Underground Miner

The Assessment Reports

Canada
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MINING INDUSTRY HUMAN RESOURCES COUNCIL
CONSEIL DES RESSOURCES HUMAINES DE L'INDUSTRIE MINIÈRE

Underground Miner
Assessment Reports - Contents

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Special thanks to CBI Workplace Solutions:

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MiHR

MiHR is the sector council for the Canadian minerals and metals industry. A recognized leader in the development and implementation of national human resources solutions, MiHR contributes to the strength, competitiveness, and sustainability of the Canadian mining sector.

Products and services developed by MiHR are based on sound research into the skills and labour market issues that matter most to the Canadian mining industry. MiHR remains committed to actively engaging and working with all communities of interest—employers, educators, organized labour, and Aboriginal groups, among others—to develop solutions tailored to human resources needs in the mining sector.

About The Physical Demands Analysis (PDA) Project

The objective of the Physical Demands Analysis Project was to obtain, through full assessment of tasks outlined in the National Occupational Standards developed by MiHR, information to:

- To meet current and projected human resource demands by increasing and making best use of all potential sources of supply
- Address existing and expected skills gaps in the industry, by understanding true physical job requirements that may have put up barriers for certain demographic groups in the past (i.e., women, mature workers, persons with disabilities)
- Determine compatibility between a worker and a specific job (Post Offer Testing)
- Assist employers when returning injured employees to work (Early and Safe Return to Work)
- Assist with recognition of highly physical jobs and ones that have a potential to cause injury (Job Matching)
- Assist employers to accommodate workers with permanent medical restrictions.

Underground Miner

Area of Competence: Communicate

Assessment Report

Minerals Processing Operator
Communicate — The Assessment Report

Overview

Occupational Domain:	Underground Miner	National Occupational Standard (NOS) Area of Competence:	Communicate
Hours of Work:	Variable, dependant on mine. May work 10- or 12- hour shifts.	Breaks:	Flexible break schedule; ~1- 1½ hours in total.
Shift Work:	Rotating schedule, which is dependant on the mine site.	National Occupational Classification (NOC) Level of Work:	Light
Dates of Assessment:	February 17-19, 2009	Evaluators:	Trevor Hawksby, B.Sc. (H.K.), C.K. Charlene Martin, B.Sc. (H.K.), C.K.

Section 1: Detailed Task Description

Overall, the Communication job tasks fall within the Light strength category, as defined by the National Occupation Classification (N.O.C.).

As an Underground Miner, workers are required to use many forms of communication when interacting with their co-workers, supervisors, contractors, and/or visitors. The modes of communication include:

1. Light Signals:

All Underground Miners are required to wear a hard hat, equipped with a cap light, which weighs 1.0 kg. In many instances, the cap light is used as a form of communication, especially when corresponding with mobile equipment operators. The worker requires unrestricted neck movements in all directions to communicate using cap light signals. Cap light communication may be completed from a standing position, or while sitting when operating mobile equipment.

2. Two-Way Radio / Telephone:

The cap light and battery pack, may also be equipped with a two-way radio, which may be used to converse with co-workers. A tip pinch grip is needed in order to depress the radio when conversing.

There are telephones located underground, in the safe rooms, maintenance rooms, and near any transformers. The telephones are mounted on the walls, at shoulder level. A unilateral forward reach and power grip is required to access the telephone receivers.

3. Bells, Horns, and Whistles:

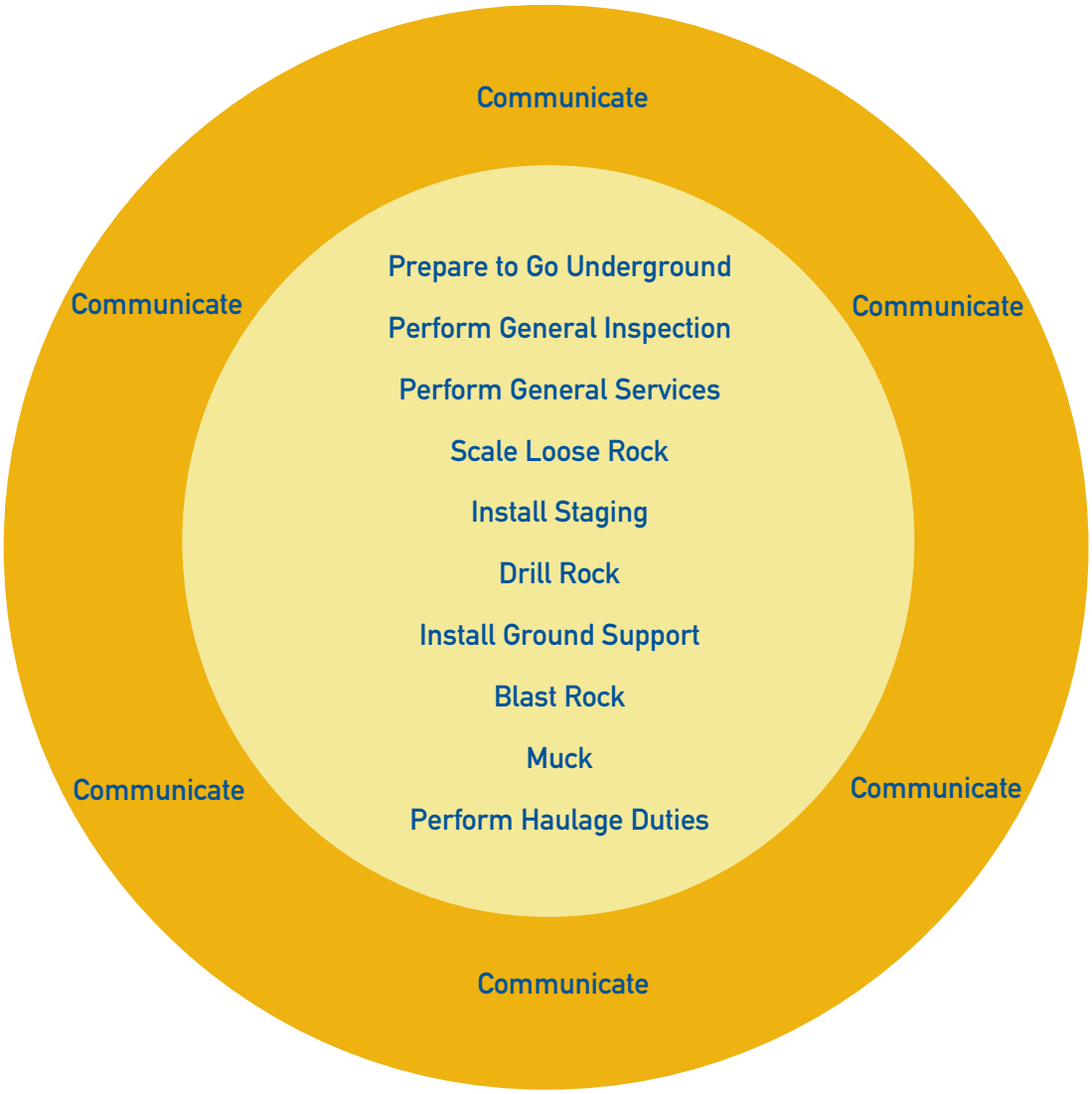
Any Miners operating mobile equipment will sound the horn as a form of communication. This form of communication is typically conducted from a seated position, and requires a forward reach in order to access the horn. Minimal push force is required when operating vehicle horns. The worker may be exposed to seat vibration, which will vary depending on the type of mobile equipment, the ground surface, and the mine.

The Cage Tender is required to frequently communicate with the Hoist man, which is predominantly completed using bell signals and a two-way radio. The Cage Tender is required to reach forward or to the side in order to signal the bell. Depending on size of the bell, 4-17 kg of vertical pull force is needed.

4. Written Based Communication:

Miners are required to read, write and interpret various written forms of information. Miners use written forms of communication to complete log books, read and interpret mine plans, and complete production reports, safety reports and any other reports dictated by the mine policy or government regulations.

Section 2: Workflow



Section 3: Task Objectives and Duties

Overview

Must be able to effectively communicate with supervisors, co-workers, contractors, and/or visitors. This may include, but is not limited to, communication using verbal, audible, written, electronic devices, as well as interpretation of signs.

Essential Tasks

1. **Speak Clearly and Concisely**
- Workers must be able to communicate with each other, and supervisors using appropriate language and mine terminology.
- Workers must be able to convey any safety concerns, and/or questions.

2. **Listen Actively**
- Due to the nature of the Underground Miner occupation, workers must be able to validate and acknowledge any communication.

3. **Convey Messages with Hand, Cap Light, and Audible Signs**
- Each miner must follow company procedures and/or government regulations for signalling.
- Cap light signals may be used when communicating with any heavy equipment operators.

4. **Use and Respond to Communication Devices**
- Workers must be able to recognize bells, whistles, horns, according to company policies, and/or government regulations.
- Workers must be able to listen and converse using telephones and/or two-way radios.
- Workers must be able to identify and read signs, such as symbols, colour coding, as well as recognize traffic signs, as needed.

5. **Use Workplace Software and Hardware**
- Depending on the mining company, workers may be required to operate and/or communicate using a computer.
- Basic keyboarding and mouse skills may be needed.

6. **Complete Reports**
- Any workers operating heavy equipments, workers must complete the safety systems reports.
- Workers must be able to complete any log books, shift reports, safety reports, etc., as well as convey appropriate information to the supervisor.

7. **Read and Interpret Mine Plans/prints**
- Workers must be able to review and comprehend all symbols, abbreviations, and colour coding on any mine plans/or prints.
- Workers must be able to understand the different ground classifications, according to company policies.
- Workers must be able to communicate any questions or concerns to the appropriate personnel, for clarification.

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Personal Protective Equipment (PPE)

- Leather or rubber safety boots, equipped with metatarsal guards;
- Coveralls, equipped with appropriate reflective markings;
- Belt with fall arrest ring and holster for light battery pack / two-way radio;
- Hard hat;
- Safety glasses;
- Hearing protection, which may include ear plugs and/or ear muffs;
- Gloves;
- Respirator; and
- Additional task specific PPE, such as face shield, specialized hand and forearm protection, self-contained breathing apparatus, etc.

Equipment

- Cap light and battery packs;
- Two-way radios;
- Telephones;
- Watch and miners wrench
- Computer systems;
- Bells, whistles, and horns;
- Signs;
- Mine plans or prints; as well as
- Report logs and writing instruments.

Section 4: Strength and Positional Requirements

STRENGTH REQUIREMENTS		FREQUENCY	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Lifting/ Lowering	Floor to Waist† (0-104cm)	Occasional	2.0-4.5		• Rubber or leather safety boots equipped with metatarsal covers.
	Waist† to Shoulder† (104-137cm)	Occasional	<0.5-8.0		• Cap light with radio (1.5 kg), safety belt (3.0-8.0 kg), telephone receiver (<0.5 kg).
	Floor to Shoulder† (0-137cm)	Never	-		
	Above Shoulder† (>138cm)	Occasional	0.5-1.0		• Hard hat with ear muffs (0.5-1.0 kg).
Carrying	Unilateral/ Bilateral	Occasional	1.5-2.0		• May carry light pack from charging station ~2-5 m. • Workers may carry mine prints, log books, etc.
Pushing/ Pulling (kg of Force)	Vertical	Occasional		~4-22	• Pulling full basket (21.7 kg of force), containing personal items in the Dry Room. • The rope is secured on an "eye" hook, located at shoulder level. An overhead vertical pull, is needed to lower or raise the basket. • The Cage Tender is required to use pull 10-50 lb bells when signalling the Hoist man. Depending on the weight of the bell, this requires 4.0 -17.2 kg of pull force.
	Unilateral	Occasional		~6-8	• Open / close doors to buildings, head frames, change rooms, etc. • Worker has the option of using one or two-hands.
	Bilateral	Occasional		~6-8	

The Frequency Definitions are outlined in Appendix 2.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

† Anthropometrics are based on the 50th percentile male (waist height, standing 106.3±5.4 cm; shoulder height, standing 143.7±6.2 cm) and the 50th percentile female (waist height, standing 101.7±5.0 cm; shoulder height, standing 132.9±5.5 cm); Eastman Kodak Company (1986). *Ergonomic Design for People at Work: Volume 2.* New York: Van Nostrand Reinhold Company.

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY	COMMENTS*
Sitting		Occasional	• May be needed when sitting during morning communication meetings. • Horn signals while operating mobile equipment, such as trams, personal carriers, trains, etc. • Frequency will vary depending on work assignment.
Standing		Occasional	• Light, whistle, or hand signals to convey messages to mobile equipment operators, co-workers, etc.
Walking		Occasional	• Reading signs, light signals, horns, etc.
Climbing	**Stairs**	Never	
	Ladders	Occasional	• Communicating with ground worker.
	Uneven Ground	Occasional	• Reading signs, communicating with mobile equipment operators while in safety stations on ramps.
Balancing		Never	
Crawling		Never	
Kneeling		Never	
Crouching/Squatting		Occasional	• Lamp signals, hand signals, and other forms of communication with co-workers, may be required during blasting, drilling low levels, mucking, etc.
Trunk Movements		Occasional	• Partial range of motion in all directions may be needed, such as lateral flexion when peering out of a safety location in a ramp or stooping when communicating from a scissor lift.
Neck Movements		Occasional	• Unrestricted neck range of motion in all directions is required. Especially important when using cap light to convey signals. • Static cervical flexion required when reading mine prints, plans, report and safety logs. • Full bilateral rotation needed when communicating during mobile equipment operation. • Extension required when performing tasks above shoulder level.
Reaching	**Forward/ Backward**	Occasional	• Hand signals, reading prints, writing information, typing data, using flash light.
	Upper Level	Occasional	• Cage operator required to reach above shoulder level when using bell signals. May be required to access the telephone or complete hand signals.
	Sideways	Occasional	• May be needed when signalling bells, using the two-way radio or telephone, conveying hand signals.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS	FREQUENCY	COMMENTS*
Elbow Posture	Occasional	• Pronation needed when conveying hand signals, typing. Supination may be required when reading mine prints or using hand signals.
Wrist Posture	Occasional	• Extension and flexion is needed when conveying hand signals.
Gripping	Occasional	• Power grip needed when using telephone, computer mouse, bell signals.
Pinching	Occasional	• Tip pinch grip required when operating two-way radio, whistles, or writing communication. Key pinch grip needed when holding mine prints/plans while reading.
Fine Finger Dexterity	Occasional	• Needed when completing reports, such as log books, shift reports, production reports, and safety system reports. May also be used when typing.
Striking with Hand	Never	
Foot Action	Occasional	• Plantarflexion and dorsiflexion required to use the pedal controls while operating mobile equipment.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 5: Sensory/Mental Requirements

SENSORY/MENTAL REQUIREMENTS		ESSENTIAL		COMMENTS*
		Yes	No	
Vision	Near	X		• Reading log books, shift reports, production reports, safety system reports, interpreting mine plans/prints, computer work.
	Far	X		• Peripheral and far vision needed when acknowledging cap light signals. Also needed when reading signs.
	Colour	X		• Interpretative information presented on mine plans/prints; colour coded signs; recognize traffic, safety, and warning lights.
Light Quality and Measurements		X		• Primary underground mining tasks require the ability to work in low level light, less than 200 Lux. • Typical underground working light is 10-15 Lux (single worker with cap light). • Ambient light while operating mobile equipment is ~200 Lux. • Typical light in headframe is 500-680 Lux and lunch room is ~120-160 Lux.
Hearing	Conversation	X		• Communicating over two-way radio, telephone, and in-person.
	Other Sounds	X		• Machinery, bells, whistles, and alarms. • Hearing protection is mandatory. Noise levels regularly exceed occupational exposure limits. • Level of noise ranges from 50 dB to 107 dB (heavy equipment operation).
Talking		X		• Conversing with the use of hearing protection. Worker may be required to speak loud or shout.
Reading/Writing		X		• Reviewing mine prints/plans, reports and log books, signs, as well as information on the computer.
Feeling			X	
Judgement/Decision Making		X		• Communicate safe working conditions.
Concentration		X		• Multi-tasking, communicating while operating mobile equipment. • Required when interpreting mine plans/prints.
Alertness		X		• Workers must be alert to workplace hazards, which may include ground conditions, mobile equipment, or power tools.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 6: Work Environment

WORK ENVIRONMENT	ESSENTIAL		COMMENTS*
	Yes	No	
Slippery Floors or Ground	X		• Wet/muddy ground conditions.
Sloping or Uneven Terrain	X		• Ascending/descending ramps, loose rocks.
Inside Work	X		• Performing work in the underground mine. • Ventilated air environment.
Outside Work		X	
Extreme Heat/Extreme Cold	X		• Exposure to hot or cold conditions possible. Colder environments may occur when working in close proximity to fresh air raises or near the surface. Typically ambient temperature is controlled through the use of proper ventilation.
Dry/Humid	X		• Conditions vary depending on task performed and mine site.
Dust (PPE required)	X		• May be exposed to dust scaling, drilling, blasting, spraying shotcrete. Workers are required to wear respirators. • Workers also control dust by spraying the rocks, muckpile, and/or equipment with water.
Vapours / Fumes (PPE required)	X		• From heavy equipment and/or power tools. • Some chemical use may require use of a respirator.
Chemical Irritants (PPE required)	X		• Type of chemical exposure depends on the material being mined and the mining process.
Noise (PPE required)	X		• Hearing protect mandatory, depending on the task performed and area within the mine. • Noise levels regularly exceed the occupational exposure limits. • Noise levels range between 50-107 dB, depending on the heavy equipment and fans.
Moving Objects/Vehicles	X		• Mobile equipment.
Electrical Hazards		X	
Sharp Tools	X		• Grub hoe, box cutters, axes.
Congested/Confined Work Site	X		• Parts of a tunnelling operation or an underground mine (stopes, drifts, ramps, shafts, raises), are designed and constructed specifically for people to carry out work within them. Specific codes, standards and requirements are intended to make the space adequate for the health and safety of workers. However, parts of a tunnel or mine could include confined spaces. Tunnels and mines could also include confined spaces within them, such as bins and tanks.
Working at Heights	X		• Workers may be required to perform work on scissors lifts, ladders, muck piles, and staging.

Continued...

WORK ENVIRONMENT	ESSENTIAL		COMMENTS*
	Yes	No	
Vibration (Whole Body)	X		• Communicating while operating heavy equipment. The degree and duration of exposure will vary according to the type of equipment; task performed; and mine location. • Vibration frequencies vary from 8-1560 Hz (Scoop Tram 8-44 Hz; Maclean Bolter 231 Hz; Crusher Operation Deck 291-450 Hz; Crusher Overpass Floor 208-646 Hz; Floor of the Jumbo Drill 1560 Hz).
Vibration (Segmental)	X		• Exposure when operating power tools and other heavy equipment, such as drills. • The degree and duration of exposure will vary according to the type of equipment; task performed; and mine location. • Vibration frequency ranges from 500-1700 Hz, and will vary according to the mine location (Stoper 500-1200 Hz; Jumbo Drill Controls 1560 Hz; Jackleg 960-1700 Hz).
Vehicle Operation	X		• Required to communicate with co-workers when operating mobile equipment.
Overtime	X		• Voluntary overtime hours may be needed, depending on production requirements.
Shift Work	X		• May be required depending on company policies. Typical shifts are 10- and 12- hours.
Working Alone	X		• Works independent within a group of individuals. Check-in policy mandatory.
Working with Others	X		

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 7: Behavioural/Cognitive Demands

BEHAVIOURAL/COGNITIVE DEMANDS	CDA£ RANKING SCALE				COMMENTS*
	1	2	3	4	
Degree of Self-Supervision Required			X		• Receive instructions from supervisor during line-up meeting conducted at start of shift. The worker may not see supervisor until the end of the shift. • May need clarification regarding mine prints/plans, and/or safety issues.
Degree of Supervision Exercised	X				
Deadline Pressures (Time Pressure)			X		• Daily, weekly, and month production targets.
Attention to Detail		X			• Reviewing mine prints/plans, completing reports, such as safety, shift report, daily log.
Performance of Multiple Tasks Required		X			• Communicating while performing underground mining tasks, such as mobile equipment operation.
Exposure to Distracting Stimuli				X	• High noise levels, moving equipment, ground conditions.
Need to Work Co-operatively with Others			X		• Light, hand, whistle, horn, and bell signals.
Exposure to Emotional Situations	X				
Exposure to Confrontational Situations	X				
Responsibility and Accountability Required				X	• Communication through light signals, safety reports, and interpreting mine plans/prints.
Reading Literacy			X		• Reviewing reports, such as safety, daily logs, production reports, mine prints/plans. • Required to follow written instructions.
Written Literacy		X			• Completing reports, log books, and pre-operation checks.
Numerical Skills		X			• Horn, whistle and bell signals when communicating.
Verbal Communication			X		• Conversational, two-way radio, telephone.
Memory		X			• Signals, signs, colour coding.
Computer Literacy		X			• Basic computer skills may be required.
Shift Work Demands			X		• Rotating shift schedule may be required, depending on company policies. Typical shift durations are 10- and 12- hours.

£ The Cognitive Demands Assessment (CDA) definitions and scale are outlined in Appendix 3.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 8: Photographs

Figure 1: Telephone Station in Underground Mine

Figure 2: Cage Tender Signalling the Hoistman

Underground Miner

Area of Competence: Prepare to Go Underground

Assessment Report

Minerals Processing Operator

Prepare To Go Underground — The Assessment Report

Overview

Occupational Domain:	Underground Miner	National Occupational Standard (NOS) Area of Competence:	Prepare To Go Underground
Hours of Work:	Variable, dependant on mine. May work 10- or 12- hour shifts.	Breaks:	Flexible break schedule; ~1- 1½ hours in total.
Shift Work:	Rotating schedule, which is dependant on the mine site.	National Occupational Classification (NOC) Level of Work:	Limited - Light
Dates of Assessment:	February 17-19, 2009	Evaluators:	Trevor Hawksby, B.Sc. (H.K.), C.K. Charlene Martin, B.Sc. (H.K.), C.K.

Section 1: Detailed Task Description

According to the National Occupational Classification, the Prepare to Go Underground tasks falls within the Limited -Light strength categories.

1. Tag-In:

For safety reasons, miners are required to check-in and indicate their work location. This procedure will vary according to mine location; however may be completed with a sign-in book or board, or meeting with the supervisor. Workers may be required to reach above shoulder level if using a wall-mounted board to tag-in.

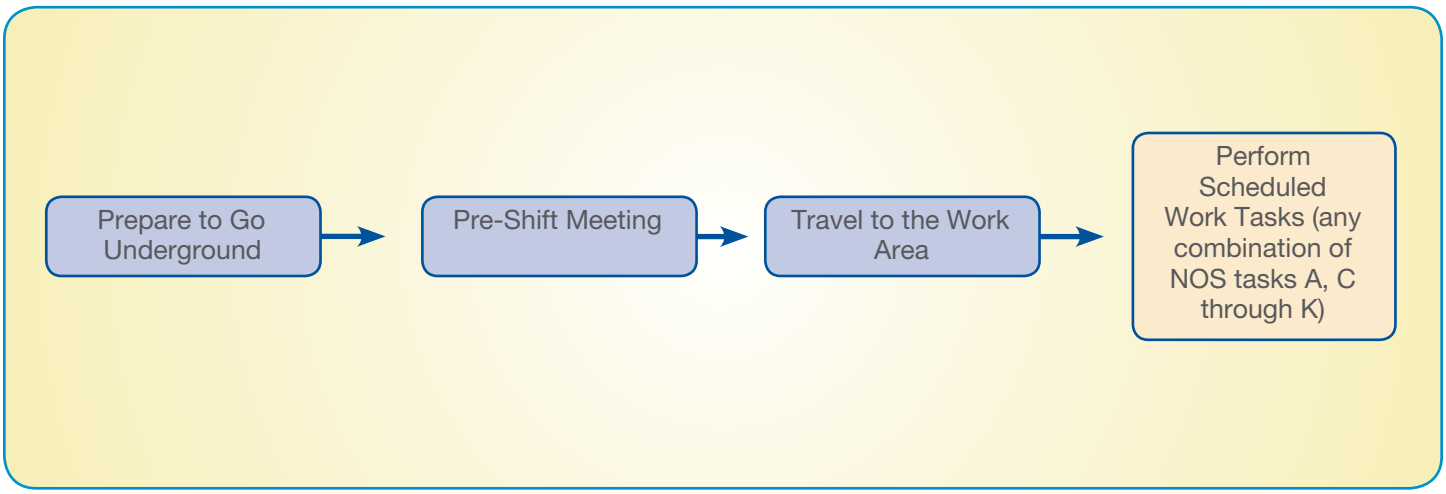
2. Personal Protective Equipment:

Prior to going underground, each miner is required to obtain, inspect, and don all required personal protective equipment (PPE), which may include coveralls, safety shoes, hard hat, gloves, respirator, hearing protection, fall restraint systems, as well as a cap light and battery pack. The safety shoes range in weight, from 2.0-4.5 kg and the cap light and battery pack weighs 1.5 kg. The respiratory and battery pack is secured to safety belt. Depending on the miner, additional tools and packs may also be secured to the belt, which weighs 3.0-8.0 kg. Full shoulder flexion may be required to raise and lower the hooks and baskets from the Dry room, when obtaining the coveralls (if the baskets are suspended). At some mine locations the Dry's may be placed in lockers or suspended from clothing hooks instead of being placed in a basket. In general the miners will have to be able to reach from floor to an overhead level to store and obtain their gear. Partial shoulder range of motion is also needed in order to obtain the cap light and/or two-way radio from the charge station.

3. Mine Layout, Training:

Each miner must familiarize themselves with the mine layout, communication tools, emergency procedures, ventilation systems, air flow, and evacuation. This may entail additional on-site training, which may be conducted in a classroom, tour, or computer-based learning. Sitting for short durations, reading, as well as basic computer skills are needed when completing the computer-based learning.

Section 2: Workflow



Section 3: Task Objectives and Duties

Overview

Prior to going underground, each miner must be knowledgeable of the underground layout and any emergency procedures; as well as ensure they have all appropriate protective equipment and/or any additional equipment required to complete the underground mining tasks.

Essential Tasks

1. **Tag In**
- Workers are required to report to their supervisor and participate in the pre-shift meeting.
- For safety concerns, workers may be required to tag in and indicate work location, prior to going underground.

2. **Use Personal Protective Equipment**
- Obtain, inspect, and don all required personal protective equipment, according to government regulations and/or company policies.
- Workers are required to report and/or replace any damaged or defective personal protective equipment, such as torn coveralls, damaged fall arrest system.

3. **Use Communication Devices**
- Each miner must follow company procedures and/or government regulations for when using communication devices, such as two-way radios; light, bell, horn, whistle signals; telephones; written communications.
- Workers must be able to communicate with each other, and supervisors using appropriate language and mine terminology.
- Workers are required to check the cap light bulbs, two-way radio, and battery packs to ensure correct charge.

4. **Familiarize Self with Underground Work Areas and Emergency Procedures**
- Workers must familiarize self with the underground layout, such as shaft stations; first aid, refuge stations; fire and ventilation doors; emergency tents; storage areas; hazard areas.
- Workers may be required to attend additional on-site training regarding fire procedures, evacuation, and/or other emergencies. This may be completed in a classroom setting or computer-based learning.
- Workers must have knowledge regarding ventilation flows, in case of emergency.

Personal Protective Equipment (PPE)

- Leather or rubber safety boots, equipped with metatarsal guards;
- Coveralls, equipped with appropriate reflective markings;
- Belt with fall arrest ring and holster for light battery pack / two-way radio;
- Hard hat;
- Safety glasses;
- Hearing protection, which may include ear plugs and/or ear muffs;
- Gloves;
- Respirator; and
- Additional task specific PPE, such as face shield, specialized hand and forearm protection, self-contained breathing apparatus, etc.

Equipment

- Cap light and battery packs;
- Two-way radios;
- Obtain watch and miners wrench
- Telephones;
- Computer systems;
- Bells, whistles, and horns;
- Signs;
- Mine plans or prints;
- Report logs and writing instruments; and/or
- Any additional equipment required to complete the underground mining tasks.

Section 4: Strength and Positional Requirements

STRENGTH REQUIREMENTS		FREQUENCY	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Lifting/Lowering	Floor to Waist† (0-104cm)	Occasional	2.0-4.5		• Rubber or leather safety boots equipped with metatarsal covers.
	Waist† to Shoulder† (104-137cm)	Occasional	<0.5-8.0		• Cap light with radio (1.5 kg), safety belt (3.0-8.0 kg), telephone receiver (<0.5 kg).
	Floor to Shoulder† (0-137cm)	Never	-		
	Above Shoulder† (>138cm)	Occasional	0.5-1.5		• Hard hat with ear muffs (0.5-1.0 kg), cap light with radio (1.5 kg) from charging station.
Carrying	Unilateral/ Bilateral	Occasional	1.5-2.0		• May carry light pack from charging station ~2-5 m. • Workers may carry mine prints, log books, etc.
Pushing/Pulling (kg of Force)	Vertical	Occasional		~0-22	• Pulling full basket (21.7 kg of force if equipped), containing personal items in the Dry Room. • The rope is secured on an "eye" hook, located at shoulder level. A vertical pull, from overhead, is needed to lower and raise the basket. • Some sites may not have suspended baskets for the Dry's.
	Unilateral	Occasional		~6-8	• Open / close doors to buildings, head frames, change rooms, etc. • Worker has the option of using one or two- hands.
	Bilateral	Occasional		~6-8	

The Frequency Definitions are outlined in Appendix 2.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

† Anthropometrics are based on the 50th percentile male (waist height, standing 106.3±5.4 cm; shoulder height, standing 143.7±6.2 cm) and the 50th percentile female (waist height, standing 101.7±5.0 cm; shoulder height, standing 132.9±5.5 cm); Eastman Kodak Company (1986). *Ergonomic Design for People at Work: Volume 2.* New York: Van Nostrand Reinhold Company.

