

Part 36 Mining

Highlights

- Section 546 requires the number of mine rescue teams to be related to the number of workers underground.
- According to section 573, an employer requires approval from the Director of Inspection with responsibility for mines only when the gross weight of a rubber-tired, self-propelled machine is more than 32,000 kilograms GVW. However, the Director retains the right to request that an employer have tested and approved any rubber-tired, self-propelled machine at a mine site. Any machine approved under the *Traffic Safety Act* is approved for use in a mine.
- Section 573 allows rubber-tired, self-propelled machines to exceed their manufacturer-specified load weights if the listed conditions are met.
- Section 648 requires that machinery directly involved in loading an explosive is allowed to operate within eight metres of a hole being loaded with explosive. The distance has been reduced from 15 metres.
- Section 692 requires underground storage of rescue breathing apparatus.
- Section 693 allows employers to search workers entering an underground mine for prohibited means of ignition e.g. lighters, matches, etc.
- Section 731 lowers allowable flammable gas concentrations to 40 percent of their lower explosive limit (LEL) from 50 percent of their LEL.

Requirements

Section 531 Application

This Part of the OHS Code applies only to mines and mine sites. Special rules, not applicable elsewhere in the OHS Code, apply in this Part.

Section 532 Building safety

Employers must control the accumulation of dust in mine site buildings so that dust does not create a hazard to workers. Part 4 of the OHS Code covers concerns with exposure to coal dust in greater detail.

Dust itself is hazardous if it accumulates because it can create health problems for workers who inhale it. Fires and explosions can also result if an ignition source such as a spark from a piece of equipment is introduced. There have been several examples of coal dust explosions in plant galleries containing conveyors. Depending on the dryness and temperature at which coal leaves the dryer, its dust can pose a real threat of creating an explosion.

The variables in a possible dust explosion generally include the concentration and explosivity of the dust, dryness, sources of ignition and the spontaneous combustion characteristics of the material. The cleaner a plant or facility is kept, the less likely dust will present a hazard to workers.

Section 533 Mine plans

The need for detailed, up-to-date work site plans has been established by experience. The availability of such information helps officers, mine managers and workers fulfill their respective roles and responsibilities. The importance of such information being readily available is particularly evident during an emergency.

The information helps in:

- (a) mounting an effective rescue operation, particularly underground;
- (b) decision making;
- (c) monitoring the operation;
- (d) having a better appreciation of the mineral deposit and related problems; and
- (e) identifying possible impacts of mine operations on pipeline or utility corridors.

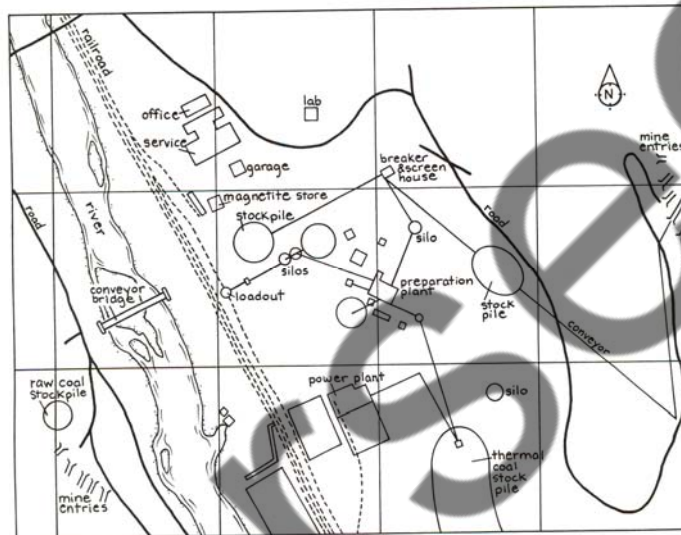
It is important that mine plans be current, accurate and comprehensive. The requirements listed in this section represent the minimum and include both historic and current mine workings, geology, land ownership and other relevant activities affecting the mine.

Mine plans support effective safety planning so they must include major surface features such as bodies of water, unconsolidated deposits, transportation and utility corridors, etc. A specific feature that can threaten mine safety and therefore needs to be included is the presence of exploration holes drilled for any purpose in or through the deposits mined or to be mined. These could contain fluids which, if mined through, could unexpectedly flow into the mine workings. Disasters can be avoided by requiring that such hazards be clearly marked on mine plans. At Lake

Peineur, Louisiana, U.S. in 1986, a salt mine was flooded when an unknown oil/gas exploration borehole drilled through the bottom of a lake.

An example of a detailed mine site plan is provided in Figures 36.1 and 36.2. Figure 36.1 shows the buildings and general working of the site; Figure 36.2 shows the direction and inclination of the strata being worked. When mining multiple seams or ore bodies, separate plans need to be kept for each one, together with one master plan showing how the different workings are related to each other, both vertically and horizontally.

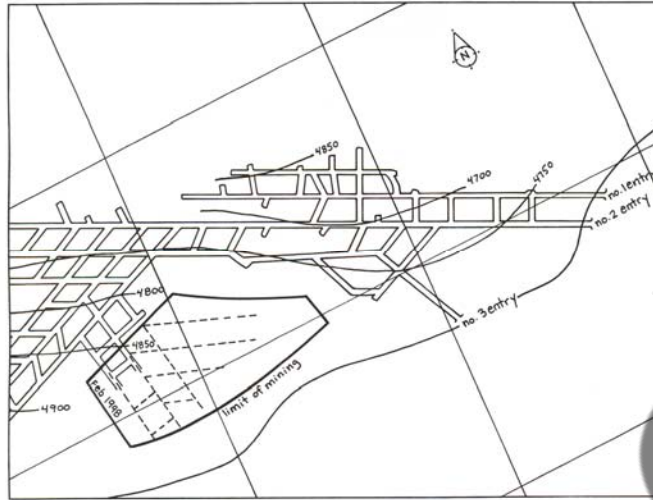
Figure 36.1 General mine site plan



It is important to keep all mine plans up-to-date to support effective decision making.

No longer than three months can lapse between surveys of an active mining operation. This is a minimum requirement and, depending on the rate of mining, more frequent surveys may be appropriate to keep plans up-to-date. To help with updating plans, areas that have been mined within one month of the most recent survey may be sketched in to indicate the most recent changes.

Figure 36.2 Operations plan



Section 534 Record retention

Records of equipment inspections and incidents prove invaluable as one of the tools used in assessing the condition of equipment. Well kept records can help prove that equipment has been approved as capable of operating safely within the parameters for which it was designed.

In case of an incident or equipment failure, records can help pinpoint causes and trends. Repeat incidents or equipment problems can indicate design problems. Record keeping is useful in developing strategies and action plans for improving the overall safety and productivity of a mine.

Section 535 Excavation

Subsection 535(1)

Safe distances must be maintained while approaching any boundary of an operating property and other facility.

Subsection 535(2)

To meet the requirements of this subsection, designers of the walls of an excavation must consider both the eventual deterioration of the walls during the life of the mine as well as their final location when the mine is abandoned.

Section 536 Open stockpiles

Effective design and operation of open stockpiles relies on engineering principles that address the potential instability of the stockpile.

To ensure stability, stockpile design and construction should address the geotechnical behaviour and physical dimensions of the stockpile, chemical properties of the waste rock, location of the water table, and the permeability, size and strength of the rocks or other materials in the stockpile. Stockpile areas should be marked for hidden hazards e.g. those associated with potential surface collapse into hidden cavities and voids that may be present close to the surface of the stockpile.

Section 537 Dust from drills

Subsection 537(1)

Dust generated by drilling operations must be controlled to minimize related health and safety risks. Control is generally done in two ways. The primary method is the use of a wetting agent right at the tip of the drilling bit. This conforms to the long held belief that the dust should be suppressed at its point of generation.

Dust control is also possible through mechanical means by routing dust-laden air through dust-collection equipment with filters and then releasing the filtered air.

Until recently, only water systems were approved for underground drilling operations. Now, with advances in filtering capability, some drills equipped with mechanical filtration and separation systems have been approved.

Drilling dust is normally controlled in open pit mines by one or more means that can include water, a mixture of water and methanol, bag filters, and cyclone filters.

Subsection 537(2)

If drilling is intermittent and dust cannot be effectively controlled, alternative methods of protecting workers may be approved by the Director through an acceptance as described in section 10 of the *OHS Regulation*. The Director is a member of the staff of Alberta Employment and Immigration, appointed by the Minister under section 5 of the *OHS Act*.

In place of engineered dust controls, the use of suitably effective respiratory protective equipment may be acceptable, but only as a last resort and only in short-term drilling operations.

The term “intermittent drilling” would be interpreted based on the overall mining plan concept for the particular mining environment. If drilling should reasonably have been predicted, then engineered dust controls would be the expected standard on drills for production-drilling operations.

Section 538 Light metal alloys

The general expectation of this section is that the use of light metal alloys in underground coal mines is restricted. This reflects the hazard of light metal alloys becoming a source of potential ignition of gas or dust.

Subsection 538(1)

The term “light metals” refers to metals containing aluminum, magnesium and/or titanium, including aluminum paint and aluminum cans. Products containing these metals are generally not allowed in underground coal mines or other hazardous locations. Friction or sparking resulting from light metals striking or being struck by oxidized (rusty) ferrous metal is enough to ignite a mixture of methane and air.

The specific definition of the various light metals and their percentages in alloys is based on that of the former National Coal Board (NCB) of the United Kingdom (UK). Readers are referred to (i) NCB Spec No 481, CENELEC 1977 & (ii) Light Alloys Fact Sheet, on webpage: www.ugcoal.ca). The use of aluminum was restricted, but not prohibited, in the UK following 12 international incidents that occurred between 1950 and 1955 and one in 1962. Ten of these incidents resulted from the use of aluminum face supports and one involved auxiliary fan blades.

Restrictions on the use of light metal alloys in underground coal mines and similar hazardous locations are intended to prevent light alloy metals from being struck by rusty iron or steel. For example, British Columbia restricts their use to the following:

- (a) electrical equipment within a flameproof enclosure;
- (b) use in circumstances when there is no possibility of friction or impact;
- (c) adequate coating with non-sparking material and immediately removed from service if the coating is damaged; and
- (d) handheld tools which are placed in a non-sparking storage container following use.

(See Health, Safety and Reclamation Code for Mines in British Columbia (2003) Section 6.43.3 Prohibited Metals.)

Subsection 538(2)

It is impossible in some instances to prohibit the presence of all light metals. For example, many common fire extinguishers are made with light metals, but are required as fire protection underground. In these instances, equipment with aluminum components must be equipped with a protective canopy or other measure that serves to prevent friction or impact on the light metal.

Subsection 538(3)

The use of fan blades made of light metal alloy needs to be restricted in underground mine ventilation fans because light metal alloys can cause incendiary sparking when struck by oxidized ferrous metal (rusty iron). If a spark was created at a time when high explosive levels of methane gas were present, a catastrophic explosion could occur. Restrictions typically require protective coatings with a non-sparking material and periodic inspection to identify and repair damaged coatings. (See Health, Safety and Reclamation Code for Mines in British Columbia (2003) Sections 6.36.3 and 6.36.4.)

Subsection 538(4)

Potentially explosive atmospheres occur not only in underground mines but also at surface facilities where potentially explosive dusts are present. Therefore light metal alloy restrictions apply there as well. Examples of such hazardous locations include coal preparation plants, coal silos or underground reclaim galleries beneath surface coal stockpiles and in small ventilation/cooling fans within some surface buildings.

Section 539 Haul roads

Subsection 539(1)

The major consideration in haul road design is safety. The design must anticipate the varying sizes, speeds, capabilities and loads of the vehicles and equipment that will travel on the road. Since most haul roads are built on pit walls and wind down to the bottom of the pit, a significant amount of capital is tied up in their development. Economic considerations tend to force an increase in the road gradient to shorten the haul road and a reduction in road width to minimize the required excavation of waste material. The employer must ensure the road is sufficient to handle emergencies.

Common factors considered in effective haul road design include:

- (a) width;
- (b) gradient;
- (c) radius of curvature;
- (d) super elevation;
- (e) rolling resistance;
- (f) vehicle requirements;
- (g) speed limits;
- (h) sight distance;
- (i) run-off lanes;
- (j) berm height; and
- (k) traffic control and signage.

Vehicles with the lowest performance capabilities in a fleet often dictate road design. Although some work can be done to improve a vehicle's performance, it is best to ensure that the road design accommodates the vehicle with the lowest performance capabilities.

Subsection 539(2)

Emergency escape roads are critical to safe haul road design. Many factors control the number and design of emergency escape roads. These include:

- (a) location of normal exit points;
- (b) potential entering speed;
- (c) vehicle gross weight;
- (d) location and available space;
- (e) maximum acceptable gradient; and
- (f) materials suitable for retarding a runaway vehicle.

Mine operators must assess the hazards of their particular mine environment and where a gradient of more than 5 percent is present, design suitable escape routes to minimize the exposure of mine workers to the hazard of an out-of-control or runaway vehicle.

Subsection 539(3)

Employers must consider berm height and drainage breaks to ensure that haul roads are sufficient to handle emergencies. Sufficient berm height ensures that vehicles do not simply ride over the berm. Drainage breaks in berms must be designed to be small enough to prevent a vehicle from going through them.

Section 540 Discard from mine

A variety of solid and liquid waste materials can be generated by a mining operation. Disposal of these materials must comply with accepted engineering principles to ensure the stability of the dump or impoundment. If failure of such a waste disposal structure could cause potential injury to a worker, or cause environmental contamination, design by a professional geotechnical engineer is the accepted standard.

Section 541 Mine walls

Subsection 541(1)

The proper design and control of pit walls significantly affects worker safety and the ability of workers to extract ore. Consequently, any design or related operating procedure used to maintain pit walls must be certified by a professional engineer. Section 8 of the *OHS Regulation* requires procedures to be in writing and available to workers.

Subsection 541(2)

To minimize the risk of injury in a mine, the employer must ensure that

- (a) undermining is prohibited since undermining of unconsolidated material can cause the material to collapse,
- (b) working faces receive a good cleaning before being left to stand. Bench heights are designed and excavated to be less than 1.5 metres above the maximum height the excavation equipment can reach. It becomes difficult above this height to clean loose materials that can contribute to an overhang,
- (c) the horizontal flat bench area within 2 metres of the working face crest must be kept clear of unconsolidated material. The height and stability of the bench above could dictate more than this specified 2 metre horizontal separation from the crest of the next lower working bench,
- (d) unconsolidated material lying more than 2 metres from the crest of the horizontal bench is stabilized to prevent it from falling onto workers below, and
- (e) safety berms are established at certain intervals along the height of the pit wall to catch rocks loosened from the face by weathering or vibration from blasting.

Section 542 Dumping block

Sections 542(a) and 542(b)

Dumping blocks or a ridge of material such as a berm are required if equipment may back into an opening or over the edge of a dump. Dumping points may include hoppers, stock piles or waste dumps. Dumps can be very high and a flip-over or roll-over can cause serious injury. To reduce the risk to workers and their equipment, physical barriers are required to assist in stopping.

Section 542(c)

If physical barriers are not practicable, a designated signaller with a stop signal may be designated to direct equipment. All appropriate measures must be in place to address hazards involving the equipment and the designated signaller.

Section 543 Flammable gas monitors

Subsection 543(1)

This subsection requires the installation of gas monitors in any location that can be classified as a hazardous location according to section 18 of the *Canadian Electrical Code*. In part, section 18-004 states that:

“Hazardous locations shall be classified according to the nature of the hazards, as follows:

- (a) Class I locations are those in which flammable gases or vapours are or may be present in the air in quantities sufficient to produce explosive gas atmospheres;
- (b) Class II locations are those which are hazardous because of the presence of combustible or electrically conductive dusts;
- (c) Class III locations are those which are hazardous because of the presence of easily ignitable fibres or flyings, but in which such fibres or flyings are not likely to be in suspension in air in quantities sufficient to produce ignitable mixtures.”

In mining operations a hazardous location can exist in an underground mine, conveyor gallery, reclaim tunnel, storage silo, drying plant, heating furnace, electrical room, battery charging room or other similar location.

Gas concentrations in hazardous locations can increase suddenly and trigger an alarm. Such an alarm is only effective if it prompts an immediate response. This may not occur if the monitoring device gives only a local alarm, but will occur if it is linked via a remote control and monitoring system to a permanently attended

communication station. Such stations are typically found on the surface in the mine offices. They are computer controlled with comprehensive visual and audible alarm systems.

The general expectation under this subsection is that monitoring for flammable gases takes place at every location that is classified as a hazardous location as the result of a hazard assessment. It is further expected that a continuous monitoring system will be used, linked to a permanently attended communication station. Where necessary, the mine electrical inspector is available to provide guidance and interpretation of the OHS Code and the *Canadian Electrical Code*. Readers are referred to the explanation to section 165 for additional information about hazardous locations.

Subsection 543(2)

The alarm given at a permanently attended communication station by flammable gas monitors can be visual, audible or both. Frequent calibration of these instruments is critical to assuring their proper function and accurate reading. Note the requirement that the alarm must sound when the gaseous content of the atmosphere exceeds 20 percent of the lower explosive limit of the gas being monitored. Since the lower explosive limit varies depending on the physical characteristics of the particular gas, the remote control and monitoring system must be programmed accordingly. Workers must be trained to correctly use the related monitoring device.

Section 544 Reporting dangerous occurrences

Subsection 544(1)

Paragraphs 544(1)(a) to (g) list the incidents that require the Director to be notified about as soon as possible after the event. If requested by the Director, an investigation report may have to be submitted to the Director.

The reporting of dangerous occurrences is required for a variety of reasons:

- (a) monitoring safety and health conditions at individual mines and throughout the mining industry;
- (b) taking appropriate remedial actions if required;
- (c) informing other employers to take necessary precautions;
- (d) compiling statistics for evaluation and development of action plans;
- (e) ensuring the Director is kept informed; and
- (f) calling upon the resources of other companies to help resolve problems, if required.

The expectation of this section is that all dangerous occurrences will be reported. Several dangerous occurrences are listed and are typically self explanatory. They include deterioration of underground conditions, ventilation and gases, equipment malfunction or failure, and circumstances requiring the withdrawal of workers from an area of the mine.

Subsection 544(2)

The failure of a containment dam or dike can seriously affect workers and mine facilities. At a minimum, a serious environmental situation will result from the uncontrolled spillage of liquid waste products. For this reason the Director must be notified when any sign of dam or dike deterioration is identified.

Fire Prevention and Emergency Response

Section 545 Emergency response station

Subsection 545(1)

Unless exempted by the Director, each mine must maintain and operate an emergency response station and provide facilities from which rescue operations and emergency work can be conducted.

Subsection 545(2)

Emergency equipment must be chosen for its suitability to the work site and must be regularly maintained to ensure it is always ready for operation. A suitable number of trained emergency response personnel must be available to respond to an emergency.

There are many types of rescue equipment with equally diverse capabilities and performance characteristics. Some equipment has been found to perform poorly under extreme temperature conditions. Equipment capability plays an important role in effective emergency response plan design and implementation. The reliability and effectiveness of emergency equipment are vitally important to the confidence and success of emergency response teams.

Subsection 545(3)

Because of the specialized skills and training involved, an employer must ensure that a sufficient number of workers are trained and available to safely perform a rescue operation.

Section 546 Emergency response team

Subsection 546(1)

A well trained emergency response team is required by the OHS Code. The employer must appoint a competent worker as responsible for training the members of the emergency response team.

Subsection 546(2)

The medical fitness and competency of each member of an emergency response team is critical to the team's performance. In addition to holding a standard first aider certificate, each member must be suitably trained and be physically capable of carrying out very demanding tasks. Members may be required to carry and work with heavy loads, wear breathing apparatus and function effectively in hostile mine environments where visibility could be almost zero due to the presence of smoke or airborne dust.

Section 546(3)

Familiarity gained through regular emergency response practice sessions and worksite tours provides needed confidence among team members and reduces the time taken to rescue workers during a real emergency.

Practice training sessions must take place at least every two months.

Section 546(4)

For emergency response teams to be effective in underground coal mine emergencies, members must be trained and equipped appropriately and there must be a sufficient number of teams. Typically in a mine rescue event at least three teams are required: one in action, one on standby and one resting. At small mines where it may not be practical to maintain three or more teams, it is important to have a minimum number of trained personnel on site. These personnel will provide a first response and assessment capability. They can also guide and instruct other teams in local conditions when these teams arrive at the mine from elsewhere. (See Health, Safety and Reclamation Code for Mines in British Columbia (2003), Section 3.7.)

Section 547 Fire fighting training

Having fire fighting equipment available is only one ingredient in successful fire fighting. Training in effective fire fighting for all workers employed underground is another essential ingredient. Every worker must be able to respond quickly and correctly to any type of fire that might develop. Training at the beginning of employment, with regular follow-up training at least every two years thereafter ensures workers can respond to fires as needed. Records of training help supervisors manage the training program.

Section 548 Fire precautions

Wherever possible, employers must reduce the potential for fire by reducing the quantity of flammable materials present and by using fire-resistant or non-flammable materials.

Combustible materials include items such as oily rags, plastic, paper, wood and coal dust. These materials can be easily ignited by an ignition source and can rapidly grow into an uncontrollable fire. Good housekeeping minimizes the potential for such a fire to occur.

This section lists several specific precautions appropriate for preventing fires and explosions in underground coal mines. However, this section does not imply that fire and explosion hazards are limited to the items in the list. Employers and workers are responsible for being constantly on the lookout for these and any other hazards.

One hazard specifically addressed in subsections (5) to (7) is that of flammable hydraulic fluids which can leak onto hot surfaces and ignite. This hazard can be mitigated by using fire resistant hydraulic fluids. However, the use of some of these requires qualification based on practical experience with their use in Alberta's harsh winter conditions. The use of fire resistant fluids (FRFs) in mobile diesel equipment underground has proven problematic in very cold weather and has led to many premature failures of hydraulic pumps on diesel vehicles. The temporary failure of steering, lifting and braking systems has been one result.

In the United States, other controls are used to mitigate this potential fire hazard e.g. automatic fire suppression systems. The flash point of non FRF hydraulic fluids is typically 5 times higher than that of the diesel fuel carried on board the vehicle. In the OHS Code, subsections 548(5) through (7) allow alternatives to the use of non-fire resistant fluids by recognizing the use of fire suppression systems. Automatic fire suppression systems are standard on many items of mobile diesel equipment.

Section 549 Fireproofing of roadways

Use of combustible materials on roadway supports and linings must be minimized as much as possible. Any combustible materials used must be treated with a fire resistant coating.

Non-combustible or treated materials must be used at conveyor transfer and loading points and extend at least 5 metres on the air intake side and to not less than 10 metres on the return side. This minimizes the potential for a fire to spread and provides some protection to workers during fire fighting activities.

Section 550 Conveyor clearance

Section 550(a)

Removal of dust and other combustible materials from beneath conveyors is important to preventing fires. Some materials can ignite by friction when they come into contact with moving parts, while coal dust accumulations can ignite spontaneously.

Section 550(b)

If pillars are used to provide clearance beneath conveyors to allow removal of debris, the pillars must be made of non-flammable material so that they do not become part of any fire.

Section 551 Fire detection systems

Subsection 551(1)

The ability to control and extinguish a fire is greatly improved with early detection of the fire. Detection devices used in mines must be continuously operational to be effective. They must also be capable of giving a warning signal if their ability to monitor for and detect fire is impaired. The employer can then immediately repair or replace non-functioning devices. The effectiveness of such equipment is greatest if automatically connected to an audible alarm in a permanently attended communication station or control room.

Subsection 551(2)

Specific locations where detection systems should be located are identified throughout this Part. If the Director thinks an additional device is needed at a particular location, this section authorizes the Director to order the installation of such a device.

Section 552 Emergency warning system

Section 552(a)

Workers must be made aware of fires or other emergencies as soon as they are detected. The emergency warning system in some mines consists of compressed air lines that release a distinctive smelling gas that workers are trained to recognize as an immediate order to evacuate. Faster and more sophisticated communication systems are used in other mines. The types and sophistication of emergency communication systems available vary significantly. The employer must use the one(s) most appropriate to the prevailing conditions. On becoming aware of the emergency warning, workers should know what to do and evacuate the area promptly and appropriately. If immediate first response is not appropriate, then the area should be evacuated in an orderly manner. (See Section 553.)

Section 552(b)

Testing the emergency warning system at least every 12 months ensures the system functions properly and workers recognize and respond appropriately to its warning signals. Testing also allows the employer to assess the overall effectiveness of the emergency warning and response systems and fine tune them as necessary. A record of such tests must be kept in a logbook or its electronic equivalent. Such records provide evidence of compliance and may help to better understand and optimize the operation of emergency warning systems.

Section 552(c)

Assessing emergency response evacuations and testing warning systems often means that actions can be taken to improve future performance. A record of these remedial actions must be kept in a logbook or its electronic equivalent.

