



Government of **Western Australia**  
Department of **Mines, Industry Regulation and Safety**

## **Underground ventilation management audit – guide**

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## Introduction

This document was reformatted in November 2015. At this time no material changes were made to the content of the guide, which was originally published in February 2008 under the title *Guide to underground ventilation management HIF audit 2008*.

Minor typographical errors were corrected in elements 3.1 and 6.10 in March 2020.

*Note: The Safety Regulation System (SRS) has replaced the AXTAT system and all reporting is done online through SRS.*

# 1 Ventilation personnel

Point	Standard	Guideline
1.1	The manager has appointed an underground ventilation officer for the mine.	<p><b>Intent:</b> To ensure that a person is appointed by the manager to be the Underground ventilation officer at the mine.</p> <p><b>Personnel:</b> Mine manager, underground ventilation officer.</p> <p><b>Method:</b> Verify by examination of the letter of appointment and an entry in the record book. The letter of appointment should include the summary of responsibilities, the area of responsibility, and be countersigned with an acknowledgement of the appointment. Refer to MSIR 9.3(1) and MSIA s44.</p>
1.2	The District Inspector of Mines was notified in writing of the appointment.	<p><b>Intent:</b> To ensure that the District Inspector of Mines has been informed in writing of the appointment.</p> <p><b>Personnel:</b> Mine manager, underground ventilation officer.</p> <p><b>Method:</b> Verify by examination of the letter of appointment and cross reference with department files. Refer to MSIR 9.3(3).</p>
1.3	The underground ventilation officer is appropriately qualified.	<p><b>Intent:</b> To ensure that the underground ventilation officer has the qualifications and experience to perform the required duties.</p> <p><b>Personnel:</b> Mine manager, underground ventilation officer.</p> <p><b>Method:</b> Verify by interview and sighting the officer's qualifications. Refer to MSIR 9.4(1).</p>

Point	Standard	Guideline
1.4	The underground ventilation officer has the authority, in consultation with management, to close down operations in areas where inadequate ventilation is identified.	<p><b>Intent:</b> To ensure that the underground ventilation officer has the authority commensurate with the duties of the position.</p> <p><b>Personnel:</b> Registered manager, underground manager, underground ventilation officer.</p> <p><b>Method:</b> Interview personnel. View the position description for the underground ventilation officer and documentary records of surveys, inspections, etc. associated with the underground ventilation officer's duties.</p>
1.5	Underground ventilation technicians, undertaking measurements of air and atmospheric contaminants on behalf of the underground ventilation officer, are adequately trained.	<p><b>Intent:</b> To ensure that the underground ventilation technicians have the qualifications and experience to perform the required duties.</p> <p><b>Personnel:</b> Mine manager, underground ventilation officer, ventilation technicians.</p> <p><b>Method:</b> Verify by interview and sighting qualifications such as attendance at the underground ventilation officers course.</p>
1.6	Mine supervisors and operators receive basic mine ventilation training.	<p><b>Intent:</b> To ensure that persons involved in daily underground operations and activities are trained in the basics of underground mine ventilation.</p> <p><b>Personnel:</b> Underground supervisors, underground personnel, training officers.</p> <p><b>Method:</b> Interview personnel and view training documentation.</p>

## 2 Air measuring equipment

Point	Standard	Guideline
2.1	The mine has ventilation instruments to conduct the required air pressure and flow measurements.	<p><b>Intent:</b> To ensure that airflow measurements can be carried out.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify that the mine has air flow measurement equipment which should include: 1. Anemometer or air velocity devices appropriate to the air velocities encountered. 2. Pitot tube. 3. Extension devices for measuring large openings.</p>
2.2	The mine has the appropriate measuring equipment, provided in house or externally, to measure the atmospheric contaminants anticipated to occur.	<p><b>Intent:</b> To ensure that atmospheric contaminants such as respirable dust, asbestos fibres, organic vapours, etc. can be measured and monitored.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify that the mine has routine measuring equipment for dust and asbestos monitoring, etc. Refer to MSIR 9.13 and 9.33.</p>
2.3	The mine has equipment to measure the levels of oxygen and gases when any toxic, asphyxiant, or explosive gases are anticipated to occur.	<p><b>Intent:</b> To ensure that the levels of oxygen and any toxic, asphyxiant or flammable gases present, can be measured.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify that the mine has monitoring equipment which should include an oxygen monitor and a flammable gas indicator and may include testing equipment for other gases such as: carbon monoxide, carbon dioxide, nitrogen oxide, nitrogen dioxide, sulphur dioxide, hydrogen sulphide, ammonia, etc. Refer to MSIR 9.13 and 9.29.</p>

