

# EXAMINATION PAPER

## Mechanical engineering manager of underground coal mines certificate of competence

### Written examination held 8 August 2019

#### Instructions to candidates

Unless otherwise stated all references to the Act and Regulations are to the

- Work Health and Safety Act 2011
- Work Health and Safety Regulation 2017
- Work Health and Safety (Mines and Petroleum Sites) Act 2013
- Work Health and Safety (Mines and Petroleum Sites) Regulation 2014

10 minutes reading time is allowed prior to the start of the examination. Candidates can use a **highlighter only** to mark points of importance during the reading time but may not begin answering the questions. You must NOT use any other writing item during the reading time such as a pen.

It is expected that candidates will present their answers in an engineering manner, making full use of diagrams, tables, and relevant circuits where applicable, and showing full workings in calculations.

Consideration will be given in marking for **neatness in diagrams and handwriting**.

Provide answers in point form wherever appropriate. If you are unable to fit your answers in the available space use the three (3) blank pages included at the end of the paper. Ensure the question you are answering is clearly marked.

Electronic aids may not be used, apart from a non-programmable calculator.

All six (6) questions are to be attempted.

All questions are of equal value, but parts of questions may vary in value. The marks applicable to each part of a question will be indicated adjacent to the question.

This examination is a **closed book** examination – that is you cannot bring any reference material into the exam, such as copies of legislation. Reference material will be provided in the exam paper as applicable.

Place your identification number only, NOT your name, at the start of this paper at the commencement of the exam – that is after the reading time is over.

## CME1 – Mechanical engineering practices applicable to underground coal mines

### Question 1

As the mechanical engineering manager of an underground coal operation, you are also responsible for the coal handling plant. Earthmoving equipment is planned to be utilised on both the raw and product stockpiles.

1. MDG28 Safety requirements for coal stockpiles and reclaim tunnels section 3.1.4 identifies six (6) risks of harm to the dozer driver that shall be considered. Identify four (4) of these risks:  
(12 marks)
2. MDG28 section 3.2.1 tables five (5) minimum recommended controls to be considered when a dozer is engulfed in the draw down point on the stockpile. Identify four (4) of these controls:  
(12 marks)

You are about to sign a contract with a local earthmoving company to take over managing coal movement on your ROM and product coal stockpiles. Both stockpiles are configured with aerial conveyor gantries and travelling trippers, as well as reclaim tunnels with coal valves.

You are reviewing your introduction to site process as part of managing the change to contractor supplied, operated and maintained equipment.

3. What documents do you want to see as part of the equipment introduction process for the plant proposed by the contractor? List five (5) (10 marks)
4. What specific checks on the machine would you ensure are included in the site introduction? (8 marks)

5. Describe what process you would implement to ensure the contractor equipment is maintained for its lifecycle on site. (8 marks)

## Question 2

### Part A – Development panel dewatering schematic

1. Draw common services schematic symbols for the following components (2 marks each)
  - i. Schematic symbol for a gate valve at the end of a main pipe range
  - ii. Schematic symbol for a non-return valve on a branch into a waste water pipe range
  - iii. Schematic symbol for a hydrant outlet on a gravity fed raw water pipeline / firefighting line
  - iv. Schematic symbol for an inline pipe manifold with 25mm and 50mm outlets
  - v. Schematic symbol for a 50mm diaphragm air pump with suction strainer
  - vi. Schematic symbol for a 2000 litre fish tank with a baffle and external electric pump
2. Use appropriate schematic symbols, including those identified in i. to vi. above to draw an operational development panel dewatering schematic including all the required mechanical services? (15 marks)
3. Describe how the schematic you have drawn in 2 above will operate, and where you would isolate to carry out maintenance on each of the pumps shown. (10 marks)

### Part B – Dewatering practical application

Your mine has decided to drift down through a 30m throw fault to a new mining domain with around 300m total depth of cover. Exploratory boreholes indicate high permeability with suspected connectivity to overlying water bearing strata. You are tasked with developing a pumping strategy.

