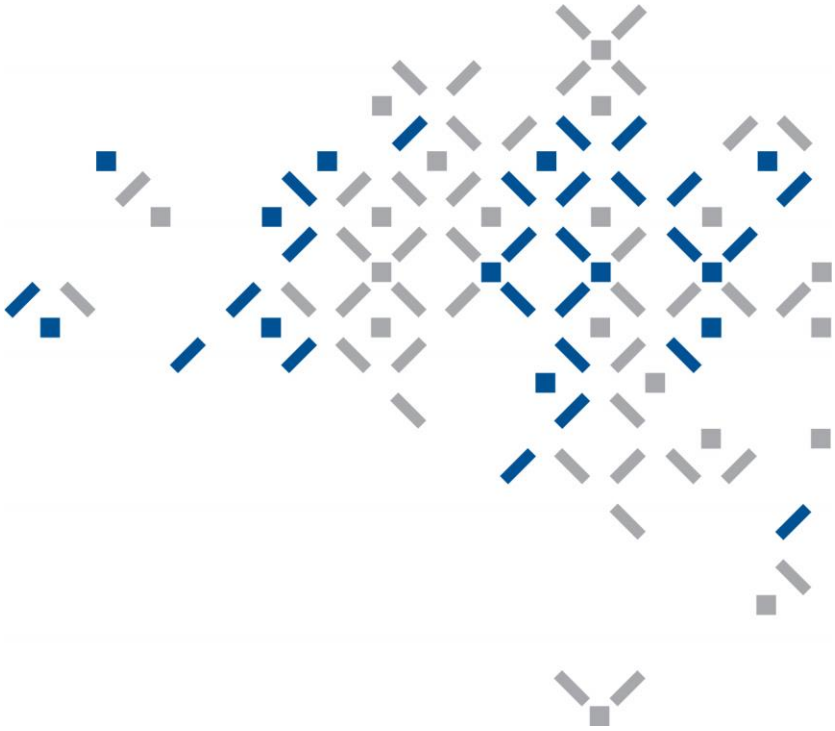

Recognised standard 14

Monitoring respirable dust in coal mines

Coal Mining Safety and Health Act 1999

Queensland Government

CS6275 11/16

This document is issued in accordance with PART 5—RECOGNISED STANDARDS and section 37(3) of the *Coal Mining Safety and Health Act 1999*. An extract of the legislation is provided below.

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

(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 2001, the Act or Regulation takes precedence.

This recognised standard was issued under the authority of the Minister for Natural Resources and Mines

[Gazetted 23 December 2016]

Note: This document is controlled electronically. For the current copy, visit www.business.qld.gov.au or contact the nearest departmental office.

Version no.	Date effective
1.0	1 January 2017

Contents

1 Purpose

To state ways to achieve an acceptable level of risk to persons arising out of coal mining operations by providing the minimum requirements that shall be included in a coal mine's safety and health management system for monitoring, preparing records and reporting concentrations of respirable dust levels as required under sections 49, 89 and 89A of the Coal Mining Safety and Health Regulation 2001.

2 Scope

This standard applies to all underground and surface coal mines, and includes all on-site activities as defined by the *Coal Mining Safety and Health Act 1999*.

3 Introduction

Workers exposed to respirable coal mine dust that exceed exposure limits are potentially at risk of developing simple coal worker's pneumoconiosis, progressive massive fibrosis, silicosis, lung cancer and chronic obstructive pulmonary disease.

The type of disease that occurs is influenced by the dust particle size and composition.

The size (or aerodynamic diameter) of a dust particle will influence:

- how far into the lungs it can be inhaled
- where it will be deposited in the respiratory system
- whether the respiratory system can successfully clear the dust particle.

Furthermore, the composition of a dust particle influences how the respiratory system reacts to the particle once it has been deposited. If a dust particle is unable to dissolve in the respiratory system fluids or is unable to be broken down by inflammatory or immune responses, it remains in the lung tissue, potentially causing fibrosis (or scarring). If a dust particle is toxic it may cause localised cellular dysfunction or death, or it may be able to enter the bloodstream and cause systemic toxicity in the relevant target organ/s, or it may cause an inflammatory or immune response that results in fibrosis. Some toxic dust particles such as crystalline silica (or free silica) are also classified as carcinogenic, which may result in lung cancer (AIOH 2009).

Any coal mine dust able to enter the respiratory system poses a potential health risk. However, it is the respirable dust fraction (or dust particles less than 10 micrometres in aerodynamic diameter) capable of reaching the lower bronchioles and alveolar (or gas exchange) regions of the lungs that is a priority to manage (AIOH 2009). Once dust particles enter the lower lungs, it becomes more difficult for the respiratory system to clear that dust. Therefore, exposure to respirable dust and protecting the health of workers is an important part of the risk management process at a coal mine (the site senior executive needs to ensure that the risk to a person at a coal mining operation is at an acceptable level).

