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MINING LEARNING SERIES

Mining Safety, Health & Risk

A South African learner's guide to hazards, controls and Zero Harm

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LEARNING OUTCOMES

After studying this note, you should be able to distinguish hazards and risks, explain a risk-assessment process and the hierarchy of controls, identify major mining safety and health hazards, describe emergency and incident-learning systems, and understand key rights and responsibilities under South African mining law.

How to Use This Study Note

This guide introduces mining safety, occupational health and risk management. It supports learning but does not replace mine-specific induction, legal appointments, authorised procedures, supervision, competency training or emergency instructions.

A five-step safety study method

Step	Action
1. Identify	Name the hazard, people exposed and possible unwanted event.
2. Assess	Consider the likelihood, severity and existing controls.
3. Control	Use the strongest reasonably practicable controls.
4. Verify	Check that critical controls exist and work as intended.
5. Learn	Report, investigate, communicate and improve after changes or incidents.

Important warning

USE AUTHORISED PROCEDURES

Never use a study note as permission to operate equipment, enter a restricted area, handle explosives, perform electrical work or attempt a rescue. Follow the mine's rules and instructions from competent, authorised persons.

The goal

Zero Harm is supported by good design, competent people, effective controls, honest reporting, worker participation and continuous learning. Safety is not only the absence of injuries; it also includes prevention of occupational disease and protection of everyone affected by mining work.

1. Safety, Health and Risk

Term	Meaning	Example
Hazard	A source or situation with potential to cause harm.	Unsupported ground, moving machinery or silica dust.
Risk	The combination of the chance of harm and its possible consequence.	Likelihood and severity of a fall-of-ground injury.
Exposure	Contact with a hazard over time or during a task.	Breathing dust or working near high noise.
Control	A measure that eliminates a hazard or reduces risk.	Remote operation, guarding or ventilation.
Residual risk	Risk remaining after controls are applied.	Remaining mobile-equipment interaction risk.
Critical control	A control essential to prevent or limit a material unwanted event.	Proximity detection or verified ground support.

Safety and health are connected

- Safety incidents can cause immediate injury or death.
- Health hazards may cause disease after repeated or long-term exposure.
- Fatigue, heat, stress and poor communication can increase incident risk.
- A safe workplace considers people, equipment, environment and organisation together.

RISK CHANGES

Conditions can change during a shift. New ground conditions, weather, equipment status, people, work sequence or nearby activities may require the risk assessment and controls to be reviewed.

2. South African Legal Framework

The Mine Health and Safety Act 29 of 1996, as amended, is the primary law for health and safety at South African mines. Its purposes include protecting employees and other persons, promoting a health-and-safety culture, participation, monitoring, training, hazard identification and the elimination, control and minimisation of risk.

Part of the system	Role
Mine Health and Safety Act	Sets duties, rights, participation arrangements, enforcement and health-and-safety requirements.
Regulations	Provide more detailed legal requirements for subjects such as machinery, occupational hygiene and emergency response.
Mandatory codes of practice	Mine-specific arrangements prepared where required, using relevant official guidance.
Standards and procedures	Translate legal, design and operational requirements into controlled work methods.
Mine Health and Safety Inspectorate	Administers and enforces the Act through inspections, investigations, inquiries and other functions.
Mine Health and Safety Council	Tripartite body supporting research, advice and improved occupational health and safety.

A changing legal environment

VERIFY CURRENT LAW

Regulations and guidance are amended. The official mine, Department of Mineral and Petroleum Resources, government legislation and MHSC sources must be checked for current requirements. This note is education, not legal advice.

3. Hazard Identification and Risk Assessment

A practical assessment sequence

Step	Question	Output
1. Define the work	What task, place, equipment and people are included?	Clear scope and boundaries.
2. Identify hazards	What can cause harm and how could the event occur?	Hazard and unwanted-event list.
3. Identify exposure	Who or what may be affected, and when?	Exposure groups and circumstances.
4. Review controls	What prevents the event or limits consequences?	Existing-control description.
5. Assess risk	How likely and severe is harm with current controls?	Prioritised risk rating.
6. Improve controls	What stronger or additional action is needed?	Action owner and deadline.
7. Verify and review	Do controls work, and what has changed?	Evidence and updated assessment.

