



Australian Government

Department of Education, Employment and Workplace Relations

RIIUND603A Manage, operate and maintain the mine ventilation system

Release: 1

RIIUND603A Manage, operate and maintain the mine ventilation system

Modification History

Not applicable.

Unit Descriptor

This unit covers the management, operation and maintenance of the mine ventilation system in the resources and infrastructure industries. It includes identifying, analysing and evaluating hazards and risks associated with the mine ventilation system and ventilation control options and measures. It also includes contributing to the development and maintenance of the mine ventilation management plan, implementing mine ventilation monitoring, recording and reporting systems and coordinating and controlling the maintenance of and changes to, the mine ventilation system. Licensing, legislative, regulatory and certification requirements that apply to this unit can vary between states, territories, and industry sectors. Relevant information must be sourced prior to application of the unit.

Application of the Unit

This unit is appropriate for those working in a management or supervisory role at worksites within:

- Coal mining

Licensing/Regulatory Information

Refer to Unit Descriptor.

Pre-Requisites

Not applicable.

Employability Skills Information

This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.
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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Identify, analyse and evaluate hazards and risks associated with the mine ventilation system	1.1. Access, interpret and apply compliance documentation relevant to the work activity 1.2. Identify, analyse and evaluate the sources, hazards and risks of gases and fumes 1.3. Identify and evaluate the likelihood and risks of spontaneous combustion 1.4. Identify, analyse and evaluate the hazards and risks of airborne and flammable dust 1.5. Identify, analyse and evaluate the potential for the likely impact of wind blast and outburst on the ventilation system 1.6. Identify, analyse and evaluate the impacts of fire, ignition and explosion on the ventilation system 1.7. Identify, analyse and evaluate the potential for the impact of the ventilation pressure differentials 1.8. Identify, analyse and evaluate the effect of changes in air temperature and humidity 1.9. Identify, analyse and evaluate the causes and effects of re-circulation 1.10. Identify, analyse and evaluate the impact associated with disruption to the ventilation system 1.11. Identify, analyse and evaluate the impacts of holing into previous workings
2. Identify, analyse and evaluate ventilation control options and measures	2.1. Identify, analyse and evaluate the types, applications and limitations of the ventilation control devices 2.2. Identify, analyse and evaluate the impact of mine design on ventilation system 2.3. Identify, analyse and evaluate the methods, purposes and limitations of mine monitoring systems and processes 2.4. Identify, analyse and evaluate inertisation techniques and applications 2.5. Identify, analyse and evaluate the impact of seam gas management on the ventilation system 2.6. Identify, analyse and evaluate the impact of water management on the ventilation

	system
3. Contribute to the development and maintenance of the mine ventilation management plan	3.1. Identify, analyse and confirm the objectives and criteria for safe and effective ventilation 3.2. Incorporate the principles and requirements of mine ventilation into the mine development plan 3.3. Identify, analyse and evaluate the requirements for mine <i>fans</i> and make appropriate selections 3.4. Evaluate and apply design criteria and specifications for ventilation networks and individual circuits 3.5. Evaluate ventilation control device options against requirements and select best option 3.6. Establish design criteria for ventilation and environmental monitoring systems and make appropriate selections 3.7. Prepare and incorporate procedures for the installation, establishment and operation of ventilation management systems into the <i>ventilation management plan</i> 3.8. Develop a system for early warning for each identified hazard including <i>action</i> requirements for each event and incorporate into the ventilation management plan 3.9. Formulate and implement <i>maintenance</i> program and procedures as part of the ventilation management plan 3.10. Incorporate procedures for the <i>audit</i>, review and updating of the ventilation system into the ventilation management plan 3.11. Identify <i>ventilation training</i> requirements and incorporate into the ventilation management plan
4. Implement mine ventilation monitoring, recording and reporting systems	4.1. Implement procedures for monitoring, recording and reporting on the ventilation system according to statutory requirements and those of the ventilation management plan 4.2. Implement procedures for the installation and operation of monitoring systems and equipment

