline and zircon)

Example of a Petrographic analysis finding

Hazardous Substances and Safety Data Sheets (SDS)

Respirable Crystalline Silica Dust (RCSD) is classified as a hazardous substance by Safe Work Australia (SWA) and is listed within their document titled Workplace Exposure Standards (WES) for Airborne *Contaminants April 2013.*

Hazardous substances are those that, following worker exposure, can have an adverse effect on health. Examples of hazardous substances include poisons, substances that cause burns or skin and eye irritation, and substances that may cause cancer. A substance is deemed to be a hazardous substance if it meets the classification criteria specified in the Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004] (Approved Criteria).

Under the WHS Regulations a manufacturer of a potential hazardous substance has an obligation, before first supplying the substance to a workplace, to determine whether it is a hazardous substance and, if so to establish a Safety Data Sheet (SDS) for that hazardous substance.

A SDS is a document that provides information on the properties of hazardous substances, how they affect health and safety in the workplace and how to manage the hazardous substances in the workplace.

An SDS is an important tool for eliminating or minimising the risks associated with the use of hazardous substances in workplaces.

Safety Data Sheets for Hazardous Substances must be:

- Provided to the company or person purchasing the hazardous substance;
- Reviewed at least once every 5 years;
- Amended whenever necessary to ensure that it contains correct, current information and
- Referred to when assessing risks in the workplace.

SECTION 2: HAZARD(S) IDENTIFICATION

HAZARDOUS SUBSTANCE NON-DANGEROUS GOODS

This product contains crystalline silica. Crystalline silica dust is classified as **Hazardous** according to criteria of Safe Work Australia (formerly ASCC/ NOHSC) (Approved Criteria for Classifying Hazardous Substances [NOHSC:1008]).

- Dust in/on the supplied product or created when the product is cut, drilled, abraded or crushed may contain crystalline silica some of which may be respirable (small enough to reach deep into the lungs when breathed in).

Example of Section 2 of a Safety Data Sheet

5. *Dust Movement*

Dust Generation

Any process that disturbs construction materials can become a source of potential dust:

- Drilling and Blasting rock;
- Crushing rock;
- Screening aggregates;
- Driving on haul Roads;
- Loading and unloading materials from stockpiles/trucks;
- Conveying materials and dropping materials from conveyors, into chutes, trucks or onto stockpiles;
- Cleaning, repairing or maintaining plant and equipment;
- Sweeping or compressed air blowing of workshops, amenities, mobile equipment cabins;
- Heating materials so as to ascertain moisture contents;
- Grading materials using a sieve shaker;
- Drilling, cutting or grinding.

Customers disturb construction materials through:

- The transport, storage and placement of construction materials;
- Drilling, cutting and grinding of concrete, bricks and decorative dimensional stone;
- Abrasive blasting—Note - Blasting agent must not contain >1 per cent crystalline silica;
- Foundry casting.

Customers of CMPA members should be made aware of the presence of RCSD in purchased materials. This can be done through the issue of a Safety Data Sheet prior to purchase or a warning label on the delivery docket.

Dust Carriage

Dust is easily carried and moved to another location.

Wind is the most obvious means of dust carriage but other means include:

- Overall, shirt and trouser cuffs and pockets;
- Work boot treads;
- Tyre treads;
- Truck draw bars;
- Open bodied trucks.

Dust monitoring has identified levels of RCSD higher than the Workplace Exposure Standard in lunchrooms, plant rooms and mobile equipment cabins that has been carried there by operator clothing and footwear.

6. *Exposure Standards*

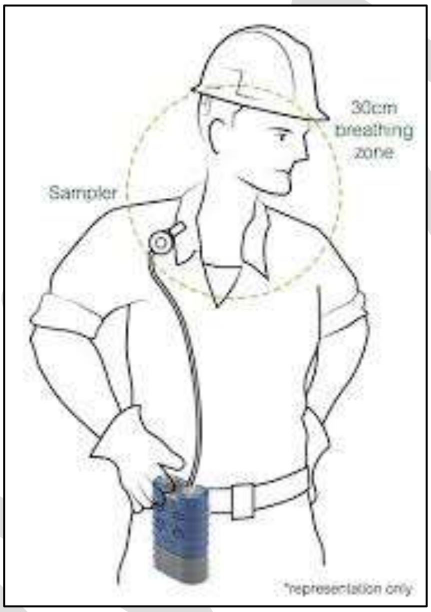
Workplace Exposure Standards

Safe Work Australia (SWA) set exposure standards for hazardous substances which are then adopted by the state or territory WHS regulatory authorities such as WorkSafe Victoria.

Exposure standards are based on the airborne concentrations of individual substances that, according to current knowledge, should neither impair the health of, nor cause undue discomfort to, nearly all workers. They do not represent a fine dividing line between a healthy and unhealthy work environment.

Exposure standards are measured at the persons breathing zone.

Breathing zone means a hemisphere of 300 mm radius extending in front of a person’s face and measured from the midpoint of an imaginary line joining the ears.



Example of a person’s breathing zone

Exposure standards are measured by milligrams of substance /cubic metre of air.

There is no formal exposure standard for respirable quarry dusts (other than Respirable Crystalline Silica Dust) or inhalable quarry dusts as they have an inherently low toxicity level and are not classified as Hazardous Substances by SWA

The exposure standard for Respirable Crystalline Silica Dust = 0.1 mg/m^3.

Action Levels

An action level triggers actions to control exposure ensuring all employee exposures stay well below the exposure standard. Industry best practice is to adopt an action level that is half of the SWA exposure standard, i.e. 0.05mg/m^3 for RCSD.

The Australian Institute of Occupational Hygienists (AIOH) recommends trigger values for these other dusts. Trigger values serve the same purpose of action levels and AIOH recommend they should be adopted by industry.

Dust type	Exposure Standard	Action Level/Trigger Value
RCSD	0.1mg/m^3	0.05mg/m^3
Respirable dust	Not applicable	1 mg/m^3
Inhalable dust	Not applicable	5 mg/m^3

Exposure standards are based on a 40 hour week.

To ensure the exposure standards and action levels are representative of the time worked, a formula called Time Weighted Average is used (TWA):

- TWA is the average airborne concentration of a particular substance when calculated over a normal eight hour work day, for a five day working week, i.e. 40 hour week
- To adjust the exposure standard to a 50 hour week the following calculation is used. 0.1 mg/m^3 X (40 hours divided by 52 hours) = 0.08 mg/m^3 or an action level of 0.04mg/m^3

Environmental Standards

The Environment Protection Authority Victoria (EPA) set standards for air quality within their Policy for Air Quality Management (SEPP-AQM) and the referenced guidelines and standards within the Protocol for Environmental Management (PEM) for the Mining and Extractive Industries.

The PEM sets out the statutory requirements for the management of emissions to the air environment arising from activities undertaken in the operation of mining and extractives sites. The PEM is used by Department of Economic Development, Jobs, Transport and Resources (DEDJTR) as a guide in the management of air quality impacts by mines and quarries. All mining and extractive industries have a requirement to comply with SEPP (AQM). The SEPP (AQM) outlines a very comprehensive process for Air Quality Assessments.