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY	COMMENTS*
Sitting		Occasional	• May be needed when sitting to don safety shoes, respirator fit testing, inspecting PPE. • Also required during on-site training and pre-shift meetings. Frequency will vary depending on work assignment.
Standing		Occasional	• Inspecting PPE, cap light bulbs, two-way radios, and verifying full charge on battery pack.
Walking		Occasional	• Walking within head frame of mine. Distances will vary depending on mine, building, and area of work. Depending on the mine location, the pre-shift meeting may be conducted underground.
Climbing	**Stairs**	Occasional	• May be required to access change rooms in head frame. This will vary across mine location.
	Ladders	Never	
	Uneven Ground	Occasional	• May be exposed to uneven terrain when walking to different buildings at mine site.
Balancing		Never	
Crawling		Never	
Kneeling		Occasional	• May kneel when donning safety gear
Crouching/Squatting		Occasional	• Donning safety shoes.
Trunk Movements		Occasional	• Partial trunk flexion may be needed when donning safety shoes, coveralls, inspecting PPE.
Neck Movements		Occasional	• Unrestricted neck range of motion in all directions is required. • Static cervical flexion required when inspecting cap light, two-way radio, battery pack, fall restraint, respirator cartridges. • Extension may be needed when tagging in on sign-in board, obtaining cap light / battery pack from top shelves of charging station.
Reaching	**Forward/ Backward**	Occasional	• Complete tag in, access basket and hanging items in Dry room, obtain items from charging station.
	Upper Level	Occasional	• May be required to reach above shoulder level when accessing items from Dry Room, donning respirator, and placing cap light on hard hat. May be required to access the telephone or complete tag in.
	Sideways	Occasional	• May be needed when verifying respirator fit, using the two-way radio or telephone.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS	FREQUENCY	COMMENTS*
Elbow Posture	Occasional	• Pronation needed when obtaining light, two-way radio, and battery pack from charging station.
Wrist Posture	Occasional	• Partial wrist range of motion required when donning PPE.
Gripping	Occasional	• Power grip needed when securing hard hat, cap light, and battery pack. Also required when using telephone, computer mouse.
Pinching	Occasional	• Tip pinch grip required when operating two-way radio, whistles, or writing communication. Key pinch grip needed when holding mine prints/plans while reading.
Fine Finger Dexterity	Occasional	• Needed when inspecting respirator cartridges, donning ear plugs, fall restraint system, gloves. • May also be used when completing any additional on-site classroom or computer based training.
Striking with Hand	Never	
Foot Action	Never	

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 5: Sensory/Mental Requirements

SENSORY/MENTAL REQUIREMENTS		ESSENTIAL		COMMENTS*
		Yes	No	
Vision	Near	X		• Inspecting PPE, tag-in, reviewing mine plans/prints, emergency procedures, on-site classroom or computer based training.
	Far	X		• Peripheral and far vision needed when reading signs, production reports within head frame.
	Colour	X		• Indicator lights on charge stations. Miners also required to read interpretative information presented on mine plans/prints; colour coded signs; recognize traffic, safety, and warning lights.
Light Quality and Measurements		X		• Typical light in head frame is 500-680 Lux. • Primary underground mining tasks require the ability to work in low level light, less than 200 Lux.
Hearing	Conversation	X		• Communicating over two-way radio, telephone, and in-person.
	Other Sounds	X		• Noise from cage bells and alarms. • Hearing protection is mandatory when working underground. Noise levels regularly exceed occupational exposure limits. • Level of noise ranges from 50 dB to 107 dB (heavy equipment operation).
Talking		X		• Conversing with supervisors and/or co-workers.
Reading/Writing		X		• Reviewing mine prints/plans safety training, reports and log books, signs, as well as information on the computer.
Feeling			X	
Judgement/Decision Making		X		• Complete safety inspection of PPE, plan for additional equipment to be transported underground.
Concentration		X		• Required when inspecting PPE, interpreting mine plans/prints.
Alertness		X		• Workers must be alert to workplace hazards, which may include ground conditions, mobile equipment, or power tools. A sense of smell is required to distinguish gas smell, which is pumped into the ventilation lines during fires.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 6: Work Environment

WORK ENVIRONMENT		ESSENTIAL		COMMENTS*
		Yes	No	
Slippery Floors or Ground		X		• Floors may be wet/slippery.
Sloping or Uneven Terrain		X		• May be exposed to uneven terrain when walking to various buildings within the mine site.
Inside Work		X		• Controlled environment.
Outside Work		X		• May be exposed to environmental conditions when walking to various buildings within the mine site.
Extreme Heat/Extreme Cold		X		• Exposure to hot conditions is possible. • Typically ambient temperature is controlled through the use of proper ventilation.
Dry/Humid		X		• Conditions vary depending on task performed and mine site.
Dust (PPE required)		X		• Certain conditions require respirator use
Vapours/Fumes (PPE required)			X	
Chemical Irritants (PPE required)		X		• Type of chemical exposure depends on the material being mined and the mining process.
Noise (PPE required)		X		• Workers are required to wear hearing protect mandatory, and should ensure they have ear plugs and ear muffs prior to going underground.
Moving Objects/Vehicles		X		• May be exposed to mobile equipment when walking around the mine site.
Electrical Hazards			X	
Sharp Tools			X	
Congested/Confined Work Site			X	
Working at Heights			X	
Vibration	Whole Body		X	
	Segmental		X	
Vehicle Operation		X		• May drive to various buildings on mine-site.
Overtime		X		• Voluntary overtime hours may be needed, depending on production requirements.
Shift Work		X		• May be required depending on company policies. Typical shifts are 10- and 12- hours.
Working Alone		X		• Works independent within a group of individuals. Check-in policy mandatory.
Working with Others		X		

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 7: Behavioural/Cognitive Demands

BEHAVIOURAL/COGNITIVE DEMANDS	CDA£ RANKING SCALE				COMMENTS*
	1	2	3	4	
Degree of Self-Supervision Required			X		• Follow-up with supervisor in order to receive work instructions for the day and/or safety issues.
Degree of Supervision Exercised	X				
Deadline Pressures (Time Pressure)			X		• Must be donned in appropriate PPE and have any equipment ready in time for cage schedule when going underground.
Attention to Detail		X			• Inspecting PPE for damage and/or defects, following line-up meeting instructions from supervisor, as well as completing reports, such as safety logs.
Performance of Multiple Tasks Required		X			• Communicating while performing underground mining tasks.
Exposure to Distracting Stimuli			X		• Cage bells in head frame.
Need to Work Co-operatively with Others			X		• Pre-shift meeting, on-site training.
Exposure to Emotional Situations	X				
Exposure to Confrontational Situations	X				
Responsibility and Accountability Required				X	• Responsible for replacing defective or damaged PPE and conveying safety issues to appropriate personnel.
Reading Literacy			X		• Reviewing on-site training documents, safety reports, daily logs, production reports, mine prints/plans. • Required to follow written instructions.
Written Literacy		X			• Completing on-site training.
Numerical Skills		X			• Horn, whistle and bell signals when communicating.
Verbal Communication			X		• Conversational, two-way radio, telephone.
Memory		X			• Signals, signs, colour coding.
Computer Literacy		X			• Basic computer skills may be required.
Shift Work Demands			X		• Rotating shift schedule may be required, depending on company policies. Typical shift durations are 10- and 12- hours.

£ The Cognitive Demands Assessment (CDA) definitions and scale are outlined in Appendix 3.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Underground Miner

Area of Competence: Perform General Inspection

Assessment Report

Minerals Processing Operator
Perform General Inspection — The Assessment Report

Overview

Occupational Domain:	Underground Miner	National Occupational Standard (NOS) Area of Competence:	Perform General Inspection
Hours of Work:	Variable, dependant on mine. May work 10- or 12- hour shifts.	Breaks:	Flexible break schedule; ~1- 1½ hours in total.
Shift Work:	Rotating schedule, which is dependant on the mine site.	National Occupational Classification (NOC) Level of Work:	Medium
Dates of Assessment:	February 17-19, 2009	Evaluators:	Trevor Hawksby, B.Sc. (H.K.), C.K. Charlene Martin, B.Sc. (H.K.), C.K.

Section 1: Detailed Task Description

Performing General Inspection begins at the start of the workday and does not end until the worker leaves, at the end of shift. The general inspection tasks involve hazard identification, safety systems inspection and maintenance/installation, equipment inspection, as well as general housekeeping tasks. All identified hazards are reported and corrective actions are taken in accordance with mine policy and/or government regulations. Overall, this task falls within the Medium strength category, as defined by the National Occupational Classification.

1. Identify and Respond to Workplace Hazards:

Inspection of workplace hazards occurs on a continual basis. Workers are constantly looking for unsafe conditions such as ground conditions and ventilation. If a hazard is identified, the worker is required to install guarding, signs, rope, barriers etc. according to the mine policy and any applicable government regulation. This task requires the ability to walk over uneven terrain, as well as full neck and shoulder range of motion. Medium strength is required for this task.

2. Inspect Ventilation:

Workers are required to ensure that all areas have proper ventilation prior to entering. All vents are inspected for sufficient airflow, and/or damage. Airflow values and the exchange rates will most often be monitored by the supervisors; however this may be the responsibility of the underground miner at some mine sites. This task requires the ability to walk over uneven terrain, as well as full neck and shoulder range of motion. Minimal strength is required for this task.

3. Check Fire Extinguishers:

All fire extinguishers are inspected according to mine policy. If a fire should occur the worker would be required to identify the class of fire and determine if an extinguisher is an appropriate tool to combat the fire. If the fire cannot be contained, the miners are required to evacuate the area and immediately report to a safe room. This task entails the ability to unclamp extinguishers using a hook grip (push force of 9.0 kg), as well as sufficient strength to lift the fire extinguisher (14.5 kg).

4. Practice Good Housekeeping:

This task involves maintaining and cleaning hand or power tools, equipment storage, spill clean-up, and lock-out tag out. This task may involve non-neutral trunk postures and ability to handle all power tools used for mining tasks. It also requires the ability to inspect and maintain jacklegs and stoppers, which weigh up to 51 kg.

Section 2: Workflow

Section 3: Task Objectives and Duties

Overview

General inspection activities involve inspection of hand/power tools and safety systems and/or devices, as part of the mines' safety system. The physical abilities required to complete inspection tasks will vary depending on the subtask being performed.

Essential Tasks

1. **Identify and Respond to Workplace Hazards**
- Workers must be able to indentify present and/or potential hazards within the work environment, and act accordingly.

2. **Inspect Ventilation**
- Due to the nature of the Underground Miner occupation, workers must be able to inspect ventilation and ensure adequate air flow of work area.
- Workers are required to report any deficiencies and take corrective action, according to company policy and government regulations.

3. **Check Fire Extinguishers**
- Workers must be able to determine the type of fire extinguisher, and inspect for damage.

4. **Practice Good Housekeeping**
- Workers are required to maintain a clean work environment.

5. **Inspect Hand and Power Tools**
- Workers are required to perform pre- and post- operational checks on tools and equipment.
- Remove, lock out, and report any damaged equipment.

6. **Evacuate Area in Emergency**
- Workers must have knowledge of refuge stations, routes, and/or emergency tents in underground mine.
- Workers must be able to determine safest escape route and evacuate area, according to company policies.
- Workers must be able to build barricades in safe areas, and have knowledge of compressed air flow.

7. **Recognize/Install Signs and/or Lights**
- Workers must be able to review and comprehend all safety signs and/or symbols.
- Workers must be able to install any safety signs, according to government regulations and company policies.

Personal Protective Equipment (PPE)

- Leather or rubber safety boots, equipped with metatarsal guards;
- Coveralls, equipped with appropriate reflective markings;
- Belt with fall arrest ring and holster for light battery pack/two-way radio;
- Hard hat;
- Safety glasses;
- Hearing protection, which may include ear plugs and/or ear muffs;
- Gloves;
- Respirator; and
- Additional task specific PPE, such as face shield, specialized hand and forearm protection, self-contained breathing apparatus, etc.

Equipment

- Cap light and battery packs, which may be equipped with a two-way radio;
- Safety logs and writing instruments;
- Power tools;
- Hand tools
- Watch and miners wrench;
- Vacuums and other cleaning instruments.

Section 4: Strength and Positional Requirements

STRENGTH REQUIREMENTS		FREQUENCY	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Lifting/ Lowering	Floor to Waist† (0-104cm)	Occasional	2-51		• Parts/supplies (2-30 kg) and tools, such as bolt cutters (6 kg), chain cutters (1.5 kg), for repairing ventilation. • Power tools (2-10 kg), stopper (47 kg), and jackleg (51 kg). • Barricade installation (weights up to 20 kg).
	Waist† to Shoulder† (104-137cm)	Occasional	2-51		• Parts/supplies (2-30 kg) and tools, such as bolt cutters (6 kg), chain cutters (1.5 kg), for repairing ventilation. • Power tools (2-10 kg), fire extinguisher (14.5 kg), stopper (47 kg), jackleg (51 kg). • Barricade installation (weights up to 20 kg).
	Floor to Shoulder† (0-137cm)	Occasional	2-10		• Parts/supplies (2-30 kg) and tools, such as bolt cutters (6 kg), chain cutters (1.5 kg), for repairing ventilation. • Power tools (2-10 kg).
	Above Shoulder† (>138cm)	Occasional	2-30		• Parts/supplies (2-30 kg) and tools, such as bolt cutters (6 kg), chain cutters (1.5 kg), for repairing ventilation. • Installation of signs.
Carrying	Unilateral/ Bilateral	Occasional	2-51		• Carry power tools and parts for repairs stemming from the general inspection tasks.
Pushing/Pulling (kg of Force)	Vertical	Occasional		Negl.-10	• May be required for some repair tasks. • Release pin on fire extinguisher requires a push force of 9.0 kg.
	Unilateral	Occasional		Negl.-10	
	Bilateral	Occasional		Negl.-10	

The Frequency Definitions are outlined in Appendix 2.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

† Anthropometrics are based on the 50th percentile male (waist height, standing 106.3±5.4 cm; shoulder height, standing 143.7±6.2 cm) and the 50th percentile female (waist height, standing 101.7±5.0 cm; shoulder height, standing 132.9±5.5 cm); Eastman Kodak Company (1986). *Ergonomic Design for People at Work: Volume 2.* New York: Van Nostrand Reinhold Company.

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY[£]	COMMENTS*
Sitting		Occasional	• Short periods of sustained sitting may be required when sitting in Personal Carrier, Tram, or heavy equipment to get to work area.
Standing		Occasional-Frequent	• Workers stand when performing general inspection, housekeeping, and installation/repair tasks.
Walking		Occasional-Frequent	• Walking within the mine. Exposure to slippery and uneven terrain when walking. • Distances will vary depending on mine, drift, and area of work. • Sustained distances up to ~1-2 km may be required. Distance walked will be dependent on whether or not a Personal Carrier, Heavy Equipment, or Tram is used to get to the work area.
Climbing	**Stairs**	Occasional	• Climbing on/off Personal Carrier, heavy equipment, or tram to get to the work area, or when transporting supplies/tools to an area requiring installation or repair tasks.
	Ladders	Occasional	• May be required during inspection and repair/maintenance/installation tasks.
	Uneven Ground	Occasional	• Ramps between levels have ~15 degree inclines/declines. • May be required to climb a muckpile.
Balancing		Occasional	• Muck pile, uneven surfaces.
Crawling		Occasional	• Maintenance and repair tasks.
Kneeling		Occasional	• Maintenance and repair tasks.
Crouching/Squatting		Occasional	• May be required during some inspection/maintenance and installation tasks.
Trunk Movements		Occasional	• General inspection and repairs/maintenance stemming from inspection requires non-neutral trunk postures, which may include: full back extension, flexion, side bending and rotation.
Neck Movements		Occasional-Frequent	• Unrestricted range of motion in all directions is required. • Workers frequently have to extend the neck when looking up to perform inspection and repair tasks.
Reaching	**Forward/ Backward**	Occasional	• The ability to reach fully forward and backwards is required and when performing inspection and general repair/maintenance tasks.
	Upper Level	Occasional	• Worker requires the ability to reach fully over head.
	Sideways	Occasional	• Worker requires the ability to reach fully to the side.
Elbow Posture		Occasional	• Full range of motion in the elbow is required.
Wrist Posture		Occasional	• Full wrist range of motion bilaterally is required when performing general maintenance, inspection and repairs tasks.
Gripping		Occasional	• Power grip needed when using hand/power tools, grasping parts and supplies. • Some tasks may require high grip strength.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS	FREQUENCY£	COMMENTS*
Pinching	Occasional	• May be required to use palmar pinch, key pinch to install/uninstall clamps, repair power tools, and use hand tools.
Fine Finger Dexterity	Occasional	• Maintenance and repair tasks.
Striking with Hand	Occasional	• May be required to loosen latches, operate machinery controls, moving parts/ controls during inspection.
Foot Action	Occasional	• Plantar flexion and dorsi flexion required to use the pedal controls while operating mobile equipment. Depending on the vehicle, 7-32 kg of push force is required to depress the foot pedals.

£ The frequencies documented will vary depending on the subtask completed during the general inspection process.
* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 5: Sensory/Mental Requirements

SENSORY/MENTAL REQUIREMENTS		ESSENTIAL		COMMENTS*
		Yes	No	
Vision	**Near**	X		• General inspection and repairs of power tools, reading fire extinguisher gauges, reports and logs.
	Far	X		• Driving Personal Carrier, looking for loose rock/safety concerns.
	Colour		X	
Light Quality and Measurements		X		• Primary underground mining tasks require the ability to work in low level light, less than 200 Lux. • Typical underground working light is 10-15 Lux (single worker with cap light). • Ambient light while operating mobile equipment is ~200 Lux.
Hearing	**Conversation**	X		• Communicating over two-way radio, telephone, and in-person.
	Other Sounds	X		• Machinery, bells, whistles, alarms, and fans. • Hearing protection is mandatory. Noise levels regularly exceed occupational exposure limits. • Level of noise ranges from 50 dB to 107 dB (heavy equipment operation).
Talking		X		• Conversing with the use of hearing protection. Worker may be required to speak loud or shout.
Reading/Writing		X		• Fire extinguisher gauges, mine prints/maps, reports and logs.
Feeling		X		• Maintenance and repair tasks.
Judgement/Decision Making		X		• Communicate safe working conditions.
Concentration		X		• Multi-tasking, operation of power tools or communicating while operating mobile equipment.
Alertness		X		• Workers must be alert to workplace hazards, which may include ground conditions, mobile equipment, or power tools.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 6: Work Environment

WORK ENVIRONMENT		ESSENTIAL		COMMENTS*
		Yes	No	
Slippery Floors or Ground		X		• Wet/muddy ground conditions, unstable footing.
Sloping or Uneven Terrain		X		• Ascending/descending ramps, loose rocks.
Inside Work		X		• Performing work in the underground mine. • Ventilated air environment
Outside Work			X	
Extreme Heat/Extreme Cold		X		• Exposure to hot or cold conditions possible. Workers may be exposed to colder temperatures when working near the surface or a vent or fresh air raise. • Ambient temperature is controlled through the use of proper ventilation.
Dry/Humid		X		• Conditions vary depending on task performed and mine site.
Dust (PPE required)		X		• May be exposed to dust. Workers may be required to wear a respirator.
Vapours/Fumes (PPE required)		X		• From heavy equipment and/or power tools. • In case of fire respirators would be donned.
Chemical Irritants (PPE required)		X		• Chemical exposure when using cleaning solvents, such as degreasers. Chemical exposure will vary across the mine sites.
Noise (PPE required)		X		• Hearing protection is mandatory, depending on the task performed and area within the mine. • Noise levels regularly exceed the occupational exposure limits. • Noise levels 50-107 dB
Moving Objects/Vehicles		X		• Exposure to heavy equipment when walking around the mine.
Electrical Hazards		X		• Damaged power cables
Sharp Tools		X		• Grub hoe, axes, box cutters, and power tools, such as grinders, saws.
Congested/Confined Work Site		X		• Parts of a tunnelling operation or an underground mine (stopes, drifts, ramps, shafts, raises), are designed and constructed specifically for people to carry out work within them. Specific codes and standards and requirements are intended to make the space adequate for the health and safety of workers. However, parts of a tunnel or mine may include confined spaces. Tunnels and mines could also include confined spaces within them, such as bins and tanks.
Working at Heights		X		• Workers may be required to perform work on muckpiles, platforms, scissor lifts, staging.
Vibration	Whole Body	X		• Exposure when operating personal carriers or heavy equipment. The degree and duration of exposure will vary according to the type of equipment, task performed, and mine location. • Vibration frequencies vary from 8-200 Hz
	Segmental	X		• Inspecting and maintaining power tools. The degree and duration of exposure will vary according to the type of equipment, task performed, and mine location. • Vibration frequency ranges from 500-1700 Hz (Stoper 500-1200 Hz; Jackleg 960-1700 Hz). • Jackleg and Stoper accelerations are in the magnitude of 15- 32m/s^2.

Continued...

WORK ENVIRONMENT	ESSENTIAL		COMMENTS*
	Yes	No	
Vehicle Operation	X		• Operate Personal Carriers or heavy equipment when traveling to work area.
Overtime	X		• Voluntary overtime hours may be needed, depending on production requirements.
Shift Work	X		• May be required depending on company policies. Typical shifts are 10- and 12- hours.
Working Alone	X		• Works independent within a group of individuals. Check-in policy mandatory.
Working with Others	X		

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 7: Behavioural/Cognitive Demands

BEHAVIOURAL/COGNITIVE DEMANDS	CDA[£] RANKING SCALE				COMMENTS*
	1	2	3	4	
Degree of Self-Supervision Required			X		• Receive instructions from supervisor during line-up meeting, conducted at start of shift. • May need clarification regarding mine prints/plans, and/or safety issues.
Degree of Supervision Exercised	X				
Deadline Pressures (Time Pressure)				X	• Daily pressures are minimal, however when pressures exist they would be considered to be high. For example part of inspection includes emergency evacuation and identification of the types of fires.
Attention to Detail			X		• Inspection of safety systems (fire extinguishers and ventilation systems) require a significant attention to detail. Mistakes will have serious consequences.
Performance of Multiple Tasks Required		X			• Completing general inspection and/or maintenance/repair duties.
Exposure to Distracting Stimuli				X	• High noise levels, moving equipment, ground conditions.
Need to Work Co-operatively with Others			X		• Light, hand, whistle, horn, and bell signals.
Exposure to Emotional Situations	X				
Exposure to Confrontational Situations	X				
Responsibility and Accountability Required				X	• Responsibility and accountability for maintaining a safe work environment.
Reading Literacy		X			• Reviewing tags, pre- and post- operational reports, safety logs, mine prints/plans.
Written Literacy		X			• Completing pre- and post- operation checks, reports, log books.
Numerical Skills		X			• Horn, whistle and bell signals when communicating.
Verbal Communication			X		• Conversational, two-way radio.
Memory		X			• Signals, signs.
Computer Literacy	X				
Shift Work Demands			X		• Rotating shift schedule may be required, depending on company policies. Typical shift durations are 10- and 12- hours.

[£] The Cognitive Demands Assessment (CDA) definitions and scale are outlined in Appendix 3.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Underground Miner

Area of Competence: Perform General Services

Assessment Report

Minerals Processing Operator
Perform General Services — The Assessment Report

Overview

Occupational Domain:	Underground Miner	National Occupational Standard (NOS) Area of Competence:	Perform General Services
Hours of Work:	Variable, dependant on mine. May work 10- or 12- hour shifts.	Breaks:	Flexible break schedule, ~1- 1½ hours in total.
Shift Work:	Rotating schedule, which is dependant on the mine site.	National Occupational Classification (NOC) Level of Work:	Medium - Heavy
Dates of Assessment:	February 17-19, 2009	Evaluators:	Trevor Hawksby, B.Sc. (H.K.), C.K. Charlene Martin, B.Sc. (H.K.), C.K.

Section 1: Detailed Task Description

The general service tasks involve a variety of different job tasks, such as operating the cage, skip, power or hand tools, as well as installation and maintenance tasks, and consequently, components of the General Services tasks will fall within different strength categories. Workers are required to inspect any tools, equipment, work area, etc. for hazard identification, complete any safety systems inspection, and perform general housekeeping tasks. All identified hazards are reported and corrective actions are taken in accordance with mine policy and/or government regulations.

1. Operate Cage:

The cage tender is responsible for transporting all resources needed to complete the underground mining tasks. This includes all personnel, such as the underground miners, supervisors, contractors, and/or visitors underground. Typically, at the start or end of shifts, the cage is busier transporting staff to and from the appropriate work areas below ground.

Throughout the shift, the cage tender is also required to transport any tools, equipment, and/or supplies, which include explosives and detonators, needed for the underground mining process. This task may require lifting or carrying items (2-51 kg), as well as pushing or pulling tram cars (24-46 kg of force). Any heavy or mobile equipment to be transported underground is dismantled into sections, and secured either within the cage or below the cage, using a pulley system.

Operating the cage requires frequent pushing and pulling (9-17 kg of force), when opening and closing the cage doors. The operator must have unrestricted neck and shoulder range of motion in order to reach overhead to access the cage door when it is in the “open” position. The cage tender is required to frequently communicate with the hoist man, which is predominantly completed using bell signals and a two-way radio. The cage tender is required to reach forward or to the side in order to signal the bell. Depending on size of the bell, 4-17 kg of vertical pull force is needed. The cage tender is also exposed to low grade vibration and jarring when standing in the cage. Standing and walking short distances are required on a frequent to constant basis. The cage tender must be able to adjust vision, as the light variances will alter between light and dark environments when travelling underground. This task falls within the Heavy strength category, as defined by the National Occupational Classification (N.O.C.).

2. Operate Skip:

The skip operator is required to monitor and ensure correct operation of the skip, which transports all mined product to the top of the mine. In some mines, the skip process is automated. The skip operator will visually inspect the crushed material that is transported on the conveyor, in order to ensure there are no tools, parts, such as bolts, etc. that may damage the skip. The skip operator will reach forward and remove the unwanted part. This job entails periods of standing and walking on metal flooring, lifting and carrying items (~5-10 kg), as well as pulling the hopper or ladder cover open (5.2-20.4 kg of force). The operator may also be required to climb a fixed ladder, in order to inspect the skip. Overall, this task falls within the Medium strength category, as defined by the National Occupational Classification (N.O.C.).

3. Handle Materials, Operate Hand or Power Tools:

Workers are required to follow all applicable regulations, policies and procedures, to ensure safety of themselves, their coworkers and the environment. This may entail completing lock-out or tag-out of any equipment or tools that are defective or damaged.

Throughout the underground mining process, workers are also required to handle materials (2-47 kg), or tools (1-51 kg), and transport to the appropriate work area. Depending on the mine, workers may use heavy equipment, such as a scooptram, personal carrier, scissor lift, etc. to transport items to the work area within the underground mine. Workers may be exposed to short durations of vibration when operating the mobile equipment, as well as hand-arm vibration when operating power tools. Workers are required to stand and walk on uneven, slippery, or muddy terrain. Miners required unrestricted neck, shoulder, elbow, and wrist range of motion to operate tools, as

well as significant grip strength. According to the National Occupational Classification (N.O.C.), this task falls within the Heavy strength category.

4. Install/Maintain Air, Water, Ventilation, Communication Lines:

Workers are required to inspect the work area, to determine if scaling is required, and ensure safety. Miners are required to complete any lock-out and shut down tasks, prior to installing or maintaining the air, water, ventilation or communication lines. All vents are inspected for sufficient airflow, and/or damage. Airflow values and the exchange rates will most often be monitored by the supervisors; however this may be the responsibility of the underground miner at some mine sites. This task requires the ability to walk over uneven terrain, work at elevated heights, on a scissor lifts, muck piles, or ladders. Workers are required to wear appropriate fall restraint equipment. Unrestricted neck and shoulder range of motion is required, as these tasks are performed above shoulder level. The hoses, valves, clamps, and ventilation ducts range in weight, from 5.5-47 kg. Workers are required to lift or carry these items; however assistance from a co-worker or the use of heavy equipment may be used when transporting heavier items. Workers will hook sections of the hose or ducts on the hanging devices, to assist with lifting overhead. Significant grip strength may be required for this task. This task falls within the Heavy strength category, as defined by the National Occupational Classification (N.O.C.).

Section 2: Workflow

Section 3: Task Objectives and Duties

Overview

Tasks within the General Services category may involve operating the cage or skip; operating hand and/or power tools; locking out equipment; as well as installing air, ventilation, and/or water lines.

Essential Tasks

1. **Lock Out and Tag Out**
- Workers are required to lock out, and tag any equipment for repair or maintenance, according to government regulations, and/or company policies and procedures.

2. **Operate Cage**
- Workers are required to organize cage operations, which include any pre-operation or pre-start procedures.
- Operate cage, ensuring the cage load is within specified limits. The cage operator must ensure that any loads are secure during transport.
- Transport explosives in cage, ensuring to segregate and separate detonators and explosives, according to government and company requirements.
- Carry out operator maintenance, as needed.

3. **Operate Skip**
- Workers are required to organize skip operations, such as pre-start checks, start-up procedures.
- Operate skip, which entails visual inspection to ensure correct operations. In some operations, the skip processes may be automated.
- Workers are required to remove blockages, as needed, and restore skip operations.
- Conduct end-of-shift activities.

4. **Handle Materials**
- Workers are required to load materials in cage or mobile equipment, transport materials to the designated work area, and unload materials.
- Workers must ensure appropriate personal protective equipment for the tasks.

5. **Operate Hand Tools**
- Workers are required to select and use the appropriate hand tools for the task.

6. **Operate Power Tools**
- Workers are required to select the appropriate power tools, and conduct pre-operational inspection, prior to use.
- Use pneumatically or hydraulically powered hand tools.

7. **Install and Maintain Ventilation Systems**
- Plan and prepare for installation of ventilation systems. Workers are required to assess the work area, in order to determine if additional scaling is needed, identify potential risks and hazards, to ensure safety.
- Workers may be required to install and maintain vents. Isolating and lock-out ventilation devices may be required, prior to disconnecting vents.
- Workers are required to conduct any housekeeping tasks, such as cleaning and storing equipment.

Continued...

8. **Install and Maintain Air, Water, and Drain Line**

- Plan and prepare for the installation of air, water, and drain lines. Workers are required to complete any lock-out and tag-out of equipment, and to dissipate any stored energy in equipment. In addition, workers must complete any pre-operation inspections of equipment, work area, as needed.
- Workers are required to perform appropriate housekeeping tasks.

9. **Extend Electrical and Communication Lines**

- Workers are required to plan and prepare for extension of electrical and communication lines, which includes lock-out or tag out of equipment, dissipating any stored energy, pre-operation checks, etc. Workers are only required to extend the communication lines. Hook-up of the communication lines is completed by qualified personnel.
- Conduct housekeeping duties, as needed.

10. **Extend Fill Lines**

- Workers are required to plan and prepare for extension of fill lines, and take any corrective action, as required.
- Workers are required to complete any housekeeping tasks, such as cleaning and storage of equipment.

