Confined Space Entry Program

Developed February 2007

Bow Valley College

Acknowledgements

Thanks and sincere appreciation to those who have given their time and consideration to this project. Without their help and input, it would not have been possible.

Carolyn Dieleman, Language Training Programs, Alberta Employment, Immigration and Industry

Greg Peterson, Administrator, Industrial and Technical Training Department, Lethbridge College

Isabel Gibbons, Acting Dean, ESL and Languages, Bow Valley College
Terri Huck, Program Coordinator, ESL and Languages, Bow Valley College
Sheila Swan, Copyright Associate, Learning Resource Services, Bow Valley College

Funding

Alberta Employment, Immigration and Industry, Language Training Programs

Design and Development

Shelley Goulet, Consultant
Lorene Anderson, Consultant

March 2007

Confined Space Entry Program

Table of Contents

Introduction

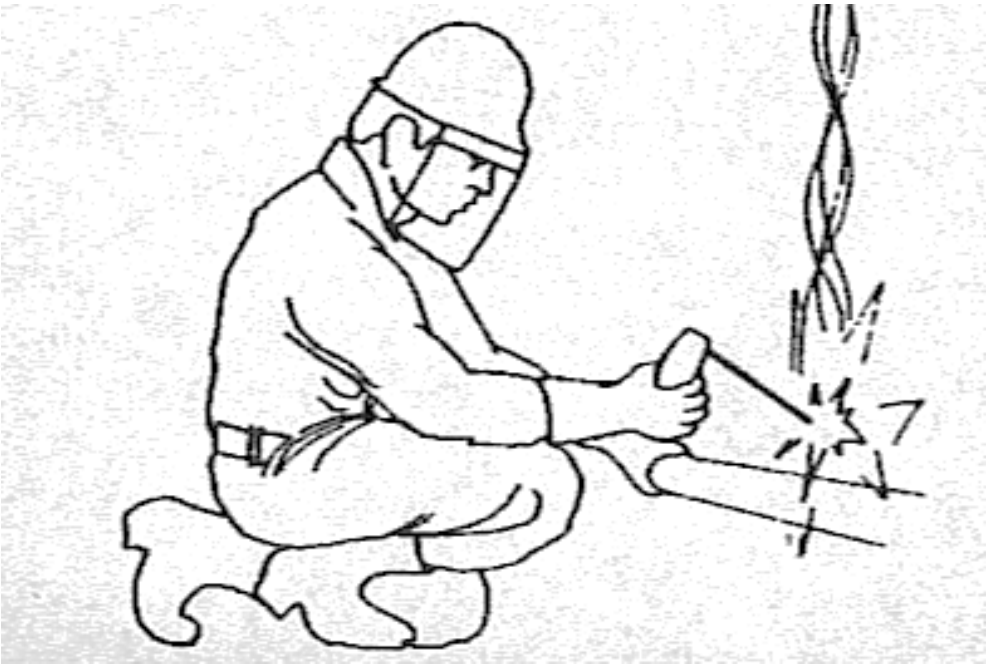
Confined spaces can be deadly. Many workers are injured and killed each year while working in confined spaces. A National Institute of Occupational Safety and Health (NIOSH) report states that there were 234 deaths and 193 injuries in confined space work during a 3 year period. The Canadian Centre for Occupational Health and Safety (CCOHS) says about 60% of the deaths have been rescuers.

Why are confined space entries hazardous?

The space can be naturally hazardous. For example, organic material such as manure sludge can release the toxic gas hydrogen sulphide during the cleaning out of a manure pit.

Source: www.midwestadvocates.org

The work done in the space often creates hazards. For example, acetylene gas may leak from welding equipment. This gas is dangerous because it can burn and explode easily.



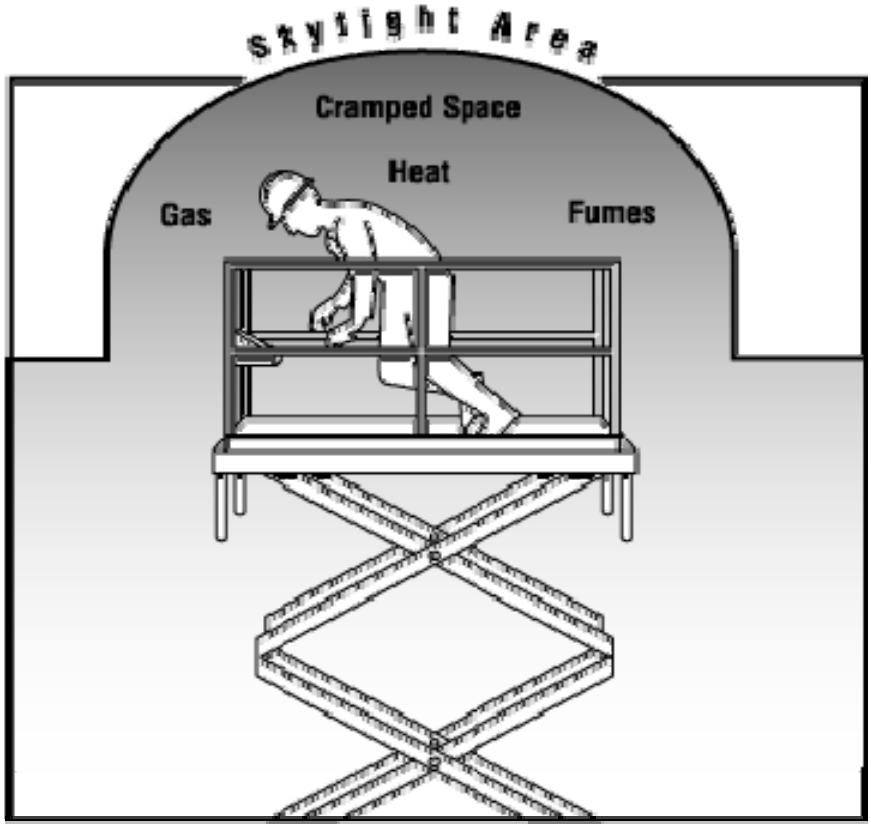
Source: Pettit, T. and H. Linn. (1987). *A guide to safety in confined spaces.* Washington, D.C.: U.S. National Institute for Occupational Safety and Health. Retrieved November 14, 2006 from http://www.cdc.gov/niosh/pdfs/87-113.pdf

Confined space entry incidents

A worker was cleaning an underground sludge tank at a textile factory. Hydrogen sulphide sludge fumes poisoned him. He fell into the tank and died. Three workers who tried to help him also died. Two other workers who tried to help were able to escape and were treated at the hospital.