Point	Standard	Guideline
2.4	The mine has wet and dry bulb instruments to measure the temperature levels.	<p><b>Intent:</b> To ensure that the temperature levels at work sites can be measured.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify that the mine has correctly maintained temperature measuring equipment which may include: 1. Hygrometer. 2. Distilled water 3. Clean wet bulb stockings fitted to the equipment, and available as spares. Refer to MSIR 9.15.</p>
2.5	All measuring equipment is maintained and calibrated to manufacturers' specifications.	<p><b>Intent:</b> To ensure that ventilation measurement equipment is being maintained and calibrated so as to produce reliable results.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting the calibration certificates etc. Refer to MSIR 9.5.</p>
2.6	When ventilation instruments and gas measuring equipment is sent away for calibration or repair, alternative equipment is made available.	<p><b>Intent:</b> To ensure that the ventilation measurement capability is maintained during periods when equipment is sent away for calibration.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Interview personnel. Inspect the equipment.</p>
2.7	A record is kept for each item of calibrated equipment that includes the latest date of calibration, the calibration factors and the next due date.	<p><b>Intent:</b> To ensure that a system is in place to manage the calibration of equipment.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View records.</p>
2.8	A procedure exists to ensure that where indicator tubes are used, the tubes are stored as recommended by the manufacturer and their use-by-date has not expired.	<p><b>Intent:</b> To ensure that the indicator tubes for each individual gas present at the mine will provide accurate results.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Sight a sample of tubes.</p>

### 3 Air measurement

Point	Standard	Guideline
3.1	To ensure that the measurement and recording of airflows is carried out systematically. There is a written procedure for the measurement and recording of airflows.	<p><b>Intent:</b> To ensure that the measurement and recording of airflows is carried out systematically.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View procedure. The key elements should include: 1. all vehicle movement is stopped in the area, 2. measurements are taken at right angles to the air flow, 3. the average of four air velocities taken by traverse or spot method is used, 4. where a traverse measurement is utilised, the start points of the traverses should be on alternate sides of the drive, 5. where spot measurements are taken each measurement area does not exceed 1m<sup>2</sup>, 6. the person taking the measurement does not traverse the measuring device with any person in a direct line between it and the airflow.</p>
3.2	Ventilation stations are selected with regard to obtaining a reliable velocity reading.	<p><b>Intent:</b> Self evident.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting plans and a sample of the ventilation stations. Verify that they are located in accordance with the attached ventilation station selection criterion diagram.</p>
3.3	The position of each ventilation station is clearly marked underground.	<p><b>Intent:</b> To ensure that the location and number of each ventilation survey station is clearly identified.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Inspect a sample of ventilation stations underground.</p>
3.4	The area of each ventilation station is accurately determined by the survey department.	<p><b>Intent:</b> To ensure that an accurate measurement of station areas is obtained.</p> <p><b>Personnel:</b> Underground ventilation officer. Mine surveyor.</p> <p><b>Method:</b> Verify by sighting area calculations.</p>



Point	Standard	Guideline
3.5	The mine has carried out an assessment of the natural ventilation system.	<p><b>Intent:</b> To ensure that, in the event of a primary fan failure, the effects of the natural ventilation system on the mine ventilation circuit can be estimated.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting documentation.</p>
3.6	Potential mine emergencies that may have an effect on the ventilation system have been modelled.	<p><b>Intent:</b> To ensure that potential mine emergencies have been investigated and modelled in regard to their effect upon the mine ventilation system.</p> <p><b>Personnel:</b> Underground manager, underground ventilation officer.</p> <p><b>Method:</b> Interview personnel and view modelling outputs. Refer to MSIR 4.30.</p>
3.7	The mine emergency plan has contingencies in place to deal with the effects on the mine ventilation system from the potential mine emergencies modelled.	<p><b>Intent:</b> To ensure that the mine emergency plan takes into account the possible expected effects on the mine's ventilation system during an emergency.</p> <p><b>Personnel:</b> Underground manager, underground ventilation officer.</p> <p><b>Method:</b> Interview personnel and view the emergency plan. Refer to MSIR 4.30.</p>

## 4 Ventilation record keeping

Point	Standard	Guideline
4.1	The Underground ventilation officer has a current copy of the Mines Safety and Inspection Act & Regulations.	<p><b>Intent:</b> To ensure that the Underground ventilation officer is aware of the duties, obligations and statutory requirements of the current legislation.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting a copy of the current Mines Safety and Inspection Act and Regulations in the underground ventilation officer's office.</p>
4.2	A copy of the current National Exposure Standards NOHSC: 1003 is available at the mine.	<p><b>Intent:</b> To ensure that the mine is in possession of the current exposure standards for each contaminant.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting a web link to, or copy of, the National Exposure Standards NOHSC: 1003.</p>
4.3	The mine has a ventilation log book.	<p><b>Intent:</b> To ensure that all the mine ventilation measurements, airborne contaminant measurements, gas measurements, records of defects and the actions taken are recorded and kept up to date.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Sight ventilation log book. Refer to MSIR 9.7.</p>