Assessing and managing risk associated with occupational exposure to respirable dust may be complex. The risk management process may require the use of specific risk assessment techniques (refer to recognised standard 2, *Control of risk management practices*, for further information (DNRM 2003)). For example, assessing the risk from occupational exposure often includes measuring workers' exposure by sampling the work environment (e.g. collecting personal respirable dust samples).

The approach outlined in Figure 1 shows the relationship between each of the risk management process steps and some of the technical and administrative activities required for the monitoring process to achieve an effective outcome.

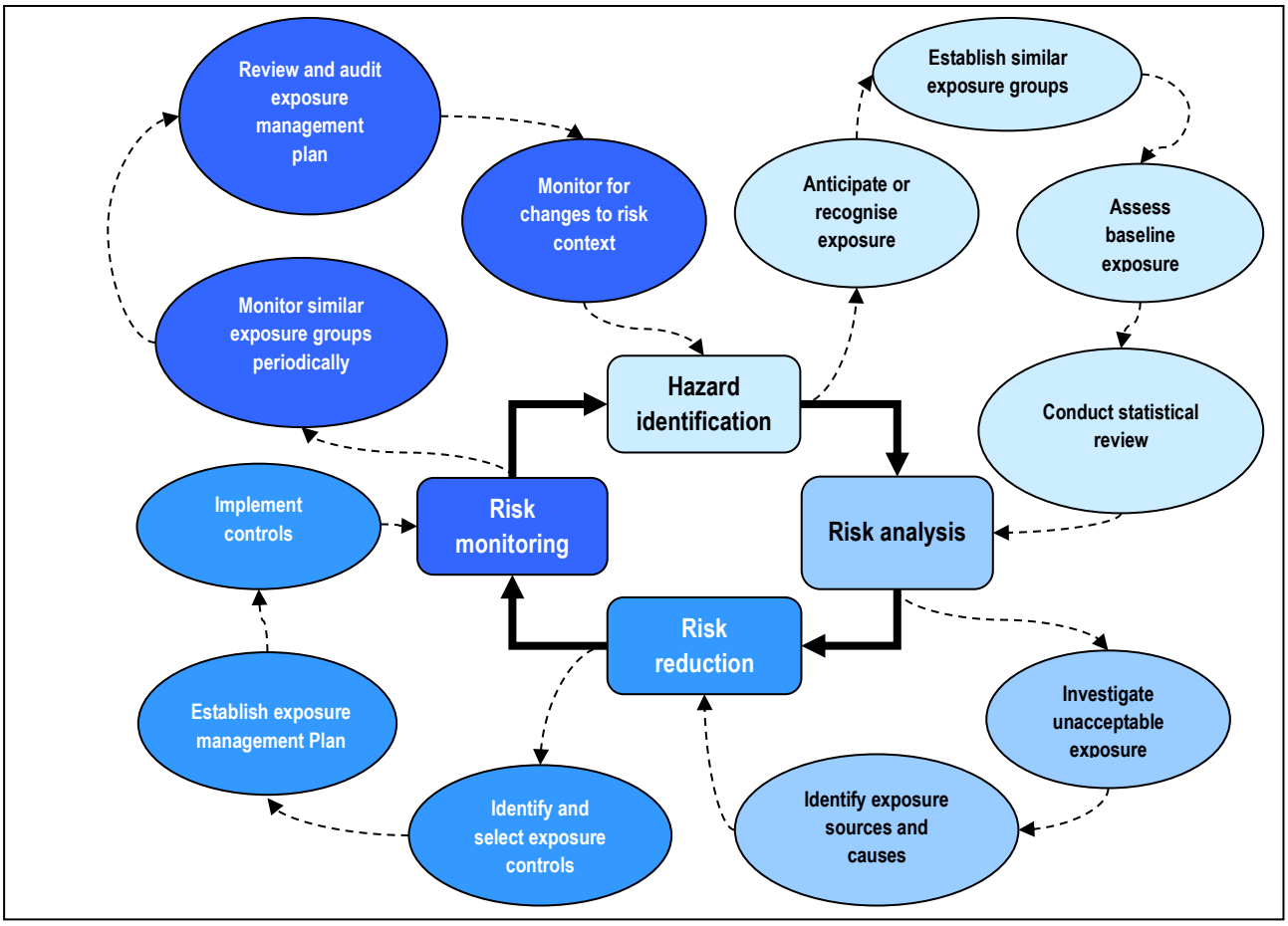

Figure 1: Approach to monitoring occupational exposure

The approach to monitoring occupational exposure in Figure 1 is based on two important assumptions:

1. A monitoring strategy must be based on multiple measurements of a similar exposure group (SEG) for it to be meaningful.
2. In order to understand if risk is at an acceptable level, appropriate sampling, statistical procedures and professional judgement by a competent person must be used to interpret measurement data (Grantham & Firth 2014).