Common assessment levels

- Baseline assessment: broad risks across the mine or operation.
- Issue-based assessment: a specific hazard, change, incident or concern.
- Continuous assessment: day-to-day checks before and during work.
- Task-level assessment: step-by-step hazards and controls for a defined task.



Risk assessment should involve the people who understand the work and those exposed to the hazards. | Source: Tecnología Minera

4. The Hierarchy of Controls

The hierarchy ranks control strategies from strongest to weakest. The aim is not to choose PPE first; it is to eliminate the hazard where possible and build several reliable layers of protection.

Level	Meaning	Mining example
1. Eliminate	Remove the hazard or avoid the exposure.	Design out manual entry into a dangerous area.
2. Substitute	Replace with a less hazardous material, method or process.	Use a less hazardous chemical where technically suitable.
3. Engineering controls	Separate people from hazards through design or equipment.	Guarding, remote operation, ventilation or ground support.
4. Administrative controls	Use planning, procedures, scheduling, signs and training.	Permit system, traffic plan or exclusion-zone procedure.
5. Personal protective equipment	Protect the individual when exposure remains.	Hard hat, hearing protection, respirator or eye protection.

Control quality questions

- Is the control suitable for the specific hazard and operating conditions?
- Who is responsible for installing, using, inspecting and maintaining it?
- How will failure be detected before harm occurs?
- Is performance tested, measured or independently verified?
- What backup prevents one failure from becoming a disaster?

PPE IS THE LAST LINE

PPE is important but usually depends on correct selection, fit, condition and consistent use. It should support stronger controls, not replace reasonably practicable elimination or engineering solutions.

5. Major Mining Safety Hazards

Hazard	Possible unwanted event	Important control themes
Ground instability	Fall of ground, rockburst, slope failure or collapse.	Geotechnical design, support, scaling, monitoring and exclusion.
Mobile equipment	Collision, run-over, overturning or loss of control.	Separation, traffic plans, visibility, braking, detection and discipline.
Machinery and energy	Entanglement, crushing, unexpected start-up or electric shock.	Guarding, isolation, lock-out, testing and authorised work.
Explosives and blasting	Premature blast, flyrock, fumes or misfire.	Competence, secure handling, clearance, guarding and re-entry controls.
Fire and explosion	Ignition, smoke, toxic gases or pressure event.	Ignition control, detection, suppression, ventilation and escape.
Working at height	Person or object falls.	Designed access, edge protection, fall prevention and rescue plan.
Inrush / inundation	Sudden entry of water, mud, gas or material.	Surveying, barriers, drilling, monitoring and emergency planning.
Confined or restricted space	Hazardous atmosphere, engulfment or difficult rescue.	Permit, isolation, testing, ventilation, standby and rescue readiness.

Interactions create risk

THINK BEYOND ONE HAZARD

A vehicle may be safe alone, but risk increases when pedestrians, poor visibility, fatigue, steep gradients, rain, production pressure and communication failures occur together.

6. Occupational Health Hazards

Health hazard	Possible harm	Prevention and monitoring
Respirable crystalline silica and other dust	Silicosis, pneumoconiosis and other respiratory disease.	Dust suppression, enclosure, ventilation, respiratory protection and exposure monitoring.
Noise	Noise-induced hearing loss and communication difficulty.	Quieter design, maintenance, isolation, hearing protection and audiometry.
Heat and humidity	Heat strain, dehydration, reduced concentration and collapse.	Cooling, ventilation, hydration, acclimatisation and work-rest controls.
Diesel particulate matter and fumes	Respiratory and other long-term health effects.	Cleaner equipment, maintenance, ventilation and exposure control.
Vibration and ergonomics	Musculoskeletal injury, fatigue and hand-arm effects.	Equipment design, maintenance, task redesign, rotation and early reporting.
Chemicals and metals	Irritation, poisoning, burns or chronic disease.	Substitution, containment, hygiene, PPE and biological/exposure monitoring.
Fatigue and mental health	Impaired decisions, distress, illness and increased incident risk.	Roster design, rest, respectful support, early help and psychosocial controls.

Occupational hygiene and medical surveillance

Occupational hygiene anticipates, recognises, evaluates and controls workplace health hazards. Medical surveillance checks workers' health in relation to occupational exposure. The two systems support prevention but do not replace effective exposure control.

