



*If you can't test,
If you can't ventilate,
If you don't have a breathing apparatus,
If you don't have any entry procedure,
Don't go in!*

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Introduction

Working in or near a confined space has potential dangers which can result in serious accidents. A few seconds can be the difference between life and death. Workers die in the short time it takes to pick up a tool from the bottom of a tank. The specific practices, tools and equipment needed to safely and effectively work in underground facilities vary from location to location, but these guidelines give a general overview of what is most common.

Some of the most common issues include falls/slips, fire or explosion, oxygen depletion, gas poisoning, heat stress, drowning, asphyxiation arising from gas, fume, vapour and entrapment by free-flowing solids. Among the potential issues, some of the most dangerous involve gases. These can often be overlooked or neglected, leading to serious casualties.

Part XI of the *Canada Occupational Safety and Health Regulations*¹ sets standards for working in confined spaces. A confined space means an enclosed or partially enclosed space that:

- A. Is not designed or intended for human occupancy except for the purpose of performing work;
- B. Has restricted means of access and egress; and
- C. May become hazardous to an employee entering it due to:
 - i. Its design, construction, location or atmosphere,
 - ii. The materials or substances in it, or
 - iii. Any other conditions relating to it.

Some examples of confined spaces are: utility holes (manholes), sewers, boilers, tunnels, pipelines, wells, fuel tanks, ballast tanks, storage tanks, tank cars and tank trucks, vats, process vessels, septic tanks, sewage lift stations, silos, boots in grain elevators, trenches, and ventilation and exhaust ducts. Although some of these are easily recognized as confined spaces, others may not be.

This guide aims to remind persons entering or working in a manhole, or other confined space, to take the necessary safety and risk mitigation measures. This guide includes tips for the prevention of gas poisoning and oxygen depletion.

¹ Confined Spaces - No easy way out. (n.d.). Retrieved October 17,2019 from the Government of Canada website: <https://www.canada.ca/en/employment-social-development/services/health-safety/reports/confined-spaces.html>

Things to Note Before Entering a Confined Space

Duties of the Employer

The employer has duties to ensure that before an employee enters a confined space that they have received the necessary training in entry, emergency procedure and the use of protective equipment. Where there is a safety and health committee, these procedures will be established with association of those representatives.

Hazard Assessment

When a confined space has not been assessed, the employee shall appoint a qualified person to:

- A. Carry out an assessment of the physical and chemical hazard that the person who is entering the space may be exposed to;
- B. Specify the tests to determine if the person will be exposed to any danger;
- C. Submit a signed report of the findings to the employer.

It is important that the employer makes a copy of this report for the health and safety committee representative. This report needs to be reviewed at least every 3 years.

Safety Measures for the Prevention of Gas Poisoning:

- A. Close of all pipelines connected to the confined space to prevent any dangerous gas or fume from entering the confined space.
- B. Remove any sewage or sludge in the confined space beforehand to prevent any toxic or noxious gases that may have accumulated in it.
- C. Use a ventilation blower to supply fresh air into the confined space to ensure that the air inside is maintained safe for the workers. When ventilation is used, the employer should not grant access to any person unless the ventilation is:
 - i. Equipped with an alarm;
 - ii. Monitored by an employee.
- D. Ensure there is a sufficient supply of power outlets for operation of the ventilation equipment.
- E. Ensure to erect fencing, posting of warning notices to ensure safety of relevant personnel.

When Entering a Confined Space

Once all the safety measures have been implemented, it is important to follow the below steps once you are entering and working in the confined space:

- A. Ensure that there is a sufficient number of persons on standby outside, including those who are appointed to carry out rescue operations inside the confined space and are responsible for support services outside when such an operation is necessary.
- B. If there are signs indicating that the safety of the workers is under threat, the evacuation of the workers from the dangerous environment shall be made according to the emergency procedure and the environment will be assessed afterward.
- C. If an accident does occur, make sure to inform the necessary government departments like the Fire Services Department to assist with the rescue. On-site personnel who have been trained shall use the appropriate rescue equipment to conduct the rescue operations according to the emergency rescue procedure.

Things to Consider:

Oxygen Deficiency

A major cause of deaths in confined spaces is a lack of oxygen. The best way to make sure there is enough oxygen is to carefully test with an oxygen monitor before you enter and, if necessary, while you are working in the space.