Point	Standard	Guideline
4.4	The mine ventilation log book indicates that inspections and testing occur at the required intervals for the various ventilation parameters, fan surveys and atmospheric contaminants.	<p><b>Intent:</b> To ensure that monitoring occurs in all operating areas at the appropriate frequency.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by examination of the ventilation records: a. primary airflows - 3 months, b. primary fans - 3 months, c. after any major change in the circuit, d. regular inspection and testing of workplaces and travel ways. Refer to MSIR 9.5.</p>
4.5	Each ventilation and contaminant measurement is documented and retained at the mine.	<p><b>Intent:</b> To verify that the airflow and contaminant measurements taken at the ventilation stations and work areas are documented and available for examination or scrutiny.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View the ventilation log book and field records. Refer to MSIR 9.7.</p>
4.6	Each entry in the ventilation record book is dated, signed and kept in area chronological order.	<p><b>Intent:</b> To ensure that each entry made is dated, signed by the person making the entry and kept in area chronological order for comparison purposes.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by examination of the ventilation records.</p>

Point	Standard	Guideline
4.7	Each ventilation circuit has a diagram showing the air flow balance.	<p><b>Intent:</b> To ensure that the air flow measurements can be shown to be correct by the existence of balanced circuits.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting a diagram for each auxiliary ventilation circuit. This should show the link with the primary ventilation system.</p>
4.8	There is a procedure for the reporting and rectification of ventilation defects within the ventilation system.	<p><b>Intent:</b> To ensure that defects are brought to the manager's attention and that instructions are issued to correct the defects.</p> <p><b>Personnel:</b> Manager, underground ventilation officer.</p> <p><b>Method:</b> View records and procedures to verify that ventilation defects have been recorded, and then noted rectified, in the ventilation log book and there is evidence of the manager being informed of the issues. Refer to MSIR 9.8.</p>
4.9	Mine ventilation performance and costs are monitored and reviewed on a regular basis.	<p><b>Intent:</b> To ensure that optimum cost effective ventilation standards are provided, and areas for improvement in ventilation flows and costs are identified.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Interview personnel and view costing system records.</p>

## 5 Ventilation plans

Point	Standard	Guideline
5.1	The mine has ventilation plans which are updated at intervals not exceeding 3 months.	<p><b>Intent:</b> To ensure that the actual ventilation conditions underground are reflected in the mine plans.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting the date the ventilation plans were last updated. Refer to MSIR 9.5 and 9.28.</p>
5.2	The position of each ventilation station is clearly marked on the plans.	<p><b>Intent:</b> To ensure that the actual location and number of each ventilation survey station is clearly reflected on the ventilation plans.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View ventilation plans.</p>
5.3	The direction and volume of air flows are clearly marked on the plans. (Intake air -blue, exhaust air – red).	<p><b>Intent:</b> To ensure that the actual directions and volumes of air flows are reflected on the ventilation plans.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting primary and secondary ventilation plans.</p>
5.4	The positions of fans and air moving equipment are clearly marked on the plans.	<p><b>Intent:</b> To ensure that the actual location of each fan and air moving equipment is clearly reflected on the ventilation plans.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View ventilation plans.</p>

Point	Standard	Guideline
5.5	The positions of all ventilation control devices are clearly marked on the plans.	<p><b>Intent:</b> To ensure that the actual locations of each air door, regulator, stopping, parachute, brattice etc. are clearly reflected on the ventilation plans.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View ventilation plans.</p>
5.6	The positions of all fresh air bases are clearly marked on the plans.	<p><b>Intent:</b> To ensure that the actual locations of all fresh air bases are clearly reflected on the ventilation plans.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View ventilation plans.</p>
5.7	The positions of all refuge chambers are clearly marked on the plans.	<p><b>Intent:</b> To ensure that the actual locations of all refuge chambers are clearly reflected on the ventilation plans.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View ventilation plans.</p>
5.8	The positions of all telephones (including numbers) are clearly marked on the plans.	<p><b>Intent:</b> To ensure that the actual locations of the telephones, and their numbers, are clearly reflected on the ventilation plans.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View ventilation plans.</p>

