

D1 UNDERGROUND STANDARDS

D1.1 GROUND CONTROL

1.0 Scope

- 1.1 This standard applies to all underground mines.
- 1.2 All prevailing government regulations must be complied with.
- 1.3 Each operation must establish a Ground Control Management Plan that consists of three elements: Design, Implementation and Verification.

2.0 Design

- 2.1 Only suitably qualified and experienced (in-house or external) geotechnical engineers must be used to develop the design rationale, calculations, support systems and specification of materials.
- 2.2 All underground excavations, drives and stopes must be designed to specified and documented minimum stability criteria for all relevant rock types. The design must ensure that all personnel work in a secure environment.
- 2.3 The design must take into account local and regional hydrology and hydrogeology to ensure that the potential for major water ingress is understood and prevented.
- 2.4 The materials used for all support types must be specified.
- 2.5 Where pillars are required for reasons of safety they must be mathematically derived and clearly marked on all mine plans and sections.

3.0 Implementation

- 3.1 Management must develop protocols that ensure that no personnel work beneath ground that has been inadequately secured.
- 3.2 Management must develop and document protocols for all aspects of Ground Control activity. These protocols must specify:
 - (a) The persons authorised to install support in accordance with approved design and the training they require.

- (b) The persons authorised to install additional, unplanned support and the training they require.
 - (c) The tools and equipment used to install ground support to cater for all sizes of excavation encountered in the mine.
 - (d) The tools and equipment used for scaling to cater for all sizes of excavation encountered in the mine and, which will allow the removal of loose material without exposing the person performing the work to injury.
 - (e) The persons authorised to scale and the training they require.
 - (f) Planned Job Observations of scaling and support practices at a frequency defined by supervisors and senior management.
- 3.3 The underground work force (miners, supervisors, contractors, management) will be trained in awareness and communication of rockfall hazards. Supervisors will undergo specific training in rockfall hazard identification and mitigation.
- 3.4 Supervisors will be trained in how to develop Standard Work Practices and carry out Planned Job Observations for key aspects of the mining cycle.
- 3.5 Up-to-date mine plans must be maintained in locations that are easily accessible to the workforce. Any potential Ground Control hazards must be clearly identified on these plans.
- 3.6 Any change to the Ground Control Management Plan must be fully documented and must be authorised by the Mine Manager.
- 3.7 Management must define the protocols for information flow between shifts and between technical and operations management.

4.0 **Verification**

- 4.1 Procedures must be in place that define:
- (a) The frequency and responsibility for inspecting, monitoring, evaluating and reporting on ground conditions in:
 - Active work places i.e. development ends and stopes, etc.
 - Shafts, declines, access ramps, airways, escape ways, etc., and
 - Other key sections of the mine i.e. workshops, stores, shaft stations, etc.

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(b) The frequency and method of testing rock bolts, cables and other support elements together with the necessary record keeping.

4.2 In addition to these routine inspections, the entire underground operation must be reviewed on a periodic basis to:

(a) Evaluate conformance to the Ground Control Management Plan and local regulatory requirements.

(b) Re-evaluate possible failure modes and up-date risk management studies.

(c) Arrange for peer review of Standard Work Procedures.

(d) Arrange periodic external review of the Ground Control Management Plan.

4.3 Programmes to measure over-break in development drives and stopes, as compared with design, must be in-place and the necessary records maintained.

4.4 Survey accuracy of underground development must be checked against the mine's standards and recorded.

D1.2 EMERGENCY PROCEDURES

1.0 Scope

- 1.1 This standard applies to all underground mines.
- 1.2 All prevailing government regulations must be complied with.
- 1.3 Management must establish an Underground Emergency Response Plan that incorporates the elements in sections 2 through 8.
- 1.4 The Underground Emergency Response Plan must be incorporated as a section in the Emergency Response Manual that is maintained by all Rio Tinto operations.

