Department of Industry
Resources & Energy

Mine Safety

EXAMINATION REPORT | CERTIFICATE OF COMPETENCE

Mechanical engineering manager of underground coal mines

Mechanical engineer of coal mines other than underground coal mines

September – November 2015

Summary of results and general comments

Written examination results

Date:	16 September 2015
Number of candidates:	15 candidates (3 Surface and 12 Underground candidates)
Number who passed:	15 (100% success rate)

Average overall mark UG:	77.4% (minimum pass mark 60%)
Highest mark obtained UG:	88.7%
Average overall mark OC:	80.4%
Highest mark obtained OC:	87.3%

CME1 Mechanical engineering practices applicable to underground coal mines

CME1 paper required 5 out of 8 questions to be answered. Questions 1-4 were compulsory, with the remaining question to be selected from Q5 to Q8. All questions are worth a total of 60 marks.

Highest mark:	**56/60**
Average mark:	**43/60**
Lowest mark:	**19/60**

Question 1 (Compulsory)

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.

a) Slack rope monitor
b) Safe coil device
c) End of travel track limit
d) Brake wear indicator
e) Broken shaft detection

Overall comment:

Candidates need to be familiar with safety critical components associated with winding equipment together with their locations, methods of operation and intended purpose.

Highest Mark: 56/60
Lowest Mark: 18.5/60
Average Mark: 43/60

Question 2 (Compulsory)

Question 2 a)

As the mechanical engineer 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”.

Detail your marking and identification requirements for the following:

- Hoses
- Hose ends
- Hose assemblies
- Fittings and adaptors

Question 2 b)

Detail the various forms of hose failure and methods of preventing each.

Overall comment:

Part (a) Managers of Mechanical Engineering are often required to develop, review and/or authorise engineering specifications, to ensure the standards of engineering practice for the mine are not being compromised. The use of MDG,s or Standards are be used to develop such documents

Part (b) With fluid power forming such a large part of mining equipment and fluid energy being transferred through conduits such as hoses or pipes, the Manager of Mechanical Engineering needs to have a good understanding of modes of failures of such items so methods of failure prevention can be implemented.

Highest mark: 53.5/60
Lowest mark; 28.5/60
Average mark: 47/60

Question 3 (Compulsory)

Part A:

A recent review of your sling, chain and lifting 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 this 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.

List a number of limitations with this approach and how you would ensure all lifting equipment meets the requirements of the MECP.

<u>Overall comment:</u>

The use of lifting and towing equipment in or about the mine is a risky task. The control of all lifting and towing equipment is through an SEP. This SEP should provide for whole of life of the components, ie cradle to grave.
Regular audits of these systems should take place in order to identify non-conformances with the process. Where a NC has been identified, a formalised process needs to be implemented to prevent reoccurrences.
With the use of external providers to undertake review and audits, comes limitation, and as the Manager of Mechanical Engineering you need to be aware of these limitations and provide additional checks to ensure plant remains fit for purpose as well as used as intended.
An example of this is lifting equipment missing out not being inspected at programmed period, how would you know?

Highest Mark: 58/60

Lowest Mark: 33.5/60

Average Mark: 43

Question 4 (Compulsory)

Question 4 required the candidates to provide short answers and an example for 20 abbreviations/acronyms. This question is designed to test the candidate's general mechanical/ mining industry knowledge.

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

Overall comment:

The Question was well answered. The question was designed to test a candidate's general knowledge of general terms or phrases used within the mine industry.

Highest Mark: 58.5/60

Lowest Mark: 34.5/60

Average Mark: 49/60

Question 5 (Elective – total 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. (6 marks)

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.

5 Candidates attempted this question

Overall comment:

As Manager of Mechanical Engineering we are often called upon to develop strategies to assist in the controls of such events as frictional ignition of gas from coal cutting machines.

Candidates need an understanding as to the causes of such events, together with the development of inspections, tests and /or measurements to assist in the management of frictional ignitions from coal cutting equipment.

Highest Mark: 54/60

Lowest Mark: 37/60

Average Mark: 44/60

Question 6 (Elective – total 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.

4 Candidates attempted this question.

Overall comment:

Managers of Mechanical Engineering are often called upon to evaluate contractor's competencies for the purposes of maintaining, overhauling or repairing equipment or plant, either on or offsite.