Point	Standard	Guideline
5.9	The positions of all second means of egress are clearly marked on the plans.	<p><b>Intent:</b> To ensure that the actual locations of all second means of egress are clearly reflected on the ventilation plans.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View ventilation plans.</p>
5.10	The positions of fire extinguishers and water hydrants are clearly marked on the plans.	<p><b>Intent:</b> To ensure the actual locations of all fire fighting equipment is clearly reflected on the ventilation plans.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting the primary and secondary ventilation plans.</p>
5.11	An explanation key (legend) is provided on the ventilation plans.	<p><b>Intent:</b> To ensure that an identification and explanation is provided for the symbols used to depict the different ventilation devices actually installed.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View ventilation plans.</p>
5.12	Mine plans containing current ventilation and survey information are issued to the mine rescue team.	<p><b>Intent:</b> To ensure that the mine has up to date plans of all ventilation circuits for use in an emergency.</p> <p><b>Personnel:</b> Underground ventilation officer, mine rescue team leader, survey department.</p> <p><b>Method:</b> Verify by sighting a set of current plans. Refer to MSIR 9.5(h).</p>

## 6 Fans

Point	Standard	Guideline
6.1	Fan selection is based on the pressure requirements for the mine parameters and the volume requirements for the equipment to be used.	<p><b>Intent:</b> To ensure that the fan outputs are capable of the required duties.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting working area ventilation design calculations. Refer to MSIR 9.20(2).</p>
6.2	Primary fans are equipped with the means to determine the air pressure across the fan and the air volume flowing through the fan.	<p><b>Intent:</b> To ensure that primary fan outputs can be measured.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by inspecting each primary fan location. Each fan should be equipped with continuous monitoring instruments for fan pressure and air flow, or have port holes through which measuring devices for those parameters can be inserted. Refer to MSIR 9.5(g).</p>
6.3	Primary fans are equipped with vibration monitoring instruments.	<p><b>Intent:</b> To ensure that vibration of a primary fan can be detected before damage occurs.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting each fan location at the mine.</p>
6.4	Fans are maintained in accordance with the manufacturer's requirements.	<p><b>Intent:</b> To ensure that fans are maintained correctly.</p> <p><b>Personnel:</b> Underground ventilation officer, mechanical and electrical staff.</p> <p><b>Method:</b> Verify by sighting manufacturers literature and site maintenance records.</p>



Point	Standard	Guideline
6.5	All fan air flow or damper adjustment controls are locked to prevent tampering.	<p><b>Intent:</b> To ensure that flow control devices fitted to fans cannot be operated by personnel other than the ventilation department.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting that such devices are locked in position.</p>
6.6	Surface fan installations are located in an area that does not exhibit evidence of ground subsidence or wall failure.	<p><b>Intent:</b> To ensure that primary fans are not exposed to any danger from ground subsidence or wall failures.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting each fan location. Examine for any cracking, subsidence, or wall failures in the area.</p>
6.7	Surface fan installations have fire breaks around them.	<p><b>Intent:</b> To ensure that there are no fire hazards present within 50 metres of each fan which could result in damage to the fan or smoke being drawn underground.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting each fan location.</p>
6.8	Primary fans located on the surface are equipped with permanent lighting.	<p><b>Intent:</b> To ensure that emergency work can be carried on at all hours.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting each fan location. Refer to MSIR 10.14 (1) (c).</p>

Point	Standard	Guideline
6.9	There is an alarm system in place to indicate a primary fan failure.	<p><b>Intent:</b> To ensure that the alarm is immediately raised should failure of a primary fan occur.</p> <p><b>Personnel:</b> Underground ventilation officer, mobile equipment operators.</p> <p><b>Method:</b> Verify by sighting the alarm system, this may include a visual device on the transport route, or a communication system to notify operators to shut down diesel equipment. Refer to MSIR 9.20(1).</p>
6.10	There is a procedure in place to manage the occurrence of a primary fan failure.	<p><b>Intent:</b> To ensure that personnel are not exposed to hazards due to primary fan failure and that diesel equipment operation is suspended.</p> <p><b>Personnel:</b> Underground ventilation officer, mobile equipment operators.</p> <p><b>Method:</b> View procedure and interview vehicle operators.</p>
6.11	The installation of each surface primary fan is such that recirculation of air is prevented.	<p><b>Intent:</b> To ensure that the primary fans do not recirculate air.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by observation and checking records.</p>
6.12	Primary fans and circuit fans located underground are equipped with permanent lighting.	<p><b>Intent:</b> To ensure that emergency work can be carried out at with ease.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting each fan location. Refer to MSIR 10.14 (1) (c).</p>

Point	Standard	Guideline
6.13	Each auxiliary fan is installed at a location that is free from obstruction and the fan is able to draw from the purest source of air available.	<p><b>Intent:</b> To ensure that auxiliary fans provide adequate ventilation of sufficient air volume, velocity and quality to remove atmospheric contaminants and maintain a healthy atmosphere at each workplace.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by inspection of fan installations and checking air flows. Refer to MSIR 9.14, 9.16(1) and 9.20(3).</p>
6.14	The installation of each auxiliary fan is such that the recirculation of air is minimised.	<p><b>Intent:</b> To verify that recirculation at auxiliary fans is maintained at the absolute minimum level.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by inspection of fan installations and checking air flows. Refer to MSIR 9.16(2).</p>