	4.3. Implement procedures for the collection and analysis of ventilation data 4.4. Process, record and report monitoring system data in accordance with the requirements of the ventilation management plan 4.5. Interpret measured data and compare with statutory requirements and those stipulated by the ventilation management plan and action requirements implemented 4.6. Include the periodic review of alarm settings and alarms raised in the ventilation management plan and implemented
5. Coordinate and control the maintenance of and changes to the mine ventilation system	5.1. Review, confirm and communicate the ventilation system maintenance program to responsible parties 5.2. Coordinate maintenance activities, including inspections, repair and maintenance 5.3. Implement the system of recording and reporting maintenance requirements and activities 5.4. Plan, control and implement changes to the ventilation system 5.5. Prepare and maintain mine ventilation plans in accordance with statutory requirements and mine standards
6. Audit and review the effectiveness of the mine ventilation system	6.1. Audit the effectiveness of the ventilation system in accordance with the ventilation management plan 6.2. Ensure that ventilation control devices comply with statutory and ventilation management plan requirements 6.3. Ensure that ventilation standards comply with statutory and ventilation management plan specifications 6.4. Operate mine monitoring systems 6.5. Maintain ventilation recording systems accurately and process data 6.6. Implement and record ventilation system maintenance program and procedures 6.7. Communicate the content of the ventilation management plan to the workforce and ensure that it is understood

	6.8. Review the ventilation system in accordance with the ventilation management plan 6.9. Ensure that the emergency plans are consistent with the ventilation management plan 6.10. Ensure that the ventilation standards remain appropriate 6.11. Ensure that the training of mine employees is current, relevant and is conducted 6.12. Identify, assess and incorporate future ventilation requirements into the ventilation planning procedures
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Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

Required skills

Specific skills are required to achieve the Performance Criteria of this unit, particularly for its application in the various circumstances in which this unit may be used. This includes the ability to carry out the following as required to manage, operate and maintain the mine ventilation system:

- apply legislative, organisation and site requirements and procedures for management, operation and maintenance the mine ventilation system
- access, interpret and apply technical information
- access and analyse archival and historical ventilation information related to the mine
- interpret and apply mathematical and scientific theorems/laws related to ventilation
- interpret and apply design criteria for ventilation systems and devices
- interpret computer spreadsheets and ventilation modelling/simulations
- collect, collate and interpret ventilation data
- prepare technical procedures relating to ventilation
- conduct enquiries/investigations and prepare reports
- communicate effectively in the workplace
- access data from monitoring systems and equipment
- operate hand held monitoring equipment
- analyse and report on ventilation training needs
- apply risk management reports processes and techniques

Required knowledge

Specific knowledge is required to achieve the Performance Criteria of this unit, particularly for its application in the various circumstances in which this unit may be used. This includes knowledge of the following as required to manage, operate and maintain the mine ventilation system:

- legislative and statutory requirements for ventilation including air quality, maximum values, control and distribution, flammable gas limits, ventilation fans, gas monitoring, dust limits and inspections and recording/reporting
- methods of mine ventilation and their applications/limitations including exhaust/force, antitropical, homotropical, flank returns, ascensional/decensional, bleeder, ZUY systems and other combinations
- methods of panel ventilation and their applications/limitations including homotropical and antitropical (and in conjunction with these, the use of goaf bleed or back return), auxiliary fans, coursed ventilation (narrow side/wide side), machine mounted scrubber systems, compressed air venturi and bleeders
- impact of mining techniques and mine and panel design on ventilation
- inertisation techniques and applications including pressure swing absorption,