NOISE EXAMPLE

The Department's occupational-hygiene information identifies 85 dB(A) over an eight-hour exposure shift as the occupational exposure limit for noise. Always use current mine measurements and legal requirements for decisions.

7. Safe Work Systems and Critical Controls

System	Purpose
Induction and competency	Ensure people understand hazards, rules, emergency actions and their authorised tasks.
Pre-start and workplace examination	Identify changing conditions, defects and missing controls before work begins.
Permit to work	Coordinate and authorise higher-risk work under defined precautions.
Energy isolation	Identify, isolate, lock, tag, test and control stored energy before intervention.
Management of change	Assess risk before changing equipment, design, material, people, software or process.
Critical-control verification	Confirm controls for material unwanted events are present, effective and used.
Shift handover	Transfer accurate information about status, hazards, defects and outstanding work.
Contractor management	Apply clear standards, competence checks, supervision and coordination to contracted work.

Before starting a task

- Confirm authorisation, competence and supervision.
- Inspect the workplace, tools, equipment and required PPE.
- Understand the task steps, nearby activities and emergency actions.
- Verify isolations, barriers, support, ventilation and other critical controls.
- Stop and obtain help if conditions differ from the plan.



Pre-shift communication helps teams understand the plan, hazards, controls and changes. | Source: Mining Outlook - Venetia Underground Project

8. Emergency Preparedness and Response

Emergency plans must be based on credible scenarios, mine layout, workforce, available equipment, communications and external support. Plans require training, drills, maintenance and review after exercises or real events.

Scenario	Preparedness needs
Fire or smoke	Detection, alarm, firefighting, refuge, escape routes, ventilation response and accountability.
Fall of ground / collapse	Exclusion, specialist assessment, rescue capability, communication and secondary-collapse control.
Inrush or flooding	Monitoring, withdrawal triggers, barriers, pumping, routes to safety and communication.
Vehicle or machinery incident	Scene isolation, energy control, medical response, lifting/recovery competence and evidence preservation.
Hazardous atmosphere	Detection, respiratory protection, ventilation, withdrawal criteria and trained rescue.
Medical emergency	First aid, trained responders, equipment, transport and medical coordination.

Raise the alarm safely

- Protect yourself before approaching the scene.
- Use the mine's alarm and communication system immediately.
- Give location, event, hazards, people affected and access information.
- Do not enter an unsafe area or attempt an unauthorised rescue.
- Follow instructions, accountability and evacuation arrangements.



Mine rescue requires specialist training, equipment, coordination and controlled access. | Source: SA Mines Emergency Response Competition

9. Incidents, Learning and Safety Culture

Incident investigation should establish what happened, why defences failed and what changes will prevent recurrence. Blaming the nearest person can hide design, organisational, supervision, workload, maintenance or communication problems.

Learning source	What it can reveal
Fatality or serious injury	Major failures requiring urgent control and organisational response.
Lost-time or medical-treatment injury	Weaknesses in task design, controls or supervision.
High-potential incident	An event that could reasonably have caused catastrophic harm.
Near miss	A warning where harm did not occur, often by chance or timely recovery.
Hazard report / observation	Problems found before an incident occurs.
Audit, inspection or monitoring result	Control drift, exposure trends and gaps in compliance or performance.

Good investigation principles

- Care for affected people and make the scene safe.
- Preserve evidence and gather facts promptly.
- Build a timeline and compare work-as-planned with work-as-done.
- Identify direct, contributing and organisational causes.
- Choose actions that strengthen controls, assign owners and verify completion.
- Share relevant learning without exposing people to unfair retaliation.

A REPORTING CULTURE

Workers report hazards and mistakes more readily when leaders respond fairly, act on concerns and distinguish honest error from reckless or deliberate violation.

10. Roles, Rights and Responsibilities

Participant	Examples of responsibility or contribution
Employer / mine management	Provide and maintain a working environment that is safe and without risk to health, assess risks, supply resources, training and systems.
Supervisors	Plan and communicate work, verify competence and controls, inspect conditions and stop unsafe activity.
Employees	Take reasonable care, follow lawful instructions and procedures, use controls correctly, report hazards and cooperate.
Health and safety representatives	Represent employees, inspect, participate and raise health-and-safety matters within the legal framework.
Occupational health professionals	Support hygiene measurement, medical surveillance, prevention and appropriate records or advice.
Inspectors	Monitor and enforce legal compliance and perform statutory inspections, investigations or inquiries.
Unions and worker structures	Support participation, representation, communication and collective improvement.

