Department of Natural Resources, Mines and Energy

Recognised standard 16

The use and control of polymeric chemicals at underground coal mines

April 2019

Coal Mining Safety and Health Act 1999

Queensland Government

Recognised Standards may be updated from time to time. To ensure you have the latest version, check the DNRME website: https://www.business.qld.gov.au/industry/mining/safety-health/mining-safety-health/legislation-standards-guidelines or contact your local Inspector of Mines.

South Region - Rockhampton PO Box 3679 Red Hill Q 4701 P (07) 4936 0184 rockyminesinsp@dnrm.qld.gov.au	**North Region - Mackay** PO Box 1801 Mackay Q 4740 P (07) 4999 8512 minesmackay@dnrm.qld.gov.au	**South Region - Brisbane** PO Box 15216 City East Q 4002 P (07) 3330 4272 sthmines@dnrm.qld.gov.au
North East Region - Townsville PO Box 1752 MC Townsville Q 4810 P (07) 4447 9248 tsvmines@dnrm.qld.gov.au	**North West Region – Mount Isa** PO Box 334 Mount Isa Q 4825 P (07) 4747 2158 isamines@dnrm.qld.gov.au	

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

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 31 May 2019]

Contents

1 Background

The Australian Coal Mining Industry has a history of safety and health incidents relating to the use of polymeric chemicals and as such the following comments are raised and support the fundamentals of this recognised standard.

- Whilst the health impacts of exposure to these substances were believed to be well understood recent testing to develop this standard have identified elements that require further testing and validation.
- The role of skin absorption as a significant route of exposure has only been acknowledged in recent times. As such a lack of historical biological monitoring data may have resulted in an underestimation of the potential exposure risks to coal mine workers using these substances.
- As more atmospheric and biological monitoring exposure data is gathered and a better understanding of the exposure profile for coal mine workers using these chemicals is gathered, the requirements within this standard may need to be reviewed and altered as appropriate.

2 Purpose

The purpose of this standard is to provide information, guidance and direction where required for a mine to develop, establish and maintain systems for the safe storage, transportation, usage and disposal of polymeric chemicals. This includes but is not limited to the following:

- Preventing the use of inappropriate chemical formulations
- Ensuring these products are only applied by trained, competent and capable organisations.
- Ensuring systems are in place to achieve an acceptable level of risk for all parts of the process.
- Ensuring systems are in place to monitor the health of coal mine workers using or who could be reasonably expected to be exposed to these products.

Implementation of this standard should be achieved in conjunction with reference to the relevant sections of the *Coal Mining Safety and Health Act 1999* (CMSHA) and Coal Mining Safety and Health Regulation 2017 (CMSHR).

3 Scope

This standard covers the use of polymeric chemicals at Queensland coal mines. This includes *any use of 'single use systems'* including but not limited to application for ventilation control device sealing. This standard does not include the polymeric substance contained in 'foam filled' tyres.

The use of polymeric chemicals is typically for void filling, strata binding, strata sealing, pumpable resin bolting systems amongst other applications, however this recognised standard is applicable for any applications at coal mines. This standard is not intended to cover all of the obligations under the WHS legislation for those who may manufacture, import or supply products covered by this standard.

This recognised standard prescribes elements for the development of site specific procedures for the use of polymeric chemicals and more broadly provides specific direction for:

1. The use of polymeric chemicals that meet requirements of manufacturers and suppliers of these substances to the Queensland Coal Mining Industry.
2. Requirements for health monitoring of those mines and organisations that practice the application of polymeric chemicals. The use of polymeric substances is more generally depicted as storage, transportation, handling, mixing, pumping, injection, void filling and disposal of excess materials and associated equipment.

3. Operational controls and practices. Such controls are aimed at the prevention of excessive heating, ignition and the control of exposure to the polymeric substances either directly through skin contact or indirectly via inhalation of vapours or aerosols. Specific direction is also outlined for the maintenances and servicing of pumps and apparatus used in such application(s).
4. Requirements for the training of personnel transporting, storing, using and disposing of polymeric chemicals.
5. Requirements for the appropriate selection, safe use and routine maintenance of equipment associated with the application of polymeric chemicals.
6. Requirements for appropriate response in the event of an uncontrolled release of a polymeric chemical.

4 Polymeric chemical testing requirements for use in Queensland

Only polymeric chemicals that have been subjected to the two (2) testing criteria specified below and have been issued with a report detailing compliance with these criteria will be acceptable for use in Queensland underground coal mines:

Testing criteria 1: "Arnsberg Test" detailed in Appendix 1 or equivalent, and

Testing criteria 2: "MDG 3608 Appendix D – Polymeric Materials Test Manual – TM003" detailed in Appendix 2 or equivalent.

The provider of these polymeric chemicals or a provider of services that uses these chemicals shall ensure that the chemicals that they are supplying or using comply with the aforementioned testing criteria.

The SSE of a coal mine shall ensure that any polymeric chemicals used on his mine site comply with the aforementioned testing criteria.

The SSE shall provide copies of certificates of testing for the aforementioned testing criteria to any coal mine worker, Industry Safety and Health Representative or inspector who requests a copy.