2.0 Underground Risk Assessment

- 2.1 Management must undertake a risk assessment to identify the possible types of emergency situations that might occur within the mine.
- 2.2 Written procedures must be developed in response to potential emergencies that have been identified and the workforce trained accordingly.
- 2.3 Where reversible ventilation fans are installed, procedures and responsibility must be established for operating the fans in reverse.
- 2.4 The risk assessment must be reviewed annually and the procedures updated as necessary.

3.0 Warning System

- 3.1 Management must determine the minimum acceptable time for an emergency warning to reach all personnel in the mine, including those personnel engaged in non-routine work such as ventilation engineers in return airways, diamond drillers and geologists in remote locations, etc.
- 3.2 Each underground operation must have an effective system, together with at least one back-up system, to warn all personnel underground, within the determined minimum time period, that an emergency exists.

4.0 Emergency Egress

- 4.1 Each operation must establish and maintain evacuation routes/secondary egress as close as practicable to existing and planned working areas.

- 4.2 Management must set a maximum period of time from the moment the emergency warning is activated to the time the last personnel evacuate the mine or are able to reach the safety of an underground refuge chamber. In setting this period the non-availability of man-hoisting and vehicular access must be considered.
- 4.3 Clear and highly visible signs must be used to demarcate all evacuation routes.
- 4.4 All persons who work underground must be instructed in the escape and evacuation plans. Procedures must be in place to advise all miners when a change in the emergency egress takes place.
- 4.5 Test evacuations must take place such that, as far as reasonably practical, all personnel participate once a year. This test must include, where relevant, the use of safety refuge stations.

5.0 Co-ordination with other Emergency Services

- 5.1 The Emergency Response Plan must incorporate the involvement of the in-house Mine Rescue Teams, third party Mine Rescue Teams (where available) and the use of local emergency services, as appropriate.

6.0 Personnel Tagging System

- 6.1 Each operation must have an effective system to identify who is underground.

7.0 Single Entry/Self-contained Refuges

- 7.1 Management must establish a Safe Working Practice (SWP) for single entry systems (these are working areas with one way in and the same way out). The SWP must state the maximum distance allowed before an alternate secondary means of egress or a refuge chamber is required. The SWP must also quantify the maximum number of personnel allowed in a single entry system and any particular PPE or other precautions that are necessary.
- 7.2 Each operation must establish the need, location and capacity for self-contained refuge chambers.

8.0 Emergency Training

- 8.1 All persons who work underground (including all contractors) must be trained in what to do in the event of an emergency. Visitors must receive a short instruction

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in the use of safety equipment and emergency procedures and must remain with a Company representative at all times while underground.

D1.3 FIRE PRECAUTIONS

1.0 Scope

- 1.1 This standard applies to all underground operations.
- 1.2 All prevailing government regulations must be complied with.
- 1.3 Each operation must carry out a Risk Assessment of all potential fire sources, e.g. fuel and material stores, electrical sub-stations, etc. Specific risk and mitigation measures will be developed for all fresh air intakes. This will include identifying fire hazards adjacent to the intake on surface and within the intake, i.e. mobile equipment entering a ramp, flammable materials being hoisted in a downcast shaft, etc.
- 1.4 An Underground Fire Risk Register that identifies the potential fire hazard, the location, the mitigation of the risk and the person responsible for ensuring mitigation measures are in place must be kept.

2.0 Mobile Equipment

- 2.1 No petrol-powered equipment (mobile, stationary or hand-held) must be permitted underground.
- 2.2 All mobile equipment must be fitted with a hand held extinguisher mounted on the unit in an accessible location. The risk assessment will determine the size and type of extinguisher.
- 2.3 All underground mobile equipment containing more than 100 litres flammable hydraulic fluid must be fitted with an automatic fire suppression system with suitable manual activation.