An Air Quality Assessment is required for proposals requiring an Environment Effects Statement or an EPA Works Approval and Licence or where specifically required by DEDJTR. In some cases a local municipality will request an Air Quality Assessment in accordance with this PEM to support an application for a planning permit.

DEDJTR are likely to request an Air Quality Assessment when activities that are likely to generate increased emissions of the indicators specified in the PEM or will have significantly increased impact at sensitive locations. Applicants for an Extractive Industry Work Authority from the DEDJTR may be required to conduct an Air Quality Assessment depending on the size/scale and location of the proposed operation and the type of activity proposed.

Assessment of air emissions arising from mining and extractive industries must be managed in accordance with the requirements of the SEPP (AQM) and the protocols and assessment criteria within the PEM.

The level of assessment required is dependent on:

- The scale or size of the operation
- The location of the site.

There are 3 levels of Assessment, level 1 being the most comprehensive.

For Level 1 or Level 2 assessment, a site representative baseline dataset of ambient suspended dust as PM10 may be required for the assessment, in conjunction with surface meteorological data. This dataset may be required to encompass an entire year of monitoring. Other constituents may require baseline monitoring such as RCS as $PM_{2.5}$ and metals within PM_{10}. These requirements for Level 1 and Level 2 assessment should be discussed with EPA prior to planning an assessment approach.

Irrespective of the level of assessment emissions must be controlled by the application of Best Practice and where Class 3 indicators are emitted these must be controlled to the Maximum Extent Achievable (MEA). In some situations extensive monitoring and modelling data may be required to assess the level of impact that emissions from the operations on site may have on the beneficial uses of the air environment defined in the policy.

For mines and quarries with less than 50,000 tonnes per year extraction, no modelling assessment of air quality is required but emissions on site must be controlled by the application of Best Practice site management.

SEPP (AQM) defines Best Practice as:

- "The best combination of eco-efficient techniques, methods, processes or technology used in an industry sector or activity that demonstrably minimises the environmental impact of a generator of emissions in that industry sector or activity."

SEPP (AQM) defines Maximum Extent Achievable:

- "A degree of reduction in the emission of wastes from a particular source that uses the most effective, practicable means to minimise the risk to human health from those emissions and is at least equivalent to or greater than that which can be achieved through application of best practice."

The following air quality indicators are defined for the purposes of the SEPP (AQM):

- Class 1 Indicators: Common or widely distributed air pollutants which are established as environmental indicators in the SEPP (AAQ) and may threaten the beneficial uses of both local and regional air environments;
- Class 2 Indicators: Hazardous substances that may threaten the beneficial uses of the air environment by virtue of their toxicity, bioaccumulation or odorous characteristics;
- Class 3 indicators: Extremely hazardous substances that are carcinogenic, mutagenic, teratogenic, highly toxic or highly persistent, and which may threaten the beneficial uses of the air environment;
- Unclassified Indicators: Indicators of local amenity and aesthetic enjoyment, namely odour and total suspended particles (nuisance dust).

PM_{10} is identified as a Class 1 indicator.

Respirable crystalline silica, $PM_{2.5}$ is identified as a Class 3 Indicator.

For all proposals requiring an air quality assessment the following indicators must be assessed:

- PM_{10} (Particles with mean aerodynamic diameter less than 10 microns)
- $PM_{2.5}$ (Particles with mean aerodynamic diameter less than 2.5 microns)
- Respirable crystalline silica (defined as the $PM_{2.5}$ fraction).

The EPA assessment criteria for maximum dust levels to be achieved at any sensitive receptor are as follows

- PM_{10} no greater than 60 μg/m^3 (24-hour average)
- $PM_{2.5}$ no greater than 36 μg/m^3 (24-hour average)
- RSC no greater than 3 μg/m^3 (annual)

7. *Dust Monitoring and Measurement*

Planning Workplace Personal Dust Monitoring

To ensure the integrity of the dust monitoring result there are many factors that must be taken in to consideration.

An assessment of workplace practices and the planning of monitoring to assess the risks associated with dust should be conducted by a qualified Occupational Hygienist.

The Occupational Hygienist should:

- Be suitably qualified in Occupational Hygiene;
- Have relevant quarry industry experience;
- Be a member of the AIOH.

The Occupational Hygienist should consult with the Quarry Manager and select persons to be monitored:

- Industry wide measurement and analysis of RCSD prove that in a properly managed quarry persons with the most potential exposure to RCSD are working in and around the fixed plant, being plant operators and maintenance/cleaning personnel.
- The standard of housekeeping applied on site generally determines the likelihood of other potential exposures, e.g. wearing boots into mobile equipment cabins and amenities blocks with dust or slurry carried in the boot treads.

When identifying potential or actual dust hazards present on site it useful to consider the following:

- Where materials are disturbed is a source of potential dust;
- Where materials are carried to becomes a source of potential dust;
- Has there been any previous monitoring and what were the results of that monitoring?
- What does a visual inspection of the site reveal?
- Are there particular crusher runs for specific aggregates that tend to generate more dust?
- Have there been hazard reports about dust exposure?
- Have you consulted with employees and contractors working around the plant/ site?

The Occupational Hygienist will arrange a suitable time with the Quarry Manager to conduct the monitoring. In doing so they should take into account:

- Weather conditions that are as reasonably representative as possible and not extreme, e.g. high rainfall, overly humid, stronger than normal winds mixed with higher than normal temperatures,
- Operating conditions, e.g. normal production out puts (TPH), typical crusher runs, not shut down days for maintenance unless planned to specifically monitor maintenance workers.

Once monitoring requirements are determined, the ongoing monitoring may be conducted to these requirements and standards by an experienced testing consultant with the analysis of collected samples by a laboratory with NATA accreditation for that particular analysis. Accumulated test data obtained may be periodically reviewed by the Occupational Hygienist with any exceedances of trigger levels actioned promptly.

The quarry manager should ensure on the day of monitoring:

- All existing dust controls are in place and operating as they normally do;
- Employees and Contractors have been informed of the monitoring program and have been briefed as to their role in the monitoring program;
- The Occupational Hygienist is fully inducted to the site and introduced to relevant employees.

Measuring Workplace Personal Exposure Levels

The following factors can potentially influence the monitoring result and the employee's level of exposure?

- Ambient condition, for example wet or dry;
- Air temperature, relative humidity, air movement, wind;
- Typical work hours, work location, work activity;
- Operating conditions, i.e. abnormal occurrences, dust spill;
- Influence of nearby activities, i.e. rock breaker, grading haul road;
- Respirator worn, dust suppression equipment operational, yes or no?

The Occupational Hygienist should complete a Field Monitoring Report for each person being monitored.

The Field Monitoring Report:

- Captures all factors that have the potential to influence results and exposures as listed above;
- Assists in making a risk based decision as to whether a Dust Control Sheet needs to be established;
- Records all information required to establish the Dust Management Data Base.