Personal Protective Equipment (PPE)

- Leather or rubber safety boots, equipped with metatarsal guards;
- Coveralls, equipped with appropriate reflective markings;
- Belt with fall arrest ring and holster for light battery pack / two-way radio;
- Hard hat;
- Safety glasses;
- Hearing protection, which may include ear plugs and/or ear muffs;
- Gloves;
- Respirator; and
- Additional task specific PPE, such as face shield, specialized hand and forearm protection, self-contained breathing apparatus, etc.

Equipment

- Pneumatically or hydraulically powered tools, such as grinders, saws, reciprocating saws, drills, impact wrenches, jackleg, stoper, etc.;
- Hand tools, such as bolt cutters, chain cutters, sledge hammers, scaling bars, gads, watch and miners wrench, tugger etc;
- Heavy equipment, such as scooptram, trams, to transport materials and equipment to work area;
- Scissor lifts;
- Personal carriers;
- Cage;
- Skip;
- Safety logs and writing instruments.

Section 4: Strength and Positional Requirements

STRENGTH REQUIREMENTS		FREQUENCY£	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Lifting/ Lowering	Floor to Waist† (0-104cm)	Occasional - Frequent	1 - 51		• Parts, supplies, explosives (2-30 kg), pallets (24 kg). • Tools, such as bolt cutters (6 kg), chain cutters (1.5 kg), gad (1.0 kg), hammers (2-3 kg), aluminum or steel scaling bars (2-14 kg), tire iron (2 kg). • Air or water hoses (5.5-13 kg), 2" bow hose (100' roll – 47 kg). A two-person lift or the use of mobile equipment may be used to lift the heavier hose. • Valves and clamps (5-21.5 kg). • Ventilation ducts (12-47 kg), 2" piping (15-30 kg). • Power tools (2-10 kg), stoper (47 kg) and jackleg (51 kg). • Barricade installation (weights up to 20 kg).
	Waist† to Shoulder† (104-137cm)	Occasional - Frequent	1 - 51		• Parts, supplies, explosives (2-30 kg), pallets (24 kg). • Tools, such as bolt cutters (6 kg), chain cutters (1.5 kg), gad (1.0 kg), hammers (2-3 kg), aluminum or steel scaling bars (2-14 kg), tire iron (2 kg). • Air or water hoses (5.5-13 kg), 2" bow hose (100' roll – 47 kg). A two-person lift or the use of mobile equipment may be used to lift the heavier hose. • Valves and clamps (5-21.5 kg). • Ventilation ducts (12-47 kg), 2" piping (15-30 kg). • Power tools (2-10 kg), stoper (47 kg) and jackleg (51 kg). • Barricade installation (weights up to 20 kg).
	Floor to Shoulder† (0-137cm)	Occasional	1.5 - 47		• Parts/supplies (2-30 kg), valves and clamps (5-21.5 kg), and tools, such as bolt cutters (6 kg), chain cutters (1.5 kg) and/ or power tools (2-10 kg), for installing, repairing, or extending ventilation, air, water, and/or communication lines. • Hoses (5.5-47 kg), ventilation ducts (12-47 kg), 2" piping (15-30 kg). A two-person lift or the use of mobile equipment may be used to lift the heavier hose.
	Above Shoulder† (>138cm)	Occasional	1.5 – 21.5		• Parts/supplies (2-30 kg) and tools, such as bolt cutters (6 kg), chain cutters (1.5 kg), for installing, repairing, or extending ventilation, air, water, and/or communication lines. • Valves and clamps (5-21.5 kg). • Workers will secure sections of duct or hoses to overhead hanging devices to assist with lifting overheard.
Carrying	Unilateral / Bilateral	Occasional	1.5 - 47		• Carry power tools, parts, equipment in order to complete the general services tasks. Distance is variable depending on the mine and transport equipment available. Some items may be carried up to 1 km. • Carry or drag hoses (5.5-47 kg) <~10 m, distance will vary depending on the mine site. Miner may obtain assistance from co-worker and use heavy equipment to transport larges hoses or ventilation ducts.

Continued...

STRENGTH REQUIREMENTS		FREQUENCY£	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Pushing/ Pulling (kg of Force)	Vertical	Occasional - Frequent		1 - 18	• Opening and closing the cage door requires a vertical push/pull force of 9.2-17.6 kg. The cage door is manipulated between heights of 50 cm and 203 cm. A sustained push force of 14-18 kg is required when opening the cage door. A one-handed pull force of 0.8-1.2 kg is needed to release the locking pin on the cage door. • The cage tender is also required to use pull 10-50 lb bells when signalling the Hoist man. Depending on the weight of the bell, this requires 4.0 -17.2 kg of pull force.
	Unilateral	Occasional		~3 - 21	• The cage tender will pull the bells when signalling the hoist man (4-17.2 kg of pull force), which is completed with one hand. • Skip operator required to open hopper or ladder cover (pull force of 5.2-20.4 kg). • May be needed to operate steering mechanism or toggle controls on mobile equipment, such as personal carriers or scissor lifts (~3-5 kg), as well as skip controls. • May also be required when installing, maintaining or extending air, water, ventilation, or communication lines.
	Bilateral	Occasional - Frequent		8 - >50kg	• Cage operator is required to open/close the exterior gate to the cage door, which requires a push/pull force of 8.0-10.6 kg. • Cage tender is also required to load trams on and off of the cage, which requires 24-46.2 kg of push/pull force. • Holding onto grab bars and pulling upward when climbing onto heavy or mobile equipment. Bars are located at or above shoulder height (100-150 cm from the ground). For safety reasons, worker must be able to support bodyweight, exert sufficient grip and pull forces. • May be required in order to maintain control of the jackleg or stoper, which may involve significant push forces if the base support slips. Forces may exceed 50 kg. Direction of the push force required to maintain control of the jackleg is based upon the angle and location of the hole being drilled. Forces can be in a combination of horizontal and vertical directions. Workers also need to control the jackleg when it deviates from the vertical plane, which requires a lateral push/pull. • Also needed in order to manipulate the water or air hoses, ventilation ducts, communication lines, during installation or maintenance.

The Frequency Definitions are outlined in Appendix 2.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

† Anthropometrics are based on the 50th percentile male (waist height, standing 106.3±5.4 cm; shoulder height, standing 143.7±6.2 cm) and the 50th percentile female (waist height, standing 101.7±5.0 cm; shoulder height, standing 132.9±5.5 cm); Eastman Kodak Company (1986). *Ergonomic Design for People at Work: Volume 2.* New York: Van Nostrand Reinhold Company.

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY	COMMENTS*
Sitting		Never - Occasional	• May be required when sitting during line-up meetings, conducted at the start of a shift. • Sitting for short durations may also be required when using personal carrier or heavy equipment to travel to work area. Frequency and duration will vary depending on mine location and work assignment. Exposure to low frequency vibration with large peak vertical displacement values when operating mobile equipment on uneven/rough terrain (see vibration values).
Standing		Occasional - Constant	• Standing within the cage when transporting personnel, equipment, and/or supplies underground. Cage tender is exposed to low grade vibration and/or jarring when standing. • Skip operator required to stand when visually monitoring conveyor process. • May also be required during operation of hand/power tools, installing, maintaining air, water, ventilation, or communication lines.
Walking		Occasional - Frequent	• Walking within the mine. Exposure to slippery and uneven terrain when walking. • Distances will vary depending on mine, drift, and area of work. • Sustained distances up to ~1-2 km may be required. Distance walked will be dependent on whether or not a Personal Carrier, Heavy Equipment, or Tram is used to get to the work area.
Climbing	**Stairs**	Occasional	• Climb into heavy equipment, such as the tram, scissor lift, or personal carriers. There are ~3-4 steps in order to access most equipment. Grab bars are available to assist with climbing tasks. • Three-point mount and four-point dismount required.
	Ladders	Occasional	• Skip operator may be required to climb ladder fixed to wall. • Ascending/descending 8' ladder may be required when using scissor lifts.
	Uneven Ground	Occasional	• Ramps and other uneven ground. Ramps between levels have ~15 degree inclines/declines. • May be required to climb a muck pile when scaling.
Balancing		Occasional - Frequent	• Standing within cage. • Worker may be required to balance on a muck pile, climbing ladders when installing, and maintaining overhead ventilation, air, water, or communication lines.
Crawling		Occasional	
Kneeling		Occasional	• Secure loads
Crouching/Squatting		Occasional	• Partial crouch or stoop may be required in order to access tools or equipment from the ground or low levels during installation and maintenance tasks. • May also be used when conducting pre-operational checks on tools or mobile equipment.
Trunk Movements		Occasional	• Partial range of motion in all directions may be needed to complete general service tasks. For example, the skip operator may stoop or bend forward to remove a steel bolt from the conveyor. The cage tender may stoop or slightly bend forward (lumbar flexion) when pushing tram cars onto the cage.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY	COMMENTS*
Neck Movements		Occasional - Frequent	• Unrestricted range of motion in all directions is required. • Workers frequently have to extend the neck when looking up to perform installation and maintenance tasks on the air, water, ventilation, or communication lines, which are located overhead. Cage tender is also required to extend neck when opening, closing cage door. • Neck rotation required when operating skip, and mobile equipment.
Reaching	**Forward/ Backward**	Occasional - Frequent	• Unrestricted shoulder range of motion is needed in order to operate hand and power tools, perform cage tender tasks (pushing/pulling trams, loading equipment into cage, opening/closing gate), operating the skip (50-70 cm reach), and installation or maintenance tasks.
	Upper Level	Occasional - Frequent	• Above shoulder reaching needed when hanging and securing ventilation ducts, tubing; installing and maintaining air, water, or drain lines; as well as extending communication lines. Also required when operating cage. The cage door is manipulated from heights of 50 cm to 203 cm.
	Sideways	Occasional	• Cage tender must reach to side in order to signal bells. Some mobile equipment operation requires reaching 0-50 cm to the side, in order to access the controls.
Elbow Posture		Occasional	• Full range of motion in the elbow is required. Forearm rotation (supinated grip to pronated grip) needed when opening the cage door.
Wrist Posture		Occasional	• Unrestricted wrist range of motion needed when operating hand/power tools, operating cage or skip, and performing general maintenance, inspection, and repairs tasks.
Gripping		Occasional - Frequent	• Power grip needed when using hand/power tools, opening/closing cage door, signalling the bells, grasping parts and supplies. Flat grip needed to open gate door to cage. • Some tasks may require high grip strength.
Pinching		Occasional	• May be required to use key or palmar pinch to operate toggle controls on mobile equipment, use hand or power tools, as well as complete installation and maintenance tasks.
Fine Finger Dexterity		Occasional	• Needed when completing reports, such as pre-operational checks on mobile equipment, log books, shift reports, production reports, and safety system reports.
Striking with Hand		Occasional	• Secure loads • Emergency stops • May be required to loosen latches, operate machinery controls
Foot Action		Occasional	• Operation of pedal controls while operating mobile or heavy equipment. Depending on the vehicle, 7-32 kg of push force is required to depress the foot pedals.

[£] The frequencies documented will vary depending on the subtask completed when performing general services tasks.
* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 5: Sensory/Mental Requirements

SENSORY/MENTAL REQUIREMENTS		ESSENTIAL		COMMENTS*
		Yes	No	
Vision	Near	X		• Inspecting power or hand tools, installing/maintaining overhead hoses and ducts. Also needed when reading pre-operating check lists, log books, shift reports, production reports, or safety system reports.
	Far	X		• Peripheral and far vision needed when operating cage, skip, hand/power tools, and mobile equipment; inspecting ground conditions; as well as completing installation or maintenance tasks on air, water, ventilation or communication lines.
	Colour	X		• Needed when identifying colour coded signs, recognize traffic, safety, and warning lights.
Light Quality and Measurements		X		• Primary underground mining tasks require the ability to work in low level light, less than 200 Lux. Cage operator requires ability to work in varying light. • Typical underground working light is 10-15 Lux (single worker with cap light). • Ambient light while operating mobile equipment is ~200 Lux. • Typical light in head frame is 500-680 Lux.
Hearing	Conversation	X		• Communicating over two-way radio, telephone, and in-person.
	Other Sounds	X		• From bells, machinery, whistles, and alarms. • Hearing protection is mandatory. Noise levels regularly exceed occupational exposure limits. • Level of noise ranges from 50 dB to 107 dB (heavy equipment operation).
Talking		X		• Conversing with the use of hearing protection. Worker may be required to speak loud or shout.
Reading/Writing		X		• Cage and skip operators are required to read, interpret, and clarify shift line-up details, when organizing the operations. Also needed to complete safety reports and daily logs.
Feeling		X		• Signals
Judgement/Decision Making		X		• Required to distinguish between the different bell signals during cage operation. • Communicate safe working conditions.
Concentration		X		• Multi-tasking, monitoring skip, communicating while operating cage, power or hand tools, mobile equipment.
Alertness		X		• Workers must be alert to workplace hazards, which may include ground conditions, mobile equipment, and power or hand tools.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 6: Work Environment

WORK ENVIRONMENT	ESSENTIAL		COMMENTS*
	Yes	No	
Slippery Floors or Ground	X		• Wet/muddy ground conditions.
Sloping or Uneven Terrain	X		• Ascending/descending ramps, loose rocks.
Inside Work	X		• Performing work in the underground mine.
Outside Work		X	
Extreme Heat/Extreme Cold		X	• Exposure to hot or cold conditions possible. Cooler temperatures when working near the surface, or in close proximity to vent or air raises. Typically, ambient temperature is controlled through the use of proper ventilation.
Dry/Humid	X		• Conditions vary depending on task performed and mine site.
Dust (PPE required)	X		• May be exposed to dust scaling, drilling, blasting, spraying shotcrete, etc. when using power or hand tools. Workers are required to wear respirators, when needed • Workers also control dust by spraying the muckpiles with water.
Vapours/Fumes (PPE required)	X		• Completing installation or maintenance tasks on air and ventilation ducts. Underground air ventilation systems are monitored for unsafe conditions. • Also from heavy equipment and/or power tools.
Chemical Irritants (PPE required)	X		• Type of chemical exposure depends on the material being mined and the mining process.
Noise (PPE required)	X		• Hearing protect mandatory, depending on the task performed and area within the mine, for example operating mobile equipment, working near fans. Noise levels regularly exceed the occupational exposure limits. • Noise levels range between 50-107 dB, depending on the heavy equipment.
Moving Objects/Vehicles	X		• Cage, skip conveyor, mobile equipment.
Electrical Hazards	X		• May be exposed when installing and maintaining ventilation or communication lines. Workers are required to dissipate any stored energy in equipment.
Sharp Tools	X		• Grub hoe, axes, box cutters, and power tools, such as grinders, saws.
Congested/Confined Work Site	X		• Parts of a tunnelling operation or an underground mine (stopes, drifts, ramps, shafts, raises), are designed and constructed specifically for people to carry out work within them. Specific codes and standards and requirements are intended to make the space adequate for the health and safety of workers. However, parts of a tunnel or mine may include confined spaces. Tunnels and mines could also include confined spaces within them, such as bins and tanks.

Continued...

WORK ENVIRONMENT		ESSENTIAL		COMMENTS*
		Yes	No	
Working at Heights		X		• Workers may be required to perform work on scissors lifts, ladders, muck piles. Workers are required to wear safety belt with fall arrest ring.
Vibration	**Whole Body**	X		• Cage tender exposed to low grade vibration and jarring when operating cage. • Short duration of exposure when operating mobile equipment, such as personal carriers or scissor lifts. The degree of vibration will vary according to the type of equipment; task performed, and mine location. Vibration ranges from 8-44 Hz.
	Segmental	X		• Exposed when operating power tools. The degree and duration of exposure will vary according to the type of equipment; task performed, and mine location. • Vibration frequency ranges from 500-1700 Hz (Stoper 500-1200 Hz; Jackleg 960-1700 Hz). • Jackleg and Stoper accelerations are in the magnitude of 15- 32m/s^2.
Vehicle Operation		X		• Operate Personal Carriers or heavy equipment when traveling to work area.
Overtime		X		• Voluntary overtime hours may be needed, depending on production requirements.
Shift Work		X		• May be required depending on company policies. Typical shifts are 10- and 12- hours.
Working Alone		X		• Works independent within a group of individuals. Check-in policy mandatory.
Working with Others		X		

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 7: Behavioural/Cognitive Demands

BEHAVIOURAL/ COGNITIVE DEMANDS	CDA[£] RANKING SCALE				COMMENTS*
	1	2	3	4	
Degree of Self-Supervision Required			X		• Receive instructions from supervisor during line-up meeting, conducted at start of shift. • May need clarification regarding mine prints/plans, and/or safety issues.
Degree of Supervision Exercised	X				
Deadline Pressures (Time Pressure)			X		• Cage tender is required for transporting personnel, equipment, and/or supplies underground according to schedule. Skip operations may occur at a designated time each day, in order to ensure efficiency within the underground mining process.
Attention to Detail			X		• Inspection of air, water, ventilation systems require a significant attention to detail. Mistakes will have serious consequences.
Performance of Multiple Tasks Required		X			• Operating cage or skip, completing general service tasks and/or maintenance/ repair duties.
Exposure to Distracting Stimuli				X	• High noise levels, moving equipment, ground conditions.
Need to Work Co-operatively with Others				X	• Cage tender works within close co-operation with hoist man to operate cage. • Light, hand, whistle, horn, and bell signals.
Exposure to Emotional Situations	X				
Exposure to Confrontational Situations	X				
Responsibility and Accountability Required				X	• Cage tender responsible for transporting all items needed for the underground miner process to appropriate level in mine. • Responsibility and accountability for maintaining a safe work environment.
Reading Literacy		X			• Review mine prints/plans during installation and maintenance of air, water, ventilation, or communication lines. • Reviewing tags, pre- and post- operational reports, safety logs, mine prints/plans.
Written Literacy		X			• Completing tag out on equipment, pre- and post- operation checks, reports, log books.
Numerical Skills			X		• Bell signals, horn, or whistle signals when communicating. May be needed during installation of air, water, ventilation, or communication lines.
Verbal Communication			X		• Must be able to effectively communicate end-of-shift information to appropriate personnel, communicate over two-way radio.
Memory			X		• Bell signals, signs.
Computer Literacy	X				
Shift Work Demands			X		• Rotating shift schedule may be required, depending on company policies. Typical shift durations are 10- and 12- hours. Check-in policy mandatory.

[£] The Cognitive Demands Assessment (CDA) definitions and scale are outlined in Appendix 3.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 8: Photographs

Figure 1: Cage Operator

Figure 2: Opening Cage Door

Figure 3: Parts to be Transported Underground by Cage Operator

Figure 4: Skip Operator, Monitoring Conveyor

Underground Miner

Area of Competence: Scale Loose Rock

Assessment Report

Minerals Processing Operator
Scale Loose Rock — The Assessment Report

Overview

Occupational Domain:	Underground Miner	National Occupational Standard (NOS) Area of Competence:	Scale Loose Rock
Hours of Work:	Variable, dependant on mine. May work 10- or 12- hour shifts.	Breaks:	Flexible break schedule; ~1- 1½ hours in total.
Shift Work:	Rotating schedule, which is dependant on the mine site.	National Occupational Classification (NOC) Level of Work:	Heavy
Dates of Assessment:	February 17-19, 2009	Evaluators:	Trevor Hawksby, B.Sc. (H.K.), C.K. Charlene Martin, B.Sc. (H.K.), C.K.

Section 1: Detailed Task Description

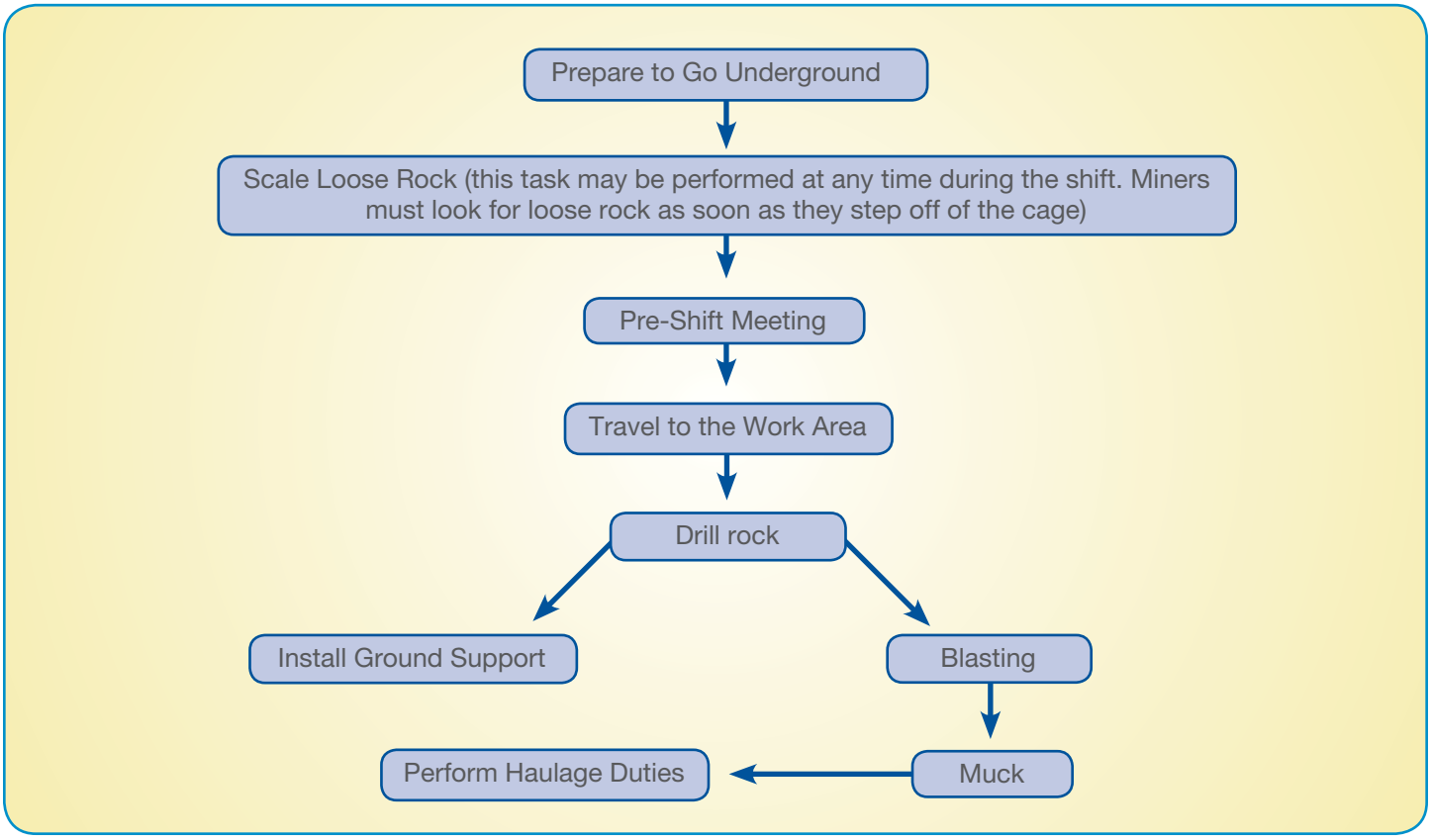
Scaling is the process whereby workers are required to remove loose rock from the walls, faces, or ceilings ("backs") of the drifts. In order to ensure worker safety, the ceilings or "backs" of the drifts are scaled first and then secured with screening and bolts, prior to scaling the walls or faces of the drifts.

Depending on the mine site, workers may travel to the designated work area with the use of mobile equipment, such as personal carriers or scissor lifts. Workers may be exposed to short durations of low grade vibration when sitting. If mobile equipment is not available, workers may be required to walk to the work area. The distance walked would depend on the mine site, drift, and work area. When walking underground, workers are exposed to uneven terrain, which may be slippery or muddy. Workers may also be required to walk up or down ramps in order to access the work area.

1. Scaling Tasks

Workers are required to use a scaling bar, which come in 2' increments ranging from 4' to 14' and weigh ~1-14 kg. One end of the scaling bar is pointed, and used to strike the wall, face, or back of the drift. The miners will listen to the wall sound and determine if the wall is solid or hollow. The opposite end of the scaling bar is used to pry any loose rock from the walls, face, or back of the drift. Workers are required to hold the scaling bar slightly wider than shoulder width apart. One arm will push the bar and the other arm will pull the bar, in order to remove rock. This task requires unrestricted neck and shoulder range of motion, as well as partial back range of motion, specifically flexion and/or rotation. Significant push or pull forces may be required when prying rock from the walls; however workers are encouraged to scale within their physical capabilities. A hammer and gad may also be used for rock that cannot be removed with a scaling bar alone. Overall, this task falls within the Heavy strength category, as defined by the National Occupational Classification (N.O.C.).

Section 2: Workflow



Section 3: Task Objectives and Duties

Overview

Workers are required to remove loose rock from the back, face, and walls of the drifts, using a variety of scaling equipment.

Essential Tasks

1. **Wash Down Area (except soft rock)**

- Inspect the work environment for any potential hazards. Apply appropriate guarding, according to government regulation and company policy, as needed.
- Prior to scaling, workers may be required to wash the rock with hoses, following company procedures.

2. **Recognize loose and/or Abnormal Ground Conditions**

- Workers are required to identify geological structures, as well as visually inspect the rock surface for: cracks, stress, ground movement, drill hole deformation, condition of ground support, floor heaving, tracks shifting, and fresh muck.
- Workers are required to listen for any rock noises, such as air blast, snapping, or popping.
- Workers may need to refer to the log book/ground control for history and determine corrective action, as needed.
- Apply appropriate guarding, according to government regulation and company policy.

3. **Recognize Faulty Ground Support**

- Workers are required to determine when abnormal conditions are present. This entails visual inspection of area, as well as listening for rock noises.
- Workers should be able to identify the types of ground support systems and determine any abnormalities.
- Scale any loose rocks, recondition, guard area, and report any deficiencies according to government legislation and company policy.

4. **Scale Rock**

- Obtain the appropriate scaling bar and inspect for wear. Discard any bent or chipped bars.
- Turn off any noisy equipment in the area to be scaled, as the worker must be able to distinguish ground sounds.
- Use the scaling bar to remove loose rock. Workers should hold the scaling bar slightly wider than shoulder width apart; ensure appropriate footing, and clearance when scaling.
- Workers are required to push the scaling bar with one arm and pull with the other when removing loose rock. On occasion, a hammer is used to wedge a gad when removing stubborn rocks.
- On occasion, the workers may use scissor lifts or level a much pile when scaling the back.

Continued...

Personal Protective Equipment (PPE)

- Leather or rubber safety boots, equipped with metatarsal guards;
- Coveralls, equipped with appropriate reflective markings;
- Belt with fall arrest ring and holster for light battery pack / two-way radio;
- Hard hat;
- Safety glasses;
- Hearing protection, which may include ear plugs and/or ear muffs;
- Gloves;
- Respirator; and
- Additional task specific PPE, such as face shield, specialized hand and forearm protection, self-contained breathing apparatus, etc.

Equipment

- Cap light and battery packs, which may be equipped with two-way radio;
- Hoses;
- Hammer and gad;
- Watch and miners wrench;
- Aluminum or steel scaling bars;
- Personal carriers; and/or
- Scissor lifts.

Section 4: Strength and Positional Requirements

STRENGTH REQUIREMENTS		FREQUENCY	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Lifting/Lowering	Floor to Waist† (0-104cm)	Occasional	1-10		• Various tools used for scaling, such as a gad (1.0 kg), hammer (2.0-3.0 kg), ½" water hoses (5.5-10.0 kg).
	Waist† to Shoulder† (104-137cm)	Frequent	<0.5-14		• Aluminum (14' scale bar- 3.0 kg) or steel (2 kg-14 kg) scaling bars, which come in 2' increments from 4' to 14'. • May also lift ½" water hoses (5.5-10.0 kg), in order to control dust.
	Floor to Shoulder† (0-137cm)	Occasional	<0.5-14		• Aluminum (14' scale bar- 3.0 kg) or steel (2 kg-14 kg) scaling bars, which come in 2' increments from 4 to 14'.
	Above Shoulder† (>138cm)	Occasional	2 -14		• Aluminum (14' scale bar- 3.0 kg) or steel (2 kg-14 kg) scaling bars, which come in 2' increments from 4' to 14'.
Carrying	Unilateral/ Bilateral	Occasional	1-14		• Carry tools for scaling (1.0-14.0 kg); worker has the option of one or two hands. Distance is variable depending on the mine and transport equipment available. Some items may be carried up to 1 km. • Carry or drag water hoses (5.5-10.0 kg) <~10 m, distance will vary depending on the mine site. Miner may use one or two hands.

Continued...

STRENGTH REQUIREMENTS		FREQUENCY	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Pushing/Pulling (kg of Force)	Vertical	Occasional - Frequent		~10-20+	• Required when using scale bars to pry rock from the back. Miners are required to push with one arm, and pull with the other arm when scaling. • Scaling tasks involve pushing/pulling forces, which will vary depending on worker capability and the type of material being moved. May require and/or exceed forces of ~20+ kg to scale rock. Depending on the area the worker is scaling, forces may occur in a combination of horizontal and vertical directions.
	Unilateral	Occasional		~3-5	• May be needed to operate steering mechanism or toggle controls on mobile equipment, such as personal carriers or scissor lifts.
	Bilateral	Frequent		~10-20+	• Required when using scale bars to pry rock from the walls. Miners are required to push with one arm, and pull with the other arm when scaling. • Scaling tasks involve pushing/pulling forces, which will vary depending on worker capability and the type of material being moved. May require and/or exceed forces of ~20+ kg to scale rock. Depending on the area the worker is scaling, forces can occur in a combination of horizontal and vertical directions. • Also needed in order to manipulate the water hoses, when spraying the muckpiles, to control dust.

The Frequency Definitions are outlined in Appendix 2.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

† Anthropometrics are based on the 50th percentile male (waist height, standing 106.3±5.4 cm; shoulder height, standing 143.7±6.2 cm) and the 50th percentile female (waist height, standing 101.7±5.0 cm; shoulder height, standing 132.9±5.5 cm); Eastman Kodak Company (1986). *Ergonomic Design for People at Work: Volume 2.* New York: Van Nostrand Reinhold Company.

