



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

CANDIDATE NUMBER: \_\_\_\_\_ (write in from your letter)

### MECHANICAL ENGINEERING MANAGER OF UNDERGROUND COAL MINES EXAMINATION FOR CERTIFICATE OF COMPETENCE

Issued under the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2022*

Unless otherwise stated all references to 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 2022*

This Examination is held in the following location:

**Region:** New South Wales

**Venue:** Tocal College

**Room:** McFarlane Court

**Date:** 31 July 2024

**Start time:** 08:50:00

**Finish time:** 12:00:00

#### INSTRUCTIONS TO CANDIDATES:

10 minutes reading time is allowed prior to the start of the examination.

It is expected that candidates will present their answers in an engineering manner, making full use of diagrams, tables, and schematics as appropriate, and showing full workings in calculations. **Poor legibility in diagrams and handwriting** may affect the candidate being deemed competent.

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.

**All ten (10) questions are to be attempted.** All questions are of equal value.

Candidates will be marked, and determined as competent, or not yet competent. If a question is identified as **ESSENTIAL**, then the candidate must be deemed competent in that question in order to be deemed competent in the exam. If a part of a question is identified as **ESSENTIAL**, then the candidate must be deemed competent in that part in order to be deemed competent in that question and the marks for that question to be counted.

This examination is a **closed book** examination and no reference material may be used during the exam. Reference material will be provided in the exam paper as applicable.

# EXAMINATION BOOKLET

Question Number	Essential	Competent / not yet competent	Mark	Assessed by <i>Name</i>	Comments to justify, as necessary
1	A				
	B				
	C				
	D				
	E				
	<b>Total</b>			/ 25	
2	A				
	B				
	C				
	D				
	E				
	F				
	<b>Total</b>			/ 25	
3	A				
	B				
	<b>Total</b>			/ 25	
4	A				
	B				
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	E				
	<b>Total</b>			/ 25	

5	A					
	B					
	C					
	D					
	E					
	<b>Total</b>				/ 25	
6	A					
	B					
	C					
	D					
	E					
	<b>Total</b>				/ 25	
7	A					
	B					
	C					
	D					
	E					
	<b>Total</b>				/ 25	
8	A					
	B					
	C					
	D					
	<b>Total</b>				/ 25	

9	<b>A</b>	<b>Essential</b>				
	<b>B</b>					
	<b>C</b>					
	<b>D</b>					
	<b>E</b>					
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	<b>Total</b>				/ 25	
10	<b>A</b>					
	<b>B</b>					
	<b>C</b>					
	<b>D</b>					
	<b>E</b>					
	<b>F</b>					
	<b>Total</b>				/ 25	
<b>PAPER</b>	<b>Verdict</b>		<b>TOTAL</b>	<b>/</b> <b>250</b>		<i>Marks checked by:</i>

If marking is reviewed under approved processes, then examiner is to record details:

<b>Date</b>	<b>Examiner</b>	<b>Questions reviewed</b>	<b>Marks changed</b>	<b>Details/justification, as necessary</b>
<b>Eg. 2/8/19</b>	<b>Andrew Palmer</b>	<b>All</b>	<b>Q1 – 4 (previously 5)</b>	<b>Found one more criteria</b>

**CME1 – Mechanical engineering practices applicable to underground coal mines****Question 1 – Shaft sinking winder**

Your Mine has commenced a project to install two new shafts using conventional drill and blast sinking. The 420 metre deep shafts are a 6 metre finished diameter upcast ventilation shaft, and an 8 metre finished diameter intake and personnel access shaft. The collars are installed, and the initial 50 metre presinks are almost complete using an excavator and crane mounted kibble, with a second crane fitted with work box for access. The shaft sinking Contractor proposes to use a double drum stage winder and a single drum kibble winder for the shaft sinking.

- A. Sketch a typical shaft sinking winder configuration with sufficient detail to label your drawing identifying ten (10) main components. 12 marks





## Question 2 – AS3584.2 Diesel Engine Systems – Explosion Protected

You are the statutory Mechanical Engineering Manager at an underground coal mine, and your Explosion Protected Diesel Engine System Standard of Engineering Practice (SEP) refers to AS3584.2 Diesel engine systems for underground coal mines Part 2: Explosion protected.

A. In your own words what is the definition an explosion protected diesel engine system

5 marks

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B. What components are included in a diesel engine system? List five (5) of the seven items.

5 marks

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AS3584.2 Section 2 Design and Construction, identifies that engines shall be compression ignition, diesel fuelled and water cooled types. However, they may be naturally aspirated, turbo charged, or supercharged.

C. What suitable sampling points shall be provided to allow monitoring? List five (5). 5 marks

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D. The temperature of any surface that comes into contact with the atmosphere shall not exceed what under any condition of operation, including when tested 1 marks

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E. What engine shutdown systems shall be fitted to an explosion protected diesel engine system. List five (5). 5 marks

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F. Draw an open joint for an explosion protected engine.

