Department of Natural Resources, Mines and Energy

Recognised Standard 20

Dust control in surface mines

November 2019

Coal Mining Safety and Health Act 1999

Queensland Government

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This publication has been compiled by the Mines Inspectorate, Mines Safety and Health, Department of Natural Resources, Mines and Energy.

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Recognised standards

This document is issued in accordance with PART 5—RECOGNISED STANDARDS and Section 37(3) of the Coal Mining Safety and Health Act 1999.

PART 5 - RECOGNISED STANDARDS

71 Purpose of recognised standards

A standard may be made for safety and health (a "recognised standard") stating ways to achieve an acceptable level of risk to persons arising out of coal mining operations.

72 Recognised standards

(1) The Minister may make recognised standards.
(2) The Minister must notify the making of a recognised standard by gazette notice.
(3) The chief executive must keep a copy of each recognised standard and any document applied, adopted or incorporated by the recognised standard available for inspection, without charge, during normal business hours at each department office dealing with safety and health.
(4) The chief executive, on payment by a person of a reasonable fee decided by the chief executive, must give a copy of a recognised standard to the person.

73 Use of recognised standards in proceedings

A recognised standard is admissible in evidence in a proceeding if—
(a) the proceeding relates to a contravention of a safety and health obligation imposed on a person under part 3; and
(b) it is claimed that the person contravened the obligation by failing to achieve an acceptable level of risk; and
(c) the recognised standard is about achieving an acceptable level of risk.

PART 3- SAFETY AND HEALTH OBLIGATION

37. How obligation can be discharged if regulation or recognised standard made

37(3) …. if a recognised standard states a way or ways of achieving an acceptable level of risk, a person discharges the person's safety and health obligation in relation to the risk only by—
(a) adopting and following a stated way; or
(b) adopting and following another way that achieves a level of risk that is equal to or better than the acceptable level."

Where a part of a recognised standard or other normative document referred to therein conflicts with the *Coal Mining Safety and Health Act 1999* or the *Coal Mining Safety and Health Regulation 2017*, the Act or Regulation takes precedence.

This recognised standard is issued under the authority of the Minister for Natural Resources, Mines and Energy.

[Gazetted 29 November 2019]

Contents

1 Purpose

The purpose of this recognised standard is to state ways for the site senior executive (SSE) to meet their safety and health obligations, and develop their mine's safety and health management system (SHMS) for the control of dust (respirable and inhalable) at a surface coal mine.

2 Scope

This recognised standard applies to all activities at a surface coal mine.

Meaning of a surface mine is:
(a) a coal mine other than an underground coal mine
(b) the surface operations of an underground coal mine.

Example of surface operations of an underground mine:
1. a coal mine consists of an underground coal mine and related overlaying surface facilities
2. a coal mine consists of an underground coal mine and related overlaying surface facilities for mining coal seam gas. The facilities are surface operations for the underground mine.

This recognised standard also applies to exploration activities that occur on a coal mining lease.

3 Application framework

This recognised standard has been developed to help the mine SSE identify the key operational areas of airborne dust generation, as well as to assist with risk management of exposure to airborne dust. This also includes validation of the effectiveness of the controls, and implementation of corrective actions if controls have been found to be ineffective. The cumulative exposure to airborne dust is a significant health risk and as such the SSE shall consider developing a Dust Management Plan (DMP) similar to principal hazard management plans.

This recognised standard needs to be applied in conjunction with *Recognised Standard 14: Monitoring respirable dust in coal mines*, and *Recognised Standard 2: Control of risk management practices*. Recognised Standard 20 (RS20) provides specific information on compliance with the requirements of the Queensland Coal Mining Safety & Health Regulation 2017 (CMSHR), Section 89 (Dust)—including Section 89(1) on exposure to respirable dust being kept at an acceptable level.

As a minimum, the mine's SHMS shall consider dust sources and control measures including but not limited to the following areas of surface coal mines:

- exploration drilling
- topsoil stripping, removal and long term storage of topsoil
- production drilling
- blast crew operations
- pre-strip mining operations
- dragline operations
- dozer operations
- coal mining operations
- other pit activities (including pit dewatering, inspections etc.)
- coal processing plant operations
- coal processing plant maintenance
- coal processing plant laboratories
- coal stockpiles
- train load-out operations
- fly-ash and rejects haulage and disposal
- tailing dams and reject dumps
- conveyor systems
- coal rail wagons

- public road coal transportation
- road maintenance and construction
- highwall / auger mining
- crushing operations
- mine rehabilitation including bulk profiling, recovering and placing topsoil
- maintenance workshops
- field maintenance (including blowing out dragline houses)
- boilermaker activities
- abrasive blasting
- electrical maintenance (including removing dust from electrical cabinets, removing dust from electric drive truck hubs etc.)
- tyre fitting
- conveyor belt maintenance
- equipment cabins
- air conditioner systems on equipment
- area maintenance activities (including mowing, vegetation removal, cleaning of infrastructure etc)
- cleaning of offices and crib rooms etc
- construction and demolition activities.

4 Accountabilities and responsibilities

4.1 Coal Mine Operator

- The Coal Mine Operator shall ensure the risk to coal mine workers from airborne dust is at an acceptable level, including, for example, by providing and maintaining a place of work and plant in a safe state.
- Shall ensure the operator's own safety and health and the safety and health of others is not affected by airborne dust due to the way the operator conducts coal mining operations.
- Shall not carry out an activity at the coal mine that creates an airborne dust risk to a person from on an adjacent or overlapping petroleum authority if the risk is higher than an acceptable level of risk.
- Shall audit and review the effectiveness and implementation of the safety and health management system to ensure the risk to persons from airborne dust at the coal mining operations is at an acceptable level.
- Shall provide adequate resources to ensure the effectiveness and implementation of the safety and health management system that includes the DMPs.

4.2 Site Senior Executive

- Shall ensure the safety and health management system contains adequate dust controls that provide effective protection to all coal mine workers and ensures the level of risk from airborne dust is kept at an acceptable level.
- Shall ensure that a senior position within the management structure is assigned the responsibility of developing and implementing the dust management plans.
- Shall ensure supervisors and open cut examiners are trained and assessed in the mine's dust management plans.
- Shall ensure all coal mine workers are provided with awareness training on the harm airborne dust can cause to persons health.

4.3 Supervisors

- Shall as part of their routine inspections include monitoring the presence or generation of airborne dust in work areas, and this includes inside fixed and mobile plant cabins.
- Shall ensure that the requirements of the dust management plans are implemented and being complied with.

4.4 Open cut examiners

- Shall as part of their routine inspections include monitoring of the presence or generation of airborne dust within their areas of responsibility.

- Shall ensure that the requirements of the dust management plans are being complied with.
- If an open cut examiner identifies an unacceptable level of risk being caused by airborne dust the requirements of Section 107 of the CMSHR shall be applied.

4.5 All coal mine workers

- Shall conduct their work within accordance with the mine's SHMS.
- Shall not work or carry out the worker's or person's activities in a way that exposes the worker or person or someone else to an unacceptable level of risk from airborne dust.
- Shall report in pre-start inspections any defects with the systems controlling airborne dust (eg air conditioner system and filters, cabin seals, sprays), and to their supervisor hazardous airborne dust presence or generation.
- Shall wear respiratory protective equipment (RPE) where required.
- Shall participate in awareness and training in dust management programs as required.
- Shall participate in personal exposure monitoring programs, for the purpose of establishing an accurate exposure profile.

5 Safety and health management system

5.1 Ensure dust exposure is managed to an acceptable level of risk

In the context of airborne dust the *Queensland Coal Mining Safety and Health Act 1999* (CMSHA) requires a mine's safety and health management system (SHMS) to incorporate risk management elements, procedures and practices appropriate for each coal mine to:

- ensure the safety and health of coal mine workers and visitors to the workplace with regard to airborne dust exposure.
- achieve effective management and control of airborne dust exposure (e.g. through the execution of the dust management plan)
- consult with coal mine workers within areas where there are respirable dust risks
- identify, analyse and assess airborne dust hazards and resultant risks
- prevent or mitigate unacceptable risks of airborne dust exposure and control residual dust risks
- monitor levels of dust and review the effectiveness of dust risk control measures
- investigate and analyse exposure results in accordance with Recognised Standard 14
- take appropriate corrective and preventive actions when control measures fail or workers are potentially exposed to levels of dust above the prescribed occupational exposure limits
- review and audit the effectiveness of the dust management plan.

5.2 Develop a SHMS that includes effective management and control of airborne dust exposure

Under Section 42 of the CMSHA the SSE is responsible for the development of a single SHMS for the mine and to ensure the risk to persons from coal mining operations is at an acceptable level, including airborne dust exposure. The requirements of the SHMS are detailed in Section 62 of the CMSHA to ensure the risk to coal mine workers' health and safety is at an acceptable level. This includes the requirement to regularly review and continually improve the SHMS to maintain an acceptable level of risk for airborne dust exposure under Section 62(f) of the CMSHA.

Section 89 of the CMSHR requires the mine's SHMS to provide for the control, monitoring and management of airborne dust. In the context of this recognised standard this includes the requirement to develop dust management plans within the SHMS that detail the processes and procedures for controlling airborne dust exposure to an acceptable level of risk.

The SSE must ensure the development of the mine's dust management plans are conducted in accordance with Section 10 of the CMSHR, and this includes consultation with coal mine workers. The SSE must also ensure a review of the mine's dust management plans are conducted in accordance with Section 64 of the CMSHA.

5.3 Safety inspections

- Persons carrying out safety inspections under the requirements of Section 141 of the CMSHR shall include monitoring the generation and or presence of airborne dust.
- All persons conducting safety inspections shall ensure the results of these inspections, including details of hazards and recommended corrective actions are recorded.

