



Closure and Re-entry Into Abandoned and Inactive Mine Workings

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Workplace Safety North (WSN) is the health and safety association serving underground and surface mines, tunneling, smelters, refineries and related sectors in Ontario. We provide auditing and consulting services, training and information to help our member companies meet our shared vision of an industry where every worker comes home safe and healthy, every day.

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INTRODUCTION

Incidents in abandoned and inactive workings in Ontario mines have resulted in injury and death. Hazards associated with such abandoned and unused workings can be complex and extensive. Serious incidents involving abandoned and unused workings in Ontario mines came to the attention of the Mines Accident Prevention Association Ontario (MAPAO) in 1990. A sub-committee of MAPAO's Standing Committee on Safety and Loss Control was formed to address this inherent hazard with the following mandate:

- Review existing guidelines for closures of abandoned and unused workings.
- Identify hazards associated with abandoned and unused workings.
- Establish a guide and site responsibility for closing and re-entering abandoned and inactive workings.

A report entitled “*Guide for Abandoned and Unused Underground Workings*” was prepared and subsequently updated in 1994 and 2001. The present updated document has been prepared with input from members of the following Workplace Safety North (WSN) Technical Advisory Committees (TAC):

- Ground Control
- Safety and Loss Control
- Workplace Environment

WSN gratefully acknowledges the contributions of all TAC members.

The purpose of this document is not to dictate or restrict standards but only to suggest ways and means to establish a documented procedure to protect workers from the hazards associated with the closing and re-entry of abandoned and inactive workings. In this document, the use of the words “must” and “shall” mean mandatory.

This document may also apply to care and maintenance or secondary egress.

The Internal Responsibility System

The Internal Responsibility System (IRS) is a health and safety philosophy. It is based on the principle that every individual in the workplace is responsible for health and safety. It includes the CEO, executives, management and workers. Giving workplace parties responsibilities and authority is the driving force of an effective health and safety management system.

The Occupational Health and Safety Act of Ontario (OHSA) is based on the concept of IRS. It outlines the legal rights, duties, roles and responsibilities for workplace parties (workers, supervisors and the employer).

The success of the IRS depends on the effective partnership between the workplace parties to create a safe and healthy workplace. “Workplace parties” is a term that refers to the persons who are considered an owner, employer, supervisor, worker, constructors, licensees, directors, officers and suppliers. Basically it refers to all persons who enter a workplace for whatever reason.

Duties of workplace parties are defined in the OSHA, pertinent regulations and company policies and procedures.

1 - SUGGESTED POLICY

Policy

All workings that are declared abandoned or are closed for one or any combination of the outlined hazards as identified in the objective must comply with the standards as outlined in this suggested policy.

Objective

The objective of the policy and procedures presented is to prevent inadvertent access into abandoned or inactive workings which may contain one or any combination of the following hazards:

- Loose ground, ground movement, unusual seismic activity, ground support condition (corrosion, failed bolts, bagging of screen, etc.).
- Oxygen deficiency.
- Concentration of gasses; methane, radon, natural gas, etc.
- Hazardous biological agents (e.g. moulds, fungi, etc.).
- Combustion resulting from oxidation of ore or tailings.
- Explosives - old/deteriorated powder or fuse.
- Misfires, bootlegs, etc.
- Deterioration of accesses and furnishing; bulkheads, barricades, ladders, landings, travelways, timber work, metal fatigue, eye bolts, supply pipelines (water/air), electrical equipment / cables etc.
- Open holes, breakthroughs, proximity to other openings, etc.
- Water build-up.
- Water contamination.
- Inaccurate plans (old workings not shown, access drift or raise removed through stope blasting, ground failure or backfilling, sloughing of ore/waste passes, diamond drill hole locations, etc.).

Scope

All mine personnel, rescue personnel and visitors.

Responsibilities

- **Management** - Develop appropriate policies and procedures and to ensure that all relevant personnel understand and comply with company policies and procedures.

- **Front-line supervisors** - Ensure that any closure of a stope, manway, drift, raise or abandoned / unventilated workplace under their jurisdiction meets the company's policy and procedures, and that workers are aware of any closed/abandoned workings in their area and why they are closed.
- **Workers** - Once informed, workers must comply with the standards and procedures as outlined and correct/guard/report any hazards they encounter.

2 - LEGISLATED REQUIREMENTS

As of this writing, the following sections of Ontario Regulation 854 (Mines and Mining Plants) have been identified as pertaining to the closure and re-entry of mine workings:

Regulation 854

Section 18 Protecting mine openings.

Section 55 Working below

Section 62.1 Non-routine hazardous task

Section 66 Workplace examination

Section 68 Isolation of hazardous areas

Section 74 Guarding openings

Section 233 Voice communications to underground

Section 255 Non-ventilated areas

Sections 19 & 281 Mine rescue and first aid

Sections 287 to 293 Radon progeny

Other regulations

Regulation 460 Workplace Hazardous Materials Information System

Regulation 490 Designated Substances

Regulation 632 Confined Spaces

Regulation 833 Control of Exposure to Biological or Chemical Agents

Guidelines for Canadian Recreational Water Quality, 1992

American Conference of Governmental Industrial Hygienists, 2015 TLVs and BEIs

Ministry of Labour Guideline, Confined Spaces, 2011

3 - GLOSSARY OF TERMS

<i>Abandoned workings / areas:</i>	Workings declared to have no future use and all work has stopped. They must be closed by a permanent closure designed to prevent access.
<i>Authorized/qualified personnel:</i>	Personnel who have been formally given permission and training in company policies and procedures to enter a restricted area.
<i>Buddy system:</i>	Working with a partner.
<i>Closure, permanent:</i>	A permanent closure must be used for abandoned areas and can be a complete seal (no ventilation, no services) or a type to prevent inadvertent access only.
<i>Closure, temporary:</i>	A closure/ restrictive device for inactive areas. Suspension of activities has occurred.
<i>Competent person</i>	“competent person” means a person who, (a) Is qualified because of knowledge, training and experience to organize the work and its performance, (b) Is familiar with this Act and the regulations that apply to the work, and (c) Has knowledge of any potential or actual danger to health or safety in the workplace:
<i>Inactive workings / areas:</i>	Areas where no work is being done, but fully serviced and accessible.
<i>Manway, closed:</i>	Manway that has been closed for reasons such as hazardous conditions and/or men are working in or around the manway.
<i>Manway, permanently capped:</i>	Manway that has been permanently capped and never will be used again for any purpose. Permanently capped manways can also be backfilled.
<i>Manway, temporarily capped:</i>	Manway that has been capped for mining cycle reasons. Some temporarily capped manways may have a muckpile on top of them, but will be opened at a later date for mining and/or for the establishment of a travelway or use as an airway.