## 7 Ventilation control devices

Point	Standard	Guideline
7.1	Permanent ventilation control devices are of robust construction.	<p><b>Intent:</b></p> <p>To ensure that those permanent ventilation control devices including walls, air doors, regulators, stoppings etc. built at the mine are of robust construction capable of withstanding air blast, ground movement or similar stresses applied to them.</p> <p><b>Personnel:</b></p> <p>Underground ventilation officer.</p> <p><b>Method:</b></p> <p>Verify by sighting samples of permanent ventilation control devices. The ventilation control devices should be made of non flammable material. (Brattice and parachute ventilation control devices installed for periods greater than 3 months fail this standard).</p>
7.2	Permanent ventilation control devices are free from obstruction and easily accessible.	<p><b>Intent:</b></p> <p>To ensure that permanent ventilation control devices are accessible and free from trip hazards.</p> <p><b>Personnel:</b></p> <p>Underground ventilation officer.</p> <p><b>Method:</b></p> <p>Verify by sighting a sample of permanent ventilation control devices. Refer to MSIR 9.20(3).</p>
7.3	Air doors are designed and built to be self closing where practicable, and are able to be operated easily.	<p><b>Intent:</b></p> <p>To ensure that all air doors are self closing to prevent a short circuit of airflow in the mine and are provided with a high air pressure release device for ease of opening.</p> <p><b>Personnel:</b></p> <p>Underground ventilation officer.</p> <p><b>Method:</b></p> <p>Verify by sighting a sample of air doors installed underground. Refer to MSIR 9.20(4)(a).</p>
7.4	Signs are displayed indicating whether air doors should be left open or closed.	<p><b>Intent:</b></p> <p>To ensure that adequate signs are displayed at each air door to instruct persons as to whether the door should be left open or closed for ventilation air circuit control purposes.</p> <p><b>Personnel:</b></p> <p>Underground ventilation officer.</p> <p><b>Method:</b></p> <p>Verify by sighting a sample of air doors and signage. Refer to MSIR 9.20(4)(b).</p>

Point	Standard	Guideline
7.5	Regulators are provided with a means to prevent tampering.	<p><b>Intent:</b> To ensure that regulator settings cannot be altered, except by an authorised person, or tampered with.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting a sample of regulators.</p>
7.6	Any instruction regarding a change to a brattice or regulator setting is recorded in the ventilation log book.	<p><b>Intent:</b> To ensure that all ventilation circuit control instructions and changes are documented.</p> <p><b>Personnel:</b> Underground ventilation officer, manager or managers' representative.</p> <p><b>Method:</b> Verify by sighting a sample of brattice and regulator settings and examine the mine ventilation records to check that the instructions are in agreement. Refer to MSIR 9.21(2).</p>
7.7	Permanent ventilation control devices are inspected regularly.	<p><b>Intent:</b> To ensure that the permanent ventilation control devices including walls, air doors, regulators, stoppings etc are regularly examined for effectiveness where there is the potential for damage to occur from blast vibration, ground movement, vehicle movement, etc.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View records of inspection completed by a supervisor, underground ventilation officer, etc.</p>
7.8	All temporary ventilation control devices such as parachutes, brattices, etc., that are installed to control airflow in a workplace, are inspected each shift for damage and leakage.	<p><b>Intent:</b> To ensure that parachutes, brattice devices, etc. are examined for effectiveness on a shift by shift basis in order that satisfactory ventilation is maintained in the workplace.</p> <p><b>Personnel:</b> Underground ventilation officer, supervisors, underground manager.</p> <p><b>Method:</b> Verify by interview, view shift inspection records, etc.</p>

## 8 Ventilation system operation

Point	Standard	Guideline
8.1	There are no unnecessary activities in the vicinity of the intake airways that could generate dust or fumes.	<p><b>Intent:</b> To ensure that no contaminants are drawn into the mine from the surface.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by inspecting each air intake access to the mine to ascertain that no work is carried out which could have an adverse affect on the underground ventilation.</p>
8.2	Intake air velocities in roadways do not exceed 6 metres/second.	<p><b>Intent:</b> To ensure that the air velocity in an intake roadway is not sufficient to raise dust in the roadway.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by carrying out an air velocity measurement in each main intake roadway and examine the mine ventilation records.</p>
8.3	A means and procedure exists to provide dust suppression in the main intake air roadway.	<p><b>Intent:</b> To ensure that any dust generated by vehicles travelling through a main intake air roadway is not uplifted by the air.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify that a dust suppression device is installed at each intake roadway.</p>
8.4	Parallel ventilation circuits are utilised at the mine to ensure that atmospheric contaminant levels in each workplace are minimised.	<p><b>Intent:</b> To ensure that the lower working areas of the mine are not exposed to a cumulative contaminant level that has the potential to expose employees to elevated levels of atmospheric contaminants.</p> <p><b>Personnel:</b> Underground manager, underground ventilation officer.</p> <p><b>Method:</b> Interview personnel and view relevant ventilation plans to determine whether series or parallel ventilation circuits are utilised. Refer to MSIR 9.16(2).</p>

