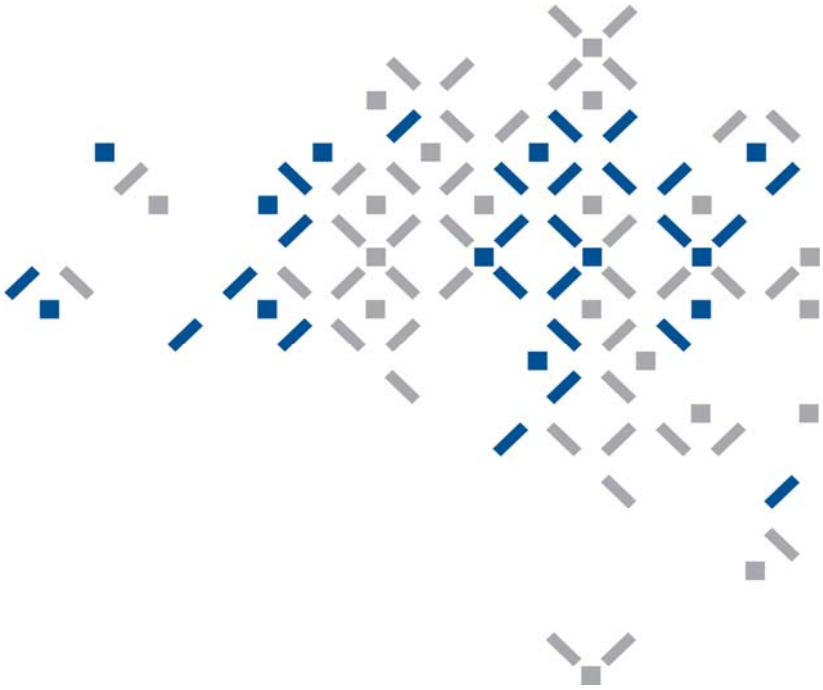

Recognised Standard 09

The Monitoring of Sealed Areas

Coal Mining Safety and Health Act 1999

Queensland Government

RECOGNISED STANDARD 09
THE MONITORING OF SEALED AREAS

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

Purpose of recognised standards

71. 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.

Recognised standards

72.(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.

Use of recognised standards in proceedings

73. 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 2001*, the Act or Regulation takes precedence.

This recognised standard is issued under the authority of the Minister for Mines and Energy [Gazetted]

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RECOGNISED STANDARD 09
THE MONITORING OF SEALED AREAS

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RECOGNISED STANDARD 09
THE MONITORING OF SEALED AREAS

1. OBJECTIVE

Monitoring of sealed areas should be carried out in order to adequately predict and define the potential for an explosive atmosphere to occur within a sealed area. Sufficient samples should be taken to delineate both the size of any explosive zone and the time that the zone will be within the explosive range.

In addition, monitoring is to be carried out to identify any occurrence of spontaneous combustion within the sealed area, as a potential ignition source of possible explosive gas mixtures.

Gas monitoring protocols relating to sealed areas are to be integrated into the existing mine gas monitoring system and to include suitable alarm levels which have been established. The gas monitoring system must be maintained in accordance AS2290.3.

The facility for monitoring of sealed areas should be developed using a risk assessment approach and is to include, but not necessarily limited to, the following:

- Location of Monitoring Points;
- Gases to be Monitored;
- Sampling Frequency for each of the four sealed area types considered into this standard:
    - Type 1: Non Explosive
    - Type 2: Explosion Risk
    - Type 3: Fuel Rich
    - Type 4: Abnormal Oxidation and/or Spontaneous Combustion
- Seal Maintenance

Further information in regards to these topics is located within this document.

2. LOCATION OF MONITORING POINTS

The ventilation officer is responsible for the location of suitable monitoring sites of relevance to the area being sealed. They are to ensure that sufficient monitoring points are installed to enable as complete an understanding as possible of the behaviour of the gases within sealed areas and to facilitate the early identification of explosive mixtures of gases and / or the development of a spontaneous combustion event.

The number and location of such monitoring points should be identified via risk assessment, which should take into consideration the following factors:

- the history of previously sealed areas in the mine and the panel being sealed.
- the number, quality and type of existing seals;
- any induced air flows through the sealed areas – induced air currents;
- the degree of hazard posed by sealed areas eg. explosibility;
- rate of ingress / diffusion of seam gas and its nature i.e. methane and / or carbon dioxide;
- seam contours within the sealed areas;
- the topographical variation in gas concentration within the sealed area;
- gases to be monitored; and
- any layering of gases, for example, hot spontaneous combustion gases tend to layer toward the roof.
- Inertisation outlet at the point of discharge into the underground workings.