Restricted workings / areas:

An area that requires controlled access by authorized personnel. This may be due to the potential for hazards or lack of services.

Supervisor: as per OHS

A person who has charge of a workplace or authority over a worker.

4 - SIGNAGE AND SYMBOLS

Suggested mine ventilation symbols are shown in Fig. 1.

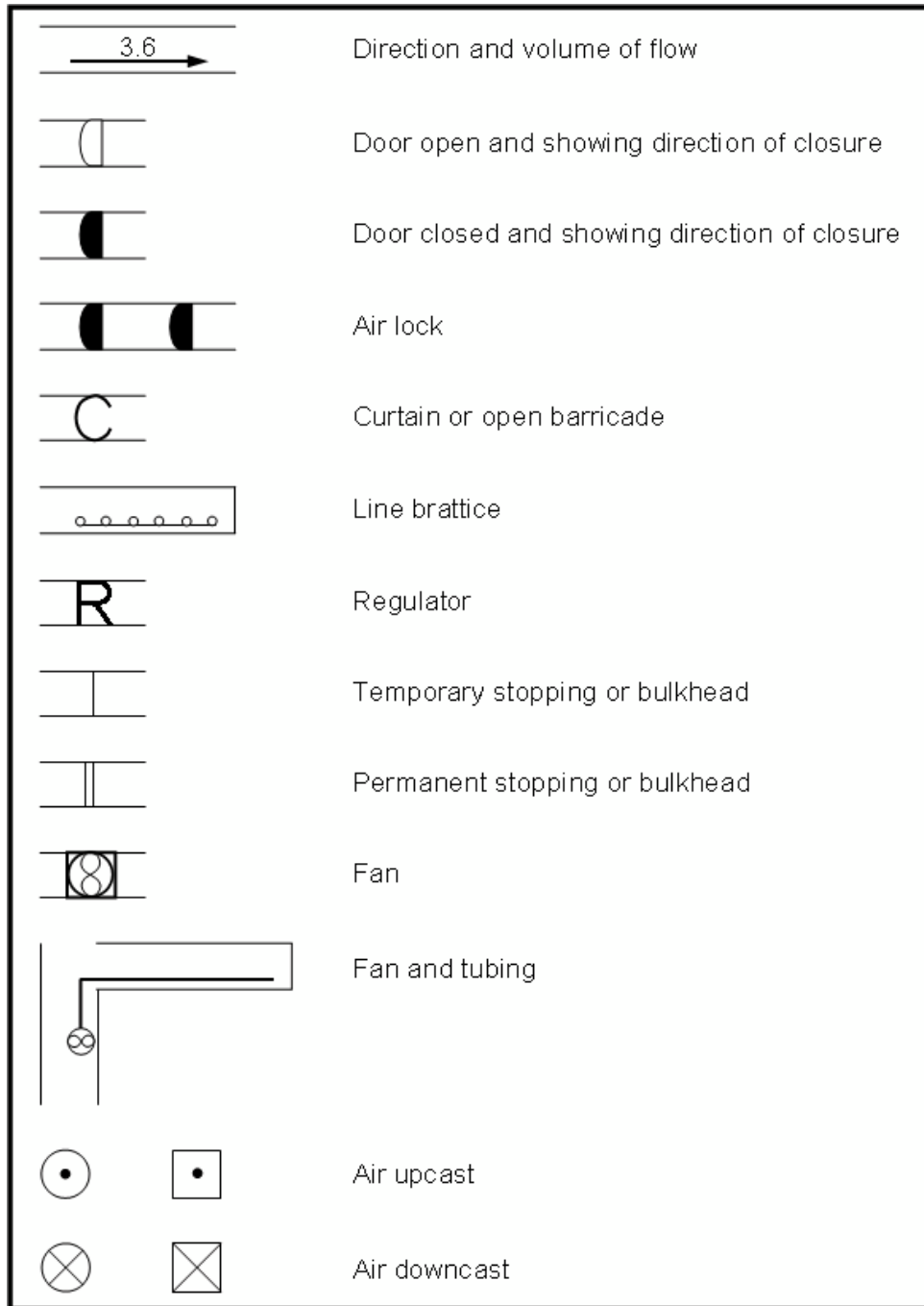


Figure 1. Suggested mine ventilation symbols

As required under Section 68 of Regulation 854, indicate on signs the reason for closure or restricting the area e.g. closed due to specified hazard such as toxic environment, open hole, ground conditions, etc. Standard colors should be used to depict specific warnings, i.e. red for danger, yellow for cautionary and green for information. Refer to Appendix V for more information (WSPS guidelines for safety signs and colour at work).

5 - SUGGESTED STEPS FOR CLOSURE AND RE-ENTRY

5.1 ABANDONED WORKINGS

Abandoned workings are declared to have no future use, and all work has stopped.

The following policy will be in place and enforced:

- Abandoned workings shall be closed by a permanent structure with signage attached indicating reason for closure.
- For areas not requiring access, but where ventilation must pass through, access should be prevented by chain link fence or other suitable material permitting airflow, secured to the back, floor and walls or equal design; not permitting passage by people or equipment (as per company standard).
- For permanent closures, all air and water pipelines and items deemed reusable should be removed from the work area. All electrical services such as electrical wires, transformers, circuit breakers, etc., should also be removed and ensure Zero Energy.
- The closure may be more substantially constructed using concrete, timber, cable lacing, etc.
- The appropriate signage should be attached to the closure. Reasons for closure and date closed should be indicated on the signage.
- It will be the responsibility of senior management or designate to ensure all dangerous areas are closed according to site policy.
- The permission for opening of any such closure will be given in writing by senior management or designate. Notification should be given to the Joint Health and Safety Committee (JHSC). The supervisor and JHSC worker member should be at the site of the closure to ensure all precautions are being followed when opening.
- Engineering plans must indicate location of the closure for abandoned areas of the mine.
- All abandoned areas shall be logged to identify location, reason for closure and type of structure used to close area. Any opening of a closed area shall also be logged.

All closures to abandoned areas shall be inspected on an annual basis as to adequacy of the closure. A record of the inspection shall be logged.

5.2 INACTIVE WORKINGS

Inactive workings are areas where no work is being done but fully serviced and accessible.

Inactive workings shall be closed by temporary closures.

5.2.1 Suggested steps for closure and re-entry of inactive workings

The length of time the area is scheduled to be inactive and the hazards involved, will determine the scope of the closure and re-entry requirements. All closures should be logged with date, and the reasons and description for closure indicated.