There are two main causes of oxygen deficiency:

- A. Oxygen is displaced by gases such as nitrogen, an inert gas introduced to displace flammable gases when purging vessels in preparation for hot work.
- B. Oxygen is used up by:
 - i. Combustion of flammable substances such as in welding and other hot work;
 - ii. Explosions or fires (oxygen levels may stay dangerously low long after the fire is out because the oxygen is replaced by the products of combustion);
 - iii. Chemical reactions such as rusting of metal;
 - iv. People working in the space and using oxygen as they breath.

Normal air has approximately 21% oxygen by volume at normal atmospheric pressure. At 16% oxygen, your judgement and breathing are impaired, and you are quickly exhausted. At 12% you become unconscious and will die unless removed to fresh air. At 6%, you have difficulty breathing and will die in seconds.

Oxygen Enrichment

An oxygen-enriched atmosphere contains more than 23% oxygen. This will cause flammable materials, such as clothing and hair, to burn violently when ignited. Never use pure oxygen to ventilate a confined space since this would be a fire and explosion hazard.

Fires and Explosions

Combustible gases have an explosive range with a lower explosive level (LEL) and upper explosive level (UEL). When the fuel and air mixture fall below the LEL or above the UEL, an ignition will not take place. The gas is only combustible when it falls between the LEL and UEL. Combustible gases have different characteristics. Some have a wider range between their upper and lower explosive limits, which would make them more dangerous. Fires and explosions are serious dangers in confined spaces. Chemicals, poor ventilation, static electricity, or machinery can contribute to explosions or fires.

Hot Work

This refers to any work where flame is used, or a source of ignition may be produced.

Unless a qualified person has determined that the work can be performed safely, hot work shall not be performed where there are concentrations of explosive or flammable hazardous substances that do not meet the prescribed standards.

If hot work is to be performed where concentrations of explosive or flammable hazardous substances exist, a qualified person shall:

- A. Patrol the area surrounding the confined space;
- B. Maintain a fire-protection watch;
- C. Provide fire extinguishers.

Where airborne hazards are produced by the hot work, no person shall enter or occupy the confined space unless equipped with a prescribed respiratory protection device.

Work Zone Protection

It is important to consider work zone protection through the duration of the underground work to protect workers, motorists and pedestrians. The best way to ensure this is to separate the area from the non-work area. It is important to use clear signage regarding changes to traffic flow. Well in advance of the work zone, signs should be posted that there is a change to the normal flow to give motorists sufficient time to make changes. It also might be a good idea to plan the work around times when traffic may be reduced to minimize this exposure. Many companies are now working with third-party companies that provide work zone protection.

Structural Inspections

Once a worker has gained access to the confined space, an inspection of the surrounding area should take place. The employee should look for any structural defects that can only be seen while inside the confined space. Another thing that an employee can look for is low suspended pipe, cable trays and equipment. Some of these might be pressurized or energized. Other considerations are water and lighting. It is possible that water has seeped into the area over time and has caused hazardous working surfaces.

Emergency Procedures and Equipment

When conditions in a confined space cannot be complied with, the employer shall:

- A. Consult with the safety and health committee or representative to establish emergency procedures;
- B. Provide protective equipment;
- C. Ensure that a qualified person trained in the entry and emergency procedures is in attendance outside the confined space;
- D. Ensure that the qualified person is in communication with the person inside the confined space;
- E. Provide the qualified person with a suitable alarm for summoning assistance;
- F. Ensure that two or more persons are in the immediate vicinity of the confined space to assist in the event of an emergency;
- G. Ensure that the person in the confined space is wearing an appropriate safety harness that is attached to a secure anchor outside the confined space and attached to a mechanical lifting device; and
- H. Keep records.

If you notice changes in how you feel, get out of the confined space! A few seconds can be the difference between life and death. Workers die in the short time it takes to pick up a tool from the bottom of a tank. Wear the prescribed respirator and personal protective equipment only if you have been trained in their use and if the employer has taken all the necessary safety measures.

Conclusion

The specific practices, tools and equipment needed to safely and effectively work in underground facilities vary from location to location, but the items mentioned above will provide a general overview of what is most common. A good set of rules to follow are:

If you can't test,

If you can't ventilate,

If you don't have a breathing apparatus,

If you don't have any entry procedure,

Don't go in!

References

Safety guide for work in manholes. (n.d.). Retrieved October 18,2019 from the Labour Department, Government of Hong Kong website: <https://www.labour.gov.hk/eng/public/os/D/Manhole.pdf>

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