Deaths: 1 Worker and 3 rescuers

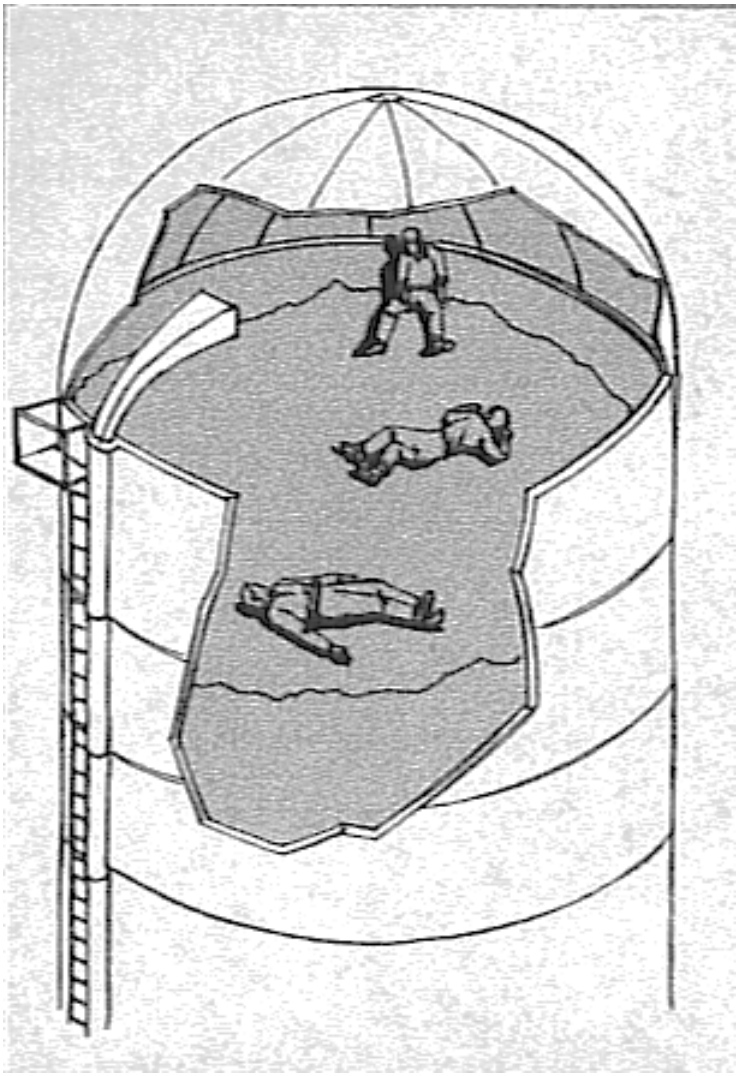
Injured: 2 Rescuers



Source: *Confined space entry: introduction* (Retrieved November 5, 2006 from: http://www.ccohs.ca/oshanswers/hsprograms/confinedspace_intro.html

A farmer and two rescuers died after entering a silo. The decaying silage used up the oxygen and produced the toxic gas nitrogen dioxide.

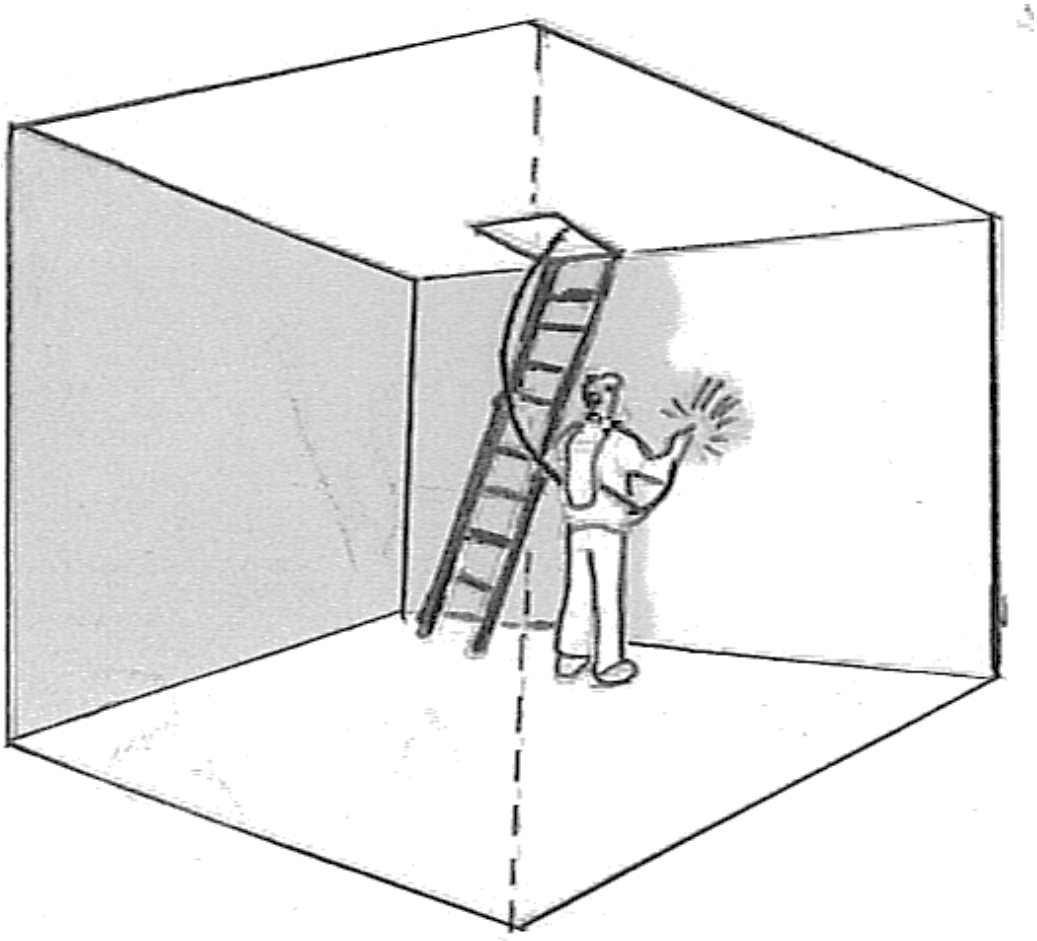
Deaths: 1 Worker and 2 rescuers



Source: *Confined space entry*. (2004). Nisku, AB: Leduc Safety Service Ltd. p.1-35.

An explosion and flash fire at a worksite seriously burned two workers. The two workers had just finished spray painting the interior of a tank. One worker stayed in the tank and handed his non-explosion-proof light and spray gun to the worker outside the tank. As this worker walked away from the tank, he heard a noise. He turned towards the tank. An explosive blast coming from the entry struck him. The other worker was still inside the tank when the explosion occurred.