5.2.2 Responsibility for closure

1. Authorization from senior management or designate, in accordance with company policy and procedures is required to declare an area inactive.
2. Supervisors shall notify work crews of reason for closure.
3. The work crews are responsible for following the prescribed procedure when closing the area.
4. Supervisors are responsible for the inspection of the closure to ensure that it meets company standards and have complied with the requirements of Ontario Regulations 833 and 854.
5. Supervisors shall ensure that any subsequent re-entry and closure is logged.
6. An annual inspection of the closure shall be the responsibility of the supervisor of the closed area.

5.2.3 Steps for closure (a suggested checklist for closure procedure is shown in Appendix II):

1. Check the area for hazards, which could include:
 - a. Check scale and assess ground support conditions as necessary. A formal procedure should be in place for the assessment of ground and support conditions prior to closure. A generic procedure is shown in Appendix I. The objective of the procedure is to determine the short term (immediate) and long term stability concerns of the area prior to closure. The process generally includes evaluating ground support, rock conditions and risk. Additional ground support may have to be installed prior to closure.

- b. Wash faces, check for misfires and mark bootlegs and lifters. Mark inspection date on the wall of heading.
 - c. Bleed all air and water lines, and disconnect at point of closure (unless services required). Disconnect electrical services (i.e. Zero Energy).
2. Safely remove all material, equipment, explosives, etc., as required.
3. All accesses to an inactive area must have a closure built. Such openings may be screened off, or bulkheaded. An engineering standard should describe the construction and standard operating procedure for building closures. A rope and sign is not considered adequate. Screen fencing must block the opening and be secured to the rock on either side by a minimum of 2 rockbolts or other suitable attachments. Signs indicating that the area is CLOSED, reason for closure (e.g. unsupported area, unventilated area, danger – keep out) and date of closure must be posted.
4. Supervision shall record areas that have been closed and this information shall be forwarded to management and the engineering department. The best way to do this is to indicate the location and type of newly constructed fence on a level plan.
5. Engineering plans should indicate closure for inactive areas of the mine.
6. A document outlining the closure date, current condition of the workings, including ventilation, location and state of services, water flow, known and potential hazards, and pertinent engineering plans should be prepared and kept on record.

5.2.4 Responsibility for re-entry

1. Senior management or designate shall authorize re-entry. For the “Off Shifts”, the senior supervisor or supervisor-on-call can authorize re-entry.
2. Permission for re-entry must be received from the front line supervisor of the workplace which is being re-entered. The worker’s supervisor shall issue a permit for entry to the area. Consideration should be given to having a rescue team on standby or readily available.

5.2.5 Steps for re-entry (a suggested checklist for re-entry procedure is shown in Appendix III)

1. The engineering department, mine supervision, the safety department and the JHSC should be notified of the re-entry to an inactive/closed area.
2. A Re-Entry Permit (a sample is shown in Appendix IV) should be obtained from senior management or designate which states the reason(s) for re-entry and hazards and potential hazards that may be encountered. For the “Off Shifts”, the senior supervisor or competent

supervisor-on-call shall issue the permit. The person who issued the permit shall send a copy of the permit to the engineering department. It is important to limit the number and nature of entries into inactive areas.

3. Re-entry personnel should use a “Re-entry Permit”, which can be a two-part form - one part is placed on the tag board with the person’s mine tag prior to going underground, the second part is affixed to the barricade of the inactive working that is being entered. Upon leaving after work has been performed to make the area safe, both parts of the “Re-entry Permit” shall be returned to senior management or designate for filing in the mine office after the barricade has been replaced.
4. Re-entry must be conducted by competent persons using the buddy system. The procedure, hazards and controls involved for the re-entry should be discussed with the crews doing the work. In some circumstances, a mine rescue team may be used. The crew must:
 - a. As a minimum, carry a gas testing device which indicates the oxygen level, presence of carbon monoxide and nitrogen dioxide as well as the LEL (percentage of the lower explosive limit of any gas).
 - b. Review any available ground monitoring data and microseismic system records.
 - b. Ensure a communication plan including a rescue plan is developed and reviewed with the workers prior to re-entry.
 - c. Consideration should be given to assigning an attendant who will be in constant communication with the re-entry personnel.
 - d. Check for adequate ventilation flow to the area and the presence of toxic gases after barricades have been removed.
 - e. Check scale and perform a preliminary assessment of ground and support conditions during the re- entry. If ground and support conditions are poor, such as ground failure, excessive bagging of screens, and existence of unstable blocks, wedges or stress-induced damage, re-entry should be suspended and the area barricaded until a procedure for rehab has been prepared and executed. A generic program is shown in Appendix I.
5. Upon re-entry the personnel must take the most direct route into and out of the area to be visited or worked in. At no time shall detours, alternate routes or manways behind barricades/fences be used (e.g. supervisors using manway to visit crews on another level).
6. The permit must be removed when exiting the area, and closure re-established as required. Observations and recommendations must be recorded and communicated to the appropriate personnel, including senior management or designate.

7. Engineering plans shall be changed and dated once permanent re-entry is completed.

5.3 RESTRICTED WORKINGS

Restricted workings / areas: Areas that require controlled access by authorized personnel. This may be due to the potential for hazards or lack of services.

5.3.1 Responsibility for closure

1. Authorization from senior management or designate is required to declare an area restricted.
2. The working crews are responsible for closing the area by following the prescribed procedure. The crew should report any hazards to their supervisor.
3. Supervisors are responsible for the review of procedures and hazards with crew. Supervisors should inspect the closure to ensure that it meets company standards and have complied with the requirements of Ontario Regulation 854, Section 255.

5.3.2 Steps for closure (a suggested checklist for closure procedure is shown in Appendix II):

1. Check for air quality - correct hazards as required and practical.
2. Check for open holes - correct hazards as required and practical.
3. Wash faces, check for misfires and mark bootlegs and lifters. Mark inspection date on the wall of heading.
4. Check scale and assess ground support conditions as necessary. A formal procedure should be in place for the assessment of ground and support conditions prior to closure (a generic procedure is shown in Appendix I). The objective of the procedure is to determine the short term (immediate) and long term stability concerns of the area prior to closure. The process generally includes evaluating support, rock conditions and risk. Additional ground support may have to be installed prior to closure.
5. Remove all unnecessary items from the area.
6. All entrances to a restricted area must be blocked by a closure similar to those used in an inactive area. A single closure should be designated as the sole access route and should be constructed to allow access through the closure.
7. Engineering plans should indicate the restricted areas.

8. Maintain log books of restricted areas.

5.3.3 Responsibility for re-entry

1. Senior management or designate shall authorize re-entry. For the “Off Shifts”, the senior supervisor or supervisor-on-call can authorize re-entry.
2. Permission for re-entry must be received from the front line supervisor of the workplace which is being re-entered. The worker’s supervisor shall issue a permit for entry to the area. Consideration should be given to having a rescue team on standby or readily available.