Section 553 Evacuation

Section 553(a)

To ensure an effective response, detailed and logical evacuation procedures must be prepared for fires, flooding, cave ins, explosions and other life-threatening emergencies. How quickly the mine can be evacuated using the safest routes is one of the most important criteria in assessing the efficiency of evacuation procedures. To meet such criteria training instruction and worker familiarity with the evacuation procedures is essential. (See Section 553(c)). Section 8 of the *OHS Regulation* requires that the procedures be in writing and available to workers.

Section 553(b)

Copies of the evacuation procedure must be posted in conspicuous places on the surface and underground to be readily available to all persons. Posted copies help to maintain worker familiarity with procedures to ensure that they evacuate in the right direction.

Section 553(c)

Site-specific training, familiarization with escape routes, and the ability to recognize warning signals and respond accordingly are all critical to successful evacuations. A successful execution of any emergency plan or procedure is the result of adequate planning, training, and provision of needed equipment and resources. Although emergency response procedures are rarely used in a well-managed mining operation, each mine's preparedness and ability to execute its plan with a high degree of efficiency and effectiveness helps ensure high morale and confidence among workers.

Section 553(d)

Classroom-based training and instruction in emergency evacuation procedures alone has been found to be inadequate. Experience in other jurisdictions with periodic physical mock evacuations show that, while being costly and time consuming, mock evacuations pay large dividends in terms of developing a practical, feasible, efficient and effective evacuation system.

A mock evacuation allows the evacuation plan and procedures to be demonstrated in the actual workplace and can provide valuable information to ensure the best results in the event of a real emergency. Mock evacuations can identify significant deficiencies like stretchers that may not fit in transport vehicles, insufficient or misplaced self-rescuer devices and defective lifelines. All such deficiencies can then be corrected to improve performance in any subsequent real emergency evacuation.

Section 554 Fire fighting equipment

Subsection 554(1)

Fire fighting equipment must be provided, readily available, maintained in working condition, and accessible without obstruction at any place where a fire hazard may exist in an underground coal mine.

Subsection 554(2)

Fire fighting equipment should not be located in areas in which smoke will accumulate. It is therefore essential that the location of fire fighting equipment take into consideration the direction of air flow from the mine ventilation system. Since the ventilation system could potentially be subjected to a change of air flow direction during an extreme emergency, some contingency planning of additional fire fighting equipment locations would be appropriate.

Subsection 554(3)

To ensure it operates properly, the fire fighting equipment must be inspected once a month by a competent person. Except for fire extinguishers, this equipment must also be tested once every three months to ensure that it operates properly. The results of this inspection must be recorded in a log book maintained for that purpose.

Section 555 Fire extinguishers

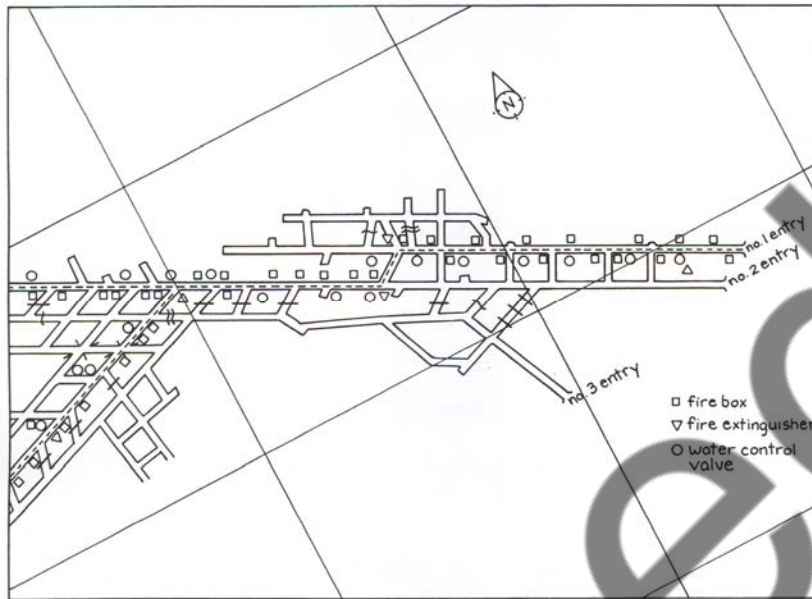
This minimum standard for the provision of two fire extinguishers at electric or diesel stationary motors, transformers and switch gear increases the potential that a minor fire can be extinguished before it gets out of control. Extinguishers should be classified for their intended service.

Section 556 Location of equipment

Up-to-date, detailed fire fighting plans are particularly useful in training workers in fire fighting response. Detailed information about the locations of fire fighting equipment is also helpful as a reminder during emergency situations.

Figure 36.3 provides a sample plan showing the location of fire fighting equipment. Note the requirement to review and update the plan at intervals not exceeding three months.

Figure 36.3 Sample fire protection plan



Section 557 Water supply

Minimum acceptable requirements respecting water supplies and pumping systems used to fight fires must be met.

Subsection 557(a)

A minimum volume of 100 cubic metres of water must be readily available. This is specified as a “minimum” dedicated water reserve. This supply must always be available for fire fighting.

Subsection 557(b)

The fire fighting water main must be able to distribute water to any part of a mine where a fire could be encountered. Water must be available at sufficient pressure and quantity to support fire fighting. It must not be used for day-to-day operational requirements.

Subsection 557(c)

A standby pumping system must be available whose power supply is not dependent on the main electrical system for the mine. All pumps must be capable of delivering water at an adequate volume and pressure as specified in section 558.

Subsection 557(d)

The main fire fighting water supply systems are not typically located in return airways. This ensures that emergency response personnel will not be exposed to smoke and fumes from fires or explosions. However, in some mines under very cold winter conditions, parts of the fire fighting water main located in an intake can freeze. In circumstances where suitable thermal insulation cannot be provided, or where fan reversal in an emergency is possible, it is acceptable to place the fire fighting water main in the return. At appropriate intervals however supply control valves in the main must be located in the intake airway.

Section 558 Water control valves

Subsection 558(1)

Water control valves must be strategically placed along potential fire ranges and in other critical areas to provide workers with adequate access to the emergency water supply. Availability, accessibility, standardization of materials and proximity of water control valves to a potential fire hazard are important considerations when designing and installing fire fighting systems in underground mines. Since the mine continuously advances, adding or locating control valves close to any particular working face is an on-going activity.

Subsection 558(2)

Nozzles and hoses of the specified size and capacity must be available at each water control valve. In this case it is specified that the water control valve must be capable of delivering not less than 4 litres per second of water flow.

Subsection 558(3)

The length of hoses and the size of nozzles are fixed by this subsection. Meeting these criteria ensures that the largest possible area can be reached by each hose to extinguish the fire, delivering the stated minimum volume of water per second.

Section 559 Refuge stations

In the event that exits are blocked or the ventilation system has been disrupted during or following an emergency, a refuge station must be available to underground mine workers as a safe place to wait until rescue teams arrive. Although miners carry self rescuers, (a type of respiratory protective equipment), the air may be lacking in sufficient oxygen to support life. Additionally, the useable life of the self rescuers may not be enough for workers to make it safely back to the

surface. The size and number of refuge stations depends on the number of workers expected to use them and the distances workers must travel to reach them.

Refuge stations must have water, supplied air and a system that communicates effectively with the surface. Refuge stations may also contain dried foods and other survival supplies.

Electrical Systems

Section 560 Electrical standards

CSA Standard M421-00 (R2007), *Use of Electricity in Mines*, is adopted in its entirety. If CSA Standard M421-00 (R2007) does not address a particular electrical issue, CSA Standard C22.1-06, *Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations*, becomes the standard to be met.

Section 561 Notice to Director

Subsection 561(1)

Notification allows the Director to review the various requirements as a final check and ensure that all safety issues have been satisfactorily addressed. Similarly, it provides an incentive to the employer to review the work from all aspects before informing the Director and requesting permission to energize equipment.

Requirements for underground coal mines or hazardous locations at other mines are very rigorous. Accordingly, the employer is required to inform the Director and obtain permission on each and every electrical modification made. This provision exists because of the hazardous nature of underground coal mines and is similar to provisions in other jurisdictions.

An earlier requirement to notify the Director of power increases in excess of 500 kilovoltamperes has been repealed as out-dated and unnecessary as other provisions of this section are considered to be adequate.

Subsection 561(2)

Written approval from a Director ensures that safety requirements and concerns have been dealt with before electrical installations that are new or have undergone major modifications are energized.

Subsection 561(3)

Schematics that indicate where new electrical energy is to be transmitted and used help clarify the design and conditions of the mine.

The schematics should identify the main mine substation, the power line distribution system, the location of unit substations, major electrical equipment and the respective voltages of the distribution systems and operating equipment.

Section 562 Electrical installations

Subsection 562(1)

Electrical safety at mine sites relies primarily on the competency of authorized workers installing, repairing or modifying electrical installations. In Alberta, persons who work on electrical equipment must be certified as specified in section 21(3) of the *Apprenticeship and Industry Training Act*, which states:

- “A person shall not work in a compulsory certification trade unless that person
- (a) holds a trade certificate in that trade,
 - (b) has filed an application under this *Act* to participate in the apprenticeship program in that trade and that application is subsisting,”

Non-certified personnel can work on electrical equipment only by special approval under Section 23 of the *Apprenticeship and Industry Training Act* which states:

- “For the purposes of section 21(3) and 22(3)(f), the Executive Director may, after notifying the Board and subject to the approval of the Minister, do the following:
- (a) authorize a person or a class of persons who are not permitted under section 21(3)(a) to (d) or 22(3)(a) to (c) to work in a designated trade, to work or to perform one or more tasks, activities or functions in that trade, or
 - (b) authorize an employer or a class of employers to employ a person or class of persons who are not permitted under section 21(3)(a) to (d) or 22(3)(a) to (c) to work in a designated trade, to work or to perform one or more tasks, activities or functions in that trade.”

Subsection 562(2)

Records of electrical installation and repair work are critical for troubleshooting and incident investigation purposes. Records must be kept at the mine for two years following the activity.

Section 563 Surface mine

Subsection 563(1)

The employer must assess the impact of electrical equipment and the surrounding environment on safety and then select equipment that fully meets applicable standards and adequately addresses local conditions. These conditions may include temperature, humidity, gases that may be flammable, corrosive or reactive, dusts such as coal dust, metallic powders and ammonium nitrate, fire and explosion hazards and so on.

For example, an electrical switch designed for use in hazardous locations at a gas plant may not be safe for use in a hazardous location in a surface plant at a coal mine. Coal dust poses an additional hazard for which the switch may not be designed.

Subsection 563 (2)

An electrical spark can initiate an explosion of accumulated gases. This subsection requires that electrical repairs or adjustments that are done in a hazardous location only be done after

- (a) the equipment is de-energized, and
- (b) the worker doing the work has confirmed that no dangerous concentration of gas is present.

Section 564 Underground coal mine

Subsection 564(1)

A certified underground coal mine electrical superintendent must approve all electrical apparatus prior to its use underground. The requirement is meant to apply in conjunction with the notification and approval of the Director, provided under section 561. While the Director's approval is required, it is the electrical superintendent that is ultimately responsible. As such, the electrical superintendent must be intimately involved in the specification, acceptance, installation, modification, maintenance and repair of underground electrical equipment.

Subsection 564(2)

On a day-to-day basis, the underground coal mine electrical superintendent must supervise and assume responsibility for all electrical work performed in the mine. Further, the electrical superintendent must ensure that underground electrical equipment remains in compliance with the requirements reflected in CSA Standard CAN/CSA - M421-00 (R2007), *Use of Electricity in Mines*.

Subsection 564(3)

Similar to the hazard posed by accumulated explosive gases in any other hazardous location, the concerns are the same in an underground coal mine. As a result, no electrical repairs or adjustments can be made unless the equipment is de-energized and the worker has confirmed that no dangerous accumulation of gas is present.

Section 565 Equipment supply systems

Subsection 565(1)

Ground fault protection is an essential safety feature on all mobile electrical equipment. To ensure this safety system is working properly, it must be tested before the equipment is put into service and at least annually thereafter.

Subsection 565(2)

Records related to ground fault system testing must be kept at the mine for two years after the test. The records should include information such as

- (a) the date of testing,
- (b) the equipment tested with identification numbers where available,
- (c) the name of the person(s) conducting the test,
- (d) the test results, and
- (e) any repairs and re-testing, if applicable.

Records required by this subsection must be available for examination by an officer.

Section 566 Batteries

Subsection 566(1)

Clause 5.5 of CSA Standard CAN/CSA-M421-00 (R2007), *Use of Electricity in Mines*, defines the safety requirements of surface storage battery rooms and battery changing stations.

"5.5.1 Location

Stationary-type storage batteries whose aggregate capacity is 5 kW at the 8 h discharge rate shall be located in storage-battery rooms or in areas with equivalent enclosures."

Adequate ventilation is one of the most important requirements of the standard. Since charging operations generate hydrogen which is highly flammable and explosive, the area must be continuously ventilated to be safe.

Subsection 566(2)

For underground coal mine battery charging rooms, clause 6.10.4 of the CSA Standard applies and is closely followed by the Director.

“6.10.4 Storage Batteries

6.10.4.1

Storage batteries that are stationary when in use shall be located in storage-battery rooms or equivalent enclosures if the aggregate capacity at the 8 h discharge rate exceeds 5 kW, and the batteries are in unsealed jars or tanks.

6.10.4.2

Storage-battery rooms or other enclosures and battery-charging areas shall be provided with ventilation adequate to prevent the accumulation of an explosive mixture of battery gases.

6.10.4.3

Storage-battery rooms or other enclosures and battery-charging areas shall be in accordance with the applicable requirements of Clauses 6.10.4.4 to 6.10.4.14, and they shall be ventilated by an intake-air split adequate to ensure the diffusion of gases discharged into the return airway.

6.10.4.4

The location for battery-charging stations shall be designated as such and shall not be used for other purposes.

6.10.4.5

The construction of the battery-charging station shall be rendered fireproof.

6.10.4.6

An air vent shall be installed at the highest part of the structure to allow any gases generated to escape into the atmosphere.

6.10.4.7

All stations shall be equipped with adequate firefighting apparatus suitable for fighting Class C fires.

6.10.4.8

Heating, if required, shall be of the forced-air type, with the heating element located outside the charging station and arranged so that fresh air shall flow over the heating element when the element is operating.

6.10.4.9

The battery-charging station shall be adequately and continuously ventilated during battery-charging operations.

6.10.4.10

Material, other than standby batteries and material required for routine battery maintenance, shall not be stored in the battery-charging station.

6.10.4.11

Electrical equipment shall either be approved or be located so as to ensure that no possibility for the ignition of hydrogen exists.

6.10.4.12

Battery-charging equipment shall be located at or near floor level and shall be permanently connected to the main power supply.

6.10.4.13

Battery-charging cables installed after January 1, 2001, shall be contained within a protective jacket having an FT5 rating as specified in CSA Standard C22.2 No. 0.3.

6.10.4.14

Battery repairs shall be permitted only after precautions have been taken to ensure the dissipation of flammable gases. Battery-charging shall be discontinued for the duration of the time taken to effect the repair.”

Air flowing into the storage room or battery charging station must come from an uncontaminated source that will not bring with it any additional flammable gases. The volume of air must be sufficient to dilute gases generated by the battery charging process. The flow of air must be directed into the return air flow so that the hydrogen gas does not flow into working areas of the mine.

An approval by the Director ensures that adequate consideration has been given to identified safety issues. The room design should include air quality monitoring and automatic power disconnects for situations where flammable gas accumulates above defined lower explosive limits.

Subsection 566(2)

Because of the potential for initiation of explosive gases, repairs to batteries must not be performed underground or in any hazardous location. A spark from a short circuited battery could be catastrophic.

Section 567 Overhead power lines

Cables between overhead power lines and moveable switch houses, or between an overhead power line and a substation, must be continuous, without couplers or junction boxes. In addition, the supply cable must not exceed a length of 25 metres unless the noted conditions are met.

At the overhead line end of the cable, a separate means of disconnection must be located on the power pole. Such a disconnect system can use “cut-outs” on a pole or be of some other design, subject to approval by the Director.

To minimize the risk of injury to workers, cable connections to moveable switch houses or substations must be directly through suitable cable glands.

Section 568 Ground fault protection

Because of the hazards associated with the arcing or short-circuiting of a power cable in an underground mine, any cable that exceeds 125 volts must include ground fault protection.

The intent is to provide automatic cut-off of the main power supply to ensure that arcing or sparking does not create the potential for fire or a methane gas or coal dust explosion.

Since re-setting the power supply could re-create the fault, the related ground fault protection system must be designed so that it is impossible to restore the power until the ground fault has been identified, repaired and tested to ensure the fault has been removed from the system.

Section 569 Switchgear

Subsection 569(1)

The ability to switch off the supply of electricity to an underground mine is important. In case of an electrical fire, power must be turned off if having the power on creates additional hazards.

Similarly, if an explosion damages electrical circuits and leaves parts of the system live, it may be necessary to isolate the damaged parts before they can be repaired.

At an underground mine, an authorized worker must be available to operate the switchgear whenever the circuits are energized. The availability of such an authorized worker could be essential to a rapid response in case of an underground emergency. It is simply not acceptable that underground workers be placed at additional risk while waiting for an authorized person to be “called-out” to the scene of an emergency.

Subsection 569(2)

Locating switchgear near a working face allows workers to operate and isolate electrical equipment and related circuits as needed. Switchgear can be hazardous if it is exposed to accumulations of flammable gas or if it catches fire. For these reasons it must not be located any closer to a working face than the last ventilated cross-cut. This minimizes the potential for exposure to flammable gases generated at the working face. If the switchgear itself catches fire, the last ventilated cross-cut location will ensure that toxic smoke and gases will not flow into the working face where workers may be endangered.

Section 570 Grounding

Subsection 570(1)

Continued integrity of the ground electrodes is essential to the safety of the electrical system and workers.

Inspection and testing of ground electrodes ensures that the system is properly maintained and operated. Ground resistance must be maintained at its lowest possible level. Normal oxidation or other causes may affect the measured resistance value. Electrical current leaks can occur as a result of deteriorating cable insulation or when an energized line comes into contact with another path to ground. Grounding prevents equipment and cables from becoming a serious threat to the safety of workers.

Subsection 570(2)

Records must be maintained and kept for two years. An officer may request the records to confirm compliance with this section.

Section 571 Electric welding

The return cable must be the same size as the welding cable and be connected to the work piece being welded. This avoids the possibility of the return current seeking other paths back to the welding machine, creating a secondary energized conductor and associated electrocution risk.

Section 572 Hand held electrical drills

Hand held electric drills must be equipped with a fail-safe mechanism that automatically cuts power to the drill. With this mechanism, the drill operates only when the power switch is depressed. The drill stops any time positive pressure on the switch is removed.

Rubber-Tired, Self-Propelled Machines

Section 573 Approval

Subsection 573(1)

The OHS Code is intended to prevent the introduction of sub-standard vehicles into mines. All new rubber-tired, self-propelled equipment that meets the size criteria must meet the requirements of the OHS Code and a representative unit must be accepted by the Director before being put to use.

With the exception of section 574, the requirements of sections 573 to 596 are directed at large-sized mobile equipment that is self-powered and rubber-tired. Considering the gradient and condition of mine roads, the safety equipment provided on these vehicles has always been the focus of special attention. Although there have been few recent incidents in Alberta, statistics on brake failures, loss of steering, instability and road handling have not always been favourable. As the performance of safety components has improved over time, truck load factors and vehicle speeds have increased. As a result, the OHS Code requires correspondingly greater attention to these safety requirements.

Subsection 573(2)

The OHS Code does not apply to vehicles having a GVW of less than 32,000 kilograms unless specifically noted or specifically designated by the Director. This subsection provides the Director with the authority to request that any size or type of rubber-tired, self-propelled machine be tested and approved before being put into use. Such a request would be made after reported safety incidents, or upon the recommendation of the Director's mechanical engineering consultant.

Subsection 573(2)(c) provides an exemption for testing for any machine that has already been approved for use on Alberta's highways by being approved under the *Traffic Safety Act*.

Subsection 573(3)

Instead of complying with the manufacturer's specifications requirements of section 12 of the OHS Code, rubber-tired, self-propelled machines that exceed their manufacturer-specified load weights can be operated if

- (a) a written hazard assessment meeting the requirements of Part 2 has been completed, and
- (b) controls that ensure safe operation of the rubber-tired, self-propelled machine have been implemented.

The assessment and controls do not need to be reviewed by the Director prior to being implemented. If an officer inspects a work site and considers the assessment or controls insufficient, then the assessment and controls may need to be reviewed by the Director.

Section 574 Standards

The intent of this section is to ensure the safety of underground mine workers who often work in mines where road and ramp gradients are much steeper than those seen in surface operations.

Subsection 574(1)

CSA Standard CAN/CSA M424.3-M90 (R2007), *Braking Performance — Rubber-Tired, Self-Propelled Underground Mining Machines*, has been adopted in total despite the specifications of section 573(1). The Standard applies to all underground mining machines with rated speeds of 32 kilometres or less and having a rated gross mass of 45,000 kilograms or less.

According to the Standard, such underground equipment requires the Director's approval prior to being used in an underground mine.

"The test course for service, secondary and parking brake systems shall consist of a hard dry surface with a well-compacted base. The test surface shall

- (a) not exceed a 3 percent grade at right angles to the direction of travel, and
- (b) have a uniform down grade of 20 percent, plus or minus 1 percent.

The approach to the test course shall be of sufficient length, smoothness and uniformity of grade to ensure the required machine speed is reached before the brakes are applied."

Subsection 574(2)

Under certain conditions the Director may exempt a rubber-tired, self-propelled machine from subsection 574(1). Such conditions could include restrictive safe operating procedures or a certification from a professional engineer.

Section 575 Prototype machines

Subsection 575(1)

This section applies only to those vehicles defined as self-propelled machines by ISO Standard 6165: 2006, *Earth-moving machinery – Basic Types – Vocabulary*. According to clause 3.1.1 of this standard, the family of machines covered includes

- (a) backhoe loader,
- (b) dumper,
- (c) excavator,
- (d) grader,
- (e) land fill compactor,
- (f) loader,
- (g) pipelayer,
- (h) roller,
- (i) scraper,
- (j) tractor-dozer, and
- (k) trencher.

Subsection 575(2)

Prototype equipment in this section is interpreted to mean any new or used piece of rubber-tired, self-propelled mobile equipment that is brought into Alberta for the first time and intended for use in any Alberta mine.

Subsection 575(3)

Repealed

Subsection 575(4)

Repealed

Subsection 575(5)

No explanation required.

Subsection 575(6)

The required "Test Report" must include the following information taken from clause 8 of ISO Standard 3540: 1996, 8 Test report:

- (a) a reference to this International Standard;
- (b) type of machine;
- (c) make of machine;
- (d) model and serial number of the machine;
- (e) condition of the brake system e.g. new, in operation for 1000 h, etc.;
- (f) mass and axle distribution of the machine as tested, in kilograms;
- (g) manufacturer's approved maximum machine mass and maximum axle distribution, in kilograms;
- (h) tire size, ply rating, tread pattern and pressure, in megapascals;
- (i) description of the brakes e.g. disc or drum, hand or foot control;
- (j) type of brake systems e.g. mechanical or hydraulic;
- (k) which tests were carried out using a retarder and a description of the retarder e.g. hydraulic or electric;
- (l) surface of the test course e.g. asphalt, concrete or soil;
- (m) longitudinal and cross slope of the test course;
- (n) results of all stopping and holding tests;
- (o) percentage of the service brake system stored energy after the brake application test calculate from the following formula (see clause 7.2 of the Standard);

$$p = \frac{P_2}{P_1} \times 100$$

where

p is the residual pressure as a percentage,

p₁ is the brake application pressure during the first brake application,

p₂ is the lowest brake application pressure measured during subsequent brake applications;

- (p) force levels applied to the controls (see clause 7.1.1 of the Standard);
- (q) machine maximum level surface speed, in kilometres per hour;
- (r) secondary brake system capacity for stored energy system (see clause 7.3 of the Standard).

Section 576 Representative machines

Subsection 576(1)

For rubber-tired, self-propelled mobile equipment that exceeds 32,000 kilograms and that is not covered by ISO Standard 6165, the employer must provide brake performance test results as described in clause 7.6 of ISO Standard 3450: 1996.

If testing of a prototype unit has not been conducted by the manufacturer prior to delivery, the employer can elect to test a representative unit at the mine site. The unit to be tested must be equipped similarly to other units of the same fleet in order to be considered as truly “representative”. The related test course conditions are specified in clause 6.0 of the ISO Standard.

Although relevant excerpts from the Standard are provided below, readers are advised to consult the actual standard to confirm the detailed requirements. Note that additional information is provided in the Standard.

From ISO Standard 3450:

6.2

The test course shall consist of a hard, dry surface with a well-compacted base. Ground moisture may be present to the extent that it does not adversely affect the braking test.