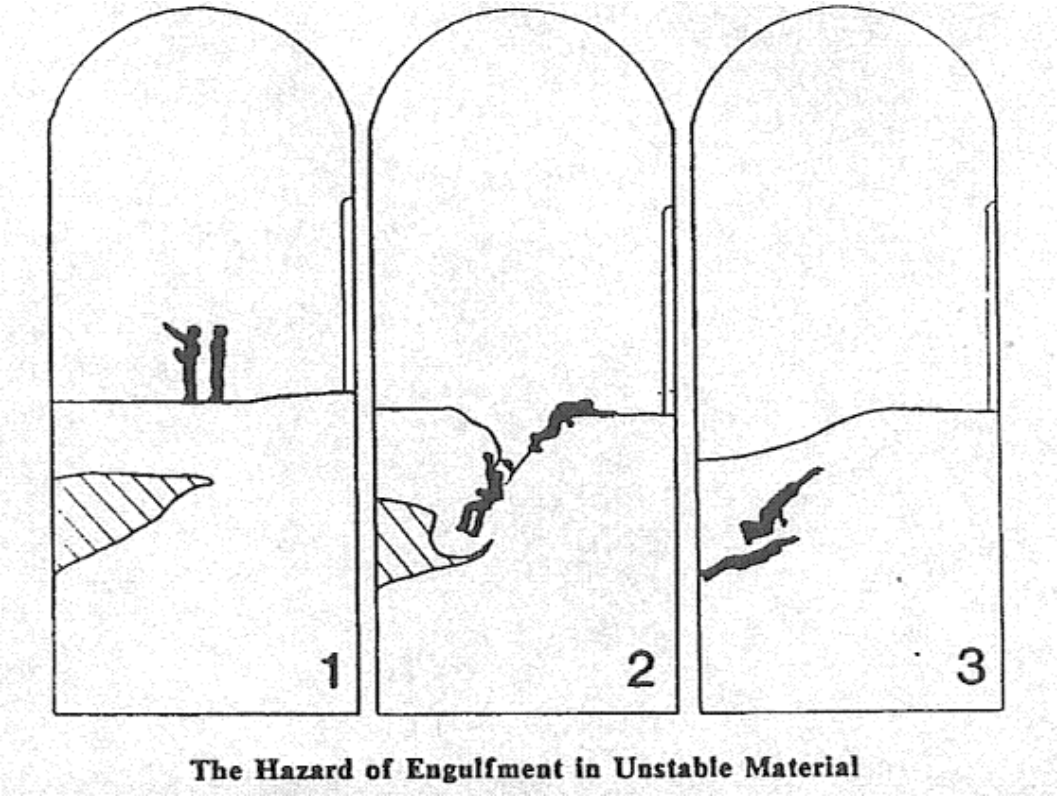
Injured: 2 Workers



Source: *Hazards of confined spaces*. (2006). WorkSafeBC. (2006 ed.) Retrieved November 14, 2006, from http://www.worksafebc.com/publications/health_and_safety/by_topic/assets/pdf/confined_space_bk80.pdf

Grain stored in bins can suffocate workers. Two farmers entered a grain bin. The loose grain crusted over in the bin. The crust broke loose when the farmers stepped on it. The farmers were buried in the flowing grain.

Deaths: 2 Workers



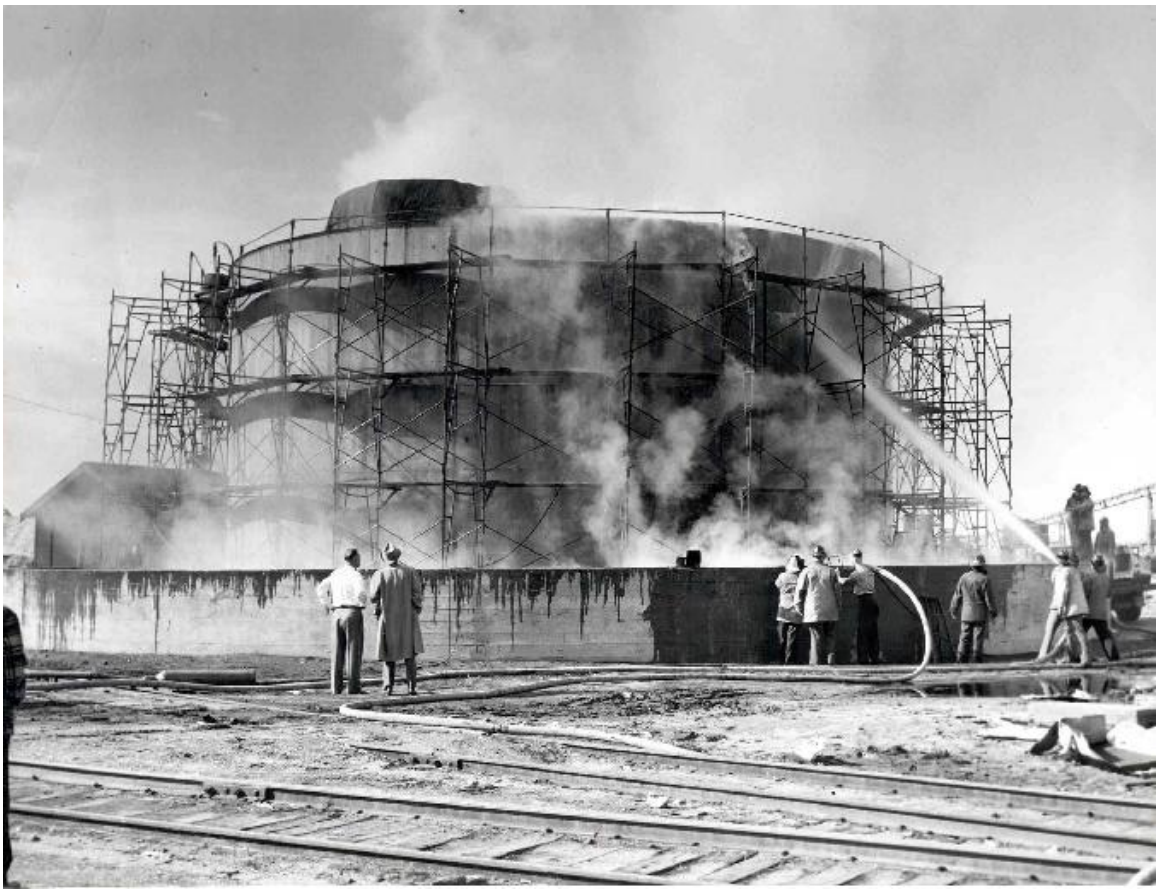
The Hazard of Engulfment in Unstable Material

Source: Pettit, T. and H. Linn. (1987). *A guide to safety in confined spaces.* Washington, D.C.: U.S. National Institute for Occupational Safety and Health. Retrieved November 14, 2006 from http://www.cdc.gov/niosh/pdfs/87-113.pdf

A fire in a storage tank killed one worker and injured one. The storage tank was under construction, and the workers were finishing the job at night. They needed extra light. They put extension cords into the tank. The cords held trouble lights which were non-explosion-proof. Each worker had a supply of acetone in an open plastic bucket. Two workers stayed in the tank to take down the scaffolding when the job was done. The heat from the non-explosion-proof lights caused the flammable acetone to burst into flame. Flames spread across the bottom of the tank. The workers could not get out because material was piled in the exit.

Deaths: 1 Worker

Injured: 1 Worker



Source: *Tank fire* (Retrieved November 27, 2006 from **www.cob.org/fire/photo-gallery/vintage-photos.htm)**

Section 1 - What is a Confined Space?

A confined space:

- Is an enclosed or partially enclosed space.
- Is **not** designed or intended for human occupancy.
- Has a limited means of entry or exit because of its location or size.
- May be hazardous to the health and safety of a worker because of:

  - Its design, construction, location, or atmosphere.
  - The work activities carried out in it.
  - The materials or substances in it.
  - Mechanical, process and safety hazards present.

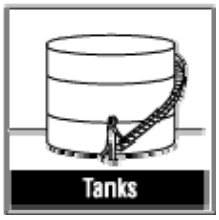
Source: (Retrieved November 5, 2006 from:
http://www.ccohs.ca/oshanswers/hsprograms/confinedspace_intro.html

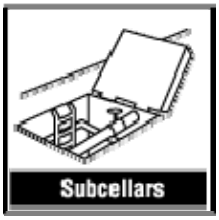
A typical confined space has one or more of the following characteristics.