5.3.4 Steps for re-entry (a suggested checklist for re-entry procedure is shown in Appendix III)

1. A Re-Entry Permit (see sample in Appendix IV) should be obtained from senior management or designate which states the reason(s) for re-entry and hazards that may be encountered. For the “Off Shifts”, the senior supervisor or supervisor-on-call shall issue the permit. The person who issued the permit shall send a copy of the permit to the engineering department. For “Off- Shifts” it is important to:
 - a. Limit the number and nature of entries into restricted areas. This limited re-entry is to allow the installation of a fence or barricade no more than 5 m (15 feet) into the heading or to allow a crew into a recently rehabbed area.
 - b. Prevent workers from entering an area that has been unvisited for an extended period of time without a review by senior management.
2. The supervisor must review with the workers the reasons the area was barricaded, the procedures for work to be done and the potential hazards in the area.
3. Proper equipment must be taken or worn when entering the area, i.e. respirators, electronic oxygen level and gas detector, etc. A checklist should also be used as indicated on the back of the entry permit.
4. A buddy system of competent persons must be used. As a minimum, the re-entry team must comply with the requirements of Section 255 in Ontario Regulation 854. Once work in the area is completed, the closure should be re-sealed and the re-entry permit filed in the mine office (unless permanently re-opened).

6 - PROCEDURES FOR MANWAY CLOSURE AND OPENING

Definitions

The closure of a manway has been categorized as follows:

- **Permanently capped manway:** Has been permanently capped and never will be used again for any purpose. Permanently capped manways can also be backfilled.
- **Temporarily capped manway:** Has been capped for mining cycle reasons. Some temporarily capped manways may have a muckpile on top of them, but will be opened at a later date for mining and/or for the establishment of a travelway.
- **Closed manway:** Has been closed for reasons such as hazardous conditions and/or men are working in or around the manway.

6.1 PERMANENTLY CAPPED MANWAYS

6.1.1 Steps for permanent closure of manways (a suggested checklist for closure procedure is shown in Appendix II)

1. Two workers are required to close a manway.
2. Workers remove all pipe and items deemed reusable from the manways, as necessary.
3. One worker must remain at the top of the manway to guard entry, while the worker proceeds to the bottom to ensure that no personnel are working in the manway. The worker at the bottom then communicates to the other worker that the manway is clear, and removes the bottom ladder.
4. Workers secure “CLOSED” and “DANGER – KEEP OUT, UNVENTILATED AREA” signs at the top and bottom of the manway. The signage must state the date of closure and why manway is closed (refer to Appendix 5 for samples).
5. Workers secure screen across the opening at the bottom and fasten the screen securely (preferably to rock if possible), using rockbolts or other suitable attachments.
6. Workers cover or cap the top of the manway.
7. The permanent closure of the manway must be recorded in a logbook system and on engineering plans.

6.2 TEMPORARILY CAPPED MANWAYS

6.2.1 Steps for closure of temporarily capped manways (a suggested checklist for closure procedure is shown in Appendix II)

1. Two workers are required to close a manway.
2. Check the raise and manways for hazards.
 - a. Scale and check ground support
 - b. Depending on the condition of the raise and manway, and how long the manway will be placed under temporary closure, a program should be in place for the assessment of ground and support conditions prior to closure. (a generic program is shown in Appendix I).
3. Remove the bottom ladder. If removing the bottom ladder is not practical then the bottom ladder must be completely planked off to a height of not less than 2.5 m (8.2 ft.), making the rungs and ladder inaccessible. Planking over the ladder will only be acceptable for “Temporarily capped manways”.
4. Secure a “CLOSED” sign at the bottom of the manway. The signage must state the date of closure and why manway is closed.
5. Place a screen across the opening at the bottom and fasten the screen securely (preferably to rock when possible). If the manway is located at the end of a dead end drift, then the drift may be screened off.
6. Cover the top of the manway to ensure that the cover will not break during the blasting cycle.

6.2.2 Steps for opening of temporarily capped manways (a suggested checklist for re-entry procedure is shown in Appendix III)

Do not climb up a capped manway. Re-open from the top.

1. A Re-Entry Permit (sample shown in Appendix IV) should be obtained from senior management or designate which states the reason(s) for re-entry and hazards that may be encountered. For the “Off Shifts”, the senior supervisor or supervisor-on-call shall issue the permit. The person who issued the permit shall send a copy of the permit to the engineering department.
2. Re-entry must be conducted by competent persons using the buddy system. The procedure and hazards involved for the re-entry should be discussed with the crews doing the work.

3. Review closure permit. Check area for hazards and record.
4. Remove screen at the bottom of the manway first followed by the top cover. The bottom of the manway must be guarded to ensure that no one gets struck by a falling object when removing the top cover or manway cleaning.
5. Remove the cover/cap from the manway and check that ventilation is adequate.
6. Proper equipment must be taken or worn when entering the area, i.e. respirators, electronic oxygen level and gas detector, etc. A checklist should also be used as indicated on the back of the entry permit.
7. Clean down the manway and check all ladders and landings to ensure that they are in safe condition. Replace any damaged manway components as required. Scale loose ground and check ground support.
8. Re-install the bottom ladder and replace the “CLOSED” sign with an “OPEN” sign.
9. Replace the “CLOSED” sign at the top of the manway with an “OPEN” sign.

6.3 CLOSED MANWAYS

6.3.1 Steps for manway closure (a suggested checklist for closure procedure is shown in Appendix II)

1. Remove all items that are deemed reusable from the manway except for the tools and equipment required for any work in or around the manway.
2. Secure a screen over the top of the manway and place a “CLOSED” sign. The signage must state the date of closure and why manway is closed.
3. For permanently and temporarily closed manways, remove the bottom ladder and place a “CLOSED” sign. Place a screen across the opening at the bottom of the manway and fasten the screen securely (preferably to rock if possible).
4. Keep a record of any material left in area.

6.3.2 Steps for opening of closed manways (a suggested checklist for re-entry procedure is shown in Appendix III)

1. Re-entry must be conducted by competent persons using the buddy system (i.e. not working alone). The procedure and hazards involved for the re-entry should be discussed with the crews doing the work. Review closure permit. Check for hazards and ventilation.
2. Proper equipment must be taken or worn when entering the area, i.e. respirators, electronic oxygen level and gas detector, etc. A checklist should also be used as indicated on the back of the entry permit.
3. Remove the screen barricade at the bottom. If cleaning of the manway is required, guard the area at the bottom of the manway to ensure that no one gets struck by a falling object.
4. Remove the cover/cap from the manway and check that ventilation is adequate.
5. Clean down the manway from the top if required and check all ladders and landings to ensure they are in good condition. Replace any damaged manway components.
6. Re-install the bottom ladder.
7. Replace the “CLOSED” signs at the top and bottom of the manway with “OPEN” signs.

