

Mechanical engineering manager of underground coal mines certificate of competence

Written examination held 9 August 2018

CME1 – Mechanical engineering practices applicable to underground coal mines

Instructions to candidates

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

Work Health and Safety Act 2011

Work Health and Safety Regulation 2011

Work Health and Safety (Mines and Petroleum Sites) Act 2013

Work Health and Safety (Mines and Petroleum Sites) Regulation 2014

Question 1

You are the mechanical engineering manager at a coal operation that has decided to implement a new process to recover and reprocess old tailings material using a dredge.

1. List five (5) processes you would undertake to ensure the dredge is fit for purpose? (5 marks)
2. Drowning is considered one of the key hazards associated with the use of dredges. List five (5) controls you consider are required to effectively manage the risk. (5 marks)
3. NSW code of practice: Mechanical engineering control plan section 4.5.8.5 Dredges lists 13 key risk issues associated with dredges. List five (5) of these, not including drowning. (5 marks)
4. From an engineering perspective list ten (10) controls you would consider implementing, specific to dredges, to manage the hazards associated with the operation of a dredge over its life cycle? (10 marks)

Question 2

Part A – Hydraulic schematic circuit

1. Draw the Australian Standard schematic symbols for the following hydraulic components
 - a) tank (1 mark)
 - b) in line filter (1 mark)
 - c) Double acting cylinder (1 mark)
 - d) Pressure relief valve (1 mark)

- e) Three position, four port, open centre, spool type directional control valve with hand lever operation and spring centering (1 mark)
 - f) Electric motor driven fixed displacement pump (1 mark)
2. Use all the components identified in i. to vi. above to draw an operational hydraulic schematic circuit? (6 marks)
 3. Describe how you consider the schematic drawn in b) above will operate through its full sequence of operation. (6 marks)

Part B – Fluid power management

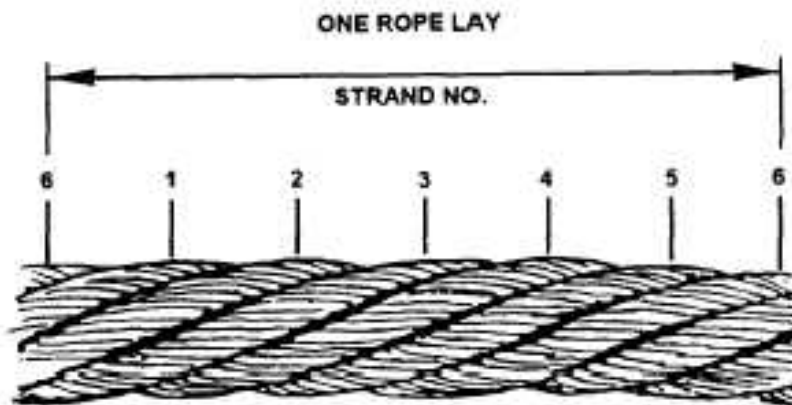
1. What are the six (6) key issues associated with pressurised fluids identified in NSW code of practice: Mechanical engineering control plan? (6 marks)
2. To which MDG (mining design guideline) would you refer in relation to fluid power system safety at mines? (1 mark)

Question 3

Multiple choice and short answer**Part A – Identify ALL correct answer(s) for each multiple choice question (1 mark each)**

- a. A non-destructive rope test report does NOT include which of the following:
 - i. Origin of rope manufacture
 - ii. Date of test
 - iii. Date of rope installation
 - iv. Test equipment used
- b. The factor of safety (FoS) for a balance rope shall be not less than what?
 - i. 6
 - ii. 5
 - iii. 4
 - iv. None of the above
- c. A drift drum winding rope when hauling personnel can safely operate with what Factor of Safety (FoS) when new, and prior to discard condition:
 - i. Not less than 6, and not less than 4
 - ii. Not less than 8, and not less than 6
 - iii. Not less than 10, and not less than 8
 - iv. A suitable factor of safety as determined by a competent person
- d. In AS/NZS 3584.2:2008 the engine safety shutdown system shall include the following, which shall automatically shut down the system:
 - i. Exhaust cooling shutdown sensor
 - ii. A sensor to measure low engine oil pressure, which shall be set to operate at a pressure of not less than the engine manufacturer's minimum recommended pressure