5 Risk management process

Prior to the use of any polymeric chemical the site will develop a documented way of working derived by risk management using a risk assessment process recognised by the mining industry as an acceptable process for identifying and controlling hazards. Consideration should be given, but not limited to the following:-

- The types of the polymeric chemical and details for its intended use.
- The physical and chemical properties of the product including reaction temperatures.
- Positioning of equipment and work locations.
- Sufficient ventilation quantity and arrangements to remove and/ or dilute airborne contaminants.
- The health hazards associated with exposure to polymeric chemicals. These will vary depending on:
    I. The individual chemical ingredients and their properties,
    II. The frequency and intensity of exposure,
    III. The route of entry into the body (e.g. Ingestion, absorption or inhalation), and
    IV. The susceptibility of the individual exposed.
- Volumes of product injected and hole spacing.
- Uncontrolled release of chemicals (e.g. Spills, ruptured hoses, ruptured containers).

- Unplanned or undesired outcomes including generation of excessive heat or ignition of products.
- Communication requirements during application (e.g. DAC location).

The development of the documented procedure will include a content expert such as an occupational hygienist, chemist or occupational physician who has a sound knowledge of the chemical ingredients and health and safety hazards associated with the use of these chemicals as well as a relevant cross section of coal mine workers involved in carrying out the tasks.

The procedure will consider and document:

- Preventing the use of inappropriate chemical formulations,
- Mixing of incompatible products,
- Ensuring these products are only applied by trained and competent coal mine workers,
- The ventilation quantities and plan,
- Any atmospheric monitoring requirements (refer to Appendix 4)
- Details of the zones of operation (ZOO) and restricted access zones (RAZ) and how these will be controlled,
- General arrangement illustrations for equipment set up locations,
- Volumes of product injected and hole spacing. Note: Volumes not to exceed quantities specified in Table 1.
- Personal protective equipment requirements,
- Ensuring systems are in place to monitor the health of coal mine workers,
- Spillage and emergency response requirements, and
- Communication plan.

Table 1: Quantity (kg) of injection resins not to be exceeded per injection hole.

Polymeric injection chemical	Maximum quantity to be injected per hole (kg)
Phenolic injection resins (excludes phenolic cavity fillers)	600 kg
Polyurethane (PUR) injection resins	200 kg
Urea silicate injection resins	400 kg
Pumpable resin grouting systems	400 kg

6 Training

The SSE will ensure coal mine workers engaged for the purpose of using polymeric chemicals are trained and deemed as competent in the safe transportation, storage use and disposal of these products as appropriate to the task they are performing. This training must cover the safety and health hazards associated with these products and response to any uncontrolled releases of these products.

Coal mine worker (CMW) awareness training shall be conducted for all CMWs with potential to be exposed to polymeric chemicals.

It is understood that the skills and tasks of the workers engaged by organisations that practise the application of polymeric substances, fall into four (4) general roles:

Pump operators /decanters – those workers directly associated with pumping, pump maintenance, and the open drum decanting of individual polymeric chemicals into the holding vessels.

Applicators / mixers – those workers that operate the nozzle and inject or cavity fill mixed polymeric substances or working at the point of application.

Transport and handling– those workers who load and transport polymeric chemicals in their sealed containers (usually contained in locked bulk storage pods).

Supervision – persons who are in control and supervise the polymeric chemical work and includes those who are appointed in control of the explosion risk zone (ERZ) in which the work is being undertaken.

The training packages relevant to the above roles are to be provided by the suppliers of polymeric chemicals to the SSE for adoption in the mines SHMS. The mines training scheme must provide for refresher training for coal mine workers.

The SSE must ensure that records of this training are documented and available at the mine.

7 Plant and Equipment

The SSE is to ensure that all plant and equipment used for the application of polymeric chemicals is designed, used and maintained in accordance to the manufacturers and/or suppliers requirements.

This includes but is not limited to the following:

7.1 Selection and design of equipment

7.1.1 Storage & transport equipment

Containers used for the storage and transport of chemicals should:

- Be of a robust design to minimise the risk of structural failure during transport and storage,
- Be constructed of materials suitable for the chemicals being transported and stored
- Provide for sufficient segregation of chemicals,
- Protect chemicals from water ingress,
- Provide means of keeping the chemicals secure from inadvertent removal from the storage and transport container (i.e. lockable), and
- Give consideration to spills and leaks in the design of equipment.

7.1.2 Mixing & pumping equipment

The use of hoses, piping and fittings shall be undertaken in accordance with Mining Design Guideline 41: *Guidelines for fluid power safety systems at mines* (MDG 41). This shall include consideration of the following to ensure equipment is fit for purpose:

- Prior to use all components (containers, pumps, hoses, o-rings, back-up rings, connectors, stand-pipes etc.) to be confirmed as being compatible with the chemicals being utilised,
- All fittings should be secured in place and have a safety factor of 4:1 on rated working pressure to the failure of the component to perform its function.
- All hoses should have a factor of safety of at least 4:1 on rated working pressure to burst pressure.
- All other components of the system should have a safety factor of at least 2.5:1 on rated working pressure to burst pressure.
- Generally hoses should not be interchangeable between chemical components. Where hoses are to be interchanged, this must only be done following a risk assessment that gives consideration to cleaning/ rinsing requirements, compatibility of the chemicals being used and the potential impact of any reaction on the integrity of the hoses and fittings.
- All hoses used shall be clearly identified

- Pumping equipment should be provided with a pressure relief safety valve on the pump that bleeds the over pressure back through the pumping system lines such that chemicals are not vented to atmosphere.
- Evidence of pump relief valve settings and calibration to be provided.