1. The space has a limited or restricted opening for entry (access) or exit (egress).
2. The space may contain hazardous atmospheres.
3. The space may contain safety or health hazards.

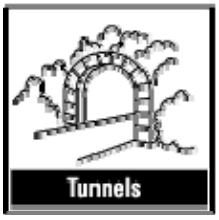
Illustrations of confined spaces

Some confined spaces are enclosed on all sides. Some examples are: grain bins, silos, windowless rooms, cement truck containers, ventilation or exhaust ducts, food processing tanks and equipment.



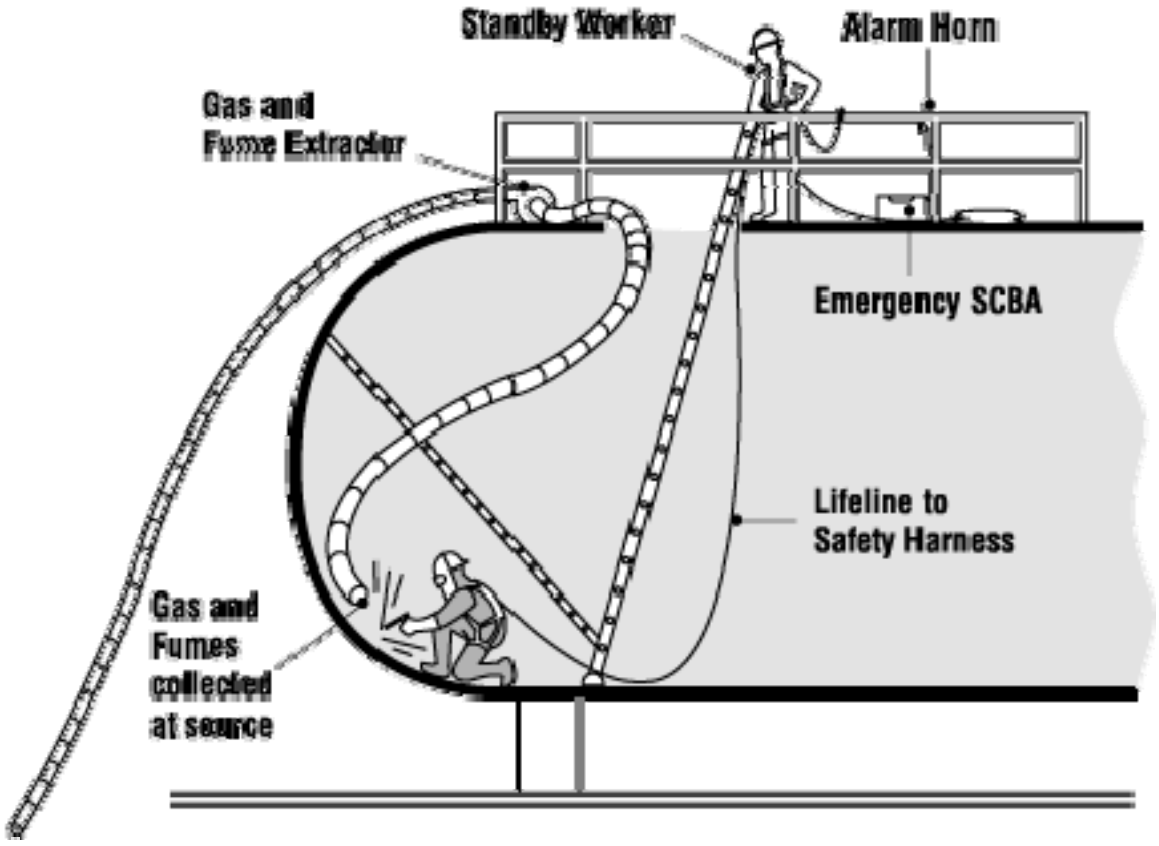


Some confined spaces not small or physically enclosed on all sides. Some examples of confined spaces that are not closed on all sides are: vats, manure pits, culverts, wells, open ditches and trenches.



Source: *Confined space: introduction* (Retrieved November 5, 2006 from: **http://www.ccohs.ca/oshanswers/hsprograms/confinedspace_intro.html**

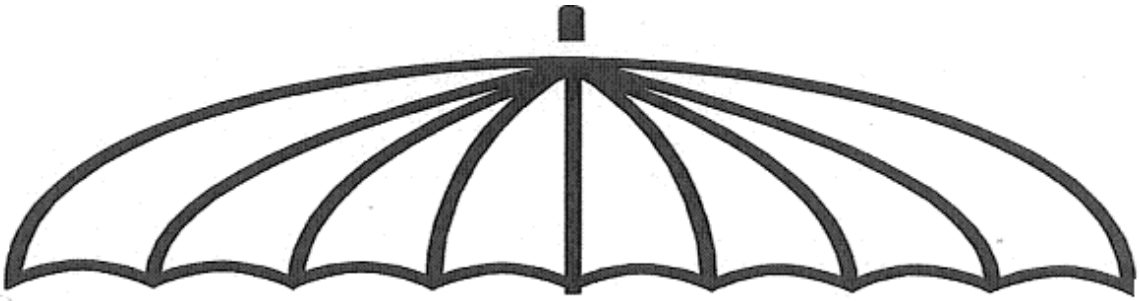
Illustration of a confined space entry operation



Source: *Confined space: introduction*. Retrieved November 5, 2006 from:
http://www.ccohs.ca/oshanswers/hsprograms/confinedspace_intro.html

Section 2 – Who is Responsible for Safety?

Governmental regulations/references



Occupational Health and Safety Act

- Gives government the authority to make Regulations and Codes regarding workplace health and safety.
- Sets out basic duties and obligations of employers and workers.

Occupational Health and Safety Regulation

- Deals with government policy and administrative issues related to occupational health and safety.

Occupational Health and Safety Code

- Contains detailed technical standards and safety rules that support the OHS Act and OHS Regulation.

Enform Canada. (2005). *GELS: General entry level safety*. (3rd ed.). Calgary: Enform Canada.p.4-4

Many activities in different industries require that employees enter confined spaces on a regular basis. Confined space entry activities are not permitted unless hazards have been identified, assessed and effective hazard controls have been implemented.

Confined space entry may only be permitted if a confined space can be made safe through effective hazard controls.

Safety is the responsibility of the worker and the employer. Workers and employers must both be involved to reduce the danger of confined space entry.

Responsibility

Supervisors and workers will make sure that all confined space entry activities are identified.

Hazards

Supervisors and workers will identify hazards by inspecting the work site. They will assess potential hazards.

Controls

Supervisors and workers will make sure that safety procedures are planned and documented. Personal Protective Equipment (PPE) will be provided.

Emergency Response

Supervisors and workers will make sure that a Rescue Plan is documented for a confined space entry site.

Section 3 - Hazards

There will always be the potential for hazards in confined spaces. Workers should be aware of the hazards that could exist or arise.

Oxygen deficient (too little oxygen)

Normally the air we breathe contains 21% oxygen. An oxygen deficient atmosphere has less than 19.5% oxygen (O_2). Any atmosphere with less than 19.5% oxygen **should not** be entered without an approved self-contained breathing apparatus (SCBA). You can die in a few minutes without oxygen. Lack of oxygen in a confined space can occur:

- From chemicals which absorb available oxygen.
- From purging with inert gases that replace the oxygen.
- From rusting (oxidation) of metal in the tank.