4 marks

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### Question 3 – Multiple choice and Short answer

Part A – Multiple Choice – identify the most appropriate answer(s). No marks awarded for an individual question if any incorrect answer is given 15 marks

A. Which Australian Standard would you consult for fixed platforms, walkways, stairways and ladders:

- i. AS1418
- ii. AS1657
- iii. AS4024
- iv. AS4100

B. The minimum width of a walkway should be equal to or greater than:

- i. 500mm
- ii. 550mm
- iii. 600mm
- iv. 750mm

C. Rung type ladders are used when the angle to the horizontal is:

- i. between 45 and 60 degrees
- ii. between 60 and 70 degrees
- iii. between 70 and 90 degrees
- iv. over 90 degrees

D. The hand rail of a walkway shall be a vertical height of:

- i. Not less than 500mm, and not more than 700mm
- ii. Not less than 600mm, and not more than 800mm
- iii. Not less than 800mm, and not more than 1000mm
- iv. Not less than 900mm, and not more than 1100mm

E. The gap between the toeboard and the floor of a walkway should not exceed:

- i. 10mm
- ii. 15mm
- iii. 20mm
- iv. 25mm

F. When considering the operational design of reclaim tunnels which of the following standards and/or guidelines should you refer to:

- i. AS4024 Safety of machinery series of standards
- ii. MDG1032 – Prevention and early detection and suppression of fires
- iii. MDG25 – Safe cutting and welding operations at mines
- iv. MDG29 – Guideline for the management of diesel engine pollutants in underground environments
- v. All of the above

- G. Which of the following should be considered a risk control for the safe operation of reclaim tunnels
- i. A system to control the entry of people to the reclaim tunnel and indicate when the tunnel is occupied
  - ii. Use of FRAS conveyor belting and accessories
  - iii. Emergency lighting and communications rated for safe operation in explosive atmospheres
  - iv. Ventilation of all parts of the reclaim tunnel to control airborne dust and prevent accumulation of gas or other airborne contaminants
- H. Which of the following risk control measures would NOT be considered appropriate to prevent a potential dozer engulfment in the reclaim draw point
- i. GPS in dozer cab with proximity alarm
  - ii. Flashing light on conveyor gantry indicating active draw point
  - iii. Spotter on conveyor gantry with two way radio to dozer operator
  - iv. Heavy duty grizzly cage over the coal valve
- I. Which of the following risk control measures would eliminate a potential dozer engulfment in the reclaim draw point?
- i. Remote autonomous dozer control
  - ii. Heavy duty grizzly cage over the coal valve
  - iii. Bucketwheel reclaimers
  - iv. Rill tower
- J. What does the term freeboard refer to with respect to belt conveyors?
- i. Distance the pulley shell is wider than the conveyor belt to allow for belt misalignment
  - ii. Distance fixed steel work is away from the edge of the conveyor belt to prevent contact during belt wander/misalignment
  - iii. The waiving of rental cost for tenants to live in the conveyor gantry
  - iv. Distance the belt is wider than the conveyed product to prevent lumps rolling off the side
- K. What method(s) could you use to increase tension in a belt conveyor fitted with a gravity tower?
- i. Increase the mass of the counterweight
  - ii. Increase the number of reeves of wire rope between the counterweight and LTU trolley
  - iii. Increase the height of the gravity tower
  - iv. Increase the installed power in the conveyor drive
- L. What factors influence the braking capacity of rubbered tyred mobile plant?
- i. Tyres with aggressive tread pattern
  - ii. Increasing brake system pressure
  - iii. Decreasing load carrying capacity
  - iv. Dust suppression watering on roads
  - v. All of the above
- M. How is the park brake applied in a truck Maxibrake system where air pressure is generated and stored in a reservoir?
- i. Air applied, hydraulic release
  - ii. Air applied, spring release
  - iii. Spring applied, air release
  - iv. Hydraulic applied, air release

N. How are the service brakes applied in a truck Maxibrake system where air pressure is generated and stored in a reservoir?

- i. Air applied, hydraulic release
- ii. Air applied, spring release
- iii. Spring applied, air release
- iv. Hydraulic applied, air release

O. Hydraulic brake systems rely on what factor(s) to correctly apply?

- i. Disc rotor not contaminated with oil, grease, or brake fluid
- ii. Brake pads have sufficient contact area of friction material
- iii. Air is bled out of the hydraulic lines
- iv. Master cylinder and calliper piston seals are not leaking
- v. All of the above

/ 15

Part B – Short Answer – winding systems

10 marks

a) Would you expect to see a balance rope on a slope haulage winder?

b) What is the purpose of a balance rope?

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c) How many hoist ropes are there on a double drum winder?

d) Name two types of brakes that can be fitted to the control car of a slope haulage winder?

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e) What is the function of a Kep?

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## Question 4 – Fire suppression

You are the Statutory Mechanical Engineer at a Coal Mine and have just been advised a fire has occurred in the engine bay of a Cat D10T dozer on the edge of the stockpile. The operator has called the emergency, then tried to activate the fire suppression system (FSS), but the activator valve and panel cover have separated from the mounting bracket when trying to withdraw the safety pin.

It was a very similar type of incident to that identified in NSW Resources Regulator Safety Alert SA22-06 Operator unable to activate fire suppression system during emergency, as shown below, and your mine's dozer driver has ended up exiting the cab through the right hand side with flames licking through the deck plate, and has been forced to jump the three (3) metres to the stockpile below. Both bones in the dozer drivers left lower leg have broken in the fall.

The site emergency response team have extinguished the fire, and the dozer driver has been taken by ambulance to hospital.



Date: October 22

### Operator unable to activate fire suppression system during emergency

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

#### Issue

When a fire occurred on a dozer, the operator tried to activate the fire suppression system when the panel cover separated from the mounting bracket, forcing the operator to abandon the plant.