- iii. A coolant pressure, level or flow sensor located in each coolant circuit to monitor coolant loss
 - iv. Three sensors for each water-based flametrap
- e. The rope shown in the picture below is of what construction?



- i. Right hand ordinary lay
 - ii. Right hand Langs lay
 - iii. Left hand ordinary lay
 - iv. Left hand Langs lay
- f. What is the definition of a winder conveyance?
- i. A carriage
 - ii. A skip
 - iii. A stage
 - iv. All of the above
- g. Wire ropes may deteriorate due to some of the cumulative effects of the following?
- i. Lightning strikes
 - ii. Localised heating
 - iii. Fretting
 - iv. Winder gearbox oil level
 - v. All of the above
- h. A compliance plate shall be provided for each diesel engine system (DES), permanently affixed either to the system or adjacent to the system in an easily seen position. The compliance plate shall include the following information:
- i. The name of the DES manufacturer
 - ii. The serial number of the DES and the original engine serial number if different
 - iii. The date of manufacture of the DES
 - iv. The maximum compound, transverse and longitudinal angles of operation
 - v. Engine system protection rating
- i. A supplier of mobile plant should provide the owner with:

- i. A statement of compliance to the relevant MDG
 - ii. Information as required by legislation
 - iii. Results of test reports
 - iv. A signed invoice in Australian dollars, Euro, or British pounds
 - v. All of the above
- j. The owner of the diesel engine system shall establish a maintenance management system that shall identify all the lifecycle maintenance activities required to:
- i. A safe condition to use that is in an explosion protected or fire protected condition over its life cycle
 - ii. Compliance with the certification documents and DES documentation
 - iii. Compliance with AS/NZS 3584.1, AS/NZS 3584.2, and AS/NZS 3584.3 as applicable
 - iv. A condition that minimises harmful exhaust emissions being emitted into the environment
- k. What is the minimum height of water between the water seal and the exhaust conditioner minimum flameproof water level?
- i. 25mm
 - ii. 50mm plus the height above the water level where effective mixing of raw exhaust gas and the conditioner water commences
 - iii. 50mm
 - iv. (ii) and (iii)
- l. 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. <0.5mm
 - ii. <0.3mm
 - iii. <0.2mm
 - iv. <0.1mm
- m. An underground trunk conveyor approximately 2,000 metres long is NOT required to be fitted with which safety feature:
- i. Emergency stop switches installed every 30m and accessible from both sides if access is available on both sides of the conveyor
 - ii. Emergency pull wire system along both sides of the conveyor if access is available on both sides of the conveyor
 - iii. Prestart warning system
 - iv. Belt tracking limits
- n. In the underground workings of a coal mine the surface temperature in degrees Celsius of any part of the conveyor or conveyor system shall not exceed:
- i. 61.5
 - ii. 100
 - iii. 150
 - iv. 250

- o. Anti-static properties the conveyor and conveyor components shall conform to the requirements of:
 - i. Grade S in AS4606
 - ii. Grade E in AS1332
 - iii. AS1333
 - iv. Any of the above

- p. Any conveyor which can run away due to the effect of gravity shall be provided with device(s) which will automatically prevent runaway. Where a hazard to people exists then:
 - i. the anti-runaway device shall be capable of holding 150% of the load
 - ii. the two anti-runaway devices shall be capable of independently holding 100% of the load
 - iii. the two anti-runaway devices shall be capable of cumulatively holding 150% of the load
 - iv. the two anti-runaway devices shall be capable of independently holding 150% of the load