The course shall not have a slope of more than 3% at right angles to the direction of travel.

The approach to the test course shall be of sufficient length, smoothness and uniformity of slope to ensure the required machine speed is reached before the brakes are actuated.

6.3.1

The test mass of all machines, except dumpers and tractor-scraper, shall be as stated in 3.4 without a payload and at the manufacturer’s specified axle load distribution.

6.3.2

The test mass of dumpers and tractor-scrappers shall be as stated in 3.4 and include a payload.

7.6.1.1

Brake performance shall be tested from a machine speed, which is the greater of 80% of the maximum level surface machine speed or 32 km/h, it shall be tested at maximum speed. The test speeds shall be within 3 km/h of the required target speeds.

7.6.1.3

The test course shall have no more than a 1% slope in the direction of travel.

Subsection 576(2)

Test data required for certification of mobile equipment can be obtained from the equipment manufacturer or a professional engineer who can provide similar data by testing a representative unit as prescribed in clause 7.6 of ISO Standard 3450: 1996. The components of the representative unit's braking system must be the same as those in the units intended for use.

The employer must maintain a copy of the brake certification, including the test report specified in clause 8 of ISO Standard 3450: 1996. One copy of the test report must be forwarded to the Director.

Section 577 Emergency energy

Braking systems using air or air-over-hydraulic mechanisms must have an emergency energy source to ensure service brakes can effectively stop the mobile equipment and hold it on any grade on which it operates. Spring coils are often used as a back-up if the hydraulic or compressed-air pressure drops drastically. Under normal conditions, hydraulic or pneumatic pressure keeps the springs compressed, releasing the wheels to move.

Section 578 Hydraulic brakes

In the event that 50 percent of this type of hydraulic braking system fails, the equipment can still be brought safely to rest on any grade on which it may operate.

The requirements for independently acting circuits provides a greater margin of safety. If one circuit fails, the other can do the job equally well. This is an example of a typical two-level safety provision, generally referred to as safety through redundancy.

The braking system must also meet the requirements of ISO Standard 3450: 1996.

Section 579 Dual brake systems

The visible or audible warning device on a divided or dual braking system is there to make the operator aware when part of the system fails. This warning is critical to the operator's efforts to bring the equipment to a safe stop. The equipment should then be parked until the braking system problem is resolved.

Section 580 Emergency brakes

The air pressure exerted by the automatic emergency braking system on service brakes must not fall below 415 kilopascals (60 pounds per square inch). This pressure is considered sufficient to bring the vehicle to a stop and hold it there. System designs using other pressures should follow the manufacturer's recommendations.

Section 581 Air brakes

Basic design features and performance criteria have been set to achieve the degree of safety required in air and air-over-hydraulic braking systems.

Section 581(a)

In case of a sudden air pressure drop, this section requires that available air in the main braking reservoir be used only for braking and that it be protected from loss of pressure resulting from demand by auxiliary accessories. The auxiliary demand may be greater than the air system's ability to replenish itself.

Section 581(b)

The minimum volume of available air in the main circuit must be not less than 12 times the full volume displaced by the brake actuators. This allows reliable operation of the actuators and maintains a degree of uniformity in the volume and pressure of the air system for safe and effective brake operation.

Section 581(c)

The purpose of the water ejection or air-drying system is to remove moisture from the air. Moisture in the system can cause brakes to malfunction. Dry air helps prevent the problem of moisture freezing which could render the system inoperable.

Section 581(d)

The availability of visual indicators such as pressure gauges allows the operator to safely operate mining equipment. A decrease in air pressure warns the operator of a brake problem and allows the operator to take necessary safety measures.

Section 581(e)

An audible or visual alarm informs the operator when available air pressure falls below the permissible operational braking pressure range. The warning should provide the operator with enough time to safely stop the equipment.

Section 581(f)

The presence of check valves ensures reservoir air is not lost by leaking through a defective tube on the supply side. With the help of the air left in the reservoir, the operator can safely stop the equipment.

Section 582 Auxiliary air reservoirs

In the event of a failure in the main braking pressure supply circuit, there must be a sufficient energy reserve available in the auxiliary system to bring the equipment to a safe stop.

This minimum volume for auxiliary air reservoirs used for modulated emergency braking is six times the actuator's displacement capacity. This volume is considered sufficient for auxiliary brakes and is approximately half the requirement for normal service braking systems. This requirement allows for repeated pumping of the brake pedal which could be required to stop the machine in an emergency.

Section 583 Front wheel brake control

The ability to reduce the braking force of front wheels directly affects an operator's ability to maintain control of the vehicle. This is especially important in the case of slippery conditions. If the front brakes lock-up, the operator may be unable to regain control.

Section 584 Parking brakes

Subsection 584(1)

This is a performance-based design parameter set for manufacturers. These minimum parking brake requirements address operations in which equipment is required to maneuver on a grade of up to 15 percent.

This requirement is consistent with clause 7.5 of ISO Standard 3450: 1996, *Earth-moving machinery — Braking systems of rubber-tyred machines — Systems and performance requirements and test procedures*.

Subsection 584(2)

Parking brakes must be designed to remain fully operational and independent of fluctuations in air pressure within the system. Brake effectiveness must not be affected by the loss of apply pressure, temperature variations or dimensional changes of components due to expansion or contraction.

These fail-safe design requirements allow the vehicle to be parked safely while every other on-board system is shut off. Any modification to brake components must not compromise their effectiveness.

Section 585 Periodic service brake testing

Subsection 585(1)

The service brakes on specified units of rubber-tired, self-propelled mobile equipment that have a GVW of more than 32,000 kilograms and travel more than 10 kilometres per hour during normal operation must be periodically tested. The purpose of regular testing is to provide a measure of the effectiveness of the brake maintenance program. This periodic brake testing must not be confused with brake certification testing that is required to demonstrate the effectiveness of the original equipment design.

The periodic brake test provides

- (a) a comparison of braking between machines,
- (b) a measure of braking improvement, deterioration or consistency over time,
- (c) workers with an opportunity to observe actual brake performance under simulated emergency conditions, and
- (d) information related to equipment maintenance program effectiveness.

Subsection 585(2)

This subsection gives the Director the authority to request that any piece of rubber-tired, self-propelled mobile equipment be tested. Such a request will not arbitrarily be made unless worker complaints, site inspections, equipment incidents or other information provides evidence that a braking problem may exist.

In all cases, the expectation is that the mining equipment will be maintained in accordance with the manufacturer's specifications.

Subsection 585(3)

Due to the increasing fleet size at some operations, the OHS Code has provided the employer with some discretion and flexibility with respect to periodic brake testing of the required units. A minimum of 30 percent of each fleet type of rubber-tired, self-propelled mobile equipment must be tested each year.

A "fleet" is defined by the individual model series or size of the respective units. For example, if a truck fleet consists of both Caterpillar and Komatsu 380 ton trucks, 30 percent of each type should be subjected to periodic brake testing.

If the fleet consists of a variety of truck sizes e.g. 400 ton, 300 ton and 200 ton units, 30 percent of each size will be brake tested in a given year to ensure an adequate sampling.

Subsection 585(4)

Despite subsection 585(3), all individual rubber-tired, self-propelled machines must be brake tested within a given three-year period. For purposes of follow-up, records should be available to an occupational health and safety officer to show that the brake tests have in fact been completed.

Subsection 585(5)

The expectation of this section is that the braking performance of any given machine will fall within the standard established by the manufacturer. Should periodic brake testing reveal that braking capability has been reduced below an acceptable level, the machine must be removed from service until repairs or adjustments are completed. After repairs or adjustments have been completed, a re-testing of the machine should be performed and documented.

Subsection 585(6)

This section provides the authority for an occupational health and safety officer to request that a given unit of rubber-tired, self-propelled equipment be brake tested. Again, this provision would normally be used only where information or evidence justifies the officer's request.

Section 586 Tests

Subsection 586(1)

Brake testing introduces an element of risk and as such must only be conducted under the supervision of a competent worker. That competent worker must ensure that the test site is suitable and the physical brake tests are conducted according to industry standards. Based on the test results, the competent worker must make decisions about continuing a test or removing a tested unit from service until repairs are made.

Subsection 586(2)

This subsection lists the conditions under which a loaded rubber-tired, self-propelled unit is to be brake tested. A straight, level road with a hard, dry surface is specified to minimize the risk of injury to workers involved in the process and to minimize the stress imposed on the mining equipment.

Subsection 586(3)(a)

For comparison purposes, the employer must ensure that the distance required to bring the unit to a complete stop is recorded during the brake test. This stopping distance must then be compared to the stopping distance determined during earlier brake tests, if the unit has previously been subjected to such tests. If available, the original brake certification test results may be relevant for comparative purposes.

If a unit is being subjected to a periodic brake test for the first time, it is recommended that the manufacturer's specifications or the original certification brake testing results be the basis for comparison.

Subsection 586(3)(b)

The actual speed of the unit prior to the service brake being applied is critical to the results of the stopping distance measurement and must therefore be recorded. In this case, the OHS Code is not specific and only requires the unit be operated at normal operating speed immediately before the brakes are applied.

It is recommended that where possible, all units of the same model and size be tested at the same "normal" operating speed during the test to allow the test results to be compared and interpreted.

Section 587 Maintenance records

Subsection 587(1)

Effective record keeping preserves a detailed history of vehicle problems, maintenance repairs and test records. This information is used to assess vehicle performance and the overall mechanical condition of the vehicle. It is also useful when planning annual production capability and when justifying equipment replacements. Maintenance history is also an important consideration during incident investigations.

The employer is required to maintain a maintenance record on each rubber-tired, self-propelled machine.

Subsection 587(2)

To ensure that relevant maintenance information is kept for a reasonable period of time, the OHS Code specifies that each record must be maintained for a period of three years from the date that a specific activity was performed. Since an occupational health and safety officer may request the maintenance records at any time, the employer must make such records available at the mine.

Section 588 Auxiliary steering

The mining environment can involve travel on busy access or haulage routes that are many kilometres in length and that are in some cases built with extended gradients of up to 10 percent. In such an environment, the loss of vehicle steering control could put mine workers at risk of serious injury. As a result, this subsection requires that any rubber-tired, self-propelled machine meeting the criteria specified in (a) and (b) must be equipped with an auxiliary power source that enables the operator to steer the machine to a safe stop.

This section provides an exemption to any machine that has its use restricted to underground operations and a maximum operating speed of 20 kilometres per hour.

Section 589 Auxiliary pump

An isolated or separate reservoir of emergency hydraulic fluid ensures that damage to any other hydraulic circuit will not affect the emergency steering system.

It is acceptable to have two reservoirs incorporated into a common container as long as the container separates the emergency steering fluid supply from other hydraulic fluid supplies.

Section 590 Auxiliary steering standards

Subsection 590(1)

SAE Standard J1511 FEB94/ISO 5010, *Steering for Off-Road, Rubber-Tired Machines*, has been adopted as the auxiliary steering standard for Alberta. The relevant parts of the Standard are reflected in subsection (2).

Subsection 590(2)

Given the steep gradients over which mine equipment can be used, automatic initiation of auxiliary steering is preferred, although a manual system is acceptable.

In any case of auxiliary steering activation, a warning device must also be activated to warn the operator that the emergency steering system is in use. This warning device is intended to minimize the potential that the auxiliary steering is being used without the operator's knowledge.

Section 591 Design safety factors

Subsection 591(1)

These design and operational requirements are intended to prevent worker injuries.

- (a) Without shock-absorbing seats, drivers could be subjected to chronic injuries from the whole-body vibration generated while travelling on rough mining roads.
- (b) Stop blocks, railings or a small ditch that will catch and hold the wheels of a vehicle can be used to prevent parked vehicles from rolling. The intention here, however, is to have a mechanical device or parking brake as the fail-safe means of preventing unintentional movement.
- (c) Starting an engine with the transmission engaged may cause the vehicle to jump or move unexpectedly. Any unexpected movement of the vehicle may threaten the safety of workers or nearby equipment.

Subsection 591(2)

Equipment stability can be a problem, especially when dump boxes have been altered or replaced to carry a larger volume of a lighter material. For example, replacement of a 100-ton truck dump box used to haul overburden that weights 3,000 pounds per cubic yard with the dump box from a 150-ton truck used to haul coal weighting about 2,000 pounds per cubic yard can disrupt the vehicle's stability.

Although the GVW might remain within the equipment manufacturer's recommended load specifications, this alteration can adversely affect equipment steering and braking and shift the centre of gravity.

Subsection 591(3)

The intent here is that the vehicle remain stable with the front wheels on the ground. In rare instances, where a short-term operational condition might present a problem, alternate procedures are allowed. The expectation however is that a proper hazard assessment is completed, safe work procedures developed, and workers advised and trained accordingly. Section 8 of the *OHS Regulation* requires the procedures to be in writing and available to workers.

Section 592 Clearance lights

Subsection 592(1)

Clearance lights let other drivers know how much space a unit of equipment needs on the road. Clearance lights are particularly helpful at night and during times of poor visibility.

Subsection 592(2)

Clearance lights must be on when the machine's engine is on. Where practicable, the clearance lights should be interlocked with the engine so that they are automatically turned on when the engine is started and remain on while the vehicle is operating. If interlocking with the engine is not acceptable, defined operating procedures and worker training must be in place to comply with the OHS Code.

Subsection 592(3)

It is simply impractical to attach clearance lights to a blade or a bucket.

Section 593 Clear view

Most equipment is now designed to provide maximum visibility. However, some units may still require other devices to ensure good visibility. These devices may include mirrors, television cameras or other similar devices.

Section 594 Lights

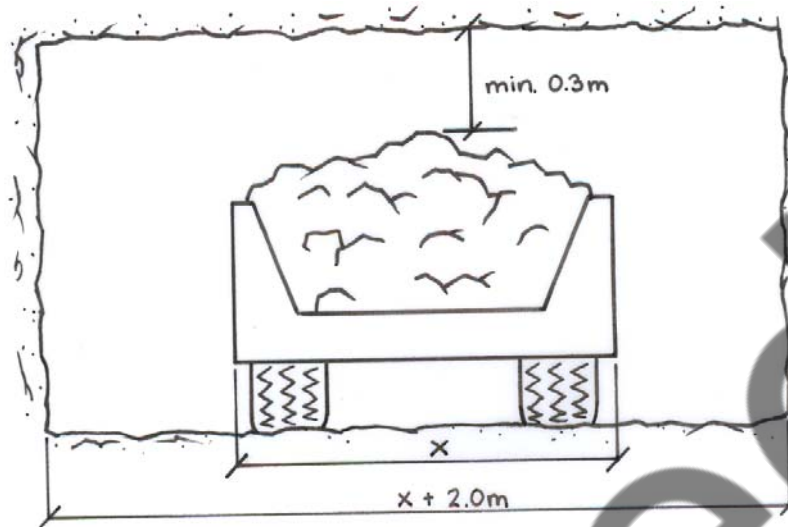
The lights listed in this section tell others in the area what the equipment is doing. Alignment, intensity and clarity are all important to the effectiveness of these lights.

Section 595 Clearances

Subsection 595(1)

Adequate clearance must be provided on each side of a rubber-tired self-propelled machine and above it as it travels underground. Both the required horizontal and vertical clearance distances are illustrated in Figure 36.15.

Figure 36.15 Vehicle clearances underground



Subsection 595(2)

Based on particular circumstances, the Director may consider an application for an exemption to the defined clearances.

Section 596 Unattended machines

Subsection 596(1)

Due to the risk of fire and the very serious consequences of a fire in an underground mine, no rubber-tired, self-propelled machine can be left unattended unless the engine has been shut down and the unit has been secured from unintended movement according to subsection (2).

Subsection 596(2)

Workers must ensure unattended vehicles are properly parked so they do not move and create hazards for other workers. By parking on the level, or by ensuring the unit's wheels are turned or blocked appropriately, the potential for a runaway is minimized.

Diesel Power

Section 597 Diesel powered machine

Subsection 597(1)

CSA Standard CAN/CSA-M424.1-88 (R2007), *Flameproof Non-Rail-Bound, Diesel-Powered Machines for Use in Gassy Underground Coal Mines*, describes the technical requirements and procedures necessary for the design, performance and testing of new or unused flameproof, non-rail-bound diesel-powered, self-propelled machines for use in gassy underground mines. The working environment of such mines is characterized by the presence of methane gas and combustible dust.

The Standard applies to all machines of 45,000 kilograms (100,000 pounds) mass or less, which are designed to operate on level ground at a maximum speed of 32 kilometres per hour (20 miles per hour) or less on level ground.

Subsection 597(2)

This Standard describes the technical requirements and procedures necessary for the design, performance and testing of new or unused flameproof, non-rail-bound diesel-powered, self-propelled machines for use in non-gassy underground mines.

The Standard applies to all machines of 45,000 kilograms (100,000 pounds) mass or less, which are designed to operate on level ground at a maximum speed of 32 kilometres per hour (20 miles per hour) or less on level ground.

The very limited size of Canada's underground coal mining industry is such that certifications and services previously available within Canada may no longer be provided. In such a case, the Director may approve equipment using the standard of another country. Compliance with this standard would still have to show that the equipment meets or exceeds the safety requirements of Alberta's OHS Code.

For example, the need to source mining equipment from outside of Canada, often from the U.S., is an increasingly common experience. An example would be diesel engines for rubber tired mobile equipment for use underground. Such equipment may not be certified to a Canadian standard but meets a standard of the source country. However, the two standards may differ to varying degrees. In such a case the employer must demonstrate how the equipment meets or exceeds the safety requirements of Alberta's OHS Code.

Conveyors

Section 598 Fire resistance

Conveyor belting and other conveyor components used in areas with high fire and explosion potential must be closely controlled. The standard referenced for additional information is CSA Standard CAN/CSA 422-M87 (R2007), *Fire-Performance and Anti-static Requirements for Conveyor Belting*.

The Standard addresses two categories of conveyor belts:

- (1) Types A1 and A2 intended for use in explosive atmospheres; and
- (2) Types B1-A, B1-B, B2 and C intended for use in non-explosive atmospheres.

The Director may use an equivalent standard where appropriate.

The use of non fire-resistant belting is allowed in a hazardous location provided the conveyor belt system is equipped with an effective fire suppression system approved by the Director.

Section 599 Stopping

Subsection 599(1)(a)

A pull cord that stops a conveyor in an emergency is a very important and reliable safety device. In almost all conveyor galleries, whether on the surface or underground, workers are required to travel beside the running conveyor either to supervise, maintain, monitor or clean.

When working around moving equipment associated with a conveyor, there is always the potential that a worker will fall into or find their clothing caught in the conveyor system. The conveyor must therefore be capable of being stopped immediately to prevent serious injury. Accessible pull cords make this possible.

To ensure it remains effective, the pull cord system must be tested frequently and adjusted as necessary.

Subsection 599(1)(b)

The requirement to manually reset and restart a stopped conveyor ensures the conveyor is not restarted until the area where the pull cord was tripped has been visually inspected and remedial actions taken.

Subsection 599(2)

In mines where material is conveyed on a series of conveyors, a sequential control is installed to stop all affected belts before their individual continuation could cause problems by dumping material and perhaps burying transfer points. This process is triggered by the use of sensor switches. A minimum of two are required:

- (i) Belt-slip switch — Friction caused by the slipping of a conveyor belt drive can generate heat that can contribute to fire and explosion hazards. This hazard is mitigated by application of a speed-sensitive “belt-slip” switch to shut down the conveyor when the belt suddenly slows to a predetermined speed.
- (ii) Blocked chute — In a series of conveyors the transfer chute directing mineral from one belt to the next can become blocked, spilling coal over the surrounding area, working areas and possibly onto personnel. This hazard is mitigated by using blocked chute switches which detect an accumulation of mineral in the chute and automatically stop the delivery conveyor.

Section 600 Travelling room

The minimum 1 metre of travelling room in an underground mine is considered sufficient to allow workers safe movement near the conveyor. If services such as electrical cable trays, water lines, communication cables and lighting systems are installed along the conveyors the required travel room must be maintained.

These travel areas may also be used as a return airway and require careful monitoring for dust, heat, methane and other gases. Since any travel way could be used as an emergency escape route, travel ways must be kept free of debris.

Section 601 Combustible dust

Subsection 601(1)

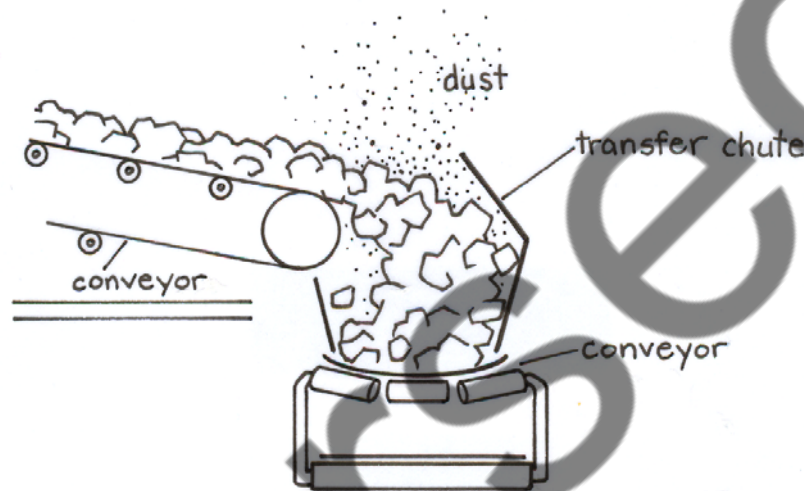
Dust generated by conveyors can be very fine and can easily become airborne. If not controlled as required by the OHS Code, much of it will eventually accumulate along the length of the conveyor, especially at the return end. Accumulations can also occur at the drive end due to spillage. If allowed to accumulate, dust can come into contact with moving parts and the resulting friction can create heat and fire leading to a possible explosion.

Belt cleaning devices should be located where the dust can be safely collected and disposed of at regular intervals.

Subsection 601(2)

The discharge of coal and similar materials generally produces dust that can be dangerous to workers' health. Dust can also create visibility problems when disturbed by air movement. Enclosed chutes and dust control measures at transfer and discharge points can help minimize the spread of dust. Figure 36.16 shows both a chute and a transfer point. Decreasing the fall distance for loose material reduces the generation of dust as does the use of water spray or dust suppression chemicals. Note that water is not very effective on coal dust.

Figure 36.16 Conveyor chute and transfer point



Section 602 Clearances

Subsection 602(1)

The minimum clearance for a rubber-tired vehicle to travel safely beside a conveyor has been set at 2 metres plus the vehicle's width. The total width required to accommodate the conveyor and a rubber-tired vehicle becomes 2 metres plus the sum of the vehicle's width, the room for the conveyor, and the clearance on the blind or non-travelling side of the conveyor. Figure 36.17 shows the arrangement and related distances.

For track-guided vehicles, the clearance is reduced to a minimum of 0.3 metres between the conveyor and the vehicle (see Figure 36.18). Since the vehicle is track guided, the likelihood of conveyor contact is much reduced.

The required clearance on the blind side of the conveyor is also 0.3 metres, mainly to provide room for cleaning accumulated dust.

Figure 36.17 Clearances for a conveyor and rubber-tired vehicle

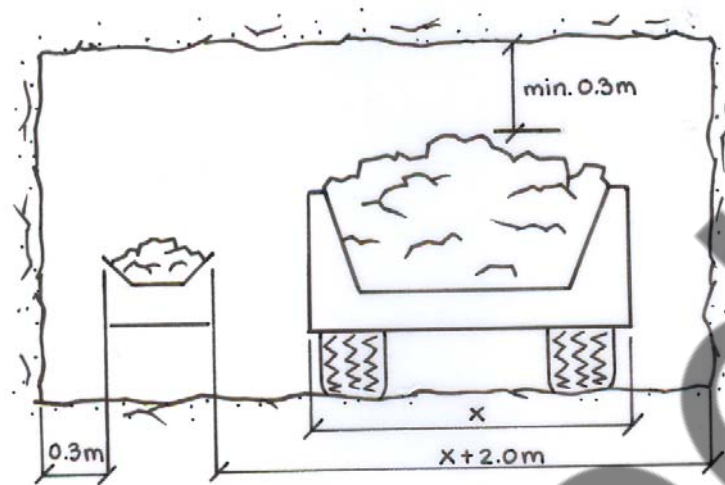
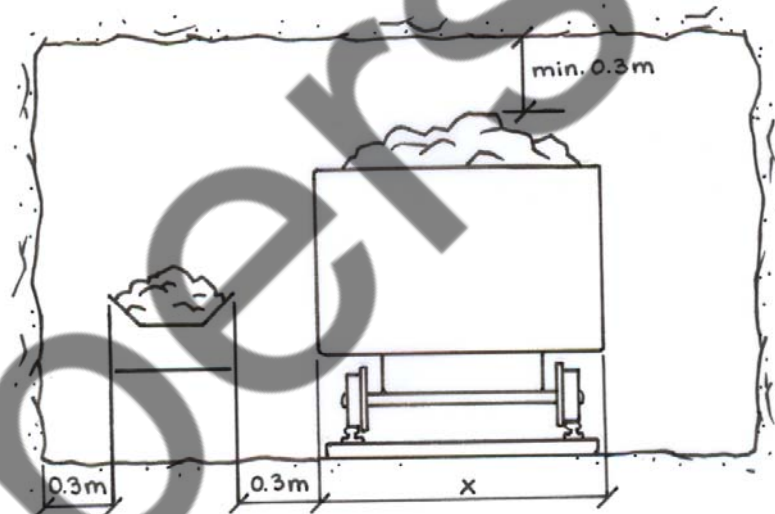


Figure 36.18 Clearance for a conveyor and track-guided vehicle



Subsection 602(2)

This minimum clearance of 0.3 metres between the roof supports and the top of the load on the conveyor provides adequate room for material movement.