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY	COMMENTS*
Sitting		Never - Occasional	• May be required when sitting during line-up meetings, conducted at the start of a shift. • Sitting for short durations may also be required when using personal carrier to travel to work area. Frequency and duration will vary depending on mine location and work assignment. Exposure to low frequency vibration with large peak vertical displacement values when operating personal carriers on uneven/rough terrain (see vibration values).
Standing		Frequent	• Weight-shifting and side-stepping needed when prying rock with the scaling equipment.
Walking		Occasional - Frequent	• Walking within the mine, to obtaining scaling bars, and other equipment. Exposure to uneven or slippery terrain when walking underground. • The distance and frequency walked will vary depending on the drift, work area, and mine site. Sustained distances up to ~1-2 km may be required. Distance walked will be dependent on whether or not a personal carrier is used to get to the work area.
Climbing	**Stairs**	Occasional	• Metal steps in order to climb into the scissor lift, which are located 46 and 79 cm high. The worker is required to climb three additional steps in order to access platform. Grab bars are available to assist with climbing tasks. • Mount dismount.
	Ladders	Occasional	• Ascending/descending ladder may be required when using scissor lifts.
	Uneven Ground	Occasional	• Ramps and other uneven ground. Ramps between levels have ~15 degree inclines/declines. • May be required to climb a muck pile when scaling.
Balancing		Occasional	• Worker may be required to balance on a muck pile when scaling the back of the drift.
Crawling		Never	
Kneeling		Never	
Crouching/Squatting		Occasional	• Partial crouch or stoop may be required in order to access gad, hammers, or hoses, from the ground or low levels. • May also be used when conducting pre-operational checks on personal carriers.
Trunk Movements		Occasional	• Partial range of motion in all directions may be needed to complete scaling tasks. For example, the miner may stoop or slightly bend forward (lumbar flexion), and/or rotate the spine, in order to pry rock from the walls.
Neck Movements		Occasional	• Unrestricted neck range of motion in all directions is required. • Static cervical flexion and rotation are required when using the scaling bars to pry rocks from the walls of drifts. • Extension is required when looking up to scale higher levels or the backs of the drifts.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY	COMMENTS*
Reaching	**Forward/ Backward**	Frequent	• Unrestricted shoulder range of motion is required when scaling. Miners are required to reach forward with both arms in order to pry rock from the walls or faces of the drift. • May also be needed when operating personal carriers or scissor lifts. Controls are typically located 100-125 cm above the floor of the vehicle, and require a horizontal reach distance of 0-55 cm.
	Upper Level	Occasional	• Workers are required to reach above shoulder level with one arm when scaling the back or ceiling of the drifts. • May also be required in order to access grab bars on scissor lifts, which are 110 and 155 cm high.
	Sideways	Occasional	• Workers are required to hold the scaling bar slightly wider than shoulder width. This requires slight shoulder abduction when scaling. • Some mobile equipment operation requires reaching 0-50 cm to the side, in order to access the controls.
Elbow Posture		Frequent	• Miners are required to hold the scaling bar, with one hand in a pronated position and one hand in a supinated position. • May also be used when operating mobile equipment.
Wrist Posture		Occasional-Frequent	• Slight extension and flexion needed when using scaling bars to pry rock.
Gripping		Frequent	• Power grip needed in order to hold onto the scaling bars, hammers, or gads. A 3” grip span is required to hold the scaling bars. • May also be used when operating personal carriers or scissor lifts.
Pinching		Occasional	• Key or palmar pinch required to operate toggle controls on scissor lift.
Fine Finger Movements		Occasional	• Needed when completing reports, such as pre-operational checks on mobile equipment, log books, shift reports, production reports, and safety system reports.
Striking with Hand		Occasional	• May be required to loosen latches, operate machinery controls
Foot Action		Occasional	• Operation of pedal controls while operating mobile equipment, such as personal carriers or scissor lifts. Depending on the vehicle, 7-16 kg of push force is required to depress the foot pedals.

£ The frequencies documented will vary depending on the work location within the mine site and the transportation method used to travel to the work area.
* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 5: Sensory/Mental Requirements

SENSORY/MENTAL REQUIREMENTS		ESSENTIAL		COMMENTS*
		Yes	No	
Vision	Near	X		• Inspecting walls and face of drifts when scaling. Also needed when reading pre-operating check lists, log books, shift reports, production reports, or safety system reports.
	Far	X		• Peripheral and far vision needed when inspecting ground conditions, as well as operating mobile equipment, such as personal carriers or scissor lifts.
	Colour	X		• Required when watching or reading the ground for loose conditions when scaling. Also needed when identifying colour coded signs; recognize traffic, safety, and warning lights.
Light Quality and Measurements		X		• Primary underground mining tasks require the ability to work in low level light, less than 200 Lux. • Typical underground working light is 10-15 Lux (single worker with cap light). • Ambient light while operating mobile equipment is ~200 Lux.
Hearing	Conversation	X		• Communicating over two-way radio, telephone, and in-person.
	Other Sounds	X		• Workers are required to distinguish between the sounds (hollow/dull or high pitch ring) from the walls, faces, or backs of drifts when scaling. Any loud equipment must be turned off in order for worker to complete scaling tasks. • Within the underground mine, workers are also exposed to noise from machinery, fans, radios, bells, whistles, and alarms. Hearing protection is mandatory when operating mobile equipment, as noise levels regularly exceed occupational exposure limits. • Level of noise ranges from 50 dB to 107 dB (heavy equipment operation).
Talking		X		• Conversing with the use of hearing protection. Worker may be required to speak loud or shout.
Reading/Writing		X		• Pre-operational checklists and production reports.
Feeling		X		• Vibration
Judgement/Decision Making		X		• Required to distinguish between the different wall sounds, in order to determine areas for scaling. • Communicate safe working conditions.
Concentration		X		• Listening to wall sounds when scaling. • Multi-tasking, communicating while operating mobile equipment.
Alertness		X		• Workers must be alert to workplace hazards, which may include ground conditions, mobile equipment.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 6: Work Environment

WORK ENVIRONMENT		ESSENTIAL		COMMENTS*
		Yes	No	
Slippery Floors or Ground		X		• Wet/muddy ground conditions.
Sloping or Uneven Terrain		X		• Ascending/descending ramps, loose rocks.
Inside Work		X		• Performing work in the underground mine.
Outside Work			X	
Extreme Heat/Extreme Cold		X		• Exposure to hot or cold conditions possible. Cooler temperatures when working near the surface, or in close proximity to vent or air raises. Typically, ambient temperature is controlled through the use of proper ventilation.
Dry/Humid		X		• Conditions vary depending on task performed and mine site.
Dust (PPE required)		X		• May be exposed to dust when scaling. Workers are required to wear respirators when needed. • Workers also control dust by spraying the muckpile with water.
Vapours/Fumes (PPE required)		X		• From heavy equipment and/or power tools. Underground air ventilation systems are monitored for unsafe conditions.
Chemical Irritants (PPE required)		X		• Type of chemical exposure depends on the material being mined and the mining process.
Noise (PPE required)		X		• Workers are required to turn off all loud equipment when scaling, in order to distinguish wall sounds, which are up to 85 dB when scaling. • Hearing protect mandatory, depending on the task performed and area within the mine, for example operating mobile equipment, walking near fans. Noise levels regularly exceed the occupational exposure limits. • Noise levels range between 50-107 dB, depending on the heavy equipment.
Moving Objects/Vehicles		X		• Falling rock when scaling. Mobile equipment within mine site.
Electrical Hazards			X	
Sharp Tools			X	
Congested/Confined Work Site			X	
Working at Heights		X		• Workers may be required to perform work on scissors lifts, ladders, muck piles. Workers are required to wear safety belt with fall arrest ring.
Vibration	Whole Body	X		• Short duration of exposure when operating mobile equipment, such as personal carriers or scissor lifts. The degree of vibration will vary according to the type of equipment, task performed, and mine location. Vibration ranges from 8-44 Hz.
	Segmental	X		• May be exposed to jarring when striking the rock with the scaling bars.

Continued...

WORK ENVIRONMENT	ESSENTIAL		COMMENTS*
	Yes	No	
Vehicle Operation	X		• Required to communicate with co-workers when operating mobile equipment.
Overtime	X		• Voluntary overtime hours may be needed, depending on production requirements.
Shift Work	X		• May be required depending on company policies. Typical shifts are 10- and 12- hours.
Working Alone	X		• Works independent within a group of individuals. Check-in policy mandatory.
Working with Others	X		

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 7: Behavioural/Cognitive Demands

BEHAVIOURAL/COGNITIVE DEMANDS	CDA£ RANKING SCALE				COMMENTS*
	1	2	3	4	
Degree of Self-Supervision Required			X		• Instructions from supervisor during line-up meeting, which is conducted at start of shift. • May need clarification regarding mine prints/plans, and/or safety issues.
Degree of Supervision Exercised	X				
Deadline Pressures (Time Pressure)			X		• Daily, weekly, and month production targets.
Attention to Detail			X		• Reviewing ground conditions and determining status when scaling. • Reviewing mine prints/plans, completing reports, such as safety, shift report, daily log.
Performance of Multiple Tasks Required		X			• Listening to wall sounds while scaling. Communicating while performing underground mining tasks, such as mobile equipment operation.
Exposure to Distracting Stimuli				X	• Falling rock when scaling, high noise levels within mine, moving equipment.
Need to Work Co-operatively With Others			X		• Light, hand, whistle, horn, and bell signals.
Exposure to Emotional Situations	X				
Exposure to Confrontational Situations	X				
Responsibility and Accountability Required				X	• Responsibility and accountability for maintaining a safe work environment, as well as the hazards associated with scaling, ground conditions, and falling rock.
Reading Literacy		X			• Reviewing reports, such as pre-operational checks, safety, daily logs, production reports, mine prints/plans. • Required to follow written instructions.
Written Literacy		X			• Completing reports, log books, and pre-operation checks.
Numerical Skills		X			• Horn, whistle and bell signals when communicating.
Verbal Communication			X		• Conversational, two-way radio, telephone.
Memory		X			• Wall sounds, signals, signs, colour coding.
Computer Literacy	X				
Shift Work Demands			X		• Rotating shift schedule may be required, depending on company policies. Typical shift durations are 10- and 12- hours.

£ The Cognitive Demands Assessment (CDA) definitions and scale are outlined in Appendix 3.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 8: Photographs

Figure 1: Scaling Wall of a Drift

Figure 2: Scaling the Back of a Drift

Underground Miner

Area of Competence: Install Staging

Assessment Report

Minerals Processing Operator
Install Staging — The Assessment Report

Overview

Occupational Domain:	Underground Miner	National Occupational Standard (NOS) Area of Competence:	Install Staging
Hours of Work:	Variable, dependant on mine. May work 10- or 12- hour shifts.	Breaks:	Flexible break schedule; ~1- 1½ hours in total.
Shift Work:	Rotating schedule, which is dependant on the mine site.	National Occupational Classification (NOC) Level of Work:	Heavy
Dates of Assessment:	Not applicable: Data obtained from research May 2009	Evaluators:	Trevor Hawksby, B.Sc. (H.K.), C.K. Charlene Martin, B.Sc. (H.K.), C.K.

Section 1: Detailed Task Description

Staging is required whenever workers are required to work at heights, however it may not be required in mines that can accommodate mechanical lifting devices such as scissor lifts. This task falls within the Heavy strength category, as defined by the National Occupational Classification (N.O.C.).

1. Plan for Staging

The workers are required to read and interpret mine prints and standards and to recognize situations where staging installation is required. The workers need to be familiar with the different types of staging and their indications for use. Once the location, type of staging and the ground conditions are determined, the miner chooses the correct materials and tools to construct the staging.

2. Inspect and Construct Staging

Once the workers select and transport the staging materials to the location, the miner inspects all materials for defects. Any defective product is not used. Once the miner determines the type of staging required and the construction location, the worker selects the proper tools and equipment (e.g. Drill, hammer, Jack leg, wrenches, parts and ladders). The worker then begins to construct or place the staging. Materials are stored at the staging site until they are no longer required.

3. Inspect and Construct Mechanical Staging

Prior to the construction of any staging, the miner is required to determine if any hazardous or potentially hazardous conditions exist. If a hazard is identified, it will be controlled or removed using an accepted method prior to construction of the staging.

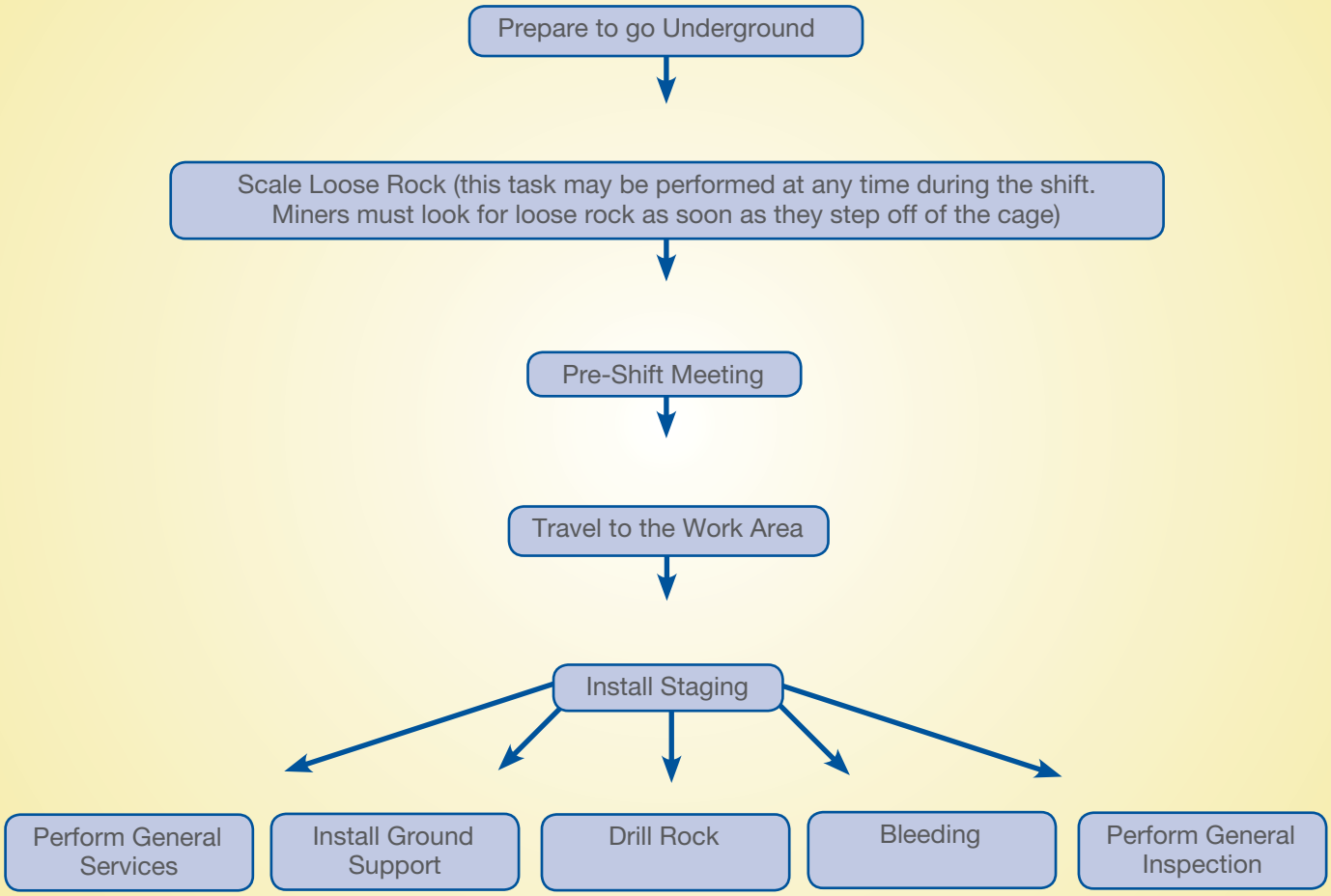
Once the site is cleared for potential hazards, the equipment used to construct the staging will be set-up and the staging will be constructed.

4. Remove Staging

Prior to removing the staging, the miner is required to determine if any hazardous or potentially hazardous conditions exist. If a hazard is identified, it will be controlled or removed using an accepted method prior to removing the staging.

Once the site is cleared for potential hazards the staging will be dismantled and transferred to a storage location.

Section 2: Workflow



Section 3: Task Objectives and Duties

Overview

Installation of staging is required when the work being performed requires the worker to work above the bench of the mine. Staging is constructed/installed according to mine policy and applicable legislation.

Essential Tasks

1. **Plan for Staging**
- Check mine prints and standards
- Determine type of staging required
- Select the required tools based on the type of staging and company standards

2. **Inspect and Construct Wooden Staging**
- Determine required timber and materials
- Store materials and timber in the staging area
- Select the required tools
- Select ladders
- Install ladders
- Inspect and maintain ladders
- Determine hazardous or potentially hazardous materials
- Construct or place staging

3. **Inspect and Construct Steel Staging**
- Determine hazardous or potentially hazardous conditions
- Construct or place steel staging

4. **Inspect and Construct Mechanical Staging**
- Determine hazardous or potentially hazardous conditions
- Set-up equipment

5. **Remove Staging**
- Determine hazardous or potentially hazardous conditions
- Dismantle staging
- Move and store staging

Continued...

Personal Protective Equipment (PPE)

- Leather or rubber safety boots, equipped with metatarsal guards;
- Coveralls, equipped with appropriate reflective markings;
- Belt with fall arrest ring and holster for light battery pack / two-way radio;
- Hard hat;
- Miners wrench and stopwatch
- Safety glasses;
- Hearing protection, which may include ear plugs and/or ear muffs;
- Gloves;
- Respirator; and
- Additional task specific PPE, such as face shield, specialized hand and forearm protection, self-contained breathing apparatus, etc.

Equipment

- Cap light and battery packs, which may be equipped with a two-way radio; and
- Jackleg;
- Hand tools and portable power tools (saws, drills, pneumatic wrenches etc.)
- Watch and miners wrench;
- Sledge hammer 4 and 6 lb;
- Scissor lifts;
- Staging supplies (steel beams, lumber, bolts, plywood sheets, rebar etc.);

Section 4: Strength and Positional Requirements

STRENGTH REQUIREMENTS		FREQUENCY	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Lifting/ Lowering	Floor to Waist† (0-104cm)	Occasional	2 - 51		• May be required to pick up the jackleg (51 kg) from the ground. Also required to pick-up drill bits for jack leg (2 -12 kg). • Jackleg may be lifted and carried on the shoulder. • Sledge hammer (2-3 kg), rebar (5-pack of rebar - 27 kg) • Lifting parts, supplies, timbers, ladders, power tools, scaffolding parts, beams, platforms, ladders etc. • Manipulation of beams, scaffolding parts may be required (lengths up to 18').
	Waist† to Shoulder† (104-137cm)	Occasional	2-51		• May be required to pick up the jackleg (51 kg) onto transport vehicles or scissor lifts for drilling holes in the raise. Also required to pick-up drill bits for jack leg (2 -12 kg). • Jackleg may be lifted and carried on the shoulder. • Sledge hammer (2-3 kg), rebar (5-pack of rebar - 27 kg) • Lifting parts, supplies, timbers, ladders, power tools, scaffolding parts, beams, platforms, ladders etc. • Manipulation of beams, scaffolding parts may be required (lengths up to 18').
	Floor to Shoulder† (0-137cm)	Occasional	2-20+		• Drill bits for jackleg (2-12 kg), screen (9 kg). • Lifting parts, supplies, timbers, ladders, power tools etc. • Manipulation of beams, scaffolding parts may be required (lengths up to 18').
	Above Shoulder† (>138cm)	Occasional	2-20+		• Drill bits for jackleg (2-12 kg), screen (9 kg). • Lifting parts, supplies, timbers, ladders, power tools etc. • Some staging platforms may be installed overhead • May have to perform sustained lifting of parts overhead during installation of staging components. • Manipulation of beams, scaffolding parts may be required (lengths up to 18').

Continued...

STRENGTH REQUIREMENTS		FREQUENCY	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Carrying	Unilateral/ Bilateral	Occasional	1.5-51		• Jackleg (51 kg) may be carried on the shoulder (three-point contact). • Carry sledge hammer, drill bits, timbers, scaffolding parts, wood platforms, rebar (5-pack of rebar - 27 kg), a minimum of ~3-5 m. The distance will vary depending on the mine site, work area, and transport equipment available. Items weighing <20kg may be carried up to 1 km.
Pushing/ Pulling (kg of Force)	Vertical	Occasional		Negl-20+	• Bolts, clamps, pushing on power tools during staging installation.
	Unilateral	Occasional		Negl-20+	• Various installation tasks may involve pushing pulling with one arm • Pushing forces exceeding 20kg may be encountered when pushing on power tools, the jackleg, or pushing on parts during staging installations
	Bilateral	Occasional		Negl.-50+	• Maintain control of the jackleg, which may involve significant push forces if the base support slips. Forces may exceed 50 kg. Direction of the push force required to maintain control of the jackleg is based upon the angle and location of the hole being drilled. Forces can be in a combination of horizontal and vertical directions. • Workers also need to control the jackleg when it deviates from the vertical plane, which requires a lateral push/pull.

The Frequency Definitions are outlined in Appendix 2.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

† Anthropometrics are based on the 50th percentile male (waist height, standing 106.3±5.4 cm; shoulder height, standing 143.7±6.2 cm) and the 50th percentile female (waist height, standing 101.7±5.0 cm; shoulder height, standing 132.9±5.5 cm); Eastman Kodak Company (1986). *Ergonomic Design for People at Work: Volume 2.* New York: Van Nostrand Reinhold Company.

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY£	COMMENTS*
Sitting		Never-Occasional	• May sit when transporting supplies or when using a personal carrier to travel to the work area.
Standing		Frequent	• A majority of staging installation occurs when standing on the bench, platforms or on ladders. • If using the jackleg or if holding parts overhead, the worker may need to assume a wider base of support (lunging position).
Walking		Frequent	• Needed when obtaining equipment/supplies, and getting to the work area. • Distances will vary depending on mine, drift, and area of work. • Sustained distances up to ~1-2 km may be required. Distance walked will be dependent on whether or not a personal carrier or heavy equipment is used to get to the work area. Exposure to slippery and uneven terrain when walking.
Climbing	**Stairs**	Occasional	• Typical step heights are ~40-50 cm (may have multiple steps per vehicle). • Metal steps in order to climb into the scissor lift, which are located 46 and 79 cm high. The worker is required to climb three additional steps in order to access platform. • Grab bars are available to assist with climbing tasks onto machinery.
	Ladders	Occasional	• May use ladders or step ladders to install staging • May climb scaffolding of varying heights. Ability to climb non-standard/non-uniform step heights is required.
	Uneven Ground	Occasional	• The worker walks on ramps and other uneven ground including muck piles. Ramps between levels have ~15 degree inclines/declines.
Balancing		Occasional	• The worker is subjected to rapid changes in directional forces when operating the jackleg. The worker requires balance in order to maintain control of the machinery. • Walking on muck piles safely
Crawling		Occasional	• May be required to crawl during staging construction or small areas to install staging materials
Kneeling		Occasional	• May be required to kneel during staging construction
Crouching/Squatting		Occasional	• The worker is required to partially squat/lunge and rest the jackleg against the forward leg. • May be required to pick-up the jack leg, drill bits, equipment and supplies etc. from the bench.
Trunk Movements		Occasional	• Full range of motion in all directions is required for staging tasks. Staging installation requires non-neutral back postures and all positions (extension, flexion, side bending and rotation may be required)
Neck Movements		Occasional	• Unrestricted range of motion required when manipulating and using power/hand tools • Full neck extension is needed when looking up to install staging overhead.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY	COMMENTS*
Reaching	**Forward/ Backward**	Frequent	• Unrestricted bilateral shoulder range of motion is required • Reaching behind the body may be required to operate machinery.
	Upper Level	Frequent	• Upper level reach is required to safely climb on to the scaffolding, or equipment. The miner may be required to support their body weight with their upper extremities when climbing. • Miners are required to reach and lift objects overhead during staging installation.
	Sideways	Occasional	• Full range of motion is required.
Elbow Posture		Occasional	• Full range of motion in all directions is required.
Wrist Posture		Occasional	• Full range of motion in all directions is required.
Gripping		Occasional	• High grip strength is required to operate hand/power tools and to install staging. The worker must maintain high grip forces while wearing rubber gloves, and is subjected to high frequency hand-arm vibration during power tool and Jack leg use.
Pinching		Occasional	• Key/palmar grip required when operating equipment.
Fine Finger Dexterity		Occasional	• May be required to complete pre-operational inspection reports.
Striking with Hand		Occasional	• Jackleg may kick back into the workers supporting hand. • May be required to operate machinery controls
Foot Action		Occasional	• Operation of the pedal controls while operating mobile equipment. • Operation of the gas and brake on heavy equipment requires ~20-27 kg force to depress pedals.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 5: Sensory/Mental Requirements

SENSORY/MENTAL REQUIREMENTS		ESSENTIAL		COMMENTS*
		Yes	No	
Vision	Near	X		• Reading drilling plans, pre-operational checklists, ground support patterns.
	Far	X		• Driving heavy machinery.
	Colour		X	
Light Quality and Measurements		X		• Primary underground mining tasks require the ability to work in low level light, less than 200 Lux. • Typical underground working light is 10-15 Lux (single worker with cap light). • Ambient light while operating mobile equipment is ~200 Lux.
Hearing	Conversation	X		• Communicating over two-way radio, telephone, and in-person.
	Other Sounds	X		• Machinery, bells, whistles, and alarms. • Hearing protection is mandatory. Noise levels regularly exceed occupational exposure limits. • Level of noise ranges from 50 dB to 107 dB (heavy equipment operation). • Noise protection is mandatory when operating the Shotcrete machine, Maclean Bolter, jackleg.
Talking		X		• Conversing with the use of hearing protection. Worker may be required to speak loud or shout.
Reading/Writing		X		• Pre-operational checklists and production reports.
Feeling			X	
Judgement/Decision Making		X		• Communicate safe working conditions.
Concentration		X		• Multi-tasking, communicating while operating mobile equipment. • Machinery operation
Alertness		X		• Workers must be alert to workplace hazards, which may include ground conditions, heavy equipment, or power tools.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 6: Work Environment

WORK ENVIRONMENT	ESSENTIAL		COMMENTS*
	Yes	No	
Slippery Floors or Ground	X		• Wet/muddy ground conditions.
Sloping or Uneven Terrain	X		• Ascending/descending ramps, loose rocks.
Inside Work	X		• Performing work in the underground mine. Ventilated air environment.
Outside Work		X	
Extreme Heat/Extreme Cold	X		• Exposure to hot or cold conditions possible. Cooler temperatures when working near the surface, or in close proximity to vent or air raises. Typically, ambient temperature is controlled through the use of proper ventilation.
Dry/Humid	X		• Conditions vary depending on task performed and mine site. • Frequent exposure to wet conditions
Dust (PPE required)	X		• May be exposed to dust. Workers may be required to wear a respirator in some areas of mine development and production.
Vapours/Fumes (PPE required)	X		• From heavy equipment and/or power tools. Underground air quality and exchange rates are regularly monitored.
Chemical Irritants (PPE required)	X		• Type of chemical exposure depends on the material being mined and the mining process.
Noise (PPE required)	X		• Hearing protection is mandatory, depending on the task performed and area within the mine... Noise levels regularly exceed the occupational exposure limits. • Noise levels range between 50-107 dB
Moving Objects/Vehicles	X		• Heavy machinery when walking in the mine.
Electrical Hazards		X	
Sharp Tools	X		• Box cutters, bolt cutters, drills, power tools etc.
Congested/Confined Work Site		X	
Working at Heights	X		• Workers may be required to perform work on muck piles, ladders, scissor lifts, staging. • Workers are required to wear safety belt with fall arrest ring when working at heights.

Continued...

WORK ENVIRONMENT		ESSENTIAL		COMMENTS*
		Yes	No	
Vibration	**Whole Body**	X		• Exposure when operating heavy equipment, such as personal carrier. The degree/duration of exposure will vary according to the type of equipment; task performed, and mine location. Vibration frequencies vary from 8-44 Hz (Personal carrier 8-44 Hz).
	Segmental		X	• Operation of power tools (drills, saws, jack leg)
Vehicle Operation		X		• Operate Personal Carriers.
Overtime		X		• Voluntary overtime hours may be needed, depending on production requirements.
Shift Work		X		• May be required depending on company policies. Typical shifts are 10- and 12- hours.
Working Alone		X		• May work independently, however a majority of staging will be performed with coworkers.
Working with Others		X		

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 7: Behavioural/Cognitive Demands

BEHAVIOURAL/COGNITIVE DEMANDS	CDA[£] RANKING SCALE				COMMENTS*
	1	2	3	4	
Degree of Self-Supervision Required			X		• May need clarification regarding mine prints/plans, and/or safety issues.
Degree of Supervision Exercised	X				
Deadline Pressures (Time Pressure)			X		• Daily, weekly, and month production targets.
Attention to Detail		X			• Reviewing mine prints/plans, completing reports, such as safety, shift report, daily log.
Performance of Multiple Tasks Required		X			• Communicating while performing underground mining tasks, such as mobile equipment operation.
Exposure to Distracting Stimuli				X	• High noise levels, moving equipment, ground conditions.
Need to Work Co-operatively With Others			X		• Light, hand, whistle, horn, and bell signals.
Exposure to Emotional Situations	X				
Exposure to Confrontational Situations	X				
Responsibility and Accountability Required				X	• Responsibility and accountability for maintaining a safe work environment.
Reading Literacy			X		• Reviewing reports, such as safety, daily logs, production reports, mine prints/plans. • Required to follow written instructions.
Written Literacy		X			• Completing reports, log books, and pre-operation checks.
Numerical Skills		X			• Horn, whistle and bell signals when communicating.
Verbal Communication			X		• Conversational, two-way radio, telephone.
Memory		X			• Signals, signs, colour coding, staging construction methods.
Computer Literacy	X				
Shift Work Demands			X		• Rotating shift schedule may be required, depending on company policies. Typical shift durations are 10- and 12- hours.

[£] The Cognitive Demands Assessment (CDA) definitions and scale are outlined in Appendix 3.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Underground Miner

Area of Competence: Drill Rock

Assessment Report

MiHR RHM
MINING INDUSTRY HUMAN RESOURCES COUNCIL
CONSEIL DES RESSOURCES HUMAINES DE L'INDUSTRIE MINIÈRE

Minerals Processing Operator
Drill Rock — The Assessment Report

Overview

Occupational Domain:	Underground Miner	National Occupational Standard (NOS) Area of Competence:	Drill Rock
Hours of Work:	Variable, dependant on mine. May work 10- or 12- hour shifts.	Breaks:	Flexible break schedule; ~1- 1½ hours in total.
Shift Work:	Rotating schedule, which is dependant on the mine site.	National Occupational Classification (NOC) Level of Work:	Medium-Heavy (depends on the type of equipment that is used for drilling)
Dates of Assessment:	February 17-19, 2009	Evaluators:	Trevor Hawksby, B.Sc. (H.K.), C.K. Charlene Martin, B.Sc. (H.K.), C.K.