Figure 1 - Actuator panel separated from the mounting bracket



#### Circumstances

A Caterpillar D10T bulldozer was operating at an open cut coal mine when a fire occurred in the engine bay. The operator saw smoke and flames and tried to activate the fire suppression system, but the valve and panel cover separated from the mounting bracket when trying to withdraw the safety pin.

Not knowing if the system could still be activated, the operator reversed a short distance, lowered the access ladder and pressed the red emergency button. With flames licking up through gaps around the deck plate, the operator exited the cabin via the left-hand door and jumped from the

deck about 3 metres to the ground. The operator was not injured and went to the rear of the machine to shut down the engine down. The fire suppression system then activated automatically.

A. Identify four (4) potential clauses / descriptions you will consider notifying the Regulator under.  
4 marks

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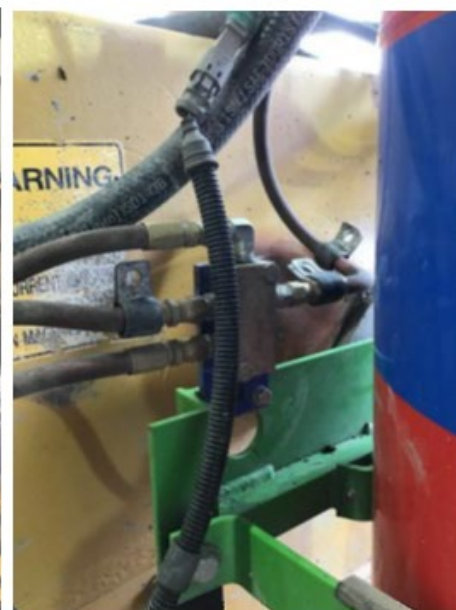
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Refer to the additional photos of the FSS below to assist with your the following two questions.



B. Consider the fire suppression system identified in SA22-06. Describe the suppressant type and activation method. 2 marks

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C. For the system in SA22-06 above describe in detail the operational functionality of the Fire Suppression System (FSS) as fitted and when operated. Basically, how is it designed to work? 5 marks

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There are a number of types of fire suppression system available to the mining industry.

D. Describe in detail the functionality of two (2) other types of mobile equipment Fire Suppression Systems (FSS's). 8 marks

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B. Identify three (3) external people you would consult to assist in the investigation. 3 marks

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C. Identify four (4) potential contributing factors to the land slip beneath the conveyor? 4 marks

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## Question 7 – Hot work

On 18th January, 2024, SafeWork Australia amended the workplace exposure standard (WES) for welding fumes. Exposure standards should not be considered as representing an acceptable level of exposure. They establish a statutory maximum upper limit.

As Mechanical Engineering Manager at a Mine, to comply with the WHS legislation you must take all reasonably practicable steps to eliminate or minimise the risks from exposure to welding fumes, not just ensure that exposure is below the WES.

- A. Identify four (4) actions SafeWork recommend you take to minimise workers exposure to welding fumes. 4 marks

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- B. List three (3) principal hazard management plans or principal control plans that directly manage aspects of hot work 3 marks

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## Question 8 – Blasting and Painting SEP

As part of your statutory mechanical role you are responsible for a relatively new coal processing plant and train loading facility. These are steel structures and some of the structural members and access systems are beginning to show signs of paint loss and surface corrosion. Your recent annual third party structural audit has identified that a blasting and painting program is required to be implemented. As your mine does not currently have a Standard of Engineering Practice (SEP) for Blasting and Painting you have been asked to develop one from scratch.

- A. Outline the logical process steps you would take to develop this new standard of engineering practice. List eight (8) steps. 8 marks

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- B. List five (5) personnel or organisations you would involve in the risk assessment for blasting and painting 5 marks

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C. List six (6) hazards that you expect to identify during the risk assessment in relation to blasting and painting 6 marks

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D. List six (6) controls you would consider implementing to mitigate the hazards you identified 6 marks

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## Question 9 – Transport Braking System (TBS)

## Essential Elements

You are the Mechanical Engineering Manager of an underground coal mine that runs a fleet of diesel mobile plant including personnel transports and LHD's. One of the safety critical functions that must be operational for safe use is brakes.

### Essential Elements

- A. In relation to brakes on mobile plant used underground at coal mines in New South Wales what must each item of plant have in place from a legislative perspective for it to be operated. **The requirement is considered essential, and must be included in your answer. If NOT included the candidate will be deemed not yet competent for the question.**

2 marks

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- B. Under what legislation are these braking system documents issued.

2 marks

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- C. There are twelve (12) items of information you would expect to find on the braking system certification document that relates specifically to the registration. List eight (8) of these.

