This document covers the principles and general methods of operation that African Underground Mining Services (AUMS) adheres to and employs in its underground mining processes. It is not intended to be a full description of each, rather an outline of how the company operates.

AUMS’s goal is to be Africa’s premier underground mining contractor. The company aims to provide the most cost effective and productive service in the safest operating environment. In all operations, AUMS’s first objective is to ensure compliance with the relevant Mines Safety and Inspection Act and Regulations, and any other statutes as the minimum standard.

AUMS operates contracting operations with a consultative and cooperative approach. It recognise that its management systems must be integrated with its clients’ to meet and exceed productivity objectives.

AUMS focuses on the entire project framework not just the underground mining. Infrastructure, systems and processes are established and optimised to deliver maximum efficiency and productivity, right from the start of the project.

Establishment

The establishment process is critical in ensuring all facilities are functional and safe for all personnel. It is also used to prepare management and employees through meetings, inductions, site familiarisation and training. Any site specific management systems that are required are determined at this time.

Communications

Communications systems are an essential component of the AUMS management structure. They take various forms including verbal, written and electronic, and include reports, notes, memos, statistics and information about shift activities, performance, safety, personnel, environment, maintenance and costs.

Mine Access

There are several requirements for personnel who are about to enter an underground mine. Three of the most important are ventilation, safe travel way and means of transport. These checks are integrated into AUMS safety systems.

Ventilation

Correct ventilation is essential for all underground mining operations. AUMS systems include checks and testing for ventilation fan operation, airflow measurement, re-entry times after blasting, clearance of fumes, air quality measurements and gas testing where required. Procedures for these tests, checks and measurement are incorporated into safety systems and operational procedures.

Travel Ways

Travel ways must be safe for all personnel and equipment that require them. This is achieved through regular checking and scaling, removal of obstructions, regular road maintenance and establishment of proper drains to keep water off the travel ways.

Transport

All vehicles that are driven underground undergo a pre-start check to ensure they are in proper working order. Special emphasis is given to brakes and steering.
Development

There are key areas of the development process that must meet certain requirements to ensure a safe and efficient operation. These relate to ventilation, scaling, ground support, dust suppression, and work procedures. All employees are to ensure these elements are checked in every work place.

Ventilation

Every workplace must have adequate ventilation for the task and machinery involved. This means installing adequately sized fans, ensuring ventilation ducting is in good condition, and locating ducting close to work areas to provide sufficient ventilation. Re-entry times need to be calculated for each working area and the times communicated to all employees on a regular basis.

Secondary ventilation fans are installed in the purest available air source and in a manner that will prevent recirculation of air. Where vertical development is carried out, the ventilation fans and ducting are supplemented with a steel pipe compressed air ventilation system for clearing of fumes after blasting.

Scaling

Scaling is the first task undertaken in any work place after blasting to eliminate the risk of rock fall. The scaling process begins in an area of supported ground back from the blasted area and progresses into the blasted area. Some mechanical scaling methods are utilised for this task to eliminate the need for personnel to be exposed to rock falls during the scaling process.

Check scaling is carried out in a planned sequence to ensure all working areas of the mine are covered. Scaled sections are recorded and dated on the plans, and on the supervisor’s log.

Dust Suppression

Suppression of dust also takes place after blasting and is coordinated with the scaling process. Washing down of the broken dirt is undertaken prior to and during the bogging process. All drilling is done with water to prevent dust being produced during the drilling process.

Bogging

Bogging is undertaken to maximise productivity and establish a suitable work place for the next mining process. This includes scraping back the development face to expose lifters, creating a smooth floor for drilling machines and personnel, and filling in holes to prevent water collection.

Drilling

After bogging and prior to drilling, each face is thoroughly checked for misfires and explosives. When drilling into other mine openings, the opening are also be checked for misfires.

When using development jumbos no person is allowed forward of the control console while the drill is operating. When rock bolting, any assistant operator is required to stand away from the bolting area when collaring, drilling or installing bolts.

Ground Support

The type of ground support installed is selected with the following criteria:

- Required life of support
- Geotechnical conditions
- Client requirements

In development headings, ground support is installed prior to the next drilling phase and up to the current working face.
Charging and Blasting

Charging is carried out with the aim of minimising over break and damage to walls and backs of the heading. To achieve this, the correct explosives and charging method based on rock type and geotechnical conditions.

Charging is generally carried out from a dedicated charging machine with appropriate controls and platform. In single heading operations, charging may be done from some other approved charging platform.

The safety of all personnel is paramount in blasting activities. Only qualified and certified personnel are authorised to initiate blasts. Strict blasting procedures ensure that no person or machinery is exposed to blasts, blasting shocks or dust explosions. Procedures include tag board checks to account for all personnel prior to blasting.

Dewatering

Water generated from mine equipment use and ground water inflows is extracted from the mine with electric pumps. As development headings are mined, small flygt pumps remove mine water to either intermediate (flygt) or primary (mono) staging pumps. They progressively lift the water out of the mine to the process water settling tanks or ponds. Additional pumping stations are added as required with the advancing depth of the mine. This water is recycled for use within the mine.

Production

Drilling

Long hole drilling focuses on accuracy. Operators are trained to read plans correctly, accurately set up the drill and drill to obtain minimal deviation. Rock drill tools will be chosen to provide maximum productivity and minimal deviation in the application.