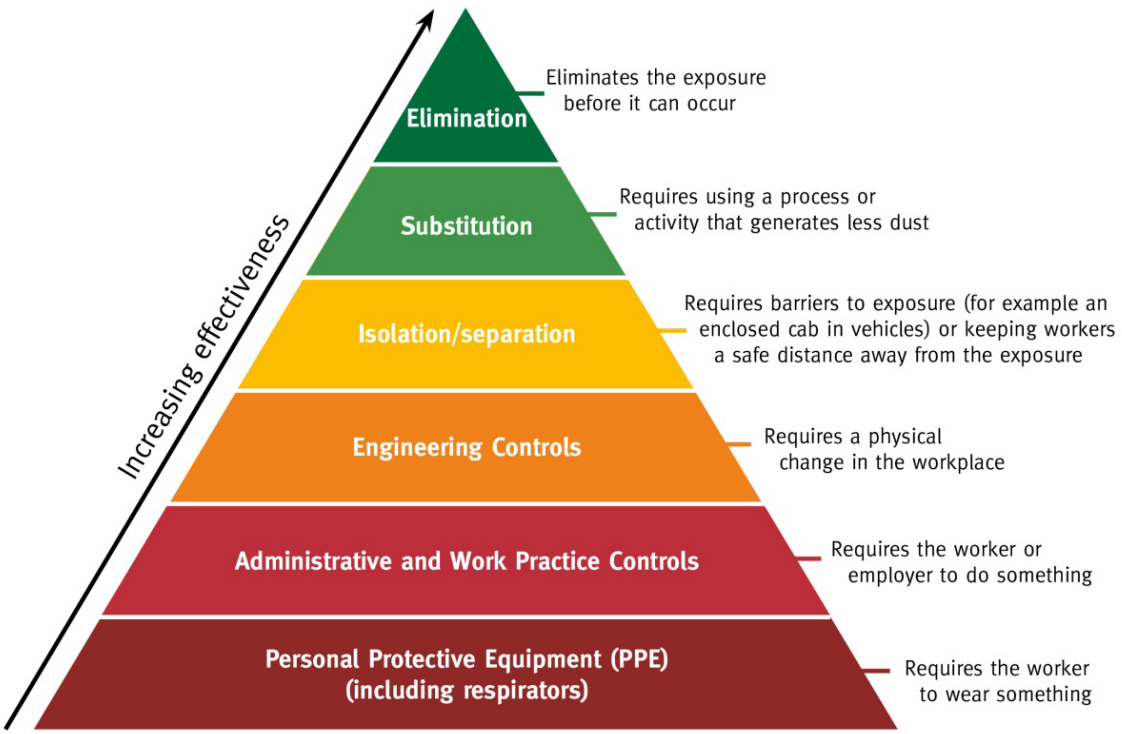
6 Technical guidance

6.1 General strategy for dust control

The variability in surface operation practices means that each mine SSE shall:

- identify sources of dust generation in all areas of the surface mine
- develop and implement dust controls for each activity at a surface mine
  - o follow the hierarchy of control principles to manage the risk of dust exposure to acceptable limits
- develop a process for the purpose of mitigating personal exposure when critical dust controls are not functioning to their designed specification
- review and ensure the effectiveness of controls in a systematic way
- inspect, maintain and monitor controls and plant (the inspection, maintenance and monitoring should be performed by appropriately trained and competent personnel)
- identify competencies related to dust control, and include within the mine's Training Scheme.
- identify relevant engineering and technical expertise (for the dust control strategy)
- undertake short-term and long-term planning to effectively manage dust controls (including resources, identifying when changes in operation will increase dust exposure).

6.2 Hierarchy of controls



The control measures reviewed in the risk management of airborne dust shall follow the hierarchy of controls, with higher order control measures considered first. Examples of applying the hierarchy of controls for effective risk management of airborne dust generation and exposure include:

- elimination - suppressing dust at the point of its generation
- substitution - using mining methods that generate less airborne dust (vacuuming instead of blowing).
- isolation/separation - using curtains, enclosures and containment
- engineering - dust suppression sprays, extraction systems, filtration systems, suppressant additives etc
- administration - task rotation and use of procedures to limit exposure, including operator positioning and location of concurrent activities
- personal protective equipment—using effective respiratory protective equipment.

6.3 Mine design

6.3.1 Early mine planning

Early mine planning shall consider dust make and dust generation to minimise airborne dust. This includes, but is not limited to:

- sequence of production operations, particularly in known high risk areas
- predominant wind direction, and environmental conditions such as temperature inversion layers
- the location of:
  - crib huts, workshops, offices, parking areas, camps etc
  - coal processing plants
  - coal crusher / breaker stations and transfer points
  - coal stockpiles
  - tailings dams and reject dumps
  - refueling stations
  - dedicated maintenance shutdown areas
  - dust generating activities external to the mine
  - and accessibility of water for dust suppressing
  - external sensitive receptors / stakeholders
- traffic management plan
- materials used for roads, stockpile bases, industrial areas etc.

6.3.2 Mine roads

Design of mine roads shall take into consideration:

- the geographical location of the road in relation to surface mine facilities and infrastructure
- selecting road surface material that minimizes dust generation
- the frequency of use and travelling speeds
- sealing of mine road surfaces where sensitive areas may be impacted (offices, workshops etc).

6.3.3 Geological conditions

Mine design shall consider the issue of whether present or anticipated geological conditions will create excessive airborne dust exposure. This may be achieved by analysing geological / geotechnical drill data to understand for example the in situ silica content within the overburden strata. Consideration shall be given to coal constituents (when considering risk of mine dust lung diseases [MDLD]). Further information is available from the National Institute for Occupational Safety and Health (NIOSH) at www.cdc.gov/niosh/docs/2011-172/pdfs/2011-172.pdf

Consideration also needs to be given to surface mines interacting with previous workings (e.g. previous underground workings), and known areas of previous heatings / spontaneous combustion. These conditions may change the composition and particle size of the dust produced during mining activities.

6.3.4 Operational planning and design review

Based on continuous improvement principles, the mine SSE shall review the availability of new operating methods (e.g. automation) or more effective higher order engineering controls to minimise dust generation (e.g. ventilation, water treatment and filtered, pressurised mobile cabins). During operational planning and design review, the mine SSE shall consider implementation of controls that address relevant factors including, but not limited to, the following:

6.3.4.1 Implementation of new technology or mining methods

When implementing new mining methods or technology ensure the SHMS can demonstrate compliance with change management and effective implementation that considers:

- documented evidence for the basis of the technology or method being selected, including documented evidence demonstrating the effectiveness of the new controls
- the introduction of any hazards from the implementation of any new technology, and the potential impacts to limit reliance on personal protective equipment as an interim measure.

6.3.4.2 Plant selection and overhaul

Plant selection shall be considered in terms of the hierarchy of controls, and equipment specifications shall consider control of dust generation at the source and ingress of dust (e.g. dust sprays, and cabin design are of the correct engineering specification for the planned application).
Plant selection and specification requires input from persons with the relevant expertise in the area of engineering control of dust generation. Plant includes:

- fixed plant installations (e.g. conveyors, dump hoppers, crushers, transfer points)
- mobile plant
- transportable and relocatable equipment (this includes mobile crib rooms).

Plant overhauls shall consider the permanent integration of effective dust controls into overhaul scopes. This includes the replacement, overhaul, and redesign of existing controls to improve integration and the reliability of these controls/parts. This may be managed by including the consideration of dust controls in the overhaul scopes of work and equipment specifications.

6.3.5 Construction and demolition

Principles outlined in this recognised standard also apply to the mine site during construction and demolition phases. It is expected that a lifecycle approach to the management of dust be adopted. For example at all phases from concept, feasibility, design, construction, operation, maintenance, modification, decommissioning, disposal and rehabilitation:

- minimise mine site exposed footprint , and maintain contemporaneous rehabilitation.

Construction

Risk of dust generation from construction activities shall be assessed and controls implemented. Consideration shall be given to:

- the impact on all construction workers eg including those undertaking manual tasks
- the impact from the generation of construction dust on adjacent facilities and activities, including intake airways into underground mines.

Shutdown and equipment assembly pads

- The potential impact from dust generation sources, e.g. mining activities and prevailing wind directions shall be considered when determining the location of shutdown and equipment assembly pads.
- Dust control measures shall be provided

Demolition

- Demolition of site fixed and mobile plant has the potential to generate significant quantities of airborne dust.
- A risk based demolition plan must be prepared and implemented prior to demolition. *Australian Standard AS 2601 demolition of structures* provides guidance on demolition
- Dust generated during demolition may include asbestos dust and synthetic mineral fibres as well as coal, silica and dust generated from mining and maintenance activities over the life of the asset.

6.4 Filters for the collection of respirable dust (including respirable crystalline silica)

Filtration devices are used at coal mines for entrapment and collection of respirable dust in a number of devices including but not limited to vacuums, local exhaust ventilation systems (LEV) and as part of heating, ventilating and air conditioning (HVAC) systems.

The filters in these devices are classified according to efficiency of the filter media to trap and contain particulate of a particulate size. Another important consideration in selection of the appropriate filter is the toxicity of the particulate being collected. Particulates are classified according to Low (L), Medium (M) and High (H) risk.

H Class (High Risk) particulates include those with a workplace exposure standard (WES) of <0.1mg/m^3 and must be able to trap and contain 99.995% of dust at 0.3µm. Respirable Crystalline Silica is classified as a H Class particulate.

A H-Class Certified extraction unit must display the appropriate warning label as per Australian Standard 60335.2.69 and must undergo Annual Dispersed Oil Particulate (DOP) testing to ensure it maintains H-Class certification.

All H Class extraction units must be maintained on a register to ensure compliance to annual servicing and testing which is conducted by an approved certified third party.

Further guidance can be obtained from:

- British Standard BSEN 1822-1: 2019. *High efficiency air filters (EPA, HEPA, and ULTA), Part 1: Classification, performance, testing, marking*
- Australian Standard "AS 60335.2.69 household and similar electrical appliances – Safety, Part 2: Particular requirements for wet and dry vacuum cleaners, including power brush, for commercial use"
- *Australian Standard 60335.2.26.2017 – Annex AA - Section 22* in *Figure AA.1 – Warning label for dust class H machines*

6.5 Fixed and mobile cabin design

Generally conventional HVAC systems are not adequate to handle high volumes of dust for long periods of time. It is also likely that standard cabin filters do not sufficiently protect operators from airborne mine dust.