4 marks

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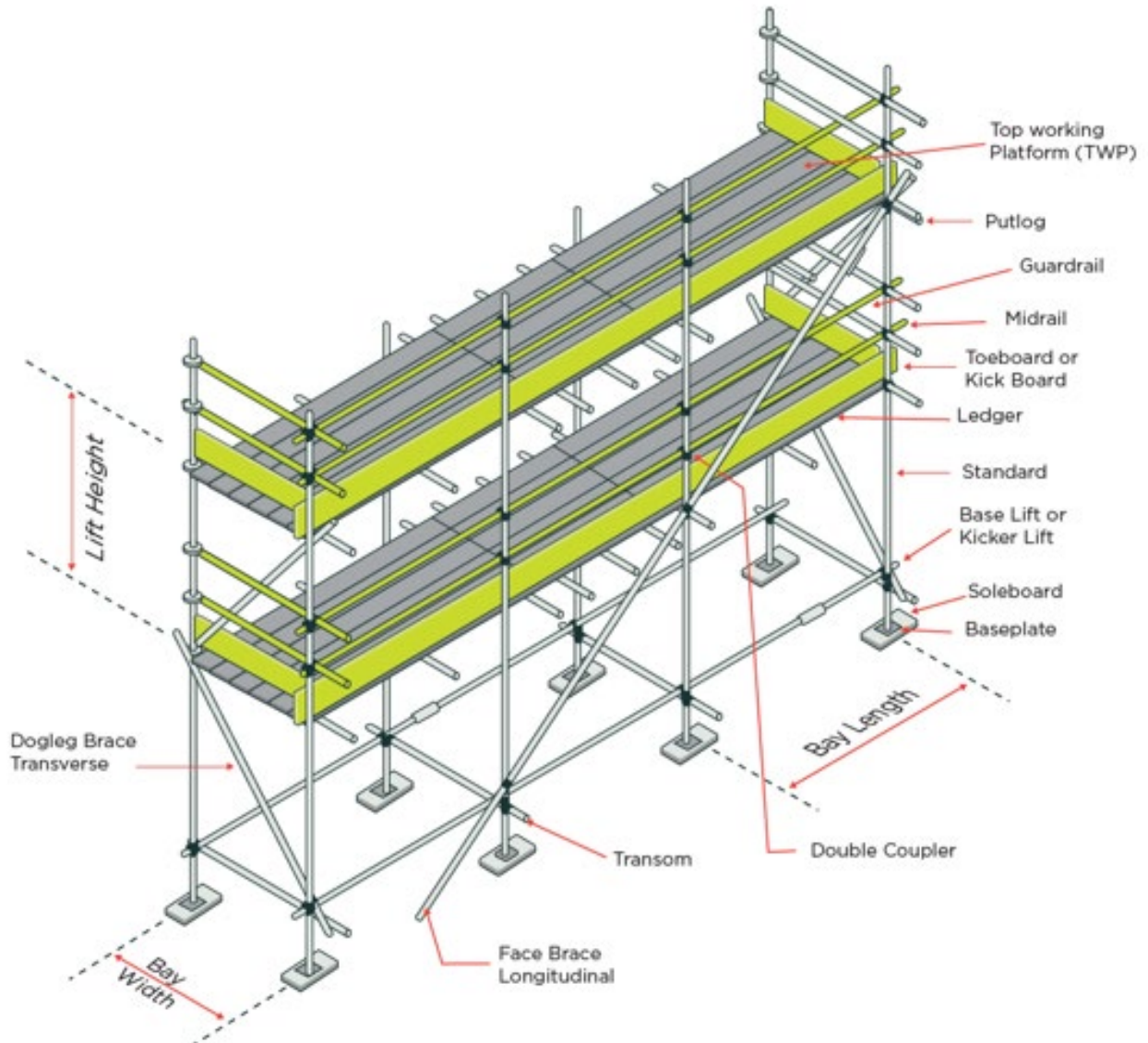


C. Which types of scaffold are required to be designed by an engineer? Circle all that apply. A wrong answer equates to no marks for this question 3 marks

- a) A scaffold that is above 30m to the top working platform height
- b) a scaffold with a cantilevered platform
- c) a scaffold that uses beam or truss elements
- d) a hung scaffold
- e) a scaffold that included containment (i.e. brattice or screen/mesh)

/ 3

Consider the drawing below and answer the following questions.



D. What are the following dimensions in millimetres

5 marks

Question	Answer (mm)
What is the maximum permitted lift height?	
What is the maximum distance a putlog can be from a standard?	
What is the minimum bay width for a light duty scaffold?	
What is the maximum allowable gap between planks forming a working platform?	
How far past the landing must the ladder extend?	
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E. What are the following requirements?

a. What is the minimum and maximum slope for a scaffold access ladder? 2 marks

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b. What is the maximum height between successive ladder landings? 2 marks

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F. What three (3) components must be present on a working platform for edge protection?

3 marks

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**End of Document**



## CME2 – Legislation and standards applicable to underground coal mines

CANDIDATE NUMBER: \_\_\_\_\_ (write in from your letter)

### MECHANICAL ENGINEERING MANAGER OF UNDERGROUND COAL MINES EXAMINATION FOR CERTIFICATE OF COMPETENCE

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**Finish time:** 15:10:00

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	C					
	total				/ 25	
6	A					

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8	A					
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	H					
	<b>total</b>			<b>/ 25</b>		
9	A					
	B					
	C					
	D					
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	F					
	<b>total</b>			<b>/ 25</b>		

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	B				
	C				
	D				
	E				
	F				
	G				
	<b>total</b>			<b>/ 25</b>	
<b>PAPER</b>	<b>Verdict</b>		<b>TOTAL</b>	<b>/ 250</b>	<i>Marks checked by:</i>

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## CME2 – Legislation and standards applicable to underground coal mines

### Question 1 – Role of Mechanical Engineer and MECP

**Essential**

The candidate must be assessed as competent for this question, both Part A and Part B, in order to be considered as being competent for the entire exam.