- q. Where pull wires are used as an emergency stop control for a conveyor the force required to activate the device and the movement of the pull wire away from its axis shall not exceed:
 - i. 50 N and 150 mm
 - ii. 150 N and 50 mm
 - iii. 70 N and 300 mm
 - iv. 300 N and 70 mm

- r. AS/NZS 4024 Safety of Machinery Part 3610: Conveyors – General requirements identifies conveyor system hazards in table 1.1. What do these hazards include?
 - i. Bio-mechanical, chemical and electrical energy
 - ii. Gravity stored potential energy, and mechanical energy
 - iii. Temperature and vibration
 - iv. Magnetic energy, and radiation
 - v. Noise and pressure

- s. When considering temporary access for maintenance and inspection of conveyor components located 2.8 metres above floor level what standard(s) would you consider?
 - i. AS1210
 - ii. AS1418
 - iii. AS1576
 - iv. AS1657
 - v. AS2865

- t. AN/NZS 4024 Safety of Machinery Part 3611: Conveyors – Belt conveyors for bulk materials handling notes which of the following to prevent accumulated material creating a hazard
 - i. 50 mm from permanent steel conveyor structures such as drive modules, loop take ups, transfer load stations and boot ends
 - ii. Not less than 300mm from the floor to the underside of belt

- iii. Not less than 150mm from rotating parts (e.g. idlers and pulleys) to the floor for the removal of accumulated material
- iv. Sufficient clearance should be provided to prevent contact between the belt surface or any rotating element and any spillage which might occur
- v. All of the above

Part B – The International Council on Mining and Metals (ICMM) published the *Health and Safety Critical Control Management: Good Practice Guide*. What is the definition of a Critical Control? (5 marks)

Question 4

The operation of mobile plant is considered a significant hazard in underground coal mines.

1. In your own words outline what is referenced in WHS (MPS) Regulations, Schedule 2 that are specific requirements for underground diesel engines (2 marks)
2. List twelve (12) Major Hazards of UG Mobile Plant (6 marks)
3. When considering an introduction to site process for underground mobile diesel plant, list what information / documentation you would require for each of the following:
 - a) Vehicle specific information – list six (6) (3 marks)
 - b) Risk Management requirements – list three (3) (3 marks)
 - c) Registration requirements – list six (6) (3 marks)
 - d) Maintenance/testing documentation - list six (6) (3 marks)
 - e) Documentation specific to the item of plant – list six (6) (3 marks)
4. Diesel emissions gas test limits for raw and diluted (2 marks)

Contaminant	Raw Exhaust Limits	Diluted (General Body) Limits
Carbon Monoxide		
Nitrous Oxide		
Nitrous Dioxide		
Diesel Particulate matter (DPM) Elemental Carbon		

Question 5

You are the Mechanical Engineering Manager at a mine with a small second egress shaft winder, being a single headrope Koeppel friction winder, with 720kg cage capacity in a 6.7m diameter shaft. The decision to convert the shaft to an upcast shaft, with fans exhausting 460 m³/s at 6.9 kPa pressure, has resulted in significant movement of the single balance rope in the air stream. You are concerned with potential contact between, and entanglement of, the balance rope and the guide ropes. An option you

are considering is installing a weighted tail sheave assembly on a pivot assembly to place tension on the balance rope and better hold it in position.