Fit for purpose cabins on mobile and fixed plant can provide a means for thermal comfort and primary dust control. For cabins that are used in potentially high concentrations of airborne dust, it is critical that these systems are capable of preventing the ingress of very fine airborne dust particles. The majority of cabins used on surface coal mines are on mobile plant. When selecting equipment or undertaking major overhauls on existing mobile plant, the SSE shall give consideration to ensuring the following capabilities:

- the ability to supply pre-cleaned and filtered air to the cabin that passes through a high efficiency particulate air (HEPA) filter of minimum Class of H13.
- The ability to pressurise the cabin to sufficient levels to prevent inward ingress of dust. Some studies show significant cab environmental benefits when cab pressures exceed 20 Pascals (Pa). Some commercial systems currently available constantly adjust to maintain 35 Pa positive pressure.
- The ability to continuously monitor cabin pressure with a system that alarms when the pressure is not adequate.

Further guidance on the use of HEPA filtration in fixed and mobile cabins can be obtained from:

- British Standard EN ISO 16890:2016 – Air filters for general ventilation

The EN Standard 14695-1: 2017 states "*The air delivery system shall cause a positive differential pressure within the cab of:*

(a) 50 Pa minimum; or

(b) 20 Pa minimum, if a device informing the operator when the pressure drops below 20 Pa is provided.

In addition the following shall also be considered:

- The ability to remove dust that has been brought into the cabin on boots and clothing or when doors are opened. This is best achieved through a return air filtration system or can be achieved by an internal cabin mounted bag-less vacuum systems that exhausts externally of the cabin, at the rear of the vehicle with minimum Class H13 HEPA filters.
- Ensure good cabin sealing to assist in pressurisation of the air space. Selection of materials, structural rigidity, seal selection and accuracy of fitment should be considered.
- The design of the cabin should be such that the need for the operator to get in/out of the cabin for operational reasons is minimised (ie adequate visibility).
- Means of ensuring cabin doors remain closed, such as self-closing cabin doors.
- Covering seats in mobile plant with less porous materials to minimise the harbouring of dust.
- Design the cabin to minimise potential for dust accumulations. Position blowers / vents / outlets such that dust is not blown around the cabin (eg from floors).
- Shrouding to minimize latent dust build up above cabin doors.

Further guidance can be obtained from:
- European Standard EN 15695-1: 2017. *Agricultural tractors and self-propelled sprayers – Protection of the operator (driver) against hazardous substances – Part 1: Cab classification, requirements and test procedures.*
- European Standard EN 15695-2: 2017. *Agricultural tractors and self-propelled sprayers – Protection of the operator (driver) against hazardous substances – Part 2: Filters, requirements and test procedures.*

6.6 Coal handling processing plant design

6.6.1 Coal handling processing plant (CHPP)

Consideration shall be given to potential dust emitting activities, including but not limited to:
- coal unloading practices (Rom Hoppers with trucks and loader operation)
- coal transfer / movement on conveyors
- creating and reclaiming stock piles including relocation of coal from one stockpile to another
- lift-off from stockpiles with high wind conditions – look at veneering or dust suppression
- loading of trains – make sure the veneering sprays are working correctly
- continuously improve management strategies and initiatives to minimise dust emissions
- design to minimise accumulations of fines and dust, such as inverting structural members ie with toes down
- design for cleaning
- concrete aprons below and around CHPP that can be hosed down (Refer to **Figure 1** in Appendices)
- other safety implications arising from dust collection systems must be considered eg risk of explosion from dust build-up, static electricity
- design for maintenance
- coal on belt sensors that activate dust suppression
- variable dust suppression dependent on loading rates
- conveyor washing systems / belt turnovers
- wash down facilities under conveyors
- dust extractor systems in enclosed areas
- enclosed transfer points and loading points. Enclosed systems to be fitted with dust extraction systems
- belt scrapers
- belt speed
- controlling and minimizing air velocity around materials
- spray systems – including liquids (eg water) with or without sufactants or liquid foams (refer to **Figures 2**, **3** and **4** in Appendices)
- enclosed galleries, wind guards
- conveyor transfer design to minimise breakage and degradation
- weather conditions and controls needed to be implemented
- spillage points.

6.6.2 Bins, crushers and transfer points

Bins, Crushers and Transfer stations are locations known to generate airborne dust, so the following shall be

considered in the design to mitigate dust release:

- At ROM Bins or transfer points give consideration to partially enclose the space to control dust spread when dumping material from mining equipment
- Water sprays (curtain sprays) to be also considered to either capture or isolate dust to the confines of the bins (refer to Figure 2 in Appendices)
- When using water sprays controls are to be implemented to prevent the outrush of fluidised material (eg control of water volumes and moisture content)
- Where crushing of coal or other materials are being undertaken, the risk of coal dust inhalation shall be considered.
- Other elements to be considered are:
- Sensitive areas near crushing activities e.g. office blocks, crib rooms
- Spillage points
- Prevalent wind direction
- Can the system be safely enclosed to prevent dust release
- Can wetting agents be used to control the generation of dust.
- Transfer points shall be designed to mitigate coal generation or release. This can be achieved by good design of the chutes to minimize energy transfer e.g. minimizing vertical drops, changing direction of coal in the direction of the running belt.

6.7 Coal laboratories

Minimising airborne dust generation shall be considered when designing, installing, operating, cleaning and maintaining coal laboratories and associated equipment. In particular consideration should be given to the use of local exhaust ventilation (LEV) systems (refer section 7.8) to remove dust at all dust generation points. This will include any on site labs where dust can be generated by means such as crushing or transferring from one bin to another drum or bucket. Ideally the system should be fully enclosed with access to allow for cleaning of spillage and routine maintenance.

The use of compressed air for the cleaning and blowing down of components to remove dust shall be eliminated as far as is practicable. Alternative methods for cleaning such as using a H-Class vacuum fitted with a minimum of a H13/H14 HEPA filters should be used.

6.8 Local exhaust ventilation and extraction systems.

The most effective way of reducing the airborne dust concentration is to remove the dust at the source of generation. One way of achieving this is by the use of a well-designed and maintained local exhaust ventilation (LEV) or extraction system. These systems may be fixed such as those around a coal milling machine or flexible systems such as those used around grinding, maintenance and cleaning applications. (Refer to **Figures 5**, **6**, **7 and 8** in Appendices).

When selecting an LEV or extraction system is important to consider the design of the system and factors such as:

- the shape (area) of the capture hood (refer to Figure 7 in Appendices),
- proximity of the capture hood to the dust generating source
- cross-drafts and eddies
- the power of the fan
- the angle of joins in the associated ductwork
- the material the duct work is constructed from
- the length of the associated duct work
- the access for cleaning and the removal of captured contaminants
- the availability of test points to carry out checks / inspections.

These factors may have a significant impact on the efficiency of the system and the ability of the system to achieve and maintain an appropriate capture velocity.

Specialist expertise should be considered when designing / selecting and installing LEV and extraction systems. Dust that is captured by the system must not be vented or recirculated into the environment (refer to **Figure 8** in Appendices) so that it can become a secondary source of exposure to other coal mine workers. The dust should be collected by means of a H-Class certified vacuum that is fitted with a minimum of H13/H14 HEPA filters.

Identification of the correct capture velocity is essential for the type of contaminant (e.g. dust, fume or gas) and method in which the contaminant is being generated. Further guidance for capture velocity of dusts can be obtained from Table 1 and the references listed below. It is important to regularly maintain the LEV system to ensure it continues to operate at the design capture velocity. This will include regular inspection, cleaning and assessment of the capture velocity. The capture velocity should be qualitatively checked routinely (such as smoke tubes) and quantitatively checked at periodic intervals (measured with devices such as a hot wire anemometer, or differential pressure gauges). Maintenance of the system including the replacement and cleaning of filters shall give consideration to preventing secondary dust exposure.

Table 1: Recommended minimum capture velocities for various dust generating processes.

Type of contaminant being generated	Air speed required m/s at point of capture	Inlet velocity if capture point is 1 hood diameter away m/s
Dusts from pouring operations	0.5 – 1	5 – 10
Crusher dusts	1 – 2.5	10 – 25
Grinding, blasting, high speed wheel generated dusts	2.5 – 10	25 – 100

Source: www.worksafe.qld.gov.au/__data/assets/pdf_file/0008/83186/silica_managing_workplace.pdf

Further practical guidance can be obtained at:

- American conference of Governmental Industrial Hygienists (2013) *Industrial Ventilation: A manual of recommended practice for design, 28th Edition*, ACGIH®, Cincinnati.
- www.worksafe.qld.gov.au/injury-prevention-safety/managing-risks/local-exhaust-ventilation-lev
- www.hsa.ie/eng/publications_and_forms/publications/occupational_health/local_exhaust_ventilation_lev_guidance.pdf
- www.hse.gov.uk/lev/what-is-ileve.htm
- www.hse.gov.uk/pubns/priced/hsg258.pdf
- www.nwleics.gov.uk/files/documents/doc05/Doc%2005%20IT%20Fleet%20Coalville%20LEV%20Checklist.pdf
- www.commerce.wa.gov.au/worksafe/local-exhaust-ventilation
- www.cdc.gov/niosh/mining/features/dustcontrolhandbooks.html

6.9 Design for maintainability

- Selection of fit for purpose materials and components suitable for the operating environment. Consideration should be given to factors such as operating temperatures, impacts of wind, humidity, water quality, material and chemical properties of the dust being controlled.
- Maintainability of installations should be considered in the design of equipment and plant. This includes the provision of suitable access platforms, isolation and depressurisation points for spray systems, ease of change-out and component replacement eg spray nozzles, filter elements, conveyor belt scrapers, chemical dosing points etc.
- Commissioning tests should be undertaken and documented to confirm dust control equipment and plant is operating as intended. System performance baselines should be established when equipment is commissioned and the plant performance monitored on an ongoing basis and compared to the baseline. Deviations from the baseline should be investigated and rectification works undertaken as required.

6.10 Design of electrical equipment

When designing enclosures for electrical equipment consideration shall be given to prevention of dust ingress into the enclosures. This includes but is not limited to the following methods for preventing dust ingress in the draglines, electric shovels and electric drive mobile equipment.

6.10.1 Draglines

- Conversion to AC Drives
- Extraction systems (refer to previous LEV section)
- Enclosed MG sets with positive pressure filtered with sub-floor extraction

- Provision for setting up shrouds (tent) for maintenance days
- Remote controlled blow out systems
- Misting systems for air intake systems
- Positive air pressure monitoring systems for enclosures
- Automatic cleaning filtration system (air scrubbers).