4 Accountabilities and competencies

4.1 Accountability for monitoring respirable dust in coal mines

The site senior executive must ensure:

- the mine has a respirable dust monitoring program as part of the mine's safety and health management system
- the respirable dust sampling plan has been developed by a competent person
- respirable dust sampling is only conducted by a competent person
- an investigation is conducted when a personal sample exceeds the exposure limit
- the respirable dust monitoring program is reviewed by a competent person at regular intervals.

4.2 Competencies required to develop and review a respirable dust monitoring program

A person who has a recognised competency as a certified occupational hygienist, or an equivalent competency under an international certification scheme (e.g. certified industrial hygienist), must review the adequacy of and endorse the coal mine's respirable dust monitoring program, and specifically:

- establish SEGs
- develop a respirable dust sampling plan that is representative of worker numbers, workers, shiftwork, tasks performed and conditions at the mine
- estimate exposure of a SEG using descriptive statistics
- submit their review of the respirable dust monitoring program to the site senior executive.

4.3 Competencies required to conduct respirable dust sampling

Carrying out respirable dust sampling at a coal mine in accordance with AS 2985 is a prescribed task under section 76(3)(a) of the *Coal Mining Safety and Health Act 1999*. Only a person who has a competency recognised by the Coal Mining Safety and Health Advisory Committee for the task, and adequate knowledge and understanding of mining activities (e.g. operating methods, conditions, and environment) may conduct respirable dust sampling at a coal mine.

The list of recognised competencies is available on the Queensland Government Business Queensland website at www.business.qld.gov.au.

5 Minimum technical requirements

5.1 Establishing SEGs

The site senior executive shall ensure that applicable SEGs are established for the coal mine's operations, and cover activities in the following areas:

- underground coal mines
    - longwall operations
    - development operations
    - outbye operations
    - return roadways
    - stone drivage (including drift construction)
    - surface operations
    - maintenance activities
    - coal processing plants (including stockpiles and laboratories)
- surface coal mines
    - coal processing plants (including stockpiles and laboratories)
    - drill and blast operations
    - excavation operations
    - haulage operations
    - maintenance activities
    - other support services (e.g. pumps, inspections, survey)
    - exploration drilling
    - highwall/auger mining.

For simplicity, SEGs can generally be based on work or functional groups, but in some instances may be more specific due to particular exposure circumstances (i.e. if a discrete work group has a unique exposure not experienced by other workers).

Further guidance on SEGs can be found in the *Similar exposure groups: coal mine workers' health scheme factsheet* (DNRM 2016).

5.2 Sampling equipment

Equipment used to sample respirable dust shall be subject to periodic calibration and maintenance if relevant, as per AS 2985 and the manufacturer's recommendations. Records of calibrations performed shall be maintained.

Electrical equipment used to monitor dust in underground coal mining environments shall have relevant certification and/or be used in accordance with the coal mine's safety and health management system, as per section 202 of the Coal Mining Safety and Health Regulation 2001.

5.3 Types of sampling

Sampling is the process of conducting a measure or series of measures of the concentrations of airborne contaminants, such as respirable dust and respirable crystalline silica.

Types of sampling and applications include:

- personal sampling
    - baseline monitoring (risk identification)
    - periodic monitoring (risk monitoring)
    - investigative monitoring (risk analysis)
- static and real-time sampling
    - investigating the source and/or causes of unacceptable personal exposure (risk analysis)
    - assessing the efficiency of dust controls (risk monitoring).

5.3.1 Personal sampling

Personal sampling is the process used to measure an individual's unprotected exposure to dust during the course of their usual activities, and includes both exposed and non-exposed time (e.g. breaks). Personal sampling requires a dust measurement to be collected from within the breathing zone of the worker. The results of personal sampling for groups of workers performing similar tasks or working in the same area (e.g. SEGs) can be combined and analysed using statistical tools to provide an estimate of exposure for the SEG.

Baseline monitoring is conducted to establish an initial estimate of exposure for a new or modified process or activity, to enable comparison with exposure limits and identify areas requiring additional exposure control.

Periodic monitoring commences when baseline monitoring is completed. Periodic monitoring provides information on the ongoing adequacy of exposure controls to ensure the exposure of workers remains compliant with relevant exposure limits, and the risk of adverse health effects to coal mine workers from coal mining operations is at an acceptable level.

One of the drawbacks of personal dust sampling is that it typically does not indicate the source or cause of dust entering the worker's breathing zone or at what times during the shift specific exposure may have occurred.

5.3.2 Static sampling

Static (or fixed) sampling can be used to measure area-specific dust levels and identify sources and causes of dust generation, to enable dust control efforts to be focused and prioritised. Dust measurements collected at static sampling points are not representative of actual worker exposure and should not be compared to an exposure limit. Static sampling is a valuable tool for assessing the effectiveness of process controls, for example, sampling before and after the implementation of controls so the effectiveness of those controls can be verified (Ren, Plush & Aziz 2013)

It is recommended that static sampling points are located in close proximity to sources of dust to assess the magnitude of dust levels. However, static sampling points can also be positioned to measure dust being carried by ventilation into a work area (e.g. outbye of a longwall on a roadway in an underground coal mine, or upwind of a shot being loaded at a surface coal mine). Furthermore, it is recommended that the location of static sampling points are documented in sufficient detail so measurements can be repeated if necessary.