1. What process would you use to develop the pumping strategy, and who would you involve? (7 marks)
2. Describe the specification and operating parameters of two (2) components of the pumping system, and why you would select that type of component, that you would include in the system between the face and the surface? (6 marks)

## Question 3

Multiple choice and short answer

- Part A – Identify **ALL correct answer(s)** for each multiple-choice question (2 marks each)

1. MDG12 Guide for the construction of friction winders, clause 5.2 (iii) nominates the maximum winding speed for persons approaching the top or bottom of the shaft as?
  - i. m/s
  - ii. 5 m/s
  - iii. 6 m/s
  - iv. 9 m/s
2. MDG12 Guide for the construction of friction winders, clause 5.2 (ii) nominates the maximum approach speed for lowering persons as?
  - i. 6 m/s
  - ii. 9 m/s
  - iii. 15 m/s
  - iv. 20 m/s
3. MDG12 Guide for the construction of friction winders, clause 5.3 states that every friction winding engine shall be provided with two or more mechanical brake systems each of which?
  - i. Howsoever applied shall act directly on the driving sheave
  - ii. Shall be designed, adjusted and maintained to safely stop and hold the conveyance, cage or skip under all conditions of loading, direction of travel and speed
  - iii. Will be capable of producing braking torque of not less than two and a half times the maximum static torque which will be applied to the winding sheave by the normal load
  - iv. Is sufficient to cause retardation under worst conditions of not less than 1 m/sec<sup>2</sup> when winding personnel and 0.5 m/sec<sup>2</sup> when winding material
  - v. Will result in a retardation rate of not more than 3.5 m/sec<sup>2</sup> when winding personnel
4. MDG12 Guide for the construction of friction winders, clause 2.5 states the winder should be designed for?
  - i. multiple head ropes
  - ii. minimum of four (4) head ropes
  - iii. at least one head rope
  - iv. none of the above
5. MDG12 Guide for the construction of friction winders, clause 5.1 (iv) states the diameter of any deflecting sheave shall not be less than how many times the diameter of the corresponding drive sheave?
  - i. 0.33

- ii. 0.5
  - iii. 0.67
  - iv. 0.9
6. MDG12 Guide for the construction of friction winders, clause 6.2.5 (b) requires calculations for each rope showing?
- i. Maximum load applied to the rope
  - ii. Factors of safety based on the maximum load and rope breaking loads
  - iii. Minimum factor of safety required by the requirements for use of friction winding equipment
  - iv. All of the above
7. Storage of gas cylinders is in accordance with which Australian Standard
- i. AS 4332
  - ii. AS 1940
  - iii. AS 1596
  - iv. All of the above
8. A welding management plan (WMP) should be based on a quality WHS management system as defined in:
- i. AS 4606
  - ii. AS 4804
  - iii. AS 4801
  - iv. AS 4801 and AS 4804
9. Hydraulic intensification can occur in:
- i. Single acting hydraulic cylinders
  - ii. Air driven hydraulic intensifiers
  - iii. Automatic greasing systems
  - iv. All of the above
10. Magnetic particle non-destructive testing is used to determine:
- i. whether the material is ferrous or non-ferrous

- ii. the microstructure of the material
  - iii. evidence of cracking in ferrous materials
  - iv. none of the above
11. Which Australian Standard would you consult in relation to fixed platforms, walkways, stairways and ladders?
- i. AS 4024
  - ii. AS 4100
  - iii. AS 1657
  - iv. AS 1418
12. Rung type ladders operate between:
- i. 45 to 60 degrees
  - ii. 60 to 70 degrees
  - iii. 70 to 90 degrees
  - iv. None of the above
13. The top handrail of a walkway shall be a vertical height above the walkway of:
- i. Not less than 500mm, and not more than 1100mm
  - ii. Not less than 600mm, and not more than 1000mm
  - iii. Not less than 750mm, and not more than 1000mm
  - iv. Not less than 900mm, and not more than 1100mm
14. When testing open joints on the inlet or exhaust system of a diesel engine system, what is the maximum thickness of the feeler gauge that should be used?
- i. Less than 0.5 mm
  - ii. Less than 0.3 mm
  - iii. Less than 0.2 mm
  - iv. Less than 0.1 mm
15. The MDG for fluid power systems at mines is:
- i. MDG 10
  - ii. MDG 16