6.10.2 Electric shovels

- Prototype containment screens and provision for mounting portable local extraction ventilation (pLEV) (refer to Figure 9 in Appendices).

6.10.3 Electric drive mobile equipment

- Dust ingress protection via pressurisation and sealing (refer to Figure 10 in Appendices).
- Prototype containment screens and portable local extraction ventilation (pLEV) that includes verification of negative pressure inside the cabinet (refer to Figure 11 in Appendices).

7 Exposure or risk profile for similar exposure groups

At a minimum, the site senior executive shall establish an exposure risk profile for each applicable similar exposure group (SEG) as required by *Recognised Standard 14 Monitoring respirable dust in coal mines* (for further information regarding SEG's refer to fact sheet www.dnrm.qld.gov.au/__data/assets/pdf_file/0008/977498/similar-exposure-groups.pdf).

8 Dust control factors in operational areas

8.1 General principles that apply to all mining methods

The mining methods in conjunction with environmental conditions shall be considered to minimise operator exposure to airborne dust, with priority given to the hierarchy of controls.

Where any changes to the mining method result in potential deficiencies in dust management (including dust suppression or maintenance issues) interim controls shall be considered.

The additional interim controls (e.g. rotation of personnel to limit exposure to dust) shall meet legislative requirements (i.e. within acceptable limits and as low as reasonably achievable) until a review of the dust control measures for that activity is conducted.

8.2 Mining methods

Minimising dust exposure shall be considered when determining the mining method. This includes interaction between mining activities, dust generation sources, wind direction, environmental conditions and mine roads. Some examples include:

- vegetation clearing and topsoil removal
- drilling (exploration and production)
- blast crew activities
- dozer activities
- shovel / Excavator / Truck, and Dragline operations
- coal loading face, haul and dump
- coal processing (crushing, stockpiling etc)
- field maintenance activities
- highwall / auger mining
- onsite rock crushers.

8.3 Overburden spoil and waste dumps

For consideration the following are some methods used to eliminate or minimise dust generation from these areas:

- Consider the predominant wind direction when selecting a location for spoil and waste dumps.
- Minimise the footprint area of spoil and waste dumps, avoid dumping over large surface areas.
- Rehabilitate exposed spoil and waste dump areas.
- Use sprinkler systems to suppress the dust.

8.4 Automation as a control

Automation (including semi-autonomous) can provide benefits in reducing airborne dust exposure to the individual operators by removing them from the generating source. Consideration needs to be given to other activities such as maintenance activities and other coal mine workers working in the vicinity.

The generation of dust within an automated operation still needs to be managed with effective controls.

8.5 Water application and spray design

Correct dust capture and spray design (including droplet size and interactions with dust particle size) is required to achieve effective airborne dust management. Specialist advice may be required.

Airborne dust suppression design considerations**:**

- environmental factors
- size of focus area
- wind velocities
- water consumption / availability
  - Sufficient flow and pressure
  - Water quality suitable to prevent blockages
- ability to contain and manage the water generated
- physical barriers
- hazards (such as machine or equipment movements and flying rock,
- dust properties, including Particle Size Distribution (PSD). Dust suppression sprays work best when dust particles and atomized water droplets are of equivalent sizing.
- concentration levels
- velocity (air and particle movement, belt speed eg)
- nozzles Selection and Position
  - positioned for maximum coverage, maintenance access, and free of any interference issues that could cause damage
  - Nozzle selection for maximum capture efficiency
- use of surfactants and/or liquid foams.

8.6 Mine road and general dust suppression

For the purpose of maintaining mine roads the following should be taken into consideration:

- The location, availability and accessibility of water stations (fill points)
- The flow capacity of water stations (reduce fill time)
- The number, capability and availability of water trucks (including contingencies for breakdowns)
- The use of fixed sprinkler systems, especially near infrastructure such as workshops and coal processing plants (refer to Figure 12 in Appendices)
- Safety implications need to be considered when selecting watering methods (uncontrolled movement of equipment verse dust generation)

Consider the utilisation of additives which may improve the suppression of dust or sealing of roads.

Dust generation from mine roads shall be continually monitored by open cut examiners, supervisors and coal mine workers.

8.7 Drilling (production and exploration)

8.7.1 Overburden and production

Overburden drilling is an activity that can generate excessive dust, and this dust then has the potential to cause secondary exposures to post drilling activities (eg blast crew).

Dust suppression shall be carefully considered during the drilling process, this could include the following depending on the mine requirements:

- Removal of the dust collection systems. These systems are known to deposit fine dust particles on the bench in the path of traffic during the loading process.
- The use of water and dust binding agents during the drill process will bind and coat cutting piles.
- Under deck spray bars have the ability to apply extra dust suppression to the cutting piles without affecting the drilling process.
- Drill deck skirting to restrict dust from spreading out across a larger than required surface area.
- Ensure the drill bit and drill rods size match to allow adequate annulus (clearance between the side of the drill pipe and the wall of the drill hole). This will allow the cuttings to be ejected from the hole without being subjected to extra grinding and size reduction.

8.7.2 Exploration

When drilling with compressed air the following controls shall be considered;

- Drill rigs to be fitted with fixed diverters (engineered T piece), pressed into the ground over the borehole casing.
- A blooie line shall be coupled to the diverter that removes the dust from the immediate work area.
- Drill site setup shall ensure T-Piece is angled away from people and equipment.
- Drill site setup to include restricted areas around T piece diverter and blooie lines.
- Drill site inductions should include adequate familiarisation of drill site work area including restricted areas.
- Dust suppression via water injection shall be applied while spudding in holes by incorporating water misting sprays into the engineered T-piece.
- Exploration drill site inspections to include checks for dust generation.

8.8 Blasting activities

Mines should give consideration to the following:

8.8.1 Magazine and explosive reload compounds

Surfaces around these facilities should be constructed of low dust generation materials e.g. concrete, bitumen or gravel.

General care and maintenance should also be undertaken e.g. watering, cleaning and resurfacing when required.

8.8.2 Design phase

- Material type and geological properties of the blast area should be considered in the design phase.
- Geological structures containing high levels of silica will require additional diligence throughout the process. The elevated risks from this should be highlighted to drillers and blast crews.

- Powder factors designed to achieve desired outcomes and correct material size for extraction should be used. Excessively high powder factors will lead to high dust generation throughout the muckpile and may contribute to general mine dust issues during the excavation phase of the mining process.
- Stemming heights incorporated in the design should also be considered. Shorter stemming heights will cause a higher level of dust to be released into the air during initiation of the shot. (Scale Depth of Burial equations are usefully in determining the reaction of the shot surface during initiation)
- Decking of blasts with longer delay periods between the lower explosive decks can lead to a reduction in dust liberation from the shot during the initiation.

8.8.3 Bench preparation

The mine should have a drill bench preparation procedure which should be undertaken prior to drilling commencing. This procedure should explain the process to remove excessive fines from the bench and possible watering of the area to create a surface seal on the bench.

Adequate resourcing of labour and correct equipment should be made available. Note these resources should be capable of undertaking the final trim work required to achieve the standard outlined in the bench preparation procedure.

8.8.4 Dipping and logging holes, barricading blast bench, baiting blast holes and connecting blast for initiation

- General mine dust control methods that should be considered around the blast bench - road design and maintenance, mine layout, the use of water carts and dust suppression agents.
- Reduction of dust generation by limiting interaction between neighbouring activities in the initial mine layout - design and scheduling process should be considered.
- The drill pattern surface may be watered or coated with a dust suppression agent prior to on bench activities commencing (refer to Figure 13 in Appendices).
- When the dust cannot be effectively managed work should be suspended. Work should not resume until effective controls are implemented for the current conditions (eg relocation of adjacent activities, or additional provision of dust suppression).

8.8.5 Loading blast holes

- Blast bench traffic management plan should consider the wind direction and how this will influence potential dust being generated from the moving vehicles and the impact on personnel.
- Steady movement of the explosive truck and other traffic across the bench will reduce surface dust being created. All equipment movement should avoid contacting drill cuttings.
- Manufacturers of explosives trucks should consider the impacts on ground personnel from the air flow and dust generation during the loading process. Skirting or ducting may be able to direct dust away from personnel positioned at the point of loading.

8.8.6 Stemming blast holes

Downlines should be attached to a securing device to prevent loss during the stemming process. (This will eliminate the need for the ground personnel to be close to the collar of the hole during the stemming process) Stemming material should have fines removed through screening.

When selecting machines for the stemming process consideration shall be given to:
- Machines with large carry capacities will assist in limiting equipment movement across the bench reducing the amount of dust generated from the movement.
- Operator seating positions should be considered, machines with low mounted cabins such as bobcats may incur a higher dust exposure than machines with high mounted cabins found on small loaders.
- Stemming machines should be fitted with air conditioners and sealed cabins that prevent dust ingress (refer to section 7.5).

- Stemming equipment should be able to deliver stemming accurately in through the collar of the hole as this will reduce wastage and the material required to stem the hole. These may include stemming trucks or specially designed stemming buckets. (refer to Appendices Figures 14 & 15).
- Stemming material may be wet down or coated with a dust suppression agent to reduce dust. Some stemming trucks are able to spray the material while being delivered.

8.8.7 Firing of shot

A dust path should be formulated and included on the blast exclusion zone. Factors for consideration when determining the dust path are:

- weather conditions e.g. wind speed, wind direction, wind gusts, inversion layers, boundary heights, temperature and atmospheric moisture.
- bench surface area being disturbed, this should include any free faces which may create dust during the blast.
- surface and strata moisture levels.
- topography and the likely influences.
- estimated time the dust will be airborne.
- distance and down wind direction of dust cloud.

Fog cannons may be considered in some highly sensitive locations to suppress dust from the initiation of the shot.

The Shotfirer or Blast Controller should view the blast from a vantage point if possible, and indicate to the Blast Guards the direction, size and speed of the dust cloud from the blast. The actions required to maintain a safe zone away from the dust cloud should also be communicated.

8.8.8 Post blast inspection

The post blast inspection shall only be undertaken when dust has cleared from the shot area.