Section 603 Riding conveyor belts

Subsection 603(1)

Working areas in underground coal mines are sometimes a great distance from the surface and walking conditions can be poor. In some underground mines, workers ride on specially designed conveyor belt systems to get to and from their respective work areas. In such cases, the entire system must be specifically designed and certified by a professional engineer.

This system includes provisions for getting on and off the moving conveyor and worker training to use the system. The system must also include various fail-safe protective measures to prevent incidents, e.g. if workers cannot get off the belt as anticipated, a method of stopping the belt before the worker is endangered must be incorporated.

Subsection 603(2)

This subsection provides basic design criteria for the professional engineer to use when designing the system. The success and safety of the system relies on proper design, protective features, safe operating procedures and training.

Subsection 603(2)(a)

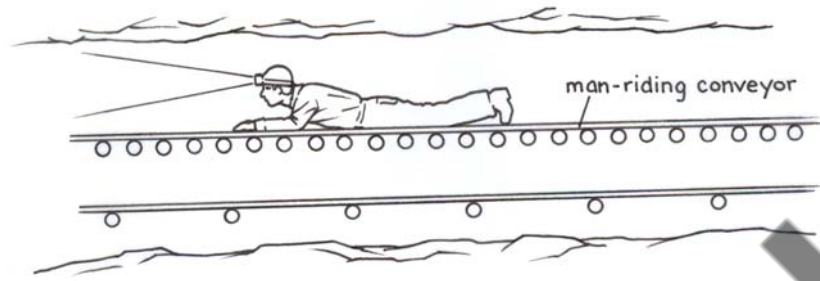
The gradient of conveyors used to transport workers is limited to a maximum of 15 degrees, while the maximum gradient for conveyors used to carry rock or coal is normally about 17 degrees.

Subsection 603(2)(b)

The head room clearance of 0.9 metres allows a worker to lie comfortably on the belt with head lifted to see disembarking signs ahead. Figure 36.19 illustrates this point. The clearance must also provide enough room for the worker to get on and off the conveyor.

The roof of a mine is generally rock bolted and may be equipped with other attachments to carry a variety of items. As a result, the required clearance must be measured between the belt and any protruding part of rock bolts or other attachments.

Figure 36.19 Head room clearance



Subsection 603(2)(c)

For the safety of workers who get on and get off a moving conveyor, the OHS Code limits the maximum belt speed to 2.65 metres per second (approximately 6 miles/hour). A faster speed could place workers at a greater risk of injury by overbalancing and falling over when mounting or dismounting the moving conveyor.

Subsection 603(2)(d)

A minimum belt width of 915 millimetres (36 inches) is specified to provide adequate space for a worker. This width is critical to a worker attempting to get on the conveyor. This width provides a reasonable safety factor in case of a trip or misstep when mounting or dismounting the moving belt.

Subsection 603(2)(e)

Non-slip surfaces ensure the safe mounting and dismounting of moving belts. Workers need a solid foothold from which to make the angular step necessary to get on the belt. The length of the non-slip surface must be sufficient to give workers enough time for mounting.

Subsection 603(2)(f)

Properly designed dismounting platforms are a critical safety component of any belt-riding system.

Since the conveyor belt is moving at a consistent speed of up to 2.65 metres per second (6 miles per hour), the dismounting platform must be large enough, at least 0.6 metres wide, and long enough, at least 15 metres in length, to accommodate the moving worker. To minimize the risk of injury, the platform surface must be treated or constructed of materials that provide a non-slip surface. A properly fitted handrail provides an additional means of protecting workers.

Recognizing the limitations of space in a typical underground mine, the OHS Code requires that adequate head room clearance be provided at a dismounting platform so that a worker can dismount in an upright position. With adequate overhead clearance, a worker need not be concerned with suspended or protruding objects at roof level. An upright body position provides the worker with a better chance of maintaining balance during dismounting, thus minimizing the potential of a trip or fall.

Subsection 603(2)(g)

Underground lighting is often limited, so proper illumination is critical at mounting and dismounting platforms. Without proper illumination, a worker will have difficulty seeing or judging distances at a mounting or dismounting location. Further, at an inadequately illuminated dismounting platform, the loss of a miner's lamp could be disastrous to any worker who was already riding the conveyor belt. As a result, the OHS Code requires that all conveyor mounting and dismounting platforms be electrically illuminated.

Subsection 603(2)(h)

Again, due to the limited availability of fixed lighting in an underground mine, it is important that workers be directed to mounting and dismounting platforms by the use of reflective signage. It is important for workers riding the conveyor belt that reflective signage is installed to indicate that they are approaching a dismounting platform. According to this subsection, those reflective signs must be installed at distances of 30 metres, 20 metres and 10 metres from any dismounting platform. Such advanced notice provides adequate time for a worker to get ready for a safe dismount.

Subsection 603(2)(i)

Since it is possible that a worker will miss the dismount platform or have difficulty in dismounting as planned, a belt-stopping safety device is required. This safety device must be installed in a location that will stop the belt prior to a worker being transported into a more dangerous situation such as into a chute or hopper.

Subsection 603(2)(j)

Any man-riding conveyor belt must be equipped with brakes that automatically apply to stop and hold the conveyor when a belt-stopping safety device is activated.

Subsection 603(2)(k)

A principal safety hazard with man-riding conveyors is the danger of stepping onto a torn or split belt. This could allow the human rider to contact the rotating rollers underneath, usually resulting in tragic consequences. This is typically addressed in the industry by use of “torn belt” sensors which are interlocked with the drive. Whenever a split in the belting is detected, the belt stops, allowing it to be repaired and preventing any subsequent accident.

Subsections 603(3) and 603(4)

Workers riding conveyor belts must be adequately trained and have access to detailed safe operating procedures for riding conveyor belts. Section 8 of the *OHS Regulation* requires the procedures to be in writing and available to workers.

Procedures and precautions must be posted in a conspicuous place for easy reference and should include such things as

- (a) pre-use inspection of the belt,
- (b) prohibited materials that cannot be transported with a worker;
- (c) periodic testing of safety dismount devices, and
- (d) separation distance between riders on a belt.

Section 604 Examination

Proper care and maintenance of a conveyor system in any underground mine can significantly reduce the potential for fire. Given the combustible nature of coal and coal dust, the problems associated with a conveyor fire are increased many-fold. A competent worker must therefore frequently inspect the conveyor system and all its related components.

In an underground coal mine each conveyor system (belt line) must be inspected at least once each shift to check for hot spots caused by friction of the belt or other moving components such as belt-carrying-idlers.

Dangerous buildups of coal dust must not be allowed to accumulate beneath the moving belt, under pulleys, or around conveyor belt rollers. Friction could result in a fire or explosion.

Prior to resuming operations after an interruption in mining activity, the total conveyor system must be examined to ensure that it is safe to start up. Given the nature of the underground mining environment, any number of serious hazards could have developed since the last time the system was operated or inspected. For example, a fall of ground could have damaged the conveyor belt or blocked

individual conveyor components. As well, maintenance or operating materials could have been inadvertently left on the belt, or previously undetected electrical cable damage could now become evident. It is essential therefore that pre-use inspections be conducted to identify and correct any conveyor system hazards.

Section 605 Carbon monoxide monitors

Fire is a real threat associated with conveyor operations in a mine. In coal mines, the threat is increased due to the possibility of a methane gas/coal dust explosion. The presence of carbon monoxide indicates a heating process resulting from either spontaneous combustion or other heating process. Based on the content of carbon monoxide in the air, the state of the fire or heating can be predicted.

The location and frequency of monitoring installations depends on variables such as the length of the gallery, the nature and quality of the coal being mined, and the velocity of ventilation air.

Section 606 Conveyor roadways

Subsection 606(1)

All roadways in an underground mine may be used as escape routes by workers. As a result, such roadways must be kept clear of obstructions at all times.

Subsection 606(2)

The height of a conveyor roadway is dictated by the conveyor profile, the clearances required to move materials safely and the need to have the mine easily accessed by workers. The minimum requirement of 1.5 metres may be increased at the employer's discretion to accommodate variations in material heights and other conditions in the mine.

Subsection 606(3)

Because of the hazards associated with operating conveyors, all workers must travel only in the clear space on the conveyor roadway. As noted in subsection (1), these roadways must be kept clear of any obstructions that could impede the effective movement of any worker.

Division 2 Explosives

Section 607 Theft of explosives

Subsection 607(1)

Both federal and provincial authorities, including the RCMP, are to be informed of suspicious incidents involving explosives. Other mines may also need to be informed of such incidents to protect their own explosive supplies. A blaster must immediately inform the employer of any suspected attempt or known unlawful entry into a magazine or theft of an explosive product.

Subsection 607(2)

Upon becoming aware of a suspected attempt or known unlawful entry into a magazine or theft of explosive product from a mine site, an employer must immediately inform the Director. It is recommended that the employer also notify the RCMP.

Section 608 Non-sparking tools

Tools used for the handling of explosives must be made of non-sparking materials such as copper or brass to ensure they do not become a source of ignition. Both the employer and worker are responsible for ensuring that only non-sparking tools are used.

Section 609 Underground mine blaster

Subsection 609(1)

Responsibility for blasting and the related handling of explosives rests with the employer. At an underground mine, the employer must appoint a certified underground mine blaster to act on the employer's behalf. Once appointed by the employer, a certified underground mine blaster is responsible for the direction of explosive handling activities and for the safe execution of all blasting operations at the mine.

Only a certified underground mine blaster or another worker who works under the direct supervision of a certified underground mine blaster can handle an explosive product or blast a misfire.

Subsection 609(2)

Due to the knowledge required to properly handle explosives and the hazards related to improper use, non-certified underground mine workers must not handle explosives, except as noted in subsection (1).

The employer is responsible for ensuring that non-certified underground mine workers are trained to be aware of the hazards associated with explosive products. Those mine workers must also be trained in the company's blasting procedures .

Section 610 Surface mine blaster

Subsection 610(1)

Responsibility for blasting and the related handling of explosives rests with the employer. At a surface mine, the employer must appoint a certified surface mine blaster to act on the employer's behalf. Once appointed by the employer, a certified surface mine blaster is responsible for the direction of explosive handling activities and for the safe execution of all blasting operations at the mine.

Only a certified surface mine blaster or another worker who works under the direct supervision of a certified surface mine blaster can handle an explosive product or blast a misfire.

Subsection 610(2)

Due to the knowledge required to properly handle explosives and the hazards related to improper use, non-certified surface mine workers must not handle explosives, except as noted in subsection (1).

The employer is responsible for ensuring that non-certified surface mine workers are trained to be aware of the hazards associated with explosive products. These mine workers must also be trained in the company's blasting procedures.

Section 611 Magazines

This section applies to an explosive magazine intended for use in an underground mine. Magazines at a surface mine must be certified by federal authorities.

Explosives are classified as hazardous materials. Due to the confinement of an underground working environment, the effects of an unplanned explosion could be catastrophic to mine workers. Explosive products cannot be stored in an underground mine except in a magazine that meets very strict conditions.

According to the OHS Code, the minimum requirement for an underground explosive storage magazine is that the facility be designed and certified by a professional engineer. Further, the Director must also approve the magazine to ensure that an acceptable standard has been maintained.

Section 612 Illumination of magazines

Inappropriate portable lights may introduce fire or ignition hazards if brought into a magazine. Approved lights provide safety measures against any such possibility through shielding, lower surface temperatures and proper air flow. Approved lights are tested and certified for use in such hazardous locations.

Section 613 Stored explosives

Section 613(a)

Frequent examination is needed to ensure explosives are not deteriorating and becoming dangerous. For example, dynamite sticks “sweat” and produce nitroglycerine liquid. The liquid can be detonated with a fairly low-intensity vibration or impact. Similarly, ammonium nitrate blasting agent allows its diesel fuel to percolate down to the bottom, affecting the composition of the blasting agent and its performance when initiated. Regular examination and use of the explosives on the basis of first received, first used will avoid using explosives that have deteriorated due to an extended storage period.

Sections 613(b) and (c)

Deteriorated explosives must be carefully removed and destroyed by a blaster according to the manufacturer’s specifications. Destruction must be carried out at a remote location to ensure the safety of anyone involved in or near the operation.

Section 614 Electric detonators

Leg wires must be shunted to avoid any possible initiation of the detonator from electrical sources such as static electricity, electrical storms, electrical wires/cables or similar energy sources. The wires are disconnected only before being connected to the blasting circuit. Leg wires must be kept coiled as they are more susceptible to electromagnetic fields if they are extended like an antenna.

Section 615 Access to explosives

Subsection 615(1)

The employer is responsible for controlling access to blasting magazines and their contents. Common practice is that the blaster-in-charge is provided with a set of magazine keys by the employer. Control of the magazine keys and related access to storage magazines and their contents is then the responsibility of the blaster while on the mine site. When a blaster is away from the site, the magazine keys are expected to be stored in a secure location under the control of the employer. If an additional replacement blaster-in-charge has been appointed by the employer, the keys can be reassigned by the employer.

During routine loading and blasting activities, only the designated blaster or other workers under the direct supervision of the designated blaster can have access to a magazine and its contents.

Subsection 615(2)

The subsection reaffirms the employer's responsibility for ensuring that only the authorized workers noted in subsection (1) have access to explosives. As a result, the employer must have control systems in place to ensure compliance with this section.

Accepted controls include defined policies and procedures that have been communicated to workers. These policies and procedures should be included in orientation packages, training and refresher training programs. The employer should keep on file all documentation to confirm the orientation and training.

Section 616 Removal from magazine

Subsection 616(1)

Detonators are very sensitive and as such must be kept separate from other explosive accessories like primers and detonating cord. The intention here is to minimize the potential that detonation of the more sensitive explosive could affect other nearby explosive products.

Subsection 616(2)

Non-conductive linings safeguard against electrical currents from static electricity, electrical storms or other similar energy sources. Theft, which sometimes occurs, is minimized by ensuring containers can only be opened by authorized personnel.

Subsection 616(3)

All practicable steps must be taken to prevent explosives from detonating prematurely. The employer must ensure that any explosives in a container are arranged and protected against contact with anything that could cause premature detonation.

Subsection 616(4)

Accidental initiation of electric detonators is a significant hazard prevented by shunting leg wires. Documented cases of accidental initiation and related worker fatalities are available from international explosives databases. The wires are to be kept shunted until the detonators are ready to be connected to the blasting circuit.

Section 617 Priority of use

Use of the oldest explosive first prevents deterioration from extended storage and ensures effective blasting. To simplify removal of explosives from storage magazines, supplies should be rotated so that older explosives are stacked in front of newer ones.

Section 618 Magazine record

Subsection 618(1)

Records indicating how explosives have been used are important for tracking performance, use and potential loss from theft. Both the public and workers are better protected when such controls and tracking methods are used.

Subsection 618(2)

The three year retention period for records allows authorities to investigate any related incidents.

Section 619 Explosive location

Subsection 619(1)

A worker is prohibited from taking an explosive product into any mine building or similar facility other than a licensed magazine. The intent here is to avoid the risk of injury to other workers or site visitors due to a premature detonation. An additional benefit is that explosives are less likely to be lost, stolen or simply misplaced, thus providing an additional measure of control.

Subsection 619(2)

Explosives must be handled with care by persons trained and qualified to do so. If explosive products are discovered in a building, both the employer and workers must ensure that a certified mine blaster is called to remove the explosives.

Subsection 619(3)

All explosives must be used or returned to the licensed magazine by the end of any shift. Any worker who has explosives in his or her possession at the end of the shift must return the explosives to the magazine and record the details in the mandatory log book. The requirement reduces the potential of theft, misplacement or premature detonation.

Transportation

Section 620 Removal and transfer

Subsection 620(1)

Proper transportation and handling of explosives by competent personnel ensures the safety of the work site. Limiting who transfers explosives reduces the number of workers at risk and reduces the potential for errors.

Subsection 620(2)

Explosives being transferred to a work site must be transported as quickly as possible to minimize the extent to which mine workers are exposed to a potential explosion hazard.

Section 621 Restriction on open flames

All potential sources of ignition must be controlled to ensure the safety of mine workers. Open flames and smouldering substances are prohibited from coming within eight metres of a vehicle transporting explosives.

Although other ignition sources may be of concern, this section deals specifically with open flames and smouldering substances such as matches, cigarettes, cutting torches, etc.

Section 622 Vehicle requirements

Transporting explosives at a mine site introduces a number of hazards that must be controlled. The employer is responsible for ensuring that any explosive-carrying vehicle is properly maintained. Once appointed or designated by the employer, the mine blaster also takes on some responsibility under this section. In particular, under subsection 622(2), a vehicle used to transport explosives can only be operated by a mine blaster or a worker authorized by the mine blaster.

Subsection 622(1)

This subsection lists some of the characteristics that a vehicle transporting explosives must meet. In summary, the vehicle must be in reasonable operating condition and must be serviced and fully fuelled prior to being loaded with explosives. These precautions are intended to reduce the potential for premature initiation of the explosives as a result of equipment defects or a source of ignition provided by the servicing and fuelling activity e.g. sparks, static electricity, fire resulting from hydrocarbon fumes, etc.

Design and construction of the vehicle's explosive-containing compartments must be such that detonators and other explosives can be kept separated from each other. Further, the on-board storage compartments must be constructed to ensure that the explosives cannot inadvertently fall from the vehicle. Additional criteria related to storage compartment design are provided in subsection 625(1).

Subsection 622(2)

Only the mine blaster or a worker authorized by the mine blaster can operate a vehicle that is used to transport explosives. The intent here is to ensure that only a competent worker, familiar with the hazards of explosives, is allowed to operate the vehicle. Given the hazards associated with handling and transporting explosives, a well-intended, non-competent worker could inadvertently place himself or herself at risk without even realizing it.

Subsection 622(3)

Since fire is an ever-constant risk due to the presence of hydrocarbon fuels and the explosives, any vehicle that transports explosives must be equipped with at least two 9 kilogram ABC type fire extinguishers. By having the means to quickly respond to a fire, the vehicle operator can take immediate action to significantly reduce the potential for an accidental initiation of the explosives.

Subsection 622(4)

Highly visible signage is required on a vehicle transporting more than 25 kilograms of explosives to alert workers of the hazard. An orange-coloured, diamond-shaped placard containing lettering that is at least 150 millimetres (6 inches) high is the recommended standard. The placard must be clearly marked with the word "Explosives". Vehicles transporting a lesser quantity of explosives should also be placarded.

Section 623 Protection from weather

Rain and snow can damage and disable explosives and detonators. Wet explosives may not explode unless specifically designed for use in wet conditions.

Section 624 Original packaging

Explosives cannot be transported in anything but their original packaging. Repackaging is prohibited because of the potential for mislabelling and other errors. The true nature of the explosives must not be disguised by transfer to other packaging.

Section 625 Detonators

Subsection 625(1)

Maintaining a safe distance between detonators and other explosive accessories prevents them from coming in contact with one another. The material used to separate these items must have the same non-conductive properties as wood.

Subsection 625(2)

Radiofrequency energy from a radio transmitter has the potential to initiate a detonator if the leg wires are not shunted and the detonator is close to the transmitter. To reduce the likelihood of initiation, particularly during loading and unloading when the distance between the transmitter and detonators may be relatively little, the radio transmitter must be switched off.

Section 626 Vehicle breakdown

Subsection 626(1)

These requirements are intended to reduce the risk of explosives unintentionally exploding. Repairs that do not pose a risk are allowed. Since the vehicle operator is usually a blaster or other competent worker, the operator is best qualified to make such decisions.

Subsection 626(2)

Major repairs can include towing or hauling the vehicle, replacing major components, and storing or placing the vehicle in places not acceptable to this Code or other regulations, such as near welding operations or other potential sources of ignition.

Subsection 626(3)

If explosives must be removed from a vehicle so repairs can be made, the explosives must be either returned to a magazine or temporarily stored in an area that does not expose other workers or the public to undue risk. When stored temporarily under such circumstances, the explosives must be placed under proper security.

Operational Procedures

Section 627 Manufacturer's specifications

Explosive manufacturers base their specifications and procedures on extensive research and testing. Strict adherence to these specifications delivers the promised safety and performance results. Both the employer and worker are responsible for ensuring that the manufacturer's specifications are followed.

Section 628 Unsafe explosives

Responsibility for dealing with deteriorated, damaged, or otherwise unsafe explosives rests solely with the blaster. Once it has been determined that a particular explosive is unsafe, it must not be used. Unsafe explosives must be destroyed according to the manufacturer's specifications.

Section 629 Blast area control

Subsection 629(1)

Well-defined control and management of the blast area is critical to worker safety. A mine blaster must be designated to make decisions and be accountable for the work practices and safety at the work site.

Subsection 629(2)

To avoid problems related to blast site control and overall blast site responsibility, one blaster must be designated as the "blaster-in-charge".

Section 630 Access to blast area

Workers are not permitted to enter the blast area without the blaster's permission. Both the employer and workers are equally responsible for compliance.

Section 631 General duties

A blaster is appointed by the employer and assigned authority to control the blasting area. In taking charge of the area, the blaster must be prepared to direct and control the activities of everyone involved for the period required to complete the blast. The general duties of the blaster are described in subsections 631(1) through 631(6).

Depending on the complexity and size of the blasting operation, a blasting engineer may be involved in designing the loading, firing sequence and delay sequence used in the blast. Similarly, a blast involving a few hundred thousand kilograms of explosives will require a group of people to ensure that the job is done correctly. Loading of explosives, once drilling is complete, may itself take a few days or weeks to complete.

Section 632 Secondary blasting

Secondary blasting is always a dangerous undertaking since the explosive charge may be only minimally contained with stemming. Extreme fly rock should be expected and appropriate precautions taken to protect workers. As noted here, blockholes should be used if reasonably practicable.

Section 633 Mine blaster's record

To ensure that the use of explosives is strictly monitored and controlled, the mine blaster is responsible for keeping a written log book in which all blast related details are recorded. The log book must be filled out daily at the end of the mine blaster's shift.

When combined with the explosive magazine record required by section 618, the mine blaster's log book should provide a complete summary of the explosives used, explosives removed from or returned to the magazine, as well as the number of charges that remain unfired in the mine. Such information might be critical in case of an investigation related to magazine control or theft of explosives.

Section 634 Damaged blasting wires

A damaged wire may not activate the charge because current is unable to pass through the wire to the charge. The result could be a misfire. For this reason any worker who inadvertently drives over or damages blasting lead wires must immediately report the occurrence to the blaster and the employer. Blast site control in such a case should also be reviewed.

Section 635 Blasting machine control

Assignment of the blasting machine to the blaster simply eliminates the possibility of unintended blast detonation by other persons.

Undetonated or Abandoned Explosives

Section 636 Unused explosives

Subsection 636(1)

The return of unused explosives allows the employer to track inventory and ensures no explosive material is left in or around the mine. Even boxes used to carry explosives are treated as though they contain explosive residues and are destroyed according to the manufacturer's specifications. Unused explosives must be returned to the magazine and the magazine record adjusted accordingly.

Subsection 636(2)

Even small quantities or portions of explosives that are blown out of a blasted hole can be a hazard. As such, they must be treated as a misfire and handled according to defined procedures.

Section 637 Misfire procedures

Subsection 637(1)

The presence of a misfire introduces a unique hazard to any operation since it is unplanned and unexpected. Only a worker holding a valid mine blaster certificate can be authorized to handle a misfire.

As noted in this section, a blaster must not abandon a misfire unless it cannot be safely detonated or removed from its hole. When such a situation occurs it is recommended that the mine manager be included in the final decision process. Additional requirements for dealing with misfires are covered under sections 653, 672, 673 and 674 of the OHS Code.

Subsection 637(2)

As with any recognized hazardous activity, the employer is responsible for developing safe work procedures for handling misfires. Due to his or her training and expertise, it is recommended that the mine blaster be involved in that process. Section 8 of the *OHS Regulation* requires that the procedures be in writing and available to workers.

Section 638 Abandoned explosive

Subsection 638(1)

If a worker finds an abandoned explosive or misfire, the worker must first advise others in the blast area of the danger and then inform the employer or mine blaster.