Section 1: Detailed Task Description

There are several different methods and equipment used to drill holes in the underground mining process. Depending on the type of equipment used, this task falls within the Medium-Heavy strength categories.

1. Prepare Face For Drilling:

The workers prepare the face for drilling, by spray-painting drill hole locations using the appropriate layout pattern for drilling. Line grades and boot legs on the face are also marked, as appropriate.

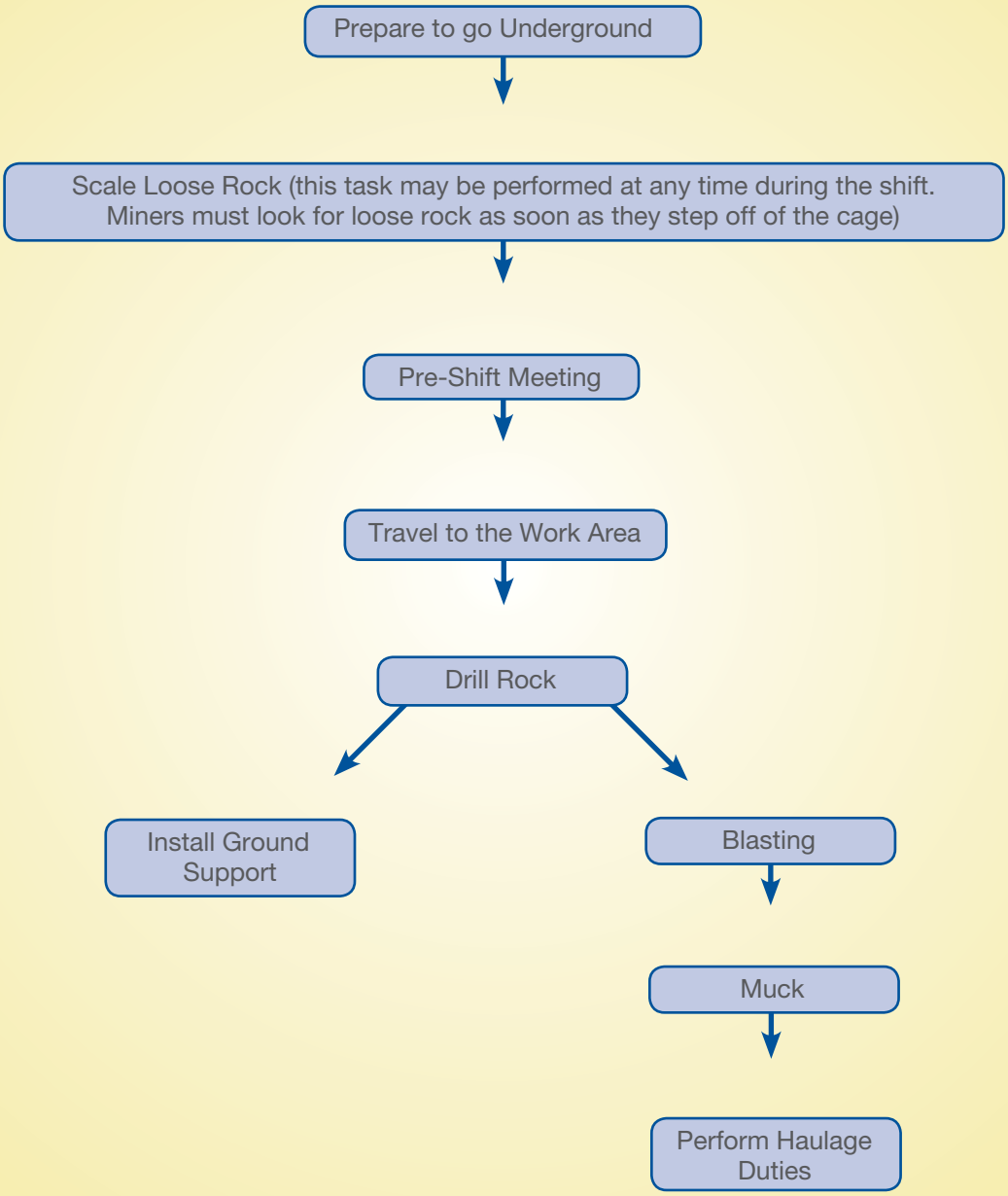
2. Set-Up or Dismantle Drills / Perform Drill Operation:

Workers are required to perform pre-operational checks on the VBM drills, Jumbo, Jack legs and stopers; depending on the type of equipment being used to drill. Workers will install all drill bits and ensure that the equipment is ready to drill. Setting up the jackleg and stoper requires the worker to assume non-neutral trunk postures and have full shoulder range of motion in all directions. Worker must have the ability to lift and carry the jack leg and stoper, which weigh up to 51 kg. Jacklegs are carried over the workers' shoulder, and the stopers are carried over the hip of the worker. The worker is required to lift steel drill bits from floor to overhead levels. Drill bits weight from 2-12 kg.

Setting-up and completing the pre-operational checks on the VBM and Jumbo drills require full unrestricted shoulder range of motion and non-neutral back postures. Operation of the VBM and Jumbo drills require the ability to stand for prolonged periods, up to 2 hours at a time. Workers operating the Jumbo drill are subjected to low frequency vibration when standing. Operation of the VBM and jumbo also requires good upper extremity dexterity and fine finger movements.

When transporting drills, the jackleg and stoper would be transferred to an appropriate storage location using a personal carrier or other heavy machinery. The worker would be required to lift the drills from ground level to waist level when placing them in the vehicles. The VBM and jumbo drills would be driven to the appropriate location. Driving these drills would require full neck rotation in both directions and full unrestricted shoulder range of motion, bilaterally.

Section 2: Workflow



Section 3: Task Objectives and Duties

Overview

Drills are used to prepare the face for blasting. Drills include the Vertical Block Mining (VBM) drill, Jumbo Drill, Jack Leg and Stoper. Drilling is performed based on engineering specifications and mine procedures.

Essential Tasks

1. **Prepare Face For drilling**
- Workers are required to ensure that the face is scaled and ground support is secure.
- Workers are required to review any plans, select the appropriate drill pattern, and layout pattern for drilling.
- Workers are required to check for bootlegs, which are remnants of explosives left in a blast hole or misholes. Prior to drilling, workers are required to mark all bootlegs with spray paint and blast any misholes, as needed.

2. **Set Up Drills**
- Before drilling, workers are required to select and set-up rock drill bits and fasten to the machinery, such as jackleg, stoper, or jumbo drill.
- Workers are required to conduct any pre-operational checks on equipment prior to hooking up air and water, as well as after the air and water are turned on.
- Workers may be required to maintain any drilling equipment, such as the jackleg, stoper, VBM or jumbo drills.

3. **Perform Drill Operation**
- Workers are required to drill the rock using the stoper, jackleg, VBM or jumbo drills.
- Workers are required to monitor the ground conditions, as well as equipment when drilling.

4. **Dismantle Drills**
- Workers are required to dismantle any drilling equipment, as well as transport and store any equipment in the appropriate area.
- Workers are required to conduct a post-operational inspection of drilling equipment and take corrective actions, if needed.

Personal Protective Equipment (PPE)

- Leather or rubber safety boots, equipped with metatarsal guards;
- Coveralls, equipped with appropriate reflective markings;
- Belt with fall arrest ring and holster for light battery pack / two-way radio;
- Hard hat;
- Safety glasses;
- Hearing protection, which may include ear plugs and/or ear muffs;
- Gloves;
- Respirator; and
- Additional task specific PPE, such as face shield, specialized hand and forearm protection, self-contained breathing apparatus, etc.

Personal Protective Equipment (PPE)

- Jackleg, stoper;
- Watch and miners wrench;
- Jumbo or VBM Drill; and/or
- Spray paint gun.

Section 4: Strength and Positional Requirements

STRENGTH REQUIREMENTS		FREQUENCY	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Lifting/ Lowering	Floor to Waist† (0-104cm)	Occasional	2.0-51.0		• Drill bits for jack leg and stoper (2-12 kg), jumbo drill bits. • May be required to pick up the jackleg (51 kg) or stoper (47 kg) from the ground. • Stoper may be cradled in arms, or lifted/carried on the shoulder or over the hip. Jackleg may be lifted and carried on the shoulder.
	Waist† to Shoulder† (104-137cm)	Occasional	2.0-51.0		• Drill bits for jack leg and stoper (2-12 kg), jumbo drill bits. • Stoper (47 kg) and/or jackleg (51 kg) may be lifted to shoulder level when transporting equipment.
	Floor to Shoulder† (0-137cm)	Occasional	2.0-12.0		• Drill bits for jack leg and stoper, jumbo drill bits (2-12 kg).
	Above Shoulder† (>138cm)	Occasional	2.0-12.0		• Drill bits for jack leg and stoper, jumbo drill bits (2-12 kg).
Carrying	Unilateral / Bilateral	Occasional	1.5-51.0		• Stoper (47 kg) may be carried over the hip or shoulder; jackleg (51 kg) may be carried on the shoulder (three-point contact). • Carry drill bits, spray paint canister and other supplies / tools, up to 12 kg. • Distance is variable depending on the mine and transport equipment available. Some items may be carried up to 1 km.
Pushing/ Pulling (kg of Force)	Vertical				
	Unilateral	Occasional		~6-10	• Unilateral operation of VBM or Jumbo drill controls.
	Bilateral	Occasional		10 to 50+	• Holding onto grab bars and pulling upward when climbing onto VBM or jumbo drills. Bars are located at or above shoulder height (100-150 cm from the ground). For safety reasons, worker must be able to support bodyweight, exert sufficient grip and pull forces. • Maintain control of the jackleg or stoper when drilling, which may involve significant push forces if the base support slips. Forces may exceed 50 kg. Direction of the push force required to maintain control of the jackleg is based upon the angle and location of the hole being drilled. Forces can be in a combination of horizontal and vertical directions. • Workers also need to control the jackleg when it deviates from the vertical plane, which requires a lateral push/pull.

The Frequency Definitions are outlined in Appendix 2.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

† Anthropometrics are based on the 50th percentile male (waist height, standing 106.3±5.4 cm; shoulder height, standing 143.7±6.2 cm) and the 50th percentile female (waist height, standing 101.7±5.0 cm; shoulder height, standing 132.9±5.5 cm); Eastman Kodak Company (1986). *Ergonomic Design for People at Work: Volume 2.* New York: Van Nostrand Reinhold Company.

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY£	COMMENTS*
Sitting		Never-Occasional	• Frequency will vary depending on work assignment and type of equipment used. Sitting is only required when driving the Jumbo or VBM drills. It is not required if operating the jackleg and stoper.
Standing		Occasional-Frequent	• Frequency will vary depending on work assignment and type of equipment being used. • Sustained standing needed when drilling using the Jumbo or VBM drills, as well as the jackleg and stoper. • Worker may need to assume a wider base of support (lunging position) when operating the jackleg and stoper, for up to ~4 minutes when drilling.
Walking		Occasional-Frequent	• Operating the jumbo or VBM drills requires occasional walking. • Operating jackleg and stoper may require frequent walking. • Also needed when walking within the mine, to obtaining drill bits, extensions, and other equipment. May be exposed to uneven or slippery terrain.
Climbing	**Stairs**	Occasional	• Climbing on/off of the Jumbo or VBM drills, Personal carriers, scissor lifts. • There are 3 steps in order to access the Jumbo drill (step heights are 20-30cm).
	Ladders	Occasional	• May climb up ladders, if using scissor lift.
	Uneven Ground	Occasional	• Ramps and other uneven ground, including muck piles. • Spray painting hole locations and inspecting the face.
Balancing		Occasional-Frequent	• The worker is subjected to rapid changes in directional forces when operating the jackleg or stoper. The worker requires balance in order to maintain control of the machinery.
Crawling		Never	
Kneeling		Occasional	• Positioning the drill as required.
Crouching/Squatting		Occasional	• The worker is required to partially squat/lunge and rest the jackleg against the forward leg. • May be required to pick-up the jack leg, stoper, drill bits etc. from the bench.
Trunk Movements		Occasional	• Full range of motion in all directions is required when manipulating and using the jackleg and stoper. • Stooping needed in order to dig a trench with a scaling bar, when seating jackleg base. • Low back rotation while exerting force is required when operating the jackleg.
Neck Movements		Occasional	• Unrestricted range of motion required when manipulating and using the jackleg and stoper. • Full neck extension is needed when looking up to drill the raise with the stoper. • Neck flexion is required when drilling low level holes.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY£	COMMENTS*
Reaching	Forward/ Backward	Occasional	• Unrestricted bilateral shoulder range of motion is required when operating jackleg and stoper. • Unrestricted shoulder flexion (0°-90°) required in order to access controls of VBM or jumbo drill, which are located within arms reach, 0-120 cm. • Stoper and jackleg controls are typically kept within 30 cm of the body, at heights of 100- 120 cm from the bench. Some positions may require internal/external rotation of the shoulders while exerting force. • Reaching behind the body may be required to operate machinery.
	Upper Level	Occasional	• Full range of motion in both shoulders is required when operating the jackleg and stoper, as well as conducting pre-operational checks on drilling machinery. • Above shoulder level reaching also needed when spray painting hole locations, line grade, and boot legs on the face for drilling (reach distance of 0-100 cm needed). Also needed for holding onto grab bars, the heights will vary depending on the equipment being used (Jumbo grab bar 150 cm from ground). Workers must be able to support bodyweight, exert sufficient grip and horizontal pull forces.
	Sideways	Occasional	• Unrestricted shoulder range of motion required to operate controls of Jumbo or VBM drills, jackleg and stoper. • Typical reach distance of 0 -120 cm needed.
Elbow Posture		Occasional	• Full range of motion in all directions is required to complete drilling tasks.
Wrist Posture		Occasional	• Operation of the Jumbo drill requires partial pronation/supination, as well as partial flexion, extension, ulnar and radial deviation. • Jackleg and stoper operation requires full wrist range of motion in all directions. This also involves non-neutral wrist postures with push forces >50 kg. When operating the jackleg and stoper, the wrists are subjected to high forces and vibration, while positioned in end-range extension and/or flexion.
Gripping		Occasional	• High grip strength is required to operate the jackleg and stoper. The worker must maintain high grip forces while wearing rubber gloves, and being subjected to high frequency hand-arm vibration. • Requires ability to grasp and turn the jackleg throttle with the right hand (6” grip circumference). • Hook grip and power grip are required when operating the controls on the various types of drilling equipment.
Pinching		Occasional	• Key/palmar grip required to operate controls on the VBM, Jumbo, stoper throttle.
Fine Finger Dexterity		Occasional	• Operation of drills
Striking with Hand		Occasional	• May strike the palm of the hand against the throttle of the stoper. • Jackleg may kick back into the workers supporting hand. • May be required to operate machinery controls
Foot Action		Occasional	• Plantar flexion and dorsi flexion required to use the pedal controls while operating mobile equipment. Operation of the gas and brake pedals on the Jumbo and other heavy equipment requires ~20-27 kg of push force to depress the pedals.

£ The frequencies documented will vary depending on the method used when drilling, the material being process at the mine locations.

Section 5: Sensory/Mental Requirements

SENSORY/MENTAL REQUIREMENTS		ESSENTIAL		COMMENTS*
		Yes	No	
Vision	Near	X		• Reading drilling plans, pre- and post- operational checklists, drill displays.
	Far	X		• Driving jumbo drill and other heavy machinery.
	Colour	X		• Distinguish between spray paint markings on the face, as significant safety concerns may arise from drilling wrong hole locations. Also required when watching or reading the ground for loose conditions.
Light Quality and Measurements		X		• Primary underground mining tasks require the ability to work in low level light, less than 200 Lux. • Typical underground working light is 10-15 Lux (single worker with cap light). • Ambient light in lunch room is ~120-160 Lux, and while operating mobile equipment is ~200 Lux.
Hearing	Conversation	X		• Communicating over two-way radio, telephone, and in-person.
	Other Sounds	X		• Machinery, bells, whistles, and alarms. • Hearing protection is mandatory when drilling (ear plugs and muffs). Noise levels regularly exceed occupational exposure limits. • Level of noise ranges from 50 dB to 107 dB (heavy equipment operation). Level of noise exceeds 100 dB at 50' when drilling equipment is in operation.
Talking		X		• Conversing with the use of hearing protection. Worker may be required to speak loud or shout.
Reading/Writing		X		• Pre-operational checklists and production reports.
Feeling			X	
Judgement/Decision Making		X		• Communicate safe working conditions.
Concentration		X		• Multi-tasking, communicating while operating drilling equipment. • Drilling using a jackleg and stoper involves concentration, due to dangers associated with the drilling task in order to avoid personal injury. Drilling using the jumbo or VBM drill requires concentration when operating the controls and to drill the correct hole locations.
Alertness		X		• Workers must be alert to workplace hazards, which may include ground conditions, mobile equipment, or power tools.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 6: Work Environment

WORK ENVIRONMENT	ESSENTIAL		COMMENTS*
	Yes	No	
Slippery Floors or Ground	X		• Wet/muddy ground conditions. Operation of the jackleg and stoper, workers are often subjected to wet conditions.
Sloping or Uneven Terrain	X		• Ascending/descending ramps, loose rocks.
Inside Work	X		• Performing work in the underground mine. • Ventilated air environment.
Outside Work		X	
Extreme Heat/Extreme Cold	X		• Exposure to hot or cold conditions possible. Cooler temperatures when working near the surface or in close proximity to vent raises. Typically, ambient temperature is controlled through the use of proper ventilation.
Dry/Humid	X		• Conditions vary depending on task performed and mine site. • Workers are sprayed with water when using the stoper to drill overhead holes.
Dust (PPE required)	X		• May be exposed to dust. Workers may be required to wear a respirator in some areas of mine development and production. • Workers also control dust by spraying the muckpile with water.
Vapours/Fumes (PPE required)	X		• From heavy equipment and/or power tools. Underground air ventilation systems are monitored for unsafe conditions.
Chemical Irritants (PPE required)	X		• Type of chemical exposure depends on the material being mined and the mining process. • Some vehicle maintenance tasks may exposure workers to chemical irritants.
Noise (PPE required)	X		• Hearing protection is mandatory depending on the task performed and area within the mine. • Noise levels regularly exceed the occupational exposure limits. • Noise levels range from 50-107 dB.
Moving Objects/Vehicles	X		• Jumbo and VBM drills, as well as other heavy machinery when walking in the mine environment.
Electrical Hazards		X	
Sharp Tools	X		• Box cutters.
Congested/Confined Work Site		X	

Continued...

WORK ENVIRONMENT		ESSENTIAL		COMMENTS*
		Yes	No	
Working at Heights		X		• Workers may be required to perform work on muck piles, ladders, scissor lifts.
Vibration	**Whole Body**	X		• Exposure when operating drilling equipment. The degree and duration of exposure will vary according to the type of equipment, task performed, and mine location. • Vibration frequencies of 1560 Hz when standing on the floor of the jumbo drill. Worker may be exposed to intermittent vibration, for up to 2 hours, with when drill is operational. Duration of the vibration exposure is dependent on the type of rock and the depth of the hole being drilled.
	Segmental	X		• Exposure when operating jackleg and stoper, as well as other drilling equipment. The degree and duration of exposure will vary according to the type of equipment, task performed, and mine location. • Vibration frequency ranges from 500-1700 Hz, and will vary according to the mine location (Stoper 500-1200 Hz; Jumbo Drill Controls 1560 Hz; Jackleg 960-1700 Hz). • Jackleg and Stoper accelerations are in the magnitude of 15- 32m/s^2.
Vehicle Operation		X		• Operate Personal Carriers, Jumbo or VBM drills.
Overtime		X		• Voluntary overtime hours may be needed, depending on production requirements.
Shift Work		X		• May be required depending on company policies. Typical shifts are 10- and 12-hours.
Working Alone		X		• Works independent within a group of individuals. Check-in policy mandatory.
Working with Others		X		

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 7: Behavioural/Cognitive Demands

BEHAVIOURAL/COGNITIVE DEMANDS	CDA[£] RANKING SCALE				COMMENTS*
	1	2	3	4	
Degree of Self-Supervision Required			X		• Instructions from supervisor during line-up meeting, conducted at start of shift. • May need clarification regarding drilling locations, mine prints/ plans, and/or safety issues.
Degree of Supervision Exercised	X				
Deadline Pressures (Time Pressure)			X		• Daily, weekly, and month production targets.
Attention to Detail		X			• Reviewing mine prints/plans, completing reports, such as safety, shift report, daily log.
Performance of Multiple Tasks Required		X			• Communicating while operating drilling equipment.
Exposure to Distracting Stimuli				X	• High noise levels from drilling equipment, ground conditions.
Need to Work Co-operatively with Others			X		• Light, hand, whistle, horn, and bell signals.
Exposure to Emotional Situations	X				
Exposure to Confrontational Situations	X				
Responsibility and Accountability Required				X	• Responsibility and accountability for maintaining a safe work environment.
Reading Literacy			X		• Reviewing reports, such as safety, daily logs, production reports, mine prints/plans. • Required to follow written instructions.
Written Literacy		X			• Completing reports, log books, and pre-operation checks.
Numerical Skills		X			• Horn, whistle and bell signals when communicating.
Verbal Communication			X		• Conversational, two-way radio, telephone.
Memory		X			• Signals, signs, colour coding.
Computer Literacy	X				
Shift Work Demands			X		• Rotating shift schedule may be required, depending on company policies. Typical shift durations are 10- and 12- hours.

[£] The Cognitive Demands Assessment (CDA) definitions and scale are outlined in Appendix 3.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 8: Photographs

Figure 1: Operating Controls of Jumbo Drill

Figure 2: Driving Jumbo Drill

Figure 3: Operating a Jackleg

Figure 4: Operating a Stoper to Drill Hole Overhead

Underground Miner

Area of Competence: Install Ground Support

Assessment Report

Minerals Processing Operator
Install Ground Support — The Assessment Report

Overview

Occupational Domain:	Underground Miner	National Occupational Standard (NOS) Area of Competence:	Install Ground Support
Hours of Work:	Variable, dependanton mine. May work 10- or 12- hour shifts.	Breaks:	Flexible break schedule; ~1- 1½ hours in total.
Shift Work:	Rotating schedule, which is dependant on the mine site.	National Occupational Classification (NOC) Level of Work:	Medium-Heavy (depends on the type of equipment that is used for installation of ground support).
Dates of Assessment:	February 17-19, 2009	Evaluators:	Trevor Hawksby, B.Sc. (H.K.), C.K. Charlene Martin, B.Sc. (H.K.), C.K.

Section 1: Detailed Task Description

Due to the nature of the Underground Miner tasks, the installation of ground support is required whenever the ground structure requires support, or if existing ground support begins to fail. This task falls within the Medium – Heavy strength categories, as defined by the National Occupational Classification (N.O.C.).

1. Recognize Loose and/or Abnormal Ground Conditions:

The workers are required to look for conditions that would warrant ground support installation. Workers would report faulty ground conditions and prepare for installation of the appropriate ground support mechanism. This requires good far-sided or distance vision, which is conducted in low-level lighting; as well as full neck range of movement, in order to inspect the drifts.

2. Recognize Faulty Ground Support:

Workers are looking for signs of faulty ground support, failing bolts, untwisted cable bolts, unsecured wire or mesh, etc. This requires good far-sided or distance vision, which is conducted in low-level lighting; as well as full neck range of movement, in order to inspect the drifts.

3. Install Ground Support:

Workers are required to install the appropriate ground support (rebar, mechanical bolts, mesh and screens and cable bolts), which occurs after the appropriate holes are drilled in the face or raise. Depending on the mine, workers will use either the jack leg and stoper, or Maclean bolter, to install the appropriate ground support fasteners.

This task requires the ability to work within a Medium to Heavy strength level depending on the type of equipment being used and the type of ground support being installed. Workers may be required to handle items weighing less than 20 kg, such as bolts and screen, when using the Maclean bolter to install ground support fasteners; which would fall within the Medium Strength category. Workers using the jackleg (51 kg), or the stoper (47 kg), to install ground support; would complete tasks within the Heavy strength category. This task also requires good far-sided or distance vision, which is conducted in low-level lighting; as well as full neck range of movement, in order to inspect the drifts.

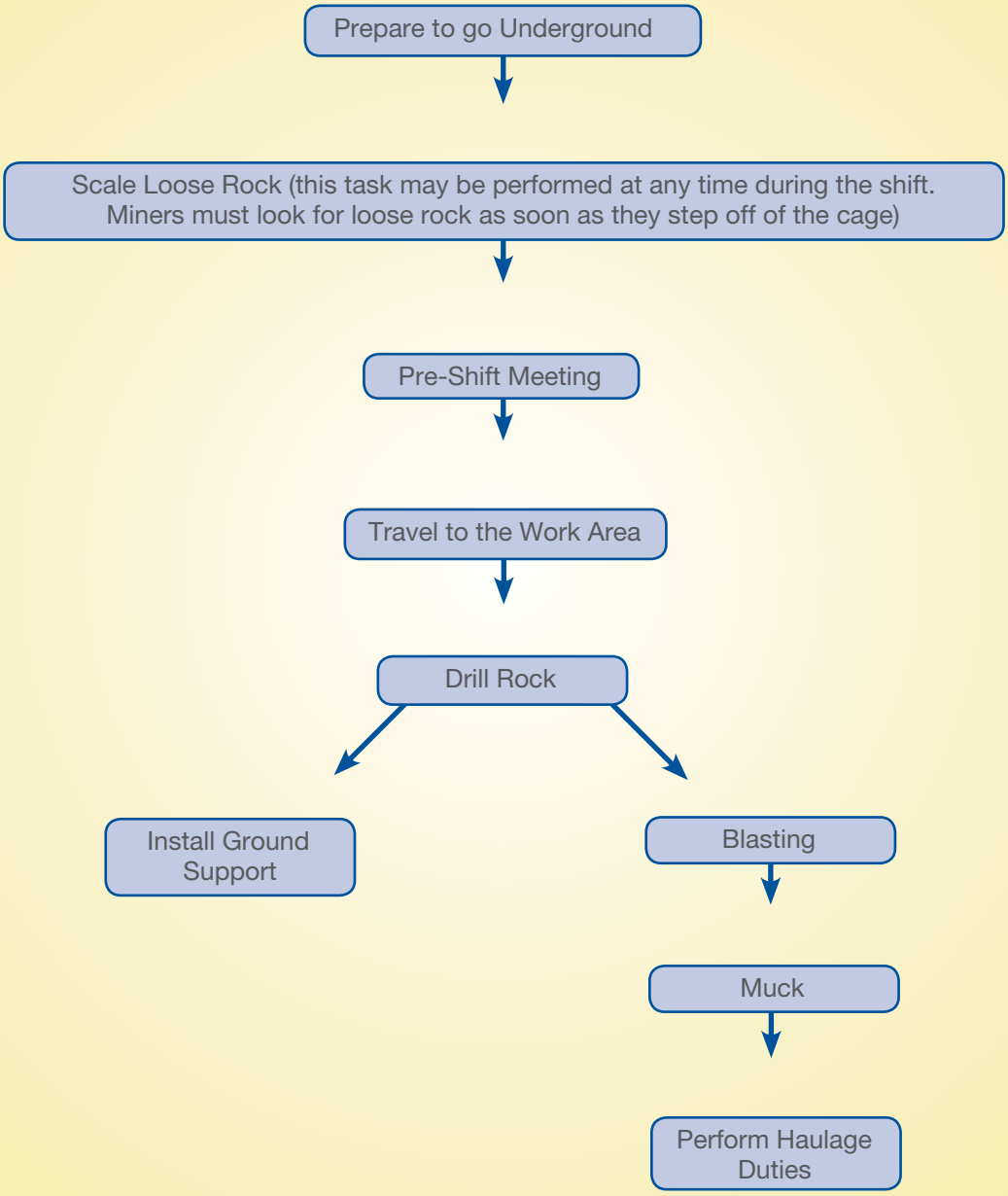
4. Place Fill:

The workers are required to select the appropriate type of fill and equipment needed for placing the fill. Subsequently the fill is placed according to company procedures and characteristics of the fill. Installation of shotcrete falls within the Heavy strength category (>20 kg); however other fills, such as rock and sand, may be transported to the correct area with the use of heavy machinery, and thereby this task would fall within the Medium strength category.

5. Store Ground Support Equipment and Material:

The ground support material and equipment is stored in an appropriate mine location. The ground support equipment and materials range in weight from 1 kg to 51 kg. The physical demands associated with the storing of equipment and/or materials are dependent on the type of material and equipment being used.

Section 2: Workflow



Section 3: Task Objectives and Duties

Overview

Installation of ground support can be performed during mine restoration, development, or during production. Ground support tasks are required whenever the ground structure requires support, or if existing ground support begins to fail.

Equipment

1. **Recognize Loose and/or Abnormal Ground Conditions**
- Obtain appropriate mine prints and standards, and determine ground conditions.
- Workers are required to determine guarding and reporting procedures, and take corrective action, as needed.

2. **Recognize Faulty Ground Support**
- Workers are required to determine when abnormal conditions are present, and take corrective action.

3. **Install Ground Support**
- Select type of ground support according to mine prints and standards.
- Workers are required to install and secure ground support, which may include rebar, mechanical bolts, mesh, screen, cable bolts, etc.

4. **Place Fill**
- Workers are required to follow mine prints and standards.
- Organize filling activity, which may include determining appropriate dust suppression and extraction methods; installing barricades, guarding, or signs; assessing work site conditions; and ensuring correct ventilation.
- Workers are required to fill voids, as well as drain and monitor fill.

5. **Store Ground Support Equipment and Material**
- Store ground support equipment and material in appropriate area, and perform any post-operational checks, as required.

Personal Protective Equipment (PPE)

- Leather or rubber safety boots, equipped with metatarsal guards;
- Coveralls, equipped with appropriate reflective markings;
- Belt with fall arrest ring and holster for light battery pack / two-way radio;
- Hard hat;
- Safety glasses;
- Hearing protection, which may include ear plugs and/or ear muffs;
- Gloves;
- Respirator; and
- Additional task specific PPE, such as face shield, specialized hand and forearm protection, self-contained breathing apparatus, etc.