During this period of intense maintenance activity, supervision of contractors play and important role to ensure procedures, practices and standards are being maintained.

Highest Mark: 58/60

Lowest Mark: 48/60

Average Mark: 53/60

Question 7 (Elective – total 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.

Overall comment:

Although no candidate answered this question, this may be a reflection of the lack of understanding of functional safety.

The examiners would suggest the future candidates undertake some formal training on the subject of functional safety

Question 8 (Elective – total 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.

3 Candidates attempted this question

Overall comment:

Entry to site for new and/or repaired plant is a necessary requirement in ensuring plant is being returned in a fit for purpose state and in readiness for work.

The mines SEP needs to cater for this function and include provision for: documentation, licensing, exemptions, risk assessments, training both operational and maintenance/testing and repairs as well as a formalised process in the event the plant fails to meet the mines expectations.

Highest Mark: 42/60
Lowest Mark: 38/60
Average Mark: 39/60

CME2 - Legislation and standards applicable to underground coal mines

Question 1 (Total 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.

Highest Mark: 20/20
Lowest Mark: 7/20
Average Mark: 18/20

Question 2 (Total 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?

Highest Mark: 20/20
Average Mark: 20/20

Question 3 (Total 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.

Highest Mark: 20/20
Lowest Mark: 2/20
Average Mark: 17/20

Question 4 (Total 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.

Highest Mark: 20/20

Lowest Mark: 0/20

Average Mark: 17/20

Question 5 (Total 20 marks)

The following question relates to 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?

Highest Mark: 20/20

Lowest Mark: 12/20

Average Mark: 17/20

Overall comments for CME 2 Legislation

The overall result for the open book format was quite a pleasing result even though LU10-10 update was not provided as a reference for question 5.

Candidates are demonstrating a good understand of being able to navigate around the legislation to answer the questions.

With the time allotted to the paper, it is somewhat difficult to drill down in the question to get a candidates understanding and application of the legislative requirement.

Perhaps in the future, the time allocation for this question can be extended to allow this.

CME3 – Safety and mining legislation applicable to open-cut coal mines

CME3 contained two parts: Part A was an open book, while Part B was a closed book. Each question was worth 25 marks. Part A contained questions 1 through to 3. Part B contained questions 4 through to 8.

PART A: Legislation (3 questions – open book)

Question 1 (Total 25 marks)

The following questions relate to the Work Health and Safety Regulation 2011.

a) In "managing risks to health and safety", what are the six (6) main elements you are required to comply with? In providing your answer, list the relevant clause numbers as well as clause headings.
b) You have been nominated to exercise the statutory function of mechanical engineer at a coal mine that is not an underground coal mine. Briefly describe how you would ensure compliance with each of the clauses identified in part (a).

Overall comment:

Candidates need to be aware of the main elements of compliance when “managing risk to health and safety” at a minesite, together with methods of ensuring compliance.

Highest Mark: 25/25

Lowest Mark: 18/25

Average Mark: 20/25

Question 2 (Total 25 marks)

The following questions relate to the Work Health and Safety Regulation 2011.

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

a) What are the “additional control measures for general plant” you should consider? In providing your answer, list the relevant clause numbers from the regulation as well as clause headings.
b) Describe the management systems would you have in place to ensure compliance with this subdivision of the regulation.

Overall comment:

WH&S Reg 2011 provides for additional control measures for plant. Candidates need to be aware of these extra measures, together with the management systems which need to be in place to ensure compliance with legislation.

Highest Mark: 25/25

Lowest Mark: 13/25

Average Mark: 21/25

Question 3 (Total 25 marks)

The following questions relate to the Work Health and Safety (Mines) Regulation 2014.

“Mechanical engineering control plan (MECP)”

a) List the risks to health and safety associated with the mechanical aspects of plant and structures that the MECP must set out control measures for.
b) For each of the risks listed in part (a) above, give an example of a specific hazard that may be present at a coal mine other than an underground coal mine, that would create the risk to health and safety.

Overall comment:

The “Mechanical engineering control plan” is a plan required by legislation. This forms the foundation for identifying and controlling hazards and risks associated with mechanical plant. Candidates need to be conversant with the requirements of the content for this control plan.