3. PARAMETERS TO BE MONITORED

Sealed areas should be monitored for **carbon monoxide, carbon dioxide, methane, oxygen, hydrogen, ethane and ethylene** on a routine basis.

The design of the sampling regime will be influenced by previous experience at the mine in monitoring of sealed areas and be based on a risk assessment. It must conform to and meet the requirements of the mines Spontaneous Combustion Management Plan and all other relevant Hazard Management Plans and this Recognised Standard.

Pressure differentials across seals and sealed areas are to be minimised with the differential to be understood and appropriate monitoring set. The installation of pressure gauges on each seal may assist in determining pressure differential and leakage.

The barometric pressure should be measured and the monitoring regime designed to take into account the effect of sealed areas breathing.

4. SAMPLING FREQUENCY

Samples should be taken from the sealed areas at a frequency appropriate to the anticipated rate of change of the gas mixture behind the seal. This should be at a rate sufficient to adequately predict explosibility and identify leakage. Any potentially highly hazardous areas should be sampled intensively and extensively; for example – areas where explosive mixtures or spontaneous combustion could occur as identified by risk assessment

The sampling frequency of sealed areas may differ from point to point dependent on the objective of the sample point. Points being used to check for the presence or absence of layering may be sampled less frequently than those designated for monitoring the explosive state of the sealed area.

The sampling frequency of these points will be determined by the safety of the atmosphere within the sealed area.

There are four sealed area types considered in this guideline:

Type 1 **Non-Explosive**	A sealed area where the atmosphere progresses from essentially fresh air to an inert atmosphere without going through the Explosion Risk Safety Zone. A subset of this type is the sealed area atmosphere that does not go inert but retains an oxygen concentration above 8% even though there is NOT sufficient methane to generate an explosive atmosphere.
Type 2 **Explosion Risk**	A sealed area where the atmosphere progresses from essentially fresh air into the Explosion Risk Safety Zone.
Type 3 **Fuel Rich**	A sealed area where the atmosphere has progressed to a Fuel Rich atmosphere.
Type 4 **Abnormal Oxidation and/or Spontaneous Combustion**	A sealed area which is, or is suspected to be, undergoing abnormal oxidation and/or spontaneous combustion. Such sealed areas will interact not only with the seam gas, but may liberate their own explosive mixture of gas.

Abnormal oxidation and spontaneous combustion can be indicated by a variety of means including:

- Abnormal levels of carbon monoxide –concentration and rate of concentration increase.

- Abnormal values of specific indicator ratios such as CO – O_2 deficiency ratio or CO – CO_2 ratio.
- Detection of increased hydrogen, ethylene and other higher hydrocarbons should be used to confirm an intense (high temperature) spontaneous combustion is occurring.

Experience from previous panel sealings may provide an indication of the initial sampling frequency and the types of gases likely to be detected.

Type 1 – Non-Explosive Atmospheres

Some sealed areas may go directly from essentially fresh air to an inert atmosphere due to the minimal occurrence of flammable gases in the mine. The levels of flammable gas are such that should the sealed area atmosphere be diluted with fresh air, the resultant gases could not form an explosive mixture. Such areas would require minimal sampling, other than to confirm that there is no evidence of the presence of spontaneous combustion.

Where the atmosphere behind a sealed area cannot form an (buffer) explosive risk safety zone (type 2) --- sampling may not be on a continuous basis.

Example

A sealed area with carbon dioxide seam gas may need to be monitored daily until three consecutive samples indicate that the entire sealed area is below 8% oxygen.

For atmospheres where the oxygen concentration remains above 8% and the methane concentration, as established by the daily sampling trends, cannot exceed 2.5%, sampling frequency may be sequentially reduced to a level commensurate with ensuring the safety of the atmosphere.

Type 2 – Explosion Risk Atmospheres

For Type 2 sealed area atmospheres that lie within the Explosion Risk Safety Zone where the oxygen concentration is greater than 8% and the methane concentration is between 2½% and 22%, sampling should be conducted either by

i. A suitably calibrated tube bundle monitoring system, or
ii. A regular sampling regime such that a maximum change in the methane concentration of 0.5% CH_4 absolute can be detected between samples

until either the oxygen concentration falls below 8%, or the methane concentration exceeds 22%.

When the oxygen concentration drops below 8% or the methane concentration exceeds 22%, the sampling rate could be reduced as defined in Section 4.3 below for Type 3 sealed areas.

