



Mechanical engineering manager

SEPTEMBER 2015

CME1 – Mechanical engineering practices applicable to underground coal mines

Examination date: Wednesday 16 September 2015

Examination time: 09:30am – 12:30pm

Examination venue: Hunter TAFE, Kurri Kurri

Instructions to candidates:

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. Credit marks will be given for such work in assessing marks for these questions. Neatness in diagrams is essential and will be considered in the allocation of marks.

Provide answers in point form wherever appropriate. If you are unable to fit your answers in the available space, you may use the space on the opposing page. Three (3) blank pages have also been 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.

Questions 1, 2, 3 and 4 are compulsory and candidates must attempt each of these questions.

Questions 5, 6, 7 and 8 are elective – candidates must attempt only one (1) of these questions. If more than one elective question is attempted, only the mark from one of the attempted elective questions will contribute to the candidate's total.

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.

Place your identification number only, NOT your name, on your paper.

10 minutes reading time is allowed prior to the start of the examination. Candidates can use a highlighter to mark points of importance during the reading time, but may not begin answering the questions.

This examination is a **closed book** examination.

The questions in this section of this examination are compulsory (questions 1, 2, 3 and 4). Candidates must attempt each of these four questions.



Question 1 (Compulsory – 60 marks)

- a) The following is a list of drift slope haulage protection systems as listed in Mechanical Design Guide MDG33. For each device, state the purpose, the method of operation and the typical location of the device. Sketches may be used to assist you to present your answers.
- Slack rope monitor
 - Safe coil device
 - End of travel track limit
 - Brake wear indicator
 - Broken shaft detection
- b) Name two (2) types of conveyance braking systems, together with advantages and disadvantages of each type.
- c) Describe the operation of the following brake functions on a drift slope winder:
- Service brakes
 - Parking brakes
 - Emergency brakes
- a) For each of the brake functions described in part (c) above, describe the method for annual and five (5) year testing.
- b) Describe the methods used for the prevention and detection of over speed on a drift slope winding system, the location of each, and the over-speed settings as a percentage of maximum travel speed.

Question 2 (Compulsory – 60 marks)

As the mechanical engineering manager nominated to exercise the statutory function of mechanical engineering manager by the mine operator, you have been requested to develop a tender specification for the supply of hydraulic hose assemblies and adaptors for the next five (5) years for your site.

The reference documentation for your tender specification will be Mechanical Design Guide MDG41. A section within your tender specification will be titled "Marking and Identification".

- a) Detail your marking and identification requirements for the following:
- Hoses
 - Hose ends
 - Hose assemblies
 - Fittings and adaptors
- b) Detail the various forms of hose failures and methods of preventing each.

Question 3 (Compulsory – 60 marks)**Part A:**

A recent review of your sling, chain and fitting equipment Standards of Engineering Practice (SEP) has identified a number of gaps or short-falls.

A report was provided to you from your independent auditor who has identified the purchase and supply of some lifting equipment that does not comply with the Australian Standard.

- a) As the mechanical engineer nominated to perform the statutory function of mechanical engineering manager by the mine operator, how do you intend on resolving this issue in the short-term?
- b) Your investigation leads you to the central purchasing department, who purchased the equipment from a new supplier. How would you ensure any newly-purchased equipment meets the required standards?
- c) You find out from the purchasing officer that the new supplier was recommended to them by the longwall superintendent. What will be your actions knowing this supplier has not gone through the supplier qualification process?
- d) What improvements would you make to your Standards of Engineering Practice (SEP) to prevent a re-occurrence?
- e) How would you communicate your requirements to the mine's process superintendents for procurement of equipment?

Part B:

After a recent incident you have been asked to review your current towing, pulling and snigging standards when using mobile equipment. This review should identify all circumstances where mobile plant is used, or is likely to be used in towing activities.

- a) Outline the items you would consider for your standards so that it ensures fit-for-purpose equipment and a safe system of work. In your answer, consider the mobile equipment being used, the equipment being moved and the equipment holding or supporting the load.
- b) Your Mechanical Engineering Control Plan (MECP) requires all lifting equipment to be periodically inspected by a 3rd party provider to help ensure the plant remains in a fit-for-purpose state.
- c) List a number of limitations with this approach and how you would ensure all lifting equipment meets the requirements of the MECP.

Question 4 (Compulsory – 60 marks)

In one or two sentences, show your understanding of the following terms or acronyms in the context of mechanical engineering (using examples to support your response):

- a) Velocity head
- b) FRAS
- c) Pressure intensification
- d) Oxygen index
- e) Static head
- f) Explosion protected
- g) Open joint
- h) Gallery test
- i) FOPS
- j) TKPH
- k) HRD
- l) LMA
- m) TOPS
- n) SIL
- o) NDT
- p) LTIFR
- q) Dry exhaust system
- r) Drum friction test
- s) ROPS
- t) Closed joint

The questions in the next section of this written examination are elective (questions 5, 6, 7 and 8). Candidates must choose only one (1) question of the four elective questions to attempt. If more than one elective question is attempted, only the mark from one of the attempted elective questions will contribute to the candidate's total.

Question 5 (Elective – 60 marks)

You are the mechanical engineer nominated to exercise the statutory function of mechanical engineering manager by the mine operator working at a mine that has had a frictional ignition occur at the face. As a result of the ignition, you are required to carry out an investigation of the incident and develop a series of actions to minimise the possibility of re-occurrence.

Your considerations should include both development equipment and longwall equipment.