Additional information on aspects of hydraulic safety can be found in:

- https://www.resourcesandgeoscience.nsw.gov.au/__data/assets/pdf_file/0008/419489/MDG-41-Fluid-power-systems.pdf
- Australian Standard AS2671-2002 Hydraulic fluid power – General requirements for systems

7.2 Inspection and maintenance of equipment

The SSE shall ensure a system is in place to perform routine operation inspection and maintenance to the equipment to ensure it is, and remains in a fit for purpose state.

A maintenance and servicing system shall be established to allow early detection of any defect in plant or equipment which could result in a reduced level of operation or protection. The maintenance system should consist of a suitable combination of documented:

- Visual checks,
- Selection of suitable hose materials and fittings,
- Calibration of pump pressures and mixing ratios,
- Periodic inspection of administrative and operational control measures and,
- Testing and preventative service.

Maintenance and servicing must be carried out by trained and competent personnel.

8 Storage

The mines procedure must ensure that polymeric chemicals are stored at the mine site in accordance with the manufacturer's requirements and any relevant Australian Standards for the storage of hazardous chemicals and dangerous goods. This includes requirements for:

- temperature control
- ventilation
- spill containment
- compatibility of chemicals
- signage
- access
- fire response

Only sufficient polymeric chemicals for the planned application shall be taken into the mine. Any materials that are not used as part of the planned application shall be removed from the underground workings within 48 hours.

The procedure must provide for a product management process to ensure that only polymeric chemical products within the manufacturer's prescribed shelf life are available for use at the mine.

Relevant Australian Standards include:

- AS/NZS 3838: 2007 *"The storage and handling of mixed classes of dangerous in packages and intermediate bulk containers"*

- AS/NZS 3780: 2008 "*The storage and handling of corrosive substances*"

9 Disposal

Spent polymeric material/substance containers are to be re-sealed immediately after use, the containers must not be used for any other material and the containers removed from underground in locked steel pods and disposed of as per the procedure.

10 General requirements for hazardous substances

Polymeric chemicals are hazardous substances as defined by the Coal Mining Safety and Health Regulation 2017 and as such the provisions of the regulations under section 54 – 56 apply. This includes but not limited to the following:

- Introduction to site process
- Provision of Safety Data Sheet (SDS) in appropriate locations
- Labelling requirements
- Provision of appropriate first aid facilities.

11 Health surveillance and biological monitoring requirements

The SSE shall ensure that personal exposure to polymeric chemicals is reduced to as low as reasonably achievable. Such responsibility will also extend to the periodic and appropriate health surveillance and biological monitoring of coal mine workers to:

- Monitor for changes from baseline at earliest opportunity (health surveillance); and
- Ensure that exposures are being controlled (biological monitoring).

For the purposes of section 11 **"apply"** means operating pump, operating nozzle, supervising application (including explosion risk zone controller [ERZC]) and handling/ throwing/ decanting opened drums of product.

11.1 Health surveillance for isocyanates

The purpose of routine health surveillance is to identify any changes from baseline at the earliest opportunity. The employer shall ensure that all coal mine workers who apply polymeric chemicals containing isocyanates must complete baseline health surveillance before starting work in an isocyanate process, and this evidence is to be provided to the SSE.

This health surveillance shall include the following:

- Demography, occupational and medical history and health advice,
- Standardised respiratory function test,
- Respiratory questionnaire,
- Skin examination

These coal mine workers must than participate in routine health surveillance at regular intervals as specified by Safe Work Australia in the document "Isocyanate Health Monitoring" included as Appendix 3 and available for download at https://www.safeworkaustralia.gov.au/doc/isocyanates-health-monitoring

11.2 Biological monitoring

Polymeric chemicals may enter the body through more than one route of entry including:

- Inhalation
- Skin absorption
- Ingestion

It is therefore necessary to measure the worker in a way that can make an assessment of the true exposure from all routes of entry. This usually involves measuring the workers urine or blood for the presence of a certain chemical or a metabolite of a chemical. This is referred to as biological monitoring.

Exposure through skin absorption is potentially the major route of entry when mixing and pumping polymeric chemicals. This is because of:

- The physical and chemical properties of the ingredients contained in polymeric chemicals,
- The work processes currently used to mix these products can increase the risk of skin contact,
- The availability of adequate ventilation in most locations where these products are applied underground will dilute vapours generated and reduce the inhalation risk.

For these reasons biological monitoring will provide a more accurate assessment of worker exposure rather than personal atmospheric monitoring methods.

Note: There may be circumstances where atmospheric monitoring may be desirable such as:

- In order to understand the inhalation risk
- In order to understand the effectiveness of ventilation
- In order to understand the effectiveness of personal protective equipment.

Additional information of atmospheric monitoring and the workplace exposure standards can be found in Appendix 4.

11.2.1 Biological monitoring requirements

The procedure shall provide for the establishment of a biological monitoring programme for coal mine workers identified in section 11.1 or any coal mine worker identified as an increased level of risk. The frequency of the biological monitoring shall be risk based. The monitoring program should be reviewed and approved by a person with relevant experience and qualifications such as certified occupational hygienist (COH) and / or an occupational physician.

The SSE shall ensure that samples are collected as soon as possible after returning to the surface but no later than within 4 hours after exposure has ceased.

Samples must be stored and transported in accordance with guidelines provided by laboratory conducting analysis. Specimens must be kept cool after collection and during transport to maintain specimen integrity. Specimens should be transported to the laboratory as soon as practicable after collection.