5.3.3 Real-time sampling

Real-time sampling uses a direct-reading device to measure dust concentrations and can be used in a variety of ways, depending on the functionality of the direct-reading device. Importantly, real-time devices can be used in conjunction with gravimetric sampling to detect changes in instantaneous dust concentrations, or even peaks in dust concentrations if the device has a logging mode. Real-time devices can also be used to give an indicative time-weighted average if collected in the breathing zone of the worker and the duration of sampling is representative of normal shift activities. Full shift sampling is preferred but, as a minimum, the real-time sampling period should be at least 80% of the shift length.

The benefits of obtaining instantaneous dust concentrations, when compared to the time delay for gravimetric analysis, are that multiple measurements can be quickly made to investigate the source or cause of dust exposure, and dust controls and positioning of workers can be adjusted in real time.

Furthermore, the limitations of real-time sampling devices must be acknowledged and understood when employed to measure dust concentrations. The most important limitation of real-time monitoring relates to the way direct-reading instruments calculate the mass of the particles being sampled.

For example, a laser photometer (a common direct-reading instrument) counts the number of aerosol particles in a sample of air. The mass of the aerosol particles is then calculated based on the properties of the calibration aerosol and converted to a dust concentration measurement based on the volume of the air sampled.

Another form of direct-reading instrument is the tapered element oscillating microbalance (TEOM), which is now commonly used technology for personal dust monitors. The mass of aerosol particles is calculated by monitoring the frequency changes in a vibrating tapered element. Again, this mass is converted to a dust concentration measurement based on the volume of air sampled.

Neither the laser photometer nor the TEOM determine mass gravimetrically in accordance with AS 2985. Therefore, measurements from these devices cannot be used to assess compliance with exposure limits and are indicative only.

5.4 Standard for collecting respirable dust samples

All samples collected for the purpose of exposure assessment shall be collected in accordance with AS 2985.

5.5 Standard for analysing respirable dust samples

All samples collected for the purpose of exposure assessment shall be analysed in accordance with AS 2985.

Laboratories performing analysis of respirable dust samples must be certified to *ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories* for the gravimetric determination of respirable dust and for the analysis of respirable crystalline silica.

5.6 Establishing a personal exposure monitoring program

5.6.1 Baseline monitoring

Baseline monitoring using SEGs shall be conducted to establish the initial estimate of exposure for the SEG and to define periodic monitoring requirements. Table 1 can be used for guidance on the sampling numbers required to establish a baseline estimate of exposure.

Table 1: Minimum sample numbers for baseline monitoring (source: *NIOSH occupational exposure sampling strategy manual*)

No. of workers in SEG (N)	Samples to be taken (n)
< 8	n = N*
8	7
9	8
10	9
11–12	10
13–14	11
15–17	12
18–20	13
21–24	14
25–29	15
30–37	16
38–49	17
50	18
> 50	22

* Minimum number of samples to be taken where N < 8 workers is 6 samples

Following the collection of sufficient samples, descriptive statistics shall be used to analyse the data and compare with exposure limit values (see Section 6.7.6). The minimum number of samples to be taken where N < 8 workers is 6 samples. By using the minimum number of samples specified in Table 1, there can be 90% confidence that at least one worker selected at random from the SEG will be in the highest 10% of all exposure in that SEG.

5.6.2 Periodic monitoring

Periodic monitoring requirements for each SEG shall be risk based and are dependent on the baseline monitoring estimate of exposure. The number of samples required as part of periodic monitoring can be determined using Table 2 (overleaf). Consideration of all existing data is also valuable in determining ongoing monitoring program requirements and may justify the need to set sampling targets above those in Table 2.

Table 2: Minimum sample numbers and frequency for periodic monitoring (source: adapted from *Occupational hygiene monitoring and compliance strategies*)

Ratio of exposure to occupational exposure limit (R)	No. of crews/shifts to be monitored per 10 workers
> 0.75	1 per month
0.5–0.75	1 per quarter
0.1–<0.5	1 per year
< 0.1	Not required*

* SEG monitoring can still be performed with an exposure to occupational exposure limit ratio of < 0.1

The model below is suitable for SEGs that have a small population, but is not suitable for large SEGs. An upper limit of 22 samples for SEGs can be applied for a periodic monitoring program. This limit does not preclude the collection of a greater number of samples if desired, and is a decision that should be guided by the statistical analysis of the data. An upper limit of 22 samples is consistent with the sampling targets that would be specified for a baseline assessment of a SEG, as defined in Table 1.

Where:

$$\mathbf{R} = \frac{\text{Average exposure (geometric mean of baseline/monitoring program data)}}{\text{Exposure limit}}$$

Example: The measurement of a longwall operator SEG baseline estimate of exposure has identified an average exposure to respirable coal dust of 2 mg/m^3. The SEG is made up of 4 crews/shifts of 5 workers, and an exposure limit of 3 mg/m^3 applies.