Oxygen enriched (too much oxygen)

An oxygen enriched atmosphere (above 23% O_2) is a serious fire hazard. Combustibles burn quickly in oxygen enriched air. Materials are more easily ignited and they may burn so quickly that they explode. A weak spark may be able to ignite materials.

Oxygen 23% and higher	Oxygen Enriched Serious fire hazard
21%	Normal oxygen level
19.5%	Minimum for Safe Entry
16%	Impaired Judgement and Breathing
14%	Faulty Judgement Rapid Fatigue
6%	Difficulty breathing Death in Minutes
Oxygen Scale	

Information Source: Pettit, T. and H. Linn. (1987). *A guide to safety in confined spaces.* Washington, D.C.:
U.S. National Institute for Occupational Safety and Health. Retrieved November 14, 2006 from http://www.cdc.gov/niosh/pdfs/87-113.pdf

Flammables

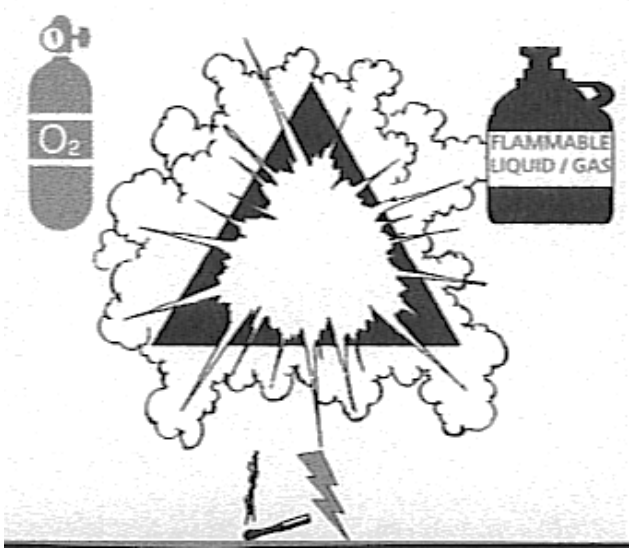
Flammable gases, vapours, liquids, and solids increase the potential for fire or explosion.

Two things make an atmosphere flammable:

1. The oxygen in the air.
2. A flammable material (gas, vapour or dust in the proper mixture).

WHMIS labels. (2006). WorkSafeBC. Retrieved November 11, 2006, from http://www.worksafebc.com/publications/health_and_safety/whmis/assets/pdf/whmis_basics.pdf

An explosion will result if a source of ignition is used in a confined space containing a flammable atmosphere. A tool that creates sparking or an electrical tool could be a source of ignition.



Source: Confined space entry. (2004). Nisku, AB: Leduc Safety Service Ltd. p.1-29.

Oxygen + flammable material + ignition source = explosion

(O_2) (fuel) (heat)

Toxic substances

Source: *WHMIS labels*. (2006). WorkSafeBC. Retrieved November 11, 2006, from http://www.worksafebc.com/publications/health_and_safety/whmis/assets/pdf/whmis_basics.pdf

Most substances (liquids, vapours, gases, mists, solid materials and dusts) should be considered hazardous in a confined space.

Toxic substances can come from the following:

- The product stored in the space.
- The work being performed in a confined space.
- Areas close to the confined space.
- Contaminants which have entered from other areas through ducts, piping, gas leaks in adjacent areas, engine exhausts.

Toxic vapours or fumes may:

- Result from poor natural or poor mechanical ventilation.
- Be due to the release of toxic substances from sludge, common scale, slow chemical reactions, or toxic fumes from nearby process areas. Sludges and other materials should be sampled to make sure they are non-hazardous (non-flammable and non-toxic) before safe work permits are issued to work in the confined space.

Crushing hazards

Processing or mechanical equipment, such as mixers, can crush a worker.

Entanglement

Rotating equipment can entangle a worker and can cause dismemberment or death.

Entrapment

Workers can be trapped in a confined space because of the restricted entry and exit, equipment inside, or the design of the space.

Engulfment

When free flowing solid or liquid materials such as grain are stored in confined spaces there is a danger of the worker being buried in the material. The worker can suffocate.

Electrical shock

Electrical shock can result from defective extension cords, welding cables other electrical equipment.

Corrosive hazards

Chemical burns can result from direct contact with corrosive or irritant chemicals.

Poor visibility

Poor visibility increases the risk of accidents. Poor visibility may result from poor lighting or from activities such as sand blasting or welding.

Temperature extremes

Equipment such as boilers, reaction vessels and low temperature systems may result in temperature extremes. Burns can occur from steam, other hot fluids or

hot metal components. Frostbite can occur from ice, cold fluids or cold metal components.

Noise

Noise produced in confined spaces can be very harmful. Noise levels from a source inside a small confined space can be four to ten times greater than the same source if placed outdoors.

Falls and falling objects

In a confined space there may be the danger of being struck by fallings objects such as tools or equipment. Ladders and slippery and uneven surfaces can result in workers falling.

Physical characteristics

The physical shape, size and location of the confined space may make it difficult to enter and exit the space.

External influences

Contaminants can enter the confined space from other areas through ducts, piping, gas leaks, and engine exhausts.

Environmental conditions

Rain, lightning, snow, extreme heat, extreme cold, traffic control and visibility may create hazards in the area of the confined space.

Human factors

Some workers may not be able to work in a confined space because of claustrophobia, disabilities, physical conditions such as diabetes or heart conditions, or intoxication from alcohol or drugs. A worker with one of these factors may cause injury to himself and others.

Past and current uses of the confined space

Residue chemicals and materials can affect the atmosphere of the confined space. The space may be non-toxic but work movement may stir up residual materials and create a hazard. Process reaction activities may release harmful substances into the air. These activities include grinding, painting, insulation removal, welding, etc.

Section 4 - Controls

Effective hazard controls must be in place before any confined space entry. Controls must be written down and must meet current workplace safety regulations.

Controls fall under three general categories:

1. Engineering.
2. Administrative.
3. Personal Protective Equipment.

Engineering Controls

Residue removal

All residues must be removed from the confined space before entering. The following methods may be used to remove residue:

- Cleaning. Cleaning procedures include steam or water cleaning, neutralization, descaling and special solvent application.
- Purging. Purging is the removal of a dangerous atmosphere in a confined space by using a fluid such as water or a non-flammable gas, such as nitrogen or carbon dioxide.
- Inerting. Inerting is used in highly explosive situations. Inerting means completely replacing the oxygen in a confined space with an inert (non-reactive) gas such as nitrogen. The oxygen must be replaced until the work is completed. All workers must wear breathing apparatus when working in an inerted space.

Residue should be washed out and disposed of in an environmentally acceptable practice. Proper bonding and grounding practices and procedures must be followed to reduce the possibility of a build up of static electricity.

Confined Space Testing and Measurements Required

Atmosphere must be checked often during the job. Atmosphere testing results must be written down. The date and time of the test should be written down

A combustible gas test of the atmosphere in the confined space is required if there is any ignition source in the confined space. This must be done before starting the job.