Analysis must be conducted by a National Association of Testing Authorities (NATA) accredited laboratory.

Samples will only be analysed for the target chemical or metabolite related to the polymeric chemical process.

Note: There may be occasions when it is beneficial to undertake biological monitoring pre and post shift (before and after application). Reasons for this include:

- Accounting for exposures that are non-work related (e.g. Using expanding isocyanate based foam products for sealing or spray painting using polyurethane based paints).

- Accounting for exposures that have occurred on another mines site where contractors are engaged to perform the application.

11.2.2 Biological occupational exposure limits guideline values

The values listed in Table 2 have been established for the hazardous chemicals contained in polymeric resins and cavity filling products. These values do not represent the difference between safe and unsafe conditions. Exceeding these values indicates that:

- Control measures may not be adequate,
- Work methods may be unsatisfactory, and
- Individual work practices may be contributing to exposure.

Table 2: Guideline biological limits for polymeric chemical ingredients

Polymeric Chemical Group	Ingredient	Test	BOEL / BMGV
Polyurethane resins (PUR)	MDI / PMDI*	Urinary isocyanate metabolites	1µmol of isocyanate-derived diamine/ mol creatinine in urine a
Silicate resins			
Phenolic resins and cavity filler	Phenol	Urinary phenol	2.1 mmol/ L b

Notes about this table.

a. This value is a Biological Monitoring Guideline Value (BMGV)

b. This value is a Biological Occupational Exposure Limit (BOELs)

***** Additional isocyanate species have been detected in air during application process and these may also be absorbed through the skin. Current urine test methods to not detect these species and this may result in underestimation of actual exposure.

11.2.3 Requirements when biological monitoring result exceeds guideline value

When biological monitoring indicates that a coal mine workers exposure exceeds the biological guideline value for a substance stated in Table 2, the procedure must provide for the following actions to be undertaken in accordance with Table 3.

Table 3: Actions and responsibilities to be undertaken when BOEL or BMGV is exceeded.

Issue	Responsibility
The operating processes and practices contributing to the exposure are reviewed and corrective actions implemented	SSE at site where exceedance occurred, and the organisation installing the chemical
Changes to processes or additional controls are communicated to the workforce	SSE at site where exceedance occurred, and the organisation installing the chemical
Resampling shall be conducted at the next available opportunity on the individual(s) where possible.	The organisation or SSE dependant on the base of employment
Records of the review process are to be documented.	SSE at site where exceedance occurred
Report exceedance to an Inspector and ISHR	SSE at site where exceedance occurred

11.2.4 Requirements for communicating biological monitoring results

The procedure must provide for the communication and interpretation of biological monitoring results. This must include the following:

- Coal mine workers who participate in biological monitoring must be provided with a copy of their individual result.
- De-identified results from all biological monitoring must be made reasonably available to all coal mine workers at the mine.
- SSE is to ensure all results of biological monitoring are to be provided to the organisation applying polymeric chemicals at the mine.

11.3 Records

The SSE is to ensure that records pertaining to all biological and personal atmospheric monitoring are to be kept by the mine for a period not less than 30 years.

The employer is to ensure that all records pertaining to health surveillance are to be kept by the employer for a period not less than 30 years.

12 Operational controls and practices

The mines Safety and Health Management System will detail the operational controls and practices to underpin the principles that personal exposure to polymeric chemicals is reduced to as low as reasonably achievable.

Such controls and practices will be specified by the mine and responsibility of enforcing these requirements will be clearly delegated and understood by mining officials at the mine.

12.1 Certain zones and areas to be identified and treated as restricted access zones (RAZ)

Relative to the inherent risks of exposure to the polymeric chemicals or their by-products, certain zones and areas are to be identified and treated as restricted access zones.

Generally the zones and areas to be identified and treated as restricted access zones will be identified at:

Pump Zone (PZ): All those points within a 10 metre radius of the pump in which containers of polymeric chemicals are being set up, pumped or demobilised.

Injection Point (IP): All those points within 10 meter radius of the site where polymeric chemicals are injected or free flow for the purpose of void filling, consolidation or injection into strata.

Zone of Operations (ZOO): The operational area between the pump zone and injection point where active hose lines run and the ventilation path from the pump to the injection point.

Restricted Access Zone (RAZ): All points for 350 metres on return airway side of ZOO whilst the product pump is energised. The RAZ ceases when pump is de-energised and confirmed by the ERZ Controller.

12.2 Restrictions and exclusion control zones

The following zones described below are represented in schematic diagrams included as **Appendix 5**.

Pump Zone (PZ) - Shall be treated as a Restricted Access Zone within a 10 metre radius of the pump in which containers of polymeric chemicals are being set up, pumped or demobilised. The only persons allowed to work within that zone will be the Pump Operator/s and individuals directly associated with the decanting or transfer of polymeric chemicals. These persons must be

appropriately trained and wear the required personal protective equipment (PPE) as per the procedure. The responsible statutory official appointed to the zone may only enter this zone during pumping activities for the purposes of inspecting the workplace or auditing the work processes and procedures within that zone. For any other persons including other mine officials to pass through this zone must have familiarisation training in the hazards associated with polymeric chemicals, have obtained permission from the ERZC and wear the appropriate PPE.