Subsection 638(2)

The employer's responsibility to protect workers from the danger of abandoned explosives or misfires includes ensuring the explosive or misfire is destroyed according to the manufacturer's specifications. The employer must also notify the Director when an abandoned explosive has been found.

Blasting Machines and Circuits

Section 639 Testing and initiation

Circuit testing devices are specifically designed for that purpose and must be used according to the manufacturer's specifications. The use of an inappropriate testing device could potentially result in a non-initiation event or an unnecessary misfire situation.

For hazardous sites and coal mines, explosive initiating and testing devices must be approved by CANMET or by the Director. Devices must be specifically designed and manufactured for use in flammable and explosive atmospheres.

Section 640 Blasting apparatus

Subsection 640(1)

The marking of the blasting machine's capacity lets the blaster know that the machine is able to initiate all the blasting detonators connected to it. The use of a blasting machine of incorrect capacity could lead to incomplete initiation and misfires.

Subsection 640(2)

Testing the blasting machine prior to any blast requiring its maximum current is essential to ensuring successful initiation of the detonator(s) connected to it. If the current is not sufficient, some detonators may not explode, creating production delays and a need to reblast.

Section 641 Circuit testing

Subsection 641(1)(a)

Workers must be removed from the blasting area before blasting circuits are tested in the event that an unintended detonation occurs.

Subsection 641(1)(b)

Testing ensures continuity of the circuit and provides confidence of a successful detonation.

Subsection 641(2)

The minimum 10 minute time period ensures that sufficient time is allowed for the delayed detonator to do its job. In case a detonator is defective, the extra time might be sufficient for it to explode. The waiting period also allows dust and smoke from the blast to clear.

Section 642 Circuit requirement

Subsection 642(1)

This section details specifications for the blasting machine, power circuits and lead wires. Any deviation will compromise efficiency and performance and may create safety problems. Most of these specifications are quite clear and self-explanatory. For ease of reference an excerpt from clause 3.7 of CSA Standard CAN/CSA M421-

00 (R2007), *Use of Electricity in Mines*, is provided below. Readers should note that the Standard deals only with the case where electricity is supplied from the power distribution system.

3.7 Electric Blasting

3.7.1 General

3.7.1.1

Clause 3.7 applies to the use of electricity supplied from the power-distribution system for blasting. Where the power-distribution system is not used for blasting, the mine shall establish alternative procedures.

Note: See Blaster's Handbook

3.7.1.2

The mine shall have procedures to prevent inadvertent detonation of electric blasting caps in the presence of radio transmitters or other radio-frequency fields (cellular phones, GPS, portable hand-held radios, etc.).

3.7.1.3

Electric blasting circuits shall be tested for continuity before a blast is set off.

3.7.2 Supply Characteristics

An isolated, underground power source shall be used for electric blasting; it shall have adequate capacity for the number of caps involved, and it shall be used for blasting only.

3.7.3 Conductors

3.7.3.1

Acceptable blasting circuit conductors shall be

- (a) not less than No. 12 AWG;
- (b) without splices, as far as practical; and
- (c) readily identifiable as being for blasting use, preferably red.

3.7.3.2

Where expendable connecting wires are used for the lead wires to the leg wires of the blasting caps, they shall be not less than No. 20 AWG.

3.7.4 Stray-Current Precautions

3.7.4.1

Blasting-circuit conductors shall be kept at least 150 mm away from power or lighting cables and, where possible, they shall be run on the side of the working opposite power and lighting circuits.

3.7.4.2

Where blasting lines are installed for a short time only, they may be fastened to sprags or sticks for adequate support during such temporary usage.

3.7.4.3

Blasting-circuit conductors shall not contact pipes, rails, or other electrically conductive materials that might be accidentally energized or be vulnerable to static charges.

3.7.5 Control

3.7.5.1

A fused service switch with provision for locking shall be installed between the source of power and the blasting switch.

3.7.5.2

In all cases where a blasting switch is used, a lightning gap of not less than 1.5 m shall be provided between the service switch and the blasting switch, and such gap shall be closed only at the time of blasting by means such as a twist-type locking device.

3.7.6 Blasting Switch

3.7.6.1

The blasting switch shall be constructed so that gravity tends to open the circuit and short the blasting leads. Where the power source exceeds 300 V, the blasting switch shall be electromagnetically operated.

3.7.6.2

The blasting switch shall be within a fixed, locked box and shall be accessible only to the authorized blaster.

3.7.7 Multiple Blasting

Where a single blasting switch is used for several blasting circuits, a three-way isolating switch that can be locked in either the shorted or closed position shall be installed in each circuit to provide for

- (a) shorting the circuit;
- (b) energizing the circuit; and
- (c) testing the circuit.

The isolating switches shall be located in a safe place.

3.7.8 Maintenance

Permanent blasting lines, blasting switches, and service switches shall be maintained by a qualified person.

3.7.9 Programmable Logic Control (PLC)

In addition to the requirements of Clauses 3.7.3.1 and 3.7.4.1, where a PLC or computer is used to control or initiate the blast, the system shall be approved by a professional engineer.

The detonation power source must provide sufficient current when the switch is closed. If the power circuit is also providing electricity to other equipment, the demand of this equipment may reduce the electricity available for blasting machines. This, in turn, may provide less than adequate power through the circuits resulting in misfires.

Subsection 642(2)

Lead wires for blasting are standard products supplied by an explosives accessories company and are readily identifiable. Despite standardization, the blaster is ultimately responsible for ensuring that the correct products are being used at a mine blast site. This subsection lists minimum specifications that must be confirmed by the blaster prior to putting the products to use. Key specifications are listed and include "AWG wire size", "waterproof", "readily identifiable for blasting use" and "used only for blasting".

Additional safety requirements are listed and are meant to minimize the potential for premature detonation as a result of extraneous electrical current. This subsection specifies minimum distances that must be maintained between the lead wires and power or lighting cables, pipes, rails or other electrically conductive materials.

Subsection 642(3)

To ensure that enough current flows through the complete blasting circuit, the disposable connecting wire between the main lead wires and the detonator's leg wires must be not less than No. 20 AWG in size.

Surface Mines

Section 643 Application

No explanation required.

Section 644 Signs

Subsection 644(1)

Any blast area must be clearly identified and access controlled. Detonating cord, non-electric tubing, detonating relays, fuses, and wires can easily be damaged by vehicles travelling over them. Depending on the status of blast preparation, there may also be a risk of premature detonation.

Subsection 644(2)

The presence of unauthorized manpower and equipment may introduce unintended hazards. As a result, the employer must train workers to ensure that they understand the hazards associated with a mine blast site. It must be clear to all personnel that the blaster in charge is responsible for controlling access to the blast area by both personnel and vehicular traffic. The blaster's approval should be obtained before any non-blasting personnel or equipment approach the defined blasting area.

Section 645 Blast holes

Subsection 645(1)

Stemming is required for conventional blast holes to confine the pressure created by a blast and to concentrate it, as needed, to break the rock.

Subsection 645(2)

In controlled blasting, a decked blasting process can be used where the explosive is alternately layered with stemming or other non-explosive material. The tops of controlled blast holes are not stemmed to allow for rapid relief of released energy, which controls and minimizes fracturing of the surrounding rock mass.

Section 646 Electrical storm

The mine blaster must be aware of the presence of nearby electrical storms that could pose a risk to blasting operations. Although extraneous electrical current is considered a major risk to electrical blasting systems, recorded incidents provide sufficient evidence that non-electric blasting systems could also be at risk from direct lightning strike.

Although not specified in the OHS Code, it is highly recommended that the employer provide the mine blaster with lightning detection devices that will assist in related blast site decision making.

In locations where it may be necessary to halt blasting activities it is recommended that company procedures be clearly defined to assist the blaster in the decision making process. Explosive manufacturers should be consulted when these procedures are being prepared.

Paragraphs 646(b) and 646(c) are considered to apply to all mine workers who may be at risk of injury from the premature initiation of a loaded blast hole or blast pattern.

Section 647 Detonating cord

Subsection 647(1)

When priming drill holes using detonating cord and primers, care must be taken to ensure that down-lines are secured at the top of the hole with sufficient excess cord to allow for settling of the explosive column and stemming.

If insufficient cord is provided, the settling column could pull the cord down. This would require other risk increasing actions to assure initiation of the explosive column during subsequent blasting operations.

Subsection 647(2)

To minimize the potential for unplanned separation of the explosives column and only partial initiation, loading operations, from priming through to stemming should be as continuous as practicable.

Subsection 647(3)

The specific requirements noted are essential for ensuring safe and successful blasting operations.

Section 648 Ignition precautions

The 8 metre distance quoted is considered a minimum distance required to protect workers from any possible ignition source that might be created by machinery, smoking or an open flame. Responsibility for compliance has been assigned to both the employer and worker for their respective roles and scope of work.

Section 649 Safety fuses

Safety fuses must be of sufficient length to permit easy connection and allow enough time for the blaster to retreat to a safe location.

Section 650 Electrical cables and wires

Blasting cables must be carefully handled, connected and insulated to avoid grounding. If they are accidentally grounded, a current might pass through them and prematurely initiate a blast. A damaged wire could result in a misfire.

Section 651 Electric blasting

Subsection 651(1)

Electromagnetic radiation may introduce sufficient electrical current in an electrical blasting system to prematurely initiate detonation devices.

Subsection 651(2)

The build-up of electrical charges can produce sufficient electrical current to cause premature detonation and explosion.

Vibration from the blast or the shock wave produced by the blast can cause arcing and damage to electrical distribution systems.

Subsection 651(3)

Radio transmitters may induce electric current flow in susceptible electric detonators, causing explosion. Tables 1 and 2 of Schedule 11 specify minimum separation distances to be maintained to prevent such induction.

Subsection 651(4)

The same rationale applies as in subsection 651(3). The induction source in this instance is electrical trailing cable. As a current flows through a wire or cable, it creates electric and magnetic fields around it. Lead wires laid out parallel to trailing cables may have a current induced in them by the magnetic field produced by current flowing through the trailing cables.

Section 652 Burning explosives

Burning explosives may explode at any time. Burning also produces large quantities of extremely toxic oxides of nitrogen gas.

Section 653 Misfires

Subsection 653(1)

Exposing a misfire by digging is an extremely dangerous activity. It must be done very carefully under the direct supervision of a blaster or competent worker appointed by the employer. This person must ensure the excavator's bucket or other parts do not contact the explosive.

To be consistent with section 610 of the OHS Code, it is expected that while not being the designated blaster, the competent person would hold a valid mine blaster certificate.

Subsection 653(2)

Drilling near a misfire is very dangerous. The blaster or competent worker appointed by the employer will have to determine if the explosive has travelled from the hole into the surrounding ground being selected for drilling. If not done properly, the drilling operation could cause the remaining explosives to explode.

Section 654 Drilling near explosives

Subsection 654(1)

For the reasons explained in subsection 653(2), drilling near a charged blast hole is very dangerous. The minimum 5 metre distance from a charged blast hole must be maintained.

Although 5 metres is the minimum distance for surface blasting, care must be taken to ensure that cracks or fissures in the surrounding rocks do not contain explosives as well.

Subsection 654(2)

A cut-off hole is a charged blast hole in which detonation was not completed i.e. cut-off, leaving behind live explosives. Prior to any drilling activity, the area must be examined by a mine blaster.

Section 655 Storage

Subsection 655(1)

This section deals with the control of explosives within the mine itself. It does not relate to the main explosive storage magazines. According to this subsection, a type 6 magazine or operational storage box can contain only a 24-hour supply of explosive products.

Subsection 655(2)

The minimum storage distance of 8 metres limits the likelihood that one box exploding will damage the other box.

Subsection 655(3)

These magazine standards are mandated by the federal *Explosives Act* (Canada) and together with requirements for handling, transport and storage, minimize the potential of worker injury.

Subsection 655(4)

Operation storage boxes are potentially a security risk. The employer must take steps to minimize the potential hazards of theft and their general use.

The boxes must be locked when not in use. This means that unless the blaster is removing or returning products, the lock must be in place and secured.

Since the risk of unplanned detonation is always present, operation storage boxes must be located away from the active blasting area, mine operating equipment, railway tracks, travelled roadways and walkways. The storage boxes must also be placed away from electrical power cables.

As with any approved explosive magazine, the operation storage box must be appropriately identified by a sign indicating that it contains explosives.

Section 656 Blasting warnings

Subsection 656 (1)

Mobile radio transmitters must be turned off within 20 metres of an electric blasting system to prevent initiation of the blast by electromagnetic energy generated during transmission.

Subsections 656(2) and 656(3)

When blasting near public highways, the general public must be warned of the blasting hazard ahead. Drivers must be advised to turn off mobile transmitters, thereby minimizing the risk of prematurely detonating explosive charges.

Section 657 Charged holes

Before leaving a charged shot hole unattended, the detonator's lead wires must be shunted and a warning sign posted. These actions are intended to prevent unintended detonation and to warn workers of the potential hazard.

Underground Mines and Tunnels

Section 658 Application

No explanation required.

Section 659 Permitted explosives

Subsection 659(1)

Permitted explosives are designed specifically for use in coal mines where flammable gases may be present. These explosives are subjected to extensive testing by the Chief Inspector of Explosives, Natural Resources Canada.

Subsection 659(2)

The use of non-permitted explosives is allowed provided they meet other requirements of this section and the Director is satisfied with the safety measures certified by a professional engineer. Rock in which these explosives will be used must not contain flammable hydrocarbon gases or coal. Many limestone formations lie near coal beds and carry flammable gases within them. The employer and the professional engineer must assess each formation before submitting an application to the Director.

Subsection 659(3)

The employer is responsible for ensuring that mine workers are appropriately trained and that controls are in place to ensure that workers do not take unapproved explosives into an underground coal mine.

Section 660 Electric conveyance

Sparking or induction from electrical sources can cause explosives to detonate. Bumps, jerky movements and other impacts created by the conveyances can also cause detonation. Enclosing explosives in specially designed containers can provide protection against such hazards. However, the Director's permission must be obtained to use containers and the described conveyances.

Section 661 Mine shaft conveyance

The mine shaft is a major means of mine entry and exit. As well, the shaft cage is the main device used for transporting workers from the surface to underground and vice versa. Explosive products may not be transported on a shaft conveyance unless related safe work procedures have been developed, workers trained and the procedures implemented. Section 8 of the *OHS Regulation* requires that the procedures be in writing and available to workers.

Section 662 Transport underground

This section is intended to provide strict specifications related to the transportation of explosives into an underground mine environment. Strict compliance and enforcement is expected from the employer in the interest of overall worker safety.

Subsection 662(1)

Detonators must be kept separate from explosives to avoid accidental unplanned detonation. The quantity of explosives that can be taken underground by a worker is limited to the quantity that can be used in one work shift. By limiting the quantity taken underground at one time by each worker, the OHS Code attempts to ensure that surplus supplies are not inadvertently left behind. Further, explosive inventories are easier to control.

Subsection 662(2)

Although the Director may exempt a mine from the requirements of subsection 662(1), such an exemption would only be provided if evidence of an “equivalent to, or better than” system of control could be demonstrated.

Subsection 662(3)

The purpose of this subsection is to control explosive product. A misplaced explosive could present a significant safety hazard. For that reason, the explosive-containing case or canister must be kept closed as much as possible.

Subsection 662(4)

Repealed

Subsection 662(5)

The underground mine blaster must ensure that when multiple cases or canisters are present at the working face, the cases or canisters are kept as far apart as reasonably practicable. Doing so limits the likelihood that one case or canister exploding will cause another one to explode or be damaged.

Subsection 662(6)

Because electric detonators can be very sensitive to extraneous electric current, a worker carrying electric detonators must not enter any room where cap lamps or related batteries are being charged.

Section 663 Drilling distances

Any hole previously in contact with explosives may still contain remnants of the original charge. As such, new holes must not be drilled within the specified distance. This prevents unintended and unexpected detonation of charge remnants.

Section 664 Underground mine blaster

Subsection 664(1)

The underground mine blaster is responsible for overall blast safety. Several safety precautions are listed and the blaster must ensure they are followed. If flammable gases or coal dust are present in higher concentrations than expected, a blast may trigger an explosion of the surrounding atmosphere which could travel through the entire mine.

Use of the correct explosive charge ensures the proper blasting of materials to be mined and minimizes damage to surrounding rock.

The defined precautions must also be taken to avoid premature initiation of charged holes.

Subsection 664(2)

If explosive gases are present, the blaster is responsible for ensuring that additional safety measures are taken. A blaster must not load or fire explosives if more than 1 percent of methane (or 20 percent of the lower explosive limit of a flammable gas) is present. Here the concern is that the blast might release additional quantities of methane that could accumulate to an explosive level during the blast itself.

Similar limitations are placed on the blaster to ensure that any coal dust is treated with non-combustible dust, or has been thoroughly wetted down to minimize the potential for a major gas or coal dust explosion.

Subsection 664(3)

If the atmosphere within 25 metres of a hole contains more than 1 percent of methane (or 20 percent of the lower explosive limit of a flammable gas), the blaster must ensure that loading or blasting is not performed. Any drilled hole must not be loaded and must be filled with stemming material.

Subsection 664(4)

This subsection is intended to protect workers from the effects of a blast. Blast guards are required to warn approaching workers. Blast guards must be stationed at a minimum distance of 75 metres from the blast area. The blaster is required to take refuge in a safe place before initiating the blast.

Subsection 664(5)

Although at least 10 minutes waiting time is mandatory, the underground blaster must ensure that this minimum requirement is consistent with the explosive manufacturer's specifications. If necessary, a longer period can be defined in the mine operating procedure.

Section 665 Blasting cable

Subsection 665(1)

The specified cable resistance ensures an adequate supply of current when using fixed voltage blasting machines.

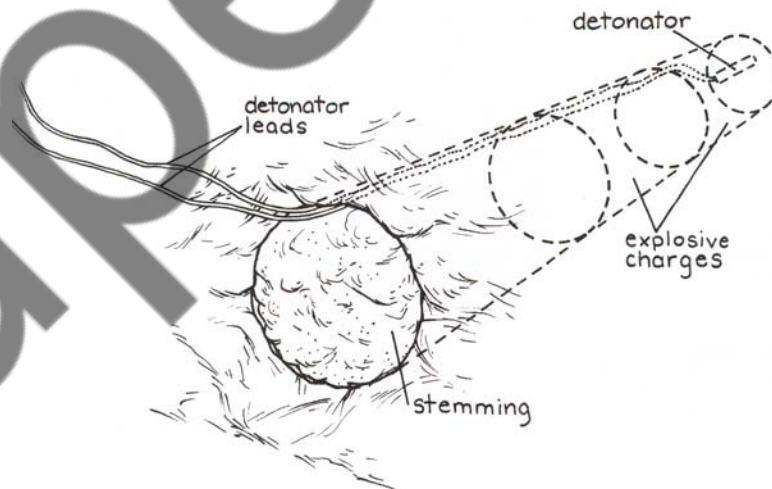
Subsection 665(2)

A cable used in blasting must be at least 75 metres long. It must reach from the blast area to a suitable refuge for the underground mine blaster.

Section 666 Delay detonator

This is a standard practice that has been legislated here to ensure blast holes are initiated from the bottom of the hole. This reduces the possibility of misfires and bootlegs. This inverse initiation is illustrated in Figure 36.20.

Figure 36.20 Inverse initiation



Section 667 Same manufacturer

This requirement prevents problems occurring due to differences in product and detonation characteristics.

Section 668 Series connection

This section requires the rounds in an underground coal mine blast to be connected in series. By using a series of tie-ins, vibration and other explosion effects are minimized. This reduces the potential damage to surrounding roof and rib formation, thus minimizing the potential for worker injury. This is not an issue in a shaft sinking (typically vertical) where all workers are removed from the shaft prior to the blast. In this specific application of blasting during shaft sinking, there is no hazard to workers so blasting during shaft sinking is exempt from this requirement.

Due to the nature of series blasting, material at the first hole to initiate has time to move, thus relieving the burden on the next hole in the series.

Section 669 Water

Water may render common explosives ineffective. Water resistant or sheathed explosives must be used in wet areas to prevent misfires and bootlegs.

Section 670 Stemming

Subsection 670(1)

Stemming prevents expanding gases created by blasting from escaping the hole. This focuses the blast energy where the rock needs to be broken. Non-flammable stemming materials are used to reduce the possibility of secondary coal dust and methane explosions.

Subsection 670(2)

Where water stemming is used, clay stemming is required to prevent the water from coming into contact with the explosive and rendering it ineffective. Two separate packings of water ensure at least one will work if the other leaks away.

Section 671 Firing in the same round

Only holes to be fired in the same round are to be loaded before the round is fired.

Section 672 Misfires

Subsection 672(1)

The handling of misfires is perhaps the most dangerous job in blasting and must be done under the direct supervision of an underground mine blaster.

Subsection 672(2)

These standard blasting practices have been legislated to stress their importance. The waiting period hopefully allows any defective detonator to detonate. It also provides time for the air to clear of fumes and smoke.

Disconnecting the blasting apparatus and short-circuiting the cable ends eliminates the possibility of an unintended detonation of the unblasted hole.

Once a parallel hole has been detonated, the blaster must search the broken rock pile for evidence that the misfire has detonated as well. If undetonated products are found, they must be carefully collected and then destroyed according to the manufacturer's specifications.

Subsection 672(3)

Water reduces the sensitivity of the explosive, thereby reducing the potential for detonation and explosion.

Subsection 672(4)

Friction along the lead wires as they dislodge from the end of the detonator could initiate the detonator.

Section 673 Misfire detonation

Subsection 673(1)

If a misfire has been identified and an effort will be made to detonate it (as compared to washing it out with water), the attempt to detonate the misfire must be done as a single hole blast. No other loaded holes or other misfires should be blasted at the same time.

The object of handling the misfire as a single hole blast is to minimize the potential for further blasting or possible dispersal of undetonated explosive products. An effort must be made to ensure the identified misfire has in fact detonated. This will reduce the hazard associated with inadvertent contact with undetonated explosive products.

Where more than one misfire is identified in the same area or blast pattern, each misfire must be handled independently.

Subsection 673(2)

If the detonation attempt is unsuccessful and the misfire clearly cannot be deactivated using a jet of water, this subsection recognizes another technique. This technique involves the drilling, charging and detonation of a parallel drill hole. Due to the extreme hazard associated with this operation, the minimum precautions that must be taken are specified. In particular, care must be taken to ensure that the drill bit does not encounter undetonated explosives in the hole. If evidence of undetonated explosives becomes apparent, all drilling activity should immediately stop and the operation should be reassessed.

Subsection 673(3)

Due to the sensitive nature of electric detonators in general, any faulty electric detonator must be handled with great care. To minimize the potential for detonation by sources of extraneous electricity, the leg wires of the faulty detonator must immediately be short-circuited. The detonator should then be handled and destroyed according to the manufacturer's specifications.

Section 674 Leaving a misfire

Subsection 674(1)

If the misfire cannot be handled and disposed of in one shift, either the subsequent shift will continue the work or the same blaster will continue the work the next day. Proper signage ensures that workers are informed that a misfire is present at that location.

Subsection 674(2)

The shift supervisor must be informed of any misfire that has not been deactivated. The supervisor must then inform any other mine workers who enter the mine.

Section 675 Compressed air

The procedure for such a coal breaking method must be developed by a professional engineer to ensure the safety and effectiveness of the process. This mode of coal breaking does not create the heat and flames that explosives do. Although it is a safe method for breaking coal, its scope is quite limited.

Section 676 Shock blasting

Subsection 676(1)

Shock blasting is generally used to relieve stresses and pressures developing for geotechnical reasons or because of gases trapped behind the face. Once stresses are released, the surrounding formations become more stable and easier to support with some degree of predictable behaviour.

A Director may allow shock blasting if the conditions of subsection 676(2) are met. An application for shock blasting must be submitted by the employer.

Subsection 676(2)

A professional engineer must prepare the procedures for performing shock blasting to ensure that related safety issues are adequately addressed.

Section 677 Surface shots

The absence of workers underground ensures no one is exposed to any hazardous condition during blasting.

Section 678 Permanent firing station

Subsection 678(1)

Firing from a permanent firing station underground is common practice. By posting blast guards and limiting the number of workers allowed in the area at the time of the blast, potential danger to the remaining workforce is eliminated.

Subsection 678(2)

Fumes and smoke created by a blast can be extremely hazardous. Since the ventilation system will carry such gases towards the return air system (downwind,) workers must be cleared to an appropriate fresh air location (upwind).

Section 679 Secondary blasting

Subsection 679(1)

These are standard procedures commonly used in coal mines. They are legislated to stress the importance and necessity of strict compliance.

For example, larger charges cause larger explosions and increase safety hazards. The limit of 0.5 kilograms of explosive and not more than two charges is designed to keep the blast to an acceptable size and limit safety hazards.

To minimize the potential for causing a catastrophic methane/coal dust explosion, the area surrounding the “top” charge must be cleared of coal dust and must be adequately rock dusted to within a 10 metre radius of the planned charge.