Tests for harmful substances and oxygen levels must be carried out. The tests must be done before entry, during the work phase, and after exit from the confined space.

- Electrical lockout must be confirmed.
- Process isolation must be confirmed.
- 0_2 must be greater than 19.5% and less than 23%.
- Explosive mixtures must be 0.
- Toxic gases must be 0.

Lighting

- Personnel-rated ground fault trip breakers must be used.
- Only explosion-proof lighting may be required.
- Battery-powered 6-volt lamps are acceptable, depending upon the original contents of an enclosed confined space.

Ventilation

Ventilating is the process of continuously moving fresh air through the confined space.

The two basic reasons for ventilation are:

1. To remove or control hazards. The confined space may have a harmful or flammable atmosphere that must be controlled, reduced, or eliminated.
2. To supply fresh air to workers. If the confined space work area is restricted or small, workers could deplete the oxygen supply.

Continuous mechanical ventilation using fans or blowers is required to control hazardous atmospheres and to maintain a fresh air supply to workers. Natural

ventilation is not a reliable method to make sure the atmosphere in a confined space is safe.

Two types of mechanical ventilation are:

1. General ventilation. General ventilation is the replacement of the entire atmosphere in the space.
2. Local exhaust ventilation. Local exhaust ventilation is used for the removal of contaminated air during work activity such as welding.

Confined spaces, with clean-out doors, must be opened and thoroughly ventilated. Eductors and air operated blowers are effective methods of mechanical ventilation. They bring in fresh air and remove contaminants from the confined space. They must not bring contaminated air back in.

The mechanical ventilation equipment should be kept operating after the confined space is cleaned and ventilated. This will provide protection in case harmful substances enter the confined space. This will also remove contamination or heat that may be produced by the work that is done in the confined space (example, welding and cutting, painting, coating).

Excessive heat can develop during welding and cutting operations in confined spaces. Local exhaust ventilation may control fumes. It may not control the excessive heat.

General exhaust ventilation will help control welding fumes and the heat from welding. More air or supplied air cooling may be needed to maintain comfortable workplace temperatures for torch cutting over long periods of time.

Administrative controls

Training and personnel

There are risks in confined space entry work. It is important to have trained, experienced workers on the job.

- The workers must be trained to handle specific hazards or to carry out special testing techniques.
- The training requirements must be written down. There must be a complete list of personnel needed to perform the following procedures:
    - Pre entry procedures.
    - Entry and work procedures.
    - Exit and clean-up procedures.
    - Emergency procedures.
    - Rescue procedures.
- The workers must know the team structure and delegation of authority if the task is complex.

Communications

Confined spaces often make talking difficult because of noise, distance, protective equipment, lighting conditions, etc. Procedures must be developed to make sure there are safe communications among all personnel.

- Special equipment and techniques may be used. Radios, microphones, safety persons, hand signals, flags, etc. may be used. Emergency communication links and networks should also be established. Visual communications are the most reliable.
- Communications by voice, phone, alarm system, beeper system, or radio, should be established between safety personnel and the emergency rescue team.

Signs

All confined spaces must have a sign identifying them as a confined space at each entry point.

Danger:

Confined Space

Do NOT enter

Without a Valid Entry Permit

- Display a sign reminding workers not to enter. It must be in a prominent position near the man way (entrance or exit). This must be done when a vessel is left open and unattended.
- Lock man way doors in the open position.
- Place tape or signs over the man way, when the last person exits. They should be placed in such a manner that the tape or signs must be removed to allow entrance. This must be done before leaving the man way at such times as coffee breaks, meal breaks or at completion of the work day.
- Maintain signs in a legible and effective condition.

Personal protective equipment required

Workers exposed to hazards in a confined space must be protected from injury. This is done by:

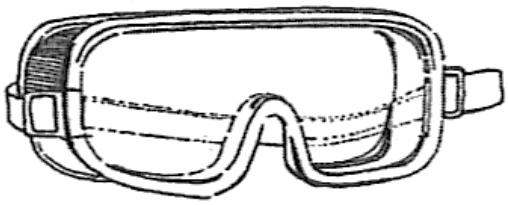
- Removing or reducing hazards.
- Reducing or eliminating worker exposure.
- Ensuring that workers wear Personal Protective Equipment (PPE).

A qualified person must make sure that the appropriate equipment is available and that workers wear it. Training and practice with PPE is required. Work and rescue will proceed safely and efficiently with training and practice with PPE.
In most confined space entries, the PPE required will be:

- Eye protection.
- Hearing protection.
- Protective clothing, example: coveralls, hard hat, footwear, gloves.
- Body harness to help facilitate rescue if required.
- Life line if possible.
- Air purifying respirator.
- Air supplying respirator.

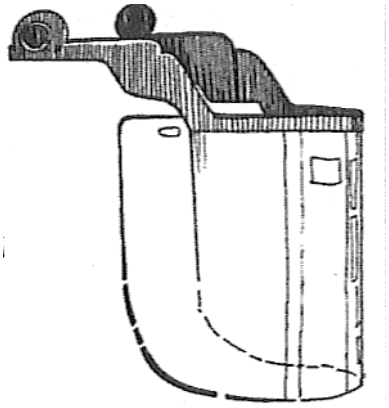
Other personal protection equipment may be required.

Eye Protection



Cover Googles

Safety Glasses

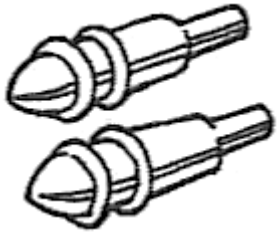


Face Shield

Source: Enform Canada. (2005). *GELS: General entry level safety*. (3rd ed.). Calgary: Enform Canada.p.2-8

Hearing protection

Class A Ear Muffs

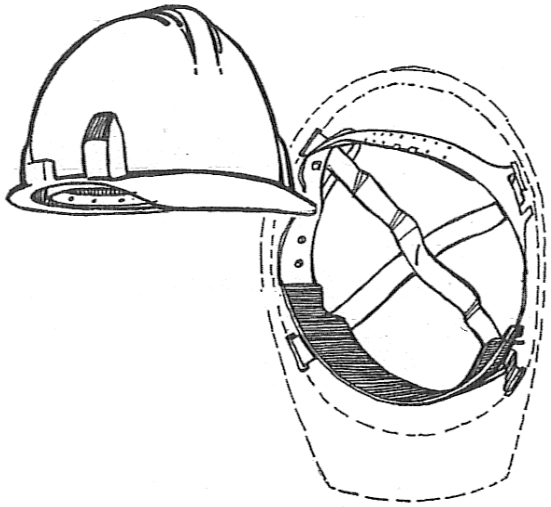


Class B Ear Plugs

Class C Ear Plugs

Source: Enform Canada. (2005). *GELS: General entry level safety*. (3rd ed.). Calgary: Enform Canada.
p. 2-10