8.9 Coal handling and processing plants

8.9.1 Management of dust in CHPPs

The generation and presence of dust in all CHPP areas shall be kept as low as reasonably achievable. The following are means of minimizing this generation and presence of dust:

- Effective housekeeping standards shall be maintained, and this includes but is not limited to the following:
  - routine hosing down of areas where materials containing dust build up
  - sumps and drains are emptied and cleaned as necessary
  - dust suppression on roadways is maintained by either water carts or sprinkler systems (refer to **Figure 12** in Appendices)
  - clean up of spillage
  - create a cleaning program that allows the operators to hose the plant from top to bottom removing all dust particles that might be collected on beams and rails.
- keep chute access doors closed when not in use to prevent airborne dust escaping
- control belt surfaces not running dry/ or too wet
- maintenance of water sprays
- maintenance of belt cleaners, skirts and liners is adequate.

8.9.2 Management of dust on stockpiles

Minimising dust creation shall be considered with respect to stockpile creation and will incorporate effective dust management plans that apply to the following area of stockpiles.

- **Design** - Consideration should be given to the design of the stockpile, where applicable stockpiles should remain static to enable the application of permanent dust suppression systems. When the coal moisture is

less than the DEM (dust extinction moisture) level applicable for the particular coal type. Look at including engineering controls such as water sprays, delivery socks, use of anemometers etc)
- **Location** - Consideration should be given to the location of stockpiles relative to the processing plant or any area with high pedestrian traffic taking into account prevailing wind direction.
- **Operation** - A review of all material handling processes should be undertaken to identify areas of improvement to reduce the level of airborne dust creation whilst minimising the exposure limit to personal.
- **Review** - Regular monitoring and review of the airborne dust control methods will be established to address any areas of exceedance.

8.9.3 Conveyor systems

When designing conveyor systems key considerations to be undertaken are the following:
- location of the conveyor system in relation to proposed or existing infrastructure including locations of offices
- environmental consideration including prevailing wind
- medium being conveyed (e.g. light friable material that may be affected by high winds)
- roof covered conveyor systems
- enclosed conveyor systems where sensitive receptors may be present
- transfer points
- sizing or crushing locations
- drive heads etc
- cleaning practices.

When dust generation points have been identified controls shall be implemented. These may include the type and size of water sprays, enclosures, dust breaks or spray material to mitigate dust generation or drift. Dust suppression sprays work best when the dust particles and atomised water droplets are of equivalent sizing.

8.10 Coal rejects haulage

Mines should have a full chemical analysis conducted on the coal rejects product that has to be transported so as to understand the contaminants it contains that may harm persons.

The following are some methods that should be considered as means to control dust emissions when hauling coal reject material:
- Consider the predominant wind direction and potential interaction with other workings when selecting the travel route
- Ensure the coal reject material is moisture conditioned before being transported.
- Ensure operators remain inside the mobile equipment pressurised cabins during the loading, transporting and dumping of coal rejects.
- Reduce load volumes so spillage on the roads does not occur. Coal rejects spillage rapidly dries and will then generate airborne dust.
- Use sprinkler systems on coal reject stockpiles to keep the surface area moist.

8.11 Tailing dams and coal reject dumps

Exposed coal reject dumps and dried tailing deposits usually contain vast sources of latent dust, and when strong winds are present this dust can travel airborne for considerable distances.

For consideration the following are some methods used to eliminate or minimise dust generation from these areas:
- Consider the predominant wind direction when selecting a location to dispose of coal rejects and tailings
- Rehabilitate exposed reject dumps and dried tailing deposits.
- Dispose rejects and tailings into small cells within overburden spoil dumps, and cover these cells with suitable material when they are full.
- Avoid dumping rejects over large surface areas.
- Use sprinkler systems to suppress the dust.

8.12 Flyash haulage and disposal

Mines should have a full chemical analysis conducted on flyash product that has to be transported so as to understand the contaminants it contains that may harm persons.

The following are some methods which should be considered as means to control dust emissions from flyash:

- Consider the predominant wind direction and potential interaction with other workings when selecting the travel route.
- Ensure the flyash is moisture conditioned before being transported.
- Ensure operators remain inside the mobile equipment pressurised cabins during the loading, transporting and dumping of flyash.
- Reduce load volumes so spillage on the roads does not occur. Flyash spillage rapidly dries and will then generate airborne dust.
- Dispose of flyash in small overburden spoil cells, and cover these cells with overburden material as per the environmental agency's requirements.
- Use sprinkler systems on flyash stockpiles or exposed cells to keep the surface area moist.

8.13 Transport of coal on public roads

Mines shall control the generation of dust when coal is being transported on public roads. When selecting the appropriate controls it is important to consider the hierarchy of controls. Some examples of controls to be considered are:

- covers placed on top of trailers preventing dust from being emitted
- applying a water based veneering solution to the surface layer of coal in trailers to minimise dust emissions
- selecting travel routes that have minimal interaction with towns and communities
- speed restrictions
- washing trucks prior to travelling on public roads
- use of shakers (for example a grid to shake dust from the exterior of trucks).

8.14 Rail wagon dust management

The veneering process is designed to minimise and control dust emissions from Rail Wagons during transportation along rail corridors from the rail loadout to coal handing rerminals (refer to **Figures 16 & 17** in Appendices). In summary; a water-based veneering solution is applied to the surface layer of coal on each wagon as it passes underneath the spray bar. The solution dries to form a flexible 'crust' over the coal and prevents coal dust from being released from the wagons.

Some additional examples of controls to be considered are:

- profiling the coal product to provide a constant profile and limit turbulence e.g. plough
- the required water based solution to best suit the mine's coal product
- constant speed of the wagons to apply the water based solution to the surface of the coal
- the ability to differentiate between different dimensional coal wagons and locomotive
- maintenance process and pre use inspection process to ensure all nozzels are operational.

8.15 Highwall / auger mining

8.15.1 Highwall mining

Controls that should be considered for the management of dust are:

- Predominant wind direction when setting up the operation, including maintenance activities
- A traffic management plan the limits vehicular movement in the work area
- Conduct real time dust monitoring to identify hazardous positions within the working area
- Permanent water reservoirs at the working area
- Sprays on the cutter head
- Sprays on the outburst protection shield
- Sprays on the transfer from belly belt to stacker belt
- Sprays on the stacker belt discharge

- Dust suppression sprinklers on main FEL work areas
- Water truck support for dust in work area
- Minimise the coal stockpile size by regular relocating of the coal from the pit
- The operator's cabin is designed and maintained as per Sections 7.4 & 10.1.2.1.

8.15.2 Auger mining

Controls that should be considered for the management of dust are:
- Predominant wind direction when setting up the operation
- A traffic management plan the limits vehicular movement in the work area
- Conduct real time dust monitoring to identify hazardous positions within the working area
- Dust suppression sprinklers on main FEL work areas
- Water truck support for dust in work area
- Minimise the coal stockpile size by regular relocating of the coal from the pit
- Permanent water reservoirs at the working area
- The operator's cabin is designed and maintained as per Sections 7.5 & 10.

8.16 Crushing and screening operations

The use of mobile crushing plants and screens on coal mines to crush and screen materials for road construction, sheeting of roads, ballast and other purposes shall give consideration to reducing the amount of airborne dust generated. Dust control capability should be considered when selecting, operating and maintaining crushing plant.

The equipment selection and introduction to site process shall give consideration to dust controls. This shall include but not be limited to the following:
- ability for water to be plumbed to the crushing plant and installation of water sprays
- the type and location of the sprays including (belts, inside crushers, screens, bins and transfer points)
- the availability of water on site to feed the plant
- the use of shrouding at transfer points, hoppers etc.
- access for the inspection and maintenance of spray systems.

During the operation of the crushing plant consideration should be given to reducing dust generation and preventing exposure to operators by:
- ensuring all dust controls are inspected and operating effectively prior to commencing crushing or screening operations.
- ensuring mobile plant feeding crusher, stockpiling and loading trucks are fitted with fit for purpose cabins that prevent dust ingress.
- considering wetting down product prior to crushing.

Consideration should also be given to managing dust generated from stockpiles, road traffic and during loading operations. This may be achieved by use of water trucks or yard sprays.

8.17 Yard maintenance and industrial cleaning

There may be potential for intermittent high intensity exposures during yard maintenance and general cleaning activities. It is important that the hierarchy of controls is considered when undertaking these activities. Examples include
Engineering controls – undertake lawn mowing and activities in equipment with pressurised, filtered cabins.

Substitution – replace blowing with compressed air for vacuuming with HEPA filters, replace dry sweeping with wet cleaning methods.

Administration – Plan activities to coincide with favourable environmental conditions. Set up exclusion zones.
RPE – Where RPE is required ensure it is used as part of a respiratory protective equipment program**.**

8.18 Abrasive blasting

Abrasive blasting activities shall be planned and risk assessed prior to activities commencing. Items to consider during abrasive blasting are:

- the method of abrasive blasting
- abrasive media being used
- items being blasted including paint or nearby structures
- work activities in the area
- the location of the blasting activities.

Care needs to be taken to identify all dust hazards involved in blasting activities; this includes identifying dust hazards being created (e.g. lead paint). If the object being blasted has an unknown covering (e.g. paint) or construction, samples should be sent away for analysis.

The abrasive media shall be considered, and a low risk media can be chosen. It is important to select an abrasive medium which generates minimal dust levels (see AS 1627 or the Model Code of practice for Abrasive blasting 2013 appendix B for further detail)

Where possible items requiring abrasive blasting should be removed and blasted in a controlled environment. However, if this is not possible exclusion zones shall be set up that excludes the area where abrasive blasting is being undertaken to isolate the dust hazard from other workers. This can be achieved by plastic sheeting (or similar).

Immediately after blasting activities have finished, housekeeping of the area shall be undertaken to clean up residual blasting by-products to prevent it creating a dust hazard at a later stage.