- natural oxidation, evaporative and pumped liquefied inert gas, seam gas, exhaust gases (Thomlinson boiler or jet engine) and water
- impact of differing geological features and conditions on ventilation including faults, dykes, intrusions and strata deformities
 - impact of coal characteristics and coal seam gradients on mine ventilation design
 - effects of ventilation on the spontaneous combustion risk
 - mine gases; the types and their characteristics, sources, physiological effects and methods of detection
 - dust and other particulate matter; the types, sources, physical and physiological effect, and control/mitigation methods
 - mine fires; the types, sources of ignition, possible effects on the ventilation circuit and prevention/control/mitigation methods
 - mine explosions; the types, ignition sources, possible effects on the ventilation circuits and prevention/control/mitigation methods
 - pressure changes; causes, the impacts on the ventilation system, responses (to include the causes and effects of natural ventilation and re-circulation)
 - heat, humidity; the sources and factors which may impact on mine ventilation and personnel
 - mine roadways and shafts; their design parameters and impact on mine ventilation
 - mine fans; fan laws, fan types, performance characteristics, configurations, applications and limitations
 - ventilation control devices; the types, purposes, design criteria and specifications, distribution/placement criteria and limitations
 - de-gassing; methods of control - including brattice, auxiliary fans, compressed air venturis, sails, hurdles and bleeders
 - ventilation networks and individual circuit design criteria, specifications and design processes
 - fixed ventilation monitoring systems types, uses/limitations, design criteria, specifications and design processes
 - portable monitoring equipment, types, uses/limitations, design criteria and specifications
 - the use of computer modelling and simulation techniques and applications relevant to mine ventilation planning; their functions, capabilities, advantages and limitations
 - computer-based systems for mine environment analysis
 - ventilation management plan development requirements and processes
 - ventilation surveys; the types, frequency and method for conducting including pressure/quantity/temperature and gas/dust
 - processes and techniques for determining alarms and trigger points/levels
 - audit and review processes and techniques
 - emergency response and disaster planning process and techniques
 - analytical and interpretive processes for gas mixtures and flammability including coward triangle, Ellicott diagram, gas make calculations and post explosion gases
 - applied ventilation theory including:

- Atkinson's equation
- methods of determining frictional resistance
- frictional resistance values for mine airways and ducts
- psychrometry and heat
- gas laws including Charles, Boyle and Dalton
- air density calculations
- natural ventilation pressures
- static velocity total pressures and shock loss
- leakage
- duct leakage
- determination of mine resistance curves
- combining system resistance and fan curves
- regulator and equivalent orifice calculation
- determination of fan operating/duty points
- Kirchoff's law

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.

Overview of assessment	
Critical aspects for assessment and evidence required to demonstrate competency in this unit	The evidence required to demonstrate competency in this unit must be relevant to worksite operations and satisfy all of the requirements of the performance criteria, required skills and knowledge and the range statement of this unit and include evidence of the following: • knowledge of the requirements, procedures and instructions for management, operation and maintenance of the mine ventilation system • implementation of procedures and techniques for the safe, effective and efficient management, operation and maintenance of the mine ventilation system • the identification of the relevant information and scope of the work required to meet the required outcomes • the identification of viable options for the management, operation and maintenance of the mine ventilation system that best meet the required outcomes • working with others to undertake and complete the management, operation and maintenance of the mine ventilation system • consistent successful management, operation and maintenance of the mine ventilation system
Context of and specific resources for assessment	• This unit must be assessed in the context of the work environment. Where personal safety or environmental damage are limiting factors, assessment may occur in a simulated environment provided it is realistic and sufficiently rigorous to cover all aspects of workplace performance, including task skills, task management skills, contingency management skills and job role environment skills. • Assessment of this competency requires typical resources normally used in a resources and infrastructure sector environment. Selection and use of resources for particular worksites

	may differ due to the site circumstances. • The assessment environment should not disadvantage the participant. For example, language, literacy and numeracy demands of assessment should not be greater than those required on the job. • Customisation of assessment and delivery environment should sensitively accommodate cultural diversity. • Aboriginal people and other people from a non English speaking background may have second language issues. • Where applicable, physical resources should include equipment modified for people with disabilities. Access must be provided to appropriate learning and/or assessment support when required.
Method of assessment	This unit may be assessed in a holistic way with other units of competency. The assessment strategy for this unit must verify required knowledge and skill and practical application using more than one of the following assessment methods: • written and/or oral assessment of the candidate's required knowledge to apply in undertaking of the management, operation and maintenance of the mine ventilation system • observed, documented and/or first hand testimonial evidence of the candidate's: • implementation of appropriate requirements, procedures and techniques for the safe, effective and efficient achievement of required outcomes • identification of the relevant information and scope of the work required to meet the required outcomes • identification of viable options for the management, operation and maintenance of the mine ventilation system that best meet the required outcomes • consistent achievement of required outcomes • first hand testimonial evidence of the candidate's: • working with others to undertake and

	complete the management, operation and maintenance of the mine ventilation system • provision of clear and timely required support and advice on the management, operation and maintenance of the mine ventilation system
Guidance information for assessment	Consult the SkillsDMC User Guide for further information on assessment including access and equity issues.

Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

Relevant compliance documentation may include:	• legislative, organisation and site requirements and procedures • mine safety management plans (ventilation, spontaneous combustion, gas, outburst) which establish procedures for maintaining a safe environment including: • hazard identification and quantification • risk assessment • authority and responsibility • controls established to manage identified risks (mine design, monitoring, procedures, trigger levels and response plans) • reporting and communication • document control • audit and review • manufacturer's guidelines and specifications • Australian standards • Employment and workplace relations legislation • Equal Employment Opportunity and Disability Discrimination legislation
Gases may include:	• seam gases or gases from other introduced sources and may include: • methane • carbon dioxide • carbon monoxide • oxides of nitrogen • hydrogen • sulphur dioxide • hydrogen sulphide • hydrocarbons • contaminations
Spontaneous combustion hazards may include:	• potential ignition sources • flammable gases

	• fire • explosion • irrespirable atmosphere • noxious atmosphere • smoke • roof collapse • reversal of ventilation • water/gas • mechanisms which contribute to spontaneous combustion and may include: • coal seam characteristics • ventilation pressure difference • mining system • mine design • humidity • temperature • moisture • physical spontaneous combustion indicators may include: • smoke • haze • sweating • smell • temperature • gaseous spontaneous combustion indicators may include: • carbon monoxide • hydrogen and hydrocarbons • indicator ratios such as: • CO make • Graham's ratio • other ratios as determined suitable
Airborne contaminants may include:	• respirable and combustible dust
Outburst hazards may include:	• ejection of materials • asphyxiant • toxic or flammable gas mixtures • entrapment • roof falls • ventilation disruption

	- mechanisms which contribute to an outburst may include: - maceral composition - depth of cover - gas content and composition - porosity - permeability - geology - stress - mining rate - outburst detection methods may include: - geological mapping - long-hole drilling - gas sampling - micro-seismic detection - changing face conditions and gas emission rates - outburst amelioration measures may include: - pre-drainage - methods of work
Ventilation system is:	- one which covers all the mine workings, including waste and sealed areas, and it includes all surface and underground fans and ventilation devices which control or impact on the mine ventilation - methods of ventilation may include: - exhaust/force - antitropical - homotropical - flank returns - ascensional/decensional - bleeder - ZUY systems - other combinations
Impacts of fire, ignition and explosion may include:	- contaminants - altered ventilation pressures/flows - direct physical impacts - complete disruption to the ventilation system
Fire may include:	- solid - liquid

	• gas • metals
Ignition is:	• the rapid chemical reaction of a combustible material with oxygen when exposed to sufficient heat • ignition sources may include: • electrical • friction • contraband • spontaneous combustion • naked flame • chemical • explosives
Explosion is:	• the sudden release of energy generated from the confinement of the rapid volumetric expansion of an ignition
Ventilation pressure differentials may include those resulting from:	• changes in barometric pressure • fall of ground • fan changes/failure • ventilation control devices changes/failure • outburst • holing into previous workings • re-circulation • ventilation circuit changes • natural ventilation pressure changes • explosions • changes in ambient temperature/humidity • fires • equipment moves
Temperature and humidity may be impacted by:	• climatic conditions • ventilation quantities • location of workplaces • mine layout and design • location of mine entries • depth • adjacent strata type • seam gas composition • sources of heat/humidity may include: • strata • equipment • oxidation

	• fire/spontaneous combustion • auto compression • exothermic chemical reactions • seam moisture content
Re-circulation causes may include or be related to:	• the underground auxiliary/booster fans • scrubber systems • leaking ducts • failure or poor design of ventilation system • ventilation velocity pressures • natural ventilation pressures • gas densities • layering and wind blast • effect of re-circulation may include: • build up of contaminant concentration (gas, dust, heat) • decrease in oxygen
Ventilation control devices may include:	• doors • regulators • seals • stoppings • air crossings • bulk heads • goaf seals • pressure chambers • other control device to control or direct ventilation flows in a mine • factors which impact on the selection of ventilation control systems may include: • the life of the installation • ground conditions (stress/heave) • operating duty (pressure/quantity) • mining method • design • explosion rating • statutory requirements • water • seam gas (make/composition) • criteria for safe mine ventilation may include: • statutory and regulatory requirements • mine ventilation management plan • measures to reduce and/or control seam gas