APPENDIX I

SAMPLE GROUND CONTROL INSPECTION PROCEDURE

The following generic inspection methodology is a resource document that may be used in the preparation of mine-specific procedures for closure and re-entry into abandoned and inactive mine workings. It is based on a document provided by a member firm. A checklist/matrix is used to evaluate the ground support, rock conditions, and the risk/ exposure.

The objectives of the inspection are defined as follows:

- **Immediate stability concerns** - Identify unsafe areas requiring immediate rehab
- **Long-term stability** - Estimate stability of all openings with respect to time and classify for future rehab and/ or monitoring
- **Assess quantity of rehab** - Compile results and quantify for operations, for planning purposes

Primary Inspection

The primary inspection consists of a physical inspection (walking tour) of headings, a risk assessment of openings, and finally a rehab plan.

Risk Categories

The risk assessment is based primarily on worker exposure. Four categories of risk are defined; they are in increasing order of risk:

1. **Seldom accessed areas** - Areas that are infrequently traveled, or restricted, and then only by trained personnel, i.e., those that are aware of the conditions.
2. **Low traffic areas** - Areas visited less frequently, but where worker exposure may still be an issue.
3. **High traffic areas** - Areas with lots of traffic but have lower personnel risk because of lower exposure time and workers often have equipment protection (truck cabs, etc.). This will be the majority of the ramps.
4. **Workplaces** - Areas such as shops, lunchrooms and stopes have high worker exposure times, and therefore pose higher risk.

Inspection Matrices

The inspection is based on the premise that the initial support design provided an adequate factor of safety (FS), and the FS has diminished over time. The cause of this reduction may be based on any number of conditions. Changing conditions due to nearby mining (stress and ground movement), support corrosion, and support damage, are the most likely reasons for this reduction in the FS. The actual FS of the opening is highly dependent on rock conditions. The ground support may show signs of corrosion, but rock conditions that have not deteriorated over time imply that the opening is still quite stable. A cumulative score is therefore used to provide a comprehensive assessment of the excavation. Upon completion of the inspection, ground support scores will be added to rock condition scores and risk categories. The result will help rank and prioritize rehab.

To simplify and provide consistency to the inspection process, matrices were developed. Since the inspection process is subjective, the ground control personnel should be aware of the general criteria to be used in evaluating conditions. The ground support inspection matrix is summarized in Table 1. Inspections should be conducted by competent personnel.

Table 1. Ground support inspection matrix.

Code	Inspection Item	1	2	3	4
S	Screen - damaged, bagged to capacity, corroded	< 10% affected	10-20% affected	20-40% affected	> 40% affected
B	Bolts/ Rebar - failed, loaded, corroded	< 10% affected	10-20% affected	20-40% affected	> 40% affected
SC	Shotcrete	No cracking	Minor cracking	Open cracking > 5mm	Large movements, and flaking

The details for interpretation are as follows:

Screen - Should be evaluated based on its condition and the estimated amount of bagging observed. The capacity of either 6 or 7 gage screen is approximately 2 tonnes or 2 ft. of loose between bolts.

Corrosion should be considered gradual, from none to total, from a time standpoint. The effect of corrosion should be a subjective estimate as “the screen will last 0, 6, 18, or >18 months”.

Damaged or strained screen should also be considered. Assess the number of broken or strained wires in an area and estimate their useful life.

Subjectively assess the reduction in the FS of the screen. If numerous screens show bagging and strain, there may be an estimated reduction in FS of 40% - in this case use an S4 Classification.

Bolts - Should be considered similar to screen with respect to corrosion. Corrosion should be considered gradual, from none to total, based on time standpoint. The corrosion should be subjectively estimated as “the bolts will also last 0, 6, 18, or >18 months”.

Broken, bent, loaded bolts should also be evaluated.

Subjectively assess the reduction in the FS of the support. If few bolts have been damaged or show only light corrosion, there may be an estimated reduction in FS of 10-20% - use a B2 Classification.

Shotcrete - Refer to Table 1 for guidelines.

Rock conditions should also be assessed. The rock conditions inspection matrix is summarized in Table 2.

Table 2. Rock conditions inspection matrix

Code	Inspection Item	1	2	3	4
R	Rock Conditions	Competent - good to fair ground	Competent - fair to poor ground	Stress fracturing, some ground movements	Large movements, burst damage

The details for interpretation are as follows:

Rock - Check scale and visually assess the current general rock conditions based on a rock mass classification system to determine the estimated baseline. This parameter is for information only and will typically be indicated on the drawings where special circumstances require it.

Inspection Procedure and Data Interpretation

The inspection will take place in 3 phases.

1. **Prior to inspection** - Maps should be prepared designating risk 1-4 (Workplace, High traffic, etc.) During the inspection personnel will mark up these maps with conditions observed.
2. **Inspection** - Will proceed using the matrix approach (shown above) including interpretation details. Check scaling will be conducted during the inspection. The maps should be marked up accordingly, i.e., by the most significant conditions. For example if a large portion of the screen is bagged to capacity, indicate conditions S4 and R3. There is no need to indicate that the bolts may be in condition B1. Note at any time during the inspection, areas judged as “imminent failure” will be barricaded and operations notified.

3. **Following inspection** - rehab categories/priorities will be assigned immediately or shortly after the inspection. These will be based both on risk rating and the inspection matrices. Categories will be assigned based on score.
4. Scores may vary from 12 - 3. Example, for highly corroded screen and bolts (condition 4) in stress fractured rock (condition 3), and in a low traffic area (risk 2) the score would be 9 (4+3+2). The scores should then naturally help in the prioritization of rehab (highest scores first).
5. The categories are as follows. For ease of visualization color-coding should be used on maps.
 - A. **Immediate Support Rehab** - Areas barricaded, and areas in work places or high traffic areas suspected to be near failure requiring immediate attention.
 - B. **Check Scaling Required** - Support is in good condition but loose found along the lower margin or below the screen will require re-scaling within a specified time.
 - C. **Short Term Stable** - Areas that should be scheduled for rehab in the next 6 months.
 - D. **Mid Term Stable** - Areas that are stable or lower risk, and should be re-assessed or may need rehab in the next 6-18 months
 - E. **Long Term Stable** - Areas not needing rehab and do not need to be re-assessed for >18 months

Rehab quantity assessments will be made from the map, to give operations personnel some estimate of the magnitude of rehab required. Ground control personnel will also specify the type of rehab required, i.e., SC, bolts, rebar, long support, etc.

The results of the inspection will be presented in drawing form indicating where, how much, and the priority for the rehab. Note that this may graphically appear in the drawings, e.g. parts of a ramp needing complete rehab for 20 m, or as a section of 100 m of ramp needing spot screen rehab.