Refer:

- **Attachment A. Field Monitoring Report**
- **Attachment B. Dust Control Sheet**

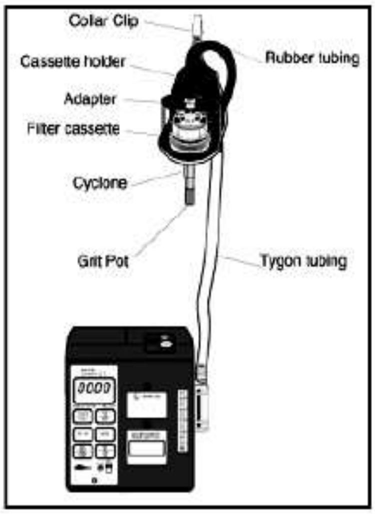
Personal exposure dust monitoring is conducted so as to identify persons who are potentially exposed to levels of dust equal to or above the TWA action levels.

The monitoring is generally conducted on an annual basis as well as on as required basis, e.g. on completion of the implementation of controls arising from a Dust Control Sheet or another initiative.

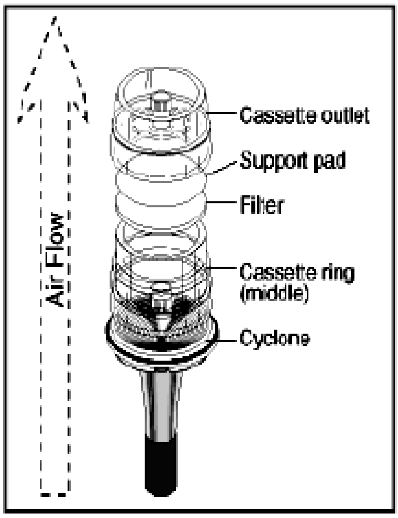
Daily exposure levels are measured by the use of a personal monitoring device that consists of the following:

- A pump (similar to fish tank aerator);
- A cyclone filter connected by a piece of piping.

The personal monitoring device will be fitted by the Occupational Hygienist and should be worn for 8 hours so as to ensure coverage of all activity in a typical shift.



Sampling Train



Filter assembly with Cyclone

Workplace Exposure Groups

Dust monitoring results can be categorised into Similar Exposure Groups.

Similar Exposure Groups list the various operational roles in a typical quarry and identify those roles by title and code, such as the example below:

- Q1 Driller;
- Q2 Face Loader Operator;
- Q3 Primary Haul Truck Operator;
- Q4 Crusher Operator;
- Q5 Sales Loader Operator;
- Q6 Bin Truck Operator;
- Up to Q21.

These titles and codes should be applied as relevant to the persons being monitored in Attachment A- Field Monitoring Report.

Recording dust monitoring results under Similar Exposure Groups allows easy identification of what operational roles are more likely to be exposed. Where the quarry owner has more than one site, the use of Similar Exposure Groups enables efficient benchmarking of the monitoring results.

Refer

- **Attachment C. Similar Exposure Groups**

The Occupational Hygienist should prepare a report based on the findings of the monitoring and forward that report to the Quarry Manager.

- The Field Monitoring report should signal whether or not a Dust Control Sheet is to be conducted;
- A Dust Control Sheet is required when monitoring results verify potential exposure is equal to or above the TWA Action Level.

Workplace Dust Management Data Base

On receipt of the report the Quarry Manager should:

- Enter all information from the Field Monitoring Reports into the Dust Management Data Base within the worksheet titled Field Monitoring Reports;
- Enter all results that verify personal exposure is equal to or above the TWA Action Levels into the worksheet titled Potential Exposures. This ensures that Dust Control Sheet can be tracked and measured for completion;
- Communicate the results of the report individually to any employee or contractor whose monitoring result was equal to or above the TWA Action Levels and inform them of the process in regards to conducting a Dust Control Sheet;
- Consult with the employee or contractor and come to agreement in regards to short term controls inclusive of Personal Protective Equipment to reduce that exposure as far as is reasonably practicable;
- Conduct a tool box talk with all site employees and contractors to communicate the results of monitoring.

Refer

- **Attachment D. Dust Management Data Base**

A Dust Control Sheet is required for all Potential Exposures and should:

- Be conducted in consultation with the employee whose exposure was monitored;
- List current control measures in place on day of monitoring;
- List possible reasons for monitoring result, e.g. abnormal operating conditions;
- List description of controls to be implemented inclusive of by who, by when, date of completion and date of review.

Environmental Dust Monitoring

Predicting the level of dust emission, deposition and carriage can be ambiguous because of the complex nature of quarry operations and the variable dispersion and dilution characteristics of airborne dust. Heavy reliance is therefore made on minimising dust emission through on site practices such as housekeeping and dust containment, e.g. screen covers and dust suppression, e.g. irrigation.

So as to identify dust deposition/carriage patterns, long-term and detailed dust monitoring may be required

Dust deposition/carriage patterns are influenced by operational activities and can be easily enhanced by wind or suppressed by rain. Understanding dust deposition/carriage patterns is vital to the sustainability of the business and the Extractive Industry as a whole, in particular when it comes to development applications.

A dust sensitive receptor (person or body potentially effected by dust emission from the site) may potentially be subject to other dust sources so it important to be able to differentiate dust from multiple sources, and to correlate this with site specific meteorological data, i.e. facts pertaining to the atmosphere, such as wind, temperature, air density, humidity and so forth and identification of mineralogy, e.g. where did the dust come from.

If a quarry is surrounded by other dust sources, directional dust monitoring would be beneficial as it highlights multiple sources. Where there is a single dust source, low levels of ambient dust, and few sensitive receptors a non-directional measurement of dust levels may be appropriate.

To achieve such environmental dust monitoring should be conducted in accordance with the site sepceific DEDJTR approved Work Plan and its accompanying Dust Management Plan. Ambient dust monitoring programs should be defined using a risk assessment of all activities onsite that may be sources of dust emissions. Those activities assessed as being of significant risk to the workforce or to off-site sensitive receivers are subject to monitoring so as to demonstrate that the associated dust management practices are being consistently and effectively applied. The assessment should be based on HB203:2006, Environmental risk management – Principles and process. The EPA has adopted this approach within their guidelines for using a risk management approach to assess compliance with licence conditions (EPA pub. 1321.2).

Records of the monitoring should be held in the site environmental register. An environmental engineer or scientist should be consulted to assist in ensuring the suitability of the monitoring process to be adopted.

Visual Dust Monitoring

Visual monitoring can make a valuable contribution to the dust control strategy on site as it provides a constant review of operational dust impacts. Visual monitoring requires a wind-speed gauge or a handheld anemometer.

Benefits of visual monitoring include:

- Quick and simple;
- Ability to respond to complaints promptly;
- Review of dust controls;
- Identifying baseline conditions for planning applications;
- Identifying the occurrence of acute dust events;
- Monitoring compliance with Work Authority;
- Demonstration of proactive approach and vigilance to authorities.

All details of visual monitoring should be recorded in a dust management diary or a dust management data base.

Passive Systems

Passive systems generally comprise deposit gauges of various types. Deposit gauges use a similar principle of collecting dust in an upturned vessel. This dust is then weighed. Deposit gauges measure dust deposition rate and involves the passive deposition and capture of dust within a funnel and bottle arrangement. The data is collected over monthly periods. The deposited dust samples may be subject to a semi-quantitative inspection for constituent proportions or analysed for insoluble, soluble, inorganic/organic or speciated metal content. A directional speciation may also be derived if the impinged samples are comparably analysed.