Example

Sealed area with a methane seam gas, where predicted rate of methane ingress is sufficient to generate an atmosphere that will become explosive after 2 days. The predicted rate of rise of methane is 0.1% per hour; therefore, 5 hourly sampling should be sufficient, until Section 4.3 applies. Of course, should the measured rate of rise differ from predicted, then the sampling rate would be adjusted accordingly.

Type 3 – Fuel Rich Atmospheres

Atmospheres which have progressed into the Potentially Explosive (Fuel Rich) zone containing less than 8% oxygen or greater than 22% methane, can be reclassified as Type 3 sealed area atmospheres.

They should be sampled at a minimum daily basis until the sealed atmosphere contains less than 5% oxygen for a minimum of 5 consecutive days. Sampling frequency may then be sequentially reduced to a level commensurate with ensuring the safety of the atmosphere

4.4 Type 4 – Areas Subject to Abnormal Oxidation and/or Spontaneous Combustion

A sealed area which is, or is suspected to be, undergoing abnormal oxidation should be sampled by a suitably calibrated tube bundle or suitable monitoring system.

The mine-site Spontaneous Combustion Management Plan shall define the limits of normal oxidation.

Such monitoring should continue for 5 days AFTER the atmosphere has moved into the ranges detailed under Type 1 or Type 3 sealed areas (need to assess with respect to other gases). Sampling frequency may then be sequentially reduced to a level commensurate with ensuring the safety of the atmosphere.

5. SEAL MAINTENANCE

A maintenance program with respect to seal quality should be implemented to remove the possibility of significant air leakage into a sealed area which could create an explosive atmosphere, this should form a part of the Ventilation and Spontaneous Combustion PHMP's.

Should monitoring data indicate significant air leakage through seals, the sampling regimes appropriate to the relevant atmosphere types will need to be reintroduced.
The finding of a major leakage path should trigger action through the site TARP.

6. GENERAL INFORMATION

- Sampling is to be undertaken in such a way as to avoid the possibility of contamination of samples or the collection of spurious samples eg. air ingress or from condensation reacting with galvanised pipes, and due consideration is given to the potential for layering or stratification of the gases within the sealed area. As a general rule, a minimum of three times the volume of gas occupying a sample pipe should be extracted from the pipe before a sample for analysis is taken.
- Sample collection devices (i.e.; bags) should be flushed at least three times with the gas being sampled before the bag is finally filled. (Include volume of tube).
- Sampling locations must be consistent to enable a meaningful comparison of time separated data to be undertaken. Sample locations within the sealed areas should extend as far as practicable into the sealed area to minimise the effects of breathing seals and dilution with air caused by diurnal pressure changes.
- Once the area is sealed it is not possible to inspect the location of a sampling point. To ensure accurate sampling there must be redundancy built into the system with additional sample pipes fitted to duplicate critical monitoring points.
- Borehole sampling should be undertaken with great care to ensure that there is no contamination of the sample from other sources such as rider coal seams or air leakage from the surface.
- Where possible boreholes should be fully cased and fitted with an airtight collar.
- Boreholes that are "breathing in" should not be sampled.
- Gas analysis data and historical records should be available and readily accessible at all times.
- Lag time should be considered in tube bundle application.

- The mines PHMP on Spontaneous Combustion should define the training and competencies required for the operation.

7. ANALYSIS OF INFORMATION AND RESPONSE

The data once analysed should be referenced to the site Trigger Action Response Plans (TARP's), from this point action should be taken that reflects the actions and associated responsibilities as defined in the TARP.

Note;

- Trends in values are more important than the absolute values.
- A rapid change in a gas concentration or indicator may indicate a potentially serious situation long before the trigger level is breached.
- Samples should be checked for reliability / consistency and, when in any doubt, the area in question should be re-sampled.
- It must be recognised that sampling data is point analysis and may not be totally representative of the entire sealed area.
- When analysing samples from sealed areas, due consideration should be made for the possible dilution of spontaneous combustion indicators due to air leaking in through seals under barometric pressure fluctuations.
- Analysis based on hand held gas-monitoring instruments, particularly stain tubes, should be treated with extreme caution and substantiated wherever possible by more accurate methods. These devices are best used to confirm or deny measurements by other devices where there is some uncertainty or ambiguity in the original measurement.
- Assessment of the explosibility of mine atmospheres should allow for the different lower explosive limits (LEL), and upper explosive limits (UEL) of the various potential explosive gases present and the variation in the LEL and UEL of complex mixtures of these gases. Determination of explosibility should include an appropriate margin for error and uncertainty in the measurement.
- In determining the controls for the Spontaneous Combustion PHMP the mine should consider the back up systems and response of the monitoring and analysis infrastructure and the quantity of suitably trained personnel.