- iii. MDG 36
- iv. None of the above

16. Which of the following is the correct definition for the acronym TRS?

- i. Temporary roof support
- ii. Time-related sequence
- iii. Total resource solution
- iv. None of the above

Part B – Mining Design Guidelines (MDG) applicable to Mechanical Engineering

1. Match the MDG number to the appropriate MDG title by writing the MDG number in the answer column. (15 marks)

MDG No.	Answer	MDG Title
MDG 1		Manually operated conveyor belt tensioning mechanism
MDG 4		Guideline for mobile and transportable plant for use at mines (other than underground coal mines)
MDG 7		Construction of friction winders
MDG 10		Fluid power systems
MDG 12		Examination and testing of mine winder ropes
MDG 15		Free steered vehicles
MDG 25		Technical standard for the design of diesel engine systems for use in underground coal mines
MDG 26		Design commissioning and maintenance of drum winders
MDG 28		Construction of fuel containers
MDG 29		Safety requirements for coal stockpiles and reclaim tunnels
MDG 33		Handbook for approval of transport braking systems
MDG 36		Safe cutting and welding

MDG 39	Construction of fixed bulk distillate installations
MDG 41	Management of diesel engine pollutants
MDG 43	Hydraulic load locking valves

2. What MDG(s) would you refer to when preparing a mine site risk assessment template?

(3 marks)



## Question 4



# SAFETY BULLETIN

**DATE: MARCH 2019**

## Workers injured by high pressure fluid

This safety bulletin provides safety advice for the NSW mining industry.

### Issue

The risk of serious injury and potential death to maintenance workers being struck in the face and body by high pressure fluid releases has been highlighted in recent incidents reported to the NSW Resources Regulator.

### Circumstances

The incidents involved experienced contract maintenance workers undertaking a variety of tasks on hydraulic systems. High pressure fluid release was not an intended outcome of the task. The hierarchy of controls relied upon to control high pressure fluid release failed to prevent the maintenance workers from being struck and injured. The consequences caused serious and high potential injuries to workers.