The PEM notes that dust deposition monitoring can be conducted at the site boundary for insoluble solids for comparison with an evidence based amenity criteria of 4 g/m^2/month or no more than 2 g/m^2/month above background. Compliance with this monitoring criterion represents a cost effective method of demonstrating the effective and consistent application of dust management practices. The PEM recommends this monitoring for most extractive industry operations. Dust deposition monitoring and analysis is undertaken in accordance with AS/NZS 3580.10.1 and the directional distribution in determined in accordance with AS/NZS 3580.10.2. The gauges may be combined into a single instrument illustrated in the following photograph.

High Volume Samplers

High Volume Samplers (HVS) involve the collection of dust through a filter and determine average dust concentrations. The data is generally collected over a 24 hour period. This method enables determination of dust levels from a particular event or source. The HVS is typically used to formally assess compliance with the PEM design criterion for PM_{10} of 60 $\mu g/m^3$ expressed as a 24 hour average at the site boundary of quarries initially subject to either a Level 1 or Level 2 assessment. The criterion is consistent with the scheduled monitoring intervention level in the SEPP-AQM and the monitoring is conducted to AS/NZS 3580.1.1.

HVS configured to measure PM_{10} is pictured below.

Note:

A HVS may also be configured to monitor $PM_{2.5}$ and the filter may be analysed for RCS.

Continuous Particle Monitors

Continuous Particle Monitors determine real-time (continuous) dust concentrations and enables determination of short term dust events and dust levels from a particular event or source.

The PEM notes that continuous monitoring for PM_{10} and $PM_{2.5}$ may be required for those extractive industries initially subject to a Level 1 assessment. Such monitoring is required to formally demonstrate compliance and should be conducted to an approved Australian Standard e.g. with a Tapered Element Oscillating Microbalance (TEOM), partisol dichotomous or a beta attenuation monitor.

However, the PEM recommends that the option for real-time monitoring for reactive dust management be included in the dust management plan for those quarries that have been initially subject to either a Level 1 or Level 2 assessment. Such an option may be a part of a suite of enhanced dust control practices to be selected from if triggered (for example) by compliance monitoring at site boundary exceeding criteria or community complaint, and can be used to first identify and then manage sources of dust.

This may be conducted with a hand-held near-reference level device for continuously monitoring PM_{10} concentrations that can provide feedback to management for the control of individual clusters of dust generating activities within the site. A short-term averaging period of 15 minutes may be adopted with a representative intervention level of, say, 90 µg/m^3. Management of peak recorded dust levels below this goal with remedial actions as required will likely enable the 24 hour average scheduled monitoring intervention level for PM_{10} (60 µg/m^3) to be complied with at the site boundary. Examples of such hand-held particulate monitoring devices are the DustTrak, Osiris or Grimm devices that may be fitted with a cut-out device on the inlet to measure the PM_{10} subset of totally suspended dust.

8. *Dust Control*

Controlling Dust Hazards

It is a legislative requirement that controlling workplace dust hazards must be conducted:

- In alignment with the Hierarchy of Controls. This ensures the focus is on both a Safe Site and a Safe Workforce;
- In consultation with those employees and contractors whose health and safety may be effected by the dust hazard;
- To ensure exposure levels are below the TWL WES as far as is reasonably practicable.

Reasonably practicable is defined that regard must be had to the following matters in determining what is (or was at a particular time) reasonably practicable in relation to ensuring health and safety:

a) The likelihood of the hazard or risk concerned eventuating;
b) The degree of harm that would result if the hazard or risk eventuated;
c) What the person concerned knows, or ought reasonably to know, about the hazard or risk and any ways of eliminating or reducing the hazard or risk;
d) The availability and suitability of ways to eliminate or reduce the hazard or risk;
e) The cost of eliminating or reducing the hazard or risk.

The Hierarchy of controls ensures focus on both a Safe Site and a Safe Workforce and assists in deeming what is reasonably practicable.

Hierarchy of Controls	
Elimination	**Safe Site**
Substitution	
Isolation	
Engineering	
Administration	Safe Workforce
PPE	

Source rock cannot be eliminated or substituted but dust exposure can be controlled effectively with a mixture of Engineering/Isolation, Administration and PPE controls as listed in the below table.

Engineering & Isolation	Administration	Personal Protective Equipment
• Dust extraction systems • Cabin filters • De Contamination Booth • Climate control cabins in plant • Enclosed hoods • Irrigation • Conveyor covers & skirts • Sealed roads/carparks • Screen covers • Belt scrapers • Reduce fall height to stockpile • Convey via transfer chute • Closed window & Air-conditioners • Wheel wash facility • Road sweeper • Road speed humps • Road truck bodies covered • Water truck & dedicated driver • Water cannon on all shots • Product balance, too dry, too wet • Hopper design to ensure a good fit with trucks • Wind shields for hoppers • Management of stockpiles, haul roads and quarry faces • Windbreaks in specific areas • Rehabilitation &revegetation processes • Dust suppression agents/additives	• Housekeeping practices • Housekeeping inspections • Control of movement in & out of workstations • Training and Education • Risk Assessments • Health surveillance • Safe work procedures • Signage • Separate shoes/slipper in mobile equipment cabins and offices • Vacuum cabs, (HEPA) not broom or compressed air • Employee rotation to reduce exposure times • Reduced traffic speed and movements • Vehicle movements restricted to defined areas • Dust Management Plan audits Reporting of duct incidents • Observation of weather forecasts • Ongoing visual monitoring • Monitoring community complaints	• Full-Face Respirators • Air Hoods • Dust Masks • Overalls • Gloves • Glasses • Gum boots (wet concrete) • Used and fitted correctly • Kept clean and hygienic • Personal, not shared • Maintained routinely • Stored appropriately

Other controls specific to areas of plant where dust is generated are listed in the table below which was published in Environment Australia's document "Best Practice Environmental Mining – Dust Control"

Plant	Controls
Crushers	• Enclosures/barriers, fog sprays.
Screens	• Screen covers, fog sprays.
Dump hoppers/boots	• Three-sided, roofed sheds for truck dumping, with low volume high pressure adjustable water atomising sprays actuated at the time of dumping. • If hoppers are open, fog sprays at a higher level coupled with atomisers at dumping level will increase fall out rates and prevent dust surges due to the up-flow of displaced air. Wind breaks are also recommended.
Conveyors	• Side wind guards, covers on high and steep conveyors, belt cleaning, dust collection systems, clean-up program, and maintenance of enclosures. • Sprays at transfer points to wet dust and particles and prevent liberation, mist/fog systems to increase fall out rates. • Belt cleaning sprays in opposite direction to travel.
Discharge Stockpiles	• Minimising discharge heights and conveyor speeds, enclosure of stockpile, atomising water sprays to wet falling stream.
Storage Stockpiles	• Fixed water cannons, or vehicular based sprays for small stockpiles. • Drainage often required at stockpile base and foundations.

Fog Cannon

RST Dust Containment Agent

Containment of dust, controlling at the source

Initially controls can be short or long term:

- Short-term controls are generally **Safe Workforce Controls**. These controls may not be adequate or sustainable to lower the risk over a long-term duration.
- Long-term **Safe Site Controls** may take longer to resource and establish. Short-term **Safe Workforce Controls** may allow the safe continuation of work whilst long-term **Safe Site Controls** are being implemented.
- Where short-term controls cannot reduce the risk to an acceptable level, the exposure of people to the activity or environment must cease until long-term controls are implemented and the risk has been reduced to an acceptable level.