Given that the value for R is in the range **0.5–0.75** (2 ÷ 3 = 0.7), and the total population of the SEG is 20 workers (4 × 5 = 20), the ongoing sample program will be **2 crews per shift per quarter** (20 ÷ 10 = 2).

So in this example, the total number of samples to be collected during periodic monitoring for this SEG over 1 quarter is 10 samples (2 × 5 = 10).

5.6.3 Monitoring underground production SEGs

Notwithstanding the sampling requirements determined in previous sections, the minimum monitoring requirements for underground production SEGs are detailed in Table 3.

Table 3: Minimum sample numbers and frequency for monitoring underground production SEGs

SEG	Sampling interval	Minimum samples per interval
Longwall production	Quarterly	8–10
Development production	Quarterly	8–10

5.6.4 Monitoring program review

The respirable dust monitoring program shall be reviewed routinely. The frequency of this will generally be determined by the duration over which the respirable dust sampling plan is run (e.g. six monthly or annually).

If there are changes to the plant, equipment, operating environment or operating methods that have the potential to impact dust exposure levels, the frequency of sampling shall be reviewed and, in some instances, a new baseline established.

5.7 Additional personal sampling requirements

5.7.1 Sample duration

All personal samples collected to estimate exposure shall be collected in the breathing zone of the selected worker and performed over a period representative of normal shift activities. Full shift sampling is preferred but, as a minimum, the sample period should be at least 80% of the shift length.

5.7.2 Random sampling

Personal sampling should be conducted randomly (to the extent practical) to ensure samples collected cover a range of workers, crews and operating conditions.

5.7.3 Data collection

Records of sampling performed for respirable dust shall be kept for 30 years at the coal mine. If the coal mine ceases operations during this 30-year period the records are required to be kept, the site senior executive must ask for, and comply with, the chief inspector's directions about the storage of the records.

Records of sampling shall include:

- certificate of analysis for samples
- information contained in Table 4 and Table 5.

Table 4 details the minimum data to be collected by a person conducting personal sampling.

Table 4: Minimum data collection requirements for personal sampling records

Worker	
Details of sampled worker (name/employee no.)	Tasks/activity performed
Employment status (employee/contractor)	Shift rotation and length
Job title/description	Crew
SEG	Personal protective equipment used
Sample	
Sample date	Flow rates (initial/final/average)
Sampler (competent person)	Sampling duration (sample start/finish times)
Lab ID/filter ID/size selective sampler ID	Void reason (if relevant)
Sampling equipment, including calibrators (serial no., calibration status)	
Work environment	
Controls (including effectiveness)	Operational conditions (normal/maintenance day/equipment failures/spills etc.)
Production information (shears/tons/cutting sequence)	Nature of material (over burden/coal/cutting stone roof or floor)
Exposure sources (including adjacent activity)	Weather/seasonal factors
Housekeeping status	Ventilation (direction/rates)
Operator interaction with exposure sources	Other relevant information

Workers sampled shall also be issued a diary to record their activities during the shift. Table 5 details the typical information that should be captured in the diary.

Table 5: Example of a worker diary to be completed during personal sampling

Worker			
Name:		Employee status: employee/contractor	
Employee number:		Crew: A/B/C/D	
Job title:		Shift rotation and length:	
Sample date:		SEG:	
Sampler			
Filter number:		Calibration date:	
Pump number:		Calibration date:	
Activity log			
Time	Activity performed/ID of equipment/vehicle operated	Location	Respiratory protection used?
0600–0700			Y/N
0700–0800			Y/N
0800–0900			Y/N
…			Y/N
Work environment			
Describe conditions: Are controls (e.g. sprays) working? (Y/N) If no, why?			

5.7.4 Void or invalid samples

Samples that do not meet the minimum sampling or quality requirements are void or invalid and shall not be used for estimating exposure. The reason for deciding a sample is void or invalid must be documented. Additional samples shall be collected for the relevant SEG to replace any void or invalid samples.

Under no circumstances shall void or invalid samples be included in SEG datasets or used to estimate exposure.

5.7.5 Estimating exposure

Following the collection of sufficient samples, descriptive statistics shall be generated to summarise the dataset and estimate exposure.

To generate descriptive statistics, download the free industrial hygiene statistical analysis software tool, *EASC-IHSTAT-V235*, on the American Industrial Hygiene Association (AHIA) website at www.aiha.org.

Table 6 (overleaf) shows descriptive statistics with a brief explanation of their use.