*Figure 1: Shirt damaged by high pressure fluid release*



*Figure 2: Facial injury caused by high pressure fluid release*

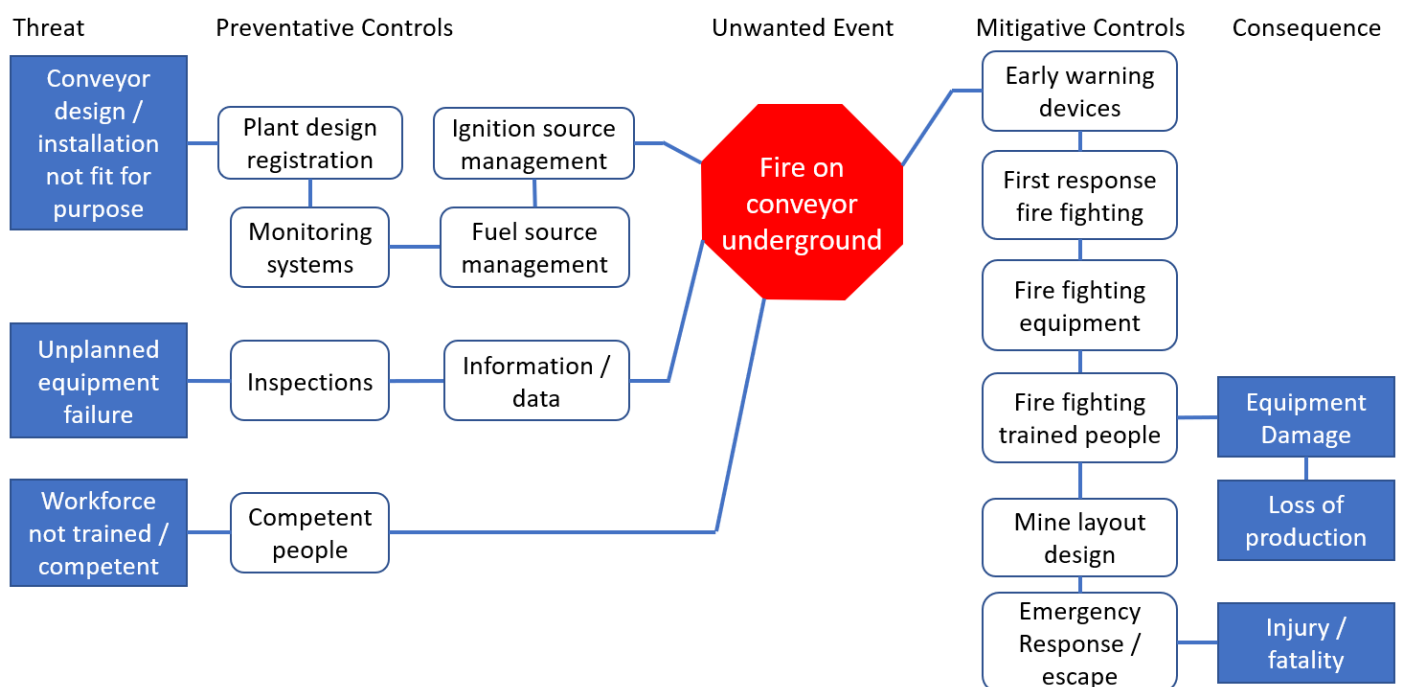


The Resources Regulator released SB19-04 in March 2019 relating to workers injured by high-pressure fluid. Your mine has just had a significant release of fluid pressure event that resulted in injury to a worker, but fortunately not an injection injury. You have decided to review your standard of engineering practice (SEP) for fluid power management.

1. NSW Code of practice: Mechanical engineering control plan section 4.5.9 identifies six (6) key issues associated with pressurised fluids. List four (4): (12 marks)
2. For each of the four (4) key issues identified above describe one (1) control you would implement in your SEP Fluid Power Management (12 marks)
3. What process would you go through to review the SEP? (14 marks)
4. Who would you involve in the review? (12 marks)

### Question 5

As the mechanical engineering manager of an underground coal mine, you are required to identify hazards and implement controls in regards to conveyors. These are documented in a conveyor management plan. A conveyor fire underground is considered a major risk at your coal mine. Below is a conceptual Threat Risk Identification, Management and Engineering Diagram (TRIMED) depicting the unwanted event of a conveyor fire underground. The format is similar to a bow tie analysis.



1. In preparing your risk analysis what documents would you refer to that will specifically identify issues relating to all aspects of conveyors? List ten (10). (10 marks)
2. When considering components associated with conveyors what items require plant registration? (4 marks)
3. What monitoring devices will you consider installing to **prevent the likelihood** of a fire? List ten (10). (10 marks)
4. When training the workforce to inspect and maintain conveyor systems what specific inspection items would you include to **prevent the likelihood** of a fire? List eight (8). (16 marks)
5. In order to **mitigate the consequences** from a fire on a conveyor what fire-fighting equipment would you install, and where would you locate it? List five (5) (10 marks)

## Question 6

NSW Code of Practice: Mechanical engineering control plan

### 3.2.1 Energy sources associated with plant and structures

1. Section 3.2.1 identifies nine (9) energy sources as categories of energy hazards associated with mechanical aspects of plant, such as “radiation energy”. Identify five (5) other energy sources.(10 marks)
2. Using your experience, for each of the five (5) energy sources you nominated above identify:
  - a) an associated mechanism or scenario likely to occur in a coal mine,
  - b) the potential consequences to people in terms of health and safety,
  - c) a critical control you would implement to effectively mitigate the risk, and
  - d) a verification process you would implement to effectively manage the critical control.(40 marks)

# CME2 – Legislation and standards applicable to underground coal mines

## Question 1 – Mechanical engineering control plan

**Part A** - As the statutory mechanical engineering manager of a coal operation you are preparing a Mechanical Engineering Control Plan (MECP)

1. What legislative clause requires a mine to have a MECP? (3 marks)
2. According to the legislative clause above when is a MECP required? (8 marks)
3. Who is responsible for ensuring the MECP is developed and reviewed? (3 marks)

**Part B** – Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 Schedule 2 (2)

1. What risks to health and safety associated with the mechanical aspects of plant and structures must have control measures set out in the MECP? (21 marks)
2. In Schedule 2 (2) (4) what matters must be specifically taken into account in respect of a belt conveyor? (15 marks)