3.0 Fuel Storage

- 3.1 Storage of flammable substances underground must be minimised.
- 3.2 The use of fire resistant hydraulic fluids will be considered where practical and viable.
- 3.3 Where fuels and oils are delivered into the mine by pipeline the Risk Assessment must address:
 - (a) The potential for catastrophic failure of the pipeline and for unobserved leakage.
 - (b) The requirement for pipelines to run empty at the end of the filling cycle.

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4.0 Self Contained Self Rescuers

4.1 All underground personnel must carry Self Contained Self Rescuers (SCSR) with a minimum 30-minute oxygen supply. Compact, robust units are now available.

2 The Risk Assessment will determine the need for caches of additional SCSRs.

5.0 Ventilation System

5.1 In the event of a fire all operations must assess, at fixed locations (fuel stores, sub-stations, etc.) and where mobile equipment operate, the air flow in the mine to ensure the safety of personnel downstream of the fire.

5.2 The potential for changes of airflow direction resulting from heat produced by fires must also be assessed.

6.0 Electric Cables

6.1 All new electrical installations must use fire retardant, non-toxic cables.

D1.4 HOISTING

1.0 Scope

- 1.1 This standard applies to all underground operations that use hoisting equipment in shafts and raises for the transport of men and material and includes “raiseclimbing” equipment. The words “hoist” and “winder” are synonymous.
- 1.2 All prevailing government regulations must be complied with.
- 1.3 Each operation must establish a Hoist Register that includes the following key components.

2.0 Safety Devices

- 2.1 The minimum safety devices and control system required for each hoist system are:
- Two independent "fail-safe" breaking systems acting directly on the drum, each set of brakes having its own operating circuit. In the case of double drum hoists, each brake on a drum constitutes one system.
 - Primary (such as Lilly controller) and secondary devices (such as tachometers for overload and limit switches in the headframe and shaft for under and overwind) to control overspeed, underwind (headframe) and overwind (shaft bottom).
 - Interlock system for clutch (if fitted) to ensure the free drum is braked and driven drum is limited to creep speed.
 - A device to stop the hoist in the event that the conveyance does not move in relation to the amount of rope paid out (the ‘slack rope’ condition).
 - An accurate indicator to show where each conveyance is in the shaft.
 - A "dead-mans switch" for manual operation.
 - An emergency off switch
 - Ammeter to indicate the winder motor current
 - For a hoisting system used for man riding, a cage detaching device (such as Humble hook) or arrester (such as SELDA, or other device, with holding jacks) in the headframe and arrester in the shaft bottom.

Any deviation from the above will require a risk analysis to be carried out.

- 2.2 The frequency and method of testing of all safety devices and control systems must be defined.
- 2.3 Records must be kept of all tests.

3.0 Maintenance and Inspection

- 3.1 Operations must establish a maintenance and inspection master plan that includes:
 - (a) Mechanical and electrical components of the hoist.
 - (b) Hoist rope attachments and all conveyances.
 - (c) Structural integrity of the hoist, headframe and shaft guides/rails etc.
- 3.2 Operations must establish the frequency and procedures for non-destructive tests on the rope attachments and structural elements holding the conveyance.
- 3.3 Records will be kept of all tests.

4.0 Hoist Rope Inspection

- 4.1 Operations must, in conjunction with the hoist rope supplier, establish hoist rope discard criteria.
- 4.2 Communication protocols between management and those carrying out the hoist rope inspection must be established to ensure that management is notified immediately of any adverse findings.
- 4.3 Operations must keep records of:
 - (a) Hoist operating data including the number of cycles spent man hoisting and rock hoisting.
 - (b) Hoist rope data including date of installation, maximum admissible legal life, construction and safety factor.
 - (c) Rope test and inspection results compared with rope discard criteria.
 - (d) Non-destructive inspections and the results of the testing of rope cuts, etc.

5.0 Medical Examination

- 5.1 Annual medical examinations of all hoist operators must be carried out to confirm fitness for hoist operation.

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6.0 Training

6.1 All persons who operate hoisting machinery and persons who inspect, maintain or test any part of the system must be adequately trained and authorised.