To protect the worker special consideration is to be taken with the style of respirable protective equipment being utilised. Compressed air line hoods as per the Model Code of Practice should be utilised. Regular testing of the air quality supply shall be undertaken as per AS 1715:2009 Appendix A “Selection, use and maintenance of respiratory protective equipment”

9 Maintenance

9.1 Maintenance of airborne dust controls on fixed and mobile plant

9.1.1 Inspection and maintenance scheme

An effective inspection and maintenance scheme is required to ensure equipment designed to manage dust emissions operates as intended on an ongoing basis.
The SSE shall ensure a documented inspection and maintenance system is in place to provide for:

- Identification of all dust control systems on equipment and plant
- Establishing the inspection and maintenance requirements for all dust control systems
- Performance of inspections and maintenance by competent operators and maintainers
- The early detection of any defect in plant or equipment which could result in a reduced level of operation or protection
- Enable identified issues and defects to be documented and remedial actions undertaken.
- Maintenance of equipment to ensure the equipment remains in a fit for purpose state when operating.
- As part of the maintenance program a process must be in place to outline what actions are to be undertaken when one or more of the critical dust controls are not functioning as per design i.e. TARP.

Elements to be considered in the development of an effective inspection and maintenance plan include:

9.1.1.1 Procedures

The maintenance system should consist of a suitable combination of documented:

- Records of equipment performance in logs that are regularly reviewed to detect any deterioration in performance.
- Documented procedures for the inspection, adjustment and maintenance of dust control plant and equipment.
- Contingency plans for continued safe operation shall be developed and implemented for when automatic systems are not operational.

- Maintenance procedures should be based on original equipment manufacturers (OEM) recommendations as a minimum. Mines need to risk assess the OEM recommendations to determine if they are effective. Changes to OEM maintenance strategies should be undertaken following a change management process. The change management process should include the analysis of data collected as part of the maintenance inspection process.

9.1.1.2 Inspections and checks

The maintenance system should include:
- Prior to commissioning; inspection and maintenance plans are to be developed, documented and scheduled.
- Inspections to be undertaken by trained and competent coal mine workers. Inspections include:
  - Pre-start, daily checks and checks when equipment is re-started after a prolonged delay or shutdown.
  - Scheduled inspections and checks by maintainers
- Where defects or substandard conditions are identified (eg blocked filters, or accumulations of dust in cabins) actions should be undertaken immediately to address the defect.
- Periodic inspection of administrative and operational control measures.
- Maintain equipment, monitor effectiveness after maintenance, feed results into periodic reviews.

It is recommended that:
- Inspection and maintenance standards and procedures include photographs which depict the required installation standard (eg cabins free of dust accumulations, no signs of dust deposits around vents).
- Replacement parts for critical items are identified and retained on site (eg filters)

9.1.1.3 Training and competence

Training of workers is a critical aspect of the dust control management plan.

- Operational checks must be carried out by trained and competent coal mine workers
- Maintenance and servicing must be carried out by trained and competent personnel
- Evidence of training and ongoing assessment of competence is required to be demonstrated

9.1.1.4 Task assessment

Prior to undertaking maintenance tasks a risk assessment shall be completed that considers the potential exposure of maintainers to accumulations of dust and airborne contaminants.

Maintenance programmes must be designed to ensure that:
- Employees performing the maintenance are not exposed to high dust concentrations
- The maintenance activity itself will not result in coal mine workers in the vicinity of the activity being exposed to elevated dust concentrations
- Post maintenance activities do not result in uncontrolled accumulations of dust eg post abrasive blasting.

9.1.2 Specific maintenance requirements

9.1.2.1 Cabins and enclosed spaces

The SSE is to ensure that:

- The requirements prescribed by the OEM for maintaining the effectiveness and adequacy to prevent airborne dust ingress into any operator's cabin or other enclosed work place including offices buildings. Which will include but is not limited to:
  - Air-conditioning systems
  - Air-conditioning components
  - Window and door seals
  - Cabin pressurisation units.
  - Using good housekeeping practices, such as periodically cleaning soiled cabin floors, using a sweeping compound on the floor, or vacuuming dust from foot well and cloth seats

This is to include all fixed and mobile plant in all different operational areas and conditions of which the plant is exposed to at the mine.

If operational conditions or systems change the effectiveness and adequacy of the maintenance scheduling must be reviewed to ensure that an acceptable level of risk for CMW's exposure to dust is maintained.

- That dust controls to prevent airborne dust ingress into operators' cabins or other enclosed work place are to become pertinent safety feature, of which these controls must be checked to ensure they are functioning properly as required by section 73 (2) of the Coal Mining Safety and Health Regulation 2017.

As part of this system a process must be in place to describe what actions are to be undertaken when 1 or more of the dust controls are not functioning properly.

- Investigate the requirements of the OEM maintenance scheme for any other dust control systems at the mine (e.g water sprays, dust collector's, extraction fans) to ensure that the maintenance schedule is effective and adequate to ensure that the system is functioning properly.

Undertake any changes that may be required to the maintenance system if there are deficiencies found in the maintenance system that prevents / restricts the dust control system from functioning properly.

The system must also incorporate actions that must be undertaken if part or the whole system is not functioning properly.

9.1.2.2 Use of compressed air for cleaning

Compressed air has been widely used for cleaning down enclosures during maintenance activities. These activities are not to generate excessive airborne dust concentrations and therefore shall be replaced by other cleaning methods wherever possible. Typical activities undertaken that may involve compressed are include the blowing out of:

- high voltage (HV) cabinets in electric drive trucks
- Motor – generator (MG) sets in dragline houses.
- The following must be undertaken:
- Sites must identify all tasks that involve the use of compressed air to clean out / blow down settled dust.
- A register of these tasks will be established and maintained.
- Sites must review current dust control measures during these activities to ensure exposures are kept within acceptable levels.
- Sites must conduct personal exposure monitoring of coal mine workers conducting any of the registered tasks to ensure controls are effective and do not exceed limits specified in Sec 89 of the CMSHR.
- Sites must review the type and level of RPE used for these tasks to ensure it is appropriate.
- Review tasks using compressed air and consider current controls with reference to the hierarchy of controls. For example:
  - Prevent / limit dust from entering enclosures through design, pressurisation of enclosures and sealing.
  - Manage roadway dust to limit volume of airborne dust produced.
  - Use alternate cleaning methods (vacuum instead of blow).
  - Schedule more frequent cleaning to limit the duration of blow outs.
  - Consider a minimum of powered air purifying respiratory protection (PAPR) for these tasks until suitable engineering controls are in place.
  - Consider use of real time monitoring devices during implementation of controls to understand the effectiveness.

9.1.2.3 Welding and boiler making

- Hazards from the generation of dust and metal fumes from cutting and grinding should be considered.
- Welders must be trained to understand the hazards of the materials they are working with. Reference to Safety Data Sheets and size and scale of exposure to welding fume must be considered.

- Welding surfaces should be as clean as practicable of any coating or oil/grease that could potentially increase overall exposure to respirable contaminants.
- Welders should be positioned as efficiently as possible to avoid or reduce exposure to welding fumes ie take advantage of natural drafts and position themselves upstream of the fume and away from other workers
- Use of dust extraction systems and appropriate respiratory protection including powered/supplied air respiratory protection
- Investigate consumable options to see if less toxic or lower fume production options are available

9.1.2.4 Air filters and dust collectors

- Dust collection facilities including bag filters fitted to drills, engine air intake filters, and particulate filters have the potential to generate airborne dust during filter replacement or maintenance.
- Procedures should be implemented to control dust during the changing of bags and filter elements; including bagging and sealing of used filters, using a vacuum cleaner to clean filter housings instead of compressed air blowers, and checking filter housing seals for correct fitment.
- When storing and handling waste elements the sealed bags should be protected to make sure they are not ruptured.
- Filter elements (engine intake, external dust filters for cabins) should not be “Tapped” clean as this could potentially expose coal mine workers to airborne dust. Consideration should be given to using exchange filters and bag/seal the old filters to be cleaned in a controlled environment. Suitable controls to protect CMWs must be in place when elements are replaced.

9.1.2.5 Tyre fitting

- Tyre fitting activities have the potential to generate airborne dust from activities including; releases of pressurised air, using compressed air to clean components, and buffing and dressing of components. Alternate risk assessed work methods that minimise the generation of airborne dust must be considered.

9.1.2.6 Instrumentation

- Procedures must be in place to make sure instrumentation such as weather stations, wind speed and direction monitoring instruments and the systems they control, chemical dosing systems remain within calibration limits and operational.

9.1.2.7 Other

Other maintenance related tasks that potentially generate airborne dust that need to be controlled include:
- Concrete cutting
- Use of grouts and cement products in maintenance

9.2 Electrical maintenance

9.2.1 Electrical cabinets

- Techniques used in removing dust from cabinets and enclosures may incorporate the following steps:
  - Wiping out the enclosure to remove the bulk of the dust prior to using other techniques. This shall be done in such a manner that the dust does not become airborne.
  - Removal of dust by not allowing the dust to become airborne via use of vacuum systems. The use of vacuum systems with long lance and shrouding of the nozzle should be considered
    - Consider the use of Carbon Dioxide (CO_2) cleaning methods as an alternative to using compressed air
  - Removal of dust by allowing it to become airborne (blowing out) in the enclosure and extracted by exhaust fans. This technique requires that the airborne dust cannot exit the cabinet or enclosure other than through the exhaust system. These systems can incorporate:
    - shielded vacuum nozzles or longer lances
    - Portable extraction systems

- Portable air curtains
- Portable vacuum units (Refer to Figures 9 & 11 in Appendices)
- Prototype containment screens and provision for mounting portable local extraction ventilation (pLEV)
- Pressurisation of critical control, I/O cabinets which may include air coolers coupled with a water trap and filtration to remove oil and moisture. This reduces dust ingress into the enclosure
- Use extended air lances with venturi tip designs combined with Blower fans to move dust away from operator (refer to Figures 18 & 19 in Appendices)

9.2.2 Dragline motors and generators

- Removal of dust via the use of blowing out the dust and using extraction fans. This may require that shrouding over the motor or generator is required.
- Conduct air flow studies of air movement in draglines, using information of air flow directions to use in work instruction for blow out method of sets, reducing line of fire of dust to personnel performing the task by running the house fans during blowout.

9.2.3 Electric drive truck grid boxes and wheel hubs

- Washing out grids during major inspections to remove bulk dust during major services
- Vacuum off the top of the grids to remove bulk dust prior to any blow out
- Portable extraction fans designed to connect to axle box for blow outs for AC wheel motors
- Use extended air lances with venturi tip designs combined with Blower fans to move dust away from operator (refer Figures 18 & 19 in Appendices)

10 Respiratory protective equipment

Respiratory protective equipment (RPE) shall never be used as the primary means for dust control in situations when other higher order controls are available and effective (e.g. use of enclosed cabins, LEV systems and water suppression). Whenever RPE is required to be worn it shall only be used as part of the mine's RPE protection program. The RPE program shall be established in accordance with applicable sections of AS/NZS 1715:2009, Selection, use and maintenance of respiratory protective equipment, for particulate filter respirators. RPE for mitigation of dust control shall meet the relevant requirements of AS/NZS 1716:2012, Respiratory protective devices.