Table 6: SEG descriptive statistics

<table>
<tr><th>Statistical measure</th><th>Description</th></tr>
<tr><td>Number of samples</td><td>This will usually be the SEG sample target. At least 6 samples are required to perform statistical analysis of a dataset.</td></tr>
<tr><td>Minimum/maximum</td><td>Describes the range of exposure values in a given dataset for a SEG.</td></tr>
<tr><td>Estimated arithmetic mean</td><td>Estimated average exposure of the SEG.</td></tr>
<tr><td>Geometric standard deviation (GSD)</td><td>A measure of the spread of data in a dataset. It’s expected that most exposures in a SEG are generally the same. If there is significant variation in a dataset, this will be reflected by the value of the GSD. High GSD values may indicate a need to undertake additional sampling or to review the accuracy of the SEGs definition.
<table>
<tr><th>GSD value</th><th>Degree of data spread</th></tr>
<tr><td>1.0–2.0</td><td>Data clustered around the mean—minimal variation</td></tr>
<tr><td>2.0–3.0</td><td>Moderate variation in the dataset, potentially due to:
elevated individual samples
samples below the limit of reporting
insufficient number of samples</td></tr>
<tr><td>> 3.0</td><td>Significant variation in the dataset, potentially due to:
significant outliers in the dataset
incorrectly defined SEG
insufficient number of samples</td></tr>
</table>
</td></tr>
<tr><td>95% upper confidence limit</td><td>This represents the value below which, a person can be 95% confident lies the true value of the SEG’s mean exposure.</td></tr>
</table>

5.7.6 SEG exposure assessment

Comparing SEG exposure data with exposure limits for respirable coal dust and respirable crystalline silica must be performed using the 95% upper confidence limit (UCL) of the mean. A SEG shall be considered conforming if the 95% UCL of exposure of the group is equal to or below the relevant 8 hour equivalent exposure limit.

Figure 2 (overleaf) shows the distribution curve for an example dataset, with the estimated arithmetic mean, 95% UCL and occupational exposure limit (OEL). In this example, the 95% UCL is greater than the OEL, and therefore considered non-conforming.

Figure 3 (overleaf) provides the same statistical measures for a different dataset, but in this case the 95%UCL is less than the OEL.

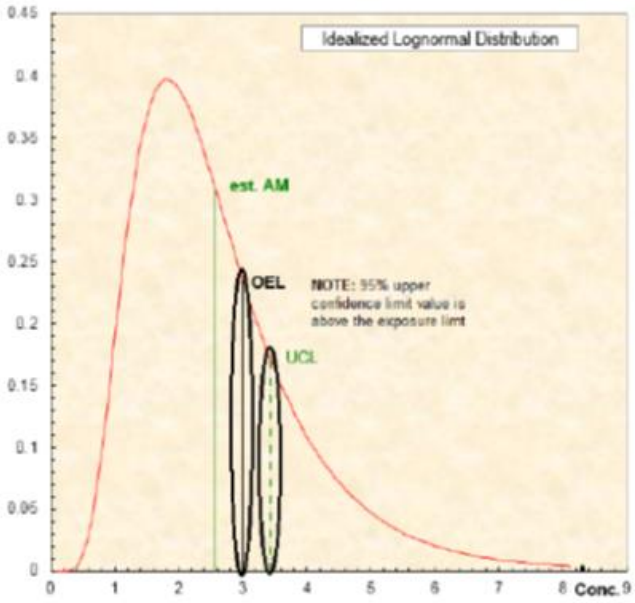

Figure 2: Example dataset—non-conforming

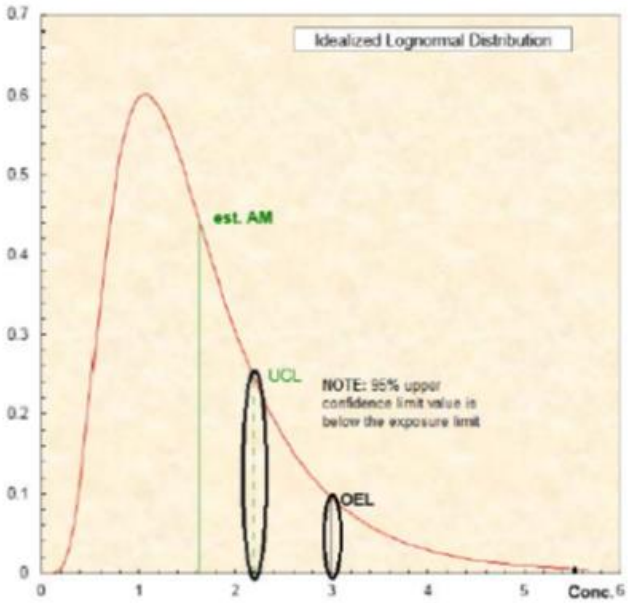

Figure 3: Example dataset—conforming

If the 95% UCL of any SEG exceeds 50% of the exposure limit, this shall be considered a trigger to undertake an ongoing review of exposure controls and their effectiveness.

If ongoing exposure data remains representative of the SEG exposure conditions, the data should be added to and analysed with the existing SEG data. SEG data should be reviewed at least annually, but more frequently if dictated by the sampling schedule, to determine if there are any differences between previous periods and identify any upward or downward trends in exposure due to reduced or increased control effectiveness.