APPENDIX II

SUGGESTED CHECKLIST CLOSURE PROCEDURE

	YES	NO
Has the procedure been reviewed in the past year?	<input type="checkbox"/>	<input type="checkbox"/>
Are responsibilities defined?	<input type="checkbox"/>	<input type="checkbox"/>
Is a non-routine hazardous procedure required? (see Sect 62.1 Reg. 854)	<input type="checkbox"/>	<input type="checkbox"/>
Have hazards been identified?	<input type="checkbox"/>	<input type="checkbox"/>
Has the type of closure been determined?	<input type="checkbox"/>	<input type="checkbox"/>
Has the closure procedure been reviewed with crews?	<input type="checkbox"/>	<input type="checkbox"/>
Are air/water lines de-energized and disconnected (removed if required)?	<input type="checkbox"/>	<input type="checkbox"/>
Are electrical lines de-energized and disconnected (removed if required)? Is the closure built to company standards?	<input type="checkbox"/>	<input type="checkbox"/>
Is the closure and other pertinent information shown on engineering plans	<input type="checkbox"/>	<input type="checkbox"/>
Has the closure been inspected by the supervisor?	<input type="checkbox"/>	<input type="checkbox"/>
Has the closure been recorded and logged?	<input type="checkbox"/>	<input type="checkbox"/>
Have the reasons for the closure and date of closure noted? Is the closure condition monitored and recorded?	<input type="checkbox"/>	<input type="checkbox"/>
Have affected employees and contractors been notified of the closure?	<input type="checkbox"/>	<input type="checkbox"/>

APPENDIX III

SUGGESTED CHECKLIST FOR RE-ENTRY PROCEDURE

	YES	NO	N/A
Has the procedure been reviewed in the past year?	<input type="checkbox"/>	<input type="checkbox"/>	
Are responsibilities defined?	<input type="checkbox"/>	<input type="checkbox"/>	
Has entry been authorized?	<input type="checkbox"/>	<input type="checkbox"/>	
Have permits been issued?	<input type="checkbox"/>	<input type="checkbox"/>	
Is this a non-routine hazardous task?	<input type="checkbox"/>	<input type="checkbox"/>	
Entry Checklist Used:			
Buddy system/communication plan implemented?	<input type="checkbox"/>	<input type="checkbox"/>	
Procedure/hazards reviewed with crew?	<input type="checkbox"/>	<input type="checkbox"/>	
Mine rescue team assigned?	<input type="checkbox"/>	<input type="checkbox"/>	
Auxiliary lighting available?	<input type="checkbox"/>	<input type="checkbox"/>	
Air monitoring equipment used, i.e. O2 level and gas detector?	<input type="checkbox"/>	<input type="checkbox"/>	
Ventilation requirements met, fans turned on?	<input type="checkbox"/>	<input type="checkbox"/>	
Air/water lines zero energy?	<input type="checkbox"/>	<input type="checkbox"/>	
Ground conditions and adequacy of ground support checked?	<input type="checkbox"/>	<input type="checkbox"/>	
Check scale upon re-entry?	<input type="checkbox"/>	<input type="checkbox"/>	
Ladders in good condition?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Landings in good condition?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Open holes protected?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fall arrest harness inspected and available?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fall arrest anchors inspected?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Water build up checked/controlled	<input type="checkbox"/>	<input type="checkbox"/>	
Conditions of track inspected?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Check for explosives?	<input type="checkbox"/>	<input type="checkbox"/>	
Flammable refuse removed?	<input type="checkbox"/>	<input type="checkbox"/>	
Check for hazardous biological agents (e.g. mould, fungi, etc.)?	<input type="checkbox"/>	<input type="checkbox"/>	
Protection from hazardous biological agents available?	<input type="checkbox"/>	<input type="checkbox"/>	
Access drift roadway intact?	<input type="checkbox"/>	<input type="checkbox"/>	
Manway/access raise intact?	<input type="checkbox"/>	<input type="checkbox"/>	
Radon testing required?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Water sample taken?	<input type="checkbox"/>	<input type="checkbox"/>	
Re-entry recorded?	<input type="checkbox"/>	<input type="checkbox"/>	
Engineering plans updated?	<input type="checkbox"/>	<input type="checkbox"/>	

APPENDIX IV - SAMPLE RE-ENTRY PERMIT

COMPANY _____

ENTRY CHECKLIST

Permit No. _____

Inactive Area Entry Permit Permanent
 Temporary

**THIS PERMIT IS REQUIRED FOR ENTRY
BEYOND FENCED OR BARICADED AREAS**

Permit AM _____ AM

Valid for PM _____ TO _____ PM

On _____ for entry

Into: _____

Notification: Engineering _____

Mine Supervision _____

Reason for Entry: _____

Precautionary Measures: _____

Personnel Authorized: _____

Authorization: _____ Date: _____

Communication Plan: _____

(Safety Messages)

THIS PERMIT IS ONLY VALID ON THE DAY OF ISSUE

Date: _____

Entry Location: _____

Personnel: _____

Authorization: _____

- Buddy system/communication plan
- Procedure/hazards reviewed with crew
- Mine rescue team assigned
- Auxiliary lighting available
- Air monitoring equipment used i.e. oxygen level and gas detector
- Ventilation requirements met, fans turned on
- Air/water lines zero energy
- Ground conditions and adequacy of ground support checked
- Timber in good condition
- Ladders in good condition
- Landings in good condition
- Open holes protected
- Fall arrest harness inspected and available
- Fall arrest anchors inspected
- Water build up checked/controlled
- Conditions of track inspected
- Check for explosives
- Flammable refuse removed
- Check for hazardous biological agents (e.g. mould, fungi, etc.)
- Protection from hazardous biological agents available
- Access drift roadway intact
- Manway/access raise intact
- Radon testing required
- Water sample taken
- Other: Specify _____
- Area Re-sealed (Sign Off) _____

Permit Returned To: _____

Signature

**THIS PERMIT IS TO BE FILED IN THE
INACTIVE WORKINGS LOG BOOK**

APPENDIX V (Source: WSPS, formerly IAPA)

A Health and Safety Guideline for Your Workplace

Safety Signs and Colour at Work

Safety signs and colour are useful tools to help protect the health and safety of employees and workplace visitors.

Safety signs are used to:

- ▶ draw attention to health and safety hazards
- ▶ point out hazards that may not be obvious
- ▶ provide general information and directions
- ▶ remind employees where personal protective equipment must be worn
- ▶ show where emergency equipment is located
- ▶ indicate where certain actions are prohibited

Colour attracts attention and can be used extensively for safety purposes. For example, colour can be used as an additional safety measure to identify the contents of pipes and the nature of the hazard.