#### Part A - The role of the Mechanical Engineering Manager

- A. Fill in the blanks in the extract of legislation below regarding the role of the Mechanical Engineering Manager. 9 marks

Work Health and Safety (Mines and Petroleum Sites) Regulation

Schedule 10 Part 2 Underground coal mines

#### 5 Mechanical engineering manager

- 1) The statutory functions of a Mechanical Engineering Manager are:

a. To \_\_\_\_\_, \_\_\_\_\_,  
\_\_\_\_\_, and \_\_\_\_\_ the mechanical engineering standards and procedures forming part of the mining operations at a mine

b. to supervise the \_\_\_\_\_, \_\_\_\_\_,  
\_\_\_\_\_ and \_\_\_\_\_ of mechanical plant at the mine.

- 2) The requirement for nomination to exercise the statutory functions is that the individual nominated

must \_\_\_\_\_

\_\_\_\_\_ that authorises the exercise of the statutory functions.







## Question 2 – Managing risks to health and safety

Work Health and Safety (Mines and Petroleum Sites) Regulation

### 14 Management of risks to health and safety

- (1) A person conducting a business or undertaking at a mine or petroleum site must manage risks to health and safety associated with mining operations or petroleum operations at the mine or petroleum site in accordance with the WHS Regulations, Part 3.1.
- (2) A person conducting a business or undertaking at a mine or petroleum site must ensure ....

A. What must the PCBU ensure?

3 marks

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B. According to 14 (3) in conducting a risk assessment the person must have regard to what?

3 marks

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C. According to 14 (5) requires records to be kept of what?

3 marks

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D. What records are not required to be kept under 14 (6)?

2 marks

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E. As part of the mines expansion project you will be introducing new mobile plant of a configuration that has not been used at the mine before. List seven (7) different roles that you would include in the risk assessment, and why you would include each of them. 14 marks

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B. You are reviewing the Mechanical Engineering Control Plan (MECP) for your mine. List six (6) subordinate systems or Standards of Engineering Practice (SEP) you plan to have in place that specifically address the requirements of WHS Act Section 19 (3) (b) **over the lifecycle of plant and structures?** 6 marks

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C. The safety management system requires a hierarchal structure of documents to effectively manage hazards at mines. List six (6) tiers of mechanical documents from highest to lowest that you will use to manage WHS Act Section 19 (3) (c) **with respect to mechanical plant and structures** 6 marks

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## Question 5 – Lifting and crantage SEP

You are investigating an incident at your mine that resulted in the rollover of a telehandler whilst lifting a reel of high voltage cable on ground that was not quite level. You have determined the operator had not lowered the outriggers as they planned to immediately tram the telehandler with the cable to load it on an A-frame skid. The jib crane attachment for the 12 tonne telehandler was only rated for a 2 tonne lift, so the operator had slung the load under the forks using chain slings. On the uneven ground the load had swung to one side and the telehandler slowly overturned. The operator was not injured, although the telehandler boom is bent.

You have decided to review your lifting and crantage standard of engineering practice (SEP). You have reviewed the Resources Regulator website for applicable Safety Alerts and Bulletins, including two in the last 12 months that directly relate to lifting and crantage. These are Safety Bulletin SB23-08 Haul truck front strut removal poses risks to workers, dated October 2023, and Safety Alert SA23-07 Haul truck engine module narrowly misses workers, dated December 2023. Refer below:

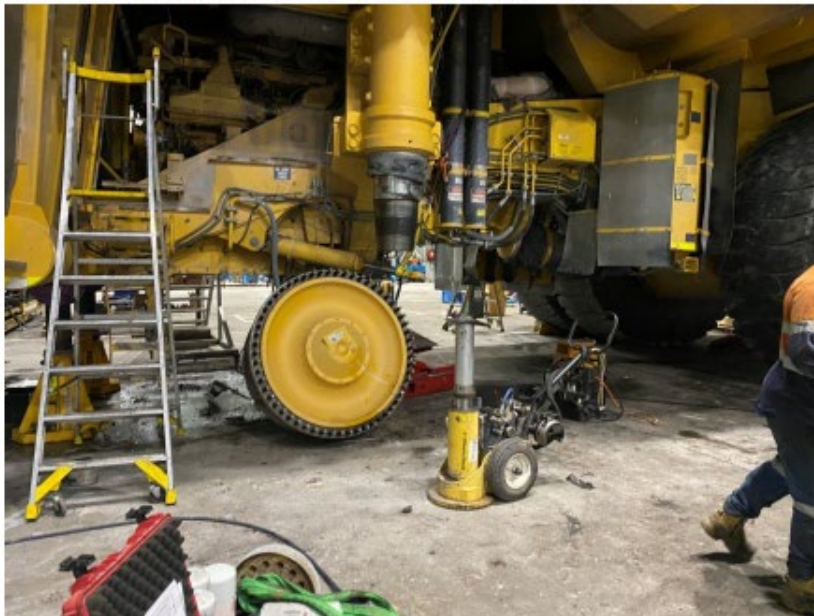


Date: October 2023

### Haul truck front strut removal poses risks to workers

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

Figure 1: The 4.8 tonne front wheel hub of the Komatsu 930E haul truck after falling off a jack stand



#### Issue

There have been 4 significant incidents with the high potential to cause serious injury or death in relation to removing and/or dismantling in situ haul truck front suspension struts over the past 20 months. Three of these incidents have occurred in the past 6 months.

All of these incidents were captured on workshop video footage. All of the incidents showed workers in close proximity to heavy components, and actual contact with workers during one incident, although none resulted in serious injury.