Injection Point (IP) - Shall be treated as an exclusion zone at all times when the pump is operating and injection or free flow application is taking place. The only persons allowed within that zone will be the Injection Point Operator/s. The responsible statutory official appointed to the Zone may only enter this zone and remain in it whilst pumping and injection or application continues for the purposes of inspecting the workplace or auditing the work processes and procedures within that zone. It is understood that various other individuals may need to inspect the injection or void filling site but this will only be undertaken during periods when all pumping and injection or application activities have suspended.

Zone of Operations (ZOO) – Shall be treated as a restricted zone at all times whilst the pump is operating and injection or application is taking place. This zone will be restricted to persons and activities carried out within that zone. Such persons accessing this zone whilst the pump is operating and injection or application is taking place will be trained in a specific general awareness of the safety and health aspects of polymeric substances underground and must don the required PPE as documented in the mines procedure. The only works able to be carried out in this zone whilst the pump is operating and injection or application is taking place will be such works directly related to the pumping, or processes for the injection or application of polymeric chemicals and shall be controlled by the outcomes of a formal risk assessment.

Where the polymeric substance pump is located on the surface of the mine and the polymeric substances reach the workings of a mine via a borehole – all those points within 10 metres of the bottom of the borehole will be treated as a Pump Zone.

Restricted Access Zone (RAZ) – All access and works in this area will be restricted. Only the statutory official responsible for that zone can access that zone at all times whilst the pump is operating and injection or application is taking place. The only works that can be carried out in that zone are those work required for the inspection of such places required by the mines health and safety management system to maintain the mine in safe condition and for any signs abnormal nature of polymeric substances. Note – no other mine officials are permitted to access this zone whilst the pump is operating and injection or application is taking place.

The demarcation and signing of the above zones will be the responsibility of the ERZC responsible for that zone. The signage and demarcation shall be installed in accordance with the mines standards.

13 Workplace Inspections

Workplace inspections are to be carried out whilst pumping or injection is taking place.

All zones and areas shall be thoroughly inspected for any evidence of heating by ERZC appointed to the zone. If any excess heating is observed, pumping shall be immediately stopped and appropriate measure activated including cooling water and stone dust applied to the site.

13.1 Fire Watch Inspection

Commencing immediately following the injection of PUR and urea silicate products, the site of operation shall be inspected at intervals of not more than 30 minutes for a period of 4 hours to ensure that no undue heating occurs. This inspection should be conducted in accordance with section 305 of the CMSHR.

Any fire watch requirements for other types of polymeric chemicals shall be based on a risk assessment considering the reaction temperatures generated during the curing process. Whilst it is understood that production activities may recommence within this period the area of application must still be able to be observed up to 4hrs after completion of the application and this limitation is not to preclude the safe recommencement of production operations.

14 Firefighting equipment

Appropriate firefighting equipment shall be available at the locations of polymeric material/substance injection points and such equipment will be of a type such that is can adequately control the class of fire that may be involved in any outbreak of fire both underground at the mine and on the surface of the mine where such inventories are stored.

15 Single use systems

Single use systems include items such as small portable canisters of polymeric chemicals used for temporary sealing of ventilation devices, cartridge type polymeric products used for plugging drill holes.

These products must meet requirements of section 4 of this standard.

Prior to the use of these products at the mine a formal risk assessment shall be undertaken and a procedure developed which shall include the following as a minimum:

- Limiting chemical exposure risks via all routes of entry
- Ventilations requirements
- Zones of operations
- Requirements for health monitoring
- Requirements for PPE
- Requirements for training
- Transport, storage, use and disposal
- Fire watch requirements

16 Audit and review process

The mine SSE shall develop and maintain an audit and review program to ensure effective implementation of this recognised standard.

16.1 Review

The sites procedures for the use of polymeric chemicals shall be periodically reviewed and modified (if required). Document the frequency, the person(s) responsible and the trigger for the review of the procedure (e.g. significant incident, repeated exceedances of BOEL or BMGV, introduction of different chemical supplier).

16.2 Audits

The mine shall develop auditing procedures and schedules to ensure that the use of polymeric chemicals is conducted in accordance with this Recognised Standard and the sites procedures.

The details of these audits shall be documented.

17 Definitions

Arnsberg Test	A suite of scientific and chemical characterisation performance testing conducted to understand the safety, health and operational properties of polymeric testing prior to being used in underground coal mines.
Biological monitoring	Monitoring a person for a level of a hazardous chemical, metabolites of the hazardous chemical, or a level of another substance that is an indicator of exposure to the hazardous chemical.
Biological monitoring guideline value (BMGV)	Biological monitoring guideline value are not health based. If they are exceeded it does not always mean ill health will occur, but it does indicate that control of exposure may not be adequate.
Biological occupational exposure limits (BOEL)	Biological occupational exposure limits are set at a level at which there is no indication from scientific evidence available that the substance being monitored is likely to be injurious to health.
Cavity filling	The pumping of a phenolic resin into a large void or cavity. When mixed with a catalyst the resin undergoes rapid expansion to form dense foam that plugs the cavity, stabilises debris and prevents gas accumulation in the void.
Health surveillance	Health surveillance is the periodic medico-physiological examination of exposed workers with the objective of protecting health and preventing disease.
Injection Point (IP)	All those points within 10 meter radius of the site where polymeric chemicals are injected or free flow for the purpose of void filling, consolidation or injection into strata.
MDI	Methylene diphenyl isocyanate.
MTSC Test	A suite of scientific, chemical characterisation and safety performance testing specified in Appendix D of MDG 3608 conducted by Mine Safety Technology Centre – NSW Resources and Energy.
PPE	Personal Protective Equipment
Phenol – formaldehyde resins (Phenolic Resins)	Phenolic resins are a two component system with Part A being the phenol and formaldehyde and Part B comprising an acid. Phenolic resins are formed by cross linking phenol and formaldehyde in the presence of an acid to form a polymer. The acid mixture generally comprises a mixture of some of the following; acetic, sulphuric, phenol sulphonic and phosphoric acid.
PMDI	Polymeric MDI is a mixture of MDI and larger molecular weight oligomers of MDI. This is the isocyanate formulation typically found urea silicate resins.
Polymeric chemicals	Polymeric Chemicals refer to a group of products used extensively throughout the underground coal mining industry for various types of strata stabilisation, cavity filling and sealing applications. For the purpose of this recognised standard a polymeric chemical is any material that is polymerised underground, including its constitute components but excluding polyester resin capsule used in strata support.
Polyurethane resins (PUR)	Polyurethane resins are often referred to as PUR. These resins are formed by mixing a diisocyanate and a polyol in the presence of a catalyst. Isocyanates are low molecular weight compounds which are highly reactive. The diisocyanate