10.1 Additional notes about RPE

RPE is the least effective form of mitigating dust exposure according to the hierarchy of control, as it does not remove the hazard and relies on correct fitment and use by the individual, as well as adequate supervision. However, it is recognised that RPE will generally always form part of the mine's overall dust management strategy. In these situations, the use of RPE will provide additional protection to coal mine workers if worn correctly and for the full duration of the task.

Examples of situations in which RPE will form part of the overall control strategy include:

- supplementing higher order controls for coal mine workers operating in high dust-generating tasks (e.g. clean out of electrical cabinets and dragline gen sets, coal milling and grinding in the laboratory)
- completing non-routine or short duration tasks with the potential for intermittent high intensity exposure (e.g. abrasive blasting, grinding)
- an interim mitigation measure if additional engineering controls are being developed, implemented and evaluated—if RPE is being used as an interim control it shall be linked to an action plan that clearly specifies the stages for implementation of higher order controls
- any task for which a coal mine worker requests the use of these devices.

More information about the selection and use of respiratory protective equipment can be obtained at: https://www.worksafe.qld.gov.au/injury-prevention-safety/managing-risks/personal-protective-equipment-ppe/respiratory-protective-equipment-rpe

11 Education on dust

The mine's SHMS must include a provision for all coal mine workers to be educated to understand the airborne dust health impacts and control mechanisms relative to their mine. Relevant general components of the education of all coal mine workers include:

- what the components of airborne dust is
- what coal dust is
- what silica is
- what is inhalable and respirable dust
- the effects of airborne dust on a person
- types of mine dust lung disease
- high risk exposure areas on site
- how to mitigate and manage the impacts of airborne dust on coal mine workers
- how the hierarchy of controls for dust management is applied.
- overview of testing and monitoring for airborne dust in the workplace and acceptable levels
- relevant coal health assessment components for respiratory health (e.g. lung function tests, chest X-rays). Refer to Qld Government / Business Queensland coal workers pneumoconiosis (https://www.business.qld.gov.au/industries/mining-energy-water/resources/safety-health/mining/medicals/pneumoconiosis
- a training aid that can be referenced is Miner's Health Matters – what is CWP (https://www.dnrme.qld.gov.au/miners-health-matters)

11.1 Mine site SHMS and training scheme

All coal mine workers engaged in a mining area or activity shall be trained and assessed in the key dust control strategy matters they are responsible for implementing and maintaining. This includes documented procedures that detail controls to mitigate exposure in the following areas:

- installed controls and their designed capability
- prestart and inspection procedures, and reporting of dust and maintenance issues
- operator positioning
- professional health monitoring programs, standard operating procedures and TARP requirements
- application of the recognised standards for dust control and monitoring
- respiratory protection standards and requirements
- high risk dust exposure zones

12 Review of dust control effectiveness and routine validation of control functionality

The SSE shall consider developing a process to review the effectiveness of dust controls introduced at the mine, including a process for routine validation of dust control functionality.

12.1 Introduction of dust controls to site

When introducing dust controls it is important to understand if the controls are effective. One way of validating the effectiveness of controls is to take dust measurements before and after the control has been introduced. This is can be achieved by using gravimetric or real time dust monitoring. The advantage of real time dust monitoring is that it only requires a short sampling period and provides quick feedback to the operator.

12.2 Routine in shift validation of dust controls

It is also important to ensure dust controls continue to work to the design parameters. In addition to dust monitoring this can also be achieved by taking other measurements such as pressure (for example measuring the pressure inside an operator's cabin) or air velocity (measuring the air velocity at the capture point on a local exhaust ventilation system).

Validation of controls should only be undertaken by personnel with relevant experience and skills, and the results should be documented and records kept.

12.3 Periodic review of dust control effectiveness

In addition, a periodic review of the effectiveness of controls in each area at the mine shall be undertaken. This review shall be based on all dust monitoring results and all hazard, geological, maintenance and incident reports that relate to these matters.

A review of dust control measures shall be considered in the event of:

- any significant changes in mining operations or conditions
- any changes in the equipment being used in mining operations
- any increase in personal monitoring results for a similar exposure group that increases the risk profile of that group (as defined by recognised standard 14, Monitoring respirable dust in coal mines).

The review must be documented to ensure that dust generation areas are identified, controlled and incorporated in the mine's dust management plan and SHMS updates.

13 Audit and review process

The mine SSE must develop and maintain an audit and review program to ensure the effectiveness of the dust management plans. These audits must be conducted at the commencement of new installations and at frequencies appropriate to the level of risk identified from reviews of all dust monitoring results.

A risk based periodic review of the maintenance scheme will be performed for any critical dust control equipment & systems at the mine to ensure the maintenance program is effective and adequate in maintaining the operating performance as per design.

Continuous Improvement (CI) identification & initiatives will form part of the review criteria and follow the hierarchy of control principles to manage the risk of dust exposure to acceptable limits or better.

Where the maintenance program is found to be ineffective in managing the operating performance of critical dust control systems actions are to be captured and documented to ensure the required changes have been implemented to rectify the inefficiency.

13.1 Demonstration of effective review

The mine's operator shall audit and review the effectiveness and implementation of the safety and health management system to ensure the risk to persons from dust exposure is at an acceptable level.

14 Definitions

Surface coal mine	(a) a coal mine other than an underground coal mine; or (b) the surface operations of an underground coal mine. Example of surface operations of an underground mine: a coal mine consists of an underground coal mine and related overlaying surface facilities for mining coal seam gas. The facilities are surface operations for the underground mine.
Inhalable dust definition	Inhalable dust refers to the particle size entering the mouth and nose during normal breathing. These particles may be deposited in the respiratory tract. The term inhalable dust applies to both non-toxic and toxic dusts. The inhalable fraction of dust entering the respiratory tract may be further divided into 'respirable' and 'non- respirable' fractions.
Respirable dust	The respirable dust fraction is composed of the very fine dust which is able to reach the lower bronchioles and alveolar regions of the lung.
Plant	includes— (a) machinery, equipment, appliance, pressure vessel, implement and tool; and (b) personal protective equipment; and (c) a component of plant and a fitting, connection, accessory or adjunct to plant.
Coal mine operator	Refer to Section 21 of the Qld Coal Mining Safety & Health Act 1999
Welding fumes	is a varying mixture of airborne gases and fine particles. The composition of the mixture depends on the welding method and the products that are welded.
Blooie line	Large diameter flow line for air drilling that diverts the flow of air from the rig into a pit area

15 Acronyms

SSE	Site senior executive
SHMS	Safety & health management system
CMW	Coal mine worker
CMSHR	Queensland Coal Mining Safety & Health Regulation 2017
CMSHA	Queensland Coal Mining Safety and Health Act 1999
CI	Continuous improvement
OEM	Original Equipment Manufacturer
QLD	Queensland
LEV	Local Exhaust Ventilation
pLEV	Portable Local Exhaust Ventilation
RPE	Respiratory Protective Equipment
FEL	Front End Loader
NIOSH	National Institute of Occupational Safety and Health
SWA	Safe Work Australia
ACGIH	American Conference of Governmental Industrial Hygienists
ROM	Run of Mine
CHPP	Coal Handling & Processing Plant
SDS	Safety Data Sheet
HVAC	Heating, Ventilation, and Air Conditioning
HEPA	High Efficiency Particulate Air (filters)
PSD	Particle Size Distribution
PA	Pascal
DEM	Dust extinction moisture
WES	Workplace exposure standard
PAPR	Powered air purifying respirator

16 References

- *Recognised Standard 14 Monitoring Respirable Dust in Coal Mines* (www.dnrm.qld.gov.au/__data/assets/pdf_file/0012/978879/recognised-standard-14.pdf)
- Qld Coal Mining Safety & Health Regulation 2017 (www.legislation.qld.gov.au/view/pdf/2017-09-01/sl-2017-0165)
- *Qld Coal Mining Safety & Health Act 1999* (www.legislation.qld.gov.au/view/whole/html/inforce/current/act-1999-039)
- NIOSH Coal Mine Dust Exposures and Associated Health Outcomes (www.cdc.gov/niosh/docs/2011-172/pdfs/2011-172.pdf)
- NIOSH 'Dust Control Handbooks' (www.cdc.gov/niosh/mining/features/dustcontrolhandbooks.html)
- Breathesafe (www.breathe-safe.com.au/images/PDF/Best-practice-for-coal-dust-and-iron-ore-sites.pdf)
- LSM Technologies (www.lsmtechnologies.com.au/index.cfm?go=Q-CABAIR)
- Similar Exposure Groups fact sheet (www.dnrm.qld.gov.au/__data/assets/pdf_file/0008/977498/similar-exposure-groups.pdf)
- European Standard EN 15695-1: 2017 *Agricultural tractors and self-propelled sprayers – Protection of the operator (driver) against hazardous substances – Part 1: Cab classification, requirements and test procedures.*
- European Standard EN 15695-2: 2017. Agricultural tractors and self-propelled sprayers – Protection of the operator (driver) against hazardous substances – Part 2: Filters, requirements and test procedures.
- British Standard BSEN 1822-1: 2019. High efficiency air filters (EPA, HEPA, and ULTA), Part 1: Classification, performance, testing, marking
- Worksafe Queensland, Silica – Technical guide to managing exposure in the workplace www.worksafe.qld.gov.au/__data/assets/pdf_file/0008/83186/silica_managing_workplace.pdf
- Worksafe Queensland, Local exhaust ventilation www.worksafe.qld.gov.au/injury-prevention-safety/managing-risks/local-exhaust-ventilation-lev
- HSA LEV Guidance (www.hsa.ie/eng/publications_and_forms/publications/occupational_health/local_exhaust_ventilation_lev_guidance.pdf)
- HSE Local Exhaust Ventilation (www.hse.gov.uk/lev/what-is-ileve.htm)
- HSE Controlling airborne contaminants at work (www.hse.gov.uk/pubns/priced/hsg258.pdf)
- Local Exhaust Ventilation Checklist (www.nwleics.gov.uk/files/documents/doc05/Doc%2005%20IT%20Fleet%20Coalville%20LEV%20Checklist.pdf)
- WA Supply, installation and commissioning LEV (www.commerce.wa.gov.au/worksafe/local-exhaust-ventilation)
- American conference of Governmental Industrial Hygienists (2013) Industrial Ventilation: A manual of recommended practice, ACGIH®, Cincinnati.
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- AS/NZS 1716:2012, Respiratory protective devices (www.worksafe.qld.gov.au/injury-prevention-safety/managing-risks/personal-protective-equipment-ppe/respiratory-protective-equipment-rpe)
- Worksafe Queensland Respiratory Protective Equipment www.worksafe.qld.gov.au/injury-prevention-safety/managing-risks/personal-protective-equipment-ppe/respiratory-protective-equipment-rpe
- Australian Standard AS 2601 demolition of structures
- Safework Australia, Guidance on the interpretation of workplace exposure standards for airborne contaminants, (2013). (www.cdc.gov/niosh/mining/features/dustcontrolhandbooks.html)
- Qld Government / Business Queensland coal workers pneumoconiosis (www.business.qld.gov.au/industries/mining-energy-water/resources/safety-health/mining/medicals/pneumoconiosis)
- Miner's Health Matters – what is CWP (www.dnrme.qld.gov.au/miners-health-matters)