- a) Draw a diagram of your understanding of the winder layout, including the proposed modification, and label the major components (3 marks)
- b) Describe the process you would use to evaluate this option. (4 marks)
- c) Discuss four (4) hazards associated with this change, and identify two (2) potential control measures you would implement for each one. (8 marks)
- d) Discuss the effect of additional balance rope tension on the operating parameters of the winder. In your answer consider that the resultant tension in the balance rope is increased by 500 N at each conveyance. (4 marks)
- e) What factors would affect the choice of tail sheave diameter(s)? (4 marks)
- f) What safety devices are required for winder balance rope(s) that will have to be fitted to the tail sheave arrangement, and how would they operate? (2 marks)

Question 6

Conveyors

Part A - NSW code of practice: Mechanical engineering control plan

- a) The code section 4.5.16 identifies nine (9) key risk issues associated with belt conveyors. List five (5) of these: (5 marks)
- b) For each of the five (5) key risk issues above identify and explain one (1) Critical Control you would implement to mitigate it. (5 marks)

Part B – AN/NZS 4024 Safety of Machinery Part 3610: Conveyors – General Requirements

- a) List five (5) requirements for the location of pull wires (5 marks)

Part C – AN/NZS 4024 Safety of Machinery Part 3611: Conveyors – Belt conveyors for bulk materials handling

- a) clause 2.2.3 has a comprehensive list of design considerations the designer of a conveyor system shall consider. List ten (10) of these (5 marks)
- b) List five (5) protective stop controls that are mandatory on conveyors in underground coal mines? (5 marks)

CME2 – Legislation and standards applicable to underground coal mines

Instructions to candidates

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

Work Health and Safety Act 2011

Work Health and Safety Regulation 2011

Work Health and Safety (Mines and Petroleum Sites) Act 2013

Work Health and Safety (Mines and Petroleum Sites) Regulation 2014

Question 1

- 1) The WHS(MPS) Regulation 2014 outlines the mine sites requirements for the management of diesel engine exhaust emissions. Identify each clause, and explain in practical terms how they are applied/managed from a mechanical perspective? (16 marks)
- 2) The WHS Regulation 2011 outlines the mine sites requirements for the management of airborne contaminants. Identify how each clause is considered from a diesel exhaust emissions perspective, and explain in practical terms how they are applied/managed? (6 marks)
- 3) What effect does WHS(MPS) Amendment Regulation 2018 Clause 71 (2) (b1) have in relation to DES vehicle operation? (3 marks)

Question 2

- a) *WHS Act* section 19 (3) relates to primary duty of care. What is your interpretation of how these requirements relate to, and are managed by, the Mechanical Engineering Manager? (16 marks)
- b) There are legislative requirements on the Operator with respect to managing work at heights and the risk of falls. As Mechanical Engineering Manager how do you manage each of these requirements? (9 marks)

Question 3

Part A

A fitter at the coal preparation plant has been replacing a valve actuator when a section of grid mesh flooring has given way beneath them. They fell approximately 3 metres to the ground below, suffering a compound fracture to the leg, and been transported to hospital in an ambulance for surgery. You notice on the ground below there are three grid mesh retaining clips near the fallen section of mesh, two of which look like they have been there for some time.

- a) Who must be notified of an incident? (2 marks)

- b) Within what time frame must they be notified of this incident? (1 mark)
- c) How is the notification to be made? (1 mark)
- d) What clause(s) could you notify under? Identify all applicable clauses to the incident (6 marks)
- e) Under what circumstances can an incident scene be disturbed? (5 marks)

Part B

The scene is preserved and you accompany the Resources Regulator inspector to the site. The inspector issues a Prohibition Notice stating “No persons are to access elevated walkways within all areas of the CHPP including conveyor gantries, except for the purpose of maintaining workers safety.”

- 1. Under what circumstances can a Prohibition Notice be issued? (3 marks)
- 2. What must the Prohibition Notice contain? (3 marks)
- 3. What must you do when you are given direction under the notice? (1 mark)
- 4. Who is eligible to apply for review? (3 marks)

Question 4

- 1) Describe in your own words the role of mechanical engineering manager, making reference to all applicable legislative clauses. (10 marks)
- 2) With reference to all applicable legislative clauses describe what must be taken into account when preparing a mechanical engineering control plan (MECP), and how you will manage them? (15 marks)

More information

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Acknowledgments

Mechanical engineering manager of underground coal mines examination panel

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