- a) During the initial investigation:
 - I. Outline what you believe may be causal factors enabling a frictional ignition to occur.
 - II. Describe what you will look for when inspecting the equipment.
 - III. In order to understand why the ignition occurred, describe what you would need to know about the equipment.
 - IV. Detail what immediate actions you would put into place to allow the mine to start cutting again.
 - V. You identify that the equipment is one of the contributors to the ignition. Describe what else you would need to understand and be aware of, and how these items would affect your immediate actions.
- b) The cutting of coal in the longer term:
 - I. Describe the checks you would put into place to ensure the integrity of the equipment.
 - II. Detail what engineering solutions you would investigate.
 - III. Describe what other solutions there might be to the issue.

Question 6 (Elective – 60 marks)

Your mine is about to relocate the longwall to a new area. During the longwall relocation, some of the equipment will be sent away for overhaul, while other equipment will undergo repairs and modifications underground.

To undertake the works, your mine needs to utilise contractors.

- a) As the mechanical engineer nominated to exercise the statutory function of mechanical engineering manager by the mine operator, describe how you would ensure the contractors working on your equipment have suitable skills for the tasks you require them to perform.
- b) Describe how you would validate the competencies and skills of the contractors.
- c) Outline how the contractors would be supervised.
- d) Describe how you would ensure the works (both offsite and onsite) are being carried out in accordance with the mine's Standards of Engineering Practice (SEP).
- e) Detail how you would ensure the onsite contracting company and their personnel are managing the identified hazards and assessed risks associated with their scope of works.

Question 7 (Elective – 60 marks)

Clause 13(f) of the *Coal Mine Health and Safety Regulation 2006* relates to mechanical engineering management plans covering the life-cycle of mechanical plant and installations.

Further to this, a clarifying Legislation Update, LU07-05, states that the intent of the provision is to ensure:

- Electrical and mechanical control systems are designed with established functional safety and machinery safe-guarding concepts (referring to AS 16508, AS 62061 and AS 4024); and that
 - Electrical and mechanical safe-guards are to have appropriate safety integrity (as defined in AS 61508) and an appropriate category (as defined in AS 4024).
- a) In your own words, define each of the following terms in the context of mechanical engineering:
 - I. Functional safety
 - II. Critical systems
 - III. Safety integrity level
 - b) List the seven (7) steps to establish functional safety requirements.
 - c) List the critical systems you might expect to find on the following machines:
 - I. Drift haulage system
 - II. Road discharge refuse bin

- d) List some of the agents of failure for the critical systems you have identified in part (c) above.
- e) Discuss how your inspection, testing and maintenance system would be configured to confirm the functionality of each of the critical systems identified in part (c) above.

Question 8 (Elective – 60 marks)

As the mechanical engineer nominated to exercise the statutory function of mechanical engineering manager by the mine operator, you are reviewing the site entry permit as part of your Standards of Engineering Practice (SEP) titled "Introduction of new plant to site".

- a) List the documentation you would expect to review as part of your site entry standards before allowing the plant to go into service.
- b) List any licensing or registration you would need to review prior to the plant going into service.
- c) A new piece of plant has been delivered to site for site induction. The plant has a number of exemptions which are going to expire during the intended operational life of the item. Describe your actions to ensure continuous use of the plant for the intended period.
- d) The plant being prepared for introduction to site is new to your site. Describe the process you are going to follow to ensure trades, operators and maintainers of the item are familiar with the plant and are competent to perform their duties.
- e) The piece of plant as above in part (d) above has failed the site introduction inspection and according to the owner, the plant has been operating at another local mine with no issues. Describe your actions, knowing the item of plant has been previously operating at a nearby mine.

END OF PAPER

CME2 – Legislation and standards applicable to underground coal mines

Examination date: Wednesday 16 September 2015

Examination time: 13:30pm – 14:30pm

Examination venue: Hunter TAFE, Kurri Kurri

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All questions are to be attempted.

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This examination is an **open book** examination.

Question 1 (20 marks)

The following question relates to the *Work Health and Safety Regulation 2011*.

In “managing risks to health and safety”, what are the six (6) main elements you are required to comply with? To assist in your answer, you may wish to list the relevant clause numbers as well as a brief clause description.

Question 2 (20 marks)

The following question relates to the *Work Health and Safety Regulation 2011*.

For “a person conducting a business or undertaking involving the management or control of plant”:

What are the “additional control measures for general plant” you are required to consider?

Question 3 (20 marks)

The following question relates to the *Work Health and Safety (Mines) Regulation 2014*.

“Winding systems”

List the items that are required to be provided by the mine operator of an underground mine when a winding system is being used, or may be put into use at a mine.

Question 4 (20 marks)

The following question relates to the *Work Health and Safety (Mines) Regulation 2014*.

“Mechanical engineering control plan (MECP)”

List the risks to health and safety associated with the mechanical aspects of plant and structures that the MECP is intended to control.

Question 5 (20 marks)

The following question relates to the *Legislation Update LU10-01: Guidelines for the renewal of item registration for diesel engine systems used in underground mines at a coal workplace*.

- a) What is meant by “Item registration” for a piece of diesel engine system (DES) plant and how often is the registration renewed?
- b) What are the responsibilities of the person in control of DES plant, operating at an underground coal work place?
- c) When renewing a DES item registration, what information do you need to provide to the registration organisation?
- d) What guidance material would you consult with when developing a maintenance strategy for your DES registered plant?
- e) When undergoing an overhaul, Code D examination or Ex repair to your DES-registered plant, how would you ensure the repairer is competent to undertake the works?

END OF PAPER

More information

Business Process and Authorisations Unit – Phone 4931 6625

Acknowledgments

Mechanical engineer examination panel

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