Point	Standard	Guideline
8.5	Airways at the mine are maintained free from obstruction except for the purpose of control.	<p><b>Intent:</b> To ensure that there are no unnecessary significant restrictions, &gt;25% of airway area, impeding the flow of ventilation within the mine.</p> <p><b>Personnel:</b> Underground manager, underground ventilation officer.</p> <p><b>Method:</b> Interview personnel, examine shift inspection reports and inspect the roadways underground. Confirm that there are controls in place for the identification and removal of significant obstructions, e.g. rockfall, waste piles, material storage. Refer to MSIR 9.21(3).</p>
8.6	The volume of primary intake air to the mine exceeds the total air volume requirement specified for the diesel equipment operating in the mine at any one time.	<p><b>Intent:</b> To ensure that there is sufficient airflow into the mine to dilute the contaminants produced by the number of vehicles in use.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by examining the mine listing of diesel volume requirements and compare with the mine ventilation records. Confirm that there are controls in place to restrict access when the diesel volume requirements exceed the mine ventilation capacity. Refer to MSIR 9.20(2).</p>
8.7	The volume of air flowing into each area of the mine meets the legal requirement for the diesel equipment operating in each of those areas at any one time.	<p><b>Intent:</b> To ensure that sufficient airflow is provided in each area of the mine to dilute the contaminants produced by the diesel equipment working there.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by comparing the diesel equipment airflow requirements and the airflow measurement records in development and production areas. Refer to MSIR 9.20(2).</p>

Point	Standard	Guideline
8.8	Ventilation ducting is maintained in a satisfactory condition.	<p><b>Intent:</b> To ensure that any damaged auxiliary ventilation ducting is repaired or replaced in order to maintain the required air supply.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting ventilation duct. Where people are working in an area, and there is a large tear in the air supply duct, the standard has not been met.</p>
8.9	The ventilating airflow is arranged such that fresh air sweeps the working place.	<p><b>Intent:</b> To ensure that the auxiliary ventilation ducting is sufficiently extended to ventilate each place of work and working face.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by inspection of workplaces.</p>
8.10	There is a procedure to be followed such that each working place ventilated by a multiple duct ventilation system is adequately ventilated.	<p><b>Intent:</b> To ensure that non working areas are isolated and sufficient ventilation flows are directed to the workplaces.</p> <p><b>Personnel:</b> Underground ventilation officer. Supervisors. Mine personnel.</p> <p><b>Method:</b> View procedure, interview personnel and inspect a sample of workplaces. Refer to MSIR 9.20(2).</p>
8.11	There is barricading, with signage displayed, to prevent unauthorised entry into temporary unventilated areas.	<p><b>Intent:</b> To ensure that unauthorised access is restricted into those areas temporarily isolated from the ventilation circuit.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by inspecting a sample of temporary unventilated areas to confirm that each unventilated area is chained and signposted to prevent unauthorised access.</p>



Point	Standard	Guideline
8.12	The second means of egress from the mine is protected from smoke contamination by the installation of permanent control devices.	<p><b>Intent:</b> To ensure that smoke is prevented from entering the escapeway to allow an orderly evacuation of personnel from underground.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by inspecting the access ways to the second means of egress.</p>
8.13	Specific areas within the mine with the potential to generate large volumes of atmospheric contaminants have a direct connection to the primary exhaust ventilation circuit return airway.	<p><b>Intent:</b> To ensure that those locations within the mine, such as refuelling and service facilities, main explosives magazines, crusher stations, conveyor transfers and internal ore passes, having the potential to expose employees in other areas to atmospheric contaminants, are ventilated direct to the return airway.</p> <p><b>Personnel:</b> Underground manager, underground ventilation officer.</p> <p><b>Method:</b> Interview personnel and view relevant ventilation plans.</p>
8.14	A computer generated model of the mine ventilation system has been developed.	<p><b>Intent:</b> To ensure that a computer generated model of the mine ventilation system has been developed to assist in the planning and monitoring of the system.</p> <p><b>Personnel:</b> Underground manager, underground ventilation officer.</p> <p><b>Method:</b> Interview personnel and view the computer model and its application.</p>