The most recent incident on 18 September 2023, had the potential for much worse outcomes, and has prompted the Resources Regulator to highlight this known hazard.

## Safety Alert

Date: December 2023

### Haul truck engine module narrowly misses workers

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

#### Issue

Two workers were in the engine bay of a Komatsu 930E haul truck adjusting lever hoists (cumalongs) and lifting chains while installing an engine module on 15 November 2023. As the overhead gantry crane operator was taking the weight of the module on the crane, the module slid back on the supporting tracks about 1.5 m. Both workers took evasive action to avoid being hit or crushed by the moving module, but were uninjured.

This dangerous incident was neither immediately reported, nor the incident scene preserved.

Figure 1: Worker manoeuvring engine module



Figure 2: Worker moves clear of moving module



#### Circumstances

Eight workers, from Komatsu and Cummins, were assigned to overhaul a Komatsu 930E rear dump truck in the mine workshop. Four of those workers were involved in changing the engine module which consisted of the main alternator, engine and radiator.

A. Who would you involve in the review of the Lifting and Cranage SEP? List eight (8). 8 marks

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## Question 7 – Falling objects

Work Health and Safety Regulation 2017  
Division 10 Falling objects

### 54 Management of risk of falling objects

A person conducting a business or undertaking at a workplace must manage, in accordance with Part 3.1, risks to health and safety associated with an object falling on a person if the falling object is reasonably likely to injure the person.

Note—WHS Act—section 19 (see clause 9).

### 55 Minimising risk associated with falling objects

- (1) This clause applies if it is not reasonably practicable to eliminate the risk referred to in clause 54.
- (2) The person conducting the business or undertaking at a workplace must minimise the risk of an object falling on a person by providing adequate protection against the risk in accordance with this clause.
- (3) The person provides adequate protection against the risk if the person provides and maintains a safe system of work, including—

A. With reference to WHS Regulation Clause 55 (3) (a) and (b) what must be included in the safe system of work? 4 marks

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B. WHS Regulation Clause 36 Hierarchy of controls identifies the duty holders requirements if risks can not be eliminated. What are these preventative requirements? 4 marks

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C. Identify eight (8) items of infrastructure (plant or structure) on a mine site where it is reasonable to consider there is a risk of falling objects potentially injuring personnel. 8 marks

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D. For each of three (3) items of infrastructure you have identified above describe three (3) controls you would implement to minimise the risk of falling objects. You **CAN NOT** use the same control more than once. 9 marks

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## Question 8 – Winders

- A. According to Work Health and Safety (Mines and Petroleum Sites) Regulation Schedule 15 Dictionary what is the definition of a winding system? 3 marks

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Work Health and Safety (Mines and Petroleum Sites) Regulation

### 50 Winding systems

- (1) The mine operator of an underground mine must ensure every winding system used or that may be put into use at the mine includes the following—
- (a) ropes and devices that can withstand all forces reasonably expected to be borne by the ropes and devices,
  - (b) control measures to prevent, as far as reasonably practicable, a shaft conveyance from ...
- B. For Section 50 (b) list all four (4) conditions with respect to the shaft conveyance that must be prevented. 4 marks

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- C. According to Section 50 (c) how many braking systems are required for any winding system and why? 2 marks

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D. Section 50 (f) requires control measures that detect 1 or more of what four (4) types of malfunctions. List all four (4). 4 marks

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E. According to Section 50 (k) in the case of multi rope winders what must be provided? 1 marks

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WHS(MPS) Regulations  
Schedule 1 Part 1

**3 Mine shafts and winding systems**

The following matters must be considered in developing the control measures to manage the risks associated with mine shafts and winding systems—

- (a) the potential for instability and loss of integrity of the shaft,
- (b) the potential for fires in underground operations, the shaft or winder areas,
- (c) the potential for an unintended or uncontrolled movement of conveyances within the shaft,
- (d) the potential for a conveyance to fall down the shaft,
- (e) the potential for failure of, or damage to, equipment and control measures, including the following—
  - i. control measures that are intended to prevent a shaft conveyance from overwind, excessive acceleration or deceleration, unsafe or excessive speeds or uncontrolled movement,
  - ii. control measures that are intended to detect the presence of slack rope, drum slip conditions or unsafe tail rope conditions,
  - iii. braking systems and systems performing an equivalent function that are intended to ensure the winder remains under control,
  - iv. warning systems that are intended to alert persons at the mine to an emergency in a winding system,
  - v. communication systems,
- (f) the potential for injury to a person from— ...
- (g) provision for the emergency exit of persons from a conveyance.



## Question 9 – Entanglement

Recent significant incidents resulting in permanently disabling injuries have highlighted the hazard of entanglement. One of the primary elements of the Mines Safety Management System to detail the preventative and mitigative strategies is the Mechanical Engineering Control Plan.

- A. WHS Regulation 2017 Division 2 Duties of persons conducting business or undertakings that design plant, Clause 189 Guarding identifies specific requirements. Fill in the missing words.