Subsection 679(2)

This subsection restricts secondary blasting if the methane content in the surrounding area is more than 0.3 percent (6 percent of methane’s lower explosive limit).

Subsection 679(3)

Since the hazards associated with secondary blasting e.g. flyrock, vibration, etc. can be greater than in normal mine blasting, the place of refuge for the blaster must be at least 150 metres from the blast site. This compares to the 75 metres required for normal mine blasting.

Division 3 Underground Coal Mines

Section 680 Application

No explanation required.

Section 681 Annual plan

Annual mining plans provide the Director with general information related to planned mine development. They provide an opportunity to review and question planned development and to assess future worker risk and general management initiatives. In designing a mining plan, the professional engineer has many other considerations besides safety to take into account. These include production, economics, use of available resources and equipment, product quality, conservation and environmental impacts. The Director however, focuses only on worker safety. Section 8 of the *OHS Regulation* requires that the plan be in writing and available to workers.

Section 682 Underground coal mine surveyor

Subsection 682(1)

The OHS Code does not specify the qualifications and experience required for an underground coal mine surveyor. The employer is responsible for ensuring the mine surveyor is competent. The plans and records created by the surveyor are used to locate workers, trouble areas, facilities, rescue routes, ventilation systems and other materials during an emergency. To ensure successful emergency response, the surveyor's records must be accurate and up-to-date.

Subsection 682(2)

The availability and preparation of accurate and up-to-date survey information is vitally important for a successful and safe underground coal mine. Under the direction of the mine manager, the mine surveyor is assigned full responsibility for conducting surveys and developing plans required under this Part.

Subsection 682(3)

The employer must ensure that workers involved in surveying are competent and the employer must also be assured of the integrity of the final product. This is ensured by having all survey plans approved by a professional engineer.

Mine Workers

Section 683 Supervision

The underground coal mine employer is responsible for ensuring that underground coal mine workers are supervised by competent supervisors and managers. For supervisory and management candidates that meet a minimum standard of academic knowledge and experience, Alberta's Board of Examiners for mining issues a formal certificate.

According to this section, only persons holding a valid certificate may be appointed by the employer. Although the Board of Examiners assesses technical knowledge, the employer must ensure that a certified candidate has all of the other management skills necessary to successfully supervise or manage an underground coal mine.

Section 684 Required qualifications

Due to the critical contribution made by an underground coal mine foreman or manager or electrical superintendent, this section reiterates the fact that an employer must not appoint any person to these positions unless that person holds a valid certificate issued by the Board of Examiners for mining under sections 30 and 31 of the *OHS Regulation*. Where a qualified and certified person is not immediately available, contracting or consulting services could be considered for short-term assistance.

Section 685 Mine Manager

Subsection 685(1)

The underground coal mine manager is the company representative who has the greatest opportunity to influence, and the greatest responsibility for, the health and safety of workers in an underground coal mine. It is the underground coal mine manager's position that is most often singled out in this Part when specific employer responsibilities are noted.

In Alberta, an underground coal mine manager must be appointed by the employer to supervise daily activities at the mine. Once the manager has been appointed, the Director must be notified without delay.

The Director confirms that the appointed mine manager is certified by Alberta's Board of Examiners for mining. This communication of appointment and the subsequent confirmation by the Director is intended to ensure the minimum qualifications established by the Board of Examiners are in fact maintained.

Subsection 685(2)

This subsection recognizes that qualified underground coal mine managers are becoming rare. This is due to the declining size of the underground coal mining industry and the fact that qualified candidates are leaving the industry.

While the appointed mine manager is temporarily away from the mine area, this section allows an employer to appoint an underground coal mine foreman to temporarily act in the mine manager's position. The foreman must hold an underground coal mine foreman's certificate. This approach is acceptable if not more than 30 workers in total work underground in the mining operation at any one time and the appointment is for not longer than seven days. The intent here is to provide the employer with some short-term flexibility while the appointed manager is temporarily away from the area.

Subsection 685(3)

An appointed underground coal mine manager is often required to be temporarily away from the mine site, possibly for several days. Such temporary absences must be recognized and accommodated appropriately. When an underground coal mine foreman is appointed as temporary underground coal mine manager, the appointed underground coal mine manager must, as far as practicable, remain in constant communication with his or her replacement. The common availability of cell phones, satellite phones and electronic communication make this possible.

Subsection 685(4)

If the appointed mine manager needs to be away from the mine area for more than seven days but less than 90 days, this section allows an employer to appoint an acting underground coal mine manager to act in the mine manager's position. The candidate must hold an underground coal mine manager's certificate. The intent here is to provide the employer with additional flexibility should the appointed manager be away from the mine area for up to 90 days.

Subsection 685(5)

If the appointed mine manager needs to be away from the mine area for more than 90 days, this section requires that the manager be replaced and a new manager be appointed. The candidate must hold an underground coal mine manager's certificate. The Director must be informed of the appointment as soon as possible.

Section 686 Combined operations

Subsection 686(1)

This section focuses on organizational and management aspects of combined operations and is important because of the impacts one operation can have on the other.

Any of the three parties listed in this section can declare a combined operation, but having made the declaration, this then binds all three parties to specific regulatory requirements for management structures.

Subsection 686(2)

If underground and surface mining operations are declared to be combined operations, the management structure at each mine and the shared management structure must be clearly defined and communicated to avoid any confusion.

The employer of the two operations must select a coordinator for the combined operation. This does not necessarily have to be one of the existing mine managers.

Subsection 686(3)

Each mine must still have its own manager. However, the requirements for a mine manager are extensive and may not leave adequate time for coordinating combined operations. A general manager or a vice-president may be a more appropriate choice for the role of coordinator.

Section 687 Working alone

Subsection 687(1)

Most production jobs in an underground coal mine are extremely dangerous. This subsection is intended to ensure that workers in such hazardous occupations do not work alone. This subsection specifically notes the activities that may be performed by a worker working alone at a working face. Workers performing the noted activities must be covered by the employer's working alone procedure.

Subsection 687(2)

The employer is responsible for ensuring that no worker works alone while producing coal at a working face. This limitation recognizes the extreme hazards associated with a dynamic coal mining face environment. The presence of two

workers increases individual safety by having extra immediate help available in case of an emergency.

Section 688 Unsafe conditions

Subsection 688(1)

This subsection is based on the principle that team work and shared accountability ensure everyone's safety. Regardless of role or seniority, any worker finding a situation that might be hazardous to workers in an underground mine is responsible for alerting workers to the problem and notifying a mine official who must implement evacuation plans and take action to remedy the situation. Records of the event are used in subsequent review, addressing both the cause of the event and the effectiveness of monitoring and management systems.

Subsection 688(2)

The same responsibilities described in subsection 688(1) apply to workers at the surface of an underground mine.

Subsection 688(3)

Given that a specified hazardous situation has been reported to a mine official, this subsection compels the official to take immediate action by withdrawing workers from the area affected by the hazard if there is any potential of workers being exposed to the reported hazard. The emphasis here is on "immediate action" to minimize worker exposure to possible injury. Such actions must be taken since the underground coal mining environment can rapidly change and a delay of decisions or action can result in serious consequences.

Subsection 688(4)

This subsection requires that a record of identified serious hazards be maintained and brought to the attention of mine workers. By recording identified hazards, workers can review the records as often as desired. Records allow developing trends to be analyzed and may assist both management and workers to identify needed remedial actions.

Section 689 Shift change

The mine foreman is responsible for underground safety. In particular, any area that is unsafe for mine workers must be isolated and access restricted.

Section 690 Shift report

Subsection 690(1)

To ensure the continuity of communication between shifts and shift foremen, an underground coal mine foreman must complete a shift report. Normally, for thoroughness, that report is finalized at the end of the shift. Any unusual safety hazards or issues must be highlighted in the shift report for the benefit of both the on-coming shift foreman and the employer.

Subsection 690(2)

Given that the shift report prepared by the previous foreman could contain essential information related to mine conditions or unusual hazards, the on-coming foreman must read and initial the report. Any unusual circumstances must be brought to the attention of on-coming workers.

Subsection 690(3)

To provide mine workers with the most current information related to mine conditions before work begins, the on-coming foreman must personally inspect the section of the mine where his or her workers will be assigned. This requirement is mandatory unless the assigned area has been inspected by another underground coal mine foreman in the preceding four hours. Of particular concern is the possibility of unstable ground, a build-up of explosive gases, an accumulation of water or other dangerous situation that could place on-coming workers at risk of injury.

Subsection 690(4)

If workers remain in the mine at the end of a shift to complete a critical task or for assigned overtime, the current shift foreman must post an inspection report that lists the names and locations of the remaining workers. This posting of information is of benefit to the remaining workers and the on-coming workers since the actions of one group could be hazardous to the other.

Subsection 690(5)

To make sure that the report described in subsection (4) is visible and available to anyone who might need to see it, it must be posted in a designated location. During an emergency, the employer must be able to quickly determine how many workers are in the mine. This can be of particular assistance to mine rescue personnel if an emergency rescue is necessary.

Section 691 Record of workers

The employer is responsible for ensuring that every worker records when they enter and leave the mine as well as when they plan to stay beyond a regular shift change. In many mines, each worker hangs an identification tag on a board showing the location in the mine where they will be working. Upon leaving the mine, workers place their tags on the logout board.

Section 692 Self rescuers

A self rescuer is a type of respiratory protective equipment that underground miners can put on quickly if the atmosphere becomes hazardous due to noxious gas concentrations or smoke. Self rescuers are intended to give workers enough time to safely reach a refuge station or the surface, depending on how far away the worker is from either of these locations. Everyone who enters an underground mine must carry a self rescuer and be trained to use it properly.

This section requires the use of self-contained self rescuer devices. Such devices are self-contained because they generate oxygen and are also known as oxygen-generating self rescuer devices. International experience in recent years has shown that carbon monoxide filter-type devices alone can be insufficient as workers have perished from oxygen deficiency. Industry has therefore adopted the more effective self-contained self rescuer device because it generates oxygen to breathe and excludes any airborne contaminants. Such devices are now widely available and typically have a one-hour rating. This means that they provide a worker with oxygen for up to 60 minutes depending on the worker's physical condition, fitness and activity level.

Subsection 692(a)

Self rescuers are intended to give workers breathable air for long enough to safely reach a refuge station or fresh air, depending on how far away the worker is from either of these locations. Self rescuers must be available for all persons underground.

Two types of self rescuers are commonly used in underground mines. The first is the filter type which is equipped with a filter that protects the wearer from as much as one percent carbon monoxide (CO) for one hour. In the presence of a high concentration of CO, the filter self rescuer can become very hot. The filter type is designed only to deal with CO, a product of combustion and lethal at very small concentrations. Thus the worker is breathing in mine air but with the CO filtered out. If the oxygen content of the air is low, this type of self rescuer cannot help and the worker is still at risk.

The second type, the oxygen generating self-rescue device, generates a supply of oxygen for the worker to breathe and is helpful in all hazardous atmospheres. In recent years experience has shown that this second type of self rescuer is more effective.

Subsection 692(b)

An employer must ensure that every person who enters an underground coal mine must be in possession at all times of an oxygen generating self rescuer. This requirement does not necessarily imply that the unit must be worn on a belt. It does require that the unit be readily available at all times.

Subsection 692(c)(d)(e)

Every person who enters an underground mine must be trained to use an oxygen generating self rescuer properly. Typically this involves an explanation and demonstration of the self rescuer often followed by a hands-on exercise of actually putting on a training unit. The context of typical emergencies and escape routes should be explained. In mines in which the walking time from the furthest working section to fresh air is greater than the life of a single unit, additional units must be provided so that an exhausted unit may be replaced with a fresh one. In such mines, it is important that training include the procedure required to exchange a used unit for a fresh one without inhaling contaminated air.

Such training ensures that there is no uncertainty or hesitation in worker response when putting on or exchanging oxygen-generating self rescuer units. Experience in incidents around the world has shown that workers have perished while trying to put on their self rescuer unit, possibly due to inadequate or out-dated training. Thus this section requires refresher training every three months.

Records of worker training in the use of self rescuer devices must be maintained and kept at the mine. This confirms that training has taken place and helps with the scheduling of refresher training.

Subsection 692(f)

The employer is responsible for providing a sufficient number of self rescuers to supply one unit to every person underground. This includes personnel not rostered to work every shift but who are required for other reasons e.g. to make inspections or visitors.

The employer must also ensure that additional self rescuers are stored and strategically located in caches along the emergency escape route(s). This allows any person to put on a fresh unit to ensure that they do not run out of oxygen when walking from the most distant working section to the defined emergency exit during a mine emergency.

Section 693 Means of ignition

Subsection 693(1)

Means of ignition are provided by any and all items that have the potential for causing a fire or explosion. Means of ignition are not limited to matches and lighters but can include non-permissible lighting, defective permissible lights, flame traps on equipment, foil wrapping on candy and other materials. All such items are commonly known as “contraband” and are prohibited in underground coal mines.

One means of enforcing this prohibition is to allow the employer to conduct periodic searches of workers and visitors prior to going underground to ensure that they are not in possession of contraband items. This section requires the employer to submit to the Director for approval a suitable system to conduct such searches and implement appropriate disciplinary action.

Subsections 693(2) and (3)

Workers are also responsible for ensuring that contraband materials are not taken into underground mines. Employers must ensure workers are aware of this requirement through a system of checks and reminders as workers enter the mine. Employers must also clearly mark restricted areas where smoking materials and other sources of ignition are prohibited. Workers must comply with these requirements.

Subsection 693(4)

Despite the prohibitions noted in subsections (1) through (3), this Part does allow some limited means of controlled ignition to be brought into an underground coal mine. For example, subsection 659(1) allows permitted explosives in the mine. Similarly, subsection 746(2) allows some cutting, welding or soldering using an arc or flame subject to the Director’s approval.

Section 694 No smoking warnings

The employer must determine that tobacco, matches or other means of ignition are not allowed in designated or hazardous locations at the surface of an underground coal mine. Such locations must be appropriately signed and marked as “no smoking” areas.

Mine Equipment

Section 694.1 Equipment for use in underground coal mines

This section addresses a concern that the Code does not always acknowledge the validity of equipment certifications/approvals from other internationally well recognized jurisdictions such as MSHA in the U.S. Underground coal mine operators are increasingly being forced to use equipment certified in other countries, especially the U.S. This section gives added flexibility to employers with no reduction to safety and health while maintaining compliance with the OHS Code.

Section 695 Propane installations

Subsection 695(1)

The manufacturer’s specifications and the *Alberta Safety Codes Act* define the general safety precautions and the technical standards to be applied when installing and maintaining propane equipment. The employer is responsible for ensuring that propane installations at an underground coal mine site comply with the applicable requirements.

Subsection 695(2)

Due to the explosive nature of compressed gases, storage facilities must be protected from impact by moving vehicles. Even a minor impact could cause a propane leak or an explosion.

All propane installations should be protected by collision barriers to minimize the potential for contact by moving equipment.

Propane is heavier than air and accumulates in low-lying areas. Care must be taken to ensure that proper air flow or ventilation is provided in storage enclosures. Where appropriate, detection devices should also be installed to ensure that leaking gas does not enter the underground workings.

Subsection 695(3)

Inspections are intended to ensure that leaking propane does not present an additional hazard to workers underground or related mine facilities. Propane accumulates in low-lying areas and could conceivably find its way into the underground workings via rock fractures or even the mine ventilation system. For this reason the location of propane installations must be carefully controlled and related propane facilities appropriately maintained.

Subsection 695(4)

This subsection outlines specific propane system components that must be checked at least every three months. The objective is to prevent propane leakage that could create an additional hazard to mine workers.

For ease of follow-up and investigation, it is recommended that all inspections be recorded in a maintenance log book or computerized database maintained for that purpose.

Subsection 695(5)

Due to the hazard created by propane leakage and accumulation, this subsection requires that each underground coal mine be equipped with propane gas detectors. These detectors must be installed to detect propane leaking into the mine ventilation system and visibly or audibly warn workers of the leak.

Subsection 695(6)

Similar to propane space-heaters used in large surface buildings, mine heaters are used to heat cold incoming air in the winter. The warming of the intake air helps avoid freezing temperatures in the mine workings, especially those close to the surface.

Mine air heating systems could ignite a fire or explosion if not used correctly. Where such mine air heating systems are used, whatever fuel source they use, the employer must satisfy the Director of their safe application and use. The employer must obtain the written approval of the Director prior to installing such a system.

Section 696 Bulk fuel storage

Subsection 696(1) & (2)

Designers of bulk fuel storage facilities must meet the requirements of this section to ensure that leaks do not occur. By locating bulk storage installations at a lower ground elevation than the entrance to the mine, leaks can be prevented from seeping into the mine.

Secondary containment structures and impermeable dikes also prevent leaking fuel from flowing into the mine by retaining gas or liquid and preventing seepage.

Section 697 Voice communication

An effective and reliable communication system is perhaps the most important instrument in maintaining safety and responding to emergencies. Worker confidence is also affected by the availability and quality of the communication system. Although a wide variety of sophisticated systems are available, the focus of this section is the minimum requirements that ensure safety.

Subsection 697(1)

An effective voice communication system is essential in an underground coal mine, both for mine efficiency and mine safety. The employer must ensure that an interconnected communication system is installed throughout the mine. Communication stations must be close to key production and high activity areas so that workers can call for assistance or rescue and pass on working instructions when required.

The use of “leaky feeder” systems throughout the underground coal mine makes the use of hand-held two-way radios an effective supplement to telephone systems. Despite this, hard-wiring of telephone stations is the expectation here.

Subsection 697(2)

Exploratory drivages up to 60 metres in length have been exempted because visual and voice communications are adequate in these smaller areas.

Subsection 697(3)

Because of the critical contribution that an electric communication system can make to worker safety, the employer must ensure that the system has a backup power supply. The backup power supply must be separate from the main power supply system and must remain operable if the main power system fails.

The focus here is on a secondary source of power such as an auxiliary generator.

Section 698 Location

Since rapid communication can minimize the potential for a major safety incident, this section specifies where some of the interconnected voice communication stations must be located. In general, the locations are where working activities are routinely undertaken and where workers are expected to be found.

The Director is authorized to order the installation of interconnected voice communications stations at any other location that the Director considers appropriate.

Section 699 Permanently attended stations

Subsection 699(1)

It is expected that an underground coal mine has at least one permanently attended voice communication station on the surface. A permanently attended station provides a critical link to workers underground and is used to pass on both routine operating and periodic emergency information.

This subsection requires that the permanently attended surface station be equipped with a telephone connection to the public telephone system. This ensures that additional emergency response assistance can be requested immediately.

Subsection 699(2)

For the primary purpose of alerting mine workers and emergency response personnel, the permanently attended surface communication station must be equipped with an audible alarm system. The alarm system must be installed and maintained so that it can be initiated from the permanently attended surface station in an emergency.

The alarm system must alarm on the surface and in the underground workings to initiate an evacuation of workers underground.

Section 700 Portal

Subsection 700(1)

In addition to protecting workers from falling or collapsing ground, portals ensure access to the mine during emergencies. Only non-flammable materials can be used for construction so that portal structures remain intact and operational during a fire.

Subsection 700(2)

A professional engineer must prepare and certify a design that adequately addresses all factors affecting the structure such as construction materials, position of the opening and stability of the formation around the opening.

Section 701 Mine outlets

Subsection 701(1)

The requirement for at least two outlets or emergency exits is the same for mines and many other workplaces. Underground mines are more restrictive and more prone to emergency situations than buildings.

These two outlets generally form part of the ventilation system in underground mines by providing fresh air to working areas through one outlet and returning used air through the other. The underground workings include cross cuts driven at certain intervals to provide alternate escape routes as well as pathways for ventilation tubing. One of the outlets often serves as a conveyor gallery for transporting coal out of the mine.

Subsection 701(2)

The availability of a voice communication system, in case of emergency, allows workers to communicate their presence directly to the command centre.

Subsection 701(2.1)

Mine outlets are typically either vertical shafts or inclined slopes. In an emergency such as a fire or explosion, two mine outlets located too close to one another may both be damaged, thus potentially trapping workers underground. A safe separation distance for mine outlets must be maintained for all foreseeable emergencies. The employer must ensure that the mine openings or outlets are at a safe distance from one another by ensuring the designs are certified by a professional engineer. In the event of an emergency, at least one opening will allow worker egress.

The safe separation distance will vary from mine site to mine site and will depend upon many factors e.g. geology – the type of surrounding rock mass, its structure and properties geotechnology – the interrelationship and stability of rock mass and soils and engineered structures such as shafts, tunnels and ground slopes; and physical factors – such as the relative geometry, shape and size of the structures involved.

Subsection 701(3)

Exploration and early development work for a mine are exempt from the requirement of subsection 701(1) for practical reasons. However, the employer must ensure worker safety by conducting site hazard assessments as required by Part 2.

Subsection 701(4)

This subsection recognizes that under some circumstances, such as in the development of new areas, workers must work in a “single-entry” or blind heading, tunnel, roadway or shaft. In such circumstances, especially in the sinking or vertical shafts, working space is restricted and thus the number of workers allowed in the mine working must be limited. In such cases this limit is set at a maximum of nine at any one time.

It is also recognized that in an emergency, should there be nine persons already in the working area, it may be impossible for some of them to come out to allow emergency response and mine rescue personnel in. This subsection allows such emergency personnel to enter in sufficient numbers to safely conduct their work. In the absence of the extra outlet, monitoring and control take on higher priorities to maintain required safety levels.

Section 702 Escape ways

Subsection 702(1)

Good housekeeping is a recognized factor that contributes to reducing worker injuries. In the confines of an underground coal mine, housekeeping is even more critical since emergency evacuation could potentially occur in complete darkness. To maximize the potential for rapid worker evacuation or escape, all underground tunnel ways, shafts and related access facilities must be kept clear of all obstructions at all times. In particular, accumulations of ice must be routinely removed and all other obstructions addressed as appropriate.

Several requirements ensure that workers, in an emergency, can quickly determine the correct direction for escape. The first is signage to guide workers to each surface outlet. Both fluorescent/retroreflective and geometrically shaped signs are recommended so that workers can determine direction under conditions of limited visibility and lighting. The second is the provision of lifelines including directional indicators, which must be used. Lifeline continuity must be maintained in practical ways and special markers will indicate the direction of exit and the location of caches of reserve oxygen generating self rescuer units.

Subsection 702(2)

All emergency escape routes should be kept free of flowing water i.e. whether from ground water, surface water or leaking pipes, etc., especially stairways and ladders. This helps prevent slippery and icy conditions or even ice-blockages, all of which could complicate, restrict or impede efficient emergency egress from the mine. All water must be directed away from stairways to minimize slipping hazards, especially during worker evacuation.

Subsection 702(3)

Escape ways inclined at more than 30 degrees from the horizontal must be equipped with devices that enable and do not hinder rapid worker escape in case of emergency. Walkways, stairs and ladders are mandatory and must be routinely inspected to ensure that they are maintained in a state of good repair.

Any shaft or tunnel way designated as an emergency escape way must allow a worker to leave the mine safely and by definition must lead to a surface outlet.

Subsection 702(4)

To ensure that escape under emergency conditions can be done as efficiently as possible, this subsection defines the minimum acceptable dimensions of an escape way. The 2 metre high and 2 metre wide dimensions allow a worker to move rapidly in an upright or semi-upright position when leaving the mine.

Section 703 Manholes

Subsection 703(1)

This subsection focuses on mine levels or tunnels in which haulage equipment and mine workers routinely travel at the same time. Facilities must be provided to give the worker an appropriate means of avoiding the moving equipment. In an underground mine that means of avoidance is provided by specially excavated “manholes” or places of refuge into which a worker can step.

Along underground haulage routes, this subsection requires that manholes be established at least every 20 metres (65 feet). Some exceptions to this requirement are provided in subsection 703(2).

Subsection 703(2)

Under certain conditions the employer is allowed to forego installing manholes. Unless a hazard assessment indicates that a manhole should still be installed, manholes are not required if haulage equipment speed does not exceed 8 kilometres per hour (5 miles per hour). The physical dimensions of the travelway must also provide a clearance of at least 1 metre between the equipment and any worker.

Subsection 703(3)

To ensure that sufficient room is available for a mine worker to avoid contact with moving haulage equipment, this subsection specifies the minimum dimensions of a manhole or place of refuge. To ensure that the manhole can be used when needed, it cannot become a storage area for garbage or spare parts, etc. Manholes must be kept clear at all times.

Manholes must be clearly identified (usually with signage) and numbered. The signage and numbering ensure that assistance can be directed to the correct location as quickly as possible during an emergency.

Vehicles

Section 704 Underground fuel stations

Subsection 704(1)

Underground filling operations and fuel storage areas are managed with extreme care and discipline because of the ever-present potential for fire and explosion. Filling stations must be certified by a professional engineer.