Details of all controls, both short and long term and actions associated with implementing those controls should be entered the Dust Control Sheet and implemented as per the agreed time frames.

The Quarry Manager should track progress of the Dust Control Sheet's implementation.

Bends in Haul road to ensure reduction of speed

Review of Dust Hazard Controls

On completion of the implementation of the controls it is imperative that they are reviewed in consultation with the relevant employees and contractors to ensure that the controls are effective by:

- Providing the protection that they are intended to;
- Being practical to use, e.g. PPE fit and comfort;
- Not causing any operational issue, e.g. material blockages, out of specification materials.

Scheduled routine workplace inspections should include the monitoring of controls to ensure they remain effective and are being maintained in the appropriate manner.

Re-monitoring of potential exposures should be conducted to verify the suitability of the controls in reducing dust exposure levels to well below the action limit/trigger value.

The Dust Management Plan Self-Assessment Checklist should be used on an annual basis to ensure the 4 steps have been completed in the required manner and to seek continual improvement on the Dust Management Plan.

Refer

- **Attachment E. Dust Control Self-Assessment Checklist**

Personal Protective Equipment

Respirator Standards

Respirators and filters must meet the requirements of Australian Standard 1716: Respiratory Protective Devices. AS 1716 categorises particulate filters into three classes being P1, P2 and P3:

- CLASS (P1) Intended for use against mechanically generated particulates, (for example, silica, asbestos).
- CLASS (P2) Intended for use against both mechanically and thermally generated particulates, (for example, metal fumes).
- CLASS (P3) Intended for use against all particulates including highly toxic materials, (for example, beryllium). Class P3 requires a full face mask.

The Construction Materials Industry (CMPA & CCAA) recommends P2 as the minimum class of filter for respiratory protection against Respirable Crystalline Silica Dust.

Refer to Protection Factor Table for more detail.

The AS number, being 1716 and the filter class number being P2 should be marked on the respirator filter. Filters for powered air-purifying respirators are specially designed and marked with the prefix PAPR.

Disposable P2

Half Face Respirator

Full Face Respirator

Powered Air Purifying Respirator (PAPR)

A Powered Air Purifying Respirator (PAPR) consists of a helmet and face shield. A fan forces air through a filter in the back of the helmet and around the face. The PAPR puts a slight positive pressure in the face piece so contaminated air cannot get in even if there is a leak or an inadequate seal, clean air is blown out instead. The PAPR can be more comfortable than having a rubber mask sealed against the skin and is effective for people with facial hair.

Protection Factor

Protection factor is the level of protection required of the respirator for the dust concentration in the air.

Respiratory Protection Factor Table		
RCSD levels (mg/m^3)	Protection Factor	Type of respirator required
Less than 0.05 mg/m^3	NIL	• None required. If they are requested, P2 disposable masks could be used
From 0.05 up to 0.1 mg/m^3	10	• P2 disposable mask
From 0.1 up to 0.2 mg/m^3	10	• Half-face rubber mask with P2 or P3 replaceable filters • PAPR respirator with replaceable P1 filter
Above 0.2 mg/m^3	50	• Full Face Mask with P2 filter • PAPR respirator with a P2 Filter

Selection of Respiratory Protection Devices

Points to consider when selecting which type of respirator to use:

- What other PPE that will needed to be worn, such as ear muffs, hard hat and goggles, and how these will affect the respirator fit;
- The task to be carried out, the workload, the possibility of heat stress and the need for mobility;
- Any facial hair or other facial features that may influence the respirator fit;
- The airborne concentration of dust in the area of working.

Fit, Test, Care & Maintenance of Respirators

Disposable Respirators:

- Adjust strap and nose clip to suit;
- Completely cover the mask with both hands and inhale sharply. The respirator should sink onto the face;
- If a stream of air around the edges is felt (particularly at the bridge of the nose) then there is a poor seal;
- Adjust strap and nose clip and re-test;
- Used respirators must be disposed of into a bin.

Non-disposable Respirators:

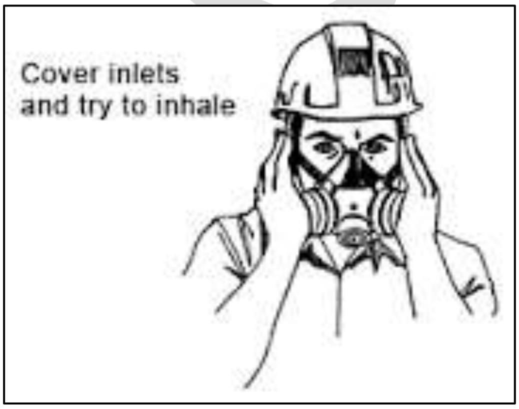
- Cover the inlets of the filters and inhale gently so that the face piece collapses slightly;
- Hold breath for about 10 seconds, if the face piece stays slightly collapsed then there is a good seal;
- Cover outlet valve and attempt to exhale;
- After use, these masks need to be washed in warm water and detergent/disinfectant, rinsed and stored in plastic bag/box in a safety equipment cabinet.

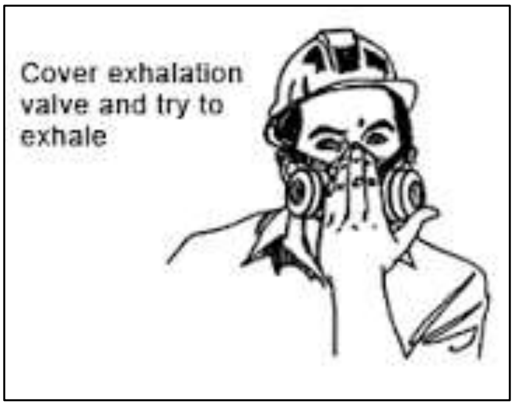
Note:

All respirator filters will eventually become ineffective and must be replaced. Dust filters may actually increase in efficiency (as the filter blocks up) but their resistance to air flow also increases gradually with use, making them harder to breathe through.

Reasons for poor fitting respirators:

- Beards, moustaches, side burns, 1-7 day growth;
- Poor or damaged seal;
- Incorrectly fitted;
- Strapping adjustment;
- Other PPE intruding;
- Sweaty, wet, dirty or dusted.





Other PPE Requirements

Overalls should be worn whilst working in dusty environments and then removed so that dust is not carried into the operator cabin, lunchroom, office, car or home:

- Remove overalls whilest still wearing a respirator;
- Do not shake out dusty overalls;
- Do not take dusty overalls home;
- Arrange contract supply and cleaning;
- Place in the bin provided for cleaning;
- Replace on a daily basis.

Gloves:

- Riggers gloves worn when carrying out maintenance tasks;
- Rubber gloves worn whenever you handle or may come in direct contact with cement dust or wet concrete.

Gum Boots/ Rubber Boots:

- When working in wet concrete or cement powder.

Work Boots & Shoes:

- Work boots worn outside should not to be worn in mobile equipment, internal workstations and office or amenities;
- Slip on shoes should be provided for this purpose.