5.7.7 Single sample exposure measurement

A single sample exposure measurement in excess of the relevant 8 hour equivalent exposure limit shall be considered a trigger for investigation and review of exposure controls.

6 Reporting

6.1 Single sample exceedance result

Figure 4 (overleaf) shows the requirements relating to a single sample exceedance result. These requirements apply if an individual personal dust sample result shows that the average concentration of respirable dust in the atmosphere of the work environment exceeds the levels stated in section 89(1) of the Mining Safety and Health Regulation 2001.

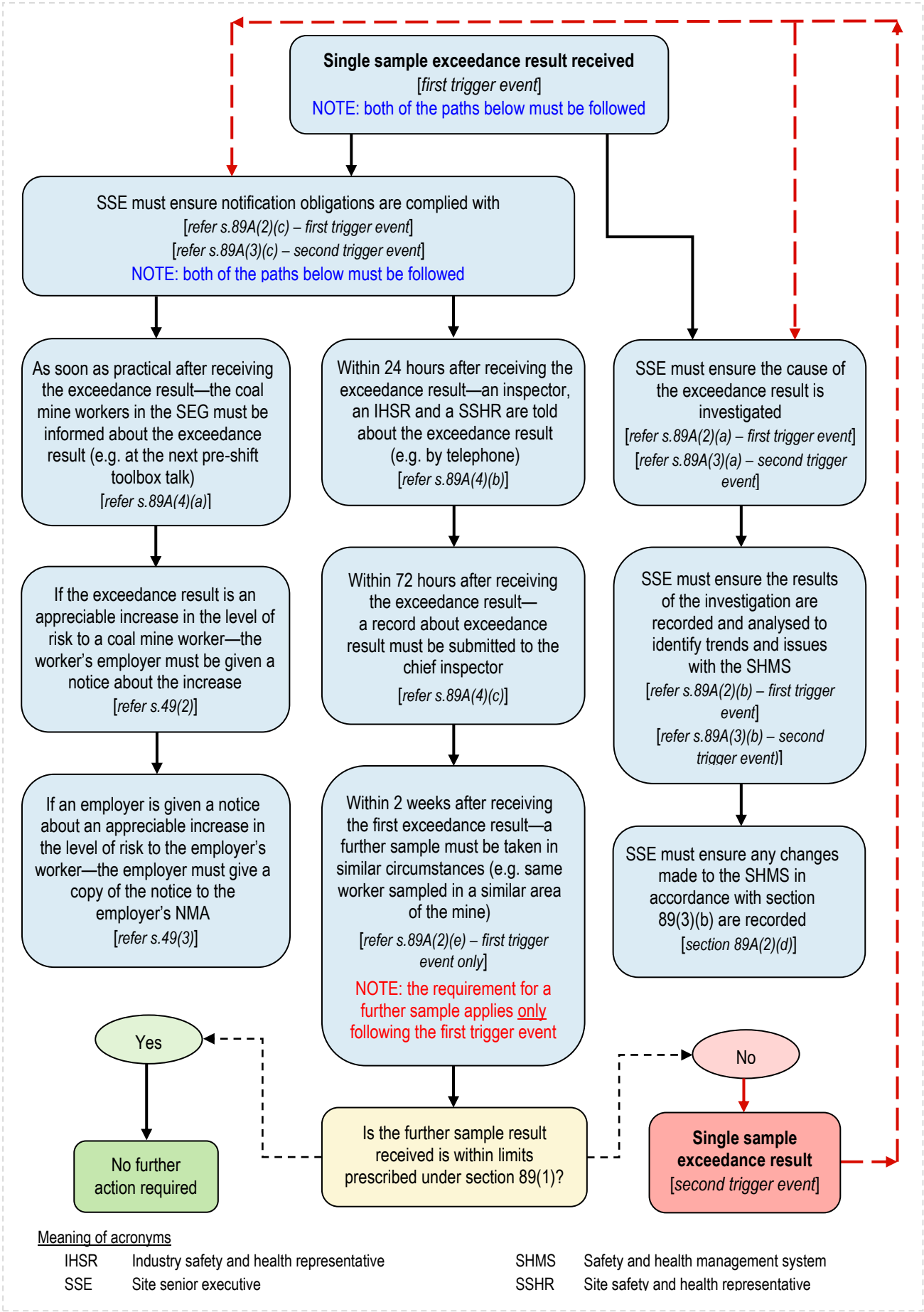

Figure 4: Single sample exceedance requirements

6.2 Quarterly dust sampling results

Each coal mine shall submit all personal respirable dust monitoring results to the chief inspector every 3 months (i.e. at the end of each quarter). The periodic dust monitoring results submitted shall include all personal exposure samples collected during the past quarter. All results should be classified into the SEGs outlined in the department's *Similar exposure groups: coal mine workers' health scheme* factsheet (DNRM 2016).