11 marks

### 189 Guarding

- 1) This clause applies if a designer of plant uses guarding as a control measure.
- 2) The designer must ensure, so far as is reasonably practicable, that the guarding designed for that purpose will \_\_\_\_\_ to the danger point or danger area of the plant.
- 3) The designer must ensure that—
  - (a) if access to the area of the plant requiring guarding is not necessary during operation, maintenance or cleaning of the plant—the guarding is a \_\_\_\_\_ physical barrier, or
  - (b) if access to the area of the plant requiring guarding is necessary during operation, maintenance or cleaning of the plant—the guarding is an \_\_\_\_\_ physical barrier that allows access to the area being guarded at times when that area does not present a risk and prevents access to that area at any other time, or
  - (c) if it is not reasonably practicable to use guarding referred to in paragraph (a) or (b)—the guarding used is a physical barrier that can only be altered or removed by the \_\_\_\_\_, or
  - (d) if it is not reasonably practicable to use guarding referred to in paragraph (a), (b) or (c)—the design includes a \_\_\_\_\_ safeguarding system that eliminates any risk arising from the area of the plant requiring guarding while a person or any part of a person is in the area being guarded.
- 4) The designer must ensure that the guarding is designed—
  - (a) to be of \_\_\_\_\_ and \_\_\_\_\_ so as to resist impact or shock, and
  - (b) to make \_\_\_\_\_ or \_\_\_\_\_ of the guarding, whether deliberately or by accident, as difficult as is reasonably practicable, and
  - (c) so as not to cause a \_\_\_\_\_ in itself.
- 5) If the plant to be guarded contains moving parts and those parts may break or cause workpieces to be ejected from the plant, the designer must ensure, so far as is reasonably practicable, that the guarding will control any risk from those broken or ejected parts and workpieces.
- 6) Despite anything to the contrary in this clause, the designer must ensure—
  - (a) that the guarding is of a kind that can be removed to allow maintenance and cleaning of the plant at any time that the plant is not in normal operation, and
  - (b) if the guarding is removed, that, so far as is reasonably practicable, the plant cannot be \_\_\_\_\_ unless the guarding is replaced.

B. Identify four (4) key controls for the management of entanglement.

4 marks

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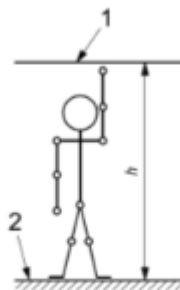


Figure 1 - Reaching Upwards (Machinery)

C. What is the minimum height (figure 1 – h above) to prevent access to a high risk hazard zone above an accessible area?

1 marks

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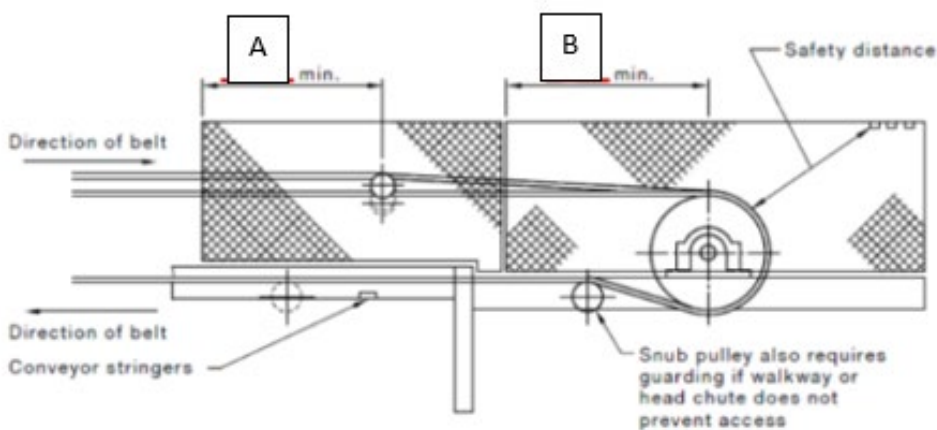
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The AS4024 series of Australian Standards cover safeguarding of machinery.