Highest Mark: 25/25

Lowest Mark: 22/25

Average Mark: 23/25

PART B: Practical mining (Closed book)

Question 4 (Total 25 marks)

Multiple choice – select the most correct answer from the options available. Select only one response to each question. Place a cross in the box corresponding to your answer, for example ☒.

4.1 Hydraulic intensification can occur in:

- ☐ Hydraulic cylinders
- ☐ Accumulators
- ☐ Needle valves
- ☐ All of the above

4.2 LPG bulk storage tanks must be inspected:

- ☐ Monthly
- ☐ Annually
- ☐ Every three (3) years
- ☐ Not at all

4.3 The after-cooler of a reciprocation compressor is used to:

- ☐ Cool the compressor
- ☐ Remove condensation
- ☐ Reduce air density
- ☐ Reduce air temperature

4.4 All signs, labels and warning notices should be designed and installed in accordance with:

- ☐ AS 1318
- ☐ AS 1319
- ☐ Both AS 1318 and AS 1319
- ☐ None of the above

4.5 The isolation of equipment while being repaired should be carried out by:

- ☐ Nominated mechanical engineer
- ☐ The equipment operator
- ☐ Job supervisor
- ☐ All persons working on the job
- ☐ All of the above

4.6 When designing risk assessment to determine safety-critical component integrity, which Australian Standard would you refer to:

- ☐ AS 4240
- ☐ AS 4024
- ☐ AS 4100
- ☐ AS 4808

4.7 All fluid power components have a minimum factor of safety of:

- ☐ 4.0 to 1
- ☐ 3.0 to 1
- ☐ 2.5 to 1
- ☐ 2.0 to 1
- ☐ None of the above

4.8 What element or elements should be contained in a plant safety file:

- ☐ Risk control measures
- ☐ Plant alterations
- ☐ Change of procedures, monitoring, audit and review reports
- ☐ All of the above
- ☐ None of the above

4.9 The Mechanical Design Guide (MDG) for fluid power system safety at mines is:

- ☐ MDG 10
- ☐ MDG 16
- ☐ MDG 36
- ☐ MDG 41
- ☐ None of the above

4.10 Wire ropes may deteriorate due to some of the cumulative effects of the following:

- ☐ Lightning strikes
- ☐ Localised heating
- ☐ Fretting
- ☐ Corrosion
- ☐ All of the above

Overall comment:

Multiple choice questions are designed to test a candidate's general knowledge of a whole range of topics in a short period of time

Highest Mark: 17.5/20

Lowest Mark: 15/20

Average Mark: 17/20

Question 5 (Total 25 marks)

As the mechanical engineer nominated to exercise the statutory function of mechanical engineer by the mine operator, you have been given a submission for review and comments from the manager of the coal preparation plant. The submission relates to the purchase of a mobile elevated work platform (MEWP) with a maximum reach of 15 metres.

a) List five (5) major points of consideration you would expect to see in the submission.
b) Identify five (5) activities where a MEWP may be able to be used on a mine site.
c) Set out a risk assessment in simple tabular form that may form part of an introduction of plant to site process with two (2) columns: (1) Hazard and (2) Controls. There is no need to risk rank in your answer.
   The risk assessment should cover the life cycle of the plant and cover all hazards and controls including safety features of the MEWP.
d) How would you ensure operators are competent to operate the MEWP?
e) List the items you would expect to find in the pre-operation checklist for this item of plant

Overall comment:

Quite often the Mechanical Engineer with statutory functions will be asked to develop and/or review submissions for the purchase of new or old plant. A candidate needs a sound understanding of the process ensuring all hazards and risks are identified, scope of operation of the plant is identified, all training and competencies are identified as well as all checks and testing to ensure safe operation have been identified.

Highest Mark: 23/25

Lowest Mark: 20/25

Average Mark: 22/25

Question 6 (Total 25 marks)

As the mechanical engineer nominated to exercise the statutory function of mechanical engineer by the mine operator for a surface coal mine, you are aware of a series of light vehicle incidents within a two (2) week period.