	used in the manufacture of polyurethane resins is methylene biphenyl diisocyanate (MDI).
Pump Zone (PZ)	All those points within a 10 metre radius of the pump in which containers of polymeric chemicals are being set up, pumped or demobilised.
Restricted Access Zone (RAZ)	All points for 350 metres on return airway side of ZOO whilst the product pump is energised. The RAZ ceases when pump is de-energised and confirmed by the ERZ Controller.
Sensitising agents (sensitisers)	Exposure to some chemicals can result in an individual becoming sensitised. Once this has occurred the individual may experience adverse reaction to further exposures well below the exposure standard for that substance. Isocyanates are known sensitisers.
Safety Data Sheet (SDS)	SDS are documents that provide critical information about hazardous chemicals. This includes ingredients, health and safety information, emergency procedures.
Silicate resins	The chemical formulations of silicate resins are more complex than those of PUR. It essentially involves the mixing of an isocyanate (polymeric MDI) with a water based sodium silicate solution. The resultant exothermic reaction cures to form a strong binding resin.
Skin absorption	Some substances can enter the body through direct contact with the skin. This is known as skin absorption.
Strata stabilisation	Involves the injection of a polyurethane or phenolic resin and catalyst under high pressure through drilled holes in the strata. The resin migrates through the cracks and fissures in the strata to form strong and flexible bonds that stabilize the surrounding ground.
Zone of operation (ZOO)	The operational area between the pump zone and injection point where active hose lines run.

18 Appendices

Appendix 1 – Arnsberg Test

The Arnsberg Test is a suite of scientific and chemical characterisation performance testing conducted to understand the safety, health and operational properties of polymeric materials prior to being used in underground coal mines.

This testing permit is undertaken by the District Government Arnsberg, Department of Mining and Energy, North Rhine – Westphalia, Federal Republic of Germany, demonstrating suitability and covering requirements for safe use of the relevant polymer material in German underground coal mines.

The source document is

COMMON TEST REGULATIONS OF THE STATE MINING AUTHORITIES FOR GENERAL PERMITS ACCORDING TO § 4 IN CONJUNCTION WITH APPENDIX 5 OF THE MINES ACT FOR THE HEALTH PROTECTION OF EMPLOYEES (HEALTH PROTECTION MINES ACT – GesBergV) DATED 31.07.1991 (WITH THE LAST AMENDMENT EFFECTED BY AN ACT DATED 10.08.2005 (BGBL. l.p. 2452)

(TEST REQUIREMENTS FOR MATERIALS ACCORDING TO § 4 GesBergV)

Appendix 2 – MTSC Test Criteria from MDG 3608

MTSC test criteria from MDG 3608 refers to a suite of scientific, chemical characterisation and safety performance testing conducted by the Mine Safety Technology Centre – NSW Resources and Energy. These tests are specified in Appendix D – Polymeric Materials Test Manual – TM003, of the August 2012 NSW guideline document MDG 3608 – Non-metallic materials for use in underground coal mines.

Appendix 3 – Safe Work Australia – Health Monitoring for Isocyanates

The March 2013 Safe Work Australia document 'Isocyanates' covers baseline health monitoring before starting work in an isocyanate process, during exposure to an isocyanate process, at termination of work in an isocyanate process, and supplementary information on isocyanates.

Appendix 4 – Atmospheric monitoring

The most accurate way to determine a workers exposure to polymeric chemicals is to measure the workers urine for the presence of a substance or a metabolite of that substance. This is because this process considers exposure by all routes of entry, however there may still be applications for the use of atmospheric monitoring. These include;

I. Assessing the risk of airborne exposure through inhalation

II. Determining the effectiveness of ventilation quantities

III. Determining the level of respiratory protection required

IV. Establishing restricted access zones.

Note: It is important to understand the limitations of air monitoring when assessing exposure to polymeric chemicals. The following points should be considered when considering atmospheric monitoring:

- Selecting monitoring methods, establishing a monitoring programme and interpreting results should be done by persons with the relevant skills and qualifications such as an occupational hygienist.
- Atmospheric monitoring only considers exposure via inhalation. It does not consider skin absorption or ingestion.
- Static or fixed position monitoring does not reflect personal exposure and therefore cannot be compared against exposure standards. Static monitoring can be used to assess effectiveness of controls or to establish risk zones.