17 Appendices

Figure 1. Concrete aprons below and around CHPP with drainage leading to sumps

Figure 2. Sprays on dump stations

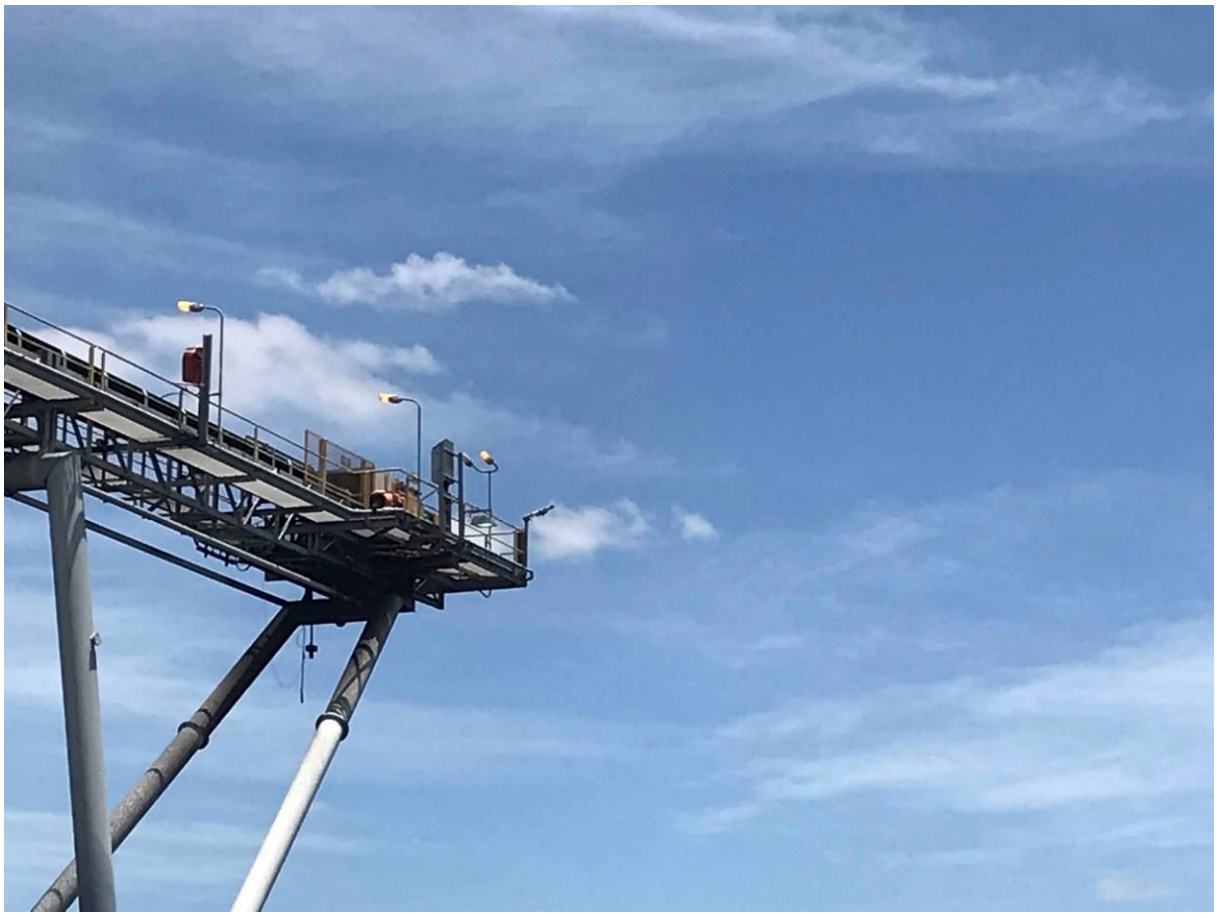

Figure 3. Cannon on conveyor delivery points to suppress stockpile dust

Figure 4. Cannons on conveyor delivery points to suppress stockpile dust

Figure 5. Example of movable and adjustable LEV's in a coal laboratory to account for dust sources (LEV's held in position by magnets)

Figure 6. Example of a LEV system in a coal laboratory. Movable and adjustable LEV's to account for dust sources (LEV's held in position by magnets)

Figure 7. Example of a fixed LEV system in a coal laboratory

Figure 8. LEV system outside a coal laboratory with all dust collected in the bin at the bottom of the system

Figure 9. Portable extraction unit

Figure 10. Pressurisation fan on top of cabinet, and the inlet filter can be seen behind the fan.

Figure 11. Blow-out cleaning with a prototype containment cover and prototype Plev

Figure 12. Sprinklers suppressing dust on roadways

Figure 13. Watering shot bench down to suppress surface dust

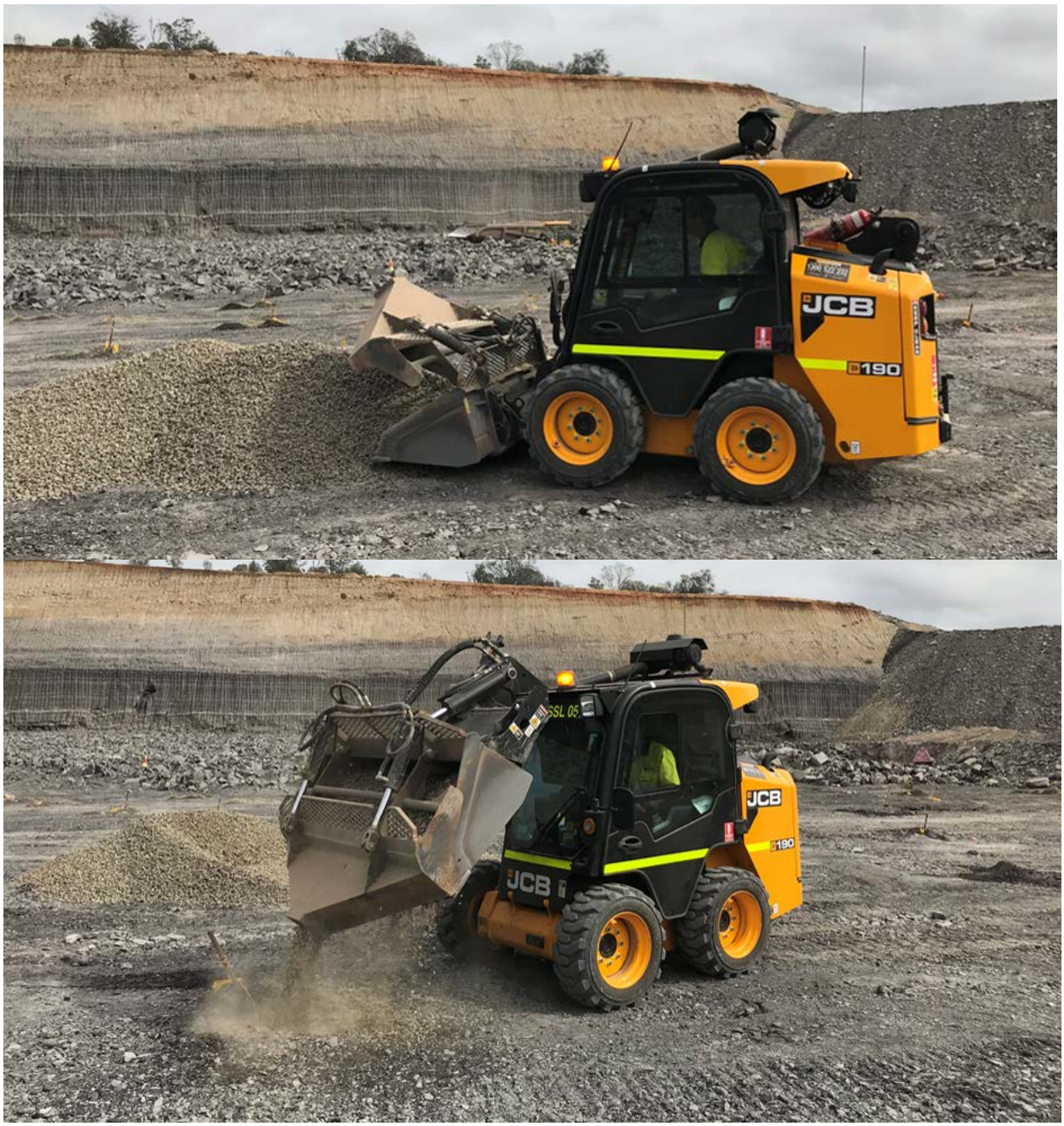

Figure 14. Engineered attachment on Bobcat to reduce spillage and dust when stemming holes

Figure 15. Stemming truck delivering stemming to blast hole

Figure 16. Veneering Station

Figure 17. Profiler and Veneering Solution being applied

Figures18 & 19. The utilisation of extended air lances