Right to leave a dangerous workplace

KNOW THE PROCEDURE

The Mine Health and Safety Act protects the right to leave a working place when circumstances arise that reasonably appear, with reasonable justification, to pose a serious danger to health or safety. Workers must know and follow the mine's communication and withdrawal arrangements.

Shared participation, clear accountability

Everyone contributes to safety, but "safety is everyone's responsibility" must never be used to hide legal duties, design responsibility, management accountability or the need to provide effective controls.

11. Safety Careers and Courses

Career area	Main contribution	Useful study background
Safety officer / practitioner	Inspections, risk systems, training, investigations and compliance support.	Occupational safety, mining, engineering or related qualifications.
Rock engineer / strata-control practitioner	Ground-control design, monitoring and excavation stability.	Mining, geology, engineering and specialist rock mechanics.
Mine ventilation / occupational hygienist	Controls air, heat, dust, gases, noise and exposure measurement.	Ventilation, occupational hygiene, engineering or science.
Occupational medical professional	Medical surveillance, fitness, health programmes and occupational-disease prevention.	Medicine, nursing or occupational-health specialisation.
Mine rescue practitioner	Emergency readiness, breathing apparatus and specialist rescue.	Mine experience plus approved specialist training and fitness.
Human factors / ergonomics specialist	Improves work design, fatigue controls, interfaces and organisational performance.	Ergonomics, psychology, engineering or safety science.
Regulator / inspector	Monitors compliance and applies statutory powers.	Relevant mining, engineering, occupational health or legal expertise.

Learning routes

- Mining engineering, geology and technical diplomas often include safety, law and risk modules.
- Universities, universities of technology and accredited providers offer occupational safety or health qualifications.
- Mine-specific competence, licences, certificates and appointments may be required for particular work.
- Short courses support development but do not automatically replace formal qualifications or legal competency requirements.

CHOOSE CAREFULLY

Before enrolling, verify the provider, qualification level, accreditation, delivery mode, workplace requirements, articulation options and whether the course supports your intended role. Requirements change, so use current official information.

12. Key Terms and Revision

Quick glossary

Term	Meaning
ALARP / reasonably practicable	Risk reduction considered against available controls, feasibility and the legal test that applies.
Critical control	A control essential for preventing or limiting a material unwanted event.
Exposure	Contact with a hazard by a person or group.
Hazard	Something with the potential to cause harm.
Hierarchy of controls	Order of preference from elimination to personal protective equipment.
Near miss	An unplanned event that caused no injury but had the potential to do so.
Occupational disease	Illness caused or worsened by workplace exposure.
Risk	Combination of likelihood and consequence of harm.
Risk assessment	Systematic identification, analysis and evaluation of risk and controls.
Zero Harm	An industry vision that no person should be harmed through mining work.

Revision questions

- 1. Explain the difference between a hazard, exposure, risk and control.
- 2. State the main purpose of the Mine Health and Safety Act.
- 3. Describe seven steps in a risk assessment.
- 4. List the hierarchy of controls and give one mining example for each level.
- 5. Identify six major mining safety hazards and their control themes.
- 6. Compare safety hazards with occupational health hazards.
- 7. Explain why critical-control verification is important.
- 8. Describe the correct first actions during a mine emergency.
- 9. Explain how near misses and hazard reports support learning.
- 10. Choose one mining task and prepare a simple hazard-control checklist.

SAFETY ACTIVITY

Study a familiar low-risk task such as carrying a school bag or using a computer workstation. Identify hazards, exposed people, existing controls and stronger controls using the hierarchy. Do not perform or simulate hazardous mining work.

13. References

Sources were checked on 17 August 2026. Laws, regulations, guidance and programme requirements change; always verify current official information.

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Image credit - SA Mines Emergency Response Competition. Underground mine-rescue exercise used in Section 8. https://www.samerc.com.au/Samerc-2022-gallery

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Learn Today, Achieve Tomorrow. Safety begins with knowledge, but competence requires approved training, mine-specific procedures, supervision and the courage to stop when controls are missing.