The choice of colour also draws attention to the probability of a hazard causing harm. For example, the colour red is used to indicate a definite hazard. A potential hazard is communicated by the colour yellow.

When employees are aware of the hazards around them and take the necessary precautions, the possibility of an injury, illness or other loss is minimized.

However while safety signs and colours are valuable in warning of hazards, they are not substitutes for eliminating or reducing those hazards, whenever possible.

This guideline will help your workplace to effectively use safety signs and colours for the protection of employees and visitors alike.

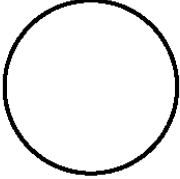
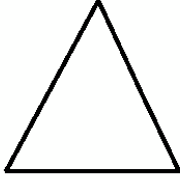
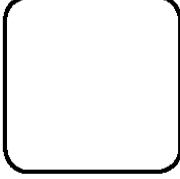
Sign Categories

As shown in the table below, there are three basic sign categories used in the workplace:

- ▶ regulatory
- ▶ warning
- ▶ information

Each category is distinguished by its shape.

These categories are divided into sub-categories that can be recognized by their colour.



















Category	Sub-category	Colour
 <p>1. Regulatory A circle indicates that an order is in force</p>	<p>1.1 Prohibition forbids an action</p>	Red and black on white
	<p>1.2 Mandatory requires an action</p>	White on black
 <p>2. Warning A triangle indicates caution or danger</p>	<p>2.1 Caution indicates a potential hazard</p>	Black on yellow
	<p>2.2 Danger indicates a definite hazard</p>	White on red
 <p>3. Information A square indicates information</p>	<p>3.1 Emergency indicates first aid, health, fire protection, fire fighting and emergency equipment</p>	White on green
	<p>3.2 General Information indicates permission or public information</p>	White on blue

Sign Types

One of three sign types should be used to communicate a message:

- ▶ symbol signs
- ▶ symbol signs with text
- ▶ text signs

Use symbols that are simple and easy to learn and recognize. Include simple wording (text) to help explain the meaning of the symbol or to provide more information. Text signs should only be used when no appropriate symbols exist. Check the CSA international standard CAN/CSA Z321-96 to see if the topic or message you want to convey is listed. Examples of the three types of signs are shown below, based on the CSA standard.

	Symbol sign	Symbol sign with text	Text sign
1. Regulatory			
1.1 Prohibition			
1.2 Mandatory			
2. Warning			
2.1 Caution			
2.2 Danger			
3. Information			
3.1 Emergency			
3.2 General Information			

Symbols for Hazardous Materials

By law, hazardous materials received in the workplace must be identified by special symbols on container labels. You may know these special symbols as WHMIS symbols. These symbols indicate the nature of the hazardous material such as compressed gas, oxidizing material, or toxic material. For information on the symbols to use and their colour restrictions, check the Controlled Products Regulation under the federal **Hazardous Products Act**.

Safety Colours

While there is no legislation requiring the use of colour in the workplace, colour can be used to indicate hazards or point out safety equipment. For example, colour can be applied on:

- ▶ indicator lights or buttons
- ▶ pipes
- ▶ separate work areas
- ▶ machinery
- ▶ vehicles
- ▶ aisles, floors and stairs

Indicator lights or buttons

With the extensive use of colour in our daily lives, we have learned to associate certain colours with specific meanings. For example, red on a traffic light means stop. These associations should be taken advantage of in the workplace to help employees easily recognize the message associated with the colour and respond quickly, as in the case of indicator lights and control buttons:

Colour	Indicator Light	Button/Control
Red	Danger or alarm	Stop/off
Yellow	Caution	Caution/intervention needed
Green	Safe condition	Start/on

Safety Signs and Colour at Work
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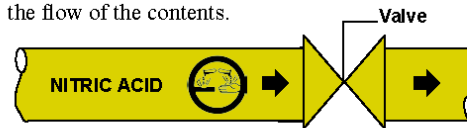
Piping Systems

There are many ways you can identify the contents of pipes. The law, however, requires you to train your workers on the identification system you use.

A way of ensuring that your employees have a clear understanding of what a pipe contains is by:

- ▶ labeling the pipe with a tag that clearly identifies the material inside
- ▶ attaching the appropriate WHMIS symbol, if the material is a controlled product
- ▶ painting the pipe with a safety colour

Use arrows on the pipe to show the direction of the flow of the contents.



Safety colours conventionally used for pipes in the workplace include:

Colour	Classification	Example
Red	Fire quenching materials *never paint sprinkler heads	Water, foam, carbon dioxide, halon, etc.
Green	Liquids that are not hazardous by nature	Liquids, liquid admixtures
Blue	Gases that are not hazardous by nature	Gas, gaseous admixtures
Yellow	Materials that are hazardous by nature	Materials that are flammable or explosive; chemically active or toxic; radioactive; or under extreme temperatures or pressures

For more information on how to identify piping systems, refer to the American Society of Mechanical Engineers (ASME) standard A13.1-2007.

Other Applications for Safety Colours

Safety colours are also useful in work areas, and on equipment and machinery. The safety colours and their meanings are listed below, based on the American National Standards Institute (ANSI) standard Z535.1-2006.*

Colour	Meaning	Examples
Red	Danger or stop	Containers of flammable liquids; emergency stop bars; stop buttons; fire protection equipment
Orange	Warning	Hazardous parts of machines which may cut, crush, or otherwise injure a worker; inside of movable guards or the inside of transmission guards for gears, pulleys, chains, etc.; exposed parts (edges only) of pulleys, gears, rollers, cutting devices, power jaws, etc.
Yellow	Caution	Physical hazards which might result in striking against, stumbling, falling, tripping or being caught in-between; storage cabinets for flammable materials; containers for corrosive or unstable materials
Green	First aid/ safety equipment/ emergency egress	First aid kits, stations; stretchers; emergency showers; emergency exit routes
Blue	Safety information	Signs requiring use of personal protective equipment (PPE)

**Note to Canadian workplaces: A few variations exist between colour and their recommended meanings. When in doubt, go with the CSA standard.*

Determining Your Requirements

Whether you are evaluating your existing safety sign and colour system, or planning a new one, the system will be more effective and easier to implement by asking for feedback and suggestions from your staff. You can also tap the expertise of your health and safety representative or committee.