Subsection 704(2)

The requirements stated in this section are the minimum required for controlling fire and explosion hazards and ensuring worker safety. Key features are systems to control or collect fuel seepage and the use of non-flammable construction materials. Outward opening fireproof doors are also mandatory.

Subsection 704(3)

Due to the ever present risk of fire, each fuel station must be equipped with suitable fire fighting equipment that is readily available and easily accessible.

Section 705 Diesel fuel

Subsection 705(1)

The characteristics of commercial diesel fuel can vary significantly and emissions from some fuels can have a negative impact on worker health. This subsection specifies that only diesel fuel that at least meets CGSB Standard CAN/CGSB 3.16-99 AMEND, *Mining Diesel Fuel*, can be used in Alberta underground coal mines. The "Specified Limiting Values" provided in the referenced standard are shown in Table 36.1. The Standard should be consulted for additional details.

To reduce the hazard associated with large volumes of stored fuel, the maximum quantity allowed to be stored underground is limited to that required for 24 hours of work unless permission to store more is given by the Director.

Table 36.1 Specified limiting values		Min.	Max.	Test Method	
				ASTM	CGSB
6.4	Flash point, ¹ °C (par.9.1)	52.0	—	D 93 or D 3828	(Par. 6.16)
6.5	Kinematic viscosity ² at 40°C, mm ² /s (cST)	1.30	4.10	D 445	
6.6	Distillation 90% recovered, °C End point, °C	— —	325.0 355.0	D 86	(Par. 6.17)
6.7	Water and sediment, % by volume	—	0.05	D 1796	(Par. 6.18)
6.8	Acid number	—	0.10	D 974	
6.9	Sulphur, ³ % by mass (par 9.1) Special Special-LS	— —	0.25 0.25	D 1266 D 1552 D 2622 D 4294 D 5453	CAN/CGSB-3.0 No. 16.0 (Par. 6.19)
6.10	Copper strip corrosion, 3h at 50°C	—	No. 1	D 130	
6.11	Carbon residue on 10% bottoms, % by mass	—	0.10	D 4530	
6.12	Ash, % by mass	—	0.010	D 482	
6.13	Ignition quality, cetane number, ⁴ (par.9.1)	—	40.0	D 613	(Par. 6.21)
6.14	Electrical conductivity at point, time and temperature of delivery to purchaser, pS/m (par. 7.1)	25	—	D 2624	
6.15	Density, at 15°C, kg/m ³	—	850	D 1298 D 4052	(Par. 6.22)

1. A higher flash point may be specified in special applications
2. The SI unit for kinematic viscosity is the square meter per second. The preferred multiple for fluids in this viscosity range is the square millimeter per second which is equivalent to a centistoke (i.e. 1 mm²/s = 1cST).
3. The sulphur limit may be established by government regulations or as specified by contractual agreement.
4. Fuel having a higher cetane number may be necessary for some engines. Conditions of operation may also indicate the specification of a higher cetane number.

Subsection 705(2)

The employer must ensure that appropriate procedures have been developed and workers trained to minimize the spilling of diesel fuel during refuelling operations. Fuelling nozzles should be designed to allow only manual filling by a worker or attendant. Automatic tripping devices are discouraged due to the potential for malfunction, with resulting over-pressurization and/or spillage. Where some spillage is inevitable, drip pans or spill collection devices must be used to minimize the fire potential.

Subsection 705(3)

Since empty fuel containers still contain some residual fuel or related fuel fumes, they cannot be allowed to accumulate within the mine. If left to accumulate they could present an additional hazard during a fire emergency. All empty diesel containers must be removed from the mine daily.

Subsection 705(4)

As a precaution against fuel spill accumulation and potential fire, all spilled fuel and oil must be cleaned up immediately. For clean up purposes a supply of non-flammable absorbent material must be available in the fuelling station at all times.

Once used to clean up spills, the absorbent material must be disposed of in a flameproof receptacle. The material must be removed from the mine at intervals of not more than three days.

Subsection 705(5)

To reinforce the requirements of subsections (1) through (4), the employer must post a copy of the subsections in a conspicuous place at the underground fuel station. To ensure that workers comply with these requirements, it is highly recommended that refresher training take place on a periodic basis and that such training be documented. To ensure that the posted copy remains legible, clean copies should be re-posted as necessary.

Section 706 Control levers

Subsection 706(1)

This section ensures mobile equipment is left with the operating lever in the neutral position so that the equipment will not move and create a danger. The lever must be designed to be removed only when the lever is in the neutral position. This prevents removal of the lever while engaged in the operating position, preventing continued unintended movement or equipment operation.

Subsection 706(2)

The use of remote controlled equipment is now common in underground coal mines. For example, in room and pillar mining where the distance from the cutting head to the driver's cab is 6 metres, the maximum depth of cut to prevent the operator from going under the unsupported roof is 6 metres. However, the conditions may allow an extended cut of 12 metres or even 18 metres to be made. In such circumstances, the use of a radio controlled remote unit allows the operator to remain under a supported roof and still control the continuous miner machine as it makes an extended cut.

Whenever such remote controlled equipment is used, the employer must ensure it is used in accordance with the manufacturer's specifications. These may include the following operational safeguards:

- (a) provision of a written procedure;
- (b) ensure that radio frequencies used underground are independent of one another so that a signal given to one machine will not somehow initiate an action on another separate machine;
- (c) allow selection of either manual or remote operation mode;
- (d) the operator must have sight of the equipment, either directly or via a camera and screen display;
- (e) clear signage of the area where remote controlled equipment is in use or may be in use;
- (f) only one authorized operator can operate remote controlled equipment at a given time;
- (g) a detailed log must be kept of remote controlled equipment use to provide a record of specific operational circumstances. This information may be useful in an incident investigation or for maintenance/operational trend analysis, etc.
- (h) ensure that remote controlled equipment is properly equipped and maintained to prevent unexpected/unauthorized use or interference with other operations that use radio frequencies, such as blasting; and
- (i) the radio frequency selection unit is sealed to prevent the operating frequency from being altered.

Roof and Side Support

Section 707 Support system

Subsection 707(1)

In designing entrances and roadways, the professional engineer must address the physical characteristics of the strata and structures, as well as stresses created by the mining sequence. Accurate evaluation of these factors must be contained in a geotechnical analysis.

Subsection 707(2)

Information collected from the geotechnical analysis is also used to determine appropriate support for the roof and sides of excavations. Safety factors addressed by the design of these support systems contribute to the stability and safety of the overall mining operation. All support systems and pillars must therefore be designed by a professional engineer.

Subsection 707(3)

To ensure a detailed geotechnical analysis is completed, this subsection specifies some of the factors that must be considered by the geotechnical engineer. Despite the requirements, other relevant factors can be included based on the engineer's professional judgment. These include the type and position of the seam and the rock layers above and below the seam, their strength, discontinuities, groundwater, geological structure, near-surface deposits, interaction of workings in more than one seam, mining sequence through time, stresses and strains, subsidence, the mine excavations and outbursts of rock, water or gas.

Subsection 707(4)

While geotechnical analysis and evaluation determine the minimum support required to provide relative stability and safety, additional support can improve workers' comfort level. Additional supports can be added at the worker's discretion to ensure safety.

Section 708 Extractions

Subsection 708(1)

A systematic and sequenced approach to the recovery of pillars is essential to ensure both the safety of workers involved in depillaring and the safety of others working in the immediate area. An uneven collapse line or roof fracture between the gob and mining area could create overhangs and cause an uneven distribution of stresses, making those areas unstable. Success in maintaining an even collapse line and systematic collapse of roof materials into the gob allows the mining and recovery of coal resources without undue reserve losses or safety concerns.

Much of the success of a depillaring operation comes from the quality of the initial ground support program, an on-going maintenance program and the operation of a systematic sequence of pillar recovery.

Subsection 708(2)

Due to the safety hazards associated with extraction operations, a professional engineer must define and certify a safe method and sequence for those extraction operations.

Section 709 Operating procedures

Subsection 709(1)

A code of practice for support systems must clearly describe how roof supports are to be safely installed and withdrawn, and how roadways are to be repaired and restored following a roof collapse. In depillaring operations, safe operating procedures must focus on maintaining an even breakline. For roadway maintenance and repair, the procedures must detail the process and frequency of these activities and illustrate support locations. Section 8 of the *OHS Regulation* requires that the procedures of the code of practice be in writing and available to workers.

Subsection 709(2)

The mine manager is responsible for posting a copy of the roof support code of practice.

Section 710 Removal of ground supports

Subsection 710(1)

Ground supports are installed to protect workers from roof or rib collapse and to maintain the structural integrity of underground openings. The installation of ground support systems is specified by a geotechnical engineer and installations are completed according to the mine manager's code of practice as noted in section 709. Due to the overall impact on mine stability and related worker safety, ground supports cannot be removed without the permission of a mine official. According to this Part, that mine official is either the underground coal mine manager or underground coal mine foreman.

Subsection 710(2)

Since removal of ground supports could lead to imminent ground collapse, the mine manager must ensure that workers are protected from falling ground by further ensuring that temporary supports are in place. Materials for such temporary supports must be readily available to the workers and installed prior to the designed supports being removed.

Subsection 710(3)

Worker safety is the ultimate concern. If a hazardous situation could quickly develop, despite subsection (2), other supports must not be used under the conditions specified unless related procedures have been certified by a professional engineer according to subsection (4).

Subsection 710(4)

The removal of supports from the area of the gob or from under an insecure roof could place a worker at significant risk of injury from falling ground. For this reason, it is mandatory that a professional engineer develop and certify the means and methodology to be used. By using certified safe work procedures the related hazard to mine workers should be minimized.

Ventilation System

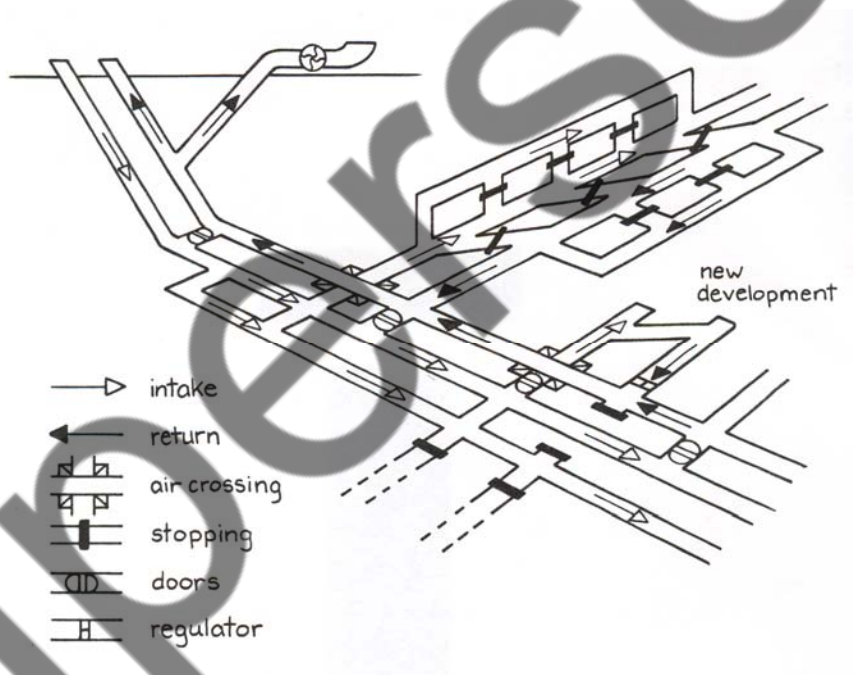
Section 711 Ventilation system

Subsection 711(1)

The professional engineer's design must ensure that air velocities are sufficient to create required turbulence without raising dust or stratifying the ventilation current. Locations of fans must prevent recirculation of contaminated air and stoppings must be provided to prevent leakage and short circuiting. Figure 36.21 illustrates a mine air distribution system.

Although the OHS Code sets specific standards for air content and quality, other considerations such as comfort level, drops in pressure and sudden emissions of methane may require higher standards.

Figure 36.21 Schematic mine air distribution system



Subsection 711(2)

Safe operating procedures are required to ensure ventilation problems are thoroughly and uniformly addressed. The safe operating procedures can also serve as a quick reference and training tool. The procedure must be certified by a professional engineer. Section 8 of the *OHS Regulation* requires that the procedures be in writing and available to workers.

Subsection 711(3)

Unless an acceptance is provided by the Director, the use of compressed air for ventilation is prohibited. Its quality is largely unknown and once the air hits the ventilation system, it becomes breathing air for workers. It must therefore meet specific quality standards. It is also quite probable that ventilation using compressed air will not meet desired velocity and turbulence objectives, especially at working faces.

Section 712 Air velocity

Subsection 712(1)

The minimum air velocity allowed at a working face under normal working conditions is specified as 0.3 metres per second. This minimum velocity is mandated to ensure that methane gas levels and coal dust generation are maintained at acceptable levels in this most hazardous location. Both methane gas and coal dust are liberated by the coal cutting activity.

Subsection 712(2)

Unused or intermittently used roadways can sometimes become pockets for methane accumulation. Minimum air velocity standards ensure that methane is adequately diluted and exhausted through the system. Methane is lighter than air and in low air velocities can accumulate in layers close to the roof. Such layers can, in certain circumstances, even move up gradient against the prevailing ventilation flow. Inadequate velocity and laminar flow in mine roadways can create conditions that lead to methane layering. Such layers can contain potentially explosive mixtures of methane in air which may go undetected. These layers can be removed by mixing the general air body by more turbulent airflow.

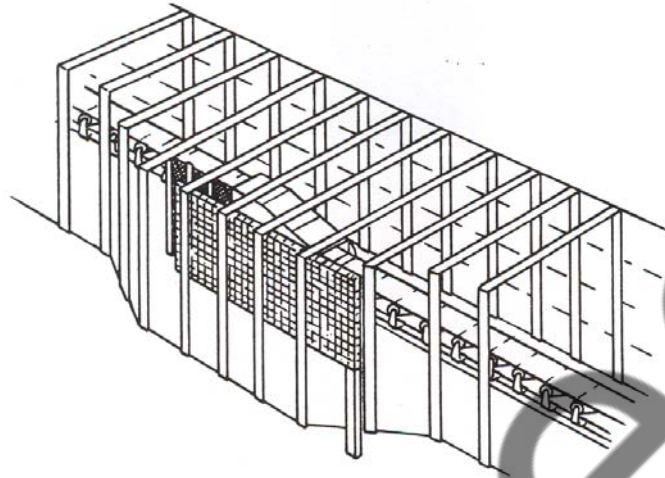
Subsection 712(3)

The maximum air velocity allowed in a coal mine must also be restricted in order to control dust. Higher velocities pick up coal particles in correspondingly larger quantities and create coal dust problems. When coal dust is combined with specific concentrations of oxygen, an explosive atmosphere can develop that can release more energy, if it explodes, than a methane atmosphere.

Apart from explosion hazards, coal dust impacts worker health, visibility, covers equipment, dulls lighting and creates a generally unhealthy atmosphere. As a countermeasure, coal dust in roadways must be removed and the areas dusted with stone dust to reduce any explosion potential and improve visibility.

To reduce dust problems at transfer points, roadways are sometimes widened to reduce air velocity. An illustration of this is provided in Figure 36.22.

Figure 36.22 Roadway enlargement



Subsection 712(4)

As indicated, the Director may issue an acceptance if an acceptable alternate has been certified by a professional engineer as providing a level of protection that is equal to or greater than the limits specified in subsections (2) and (3) for the actual mining conditions expected.

Section 713 Return airway

The air used to ventilate garages, bulk oil storage areas, filling stations and transformers rated at more than 1000 kilovoltamperes must not be reused for ventilating other areas. This air becomes contaminated with various hydrocarbon vapours and other emissions and is not fit for ventilating any other area. In coal mines, efforts are continually made to avoid the addition of any explosive gases to the already hazardous environment.

Section 714 Doors

Subsection 714(1)

Airlock doors prevent the uncontrolled leakage or loss of ventilation air from one roadway (intake air) into another roadway (return air). Airlock doors must be capable of withstanding the pressure differential between the two headings and allow workers, vehicles and materials to pass through. Generally, airlock doors are installed in tandem so that only one door is opened at a time, reducing loss and mixing of air.

Subsection 714(2)

Ventilation engineers design doors to direct or redirect air from one working area to another. Any tampering will cause serious problems with the quality and quantity of the ventilation. As a result, workers are not allowed to leave open any shut door unless properly authorized to do so. The same applies for closing any open door.

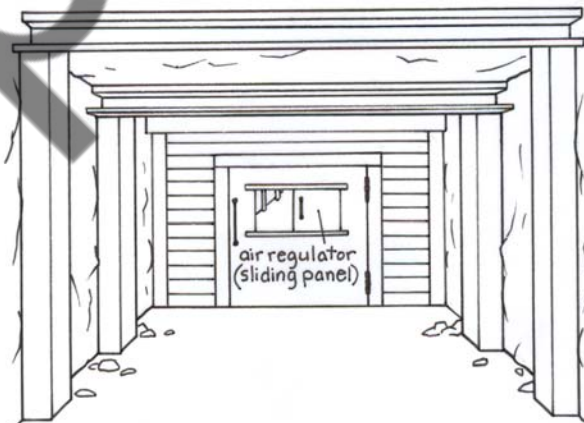
Subsection 714(3)

This safety measure of ensuring one door remains closed during an air reversal prevents uncontrolled air leakage and loss of ventilation efficiency.

Section 715 Stoppings

Stoppings are used as barriers in cross cuts between intake and return roadways. They are designed to prevent uncontrolled leakage resulting from the pressure differentials across the stoppings (see Figure 36.23).

Figure 36.23 Stopping for ventilation regulation



To ventilate a mine economically and effectively, areas not in use or not requiring any fresh air are sealed off with suitable stoppings. This prevents the loss and waste of ventilating air and prevents the potential of contaminated air in worked out areas from entering active working areas. Stoppings are also used to control the gob environment and ensure that the active working areas remain safe. If a hazardous condition develops behind stoppings, appropriate remedial measures must be taken. Ready access to the face of stoppings must be maintained at all times for monitoring, control and emergency activities.

In room and pillar mines it is important, as far as practicable, to isolate conveyor roadways. Conveyor systems are susceptible to fire. Using stoppings to isolate them minimizes the potential contamination of air in adjacent intakes or return airways. This provides the maximum opportunity for escape by mine workers.

Section 716 Seals

Subsection 716(1)

Worked out areas of a mine can still present a significant hazard to underground coal mine workers. Of particular concern is the potential for gases or water to accumulate or for the spontaneous combustion of coal or coal dust, resulting in fire and/or explosion. For this reason worked out or inaccessible areas must be securely sealed off. In exceptional circumstances there may be good reason not to seal old areas, but this practice must be approved in writing by the Director.

Subsection 716(1.1)

Seals required under subsection (1) must be built to withstand over pressure effects created by any subsequent explosion within the sealed areas. The minimum levels required are based on those recently introduced in the U.S. These minimum levels are an over pressure of 345 kPa (50 psi) for monitored seals. If such seals are designed to also contain a known or suspected fire under subsection (4), then minimum seal design requirements increase, for example, to a minimum over pressure of 800 kPa (120 psi) for unmonitored seals, rising to an over pressure of 4.4 Mpa (640 psi) if an explosion pulse can be expected.

Subsection 716(2)

Since time is the critical factor in preventing the accumulation of dangerous gases or water or the generation of spontaneous combustion, this subsection requires that such abandoned areas be sealed off within three months of mining activities ceasing in those areas.

This subsection allows the Director to approve an alternative, but such an approval would typically be provided only in exceptional circumstances.

Subsection 716(3)

Although a properly designed seal minimizes potential hazards to mine workers, knowledge of what is happening behind a seal is also critical to worker safety. For this reason the employer is responsible for ensuring that such behind-the-seal conditions are regularly monitored. Where warranted, the employer must also take actions to ensure that hazardous conditions are mitigated or eliminated. Where mitigating actions cannot be safely implemented, mine worker's health and safety must be the prime consideration when determining the next steps to be taken.

Subsection 716(4)

If a seal is being constructed to contain or isolate a fire or spontaneous heating, it is quite logical that it also be designed to withstand the effects of an explosion within the sealed area. Such seals are substantial structures and must be designed by a professional engineer guided by best industry practice considering the over pressure levels outlined in subsection (1.1). It must be also be possible to sample the atmosphere or drain accumulated water from behind a seal. Sampling can provide advance warning of gas buildup and provide a means of mitigating any problem related to water accumulation.

Section 717 Chutes

In mining an inclined seam, chutes, winces and raises are developed to transfer coal or other minerals from upper levels to lower levels or to an ore car. If the ventilating pressures at these levels are unequal, ventilating air could leak through uncovered or empty chutes. Also, the end assembly (bulkhead) of the chute, which generally has a gate and lever used in loading trucks, could be damaged if ore is dumped from an upper level to an empty chute. Some ore is usually left in the chute to act as a cushion and protect the end assembly. As well, an empty chute allows rock pieces to tumble freely, posing a hazard to workers below.

Section 718 Splits

An underground coal mine is divided into separate sections based on fresh air ventilation requirements. Accordingly, fresh air is split from the main air intake to ventilate each area. Contaminated air from each station is directed directly into the main return airway.

Section 719 Fans

This Part sets minimum requirements for ventilating an underground coal mine and providing a safe environment. The required measurements of pressure provide invaluable information about conditions in the mine. A sudden increase in pressure may indicate a sudden release of methane from the coal face, a blast of air from the gob area due to roof breakage, or problems with control devices underground. Similarly, a decrease in pressure may indicate a substantial leak.

To ensure the integrity of the system and the health and safety of workers underground, redundancy of both the fan and its power supply is required. Keeping a record of ventilating pressures is mandatory.

Section 720 Reverse flows

Subsection 720(1)

Repealed.

Subsection 720(2)

A coal mine ventilation system needs to be designed to meet the requirements of Part 2. If the design includes the ability in an emergency to reverse the main ventilation fan and thus reverse the main ventilation flow, then this section provides for its safe application.

Air flow reversal is normally only required in the event of a fire or explosion. Smoke and fumes need to be directed away from areas not yet evacuated, preventing contamination of areas under evacuation.

Air flow reversal must only be implemented with the underground coal mine manager's authorization. Air flow reversal can greatly affect worker health and safety so the decision is not made lightly.

Section 721 Surface fans

Subsection 721(1)

The main ventilation fan must be located to ensure used contaminated air is not recirculated back into the mine through an adjacent mine portal. The fan must also be protected from explosions and other air blasts. If a fan is damaged by an explosion, the entire ventilation system might fail, leaving trapped workers

exposed to contaminated air. Placing the fan at least five metres away from the nearest side of the mine opening ensures the fan is protected. The requirement for non-combustible air ducts increases the likelihood that they will survive a fire or explosion.

Subsection 721(2)

Explosion doors and or weak walls are required to provide protection for the main surface ventilating fans against air blast. The lives of mine workers could be at risk if the ventilation system failed. Air blasts can be generated by explosions or by a sudden unexpected large scale cave-in of roof rock in a mining section or sudden collapse of mine pillars. Some air blast protection is offered by the “off-set” requirement of subsection (1). Further protection must also be provided by using either explosion doors and/or weak walls located in direct line with possible explosive forces. Any such forces would thus preferentially open the explosion doors or destroy the weak wall and not pass through the main fan(s).

Subsection 721(3)

Despite the requirement of subsection (1), this subsection does allow the main ventilation fan to be located directly in front of or over a mine opening if certain criteria are met. The specified criteria limit the potential for damage of the main ventilation fan(s) in the event of an explosion or other air blast.

Section 722 Booster fans

This requirement ensures ventilation continues if the booster fan shuts down. However, if the main fan stops, the booster fan must also stop to ensure it does not create an air recirculation problem. In either case, continuous monitoring of run status and level provides timely notice of any adverse changes in operating status. Appropriate alarms in the permanently attended monitoring station should indicate problems with the booster fan.

Section 723 Auxiliary fans

Subsection 723(1)

Auxiliary fans must be electrically grounded. This is due to the fact that moving air can cause a build-up of static electricity on the fan and auxiliary fans tend to be independent systems. The grounding of auxiliary fans dissipates any statically induced charges.

Subsection 723(2)

If any single-entry heading or working area extends more than 10 metres from the nearest ventilation circuit, an auxiliary ventilation system is required to direct ventilation air toward the working face.

Such systems can use either auxiliary fan(s) and ducting or a curtain of brattice cloth or other ventilation materials that redirects air to the face. Auxiliary ducts are usually connected to a fan in the fresh air roadway.

Subsection 723(3)

The 10 metre distance specified in subsection 723(2) must be measured from a standard reference point, in this case the nearest rib.

Subsection 723(4)

Section 560 requires employers to meet the requirements of CSA Standard M421-00 (R2007), *Use of Electricity in Mines*. Clause 6.2.3 of the CSA standard requires provision of an interlock such that if an auxiliary fan shuts down automatically then so does other electrical equipment in that roadway. This subsection releases an employer from that requirement when a roadway under auxiliary ventilation is less than 200 metres long. This recognizes the difficulties in compliance in the early stages of roadway development and relies on manual rather than automatic shutdown of power to other equipment when a fan shuts down.