Equipment

- Cap light and battery packs, which may be equipped with a two-way radio; and
- Jackleg;
- Stoper;
- Maclean Bolter;
- Watch and miners wrench;
- Sledge Hammer 4 and 6 lb;
- Scissor lifts;
- Ground support supplies (screen, bolts, rebar etc.); and/or
- Shotcrete machine.

Section 4: Strength and Positional Requirements

STRENGTH REQUIREMENTS		FREQUENCY	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Lifting/ Lowering	Floor to Waist† (0-104cm)	Occasional	2 - 51		• May be required to pick up the jackleg (51 kg) or stopper (47 kg) from the ground. Also required to pick-up drill bits for jack leg and stoper (2 -12 kg). • Stoper may be cradled in arms, or lifted/carried on the shoulder or over the hip. Jackleg may be lifted and carried on the shoulder. • Sledge hammer (2-3 kg), push-on plate tool (5 kg), bundle of push-on plates (11 kg), wooden plates (15 kg), mechanical plates (14 kg), 8' bundle of bolts (16.5 kg), 16' extension bolt (16 kg), cable bolts, rebar (5-pack of rebar - 27 kg), screen (9 kg). • Bags of Shotcrete (22.5 kg).
	Waist† to Shoulder† (104-137cm)	Occasional	2-51		• May be required to pick up the jackleg (51 kg) or stopper (47 kg) from the ground. Also required to pick-up drill bits for jack leg and stoper (2 -12 kg). • Stoper may be cradled in arms, or lifted/carried on the shoulder or over the hip. Jackleg may be lifted and carried on the shoulder. • Sledge hammer (2-3 kg), push-on plate tool (5 kg), bundle of push-on plates (11 kg), wooden plates (15 kg), mechanical plates (14 kg), 8' bundle of bolt (16.5 kg), 16' extension bolts (16 kg), cable bolts, rebar (5-pack of rebar - 27 kg), screen (9 kg). • Bags of Shotcrete (22.5 kg).
	Floor to Shoulder† (0-137cm)	Occasional	2-12		• Drill bits for jackleg and stoper (2-12 kg), screen (9 kg).
	Above Shoulder† (>138cm)	Occasional	2-16		• Required when installing ground support on the raise of the mine or high areas of the face. • Sledge hammer (2-3 kg), push-on plate tool (5 kg), push-on plate (2.5 kg), wooden plate (3 kg), mechanical plates (~3 kg), 8' bolt (3.3 kg), 16' extension bolt (16 kg), cable bolts, rebar (5.4 kg). • Hold the sheet of screen overhead (9 kg).

Continued...

STRENGTH REQUIREMENTS		FREQUENCY	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Carrying	Unilateral/ Bilateral	Occasional	1.5-51		• Stoper (47 kg) may be carried over the hip or shoulder; jackleg (51 kg) may be carried on the shoulder (three-point contact). • Carry sledge hammer, drill bits, plates, bolts, and screen (2-27 kg), a minimum of ~3-5 m. The distance will vary depending on the mine site, work area, and transport equipment available. Some items may be carried up to 1 km.
Pushing/ Pulling (kg of Force)	Vertical	Occasional		20+	• Workers may be required to dig a trench to help seat the base support of the jackleg. The worker may use an 8' scaling bar (8 kg) or a pry bar with a downward force exceeding 20 kg in order to dig the trench. Requires the ability to push the scaling bar through the dirt/rock on the bench. Worker assumes non-neutral neck, and back postures when digging trenches. • Push the bolts into the drill holes in the raise.
	Unilateral	Occasional		~3-10	• Unilateral operation of Maclean bolter controls (up to 2 kg of push/pull force needed to operate controls). • Push forces of ~1 kg needed to operate hand controls on the shotcrete machine (full power grip with thumb abduction is required). • May also be required when seating base support for jackleg.
	Bilateral	Occasional		10-50+	• Maintain control of the jackleg or stoper when securing bolts, which may involve significant push forces if the base support slips. Forces may exceed 50 kg. Direction of the push force required to maintain control of the jackleg is based upon the angle and location of the hole being drilled. Forces can be in a combination of horizontal and vertical directions. • Workers also need to control the jackleg when it deviates from the vertical plane, which requires a lateral push/pull.

The Frequency Definitions are outlined in Appendix 2.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

† Anthropometrics are based on the 50th percentile male (waist height, standing 106.3±5.4 cm; shoulder height, standing 143.7±6.2 cm) and the 50th percentile female (waist height, standing 101.7±5.0 cm; shoulder height, standing 132.9±5.5 cm); Eastman Kodak Company (1986). *Ergonomic Design for People at Work: Volume 2.* New York: Van Nostrand Reinhold Company.

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY	COMMENTS*
Sitting		Never-Occasional	• Needed when transporting the shotcrete machine. May also be required when using a personal carrier to travel to the work area.
Standing		Frequent	• Required during installation of screen bolts and operation of the shotcrete machine occurs. • If using the jackleg and stoper to install ground support, the worker may need to assume a wider base of support (lunging position) when operating the jackleg and stoper, for up to ~4 minutes.
Walking		Frequent	• Needed when obtaining bit extensions and other equipment/supplies, operating jackleg and stoper. • Walking within the mine. Distances will vary depending on mine, drift, and area of work. • Sustained distances up to ~1-2 km may be required. Distance walked will be dependent on whether or not a personal carrier, or heavy equipment, such as the Maclean bolter, is used to get to the work area. Exposure to slippery and uneven terrain when walking.
Climbing	**Stairs**	Occasional	• Climbing onto the shotcrete machine, scissor lifts, or Maclean bolter (step height ~30 cm). • Typical step heights are ~40-50 cm (may have multiple steps per vehicle). • Metal steps in order to climb into the scissor lift, which are located 46 and 79 cm high. The worker is required to climb three additional steps in order to access platform. • Grab bars are available to assist with climbing tasks. Three-point mount and four-point dismount required.
	Ladders	Occasional	• May ascending/descending ladders if using scissor lifts (4 rungs).
	Uneven Ground	Occasional	• The worker walks on ramps and other uneven ground including muck piles. Ramps between levels have ~15 degree inclines/declines.
Balancing		Occasional	• The worker is subjected to rapid changes in directional forces when operating the jackleg or stoper. The worker requires balance in order to maintain control of the machinery.
Crawling		Never	
Kneeling		Never	
Crouching/Squatting		Occasional	• The worker is required to partially squat/lunge and rest the jackleg against the forward leg. • May be required to pick-up the jack leg, stoper, drill bits etc. from the bench. • May be required during maintenance, pre-inspection tasks, on the shotcrete machine. • Placing bolts into low level holes may require the ability to fully crouch or squat.
Trunk Movements		Occasional	• Full range of motion in all directions is required when manipulating and using the jackleg and stoper. • Stooping needed in order to dig a trench with a scaling bar, when seating jackleg base. • Low back rotation while exerting force is required when operating the jackleg. • Stooping/side bending is required when lubricating the shotcrete machine during operation. • Placing bolts in the holes requires the ability to fully stoop, side bend, and/or rotate.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY	COMMENTS*
Neck Movements		Occasional	• Unrestricted range of motion required when manipulating and using the jackleg and stoper. • Full neck extension is needed when looking up to install ground support on the raise with the stoper. • Full range neck flexion is required when installing ground support using low level holes, or using the Maclean bolter.
Reaching	**Forward/ Backward**	Occasional	• Unrestricted bilateral shoulder range of motion is required when operating jackleg and stoper. • Stoper and jackleg controls are typically kept within 30 cm of the body at a height of 100-120 cm above the bench. Some positions require internal/external rotation of the shoulders, while exerting force. • Reaching behind the body may be required to operate machinery. • Shotcrete controls are located within 0-100 cm in front of the worker. • Forward reach distance of 0-50 cm is needed when operating the Maclean bolter.
	Upper Level	Occasional	• Full range of motion in both shoulders is required when operating the jackleg and stoper, as well as conducting pre-operational checks on machinery. • Typical reach distance 0 to 100 cm. • Upper level reach is required to safely climb on to the heavy equipment. Grab bar positions will vary depending on the equipment being used (100 -150cm). Workers should be able to support their full body weight while pulling horizontally on the grab bars. • For maintenance and operation of the shotcrete machine the worker is required to reach from ground level to 100 cm. Most common vertical reach distances occur between 60 and 100 cm.
	Sideways	Occasional	• Full range of motion is required, with a typical sideways reach distance of 0 -120 cm (Maclean bolter controls require 0-85 cm sideways reach; shotcrete machine requires sideways reach of 0-90 cm). • Needed while operating controls of jackleg and stoper.
Elbow Posture		Occasional	• Full range of motion in all directions is required.
Wrist Posture		Occasional	• Operation of the Shotcrete machine and the Maclean bolter requires partial pronation and/or supination, along with partial flexion, extension, ulnar, and radial deviation. • Jackleg and stoper operation requires full wrist range of motion in all directions. This also involves non-neutral wrist postures with push forces >50 kg. When operating the jackleg and stoper, the wrists are subjected to high forces and vibration, while positioned in end-range extension and/or flexion.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS	FREQUENCY	COMMENTS*
Gripping	Occasional	• High grip strength is required to operate the jackleg and stoper. The worker must maintain high grip forces while wearing rubber gloves, and being subjected to high frequency hand-arm vibration. Requires ability to grasp and turn the jackleg throttle with the right hand (6" grip circumference). • Hook grip and power grip are required when operating the different types of drilling equipment. • Power grip when using grease gun to lubricate equipment.
Pinching	Occasional	• Key/palmar grip required to operate controls on the Maclean bolter, stoper throttle.
Fine Finger Dexterity	Occasional	• May be required to complete pre-operational inspection reports.
Striking with Hand	Occasional	• May strike the palm of the hand against the throttle of the stoper. • Jackleg may kick back into the workers supporting hand. • May be required to operate machinery controls
Foot Action	Occasional	• Plantarflexion and dorsiflexion required to use the pedal controls while operating mobile equipment. • Operation of the gas and brake on heavy equipment, such as the Maclean bolter, requires ~20-27 kg force to depress pedals.

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Section 5: Sensory/Mental Requirements

SENSORY/MENTAL REQUIREMENTS		ESSENTIAL		COMMENTS*
		Yes	No	
Vision	Near	X		• Reading drilling plans, pre-operational checklists, ground support patterns.
	Far	X		• Driving heavy machinery.
	Colour		X	
Light Quality and Measurements		X		• Primary underground mining tasks require the ability to work in low level light, less than 200 Lux. • Typical underground working light is 10-15 Lux (single worker with cap light). • Ambient light while operating mobile equipment is ~200 Lux.
Hearing	Conversation	X		• Communicating over two-way radio, telephone, and in-person.
	Other Sounds	X		• Machinery, bells, whistles, and alarms. • Hearing protection is mandatory. Noise levels regularly exceed occupational exposure limits. • Level of noise ranges from 50 dB to 107 dB (heavy equipment operation). • Noise protection is mandatory when operating the Shotcrete machine, Maclean Bolter, jackleg and stoper.
Talking		X		• Conversing with the use of hearing protection. Worker may be required to speak loud or shout.
Reading/Writing		X		• Pre-operational checklists and production reports.
Feeling			X	
Judgement/Decision Making		X		• Communicate safe working conditions.
Concentration		X		• Multi-tasking, communicating while operating mobile equipment. • Using a jackleg and stoper, MacLean bolter and shotcrete machine involves concentration due to the dangers associated with operating this machinery.
Alertness		X		• Workers must be alert to workplace hazards, which may include ground conditions, heavy equipment, or power tools.

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Section 6: Work Environment

WORK ENVIRONMENT	ESSENTIAL		COMMENTS*
	Yes	No	
Slippery Floors or Ground	X		• Wet/muddy ground conditions. When using stoper to install ground support on the raise workers are often subjected to wet conditions.
Sloping or Uneven Terrain	X		• Ascending/descending ramps, loose rocks.
Inside Work	X		• Performing work in the underground mine. Ventilated air environment.
Outside Work		X	
Extreme Heat/Extreme Cold	X		• Exposure to hot or cold conditions possible. Cooler temperatures when working near the surface, or in close proximity to vent or air raises. Typically, ambient temperature is controlled through the use of proper ventilation.
Dry/Humid	X		• Conditions vary depending on task performed and mine site. • Workers are subjected to water when installing ground support on the raise.
Dust (PPE required)	X		• May be exposed to dust. Workers may be required to wear a respirator in some areas of mine development and production. Workers are exposed to dangerous levels of particulate when operating the Shotcrete machine (respirators are mandatory). Workers also control dust by spraying the muckpile with water.
Vapours/Fumes (PPE required)	X		• From heavy equipment and/or power tools. Underground air ventilation systems are monitored for unsafe conditions.
Chemical Irritants (PPE required)	X		• Type of chemical exposure depends on the material being mined and the mining process. • Some vehicle maintenance tasks may exposure workers to chemical irritants. • Shotcrete has irritant properties.
Noise (PPE required)	X		• Hearing protect mandatory, depending on the task performed and area within the mine, for example operating mobile equipment, walking near fans. Noise levels regularly exceed the occupational exposure limits. • Noise levels range between 50-107 dB, depending on the heavy equipment.
Moving Objects/Vehicles	X		• Heavy machinery when walking in the mine environment, ground conditions.
Electrical Hazards		X	
Sharp Tools	X		• Box cutters, bolt cutters.
Congested/Confined Work Site		X	

Continued...

WORK ENVIRONMENT		ESSENTIAL		COMMENTS*
		Yes	No	
Working at Heights		X		• Workers may be required to perform work on muck piles, ladders, scissor lifts. • Workers are required to wear safety belt with fall arrest ring.
Vibration	**Whole Body**	X		• Exposure when operating heavy equipment, such as Maclean bolter or personal carrier. The degree/duration of exposure will vary according to the type of equipment; task performed, and mine location. Vibration frequencies vary from 8-231 Hz (Personal carrier 8-44 Hz; Maclean Bolter 231 Hz).
	Segmental		X	• Vibration frequency ranges from 500-1700 Hz, and will vary according to the mine location (Stoper 500-1200 Hz; Jackleg 960-1700 Hz). • Jackleg and Stoper accelerations are in the magnitude of 15 to 32m/s^2.
Vehicle Operation		X		• Operate Personal Carriers, transport shotcrete machine.
Overtime		X		• Voluntary overtime hours may be needed, depending on production requirements.
Shift Work		X		• May be required depending on company policies. Typical shifts are 10- and 12-hours.
Working Alone		X		• Works independent within a group of individuals. Check-in policy mandatory.
Working with Others		X		

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Section 7: Behavioural/Cognitive Demands

BEHAVIOURAL/COGNITIVE DEMANDS	CDA£ RANKING SCALE				COMMENTS*
	1	2	3	4	
Degree of Self-Supervision Required			X		• May need clarification regarding mine prints/plans, and/or safety issues.
Degree of Supervision Exercised	X				
Deadline Pressures (Time Pressure)			X		• Daily, weekly, and month production targets.
Attention to Detail		X			• Reviewing mine prints/plans, completing reports, such as safety, shift report, daily log.
Performance of Multiple Tasks Required		X			• Communicating while performing underground mining tasks, such as mobile equipment operation.
Exposure to Distracting Stimuli				X	• High noise levels, moving equipment, ground conditions.
Need to Work Co-operatively with Others			X		• Light, hand, whistle, horn, and bell signals.
Exposure to Emotional Situations	X				
Exposure to Confrontational Situations	X				
Responsibility and Accountability Required				X	• Responsibility and accountability for maintaining a safe work environment.
Reading Literacy			X		• Reviewing reports, such as safety, daily logs, production reports, mine prints/plans. • Required to follow written instructions.
Written Literacy		X			• Completing reports, log books, and pre-operation checks.
Numerical Skills		X			• Horn, whistle and bell signals when communicating.
Verbal Communication			X		• Conversational, two-way radio, telephone.
Memory		X			• Signals, signs, colour coding.
Computer Literacy	X				
Shift Work Demands			X		• Rotating shift schedule may be required, depending on company policies. Typical shift durations are 10- and 12- hours.

£ The Cognitive Demands Assessment (CDA) definitions and scale are outlined in Appendix 3.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 8: Photographs

Figure 1: Bolts Used for Ground Support

Figure 2: Operating Jackleg to Install Bolts

Figure 3: Preparing the Shotcrete Machine

Figure 4: Spraying Shotcrete

Underground Miner

Area of Competence: Blast Rock

Assessment Report

Minerals Processing Operator
Blast Rock — The Assessment Report

Overview

Occupational Domain:	Underground Miner	National Occupational Standard (NOS) Area of Competence:	Blast Rock
Hours of Work:	Variable, depending on mine. May work 10- or 12- hour shifts.	Breaks:	Flexible break schedule; ~1- 1½ hours in total.
Shift Work:	Rotating schedule, which is dependant on the mine site.	National Occupational Classification (NOC) Level of Work:	Heavy
Dates of Assessment:	February 17-19, 2009	Evaluators:	Trevor Hawksby, B.Sc. (H.K.), C.K. Charlene Martin, B.Sc. (H.K.), C.K.

Section 1: Detailed Task Description

According to the National Occupational Classification, Blasting Rock falls within the Heavy strength category. Once the miner drills the holes according the mine blueprints, the miner will obtain the blasting instructions from engineering. The miner determines the strength and blast pattern and obtains the appropriate blasting supplies from explosive storage for transport to the blast site. The worker inserts packs and pours explosives into the holes, and compact it using a tamping rod or explosive loading equipment. The worker will also insert blast diffusers and cap the holes prior to blasting to ensure the most effective explosion is obtained. The worker ensures that safety laws are observed and signals all workers that a blast is to occur. Some mines will conduct blasts on a set schedule. The worker will connect the detonators and detonate the charge from a safe location. The worker follows all reporting procedures including blast records and explosive material inventories.

1. Select Explosives, Blasting Agents and Detonators

The worker determines the correct type and amount of blasting agents, explosives, caps and detonators required. The worker obtains the basting agents and explosives from explosive storage. For safety reasons, detonators and caps are obtained from a separate storage room.

Full shoulder range of motion is required to select explosives, detonators cables, and caps, from the storage areas. Boxes and bags of explosive materials range is weight, and may weigh up to 25 kg.

2. Transport Explosives

Blasting supplies are transported following all applicable company policies and government regulations. Short duration of exposure to total body vibration is required when operating mobile equipment. Between 7-32 kg of force is required to operate the pedal controls of vehicles. Workers must have the capability to operate the appropriate transport vehicle.

3. Check and Clean Drilled Holes

The holes are cleaned using copper blowpipes (non-sparking) or Ammonium Nitrate and Fuel Oil (ANFO) loader. Full shoulder range of motion and the ability to lift hoses (5-13 kg) is required. Workers are required to manoeuvre the ~23 kg ANFO loader.

4. Operate Explosive Loaders

Use appropriate loader to pack the holes with explosives. This requires the ability to lift, carry, and use manual tamping copper devices. Workers must also have the ability to manipulate anti-friction, compressed air, and water hoses when using loaders. Loaders may weigh up to 25 kg. Single explosive cartridges weigh ~1-2 kg.

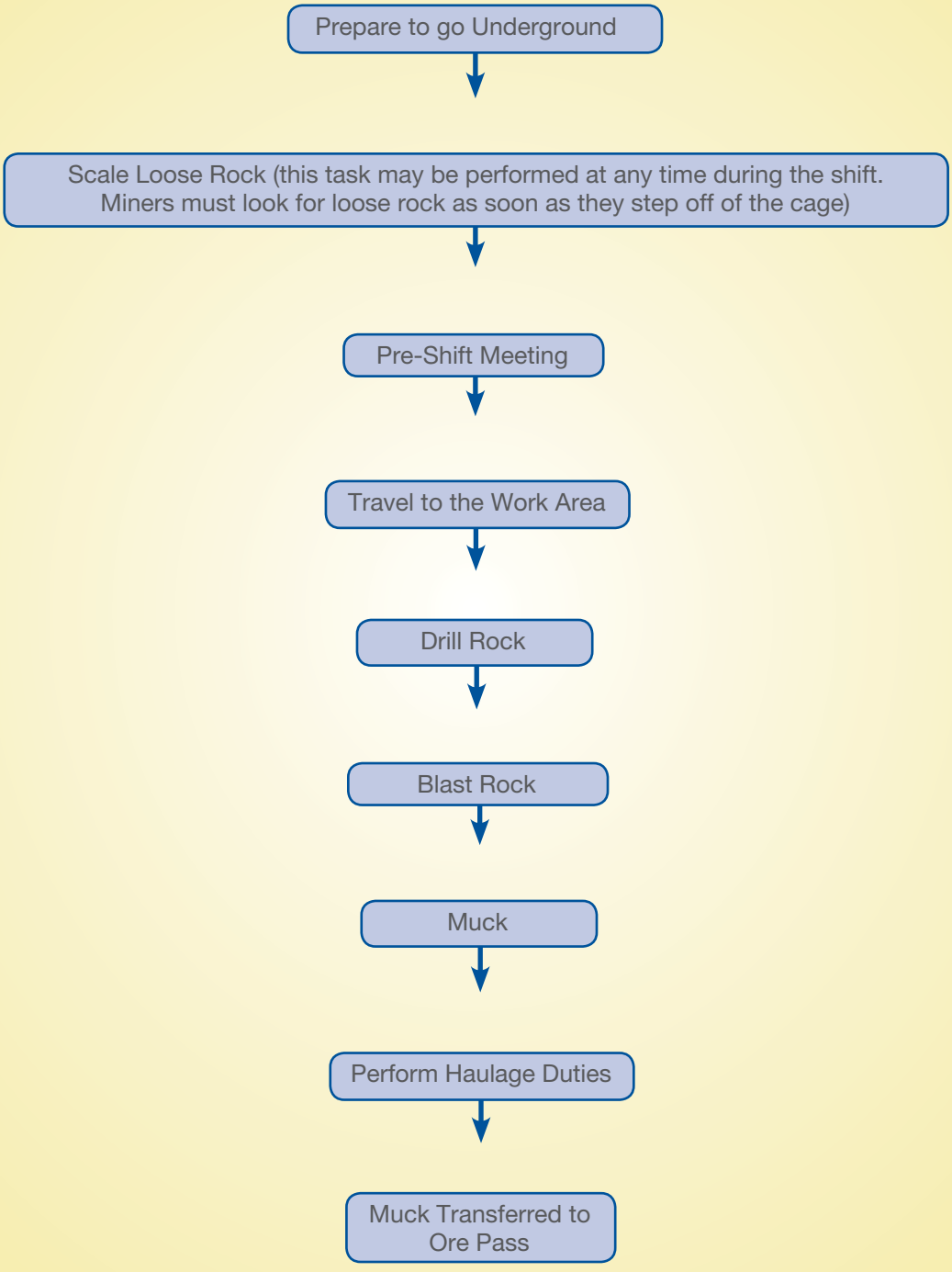
5. Dismantle, Move and Store Explosive Loading Equipment

Requires the ability to manoeuvre and lift left over explosives, as well as equipment which weighs up to 25 kg.

6. Conduct Guarding and Blasting

Scan and guard area, to ensure worker safety. Employees must follow applicable government regulations and company policies. Once area is secure, conduct blasting. Take appropriate actions when dealing with misfires. Prior to re-entering work area, ensure ventilation has been restored. Spray and thoroughly soak muckpile, rocks, and/or equipment, as needed. Workers must be able to have appropriate range of motion and strength to use water hoses, which weigh 5-13 kg.

Section 2: Workflow



Section 3: Task Objectives and Duties

Overview

Once the holes have been drilled, the Miners will blast the rock, in order to extend a drift, or to obtain the materials being mined. Workers are required to follow all government regulations and company policies regarding transportation, handling, and use of dangerous goods.

Essential Tasks

1. **Select Explosives and Blasting Agents**
- Workers must be able to identify and select the appropriate explosives and blasting agents.

2. **Select Detonators**
- Workers must have the knowledge to identify the types and function of detonators and detonator cords.
- Workers must be able to select the appropriate blasting detonator according to blasting documents.

3. **Transport Explosives**
- Workers are required to follow government regulations and company procedures for transporting explosives from the storage location to the work place, using appropriate machinery.
- Workers are required to return leftover explosives to the appropriate storage location.

4. **Clean and Check Drilled Holes**
- Workers are required to inspect any drilled holes to ensure that they are clean and that it is possible to load explosives.
- Workers may be required to clean any drilled holes, using copper blow pipes or an ANFO loader.

5. **Operate Explosive Loaders**
- Workers are required to follow all polices and procedures, as well as manufacturer's specifications for operating explosive loaders.
- Workers are required to select explosive loader, such as a loader or wooden or plastic loading stick, and conduct the pre-operation inspection.
- Workers are required to charge and prime drill holes, load and operate the ANFO loader or loading stick.

6. **Dismantle, Move, and Store Explosive Loading Equipment**
- Workers are required to complete the post-operational check after loading the explosives.
- Workers are required to dismantle explosive loading equipment; and return any explosives, and loading equipment to the appropriate storage site.

7. **Conduct Guarding and Blasting**
- Workers are required to sweep and guard area before and after blasting, according to company policy and/or government regulations.
- Workers are required to hook up blasting system, test circuit, and conduct blasting.
- Workers must inspect blast area for any misfires and take remedial actions.
- Workers are required to ensure proper ventilation, prior to returning to work area.
- Workers are required to spray the rock and muckpile with water following blasting.

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Personal Protective Equipment (PPE)

- Leather or rubber safety boots, equipped with metatarsal guards;
- Coveralls, equipped with appropriate reflective markings;
- Belt with fall arrest ring and holster for light battery pack / two-way radio;
- Hard hat;
- Safety glasses;
- Hearing protection, which may include ear plugs and/or ear muffs;
- Gloves;
- Respirator; and
- Additional task specific PPE, such as face shield, specialized hand and forearm protection, self-contained breathing apparatus, etc.

Equipment

- Cap light and battery packs, which may be equipped with a two-way radio; and
- Box cutters;
- Hammers;
- Watch and miners wrench;
- Ammonium Nitrate and Fuel Oil (ANFO) loader;
- Hoses, such as anti-static, compressed air, water hoses;
- Tamping Rod / Non-sparking loading stick (copper, wooden, or plastic);
- Explosive cartridges, primers;
- Detonating cords;
- Shock tubes;
- Scissor lift; and
- Appropriate vehicle for transportation of dangerous goods.

Section 4: Strength and Positional Requirements

STRENGTH REQUIREMENTS		FREQUENCY	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Lifting/ Lowering	Floor to Waist† (0-104cm)	Occasional	5.5-25		• Tamping Rod / non-sparking loading stick. • Air, water, anti-static hoses (5.5-13 kg). • Bazooka loader (25 kg), loaders (8-9 kg), tripod (5.5 kg). • Boxes of explosive caps (16.6-18.7 kg), bags of explosives (25 kg), ANFO loader (~23 kg, tipped on edge when loading onto vehicle).
	Waist† to Shoulder† (104-137cm)	Occasional	<0.5-8.0		• Bazooka loader (25 kg), loaders (8-9 kg), tripod (5.5 kg). • Boxes of explosive caps (16.6-18.7 kg), bags of explosives (25 kg), ANFO loader (~23 kg, tipped on edge when loading onto vehicle). • Air, water, anti-static hoses (5.5-13 kg).
	Floor to Shoulder† (0-137cm)	Occasional	1-2 kg		• Multiple unilateral lifts when placing charges in loader. • Stick of explosive (~1-2 kg).
	Above Shoulder† (>138cm)	Occasional	Up to 25 kg		• Bags of explosives (25 kg) when loading ANFO loader.
Carrying	Unilateral/ Bilateral	Occasional	1.5-25		• Carry distance is variable depending on mine site and vehicle access. • Bags of explosives (25 kg) when loading ANFO loader. • Air, water, anti-static hoses (5.5-13 kg). • Loader in case (25 kg), loaders (8-9 kg), tripod (5.5 kg). • Boxes of explosive caps (16.6-18.7 kg), bags of explosives (25 kg).
Pushing/ Pulling (kg of Force)	Vertical	Occasional		~5-10	• Hand over hand push when loading explosives in high level drill holes.
	Unilateral	Occasional		~6-8+	• Bilateral or unilateral push force needed when tamping with loading stick. Peak force values greater than 8 kg may be required when tamping explosives.
	Bilateral	Occasional		~5-10+	• Bilateral or unilateral push force needed when tamping with loading stick. Peak force values greater than 8 kg is required when tamping explosives. • Hand over hand push when loading explosives in drill holes.

The Frequency Definitions are outlined in Appendix 2.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

† Anthropometrics are based on the 50th percentile male (waist height, standing 106.3±5.4 cm; shoulder height, standing 143.7±6.2 cm) and the 50th percentile female (waist height, standing 101.7±5.0 cm; shoulder height, standing 132.9±5.5 cm); Eastman Kodak Company (1986). *Ergonomic Design for People at Work: Volume 2.* New York: Van Nostrand Reinhold Company.