Workplace exposure standards

Airborne concentrations of the individual chemical ingredients contained in polymeric chemicals formulations shall not exceed the limits specified in Table 4. These limits are taken from Safe Work Australia's *"Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC: 1003(1995)]".* These can be accessed online at HSIS: http://hsis.safeworkaustralia.gov.au/ExposureStandards

It is important to understand that the limits specified in Table 5 only account for exposure to airborne concentrations of chemicals that are inhaled by the worker.

Table 4: Workplace exposure standards for individual chemical ingredients in polymeric chemicals

Chemical	TWA (mg/m^3)	STEL (mg/m^3)	Notices
MDI and PMDI	0.02	0.07	Sen
Phenol	4	-	Sk
Formaldehyde	1.2	2.5	Sen

*Sen: Sensitising agent – After sensitisation occurs an affected individual may react to very small exposures to the substance. Caution should be exercised where any exposure to these substances can occur.

**Sk: Absorption through skin may be a significant source of exposure

Adjusting exposure standards for extended shifts

The TWA exposure standards are based on conventional work schedules (i.e. an 8 hour working day and 5 day working week). Where extended shifts or non-standard rosters are worked these exposure standards should be adjusted in accordance with the following:

a) Only perform adjustment in consultation with an occupational hygiene professional using a recognised method.

b) No adjustments to PEAK or STEL exposure limits are required where extended shifts are used.

c) Exposure standards are not to be adjusted upwards where the hours worked are less than 8 hours per day or 40 hours per week.

Table 5: Information on adjustment models applicable to the mining industry

Organisation	Model(s)	Document
Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST)	• Québec	Guide for the adjustment of permissible exposure values (PEVs) for unusual work schedules
Western Australia Department of Minerals and Petroleum (DMP)	• Québec	Adjustment of atmospheric contaminant exposure standards – guide
Simtars	• Brief and Scala	Adjustment of occupational exposure limits for unusual work schedules
Australian Institute of Occupation Hygienists (AIOH)	• Brief and Scala • OSHA • Pharmacokinetic (Hickey and Reist) • Québec	Adjustment of Workplace Exposure Standards for Extended Work Shifts - Position Paper