Safety Glasses:

- Safety glasses must be worn at all times while in the vicinity of the processing plant to avoid any airborne particulates entering and damaging eyes;
- Best practice quarries mandate use across whole sites excluding administration and amenities areas.

Storage and care of PPE:

- PPE must be stored correctly so that it does not become damaged, worn or contaminated.
- Disposable dust masks will be stocked in appropriate storage cabinets around the work site.
- PAPR should be stored in the site's safety equipment cabinet and cleaned after every use and the batteries kept charged.
- Safety glasses should kept in container so as to avoid the lenses getting scratched.

Wherever PPE is to be worn the relevant sign post should be installed.

9. *Dust Management Training*

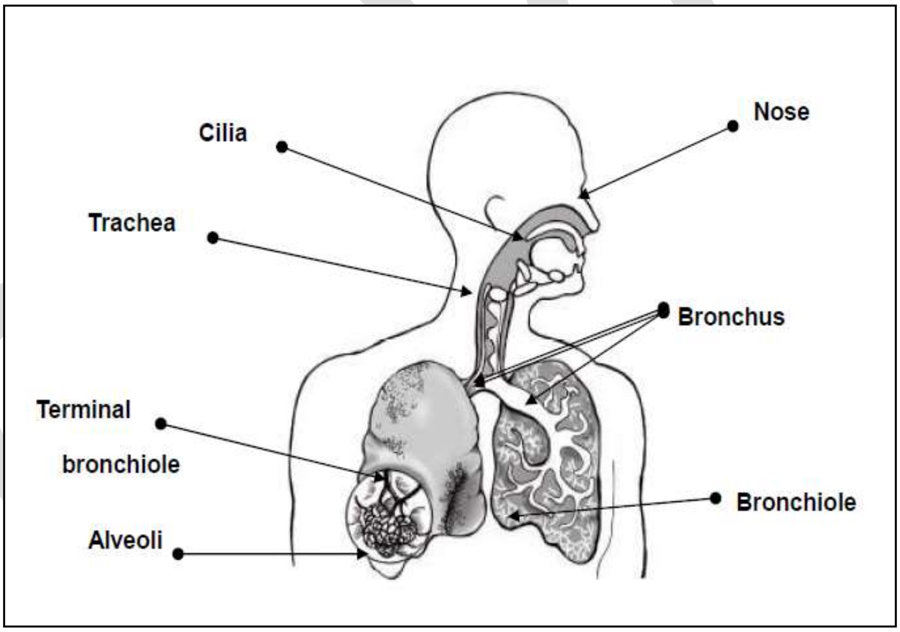
Employees potentially exposed to dust hazards should be provided with training that covers the following subjects:

- The sources of dust generation in the workplace;
- The hazards and health effects associated with working with dust;
- The health surveillance regime;
- How to measure dust concentrations and read dust reports;
- How to control dust exposure following the hierarchy of controls;
- Why there is a requirement to wear respiratory protection at work;
- How to use and care for the respiratory protection provided;
- What other PPE is provided for protection against dust in the workplace.

An assessment should be conducted on completion of the training and records of that assessment and training content maintained within the employee's employment file.

10. *Health Management*

The Respiratory System



The Respiratory system is made up of the nose, throat and lungs.

It takes in 5 litres per minute of air while the individual is at rest, and up to 20 litres per minute while working or exercising.

The lungs are protected by a series of defence mechanisms in different regions of the respiratory tract.

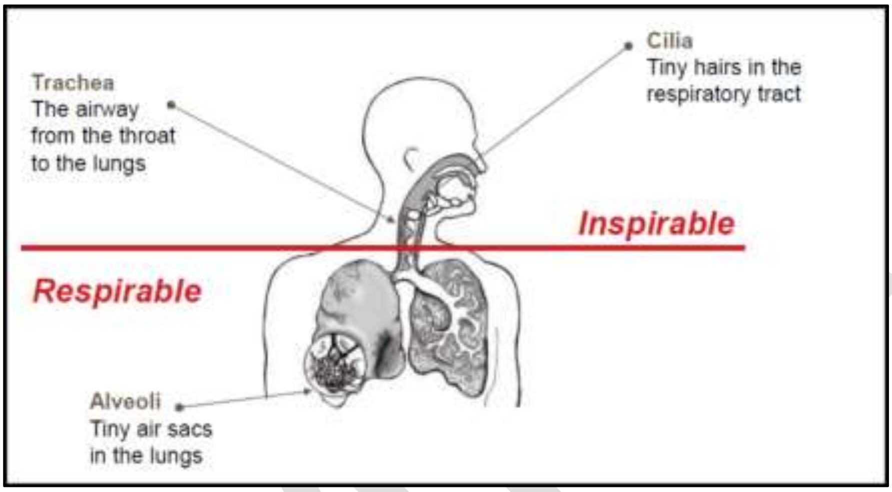
When a person breathes in, particles suspended in the air enter the nose, but not all of them reach the lungs. The nose is an efficient filter. Most large particles are stopped in it, until they are removed mechanically by blowing the nose or sneezing.

Some of the smaller particles succeed in passing through the nose to reach the windpipe and the dividing air tubes that lead to the lungs.

These tubes are called bronchi and bronchioles. All of these airways are lined by cells. The mucus they produce catches most of the dust particles. Tiny hairs called cilia, covering the walls of the air tubes, move the mucus upward and out into the throat, where it is either coughed up and spat out, or swallowed.

The air reaches the tiny air sacs (alveoli) in the inner part of the lungs with any dust particles that avoided the defences in the nose and airways. The air sacs are very important because through them, the body receives oxygen and releases carbon dioxide.

Dust that reaches the sacs and the lower part of the airways where there are no cilia is attacked by special cells called macrophages. These are extremely important for the defence of the lungs. They keep the air sacs clean. Macrophages virtually swallow the particles. Then the macrophages, in a way which is not well understood, reach the part of the airways that is covered by cilia. The wavelike motions of the cilia move the macrophages which contain dust to the throat, where they are spat out or swallowed.



The way the respiratory system responds to inhaled particles depends, to a great extent, on where the particle settles. For example, irritant dust that settles in the nose may lead to rhinitis, an inflammation of the mucous membrane. If the particle attacks the larger air passages, inflammation of the trachea (tracheitis) or the bronchi (bronchitis) may be seen.

The most significant reactions of the lung occur in the deepest parts of this organ. Particles that evade elimination in the nose or throat tend to settle in the sacs or close to the end of the airways. But if the amount of dust is large, the macrophage system may fail. Dust particles and dust-containing macrophages collect in the lung tissues, causing injury to the lungs.

The amount of dust and the kinds of particles involved influence how serious the lung injury will be.

For example, after the macrophages swallow silica particles, they die and give off toxic substances. These substances cause fibrous or scar tissue to form. This tissue is the body's normal way of repairing itself. However, in the case of crystalline silica so much fibrous tissue and scarring cause the lung function to be impaired. The general name for this condition for fibrous tissue formation and scarring is fibrosis. The particles which cause fibrosis or scarring are called fibrogenic. When fibrosis is caused by crystalline silica, the condition is called silicosis.