## Question 2 – Work health and safety regulation 2017

Chapter 3 – General risk and workplace management

1. List the Hierarchy of controls identified in Clause 36 (6 marks)
2. For each one of the hierarchies of control listed above describe one (1) instance from your experience where a hazard existed, and the control that you implemented to effectively mitigate the risk (36 marks)
3. Once a control measure is implemented, what requirement is then placed on the Duty Holder? (8 marks)

## Question 3 – Work health and safety act 2010

**Part A** - Section 19 (21 Marks)

Sub section (3) details the primary duty of care the person conducting a business or undertaking (PCBU) must ensure, so far as reasonably practicable. List all seven (7) of these duties of care.

**Part B** – Part 3 Incident Notification (21 Marks)

*In this Part, a dangerous incident means an incident in relation to a workplace that exposes a worker or any other person to a serious risk to a person's health or safety emanating from an immediate or imminent exposure to: ...*

Section 37 details twelve (12) dangerous incidents. List seven (7) of these

**Part C – Duties of workers** (8 Marks)

Section 28 identifies four (4) requirements that a worker must do whilst at work. List all four (4) of these.

## Question 4– Work health and safety regulation 2017

**Part A** - The WHS(MPS) Regulations has specific clauses relating to winders that require the mine to implement management systems for their safe operation. Schedule 1 clause 3 identifies fourteen (14) hazards or risks associated with mine shafts and winding systems that must be considered in developing control measures. List ten (10) of these: (20 marks)

**Part B** – You are preparing a standard of engineering practice for the management of winder ropes at the coal mine. In referring to legislative requirements for ropes you note:

**48** *Ropes*

*The mine operator of an underground mine (other than an opal mine) must ensure that:*

*(a) each rope used for the purposes of a winding system or slope haulage is regularly inspected and tested to ensure that it is safe for that use, and*

*(b) criteria are established to determine when a rope is no longer suitable for any such use.*

1. What testing and inspection measurements would you record and/or trend to ensure the rope is safe to use? (14 marks)
2. What factors would you consider to determine when a rope is no longer suitable for any such use? (16 marks)

## Question 5 – Work health and safety regulation 2017

Chapter 4 Hazardous Work, Part 4.3 Confined Spaces

1. Work Health and Safety Regulation 2017, Chapter 1, Clause 5 states a “*confined space means an enclosed or partially enclosed space that: ...* “.
  - What is included in the definition of a ‘confined space’? (12 marks)
2. What is specifically not included as a confined space? (4 marks)

3. The duty of designers, manufacturers, importers, suppliers, installers and constructors of plant or structures with regards to eliminating or minimising the risk relating to confined spaces is outlined in Clause 64. What must they ensure? (8 marks)

**Clause 66 Managing risks to health and safety**

*A person conducting a business or undertaking must manage, in accordance with Part 3.1, risks to health and safety associated with a confined space at a workplace including risks associated with entering, working in, on or in the vicinity of the confined space (including a risk of a person inadvertently entering the confined space).*

4. List the requirements that the PCBU must ensure under legislation, including specific controls, to assist in managing work in a confined space. (26 marks)

## Question 6 – work health and safety (mines and petroleum sites) Regulation 2014

Part 2 Managing Risks, Division 1 General requirements

1. **Clause 9 Management of risks to health and safety** outlines four (4) general steps required of the PCBU to manage risks health and safety at the mine site. Outline all four. (16 marks)

**(1) Clause 10 Review of control measures**

*A person conducting a business or undertaking at a mine or petroleum site must review and as necessary revise control measures implemented under clause 9 in the following circumstances:*

2. What are the four (4) circumstances? (8 marks)

**(2) Clause 10 Review of control measures**

*The operator of a mine or petroleum site must ensure that a control measure that is the subject of a request by \_\_\_\_\_ is reviewed and as necessary revised, ...”*

3. Under this clause who can request the review? (2 marks)

**(1) Clause 14 Content of safety management system**

*The safety management system document for a mine or petroleum site must set out the following:*

4. There are twenty-one (21) requirements identified in this clause? List twelve (12) (24 marks)

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Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (August 2019). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the NSW Department of Planning, Industry and Environment or the user's independent advisor.

CM9 reference: DOC19/675942