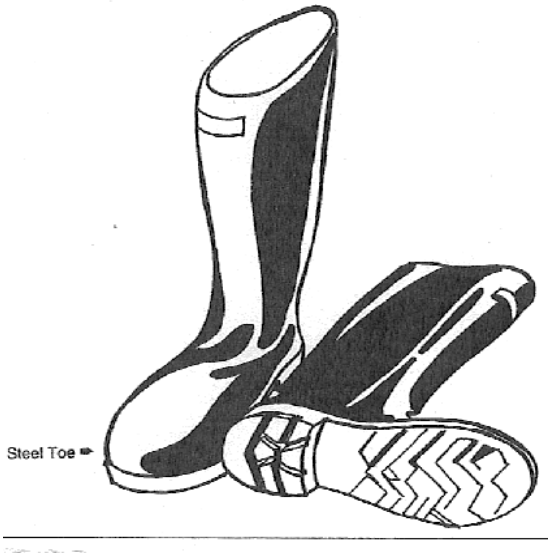
Protective clothing, i.e. coveralls, hard hat, footwear, gloves



Hard Hat

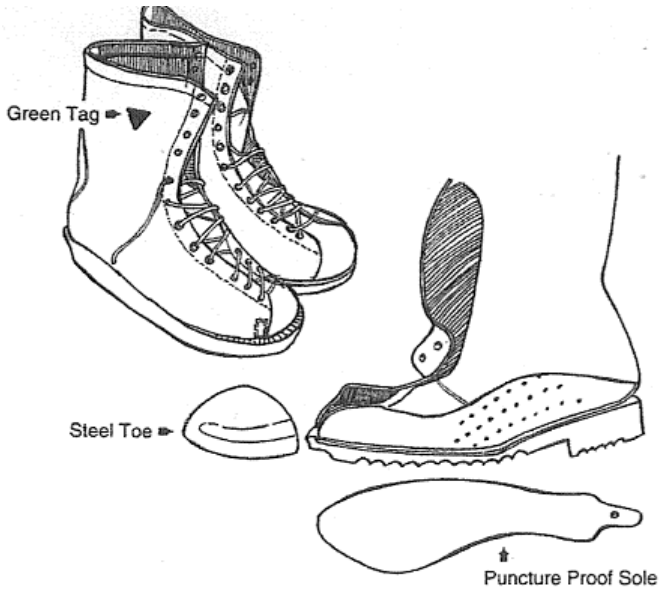
Source: Enform Canada. (2005). *GELS: General entry level safety*. (3rd ed.). Calgary: Enform Canada.p.2-7

Foot Protection



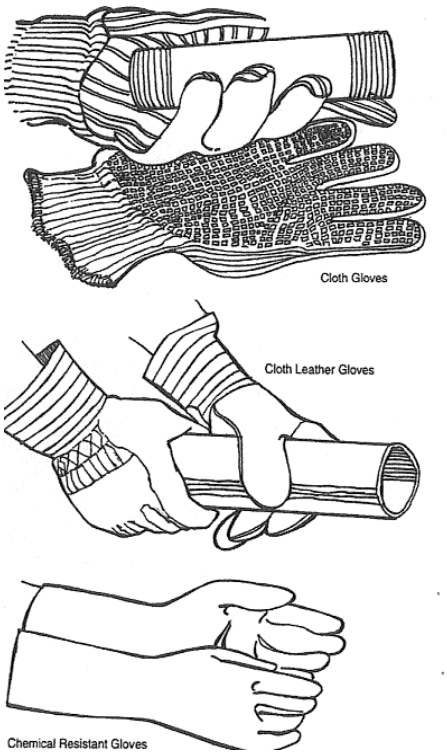
Liquid proof safety boots

Source: Enform Canada. (2005). *GELS: General entry level safety*. (3rd ed.). Calgary: Enform Canada. p. 2-15



Source: Enform Canada. (2005). *GELS: General entry level safety*. (3rd ed.). Calgary: Enform Canada.
p. 2-14

Hand Protection

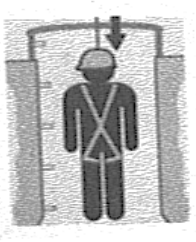


Source: Enform Canada. (2005). *GELS: General entry level safety*. (3rd ed.). Calgary: Enform Canada. p. 2-12.

Body harness

Source: *Confined space entry*. (2004). Nisku, AB: Leduc Safety Service Ltd. p.5-02

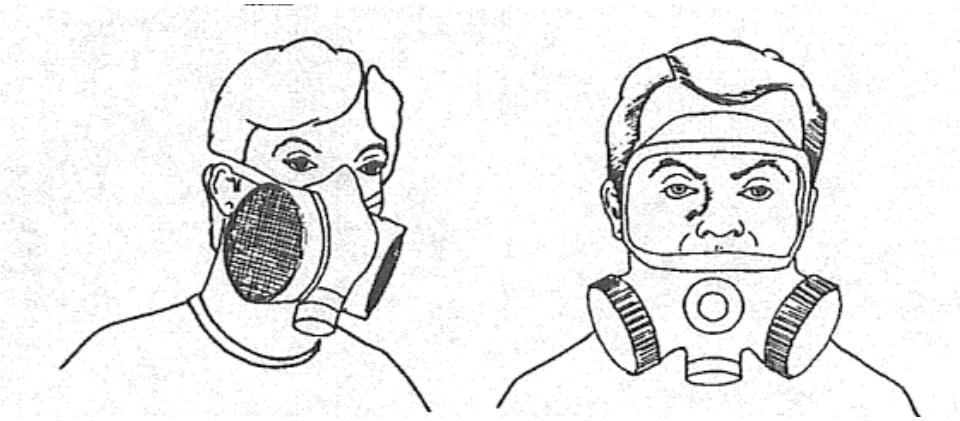
Life line



Source: *Confined space entry*. (2004). Nisku, AB: Leduc Safety Service Ltd., p.5-02

Air purifying respirator

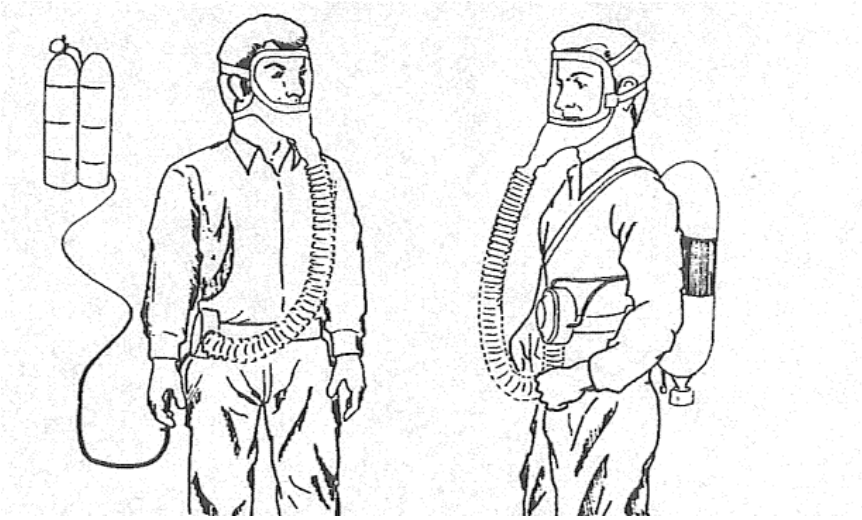
Do **not** use in oxygen deficient atmosphere



Half Mask Full facepiece

Source: Pettit, T. and H. Linn. (1987). *A guide to safety in confined spaces.* Washington, D.C.: U.S. National Institute for Occupational Safety and Health. Retrieved November 14, 2006 from http://www.cdc.gov/niosh/pdfs/87-113.pdf

Air supplying respirators



Supplied Air Respirator with Auxiliary, Escape-only SCBA

Self-contained Breathing Apparatus (SCBA)

Source: Pettit, T. and H. Linn. (1987). *A guide to safety in confined spaces.* Washington, D.C.: U.S. National Institute for Occupational Safety and Health. Retrieved November 14, 2006 from http://www.cdc.gov/niosh/pdfs/87-113.pdf

Other personal protection may be required.