Potential Health Issues Associated with Dust Exposure

Irritation:

Dust can irritate the eyes, skin, nose and upper throat, leading to watery eyes, itchy nose and throat, dry cough and rough skin. Excessive levels may scratch the eye lens leading to vision impairment.

Dermatitis:

Repeated heavy contact to the skin may cause drying of the skin and can result in dermatitis, an allergic reaction that is manifested by one or more lines of red, swollen, blistered skin that may itch or seep.

Bronchitis:

Excessive exposure to dust can cause the bronchioles to become inflamed due to constant irritation by the dust. This can lead to breathing difficulties.

Silicosis:

Silicosis is a disease that occurs as a result the body's own defence mechanisms trying to remove the crystalline silica from deep in the lungs. It causes irreversible scaring, known as fibrosis. As more fibrosis occurs, gas exchange through the lungs is reduced which makes breathing more difficult. Silicosis will also increase the risk of lung infection.

Silicosis is an irreversible and progressive condition. Early silicosis may have no untoward effects. However, severe forms can result in poor gas exchange, difficulty in breathing and death. Evidence suggests crystalline silica interacts with other respiratory hazards, like tobacco smoke, to cause airway diseases.

Worker's compensation statistics indicate there are very few new cases of silicosis arising from Australian industries

Carcinogenicity

Several work-related exposure studies indicate the crystalline silica is a potential human carcinogen, but provide little support that work-related silica exposure is a direct acting cancer initiator.

However, there is strong evidence people with many forms of pulmonary fibrosis, including silicosis, have a major risk of developing lung cancer. A number of epidemiologic studies from around the world have shown an increased risk for lung cancer among workers exposed to silica. In 1997, the International Agency for Research on Cancer (IARC) made the following evaluation: crystalline silica inhaled in the form of quartz or cristobalite from work-related sources is carcinogenic to humans (Group 1). IARC also noted that not all studies were consistent, and the carcinogenic potential of silica might be affected by the physical properties of the silica particles.

Safe Work Australia has not deemed RCSD as a carcinogen.

Health Surveillance

The Australian Institute of Occupational Hygienists (AIOH) recommends “where there is a continued likelihood of 50 per cent of the exposure standard being exceeded, exposure monitoring and health surveillance should apply.

Employees exposed to levels of Respirable Crystalline Silica Dust equal to or greater than the TWL action level should be subject to a health surveillance regime.

The health surveillance regime should begin at the pre-employment stage, be ongoing at required intervals during the course of employment and conclude on termination of employment.

A medical examination should be conducted annually and will include:

- Work history;
- Medical history;
- Physical examination;
- Lung function investigation consisting of standardised respiratory function tests e.g. a spirometry test and if necessary a chest X-ray.

A spirometry test assesses how well the person is actually breathing. The person breathes into the mouthpiece of a spirometer to measure the volume of air that can be inhaled and exhale over a period of time. This can be done at a doctor’s surgery or at a respiratory clinic at a local hospital.

Spirometry Testing

The CMPA recommends that quarry operators liaise with their local General Practitioner so as to determine the frequency and content of a health surveillance regime.

The following Safe Work Australia documents may be useful resources for the General Practitioner in making a determination:

- Baseline Health Monitoring before starting work in a Crystalline Silica Process.
- Health monitoring for exposure to hazardous chemicals guide for persons conducting a business or undertaking – 2013.

Both documents are available at Safe Work Australia’s website.

http://www.safeworkaustralia.gov.au/sites/SWA

11. *Dust Management Plan*

CMPA members can use the Dust Control Self-Assessment Checklist as the basis of their Workplace Dust Management Plan.

Refer Attachment E. Attachment E Dust Control Self-Assessment Checklist

Environmental dust monitoring and associated initiatives should be conducted in accordance with the site sepcific DEDJTR approved Work Plan and its accompanying Environmental Dust Management Plan.

The Dust Control Self-Assessment Checklist should be used on an annual basis to ensure actions are completed in a timely, effective and sustainable manner and can be included as an attachment to the Workplace Dust Management Plan.

The self-assessment process is based on the standard risk management process of identify, assess, control and review as listed below

- **Step 1)** Identify potential and or actual dust hazards present on site and select persons for monitoring;
- **Step 2)** Conduct dust monitoring and identify persons who are potentially exposed to levels of dust equal to or above the action limits;
- **Step 3)** Control the risk associated with those dust hazards as far as is reasonably practicable;
- **Step 4)** Review the controls to ensure their effectiveness and monitor those controls to ensure they are maintained.

12. *Photo Gallery*

Water Truck and Designated Driver

Screen Washing

Conveyor Irrigation

Dowsing Raw and Additive Materials

Washed Aggregates

Dust Control Water Pumps

Enclosed Screen House

Enclosed Conveyors

Enclosed Conveyors

Enclosed Crusher

Enclosed Crusher

Enclosed Feeder

Enclosed Screen

Enclosed Sieve Shaker

Enclosed Screen

Screen Flaps

Conveyor Curtains

Conveyor Curtains

Filtered Room Pressurised Air Pump

De Contamination Booth for Clothing

Portable Extraction Fan

Primary Crusher Extraction Fan and Duct

Sediment Pit

Traffic Management

13. *Attachments to this Document*

Attachment A. Field Monitoring Report

Attachment B. Dust Control Sheet

Attachment C. Similar Exposure Groups

Attachment D. Dust Management Data Base *(available from CMPA)*

Attachment E Dust Control Self-Assessment Checklist

Attachment F Guidance Materials for the Sampling, Monitoring and Analysis of Dust

Attachment A. Field Monitoring Report

1. General Information (may be completed once for the day)		
Site:	Survey Date:	
City:	State:	
Hygienist (Name):	Consultant Company:	
Consultant's Project Number:	Typical Work Hours Per Week on Site:	
Ambient Conditions: Dry / Wet	Air Temperature (Celsius):	Relative Humidity (%):
Air Movement (kph):		
Production Rate (Units/ t/p/h etc.) (or other relevant information):		

2. Worker Information (per each sample)	
Worker Name:	Job Title:
Work Area:	Job/Task:
S.E.G	Major Work Activities:
Description of Task(s) Being Performed:	
Respirator Task? Yes / No	Worker Wearing Respirator? No / Full Shift / Partial Shift
Respirator Type:	
Dust Suppression (e.g. water sprays, dust extraction, A/C in cabin, etc.):	
Operating Conditions (abnormal occurrences, e.g., sweeping up dust influence of nearby activities/processes e.g. stockpiles/road traffic): (ask worker)	

3. Sampling Data (per each sample)	
Sample Number:	Rotameter Number:
Pump Number:	Time Started:
Initial Flow Rate L/min:	Time Finished:
Final Flow Rate L/min:	Sampling Time (min):
Average Flow Rate:	Sampling Volume (l):

4. Laboratory Analysis (per each sample)	
Gravimetric Analysis Result (mg):	Silica Analysis Result (mg):
Respirable Particulate Concentration (mg/m³):	
Respirable Quartz Concentration (mg/m³): (personal exposure)	% Quartz:

5. Risk Control Sheet (RCS) – required when personal exposure is equal to or above the TWA amended action level of 0.05 mg/m³	***Required - Yes***	***Not Required - No***