Discuss such issues as:

- ▶ What messages need to be conveyed to employees and workplace visitors?
- ▶ Which messages are most important to health and safety?
- ▶ Do current signs appropriately convey the importance of a message, e.g., do more important messages stand out?
- ▶ Are current signs and safety colours easy to understand? Do they meet the needs of observers with visual limitations, e.g., those who confuse red and green? How about the needs of employees who do not speak English?
- ▶ Are employees trained to understand workplace signs and colours?
- ▶ Do employees comply with signs?
- ▶ Is there consistency in the use of safety signs and colours?
- ▶ Are signs visible, away from clutter or obstructions, and well-lighted?
- ▶ Are signs and colours effective in drawing attention to hazards?
- ▶ Are signs posted in the best possible location and within an appropriate distance from hazards?
- ▶ What is the general condition of existing signs?
- ▶ Do signs meet legal requirements?
- ▶ Do the signs, symbols and colours used reflect current standards (e.g., CSA standards)?

Pointers for Effective Safety Sign and Colour Use

After determining your needs, work with your health and safety representative or committee to set standards for signs and colours to use throughout the workplace.

Ensure the signs and colours are used consistently. Research shows that companies that have implemented a uniform sign and colour system to make hazards more visible and easy to identify have successfully lowered their injury frequency rates. Workers know that signs and colours mean the same thing even when they work in different departments or plant locations. It also enables employees to quickly locate first aid, fire fighting and other emergency equipment.

The signs and colours in your workplace should provide enough information for persons to protect their health and safety.

Signs, especially those that indicate hazards, should:

- ▶ attract a person's attention
- ▶ clearly identify the nature of the hazard
- ▶ specify the immediate action required
- ▶ be posted in a place that provides enough time for a person to read the sign and act accordingly
- ▶ be easily recognized and understood by all employees
- ▶ reflect the needs of those who have visual limitations or who do not speak English
- ▶ be sized or placed according to the importance of the message

Posting Signs

Signs should be clearly visible, positioned in the line of sight, and free from any obstructions or clutter.

Keep signs well-lighted. Observers should be able to read a sign easily and recognize its safety colour. Lighting should also be sufficient to make any hazard clearly visible.

Post the sign within an appropriate distance from the hazard it is pointing out. An observer must have enough time to see and read the sign and do whatever is necessary to keep safe.

In general, signs should be displayed alone. When signs must be grouped together, place them in an appropriate order.

Use no more than three symbols in the same location.

Ensure that directional signs are visible from all directions. Include arrows on exit signs wherever the direction is not obvious. Directional signs should be posted at a consistent height throughout the workplace. They should also be posted at appropriate locations or decision points so that the route to take is always clear.

Using Easy to Read and Easy to Understand Signs

Help employees and workplace visitors understand signs quickly by using clear language and symbols that can be learned and recognized easily.

Keep symbols as simple as possible; eliminate details that don't make the message clearer.

Avoid using signs that contain only text messages.

A combination of text and symbols is generally the most effective.

Consider multi-lingual signs if you have employees who do not speak English.

Use capital letters for the first letter of the first word and small letters for the rest.

Use appropriate warning words. These can be in capital letters, if you prefer. For example:

Danger (or **DANGER**) – to warn of a definite hazard.

Caution (or **CAUTION**) – to warn of a potential hazard.

The lettering styles (fonts) most recommended are sans-serif, bold or regular face. Examples include: Arial, Helvetica, Folio Medium, Futura, Univers, or equivalent.

Limit one message to a sign. To convey more than one message, use separate signs, as shown below. For example, if hearing protectors and safety glasses are required, use two separate signs, one for hearing protection, and another for eye protection.



Using Safety Colours

Keep colours to a minimum. This emphasizes the most important signs and colour markings, and also prevents confusion and visual fatigue.

Use colours consistently throughout the workplace. Ensure that employees who are colour blind (specifically, red-green confusing) can understand signs and coloured controls. Use symbol signs with text. Use flashing lights, audible alarms or signs beside coloured controls.

Other Pointers

Signs should have rounded or blunted corners to prevent sharp edges, burrs, splinters or other sharp projections.

Position fastening devices carefully so that they don't become hazards.

For more information on sign specifications, refer to the standards listed in References.

Training

Inform employees that signs and colours are being used in the workplace to protect employee/visitor health and safety. Also point out to employees that their cooperation and feedback are necessary for the system to be effective.

Not everyone may be aware that there is a purpose for and meaning in the shape and colour of safety signs or that colours on equipment and around the workplace indicate hazards.

Train employees so that they understand:

- ▶ the meaning of the various shapes, symbols and colours used
- ▶ the contents of pipes based on their colour, attached tags and other markings
- ▶ the consequences if exposed to the hazard
- ▶ safety precautions to follow
- ▶ what to do in an emergency
- ▶ how to use emergency equipment

Make this training a part of your orientation or induction training for new employees.

Provide employees with orientation handbooks that contain complete and updated information on the safety signs and colours used in your workplace.

Review the meaning of signs and colours periodically with employees to ensure all signs are understood. Provide refresher training as needed.

Maintenance

Maintain safety signs in good condition. Inspect signs during regular workplace inspections.

Replace worn, faded, damaged, and outdated signs.

Change signs that are often misunderstood or overlooked.

Remove signs that are redundant or no longer needed.

Repaint areas where safety colours have faded.

What the Law Says

Occupational Health and Safety Act (Ontario)
The following sections of the Regulations for Industrial Establishments (Reg. 851) deal with signs:

- ▶ Sec. 16 – door warning sign
- ▶ Sec. 20 – traffic warning sign
- ▶ Sec. 41 – live electrical equipment warning sign
- ▶ Sec. 51, 52 – lifting device capacity sign
- ▶ Sec. 62 – identification of hazardous substances in piping systems. Also see WHMIS regulation, section 11
- ▶ Sec. 89 – gangways
- ▶ Sec. 117 – warning signs on haul roads
- ▶ Sec. 118 – signs on bridges of haul roads
- ▶ Sec. 139 – noise warning signs

Hazardous Products Act (Federal)

Controlled Products Regulation

- ▶ Schedule 11 – hazard symbols
- ▶ Sec. 22 – reproduction of hazard symbols

Transportation of Dangerous Goods Regulation (Federal)

- ▶ Part 5 – Safety marks

References

American National Standards Institute

- ▶ ANSI Z535.1-2006: Safety Colour Code
- ▶ ANSI Z535.2-2002: Environmental and Facility Safety Signs
- ▶ ANSI Z535.3-2002: Criteria for Safety Symbols
- ▶ ANSI Z535.4-2007: Product Safety Signs and Labels
- ▶ ANSI Z535.5-2002: Safety Tags and Barricade Tapes (for Temporary Hazards)

American Society of Mechanical Engineers

- ▶ ASME A13.1-2007: Scheme for the Identification of Piping Systems

CSA International

- ▶ CAN/CSA Z321-96: Signs and Symbols for the Workplace

International Organization for Standardization

- ▶ ISO 3864-1:2002: Graphic Symbols – Safety Colours and Safety Signs, Part 1: Design principles for safety signs in workplaces and public areas