Section 724 Brattice, vent tubes

Subsection 724(1)

This subsection requires the end of the duct or brattice cloth at the working face to be as close to the face as possible to achieve the required amounts of air, turbulence and velocity along the working face.

Subsection 724(2)

The referenced CSA Standard ensures materials used in the manufacture of brattice and ducts do not add to the danger of fire and explosion. The survival of ventilating ducts and devices during an emergency can be essential to worker survival.

Section 725 Fan operating procedures

Subsection 725(1)

If a booster fan or auxiliary fan stops, workers must be evacuated to a place that is adequately ventilated. Since the loss of ventilation can result in a rapid deterioration of air quality, a competent worker must test the affected area before workers are allowed to return or enter the area. If air quality is below acceptable levels, workers must not return to this area until adequate ventilation has been re-established.

Subsection 725(2)

Areas affected by a stopped auxiliary fan require testing for flammable gases before they can be declared safe and the fan restarted. Testing an area for flammable gases and making the decision to restart an auxiliary fan must be done by a competent worker who is fully aware of the risks and importance of these activities. In addition to posting the declaration that it is safe to restart a fan, the supervisor must include it in his written shift report.

Subsection 725(3)

The code of practice for restarting both booster and auxiliary fans underground must be posted in a conspicuous location at the mine. Section 8 of the *OHS Regulation* requires that procedures in a code of practice be in writing and available to workers.

Subsection 725(4)

Repealed.

Section 726 Stopping fan

Subsection 726(1)

Because the air ventilation system is the most critical component of the mine's safety system, it must not be modified in any manner without the consent of the senior mine official. This subsection specifically prohibits a worker from stopping any fan without that express consent.

Subsection 726(2)

Any significant change in ventilation or the stopping of a fan requires that workers be withdrawn to a location having adequate fresh air. The employer must ensure that procedures are in place and understood by all mine workers so that no worker returns to the affected area until the area is checked to confirm it is safe.

This subsection lists the conditions under which a worker can return to the affected area. Of particular note is the requirement that a mine official must examine the affected area and declare it safe by recording his or her findings and posting a notice in a conspicuous location that is used by the mine workers.

Subsection 726(3)

Since the mine official must perform the mandatory safety checks and examinations prior to allowing workers to return to the affected area, the conditions of subsection (2) do not apply to that mine official.

Section 727 Ventilation monitoring

Subsection 727(1)

This subsection addresses the measurement and recording of ventilating air quantities and qualities that must be taken, as a minimum, by an appointed competent worker. Readings include barometric pressure outside the mine and the velocity and quantity of air in airways and accessible old workings in the mine.

Barometric pressure has significant impact on fan performance as well as on the quantity of air circulated through the mine. A rapidly dropping barometric pressure releases flammable gases from exposed coal surfaces and sealed workings into the mine ventilation circuit. Thus measurements must be taken at seals along intake air courses where intake air passes by a seal to ventilate active working sections.

Subsection 727(2)

The places where measurements required in subsection (1) must be taken are clearly described as a minimum.

Subsection 727(3)

The appointed worker taking the measurements must promptly report abnormalities in pressure or air quantity to the underground coal mine manager.

Subsection 727(4)

The measurements required under subsection (1) must be taken at least once a week. This typically involves a complete survey of air quantities throughout the mine.

Subsection 727(5)

If measurements taken under the previous subsections indicate problems, they must be immediately reported to the mine manager for action. Surveys must be repeated if any significant alteration is made to the ventilation system.

Subsection 727(6)

Before any shift commences, atmospheric temperature and pressure measurements must be taken outside the mine.

Subsection 727(7)

All measurements required under this section must be recorded and kept for analysis and inspection by the employer and the Director. A copy of all survey results must be posted at the mine portal so that they are available to all mine workers.

Section 728 Cross cuts

Subsection 728(1)

Repealed

Subsection 728(2)

Requirements under this subsection are intended to ensure that an adequate quantity of air is delivered to working faces. As the distance from the last open cross cut increases, ventilation at the face becomes weaker. The requirement that stoppings be placed at all cross-cuts except the last one nearest the face maximizes air quantity at the last cross-cut.

Subsection 728(3)

Applications for exemptions to subsection 728(2) must be certified by a professional engineer, providing justification while demonstrating that the same degree of safety will be ensured as provided by subsection 728(2).

Section 729 Operating in split

The reason for having one machine in one split is to ensure that return air from one heading does not contaminate air in the other heading. However, the Director can issue an acceptance to allow two machines in one split if ventilation is properly designed.

Gas and Dust Control

Section 730 Gas inspections

Subsection 730(1)

All mine officials must carry approved gas detectors so that they can test for methane, carbon monoxide and oxygen at any time. This serves worker safety by ensuring that the impact of any change in circumstances on the level of these gases can be assessed promptly. This facilitates effective control of changing mine ventilation conditions. This subsection also ensures that working faces, roadways and all other parts of the mine to be used or worked on are examined for methane gas within four hours of any work taking place.

Subsection 730(2)

Gas measurements must be taken not only at working places but also in areas where gas is known to accumulate, such as at the edge of gobs and in roof cavities. The reliability of such measurements is critical because workers could unknowingly enter hazardous working places.

Subsection 730(3)

Readings must be correct, communicated to management, and properly recorded so that they can be effectively communicated to workers and used in investigations if an incident occurs. The mine official who inspects the area is fully accountable for the reliability of readings and the conclusions made.

Subsection 730(4)

So that underground workers are aware of mine conditions before entering the mine, a copy of the pre-shift inspection report must be posted at the portal or other designated location where it is accessible to workers.

Subsections 730(5)

The requirement for countersigning reports by the person in charge verifies the veracity of the report and signifies that the report has been completed.

Section 731 Flammable gas levels

Through the four subsections, safe working limits for atmospheres containing flammable gases are clearly described to ensure safe operation of the mine. The manager must take appropriate corrective actions once the related limits are exceeded. These actions are clearly described in this section and cannot be altered.

Subsection 731(1)

As gas levels rise there is a critical level at which workers must be evacuated from any area. This is set at a level where the concentration of flammable gas exceeds 40 percent of its lower explosive limit (LEL). This level is consistent with established practices in many jurisdictions around the world.

Subsection 731(2)

Automatic shutdown of electrical power is ensured on equipment where 25 percent of the LEL is exceeded. This level is consistent with established practices in many jurisdictions around the world.

Subsections 731(3) and 731(4)

These subsections prohibit blasting and the use of diesel equipment where gas concentrations exceed 20 percent of their LEL.

Subsection 731(5)

A properly designed gas bleeder system collects ventilation discharged from gobs, typically containing coal dust and methane gas. The level of gas in any bleeder roadway must be controlled to be less than 40 percent of the LEL. The underground coal mine manager must ensure that appropriate corrective actions are taken if the related limits are exceeded.

Section 732 Diesel vehicle roads

Subsection 732(1)

The operation of a diesel vehicle in an underground mine introduces hazards that can negatively impact worker safety. Diesel engines produce noxious fumes such as carbon monoxide, carbon dioxide, carbon particulates, oxides of nitrogen, etc. Diesel engines can also introduce an additional source of ignition if explosive gases are present. For these reasons all diesel equipment must be pre-approved for use underground.

To minimize the hazard introduced by diesel equipment, this subsection requires that all underground roadways over which diesel units travel are tested for air flow and flammable gas on a scheduled basis at locations specified by the mine manager or the Director.

Subsection 732(2)

Repealed.

Subsection 732(3)

Reduced air quantity can lead to insufficient dilution of noxious fumes or flammable gases, thus increasing worker exposure. The tests required under subsection (1) must therefore be done at least weekly and whenever an alteration is made in the air quantity flowing. The mine manager is responsible for making sure that workers meet these requirements.

Subsection 732(4)

If the level of flammable gas in the general body of air exceeds 15 percent (0.75 percent methane) of the LEL for methane gas (the LEL limit for methane is 5 percent), the employer must appoint a competent worker to take additional measurements. The objective here is to confirm the accuracy of earlier readings and to identify not only any trend in rising gas levels but also the source and distribution of flammable gas.

Once safe operating conditions or the consistency of measured flammable gas levels are confirmed, the competent worker must submit a written report to the mine manager. Depending on the results of the testing, the mine manager may order modifications to the ventilation system or reduced diesel equipment operations.

Subsection 732(5)

If the percentage of flammable gas continues to exceed 15 percent of the LEL a continuous methane monitoring system must be installed. The continuous monitoring system must then remain in operation for the periods specified in this subsection.

Subsection 732(6)

The gas measurements required under subsection (4) must continue until either they have fallen below 15 percent of the LEL or a continuous monitoring system is installed.

Section 733 Degassing procedures

Subsection 733(1)

Due to the critical nature of degassing activities, safe operating procedures must be developed by a qualified professional engineer. Section 8 of the *OHS Regulation* requires the procedures to be writing and available to workers.

Subsection 733(2)

No explanation required.

Section 734 Gas removal

Due to the hazardous nature of a gassy environment, a responsible, knowledgeable mine official must directly supervise any gas removal activity.

Section 735 Unused areas

Subsection 735(1)

Because some areas of an underground coal mine can remain inactive for short periods of time, there is the potential that dangerous gases can accumulate in them. The employer is required to ensure that such inactive areas are kept free of gas accumulations so that a dangerous situation does not develop. Where gas accumulation cannot be controlled, the area must be sealed off according to section 736.

Subsection 735(2)

Repealed.

Section 736 Sealed off areas

Subsections 736(1)

Accumulation of flammable gas in any part of a coal mine poses a significant risk to underground coal mine workers. For this reason workers must be protected from the hazards by fencing off such areas.

Subsection 736(2)

If accumulations of gas in a part of a mine cannot be adequately removed then the area must be sealed off, isolating the area completely (see section 716).

Section 737 Specifications

This section ensures that combustible gas detectors and other devices used for testing and measuring air quality, velocity and volume in a mine in Alberta have gone through performance testing by an approved agency and meet criteria for certification.

Section 738 Combustible gas detector

Subsection 738(1)

This section deals primarily with the provision, installation and performance of combustible gas monitors used on coal cutting machines. Maintenance of monitoring devices is extremely important, as is regular testing of the accuracy of their readings. Coal cutting machines require a reliable, proven device to monitor the concentration of methane near the face.

For more information



http://employment.alberta.ca/documents/WHS/WHS-PUB_h1001.pdf

Combustible Gas Meters — Function Testing

Subsection 738(2)

The cutting operation generates significant quantities of coal dust and methane, and often produces sparks. Although water spray is used to control these hazards right where the cutting operation takes place, the situation remains challenging and dangerous. Continuous monitoring of methane near the cutting head is extremely important to worker safety and confidence. The worker operating a coal cutting machine must keep the combustible gas detector operating at all times.

Subsection 738(3)

The cutting head of a coal cutting machine, such as a continuous miner, is the point at which the coal is mined and then extracted. It is the mining process that liberates methane gas that is normally contained within the coal seam. Because of the potential that the highest levels of methane gas will be present at this active mining location, this subsection requires that methane sensing devices be installed as close as reasonably practicable to the cutting head. Early detection of unusual gas levels at the cutting head will alert the operator to a potential problem, providing time for the operator to take action.

According to this subsection, the installed gas detector must be installed within three metres of the cutting head.

Subsection 738(4)

If the circumstances unique to the coal cutting machine or its application make installation of the methane sensing device within three metres impracticable, this section authorizes the Director to approve a sensor location point that is more than three metres from the cutting head. In order for the Director to make such a decision, the employer must provide proper documentation and justification.

Subsection 738(5)

Both visible and audible alarms must be provided to gain the operator's attention quickly. The percentage of the LEL is purposely kept low to provide an early warning for workers to withdraw to a safe location. For clarity, the LEL for a methane in air mixture is 5 percent methane. The values in this section are expressed as a percentage of the 5 percent limit. For example, 20 percent of the LEL translates to 1 percent methane content e.g. 20 percent of 5 percent.

Subsection 738(6)

Since the methane detector must be interconnected with the machine control system, a methane gas excursion will trip out the cutting head. Such an occurrence would be the first warning that methane levels are rising above the levels specified in this section. Once the cutting head trips due to a high methane level, the worker must immediately back the machine away from the face and turn off electrical power to minimize the potential for initiating an explosion.

Section 739 Portable detector

Portable combustible gas detectors are extremely sensitive devices and as such must be calibrated and operated to defined standards.

Subsection 739(1)

Due to the training and technical knowledge required of all users, a worker must not use such a device until he or she is authorized to do so by the underground coal mine manager. By not complying with this section, a non-authorized worker could inadvertently expose all mine workers to a major hazard.

Subsection 739(2)

To maintain appropriate control over the use of portable gas detectors, this section specifies that only the underground coal mine manager can authorize a worker to use the devices. The mine manager must first ensure that the authorized worker is “competent” according to the definition provided in Part 1.

Subsection 739(3)

This subsection requires a portable gas detector to be approved by an authorizing agency and meet criteria for certification for use in an underground coal mine.

Subsection 739(4)

Gas detectors can be misleading and pose a danger to workers if they are not regularly calibrated. This subsection requires calibration to the manufacturer’s specifications.

Section 740 Breakdown of detector

Subsection 740(1)

This subsection allows a coal cutting machine to continue to operate if its combustible gas detector fails to operate. This exception is available only for the shift during which the gas detector has failed and specifies that manual continuous monitoring must be performed during this period by a competent, authorized worker. At no time during manual monitoring can the flammable gas reading in the operator's cab exceed 15 percent of the LEL, equivalent to 0.75% methane. If so, the equipment must be shut down immediately and the area ventilation adjusted to remedy the problem.

Subsection 740(2)

A worker must ensure that a coal cutting machine is not operated on the shift following the shift on which a gas detector ceased to function. If discovered during the pre-shift inspection, the unit must not be operated until the detector is repaired or the requirements of subsection 740(1) are met.

Section 741 Roof bolting

Subsection 741(1)

Although roof bolting may not encounter as much flammable gas as coal cutting operations, the presence of flammable gas at the drilling location can be dangerous. As a result, monitoring for combustible gases such as methane by a competent person is equally important in this situation. Gas readings must be taken at roof level because some combustible mine gases, like methane, are lighter than air and hence rise, so they will be present at higher concentrations near the roof than elsewhere.

Subsection 741(2)

If methane levels are measured at 25 percent of the lower explosive limit (1.25 percent of methane), all roof bolting activity must cease until ventilation is improved and methane levels are consistently measured below 25 percent of the LEL.

Subsection 741(3)

Many of the new bolters have methane monitors mounted on them, often with a continuous monitoring capability.

Section 742 Airborne dust

Subsection 742(1)

This subsection requires water spraying to keep coal dust from becoming airborne. Although this helps keep the dust down significantly, a good portion of coal dust remains airborne. Water does not adhere well to coal dust. In winter, some mines draw ventilation air from the outside without heating it. Since the resulting air in the mine is at a temperature much like that of the outside, an alternative to water is recommended to control dust if freezing is a problem.

Subsection 742(2)

Because underground mobile equipment cannot readily accommodate a supply of water for dust suppression purposes, this section exempts equipment such as shuttle cars from that requirement.

Subsection 742(3)

Since the movement of rubber-tired vehicles can generate large quantities of airborne dust when travelling on dry material, this subsection requires that related roadways are treated with dust suppression chemicals or wetted with water to minimize the creation of airborne dust.

Subsection 742(4)

This requirement for monitoring respirable dust concentrations reinforces the requirements specified by Part 4. The respirable portion of coal dust is a primary cause of pneumoconiosis among coal miners.

Subsection 742(5)

The Director may decide to use this authority to require the installation of dust collectors on exhaust fans if the exhaust air has the potential to become a visibility, fire, explosion or health hazard to workers.

Section 743 Incombustible dust

When coal dust is airborne it is potentially explosive. A coal dust explosion is often initiated by a methane explosion whereby its pressure wave raises any coal dust into the air and its flame front then ignites the cloud of coal dust, with devastating effect. The most recent example in Canada was at the Westray Mine in Nova Scotia in 1992. The coal dust hazard is typically mitigated by using inerting agents, usually water

and/or incombustible dust consisting of finely ground limestone rock. The latter is usually referred to as stone dust or rock dust.

Subsection 743(1)

The mining area that falls within 10 metres of the active working face is generally considered to be constantly changing as mining excavation occurs. This section therefore does not apply to this area while coal cutting is in progress.

Subsection 743.1(1)

This subsection requires the employer to prevent accumulation of combustible dusts, typically coal dust. The Westray Inquiry into the coal dust explosion at the Westray Mine, Nova Scotia in 1992, highlighted, among other things, that an important first step in mitigating the hazard of combustible dust is to ensure that accumulations of coal dust do not build up anywhere. The exception to this is the immediate mining area (see subsection 743(1)). Particular attention must be paid to conveyor systems which are well known for creating accumulations of coal dust. If unattended, these accumulations can build up around conveyor rollers. Should a roller fail and jam, the moving belt could generate enough heat to ignite the accumulation and cause a fire.

Subsection 743.1(2)

The employer must prepare a formal stone-dusting plan (which is in effect a coal dust inerting program) for filing with the Director. This plan demonstrates how the employer will achieve the minimum incombustible content of 80 percent (see section 743(3)). The plan must include the approach, methods to be used, and testing procedure and frequency.

Subsection 743(2)

Incombustible dust is liberally applied in order to inert combustible dusts and minimize the potential for a coal dust explosion. All areas that are accessible to workers must be treated with the exception of the areas noted in subsection 743(1). Other methods or materials may be allowed in place of the specified incombustible dust but must first be approved by the Director.

Subsection 743(3)

The quantity of incombustible dust applied to coal dust has been defined after extensive research. To effectively inert coal dust, post-dusting samples must consist of at least 80 percent incombustible dust.

Subsection 743(4)

The requirement for a minimum of 80 percent by weight of incombustible dust to coal dust is waived if the area under consideration contains at least 30 percent moisture. Such a high moisture content alone suppresses coal dust and its potential for explosion.

Subsection 743(5)

The requirement for 80 percent incombustible material must be increased by one percentage for every 0.1 percent of flammable gas in the ventilation current.

Subsection 743(6)

Repealed.

Subsection 743(7)

The purpose of cleaning the roadway area is to remove coal dust or any other combustible matter so that stone dust or rock dust forms the base. The effectiveness of the stone dust is reduced when applied on top of thick layers of coal dust.

Section 744 Dust sampling

Sampling accumulated coal dust is the only means available to accurately assess the potential for coal dust explosions. It is important to prevent layering of coal dust on top of rock dust because explosions tend to lift only the top few millimetres of the coal dust/rock dust layer. During an explosion, the underlying rock dust may not be capable of quenching an explosion flame front. The sampling procedure used must be acceptable to the Director. All sampling and subsequent test results must be recorded at the mine site.

Explosion Control

Section 745 Explosion barriers

Subsection 745(1)

Employers must develop an explosion prevention plan for every coal mine. The plan must be certified by a professional engineer and be acceptable to the Director. An important means for combating coal dust explosions involves explosion barriers. These are typically passive in nature. The pressure wave of a coal dust explosion creates a cloud of stone dust or water droplets which suppresses the flame front following behind the pressure wave. Explosion barriers can also be of an active type whereby pressure sensors detect an oncoming pressure wave and trigger the barrier to suppress the explosion's subsequent flame front.

Explosion barriers, if used, should be designed to stop explosions from travelling any further. Suitable explosion arresting materials and designs reduce the violent energy of explosions to almost zero as the explosion travels through the barrier. Barriers often use rock dust or water as the quenching material. The number of units comprising the barrier system and the speed at which they react to a passing shock wave are important variables to be considered in the design, as are the forces and energy associated with a potential explosion.

Any explosion barrier must be certified by a professional engineer. Explosion barriers are typically used at entrances to every production section, development district and ventilation split. Such locations are designed to confine explosions to the area in which they are most likely to occur, thus minimizing risk to other areas of the mine.

Subsection 745(2)

It is important in emergency response planning to know where explosion barriers are located. For this reason the location of all explosion barriers must be shown on the mine ventilation and emergency response plans.

Section 746 Welding, cutting and soldering

Subsection 746(1)

This subsection prohibits any hot work that could serve as a potential source of a fire or an explosion. Exceptions to this requirement may be approved by the Director according to subsection 746(2).

Subsection 746(2)

From time to time in underground coal mining exceptional circumstances may require the use of hot work activities. The employer may develop safe working procedures in advance of such cases. Once approved by the Director these can be implemented when necessary but each occasion must be reported to the Director with a justification of why it was necessary. These safe working procedures must comply with section 169 of the OHS Code and must also be directed towards mitigating hazards specific to underground coal mines.

The procedures must recognize that hot work such as cutting and welding is only allowed in situations where no other alternative is available. Such procedures typically include the following requirements:

- (a) a competent person taking flammable gas measurements before during and after all hot work activities;
 - (b) before hot work begins;
 - (c) clearing the work area and area where sparks could land of all combustible materials and either apply stone dust and/or wet down the whole area; and
 - (d) maintain a fire watch for a long period e.g. 12 to 24 hours after hot work ceases.
- Section 8 of the *OHS Regulation* requires that the procedures be in writing and available to workers.

Subsection 746(3)

Repealed.

Section 747 Pillars

Subsection 747(1)

Underground mining activity in one property can inadvertently affect the safety of workers on an adjoining property. Consequently, both property owners are required to communicate for purposes of maintaining a safety pillar between the two adjoining properties, commonly known as a barrier pillar. The required pillar separation must be sufficient to separate activities and prevent mine ventilation air, gas and water from one mine entering the other. The required pillar separation must be maintained on all working levels for all coal seams that are to be mined. To be equitable to both property owners, an appropriate portion of the required pillar must be left on each side of the common boundary.

Subsection 747(2)

Since portions of the remaining pillars will consist of material on each property, the respective owners are held responsible for ensuring that the composite pillar size is sufficient to ensure the safety of workers in each mine.

Subsection 747(3)

The technical factors that can contribute to pillar capability and stability are such that a professional engineer must determine the safe width of the pillar.

Subsection 747(4)

To avoid the potential for inadvertent over-excavation into the intended pillar, both property owners are held responsible for ensuring that no mining activities are conducted within 100 metres (330 feet) of the property boundary line between the two properties unless a professional engineer has authorized a smaller distance under subsection (3).

Subsection 747(5)

After the pillar design has been determined by a professional engineer and the physical barrier pillar limits have been reached, the employer is responsible for ensuring that no mining is performed within the barrier pillar itself. Again, for worker safety reasons the barrier pillar must remain intact.

Subsection 747(6)

Since minor surveying differences can negatively impact the intended width of the barrier pillar, this subsection allows the designated surveyor from one property to enter the mine on the adjoining property for purposes of confirming the final pillar width. Ideally both surveyors will conduct these survey checks and subsequently cross-check results to minimize the potential for error.

Subsection 747(7)

The location of all final workings immediately adjacent to the defined barrier pillar must be surveyed within 60 days of completion. The resultant plans for each property must be immediately filed with the Director.

Section 748 Drill holes

Because of the hazards associated with unplanned hydrocarbon release into a mining area, the employer must ensure that mining does not occur within 100 metres of an existing oil or gas well drill hole or a hole that is being drilled.

Section 749 Water or gas

Subsection 749(1)

Accumulations of water and/or gas pose a major hazard to underground coal mine workers. These can occur either within the rock mass itself or in old, sometimes uncharted, abandoned workings, or as bodies of surface water and/or unconsolidated materials such as peat, lying in deep ravines, gullies or cracks in the bedrock surface. To minimize the potential for an inrush of water/gas into the workings, an employer must ensure that no working face approaches within 50 metres (150 feet) of the surface or within either 50 meters vertically or 100 meters (330 feet) in plan view of any area of potential or known water or gas accumulation.

These dimensions relate to the horizontal and vertical separation distances between active workings and possible areas of accumulation. The mandatory separation distances must be maintained until any inactive workings have been examined and the absence of water or gas accumulation confirmed. Exemptions to these restrictions must be approved by the Director.

Subsection 749(2)

Such an approval will only be provided after a written application including a scheme certificate by a professional engineer. A certificate by a professional engineer provides a level of assurance that all relevant safety factors have been considered.

Subsection 749(3)

The employer must ensure that until the Director's formal written approval has been received, the specified limits are not encroached upon.

Section 749.1 Shaft access and hoisting equipment

This section recognizes that as underground coal mines exploit deeper and deeper reserves a need often arises for vertical, sub-vertical or inclined shafts. In such cases, it is important that employers present comprehensive designs, plans and procedures certified by a professional engineer for the Director's approval. These designs, plans and procedures must include the number, type and purpose of shafts, their design, construction (shaft sinking), equipping and operation. In turn, the latter must include all shaft conveyances and mine hoisting plant.

Superseded