8. STORAGE OF INFORMATION

The data must be kept in such a form as to be readily accessible and useable for trending and interpretation.

Historical data is an important resource and should be analysed and kept available to allow accurate determination of the normal behaviour of sealed areas at that mine and allow early detection of any deviation from normality.

9. RECORDS

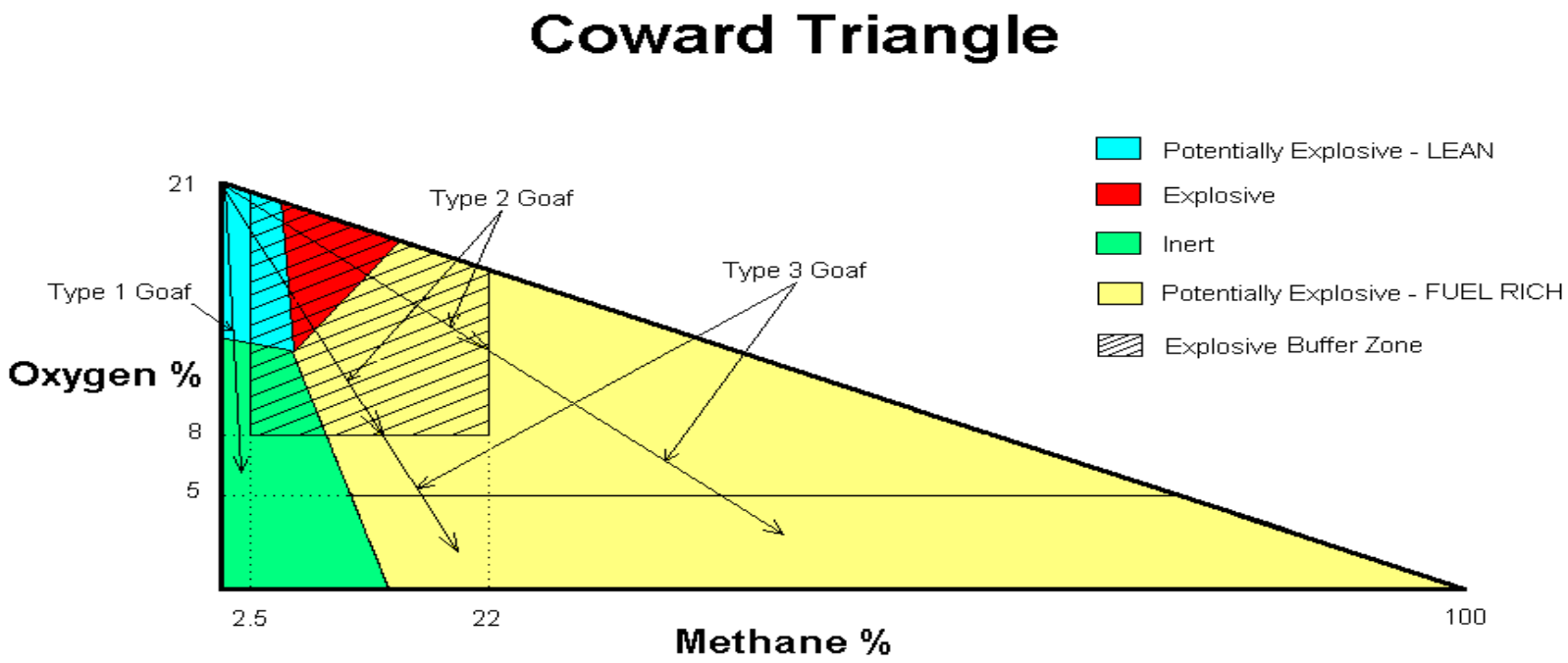
Records are to be maintained for each seal for the life of the mine and made available as a historical database for use in risk assessments for future sealings.

10. REPORTING

Systems should be established to enable the display of information to the workforce to include a graphical representation of the gases and associated trends.

The display data should also include barometric pressure and statutory inspection data and be accumulated. These shall be displayed to depict any significant trend.

Action levels, as specified within the relevant parts of the mines Hazard Management Plans, should be clearly displayed.



Sampling Regime **SUMMARY ONLY - see text for details**

Type 1 Goaf : Fresh Air to Inert : Sampled Daily Until Below 8%

Type 2 Goaf : Fresh Air through Explosive Buffer Zone : Sampled to Determine 0.5% CH4 Rise

Type 3 Goaf : From Buffer Zone into Potentially Explosive RICH : Sampled Daily Until Below 5% Oxygen

Type 1 Below 8% Oxygen and
Type 3 Below 5% Oxygen : Sampled Commensurate with Ensuring Safety of the Atmosphere

11.