The dust monitoring results must be submitted in a way and in a format approved by the chief inspector as described online at the Queensland Government Business Queensland website at www.business.qld.gov.au/industry/mining/safety-health/mining-safety-health/mining-hazards/dust

7 Investigating exposure exceedances

If a personal sample exceeds the relevant exposure limit, an investigation shall be initiated. The aim of the investigation shall be to determine the absent or failed control/s that contributed to the measured exposure, and to define the actions required (short and/or long term) to prevent a reoccurrence and the time frame for their completion.

At a minimum, the investigation shall consider the following:

- date of sample
- SEG and location
- crew
- activities/tasks carried out (including times)
- personal protective equipment used and for what activities/tasks (including times)
- controls in place
- production information (e.g. metres cut/number of shears, banked cubic metres)
- material (e.g. coal, stone, overburden, fine, blocky)
- operational conditions (e.g. normal/maintenance, shift/downtime)
- environmental conditions
    - underground—face ventilation, rate/direction, maingate, tailgate
    - open-cut weather conditions
- operator location (operating out of dust plume)
- adjacent activities
    - inbye road conditions (wet/dry)
    - support activities
- maintenance schedule vs actual—maintenance records for all equipment (e.g. belts, curtains, sprays, picks)
- equipment pre-shift checks
- sampling data (determine if sample valid)
    - sampler
    - sampling time
    - flow rate (pre, post, average)
    - calibration records of equipment (e.g. pump, microbalance, X-ray diffraction)
    - filter procedure followed
- engineering control performance
    - curtains/seals (number/locations/effectiveness)
    - sprays (system in place/operational as design/effectiveness)
    - belts (wet down)
    - any other relevant factor.

The results of the investigation shall be recorded and analysed to identify any trends and issues with the coal mine's safety and health management system. Any subsequent changes made to the safety and health management system shall also be recorded.

7.1 Resampling following an investigation

The requirements to resample a SEG following an individual exceedance shall be determined as an outcome of an investigation. Resampling would generally occur following the implementation of additional controls to verify their effectiveness at reducing exposure levels. However, if sampling for the SEG is occurring frequently (e.g. monthly) as part of the respirable dust sampling plan, resampling may not be necessary. For some SEGs the investigation may trigger a review of the respirable dust sampling plan requirements, resulting in an increase in the number of samples and/or frequency of monitoring required.

Notwithstanding the previous paragraph, there is also a requirement under section 89A(2)(e) of the Coal Mining Safety and Health Regulation 2001 for a further sample to be taken within 14 days of an individual exceedance result being received by the coal mine. The resample should, as far as practicable, be taken in the same circumstances as the initial sample (to which the exceedance relates)—for example, by resampling the same coal mine worker (or another coal mine worker in the same SEG undertaking a similar role) in an area of the coal mine similar to the area in which the initial sample was taken. A resample result shall not be included in the periodic monitoring requirements outlined in Section 6.6.2 of this recognised standard.

8 Tampering with samples or results

A person must not tamper, or allow another person to tamper, with a sample or the results of a sample taken to monitor a worker's exposure to respirable dust at a coal mine.

9 Definitions

Aerodynamic diameter	Property of a dust particle, based on its size and density, which predicts where it will be deposited in the respiratory tract
Appreciable increase in level of risk	Where the statistical analysis of SEG data shows an increase of the SEGs 95% UCL to a level at which the 95% UCL is greater than the exposure limit—if this occurs, a notice must be given to the worker's employer
Average concentration	Time-weighted average calculated under AS 2985 for a single sample
Breathing zone	A hemisphere with a 300 mm radius extending from to front of the face and measured from the mid-point of a line joining the ears
Chief inspector	Means the chief inspector of coal mines under the *Coal Mining Safety and Health Act 1999*
Competence	For a task at a coal mine, is the demonstrated skill and knowledge required to carry out a task at a coal mine to a standard necessary for the safety and health of persons

Crystalline silica (or free silica)	The terms free silica and crystalline silica are used interchangeably; and represent the most toxic form of silica
Monitoring	An ongoing program or strategy that uses sampling to estimate workers' exposure to dust levels or to assess the magnitude of dust levels
Occupational exposure limit (OEL)	The airborne concentration of a particular chemical or substance in the workers' breathing zone that should not cause adverse health effects or cause undue discomfort to nearly all workers
Periodic monitoring	The process of checking for changes to a SEGs estimate of exposure—used to assess if each coal mine worker's exposure to airborne contaminants is kept to an acceptable level, or if there has been an appreciable increase in the level of risk to a coal mine worker, or the effectiveness and efficiency of dust control measures (periodic monitoring measurements are added to baseline SEG data and statistically analysed to make these assessments)
Sampling	The process of collecting a measurement or series of measurements to assess a worker's unprotected exposure
Similar exposure group (SEG)	A group of workers who have the same general exposure to risk (e.g. the similarity and frequency of the tasks they perform, the materials and processes with which they work, or the similarity of the way they perform those tasks)
Shall	The word 'shall' is used in this recognised standard to indicate a required course of action
Should	The word 'should' is used in this recognised standard to indicate a recommended course of action

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