	• introduced gas, fumes and dust • temperature/humidity and maximum/minimum velocity specifications • criteria for ventilation efficiency • defects to ventilation devices may include: • inferior design • deterioration of materials • inadequate quality of construction • physical damage • water damage
Impact of mine design on the ventilation system may be related to:	• surface access • mining method/rate • barrier pillars and segregation of roadways • systems of mining • bleeder or back returns • number of headings • bleeders • geological features • principles of mine design include: • reserve optimisation • mining direction • geological structures • ventilation • strata control • mining method • productivity • environmental considerations • seam access
Monitoring may include:	• tube bundle • real time telemetry • portable (hand held) monitoring • bag samples • gas chromatography • fire monitoring • condition monitoring of ventilation devices • design criteria for fixed monitoring systems/equipment may include: • contingency for power outage • alarms for process faults including PC/PLC failure

	• analyser/sensor failure • communication failure • alarm system latching • alarm system fail-safe requirement • alarm/sensor likely gas matrix determination requirement • required ranges and accuracies • provision for calibration • statutory compliance • surface analysers combined gas monitoring capabilities • logistic and maintenance support • design criteria for portable monitoring equipment may include: • battery capacity (full shift) • battery recharge requirements • statutory compliance • required ranges and accuracies • provision for calibration • size • weight • light facility • ease of operation • robust construction
Inertisation techniques may include:	• pressure swing absorption • natural oxidation • evaporative and pumped liquefied inert gas • seam gas • exhaust gases (Thomlinson Boiler or jet engine) • water • inertisation may be defined as the displacing or reducing of oxygen to a level that will not support combustion. It may be either a natural process using seam gases or a process of introducing inert gases
Fans may include:	• axial flow • centrifugal • fan design considerations may include: • types • mine layout • user requirements and fan laws

	• characteristics • duty control (speed/variable pitch) • configuration (parallel/series) • explosion/protection doors • dampers • auxiliary drive • restart procedures • maintenance requirements
Action (alarm or trigger) is:	• a generic term used to describe an event determined at the mine site at which action is initiated or a response made
Procedures required to support the ventilation management plan may include those for:	• construction • action response • permit to work • condition monitoring • auditing • maintenance • document control • atmosphere monitoring • ventilation system control • communication systems • survey procedures • sealing procedures • changes • training • recording/reporting
Maintenance of the ventilation system may include:	• inspection • servicing repair
Audit is defined as:	• a systematic examination against defined criteria to determine whether activities and related results conform to planned arrangement, and whether these arrangements are implemented effectively and are suitable to achieve the organisation's policy and objectives (AS/NZS 4804: 2001)
Ventilation training may include:	• include induction • basic miner • deputy and ventilation systems operators/special requirements
Alarm systems and action plans may include those for:	• gas concentration/make • spontaneous combustion (physical and gaseous)

	• combustion indicators • condition monitoring for fans (vibration/temperature/current/failures) • ventilation devices • monitoring hardware
Mine atmosphere refers to:	• all areas in the general mine ventilation district and beyond into waste working goafs/gobs in the mine
Geological conditions may include:	• faults • dykes • intrusions • strata deformities
Coal seam characteristics may include inherent factors such as:	• rank • petrology • moisture • cleat • coal hardness • seam gas • friability • pyrites <i>or depositional factors such as:</i> • seam thickness • multiple and rider seams • seam dip • depth of cover
Mining systems may include:	• longwall • main gate or single entry • board and total or partial pillar • pillar extraction methods
Analytical and interpretive tools may include:	• Ellicott diagrams • Cowards triangle • fire-gas ratios • gas makes • trending • fan laws • airway resistance • network analysis • computer simulation • gas laws • psychrometry • ventilation laws

Surveys may include:	• pressure/quality/temperature survey and gas dust survey
Disruptions to ventilation circuits may result from changes in:	• barometric pressure • fall of ground • ventilation device changes/failure • outburst • holing into previous workings • re-circulation • ventilation circuit changes • natural ventilation pressure changes • failure (planned) unplanned • explosions • changes in ambient temperature/humidity • fires • equipment moves

Unit Sector(s)

Underground Mining

Competency field

Refer to Unit Sector(s).

Co-requisite units

Not applicable.