D. When considering conveyor boot ends what are dimensions A and B in the diagram below?

2 marks



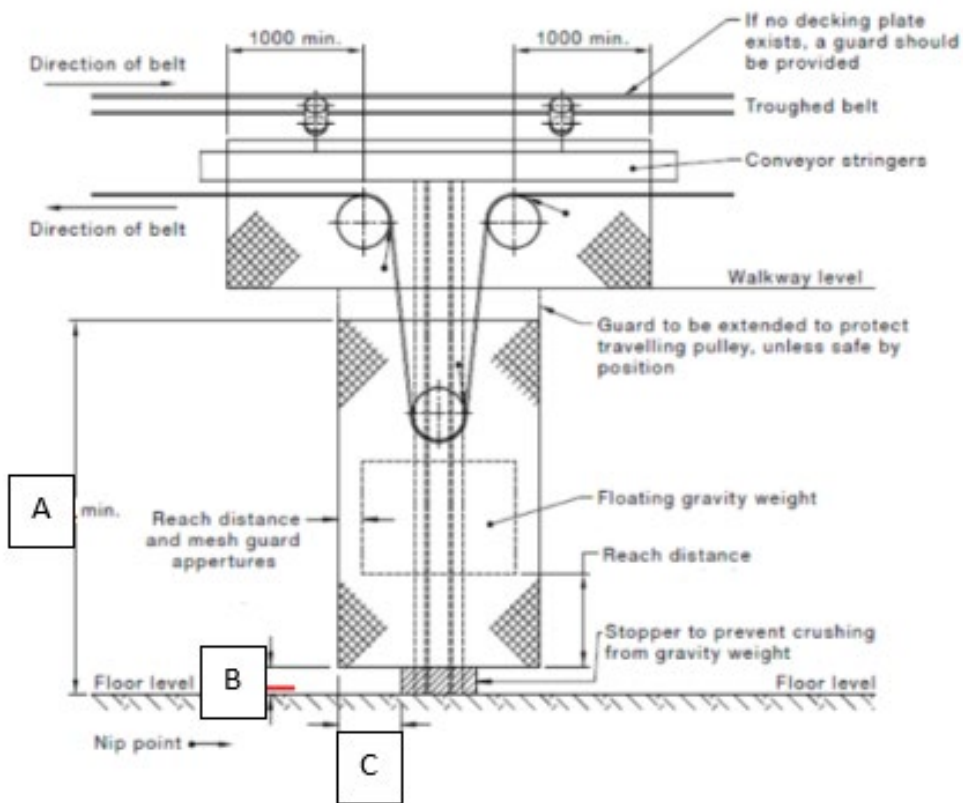
A = \_\_\_\_\_

B = \_\_\_\_\_

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E. When considering conveyor vertical loop take ups what are dimensions A, B and C in the diagram below? 3 marks



A = \_\_\_\_\_

B = \_\_\_\_\_

C = \_\_\_\_\_

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F. Polymer guards are increasingly used across the mining industry. In terms of hazards associated with poly guards describe two (2) hazards their use can reduce (Pros), and two (2) hazards their use can introduce (Cons). 4 marks

i. Pros

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ii. Cons

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## Question 10 – SB24-02 LHD crowd cylinders

You are the Mechanical Engineering Manager of a low height underground mine, and have a small fleet of CoalTram CT10LP LHD's. Your conveyor install crew were using a similar bolting rig basket in a high roof chamber to install roof bolts for rated lifting plates and conveyor hanging bolts for a new trunk conveyor drive and loop take up. Whilst the basket was lifted to full height by the LHD, and drilling a roof bolt hole, the basket attachment has rotated forward quickly, but not in free fall, resulting in the front of the basket contacting the floor. The movement was not initiated by the LHD operator, and although the worker in the basket fell forward, they were shaken but uninjured. You recollect receiving a weekly update e-mail from the Resources Regulator with a link to the Safety Bulletin below.



Date: April 2024

### LHD crowd cylinder failures - potential worker injuries

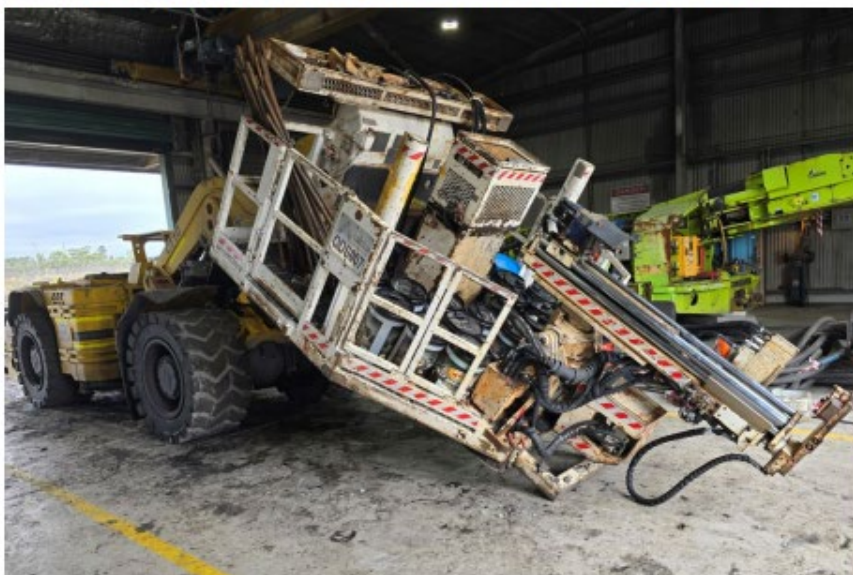
This safety bulletin provides safety advice for the NSW mining industry.

#### Issue

In the past 9 months, there have been 5 significant incidents involving the hydraulic crowd cylinders on load haul dump (LHD) machines in underground coal mines. Four of these incidents have occurred in the past 4 months.

The crowd cylinder forms the top mount supporting the attachment plate. LHDs in the underground coal industry are widely used as utility vehicles, coupling to a variety of implements including some where people are elevated (such as work baskets and drill rigs). Overloading or failure of the crowd cylinder can cause the implement to drop and rotate about the lower load arm pivot joint. Any people in the machine, or in close proximity on the ground, are placed at immediate risk of serious injury or worse.

Figure 1: LHD with drill rig attachment during simulation testing after crowd cylinder failure



Safety Bulletin SB24-02 includes two incidents where the QDS drill rig platform shown above, attached to a CT10LP, has rotated forward whilst workers were in the basket.

A. Based on having similar mobile plant and attachments at your Mine what was your obligation under legislation when you received the safety bulletin? 1 mark

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B. Identify five (5) potential causes of the unintended activation at your mine. 5 marks

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C. Who would you involve in your incident investigation. List five (5) people or organisations. 5 marks

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D. What specific documents on site would you reference. Plant safety file is not specific enough. List four (4). 4 marks

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E. What testing would you initiate to determine the root cause? Identify four (4) tests. 4 marks

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F. Detail three (3) items of information would you require from the LHD OEM to assist in determining the root cause of the incident. 3 marks

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G. Detail three items of information would you require from the attachment OEM to assist in determining the root cause of the incident. 3 marks

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