These incidents include:

- A fire on a light vehicle (LV)
- Light vehicle run away from the parking area resulting in a vehicle rollover
- Light vehicle service brake failure as the light vehicle was being driven down a steep ramp

a) In chronological order, list in point form the steps you would take in investigating these incidents
b) List the system failures that may have led to the light vehicle incidents.
c) Prepare a list of recommended controls from the system failures identified in the above question
d) From your investigation, how do you intend on implementing changes to your processes?
e) List the processes you would recommend be implemented to prevent reoccurrences.

Overall comment:

Mechanical Engineer with statutory functions needs to be able to review incident/accidents statics, identify trends, failings and implement effective changes to enable the management of such plant through the monitor, audit and review process

Highest Mark: 21.5/25

Lowest Mark: 10/25

Average Mark: 17/25

Question 7 (Total 25 marks)

As a result of recent thickness testing carried out on your “Run of Mine Bin”, the lower half of the cone will require replacement during the Easter shutdown period.

The proposed repairs will involve:

- A contracting company being engaged to manufacture and install the new cone section during the Easter shutdown period.
- The removal of the vibrating feeder from under the bin and replacement when the repairs are completed
- Cutting off the worn cone section and removing it
- Welding the new cone section into position

The process will involve the use of, the following equipment:

- Lifting equipment
- Scaffolding
- Mobile elevated work platform (MEWP)
- Electric welding equipment
- Gas cutting equipment
- Electric power tools

Other relevant information:

- Hot work processes
- Installation of internal bracing in the bin to prevent distortion when the cone section is cut off
- Working 24/7 until repairs are completed

a) List the matters (people, process and equipment) that will need to be addressed with this work.
b) List controls to be taken to ensure the work is carried out in a safe and efficient manner.
c) List the documentation you would expect the contracting company to provide you.
d) What can be done to prevent the new cone from deteriorating?

e) List the activities associated with these works that would be classified as “high risk” in terms of the Work Health and Safety (Mines) Regulation 2014..

Overall comment:

Mechanical Engineer with statutory functions needs to be able to plan and execute major repairs or upgrades to plant. These would include the management of people; plant and process by ensuring correct documentation, competent people, with correct procedures and with all areas of high risk having been clearly identified

Highest Mark: 22/25

Lowest Mark: 17/25

Average Mark: 20/25

Question 8 (Total 25 marks)

You are the mechanical engineer nominated to exercise the statutory function of mechanical engineer by the mine operator of an open-cut coal mine that incorporates a coal preparation plant and rail-loading facility.

Your preparation plant has a 500,000 tonne washed coal stock pile and utilises a 150m long reclaim tunnel to transfer washed product via a reclaim conveyor to the rail-loading facility.

a) List five (5) hazards associated with conveyors operating in a reclaim tunnel.
b) List five (5) typical controls used to limit the access of personnel when undertaking maintenance and inspection.
c) List five (5) typical items or equipment systems that are associated with the design and operation of a reclaim tunnel in providing a safe working environment.
d) List five (5) types of monitoring systems that could be found within a reclaim tunnel.
e) List five (5) different reference documents you would consult when developing a management system for the reclaim tunnel.

Overall comment:

Mechanical Engineer with statutory functions needs a clear understanding of the hazard controls as well as protection/monitoring systems available to help in the control of conveyor operations in reclaim tunnels.

MDG 28 is a good reference source, in the management of reclaim tunnels.

Highest Mark: 24.5/25

Lowest Mark: 16.5/25

Average Mark: 21.5/25

Oral examination results

Date: 17th & 20th November 2015

Underground

Number of candidates eligible to sit: 24

Number of candidates who sat: 13

Number of candidates deemed competent: 2

Surface

Number of candidates eligible to sit: 7

Number of candidates who sat: 3

Number of candidates deemed competent: 2

Oral Examination: Areas of discussion

Underground candidates:

- 1st time candidates roles and responsibilities for Mechanical Engineering Manager
- Failures of ExDes equipment
- Diesel exhaust pollutant testing
- Safety bulletin SB15-03
- Incident investigation “inrush magnetite from coal processing facility”

Surface candidates:

- 1st time candidates roles and responsibilities for Mechanical Engineer (Coal mines other than U/G mines)
- Safety alert SA15-01
- Incident investigation “inrush magnetite from coal processing facility”
- Contractor Management
- Isolation breaches

More information

Business Processes & Authorisations

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Acknowledgments

Mechanical Engineer / Mechanical Engineering Manager Examination Panel