## 9 Contamination control

Point	Standard	Guideline
9.1	A procedure exists to monitor and control the formation or emission of toxic, asphyxiant and explosive gases in the mine.	<p><b>Intent:</b> To ensure that there is a procedure to monitor and control any hazardous gases encountered underground.</p> <p><b>Personnel:</b> Geologist, underground ventilation officer.</p> <p><b>Method:</b> Where the mine is prone to outbursts of gases, etc. view the procedures and examine what monitoring or controls have been implemented. Refer to MSIR 9.29.</p>
9.2	A procedure exists for drillers to follow in the event of a gas inflow during drilling.	<p><b>Intent:</b> To ensure that there is a procedure to be followed if hazardous gases are encountered underground during drilling.</p> <p><b>Personnel:</b> Geologist, underground ventilation officer.</p> <p><b>Method:</b> Where the mine is prone to outburst of gases, etc. view the procedures and examine what monitoring or controls have been implemented at each drill area. Refer to MSIR 9.29.</p>
9.3	An evaluation of the potential for oxygen depletion in the underground workings has been carried out.	<p><b>Intent:</b> To ensure that the mine has investigated the potential for oxygen depletion.</p> <p><b>Personnel:</b> Geologist, underground ventilation officer.</p> <p><b>Method:</b> View records.</p>
9.4	Procedures have been developed to manage the hazards associated with sulphide dust explosions.	<p><b>Intent:</b> To ensure that there is a procedure to identify, monitor and control the hazards associated with sulphide dust.</p> <p><b>Personnel:</b> Geologist, underground ventilation officer.</p> <p><b>Method:</b> Where the mine is prone to sulphide dust outbursts view the procedures and examine what monitoring or controls have been implemented.</p>

Point	Standard	Guideline
9.5	Procedures have been developed to manage the hazards associated with stopes being filled with tailings containing residual chemicals.	<p><b>Intent:</b> To ensure that there is a procedure to identify, monitor and control the hazards associated with tailings filled stopes.</p> <p><b>Personnel:</b> Underground ventilation officer, process plant manager.</p> <p><b>Method:</b> View the procedures where tailings containing residual chemicals are present underground. Examine what regular monitoring or controls have been implemented. Refer to MSIR 9.26.</p>
9.6	Procedures have been developed to manage the release of ammonia gas due to the reaction between ammonium nitrate and shotcrete.	<p><b>Intent:</b> To ensure that there is a procedure to monitor and control the hazards associated with shotcrete.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View procedures where there is the potential for ammonia release from the use of ANFO and shotcrete and examine what monitoring or controls have been implemented. Refer to MSIR 9.29.</p>
9.7	Blast fumes are cleared from all rise face areas by the use of a compressed air and pipe arrangement following blasting operations.	<p><b>Intent:</b> To ensure that the clearance of blasting fumes from rise face areas is efficiently carried out to prevent fuming incidents.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Confirm that in each rise development an adequately secured compressed air pipe arrangement, capable of withstanding blasting operations, is extended to ventilate the face area. Also verify that the final air control valve is located in an adequately ventilated area on the intake side of the blasting fume path. Refer to MSIR 9.22.</p>
9.8	A written procedure or instruction exists to measure or evaluate the time for blasting fumes to clear from an area.	<p><b>Intent:</b> To ensure that there is a system in place to ascertain when blasting fumes have cleared from each workplace.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting any calculations or measures identifying the time for blasting fumes to clear.</p>

Point	Standard	Guideline
9.9	The clearance of blasting fumes is checked by gas monitoring before re-entry.	<p><b>Intent:</b></p> <p>To ensure that an inspection is carried out of each blast area, using suitable electronic gas monitors, prior to allowing general access into the area.</p> <p><b>Personnel:</b></p> <p>Underground ventilation officer.</p> <p><b>Method:</b></p> <p>Verify by sighting suitable gas monitors that verify the oxygen, carbon monoxide, nitrous fumes and ammonia levels are safe. Ascertain that the re-entry crew check all roadways where the blasting fumes travel prior to removing the “danger - no entry” signs.</p>
9.10	Contaminants are controlled in all workplaces where blasting and loading operations take place.	<p><b>Intent:</b></p> <p>To ensure that sufficient wetting down practices are utilised in each blast area prior to recommencing work and also during the work cycle after a blast has taken place.</p> <p><b>Personnel:</b></p> <p>Underground ventilation officer, shift supervisors.</p> <p><b>Method:</b></p> <p>Verify by inspecting a sample of blasting areas. Refer to MSIR 9.23.</p>
9.11	Mine workings that have high working temperatures have an adequate air velocity flow.	<p><b>Intent:</b></p> <p>To ensure that workplaces underground, where the temperature exceeds a wet bulb of 25 degrees Celsius, are provided with an air velocity of 0.5 metres per second or greater.</p> <p><b>Personnel:</b></p> <p>Underground manager, underground ventilation officer.</p> <p><b>Method:</b></p> <p>View the ventilation log book and relevant documentation. Inspect a sample of high temperature areas. Refer to MSIR 9.15(3).</p>
9.12	Where mine workings exhibit high working temperatures, safe operating procedures have been developed.	<p><b>Intent:</b></p> <p>To ensure that, where there is the potential for employees to experience heat stress problems, procedures have been developed to manage employee exposure to heat stress hazards.</p> <p><b>Personnel:</b></p> <p>Underground manager, underground ventilation officer.</p> <p><b>Method:</b></p> <p>Interview personnel and view relevant documentation and training records. Refer to MSIR 9.15.</p>