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY	COMMENTS*
Sitting		Occasional	• Required when transporting explosives using appropriate transport vehicle.
Standing		Occasional	• Necessary when cleaning and loading the drilled holes, loading explosives cartridges into the breach of the loader, setting-up machinery for blasting, compacting explosives.
Walking		Occasional - Frequent	• Walking around the mine. Distances will vary depending on mine, drift, and area of work. • Sustained distances up to ~1-2 km may be required. Sustained distances up to ~1-2 km may be required. Distance walked will be dependent on whether or not a Personal Carrier or Heavy Equipment is used to get to the work area.
Climbing	**Stairs**	Occasional	• Climbing in/out of the transport vehicle or scissor lift.
	Ladders	Occasional	• On/off scissor lift.
	Uneven Ground	Occasional	• Ramps between levels have ~15 degree inclines/declines.
Balancing		Occasional	• Uneven surfaces
Crawling		Occasional	• Lower holes
Kneeling		Occasional	• May be used when loading bottom holes.
Crouching/Squatting		Occasional	• Crouching may be required when loading explosives into low level holes.
Trunk Movements		Occasional	• Partial trunk flexion, rotation, and lateral flexion may be required when blasting. • Stooping may be used when obtaining explosives from storage area, loading explosives into low level holes. • Rotation may be required when feeding anti-static tube into drilled holes.
Neck Movements		Occasional	• Full neck range of motion is required to complete this task, such as flexion when loading low level holes, rotation when using loading stick, extension when loading high level drill holes.
Reaching	**Forward/ Backward**	Frequent	• Operating explosive materials, detonators, caps from storage area, using the non-sparking loading stick, feeding explosive cartridges, operating ANFO loader.
	Upper Level	Occasional	• Worker requires full shoulder range of motion for blasting tasks.
	Sideways	Occasional	• Access explosives, one arm when using non-sparking loading stick.
Elbow Posture		Occasional	• Full range of motion at the elbow is required for blasting tasks. • Pronation or supination may be needed when holding the non-sparking loading stick, using anti-static hoses.
Wrist Posture		Occasional	• Full wrist range of motion in all directions is required to complete tasks. • Wrist extension and/or ulnar deviation may be required when loading explosive cartridges into loader.
Gripping		Frequent	• Power grip used when handling explosive materials; using non-sparking loading stick, box cutters, hammer, air, water, or anti-static hoses.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS	FREQUENCY	COMMENTS*
Pinching	Occasional	• Palmar pinch grip needed when connecting the compressed air hose to the loader. • Key pinch grip required when blowing out the compressed air line, flooding the breach with water, lubricating explosives with water prior to loading. • Tip pinch grip when handling detonating cord.
Fine Finger Dexterity	Occasional	• May be used when working with detonating and charge wires.
Striking with Hand	Occasional	• May be required to loosen latches or operate machinery controls
Foot Action	Occasional	• Use of pedal controls while operating mobile equipment. Depending on the vehicle, 7-32 kg of push force is required to depress the foot pedals.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 5: Sensory/Mental Requirements

SENSORY/MENTAL REQUIREMENTS		ESSENTIAL		COMMENTS*
		Yes	No	
Vision	**Near**	X		• Completing appropriate documentation as per company policy and government regulations.
	Far	X		• Transporting dangerous goods, distinguishing types of explosives.
	Colour	X		• Detonator wires, explosives.
Light Quality and Measurements		X		• Primary underground mining tasks require the ability to work in low level light, less than 200 Lux. • Typical underground working light is 10-15 Lux (single worker with cap light). • Ambient light while operating mobile equipment is ~200 Lux.
Hearing	**Conversation**	X		• Communicating over two-way radio, telephone, and in-person.
	Other Sounds	X		• Machinery, bells, whistles, and alarms. • Hearing protection is mandatory. Noise levels regularly exceed occupational exposure limits. • Level of noise ranges from 50 dB to 107 dB (heavy equipment operation).
Talking		X		• Conversing with the use of hearing protection. Worker may be required to speak loud or shout.
Reading/Writing		X		• Documentation, such as explosive inventory logs, blasts, misfires, as per company policy and government regulations.
Feeling		X		• Vibrations
Judgement/Decision Making		X		• Remedial actions during misfires, guarding area.
Concentration		X		• During loading activities, sequencing of detonators to holes. • Multi-tasking, communicating while operating mobile equipment.
Alertness		X		• Workers must be alert to general workplace hazards, as well as the hazards associated with the use and transport of dangerous goods.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 6: Work Environment

WORK ENVIRONMENT		ESSENTIAL		COMMENTS*
		Yes	No	
Slippery Floors or Ground		X		• Wet/muddy ground conditions, unstable footing.
Sloping or Uneven Terrain		X		• Ascending/descending ramps, loose rocks.
Inside Work		X		• Performing work in the underground mine. • Ventilated air environment.
Outside Work			X	
Extreme Heat/Extreme Cold		X		• Exposure to hot or cold conditions possible. Workers may be exposed to colder temperatures when working near the surface or a vent raise. • Ambient temperature is controlled through the use of proper ventilation.
Dry/Humid		X		• Conditions vary depending on task performed and mine site.
Dust (PPE required)		X		• May be exposed to dust. Workers may be required to wear a respirator. • Workers also control dust by spraying the rocks, muckpile, and/or equipment with water.
Vapours/Fumes (PPE required)		X		• Possible exposure • Gas detector
Chemical Irritants (PPE required)		X		• Type of chemical exposure depends on the material being mined and the mining process.
Noise (PPE required)		X		• Hearing protection is mandatory depending on the task performed and area within the mine. • Noise levels regularly exceed the occupational exposure limits. • Noise levels 50-107 dB
Moving Objects/Vehicles		X		• Scissor lift, vehicle when transporting dangerous goods, as well as other heavy equipment within mine.
Electrical Hazards			X	
Sharp Tools		X		• Box cutters
Congested/Confined Work Site		X		• Parts of a tunnelling operation or an underground mine (stopes, drifts, ramps, shafts, raises), are designed and constructed specifically for people to carry out work within them. Specific codes and standards and requirements are intended to make the space adequate for the health and safety of workers. However, parts of a tunnel or mine may include confined spaces. Tunnels and mines could also include confined spaces within them, such as bins and tanks.
Working at Heights		X		• Workers may be required to perform work on scissor lifts or platforms.
Vibration	Whole Body	X		• Exposure when transporting dangerous goods, blasting equipment, personal carriers. • Short duration of exposure, vibration frequency varies, ~8-44 Hz.
	Segmental		X	

Continued...

WORK ENVIRONMENT	ESSENTIAL		COMMENTS*
	Yes	No	
Vehicle Operation	X		• Operate Personal Carriers, scissor lifts, and/or vehicles for transporting dangerous goods.
Overtime	X		• Voluntary overtime hours may be needed, depending on production requirements.
Shift Work	X		• May be required depending on company policies. Typical shifts are 10- and 12- hours.
Working Alone	X		• Works independent within a group of individuals. Check-in policy mandatory.
Working with Others	X		

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 7: Behavioural/Cognitive Demands

BEHAVIOURAL/COGNITIVE DEMANDS	CDA[£] RANKING SCALE				COMMENTS*
	1	2	3	4	
Degree of Self-Supervision Required			X		• Obtain instructions from supervisors during line-up meetings, conducted at start of shift. • May need clarification regarding blasting prints/plans, and/or safety issues.
Degree of Supervision Exercised	X				
Deadline Pressures (Time Pressure)			X		• Daily, weekly, and month production targets.
Attention to Detail		X			• Reviewing blast prints/plans, following instructions from line-up meetings, completing reports, such as safety, explosive inventory logs, misfires, working with dangerous goods.
Performance of Multiple Tasks Required		X			• When conducting blasting, transporting dangerous goods.
Exposure to Distracting Stimuli				X	• High noise levels, moving equipment, ground conditions.
Need to Work Co-operatively with Others			X		• Loading charges, transporting dangerous goods.
Exposure to Emotional Situations	X				
Exposure to Confrontational Situations	X				
Responsibility and Accountability Required				X	• Responsibility and accountability for maintaining a safe work environment, as well as the hazards associated with the use and transport of dangerous goods.
Reading Literacy			X		• Reviewing labels on explosives, detonators; as well as additional documentation, such as safety reports, misfires, explosive inventory log, blasting prints/plans.
Written Literacy		X			• Completing inventory, reports, pre-operation and post-operational checks.
Numerical Skills		X			
Verbal Communication			X		• Conversational, two-way radio, telephone.
Memory		X			• Identify the types and function of detonators and detonator cords.
Computer Literacy	X				
Shift Work Demands			X		• Rotating shift schedule may be required, depending on company policies. • Typical shift durations are 10- and 12- hours.

[£] The Cognitive Demands Assessment (CDA) definitions and scale are outlined in Appendix 3.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 8: Photographs

Figure 1: ANFO Loaders

Underground Miner

Area of Competence: Muck

Assessment Report

Minerals Processing Operator
Muck — The Assessment Report

Overview

Occupational Domain:	Underground Miner	National Occupational Standard (NOS) Area of Competence:	Muck
Hours of Work:	Variable, depending on mine. May work 10- or 12- hour shifts.	Breaks:	Flexible break schedule; ~1- 1½ hours in total.
Shift Work:	Rotating schedule, which is dependant on the mine site.	National Occupational Classification (NOC) Level of Work:	Light - Heavy
Dates of Assessment:	February 17-19, 2009	Evaluators:	Trevor Hawksby, B.Sc. (H.K.), C.K. Charlene Martin, B.Sc. (H.K.), C.K.

Section 1: Detailed Task Description

Mucking is the process of removing loose muck (rock) from the muckpile and transferring it into the Ore Pass using rail cars, haulage trucks, or directly using the Load Haul Dump (LHD) machine.

Some mines may use continuous mucking machines which lift the muck from the pile on to a conveyor belt. The conveyor transfers it into a truck or onto another conveyor for transfer to the Ore Pass.

1. LHD/Scooptram Operation

Based on the National Occupational Classification, LHD/scooptram operation falls within the Light strength category. However, the operator may be required to lift a 22.5 kg pail of hydraulic oil, as needed throughout the week. Unrestricted shoulder movement in all directions, bilaterally, is required to drive the LHD/scooptram. To ensure safety when driving, the worker requires full unrestricted neck rotation in both directions. The worker requires minimal grip strength bilaterally and good finger dexterity to operate the vehicle/remote controls.

2. Manual Mucking Tasks

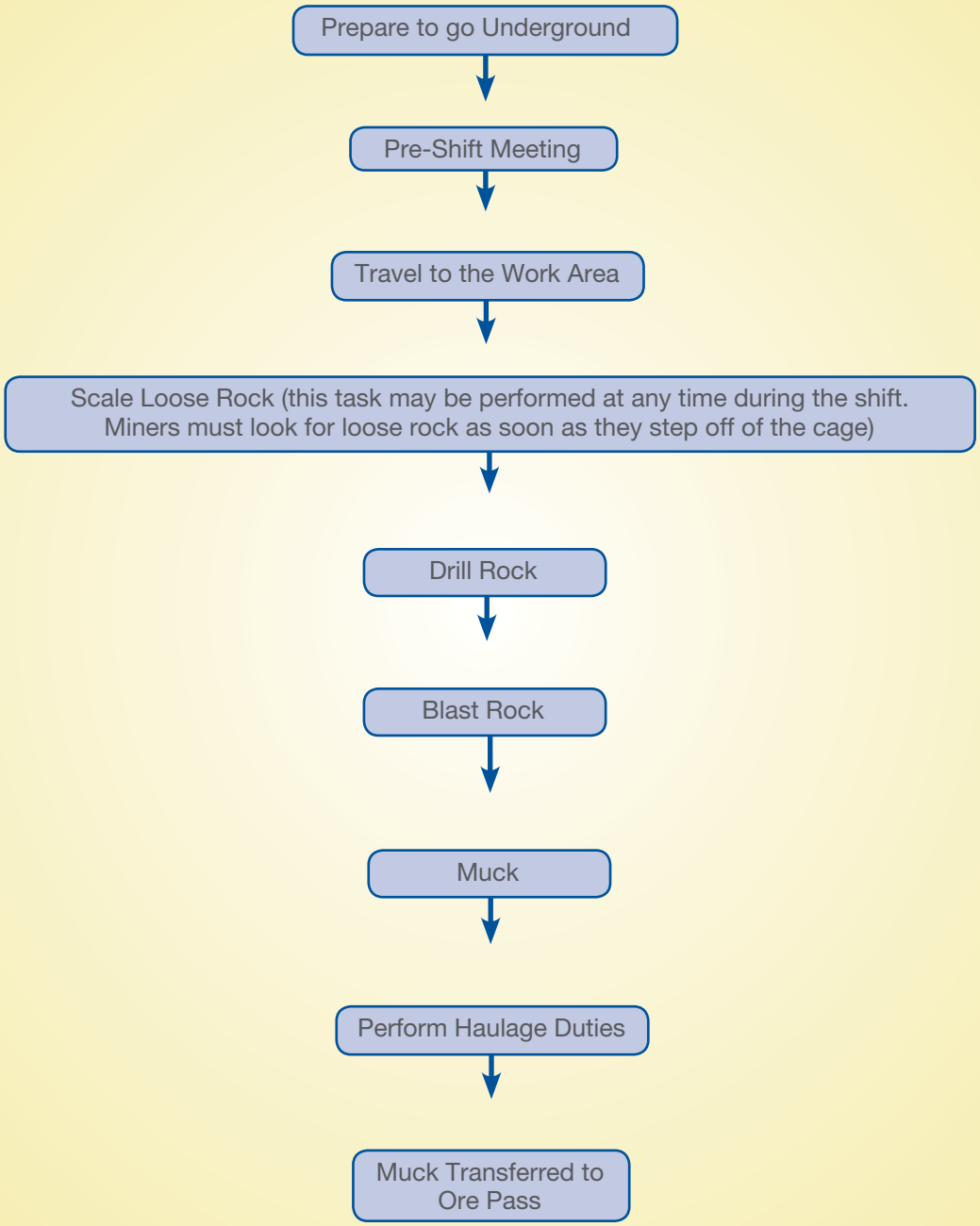
Some mines may require the miners to perform some manual mucking tasks. Manual mucking falls within the Heavy strength category, according to the National Occupational Classification. Manual mucking also occurs in areas of the mine, which cannot accommodate a mucking machine or LHD/scooptram, such as safety areas on ramps. Workers may be required to use mucking bars, grub hoes, and shovels to manipulate the muck piles, so that it can be moved using either heavy equipment or manually transferred into a haulage cart. Manual Mucking tasks involve pushing/pulling forces exceeding 50 kg (bar muck). Using the grub hoe requires the ability to stoop/partially squat and swing the grub hoe to engage the muck. The grub hoe is pulled inward towards the body to move the muck. Pull forces will vary depending on the quality of the muck and the amount being moved. Using a grub hoe requires significant grip strength. The workers may be required to break large rocks using a sledge hammer, when operating slushers/mucking machines. The task involves active trunk rotation, flexion and extension, as well as unrestricted shoulder range of motion bilaterally.

3. Mucking Machine/Slusher Set-up and Operation

Workers may be required to operate slushers and/or a mucking machine if the mine is not equipped with LHD or scooptrams. Slusher set-up and operation falls within the Heavy strength category. The miner operates a cable-drawn scraper or scoop that is pulled with a hoist to load muck into mine cars or onto a conveyor. The worker is required to set up a timber or steel foundation for the slusher. In addition, the worker is required to secure the hoist in place using pulleys, eyebolts, and anchors. This requires the use of a jackleg to drill holes and fasten the anchors. The worker manipulates a lever to activate the hoist, which drags the scraper over the face of ore, to the mine car for dumping. Workers are also responsible for moving the equipment within the mine using rail car, or other transport equipment. The workers may also be required to maintain/lubricate the appropriate mechanical parts.

Workers may be required to operate a mucking machine or power shovel to load muck into rail cars or onto conveyors. Mucking machine operation falls within the Medium strength category. The workers drive the mucking machine into position and operate control levers, which force the scoop into the muckpile. Muck is then moved from the pile into the rail car or conveyor.

Section 2: Workflow



Section 3: Task Objectives and Duties

Overview

Mucking is the process by which the blasted rock/ore is transferred to the Ore Pass or Chute.

Equipment

1. **Perform Pre-Operational Check on Equipment**
- Workers are required to set-up the slusher or mucking machine. The type of equipment used for mucking will vary depending on the mine site.
- Workers are required to perform the pre-operational or pre-start and post-start checks on any machinery.

2. **Control Dust**
- Workers are required to spray the rock pile, as needed, in order to control dust.

3. **Operate Mucking Equipment**
- Workers are required to ensure all safety precautions are implemented, before and during operation.
- Scrape material to desired location. Workers should inspect muckpile and take corrective actions, as needed.
- Workers are required to load and dump rock to the appropriate area. The type of mucking equipment used for this process will vary depending on the mine location. Workers may manually move muck, operate a mucking machine, slusher, load haul dump (LHD) machine, or electric scoop to haul and dump muck.

4. **Manage Muckpile**
- Workers are required to ensure the muckpile does not become excessively steep, and may be required to bar muck.
- Workers are required to spray rock pile, as needed, to control dust.

5. **Shut Down and Secure Mucking Equipment**
- Workers are required to shut down and/or secure any equipment, such as the slusher, mucking machine, LHD machine, and complete any post-operational checks, as required.
- Perform any housekeeping tasks and ensure signs and/or guarding are in place.

Personal Protective Equipment (PPE)

- Leather or rubber safety boots, equipped with metatarsal guards;
- Coveralls, equipped with appropriate reflective markings;
- Belt with fall arrest ring and holster for light battery pack / two-way radio;
- Hard hat;
- Safety glasses;
- Hearing protection, which may include ear plugs and/or ear muffs;
- Gloves;
- Respirator; and
- Additional task specific PPE, such as face shield, specialized hand and forearm protection, self-contained breathing apparatus, etc.

Equipment

- Cap light and battery packs, which may be equipped with a two-way radio;
- Water hoses;
- Grub hoes;
- Shovels;
- Watch and miners wrench;
- Mucking bars;
- Scooptram;
- Load Haul Dump (LHD) Machine;
- Jackleg;
- Slusher; and/or
- Mucking Machine.

Section 4: Strength and Positional Requirements

STRENGTH REQUIREMENTS		FREQUENCY£	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Lifting/ Lowering	Floor to Waist† (0-104cm)	Occasional - Frequent	2 - 51		• Water hoses (5-13 kg) to control dust when mucking. • Using grub hoe (2 kg) when manually mucking, ~5 kg when full of muck • Wheel chocks (4-7 kg), pail of hydraulic oil (25 kg) during scooptram operation • Setting up timber or steel foundation and operating jackleg (51 kg) for slusher.
	Waist† to Shoulder† (104-137cm)	Occasional - Frequent	2 - 25+		• Using mucking bar, grub hoe (2 kg) when manually mucking, ~5 kg when full of muck • Pail of hydraulic oil (25 kg) during scooptram operation • Setting up timber or steel foundation
	Floor to Shoulder† (0-137cm)	Never	-		
	Above Shoulder† (>138cm)	Never	-		
Carrying	Unilateral/ Bilateral	Occasional	2 - 51		• Carry or drag water hoses (5-13 kg) <~10 m, distance will vary depending on the mine site. Miner may use one or two hands. • Carry tools for manually mucking (2-5 kg); worker has the option of one or two hands. • Wheel chocks (4-7 kg), pail of hydraulic oil (25 kg) during scooptram operation • Carrying jackleg (51 kg). Workers were observed to cradle jackleg in arms when transporting. • Setting up timber or steel foundation
Pushing/ Pulling (kg of Force)	Vertical	Never			
	Unilateral	Occasional - Frequent		5-14	• Open/close the LHD/scooptram door (11-14 kg); handle is located ~150 cm from the ground. Worker may use one or two hands. • Directional and scoop controls 4-8 kg of push/pull force. Controls are located on each side of the worker and require bilateral arm/ hand use. • Remote controls for scooptram require push/pull force of 5 kg of force.
	Bilateral	Occasional - Frequent		11-20+	• Open/close the LHD/scooptram door (11-14 kg); handle is located ~150 cm from the ground. Worker may use one or two hands. • Manipulate the water hoses, when spraying the muckpiles. • Manual mucking tasks involve pushing/pulling forces, which will vary depending on worker capability. May require and/or exceed forces of ~20+ kg to bar muck.

The Frequency Definitions are outlined in Appendix 2.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

† Anthropometrics are based on the 50th percentile male (waist height, standing 106.3±5.4 cm; shoulder height, standing 143.7±6.2 cm) and the 50th percentile female (waist height, standing 101.7±5.0 cm; shoulder height, standing 132.9±5.5 cm); Eastman Kodak Company (1986). *Ergonomic Design for People at Work: Volume 2.* New York: Van Nostrand Reinhold Company.

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY£	COMMENTS*
Sitting		Occasional - Frequent	• Frequency will vary depending on work assignment and the type of equipment used. • Sustained sitting is required when mucking with LHD/scooptram or mucking machine. • Exposure to low frequency vibration with large peak vertical displacement values when operating vehicles on uneven/rough terrain (see vibration values).
Standing		Occasional	• Remote operation of the LHD/scooptram in dangerous areas. • Operation of a slusher.
Walking		Occasional	• Walking within the mine. Exposure to slippery and uneven terrain when walking. • Distances will vary depending on mine, drift, and area of work. • Sustained distances up to ~1-2 km may be required. Distance walked will be dependent on whether or not a Personal Carrier, Heavy Equipment or Tram is used to get to the work area.
Climbing	**Stairs or Mount/ Dismount Machinery**	Occasional	• Two steps in order to climb into the LHD/scooptram, which are located 45 and 70 cm high. Grab bars are available to assist with climbing tasks. • When remotely operating the LHD /scooptram, workers may be required to transfer to a safety platform for mounting/dismounting. • Three-point mount and four-point dismount required.
	Ladders	Never	
	Uneven Ground	Occasional	• Ramps between levels have ~15 degree inclines/declines. • May be required to climb a muckpile.
Balancing		Occasional	• Uneven surfaces
Crawling		Never	
Kneeling		Never	
Crouching/Squatting		Occasional	• Partial squat posture with stoop when using the grub hoe during manual mucking tasks. • Conducting pre-operational checks, maintenance on machinery, and/or setting up slusher.
Trunk Movements		Occasional	• Partial range trunk rotation needed when operating LHD/scooptram. • Non-neutral flexion when performing pre-operational checks, setting up mucking machine and slusher, placing wheel chocks. • During manual mucking tasks, stooping may be needed when using grub hoe, trunk rotation with flexion/extension needed when using sledge hammer.
Neck Movements		Occasional-Frequent	• Full neck rotation in both directions required when operating the LHD/scooptram or mucking machine. • Unrestricted neck range of motion in all directions is required for cap light communication and remote operation of vehicles. • Full neck extension is required for viewing the raise/back for loose rock and/or safety concerns.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY	COMMENTS*
Reaching	Forward/ Backward	Occasional - Frequent	• Required when manual mucking with grub hoe, shovel, mucking bar. • Setting up mucking machine and slusher, as well as conducting pre-operational checks. • Operating LDH/scooptram or other mucking equipment. • Machine operation typically requires horizontal reach distances of 0-100 cm. Machine controls are typically located 0-25 cm above the level of the vehicle seat.
	Upper Level	Occasional	• Accessing grab bars when climbing onto LHD/scooptram. • Handles range from 100-150 cm from the ground.
	Sideways	Occasional - Frequent	• Operating controls of LHD/scooptram, mucking machine, or personal carriers. • Controls are typically located 0-90 cm to the side of the worker. • May also be required when manually mucking.
Elbow Posture		Occasional - Frequent	• Operation of LHD/scooptram performed in neutral forearm position. • Full range pronation may be required to operate machinery.
Wrist Posture		Occasional - Frequent	• Partial range of motion in all directions required to operate machinery. • Manual mucking tasks result in end-range wrist movements in all directions with forces exceeding 20 kg (for example swinging a sledge hammer, using a mucking bar)
Gripping		Frequent	• Power grip required in order to manipulate controls on LHD, operate/set-up slusher, mucking machine. • Power grip needed to hold onto grub hoe, mucking bar, or sledge hammer.
Pinching		Occasional	• Key pinch required to operate remote controls on scooptram, pistol grip needed in order to operate directional controls on scooptram.
Fine Finger Dexterity		Occasional	• Completing pre- and post- operational logs.
Striking with Hand		Occasional	• May be required to loosen latches, operate machinery control • Impact from the mucking bar, shovels during manual mucking tasks
Foot Action		Occasional	• Plantar flexion and dorsi flexion required to use the pedal controls while operating mobile equipment. Depending on the vehicle, 7-32 kg of push force is required to depress the foot pedals.

£ The frequencies documented will vary depending on the method used when mucking, the material being process at the mine locations.
* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 5: Sensory/Mental Requirements

SENSORY/MENTAL REQUIREMENTS		ESSENTIAL		COMMENTS*
		Yes	No	
Vision	Near	X		• Operating machine controls.
	Far	X		• When driving LHD/scooptram, operating machinery, looking for loose rock/safety concerns.
	Colour		X	
Light Quality and Measurements		X		• Primary underground mining tasks require the ability to work in low level light, less than 200 Lux. • Typical underground working light is 10-15 Lux (single worker with cap light). • Ambient light while operating mobile equipment is ~200 Lux.
Hearing	Conversation	X		• Communicating over two-way radio, telephone, and in-person.
	Other Sounds	X		• Machinery, bells, whistles, and alarms. • Hearing protection is mandatory. Noise levels regularly exceed occupational exposure limits. • Level of noise ranges from 50 dB to 107 dB (heavy equipment operation).
Talking		X		• Conversing with the use of hearing protection. Worker may be required to speak loud or shout.
Reading/Writing		X		• Completing pre- and post- operational reports, reading mine prints/maps, signs.
Feeling			X	
Judgement/Decision Making		X		• Communicate safe working conditions.
Concentration		X		• Multi-tasking, communicating while operating mobile equipment.
Alertness		X		• Workers must be alert to workplace hazards, which may include ground conditions, mobile equipment, or power tools.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 6: Work Environment

WORK ENVIRONMENT		ESSENTIAL		COMMENTS*
		Yes	No	
Slippery Floors or Ground		X		• Wet/muddy ground conditions, unstable footing.
Sloping or Uneven Terrain		X		• Ascending/descending ramps, loose rocks.
Inside Work		X		• Performing work in the underground mine. Ventilated air environment.
Outside Work			X	
Extreme Heat/Extreme Cold		X		• Exposure to hot or cold conditions possible. Cooler temperatures when working near the surface or in close proximity to vent raises. Typically, ambient temperature is controlled through the use of proper ventilation.
Dry/Humid		X		• Conditions vary depending on task performed and mine site.
Dust (PPE required)		X		• May be exposed to dust. Workers may be required to wear a respirator. • Workers also control dust by spraying the muckpile with water.
Vapours/Fumes (PPE required)		X		• From heavy equipment and/or power tools.
Chemical Irritants (PPE required)		X		• Type of chemical exposure depends on the material being mined and the mining process.
Noise (PPE required)		X		• Hearing protection is mandatory depending on the task performed and area within the mine. • Noise levels regularly exceed the occupational exposure limits. Noise levels range from 50-107 dB.
Moving Objects/Vehicles		X		• LHD/scooptram, mucking machine, slusher.
Electrical Hazards			X	
Sharp Tools		X		• Grub hoe.
Congested/Confined Work Site		X		• Parts of a tunnelling operation or an underground mine (stopes, drifts, ramps, shafts, raises), are designed and constructed specifically for people to carry out work within them. Specific codes and standards and requirements are intended to make the space adequate for the health and safety of workers. However, parts of a tunnel or mine may include confined spaces. Tunnels and mines could also include confined spaces within them, such as bins and tanks.
Working at Heights		X		• Workers may be required to perform work platforms, muckpiles, staging.
Vibration	Whole Body	X		• Exposure when operating heavy equipment. • The degree and duration of exposure, as well as vibration frequency (Scooptram 8-44 Hz) will vary according to the type of equipment, task performed, and mine location.
	Segmental	X		• Exposure when operating jackleg to set-up platform for slusher. • The degree and duration of exposure, as well as vibration frequency (Jackleg 960-1700 Hz) will vary according to mine location. Jackleg accelerations are in the magnitude of 15 to 32m/s^2.

Continued...

WORK ENVIRONMENT	ESSENTIAL		COMMENTS*
	Yes	No	
Vehicle Operation	X		• Operate LHD/scooptram, mucking machine, slusher, personal carriers
Overtime	X		• Voluntary overtime hours may be needed, depending on production requirements.
Shift Work	X		• May be required depending on company policies. Typical shifts are 10- and 12- hours.
Working Alone	X		• Works independent within a group of individuals. Check-in policy mandatory.
Working with Others	X		

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 7: Behavioural/Cognitive Demands

BEHAVIOURAL/COGNITIVE DEMANDS	CDA[£] RANKING SCALE				COMMENTS*
	1	2	3	4	
Degree of Self-Supervision Required			X		• Instructions from supervisor during line-up meetings, conducted at the start of the shift. • May need clarification regarding mine prints/plans, and/or safety issues.
Degree of Supervision Exercised	X				
Deadline Pressures (Time Pressure)			X		• Daily, weekly, and monthly production targets.
Attention to Detail		X			• Reviewing mine prints/plans, completing reports, such as pre- and post-operational checks, daily production logs.
Performance of Multiple Tasks Required		X			• Communicating while operating mucking equipment.
Exposure to Distracting Stimuli				X	• High noise levels, moving equipment.
Need to Work Co-operatively with Others			X		• Light, hand, whistle, horn, and bell signals.
Exposure to Emotional Situations	X				
Exposure to Confrontational Situations	X				
Responsibility and Accountability Required				X	• Responsible and accountable for maintaining a safe work environment.
Reading Literacy		X			• Reviewing signs and/or reports, such as safety, daily logs, production reports, mine prints/plans.
Written Literacy		X			• Completing reports, log books, and pre-operation checks.
Numerical Skills		X			• Horn, whistle, and bell signals when communicating.
Verbal Communication			X		• Conversational, two-way radio.
Memory		X			• Signals, signs.
Computer Literacy	X				
Shift Work Demands			X		• Rotating shift schedule may be required, depending on company policies. Typical shift durations are 10- and 12- hours.

[£] The Cognitive Demands Assessment (CDA) definitions and scale are outlined in Appendix 3.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 8: Photographs

Figure 1: Jackleg Used in Order to Install Platform for Slusher

Figure 2: Scooptram

Figure 3: Remote Operation of Scooptram

Underground Miner

Area of Competence: Perform Haulage Duties

Assessment Report

Minerals Processing Operator
Perform Haulage Duties — The Assessment Report

Overview

Occupational Domain:	Underground Miner	National Occupational Standard (NOS) Area of Competence:	Perform Haulage Duties
Hours of Work:	Variable, depending on mine. May work 10- or 12- hour shifts.	Breaks:	Flexible break schedule; ~1- 1½ hours in total.
Shift Work:	Rotating schedule, which is dependant on the mine site.	National Occupational Classification (NOC) Level of Work:	Medium - Heavy
Dates of Assessment:	February 17-19, 2009	Evaluators:	Trevor Hawksby, B.Sc. (H.K.), C.K. Charlene Martin, B.Sc. (H.K.), C.K.

Section 1: Detailed Task Description

Workers are required to haul ore and rocks from one area of the mine to another. The workers obtain muck from the muckpile and transfer it to the Ore Pass using Load Haul Dump (LHD) machines/scooptrams, mucking machines, conveyors and chutes. This task falls within the Medium-Heavy strength categories and will vary depending on the type of machinery being used at the mine. LHD and scooptram haulage duties fall within the Medium strength category, where as miners operating slushers/ mucking machines, track haulage, conveyors, and chutes during haulage tasks will work within the Heavy strength level.