Wetting of Stope Dirt

Prior to production bogging and after blasting, stope dirt is watered down by various methods depending on the position of the broken dirt. If close to the brow, water is applied by a hose and nozzle from the bogging level. Once the dirt is past this limit a water cannon is set up on the bogging level or the level above. The alternative to both these methods, to reach a reasonable distance into the stope, is to set up a hose and nozzle on the remote loader and then drive the loader into the stope.

Bogging and Loading

Bogging and loading is undertaken with the aim of safe and productive operations. This is achieved through correct selection and matching of equipment, operator training and efficient maintenance practices.

Haulage

Haulage operations are undertaken with a focus on minimising costs and maximising productivity. This is achieved by selecting the correct size and quantity of equipment, and utilising highly skilled train operators.

Road Construction and Maintenance

Construction and maintenance of roadways form part of the daily mining cycle. The sub base of the road is formed to the correct profile with development machinery and bogger achieves the compaction required. Super elevation of curves will be mined as the decline is developed.

Material used for the roadway is development dirt for the sub base and an imported crushed aggregate (-40mm) for the final surface. Maintenance of the roadways is carried out with a grader. Sprinklers or sprays are installed to suppress any dust on main haulage ways. Ore drive roadways only use material mined from that drive - no waste or crushed road base will be used in ore drives.
**Ventilation**

Ventilation is managed to provide the purest possible air quality to each working place; rapid extraction of blasting fumes, diesel engine fumes, gases and other contaminants, and minimal creation of dust.

These aims are achieved through rapid development of primary ventilation circuits, correct sizing and placement of secondary ventilation, use of exhaust filtering on diesel engines, regular monitoring of air quality and quantity, correct maintenance of diesel engines, use of low sulphur fuel if available, and a variety of dust suppression measures.

Routine ventilation surveys are carried out to measure the quantity and quality of ventilation in all working areas. Results are recorded in record books and distributed to relevant personnel. In all operations, the requirements of the relevant Mining Regulations will be of primary importance and accepted as the minimum standard.

**Dust Management**

Dust management is a key safety issue and requires continuous attention. In underground workings drilling dust is controlled by use of wet drilling processes, blasting dust by use of ventilation, water sprays and washing down methods, and road dust by use of sprinkler systems and a water cart where necessary.

**Explosives and Charging**

AUMS has agreements with most major explosives suppliers operating in Africa for the purchase and delivery of explosives and accessories.

**Delivery and Magazines**

The explosives supplier delivers explosives direct to surface magazines or compounds. AUMS personnel then transport explosives into main underground or working party magazines as required. Transportation of explosives on the mine is undertaken in strict accordance with the laws and regulations of the country of operation. Main magazines are managed by supervisory personnel on site to ensure compliance with regulations and standards.

**Explosive Types**

The main explosive products used in mining operations are either ANFO or where possible Emulsion (ANE) for both development and bulk stoping charging. The service includes bulk delivery of the emulsion product and provision of a mobile charging unit and operator. The charging unit is capable of charging holes up to 109mm diameter and 50m length at any inclination.

Generally AUMS’s initiating systems utilise the non-electric detonator system in conjunction with detonating cord. The primary initiation is via a single electric detonator. Previously outlined blasting procedures also apply to stope blasting.

**Equipment**

AUMS’s policy is to maintain a modern fleet of equipment by trading before major rebuilds are due. This applies in particular to jumbo drilling equipment and development loaders and trucks that are key production machines. Other machines such as ancillary service vehicles may be overhauled on a regular basis. All machines are chosen to suit the application and to provide safe, productive and reliable operation in the underground environment.

**Maintenance**

The maintenance workforce is kept to a minimum by having near new main production machines under warranty. The key maintenance personnel are selected according to their experience with each machine. Training is carried out for those who require specialised knowledge.

Servicing is undertaken on a regular basis. AUMS operates on a planned maintenance basis as it is recognised that preventative maintenance leads to greater productivity. Service intervals and types are developed
according to the type of machine, its application and workload, experience in similar work environments and manufacturers’ recommendations. When major overhauls are due, AUMS will provide an alternate machine during the rebuild. This maintains the fleet and production rates at the client’s required levels.

**Maintenance Planning System**

PRONTO Plant Maintenance is a sophisticated maintenance control system designed to maximise planning and maintenance control procedures. Preventative maintenance, job costing, plant down time, fault repair and plant item repair costs can all be determined in advance using the maintenance system. This reduces maintenance and operating costs, and improves efficiency by reducing down time through programmed maintenance.

PRONTO Plant Maintenance has seven main objectives:
1. Provide procedures for the recording of and performing maintenance tasks
2. Hold the maintenance plan
3. History/event recording
4. Cost collection
5. Text management
6. Integration with accounts
7. Stock control/purchasing.

Preventative and routine maintenance details can be recorded, as can schedules of warranty expiration dates, manufacturers’ recommended service intervals, statutory inspections and if required regulations peculiar to individual sites.

Failure analysis quickly identifies equipment problems, with faulty repairs, or sub-standard replacement parts.

The maintenance module also allows monitoring of progressive wear on key items, allowing accurate prediction of when planned maintenance should be carried out to reduce down time.

The system does not computerise the maintenance procedure, but allows managers to pre-plan all aspects of plant maintenance and repair. This is especially useful in meeting client’s individual requirements.

The plant item (unique number) is set up to record engineering specifications, component history, budgets, drawing references and plant history through the condition-monitoring module. This module assists in forecasting the planned activities.

PRONTO utilises the work orders system to control activities and can be adapted to handle work permits or whatever activity is required. The maintenance frequency can be based on run time, usage, calendar intervals, statutory inspection, or scheduled shutdowns.