## 10 Diesel equipment

Point	Standard	Guideline
10.1	Enclosed cabins and cabin air conditioning equipment are provided on all underground trackless diesel equipment and for underground crushers and remote controlled equipment stations.	<p><b>Intent:</b> To ensure that employees are provided with equipment that protects them from the effects of contaminant exposure and high temperatures.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View a sample of underground diesel equipment and control cabins.</p>
10.2	Air conditioner filters are regularly inspected, cleaned and changed in accordance with the manufacturer's instructions.	<p><b>Intent:</b> To ensure that the air conditioning units are maintained so as to minimise employee exposure to the effects of contaminant exposure and high temperatures.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View the maintenance records.</p>
10.3	Exhaust treatment devices are fitted to all underground diesel engines that are turbo charged or rated at 125 kW or greater.	<p><b>Intent:</b> To ensure that the contaminant emissions of powerful diesel engines are reduced.</p> <p><b>Personnel:</b> Underground ventilation officer, maintenance supervisor.</p> <p><b>Method:</b> Verify by viewing a sample of diesel equipment underground. Refer to MSIR 10.53.</p>
10.4	Low sulphur, clean, diesel fuel is provided for underground engines.	<p><b>Intent:</b> To ensure that the production of engine exhaust contaminants is minimised.</p> <p><b>Personnel:</b> Underground ventilation officer, maintenance supervisor.</p> <p><b>Method:</b> Verify by viewing fuel specification documentation.</p>

Point	Standard	Guideline
10.5	The engine burn efficiency and contaminant emission of all underground diesel engines is monitored on a frequent basis.	<p><b>Intent:</b> To ensure that minimum emissions are being produced by the underground diesel equipment.</p> <p><b>Personnel:</b> Underground ventilation officer, maintenance section.</p> <p><b>Method:</b> Verify by sighting engine emission test results.</p>
10.6	Workplace atmospheric conditions are monitored for diesel particulates on a regular basis.	<p><b>Intent:</b> To ensure that the level of employee exposure to atmospheric diesel particulates at each workplace does not exceed the Interim Occupational Exposure Limit (OEL) of 0.1 mg/m<sup>3</sup>.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View monitoring results.</p>
10.7	A register of all underground diesel units is maintained on site.	<p><b>Intent:</b> To ensure that an accurate list of operational diesel equipment is available at the mine.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View diesel equipment register.</p>
10.8	The register details the relevant information and ventilation requirements for each diesel unit.	<p><b>Intent:</b> To ensure that accurate diesel equipment records, and the requisite ventilation requirements, are available for the number of vehicles operating at the mine.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View the register and check that the information required by the State Mining Engineer in the general exemption dated 24th June 2002 is included in the register.</p>

## 11 Disused areas

Point	Standard	Guideline
11.1	Disused areas of the mine are isolated from the primary ventilation system by an effective barricade to prevent unwanted leakage of ventilating air.	<p><b>Intent:</b> To ensure that disused areas are effectively barricaded to prevent the loss of primary ventilation from operational areas of the mine.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by viewing plans and inspect a sample of any disused areas.</p>
11.2	When an area of the mine has been isolated from the ventilation system, a corresponding entry has been made in the ventilation log book.	<p><b>Intent:</b> To ensure that the location of disused areas has been identified and documented.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View the log book.</p>
11.3	Disused areas of the mine are provided with an effective barricade at every entrance to prevent inadvertent entry.	<p><b>Intent:</b> To ensure that disused areas are completely inaccessible.</p> <p><b>Personnel:</b> Underground ventilation officer, underground manager, underground supervisors.</p> <p><b>Method:</b> Verify by viewing plans and inspecting a sample of barriers in old areas.</p>
11.4	Notices are displayed at every entrance to a disused area forbidding entry to the area.	<p><b>Intent:</b> To ensure that persons are advised as to the fact that entry to the disused area is prohibited.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> Verify by sighting no entry signs at the entrances to disused areas.</p>

Point	Standard	Guideline
11.5	A procedure exists to re-establish ventilation in disused areas before re-entry and work recommences.	<p><b>Intent:</b> To ensure that adequate steps are taken to re-ventilate disused areas before regaining access.</p> <p><b>Personnel:</b> Underground ventilation officer.</p> <p><b>Method:</b> View the procedure.</p>