1. Convey Material Using Track Haulage:

Workers are responsible for setting up safety barriers, setting up remote operation, performing basic maintenance and operation of the locomotives, which includes loading/unloading train. This task may entail lifting and carrying items.

2. Convey Material Using Heavy Equipment:

Workers are responsible for transferring muck, tools and supplies, within the mine using heavy equipment. Workers are responsible for general machine maintenance. Heavy equipment is used to grade haulage ways.

Depending on the type of equipment used for haulage, miners may be exposed to vibration when operating heavy equipment, such as the scooptram. In some instances, the directional controls and/or scoop controls are located on either side of the operator's seat, which requires bilateral hand and arm use. Unrestricted neck rotation and forward reaching is also required when driving heavy equipment within the mine.

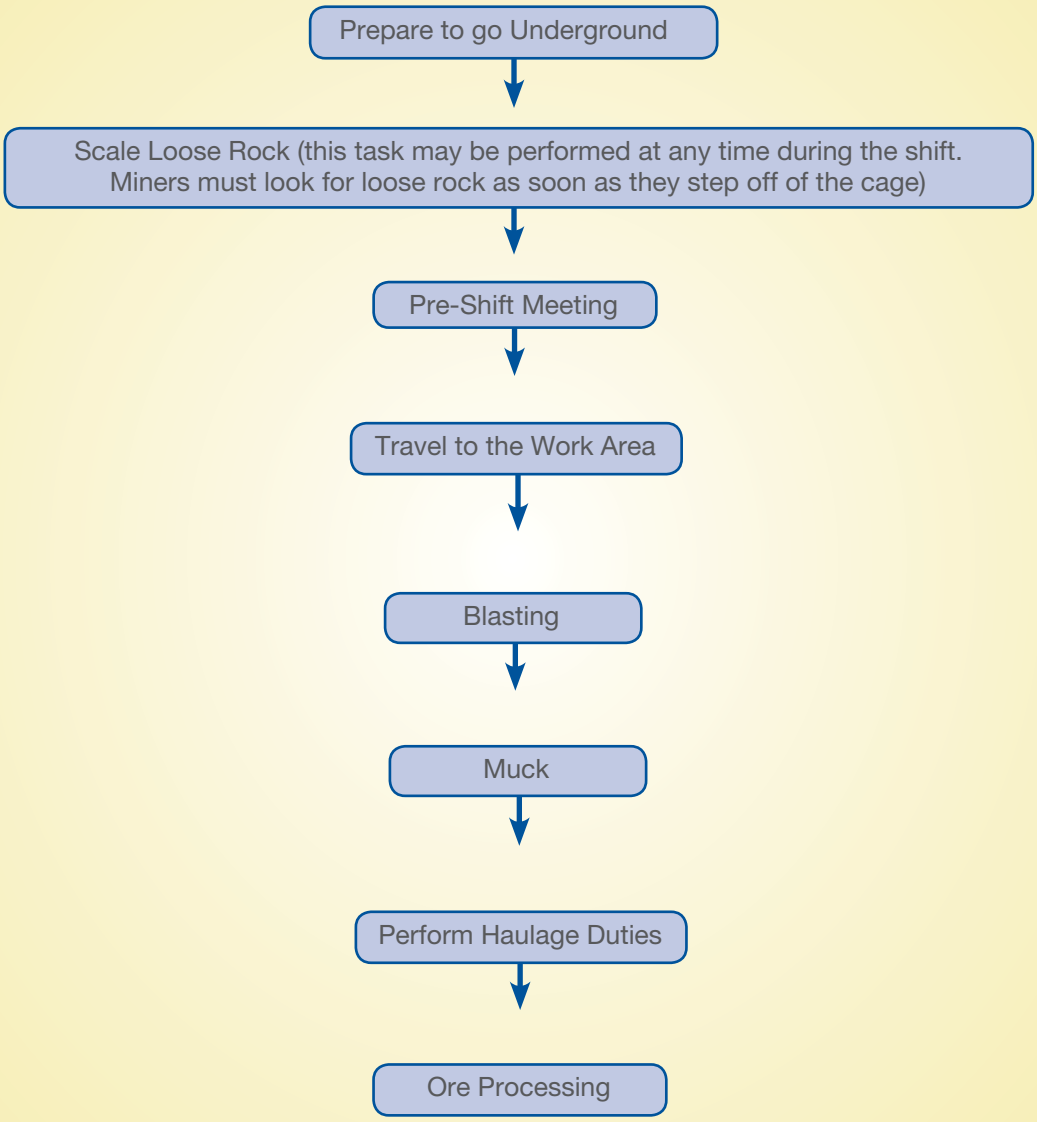
3. Inspect Chutes:

Workers are responsible for inspecting chutes to ensure that that they are free of hang-ups and water back-ups. Workers are responsible for installation of pumps, water diversion and installation of signs, barriers and fall restraint devices around the chutes.

4. Operate Crusher/Rock Breaker:

If Ore/Rock is too large and cannot be broken by hand or it is unsafe to do so, the workers will be required to operate a rock breaker. Depending on the mine location, the worker may be required to climb several steps in order to access the crusher / rock breaker machine. Bending the neck or trunk to the side, may also be required in order to monitor the rock while it is transferred through the crusher. Operation of the crusher / rock break machine requires the ability to stand for prolonged periods. Workers operating the rock breaker / crusher are subjected to low frequency vibration from the floor and/or overpass of the crusher machine, when standing.

Section 2: Workflow



Section 3: Task Objectives and Duties

Overview

Workers are responsible for hauling muck from the muckpile to the Ore Pass. Workers may also transport equipment from one area of the mine to the other using heavy equipment, track haulage, and conveyors. Prior to completing any haulage duties, workers are required to plan and prepare operations, according to mine policies and procedures.

Essebtial Tasks

1. **Perform Track Haulage**
- Workers are required to set-up remote operation and ensure correct transmission. Perform maintenance, as required.
- Prepare for track haulage operations and conduct pre-operation inspection.
- Prior to hauling material, workers are required to hook up and secure locomotives to cars, and operate locomotive.
- Workers are required to position cars underneath material chute / loading point, and load/unload train.
- Workers are required to complete any maintenance tasks, perform post-operational checks, and shut down equipment.

2. **Operate Heavy Equipment**
- Workers are required to conduct any pre-operation checks according to mine policies and procedures.
- Operate heavy equipment in order to load and dump material.
- Perform any post-operational checks and shut down equipment.

3. **Manage Haulage Ways**
- Workers are required to assess the surface conditions and grade site in order to ensure suitable hauling surface.
- Workers are required to perform equipment inspections and carry out any routine operational servicing, as needed.
- Shut down equipment and complete any required documentation.

4. **Inspect for Water in Chutes and Hang-Ups**
- Workers are required to visually inspect water in the chutes and hang-ups, and take remedial actions, as required.

5. **Operate Rock Breaker**
- Conduct any rock breaker warm-up operations, pre-operational checks, and erect any signage or barricades.
- Workers are required to operate rock breaker, according to job specification.
- Workers are required to shut down, maintain, and store rock breaker.

6. **Conduct Conveyor Operations**
- Workers are required to perform pre-operation check on the conveyor, prior to operating.
- While conveying material, workers are required to inspect and remove any contaminants.
- Workers are required to conduct any minor maintenance tasks, and shut down system.

Continued...

Personal Protective Equipment (PPE)

- Leather or rubber safety boots, equipped with metatarsal guards;
- Coveralls, equipped with appropriate reflective markings;
- Belt with fall arrest ring and holster for light battery pack / two-way radio;
- Hard hat;
- Safety glasses;
- Hearing protection, which may include ear plugs and/or ear muffs;
- Gloves;
- Respirator; and
- Additional task specific PPE, such as face shield, specialized hand and forearm protection, self-contained breathing apparatus, etc.

Equipment

- Cap light and battery packs, which may be equipped with a two-way radio;
- Scoop tram;
- Track haulage / train;
- Crusher; and/or
- Conveyor;
- Watch and miners wrench.

Section 4: Strength and Positional Requirements

STRENGTH REQUIREMENTS		FREQUENCY£	LOAD (KG)	FORCE (KG OF FORCE)	COMMENTS*
Lifting/ Lowering	Floor to Waist† (0-104cm)	Occasional - Frequent	2 – 20+		• Wheel chocks (4-7 kg), hydraulic oil (25 kg) during pre-op checks.
	Waist† to Shoulder† (104-137cm)	Occasional - Frequent	2 - 20+		• Pail of hydraulic oil (25 kg) hydraulic oil (25 kg) during pre-op checks.
	Floor to Shoulder† (0-137cm)	Occasional	25		• Pail of hydraulic oil (25 kg) hydraulic oil (25 kg) during pre-op checks.
	Above Shoulder† (>138cm)	Occasional	25		• Pail of hydraulic oil (25 kg) hydraulic oil (25 kg) during pre-op checks.
Carrying	Unilateral/ Bilateral	Occasional	2 – 25		• Wheel chocks (4-7 kg), pail of hydraulic oil (25 kg) during scooptram operation.
Pushing/ Pulling (kg of Force)	Vertical	Never			
	Unilateral	Occasional - Frequent		5-14	• Open/close the LHD/scooptram door (11-14 kg of force). Handle is located 150 cm from the ground. Worker may use one or two hands. • Directional and scoop controls require 4-8 kg of push/pull force. Controls are located on each side of the worker. • Remote controls for scooptram require push/pull force of 5 kg of force.
	Bilateral	Occasional - Frequent		11-20+	• Open/close the LHD/scooptram door (11-14 kg of force). Handle is located 150 cm from the ground. Worker may use one or two hands. • Directional and scoop controls 4-8 kg of push/pull force. Controls are located on each side of the worker. • Remote controls for scooptram require push/pull force of 5 kg of force. • Hooking up and securing the locomotives to a rack of cars.

The Frequency Definitions are outlined in Appendix 2.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

† Anthropometrics are based on the 50th percentile male (waist height, standing 106.3±5.4 cm; shoulder height, standing 143.7±6.2 cm) and the 50th percentile female (waist height, standing 101.7±5.0 cm; shoulder height, standing 132.9±5.5 cm); Eastman Kodak Company (1986). *Ergonomic Design for People at Work: Volume 2.* New York: Van Nostrand Reinhold Company.

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY£	COMMENTS*
Sitting		Occasional - Frequent	• Frequency will vary depending on work assignment and the type of equipment used. • Sustained sitting is required when hauling with LHD/scooptram or mucking machine. • Exposure to low frequency vibration with large peak vertical displacement values when operating vehicles on uneven/rough terrain (see vibration).
Standing		Occasional	• Remote operation of the LHD/scooptram in dangerous areas.
Walking		Occasional	• Walking within the mine. Exposure to slippery and uneven terrain when walking. • Distances will vary depending on mine, drift, and area of work. • Sustained distances up to ~1-2 km may be required. Distance walked will be dependent on whether or not a Personal Carrier, Heavy Equipment or Tram is used to get to the work area.
Climbing	**Stairs or Mount/ Dismount Machinery**	Occasional	• Two steps in order to climb into the LHD/scooptram, which are located 45 and 70 cm high. Grab bars are available to assist with climbing tasks. • When remotely operating the LHD /scooptram, workers may be required to transfer to a safety platform for mounting/dismounting. • Mount/dismount. • Stairs required in order to access crushing machine.
	Ladders	Occasional	• Climbing on fixed ladders
	Uneven Ground	Occasional	• Ramps between levels have ~15 degree inclines/declines.
Balancing		Occasional-Frequent	• Mounting and dismounting
Crawling		Occasional	• Machinery repair/maintenance
Kneeling		Occasional	• Machinery repair/maintenance
Crouching/Squatting		Occasional	• Conducting pre-operational checks, maintenance on machinery.
Trunk Movements		Occasional	• Partial range trunk rotation needed when operating LHD/scooptram. • Non-neutral flexion when performing pre-operational checks or placing wheel chocks.
Neck Movements		Occasional-Frequent	• Full range neck rotation in both directions when operating the LHD/scooptram or mucking machine. • Sustained flexion needed when operating and monitor crushing machine. • Unrestricted neck range of motion in all directions is required for cap light communication and remote operation of vehicles. • Full neck extension is required for viewing the raise/back for loose rock and/or safety concerns.

Continued...

MOBILITY AND POSTURAL REQUIREMENTS		FREQUENCY£	COMMENTS*
Reaching	Forward/ Backward	Occasional - Frequent	• Operating LDH/scooptram. • Operation of machinery typically occurs in the range of 0 to 100 cm forward reach. Machine controls are typically located 0 to 25 cm above the level of the vehicle seat. • Remote operation of the locomotive.
	Upper Level	Occasional	• Accessing grab bars when climbing onto LHD/scooptram. • Handles range from 100-150 cm from the ground.
	Sideways	Occasional - Frequent	• Operating controls of LHD/scooptram, mucking machine, or personal carriers. • Controls are typically located 0-90 cm to the side of the worker.
Elbow Posture		Occasional - Frequent	• Operation of LHD/scooptram performed in neutral forearm position. • Full range pronation may be required to operate machinery.
Wrist Posture		Occasional - Frequent	• Partial range of motion in all directions required to operate machinery.
Gripping		Frequent	• Power grip to manipulate controls on LHD and remote operation.
Pinching		Occasional	• Key pinch required to operate remote controls on scooptram, pistol grip needed in order to operate directional controls on scooptram. • Key/palmar pinch grip needed to operate controls on crushing machine.
Fine Finger Dexterity		Occasional	• Pre-operational checks.
Striking with Hand		Occasional	• May be required to loosen latches, operate machinery controls.
Foot Action		Occasional	• Plantar flexion and dorsi flexion required to use the pedal controls while operating mobile equipment. Depending on the vehicle, 7-32 kg of push force is required to depress the foot pedals.

£ The frequencies documented will vary depending on the method used when performing haulage tasks.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 5: Sensory/Mental Requirements

SENSORY/MENTAL REQUIREMENTS		ESSENTIAL		COMMENTS*
		Yes	No	
Vision	Near	X		• Operating controls, pre- and post- operational checklists.
	Far	X		• Driving LHD/scooptram, looking for loose rock/safety concerns.
	Colour		X	
Light Quality and Measurements		X		• Primary underground mining tasks require the ability to work in low level light, less than 200 Lux. • Typical underground working light is 10-15 Lux (single worker with cap light). • Ambient light while operating mobile equipment is ~200 Lux.
Hearing	Conversation	X		• Communicating over two-way radio, telephone, and in-person.
	Other Sounds	X		• Crushing or scooptram, and other machinery, bells, whistles, and alarms. • Hearing protection is mandatory. Noise levels regularly exceed occupational exposure limits. • Level of noise ranges from 50 dB to 107 dB (heavy equipment operation).
Talking		X		• Conversing with the use of hearing protection. Worker may be required to speak loud or shout.
Reading/Writing		X		• Reading pre-operational checks, mine prints/maps.
Feeling			X	
Judgement/Decision Making		X		• Grading site to ensure adequate haulage surface, communicating safe working conditions.
Concentration		X		• Multi-tasking, communicating while operating scooptram, track haulage, or rock breaker equipment.
Alertness		X		• Workers must be alert to workplace hazards, which may include ground conditions, mobile equipment, power tools, cap light, horn, whistle, or hand signals.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 6: Work Environment

WORK ENVIRONMENT		ESSENTIAL		COMMENTS*
		Yes	No	
Slippery Floors or Ground		X		• Wet/muddy ground conditions.
Sloping or Uneven Terrain		X		• Ascending/descending ramps, loose rocks.
Inside Work		X		• Performing work in the underground mine. • Ventilated air environment.
Outside Work			X	
Extreme Heat/Extreme Cold		X		• Exposure to hot or cold conditions possible. Cooler temperatures when working near the surface or in close proximity to vent raises. Typically, ambient temperature is controlled through the use of proper ventilation.
Dry/Humid		X		• Conditions vary depending on task performed and mine site.
Dust (PPE required)		X		• May be exposed to dust. Workers may be required to wear a respirator.
Vapours/Fumes (PPE required)		X		• From heavy equipment. Underground air ventilation systems are monitored for unsafe conditions.
Chemical Irritants (PPE required)		X		• Type of chemical exposure depends on the material being mined and the mining process.
Noise (PPE required)		X		• Hearing protection is mandatory depending on the task performed and area within the mine. • Noise levels regularly exceed the occupational exposure limits. Noise levels range from 50-107 dB. • Noise levels when operating LHD or scooptram exceed 95dB.
Moving Objects/Vehicles		X		• LHD/Scooptram • Mucking Machine
Electrical Hazards			X	
Sharp Tools			X	
Congested/Confined Work Site			X	
Working at Heights			X	
Vibration	Whole Body	X		• Exposure when operating heavy equipment, as well as from floor and overpass of crushing machine. • The degree and duration of exposure, as well as vibration frequency (Scooptram 8-44 Hz) will vary according to the type of equipment; task performed, and mine location.
	Segmental		X	
Vehicle Operation		X		• Operate LHD/Scooptram, Personal Carriers.
Overtime		X		• Voluntary overtime hours may be needed, depending on production requirements.
Shift Work		X		• May be required depending on company policies. Typical shifts are 10- and 12-hours.
Working Alone		X		• Works independent within a group of individuals. Check-in policy mandatory.
Working with Others		X		

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 7: Behavioural/Cognitive Demands

BEHAVIOURAL/COGNITIVE DEMANDS	CDA[£] RANKING SCALE				COMMENTS*
	1	2	3	4	
Degree of Self-Supervision Required			X		• May need clarification regarding shift line-up details, mine prints/plans, and/or safety issues.
Degree of Supervision Exercised	X				
Deadline Pressures (Time Pressure)			X		• Daily, weekly, and month production targets.
Attention to Detail		X			• Reviewing mine prints/plans, completing reports, such as safety, shift report, daily log.
Performance of Multiple Tasks Required		X			• Communicating while performing underground mining tasks, such as mobile equipment operation.
Exposure to Distracting Stimuli				X	• High noise levels from scooptram, crushing machine, moving equipment, ground conditions.
Need to Work Co-operatively with Others			X		• Light, hand, whistle, horn, and bell signals.
Exposure to Emotional Situations	X				
Exposure to Confrontational Situations	X				
Responsibility and Accountability Required				X	• Responsibility and accountability for maintaining a safe work environment.
Reading Literacy			X		• Reviewing reports, such as safety, daily logs, production reports, mine prints/plans. • Required to follow written instructions.
Written Literacy		X			• Completing reports, log books, and pre-operation checks.
Numerical Skills		X			• Horn, whistle and bell signals when communicating.
Verbal Communication			X		• Conversational, two-way radio, telephone.
Memory		X			• Signals, signs, colour coding.
Computer Literacy	X				
Shift Work Demands			X		• Rotating shift schedule may be required, depending on company policies. Typical shift durations are 10- and 12- hours.

[£] The Cognitive Demands Assessment (CDA) definitions and scale are outlined in Appendix 3.

* Tasks outlined in the Comments section of this report are examples only and are not inclusive of all Underground Mining tasks.

Section 8: Photographs

Figure 1: Remote Operation of Scooptram

Figure 2: Scooptram

Figure 3: Operating Rock Breaker Equipment

Underground Miner

Appendix

Appendix: 1: Strength Definitions

The following information was obtained from the National Occupational Classification (N.O.C.) 2006 Career Handbook.

Strength

The use of strength in the handling of loads such as pulling, pushing, lifting and/or moving objects during the work performed.

RATING	N.O.C. STRENGTH CATEGORY	N.O.C. DEFINITION
1	Limited	**Work activities involve handling loads up to 5 kg.** Examples: • Examining and analyzing financial information • Selling insurance to clients • Conducting economic and technical feasibility studies • Administering and marking written tests
2	Light	**Work activities involve handling loads of 5 kg but less than 10 kg.** Examples: • Repairing soles, heels and other parts of footwear • Filing materials in drawers, cabinets and storage boxes • Preparing and cooking meals • Repairing paintings and artifacts
3	Medium	**Work activities involve handling loads between 10 kg and 20 kg.** Examples: • Setting up and operating finishing machines or finishing furniture by hand • Measuring, cutting and applying wallpaper to walls • Adjusting, replacing or repairing mechanical or electrical components using hand tools and equipment • Operating film cameras to record live events
4	Heavy	**Work activities involve handling loads more than 20 kg.** Examples: • Operating and maintaining deck equipment and performing other deck duties aboard ships • Shoveling cement into cement mixers and assisting in the maintenance and repair of roads • Measuring, cutting and fitting drywall sheets for installation on walls and ceilings • Operating power saws to thin and space trees in reforestation area

Appendix: 2: Frequency Definitions

The following information was obtained from the United States Department of Labour Standards (1993).

Frequency

FREQUENCY RATING	PERCENT OF WORKDAY	HOURS (BASED ON AN 8-HOUR SHIFT)
Occasional	0-33%	0 – 2 hours and 40 minutes
Frequent	34-66%	2 hours and 41 minutes – 5 hours and 20 minutes
Constant	67-100%	5 hours and 20 minutes – 8 hours

Appendix: 3: Behavioural Cognitive Demands Assessment Key

CDA CATEGORY and DEFINITION	CDA RANKING SCALE
Degree of Self-Supervision Required: The extent of self-supervision required in the course of duties. Where this demand is rated high and the demand for performance of Multiple Tasks Required and/or Accountability and Responsibility is also high, the worker may be expected to exercise good problem solving and judgement.	1. No self supervision required (fully supervised) 2. Occasional self-supervision is required (supervisor frequently provides work directions or guidance.) 3. Frequent self-supervision required (supervisor occasionally provides work directions or guidance) 4. Predominately self-supervised throughout the shift (may contact supervisor to obtain work direction as needed.
Degree of Supervision Exercised: The extent of work directions and/or supervision provided to other workers.	1. No supervisory responsibility 2. Provides work directions only with no other supervisory duties. 3. Provides work directions and some elements of managing work performance with the exclusion of disciplinary action 4. Has full supervisory responsibility for other employees.
Deadline Pressures (time pressure): The extent to which work tasks are expected to be completed within a given time period or the extent to which as fast paced work tempo is required because of the nature of work or work volume. Low rating implies low demand to complete tasks according to a timeline whereas a high rating implies that many of the work tasks must be completed under time pressure.	1. Worker is not exposed to time pressures because the work is self-paced, without rigid time constraints. 2. Time pressure is low: there is occasional pressure to meet deadlines or work within time constraints, the volume of work and the work pace are moderate. 3. Time pressure is moderate: there is frequent pressure to meet deadlines or work within time constraints and/or the volume of work is high and the work tempo is moderately fast. 4. Time pressure is high: the majority of work is performed under rigid time constraints and the volume of work is high (assumes that the work tempo is high or the worker must extend the workday to manage the volume of work)
Attention to Detail: The extent to which work tasks require attention to or concentration on details of information. A high demand implies that insufficient attention to detail will result in work errors and/or inefficiencies. The rating does not reflect the extent of attention/concentration required due to external environmental stimuli.	1. Attention to or concentration on details is not required 2. Attention to detail or concentration is required for some tasks, although not at an intensive level 3. Significant attention to detail or concentration required for many tasks or intense attention to detail or concentration required for some tasks. 4. Intense attention to detail or concentration is required for the majority of the shift.

Continued...

CDA CATEGORY and DEFINITION	CDA RANKING SCALE
Performance of Multiple Tasks Required: The responsibility for performing and monitoring more than one task or function at a time and for judging when tasks or functions require attention. It requires the ability to prioritize tasks and manage time effectively (juggle various tasks efficiently). It does not reflect the performance of sub tasks concurrently within one task assignment or activity.	1. Not responsible for concurrent multiple tasks. Responsible for performing one task at a time until completion or further directions from supervisor. 2. Some responsibility for multiple tasks, but with very clear guidelines or cues about when to perform each task. 3. Responsible for multiple tasks, with some time management skill and judgement required to determine priorities. 4. Constantly responsible for multiple concurrent tasks and/or functions and must exercise a high degree of judgement to determine when to attend each task.
Exposure to Distracting Stimuli: Exposure to visual, auditory or other sensory stimuli in proximity of the worker such that it could be distracting during the performance of work duties. Auditory stimuli many include verbal conversations of colleagues in an open office area, phones ringing, alarms, pagers, motors and noises that are loud, sudden or unpredictable in occurrence. Visual stimuli may include movement of people, vehicles, objects, and noticeable changes in illumination.	1. Little or no distracting visual, auditory, or other visual stimuli. 2. Minor degree of distracting stimuli present during some tasks or portions of the shift. 3. Moderate degree of distracting stimuli during some tasks or portions of the shift. 4. High degree of distracting stimuli are present for the majority of the shift or for any portion of the shift where it is essential to work effectively despite distracting stimuli (i.e. very noisy, busy environment with multiple stimuli)
Need to Work Co-operatively with Others: The degree to which a worker must work co-operatively with others. This may include team projects, shared job duties, management interaction with staff, etc. This rating considers the extent to which one must have good communication skills, good teamwork and interpersonal skills, be open minded, diplomatic or have good negotiation skills.	1. Not required to work co-operatively with others, other than to receive directions from supervisors. 2. Infrequently required to work co-operatively with others, although may be in proximity to others. 3. Required to work in co-operation with others for some tasks. 4. The majority of work requires close co-operation with others.
Exposure to Emotional Situations: Where the worker may face emotional or stressful circumstances (i.e. an ambulance attendant with a dying patient or attending a traumatic accident), or exposure to situation where a client of the public may be emotionally distressed and the worker is required to interact with the individual in order to complete a job requirement. Exposure to emotionally distressed clients may be in person or over the telephone.	1. No exposure to emotionally or stressful circumstances or emotionally distressed individuals in the normal course of duties. 2. Infrequent exposure (approx. monthly) to emotionally distressed individuals with whom the worker must interact in order to complete the job requirements. 3. Occasional exposure (approx. weekly) to emotionally stressful circumstances or emotionally distressed individuals with whom the worker must interact in order to complete the job requirements. 4. Frequent exposure (approx. daily) to emotionally stressful circumstances or emotionally distressed individuals with whom the worker must interact in order to complete job requirements.

Continued...

CDA CATEGORY and DEFINITION	CDA RANKING SCALE
Exposure to Confrontational Situations: Exposure to situations where, in the course of their duties, workers may be directly confronted by an individual or may encounter confrontational situations requiring any action on their part. The confrontation may be in person or over the telephone. The client or public may be verbally aggressive or abusive, insistent, hostile, loud, threatening, disruptive, or may refuse to follow instruction. It would be beneficial in the "comments" box to indicate whether there are any security or safety measures in place.	1. No Exposure to Confrontational Situations in the course of duties. 2. Occasional exposure (up to weekly) to confrontational situations in which assistance is immediately available. 3. Occasional Exposure to Confrontational Situations (up to weekly) where assistance is not immediately available. 4. Frequent exposure (up to daily) to confrontational situations or hostile people whether or not assistance is available.
Responsibility and Accountability Required: The extent of liability or safety risk that could result if the employee does not exercise appropriate judgement or attention during the performance of job tasks. A high rating indicates that the job is a safety-sensitive position with the potential for grave consequences if errors or inattention occur.	1. Errors in judgement or attention would have insignificant consequences. 2. Errors in judgement or attention would create inconvenience. 3. Errors in judgement or attention could create difficulty of significant expense. 4. Errors in judgement or attention could have grave or life-threatening consequences.
Reading Literacy: The ability to comprehend English text.	1. No reading required in the course of duties. 2. Minimal reading ability is required in order to recognize single words, short phrases, or names. 3. Moderate reading ability is required. E.g. to follow written instructions. 4. A high degree of reading literacy is required to read reports, manuals, or other documents with a high degree of comprehension.
Written Literacy: The requirement to create English test. It is independent of the physical ability to produce text in a specific format. E.g. handwriting, typing or keyboarding.	1. No composing English text is required in the course of duties. 2. Required to compose text in which accurate grammatical construction and spelling are not essential, e.g. messages, forms, lists etc. 3. Required to create memos or letters with accurate spelling, grammatical form and/or careful wording.
Numerical Skills: The requirement to process and analyze numerical information even if the calculation is performed electronically. Higher ratings reflect the need for abstract mathematical thinking.	1. No number manipulation required other than counting. 2. Required to carry out basic arithmetic operations such as addition and subtraction. 3. Required to use more complex arithmetic operations such as division, manipulation, percentages, and ratios. 4. Required to use abstract mathematical formulae or carry out complex mathematical operations, e.g. accounting.

Continued...

CDA CATEGORY and DEFINITION	CDA RANKING SCALE
Verbal Communication: The extent to which a job requires the ability to clearly comprehend and express ideas and information in spoken English. Higher ratings reflect the complexity of the content or the extent to which good communication skills are required.	1. Little or no requirement for communication skills: receives and relays concrete information only. 2. Basic communication skills are required to comprehend and communicate information at a basic level within well-defined parameters e.g. communicate status of job or job task with supervisor. 3. Moderate communication skills are required to comprehend and communicate information fluently e.g. to work crews. 4. Highly developed communication skills are required to comprehend and communicate effectively in complex situations. E.g. explaining the design of a complex system, exchanging information with physicians regarding public health issues, policy discussions, and conflict resolution.
Memory: The extent to which a job requires the ability to retrieve and recall information on demand that has been previously learned. Level of difficulty is dependent on the complexity and amount of the information, the context in which it must be recalled and how frequently the information is used.	1. Little or no need to remember information and apply to work tasks e.g. clear processes/instructions are available for carrying out job tasks. 2. Basic memory ability is required to recall information that is applied to work tasks on a regular basis without rigid timelines. 3. Moderate memory ability is required to recall many different pieces of detailed information and/or sequences which may have to be recalled infrequently, or because there are time constraints within which to recall information. 4. High memory ability is required to recall many different pieces of detailed information and/or sequences which may have to be recalled in demanding situations e.g. due to deadline pressures or being sent out of context.
Computer Literacy: The extent to which a job requires the ability to use computer technology.	1. Not required to use computers in the course of duties. 2. Required to use computers for basic data input e.g. using a hand scanner, using basic email for communication only. 3. Required to use one or more computer programs at a competent level. E.g. MS Word. 4. Extensive computer knowledge and problem solving ability required. E.g. IT Support, programmers, key users.
Shift Work: The extent to which the shift schedule places additional cognitive and physical demands on the worker.	1. Shift work is not required. 2. Shift rotation (two-week rotation, rotated backwards, or exceeds 3 days). 3. Weekly shift rotation is inconsistent and is based on production demand. 4. Shift rotation and shift starts just prior to sunrise.

MINING INDUSTRY
HUMAN RESOURCES COUNCIL

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