Attachment B. Dust Control Sheet

To be completed for each monitoring sample result = to or > than the TWA amended action level or trigger value			
Site	Date of this RCS	Name of person who was monitored	
Person(s) Completing the RCS			
Similar Exposure Group Title and Number		Work area / location within site	
Sample Number	Monitoring Result	Action level or trigger value	Monitoring Date
Job *(list dusty tasks/activities)*	Current control measures in place on day of monitoring		
List possible reasons for monitoring result *(e.g. weather, breakdowns, plant shutdowns, etc, which could make the job more dusty)*			

Description of controls to be implemented:	By Whom:	By When:	Date Completed:	Date Reviewed:

Attachment C. Similar Exposure Groups

SEG Code	SEG Titles	SEG Description
Q1	Driller	Drill operator drilling benches, etc. for blasting. Most likely a contractor and only on site from time to time to conduct a drilling campaign.
Q2	Face Loader Operator	Loaders working at quarry face, loading blasted rock into haul trucks.
Q3	Primary Haul Truck Operator	Truck carting blasted rock from quarry face to the primary crusher or ROM pad.
Q4	Crusher Operator	Operator responsible for the operation on the crushing circuit.
Q5	Sales Loader Operator	Loader working in stockpile area, loading product into trucks for transport to client.
Q6	Bin Truck Operator	Truck carting product from crushing circuit to the sales stockpiles.
Q7	Quarry Supervisor	Supervisor or foreman or the quarry. At smaller sites, may also be the quarry manager.
Q8	Excavator (rock pick) Operator	Excavator working at face, loading blasted rock into haul trucks or breaking over size rock to as suitable size.
Q9	Pug Mill Operator	Operator responsible for the operation of the Pug Mill circuit.
Q10	Quality Technician	Sampler and or laboratory technician. Prepares and processes samples from the crushing circuit for QA.
Q11	Truck Driver (road transport)	Truck operator transporting product offsite to clients.
Q12	Quarry Cleaners (dust and other build up)	Removing re settled dust from around plant and equipment.
Q13	Maintenance Workers	Quarry maintenance operators. May include mechanical / electrical fitters and boilermakers.
Q14	Dredge Operator	Operating the dredge in a sand plant that extracts sand from the pit and pumps to the washing plant.
Q15	Water Truck	Driving water truck and operating water cannon to suppress dust around the site.
Q16	Weighbridge Person	Administering weighbridge duties.
Q17	Excavator Operator, (not Rock Pick)	Excavator operator in involved in quarry stripping, moving or loading sand, Not hard rock or rock pick work.
Q18	Dozer Operator	Operating dozer to push up sand, other stockpiles or strip overburden prior to drill and blast
Q19	Grader Operator	Grading roads around site.
Q20	Scraper Operator	Operating scraper to deliver sand to feeder or strip overburden.
Q21	Front End Loader Operator	Loader loading product into feeder bins.

NOTE:
In some instances an operator will fulfil more than one of the SEG descriptions above.
Where completing the Field Monitoring Report Form the SEG Code for the operator's **primary** activity shall be listed first. SEG Codes for **secondary** activities and duties shall follow and be in brackets.

Attachment E Dust Control Self-Assessment Checklist

This Dust Control Self-Assessment Checklist can be used as an audit tool to ensure the 4 steps have been completed in the required manner and becomes the basis of the Workplace Dust Management Plan.

Site -	Date -	Manager -

Step 1) Identify potential and or actual dust hazards present on site and select persons for monitoring	Actions Required	Who	When
Does the site have a current petrographic analysis that identifies rock source and verifies quartz content?			
Has the Occupational Hygienist consulted with the Quarry Manager to select persons to be monitored?			
Step 2) Conduct dust monitoring and identify persons who are potentially exposed to levels of dust equal to or above the action limits			
Have all employees and contractors been informed of the monitoring program and have they been briefed as to their role in the monitoring program?			
Is personal exposure dust monitoring being conducted on an annual basis or as required basis and on completion of the implementation of controls arising from a Dust Control Sheet?			
Step 3) Control the risk associated with those dust hazards as far as is reasonably practicable			
Has all information from the Field Monitoring Reports been entered into the Workplace Dust Management Data Base? (Larger or multiple site quarries)			
Have all results that verify potential personal exposure been entered into the worksheet within the Dust Management- Potential Exposures?			
Has the quarry manager communicated the results of the report individually to any employee or contractor whose monitoring result signalled potential exposure and come to agreement in regards to short term controls?			

Has the quarry manager conducted a tool box talk with all site employees and contractors to communicate the results of monitoring?			
Has a Dust Control Sheet been established and implemented for all Potential Exposures?			
Was the Dust Control Sheet established and implemented in consultation with the person incurring the Potential Exposure?			
Have controls been established in alignment with the Hierarchy of Controls?			
Are Dust Control Sheets being tracked for implementation progress?			
Have all new employees or contractors who are potentially exposed to dust in the workplace undertaken an initial induction?			
Have all existing employees and contractors who are potentially exposed to dust in the workplace undertaken dust management training on a two yearly basis?			
Step 4) Review the controls to ensure their effectiveness and monitor those controls to ensure they are maintained			
Have the controls been reviewed in consultation with the relevant employees and contractors to ensure they are effective?			
Have routine workplace inspections been scheduled and conducted to monitor controls to ensure they remain effective and maintained in the appropriate manner?			
Are all employees and contractors who are potentially exposed to dust in the workplace at levels equal to or above the TWA amended action level for RCSD undertaking health surveillance?			

Attachment F Guidance Materials for the Sampling, Monitoring and Analysis of Dust

Australian Standards required to be adopted for workplace monitoring, specifically:

- AS2985-2009 Methods for sampling and gravimetric determination of respirable dust
- AS3640-2009 Workplace atmospheres – method for sampling and gravimetric determination of inhalable dust

EPA Victoria publication 440.1 of 2002:

- A Guide to Sampling and Analysis of Air Emissions and Air Quality, December 2002

Australian Standard for location of monitoring sites:

- AS/NZS 3580.1.1 Methods for sampling and analysis of ambient air, Guide to siting air monitoring equipment

Australian Standards for dust deposition and directional dirtiness monitoring:

- AS/NZS 3580.10.1 Methods for sampling and analysis of ambient air, Method 10.1: Determination of particulate matter—Deposited matter—Gravimetric method
- AS/NZS 3580.10.2 Methods for sampling and analysis of ambient air Method 10.2: Determination of particulate matter—Impinged matter—Gravimetric method

Australian Standard for high volume air sampling for PM10.

- AS/NZS 3580.1.1 Methods for sampling and analysis of ambient air Method 9.6: Determination of suspended particulate matter—PM10 high volume sampler with size selective inlet—Gravimetric method

Further standard methods for the monitoring of totally suspected, inhalable/inspirable or respirable fractions of dust in the ambient environment are presented in the AS/NZS 3580 series, e.g. with partisol, TEOM or Beta attenuation monitors for PM10 or PM2.5; or with high volume samplers with different size-selective heads for PM2.5 or suspended dust. Filters are subject to gravimetric assessment and may also be subject to analysis for RCS, particle size distribution and metals.

Notes

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