Appendix 5 - Schematic and exclusion control zones

Figure 1: Normal antitropal pump configuration

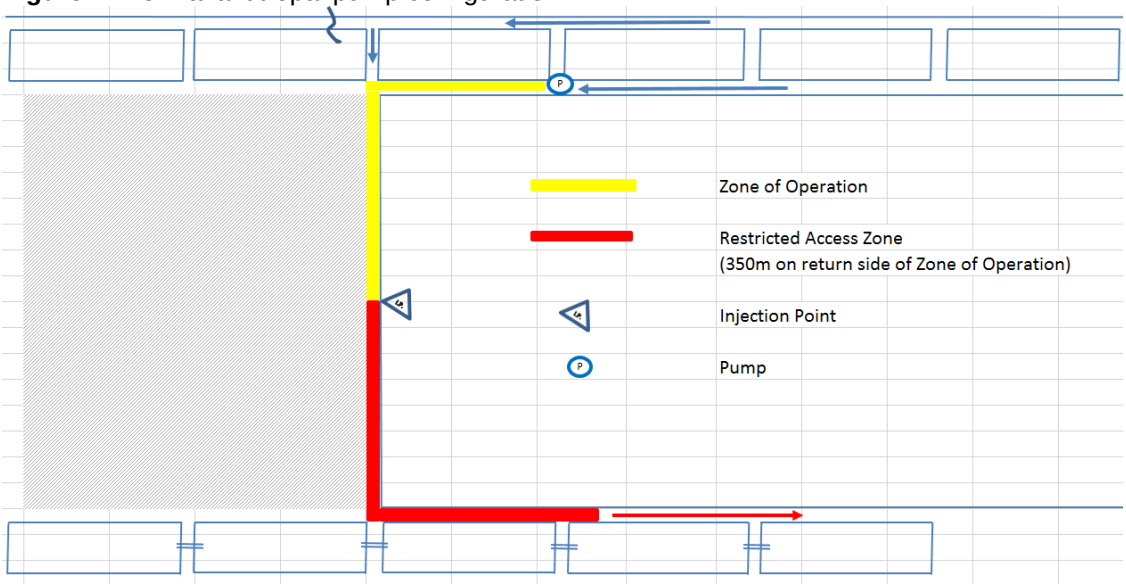


Figure 2: Pump in travel maingate bleeder road

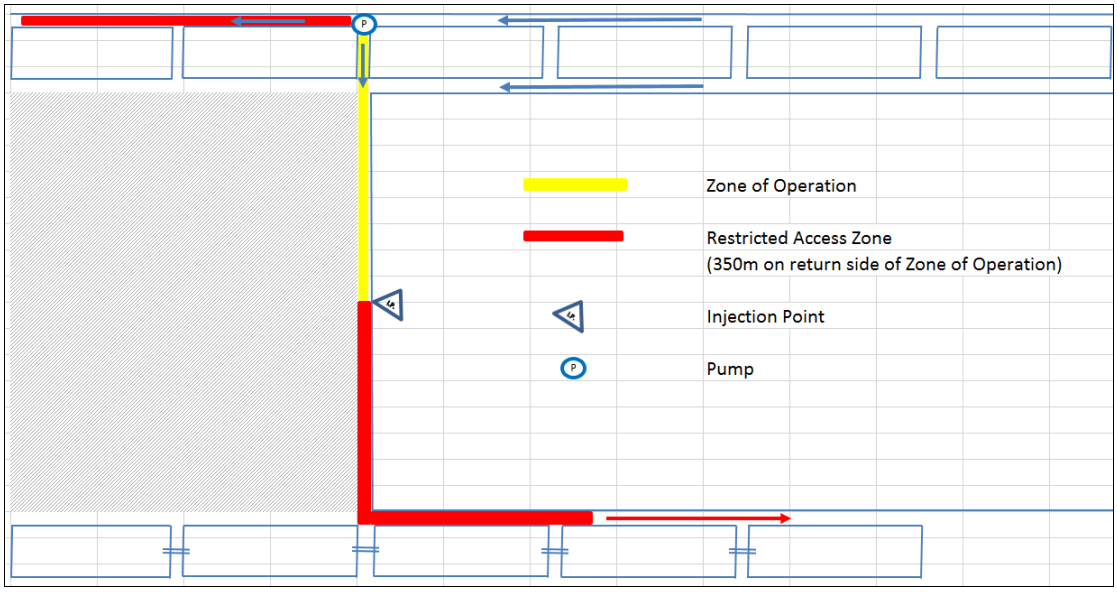
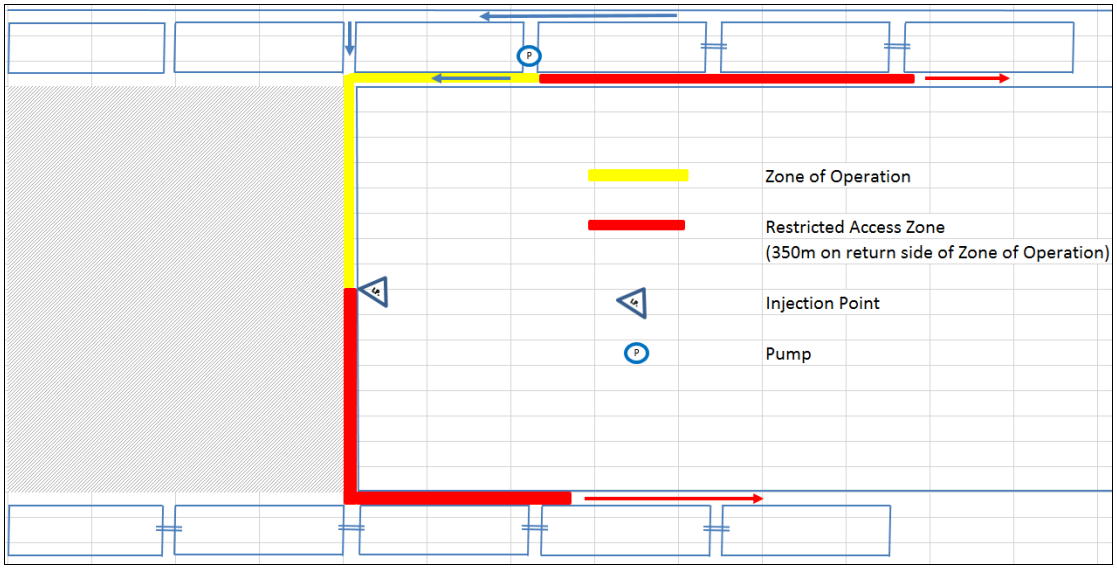


Figure 3: Normal homotropal pump configuration



19 References

1 Hickey J, Reist P. Application of Occupational Exposure Limits to Unusual Work Schedules. American Industrial Hygiene Association Journal. 38:613-621, 1977.

2 New South Wales Government (2012). Mining Design Guideline 3608: Non-metallic materials for use in underground coal mines. Available for download at: https://www.resourcesregulator.nsw.gov.au/__data/assets/pdf_file/0003/444198/MDG-3608-FINAL-120921.pdf

3 New South Wales Government (2010). Mining Design Guideline 41: Fluid power system safety at mines. Available for download at: https://www.resourcesandgeoscience.nsw.gov.au/__data/assets/pdf_file/0008/419489/MDG-41-Fluid-power-systems.pdf

4 Queensland Legislation (2018). Coal Mining Safety and Health Regualtion 2017. Queensland Parlimentary Counsel: Coal Mining Safety and Health Regulation 2017

5 Queensland Legislation (2018). Coal Mining Safety and Health & Safety Act 1999. Queensland Parlimentary Counsel: *Coal Mining Safety and Health Act 1999*

6 Safe Work Australia (1995). Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC: 1003(1995)]". Available online at HSIS: http://hsis.safeworkaustralia.gov.au/ExposureStandards

7 Safe Work Australia (2013). Guide: Hazardous chemicals requiring health monitoring – Isocyanates. Available for download at: https://www.safeworkaustralia.gov.au/system/files/documents/1702/isocyanates_0.pdf

8 Simtars. Adjustment of occupational expsoure limits for unusual work schedules. Brisbane: s.n., 2001.

9 Standards Australia (2002), AS/NZS 2671: 2002 Hydraulic fluid power – General requirements for systems.

10 Standards Australia (2007), AS/NZS 3833: 2007 The storage and hanlding of mixed classes of dangerous goods, in packages and intermediate bulk containers.

11 Standards Australia (2008), AS/NZS 3780: 2008 The storage and handling of corrosive substances.

12 Western Australian Department of Mine and Petroleum: Resource Safety (2016), Adjustment of atmospheric contaminants exposure standards - Guide, Perth.