Section 5 - Code of Practice

Confined space entry code of practice summary

- The following procedures must be followed before entering a confined space:
- Identify all hazards and controls.
- Prepare a plan for the work to be done in the confined space.
- Make sure the confined space is isolated from any dangerous fluid or gas and the method is documented.
- Make sure a Man Watch is named for the job. The person must be aware of his or her responsibilities. The person is to watch work activities and respond to emergencies.
- Identify the hazards. Make sure all workers are aware of the hazards and how to avoid them.
- Make sure the safety equipment, emergency equipment and test equipment are there. Make sure personnel know how to use the equipment.
- Use a whiteboard or notice board to write down who is in the confined space.
- Make sure a safe communications system is in place between the Man Watch and all workers in the confined space.
- Make sure a rescue plan is prepared and all workers are aware of this before the work is started.
- Make sure that all safe work permits have been acquired and reviewed with workers.
- Conduct Combustible Gas, Oxygen, and Toxic gas tests before any confined space entry.

Training required for confined space entry

Personnel responsible for supervision, planning, entering or participating in confined space entry and rescue should be trained in their duties before any confined space entry.

The confined space entry work must be under the direction of a competent supervisor. The supervisor must know:

- The hazards in the confined space.
- Fire and accident prevention.
- First Aid.
- Rescue plans.

The workers must know:

- The hazards.
- Safety rules.
- Rescue plans needed in an emergency.

Training requirements may include:

- First Aid.
- Hazard identification.
- Hazard controls.
- Rescue plans.
- Physical Entry into Confined Spaces.
- H_2S Alive.

Section 6 - Isolation of the Confined Space

The workspace must be isolated from other worksite areas, before a confined space entry. The confined space may be closed off or it may have a barrier placed around it. This may prevent regular hazards from entering the system. It is the employer's responsibility to make sure that all isolation methods are properly installed.

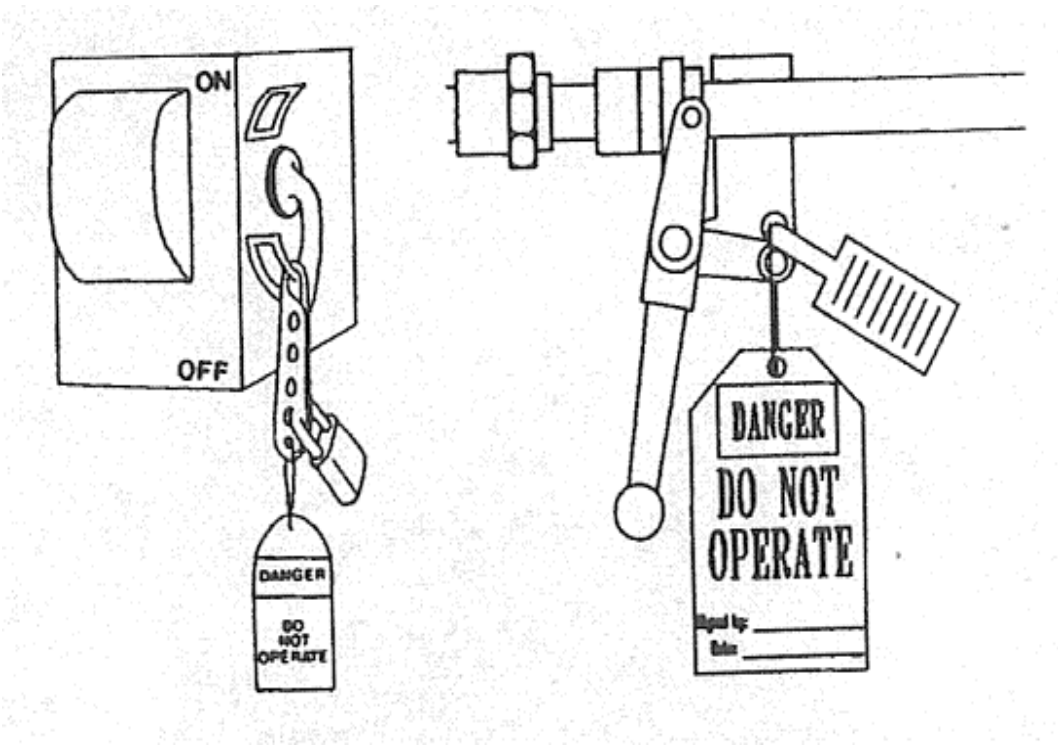
Confined space isolation methods

A worker's safety may be put in danger by equipment or hazardous materials in a confined space. Workers need to be trained in isolation safety methods to protect themselves from these dangers. Isolation safety procedures include:

- Lockout and Tagout.
- Area Isolation.
- Blanking off and Blinding.
- Separating and Proper Blocking.
- Double Block and Bleed.

Lockout and Tagout

All mechanical equipment in the confined space must be disconnected from the power source. The controls must be locked out to prevent accidental start up. This includes electrical, mechanical, steam, compressed gas, hydraulic, gravity, wind, and radiation devices. There should only be one key for the lock. The equipment control switch must be operated to make sure that the power source is disconnected. Locking out, separating, and blocking may isolate hydraulic devices.



Examples of Lockout

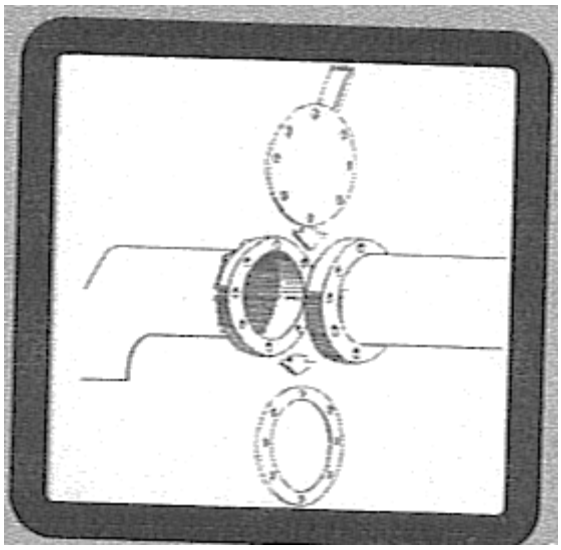
Source: Pettit, T. and H. Linn. (1987). *A guide to safety in confined spaces.* Washington, D.C.: U.S. National Institute for Occupational Safety and Health. Retrieved November 14, 2006 from http://www.cdc.gov/niosh/pdfs/87-113.pdf

Area Isolation

Area isolation is an effective method to prevent contaminants from entering or exiting a confined space. Hoarding for an area asbestos removal job uses area isolation.

Blanking off and Blinding

All lines and systems that allow hazardous materials to enter a confined space must be blanked off. Blanking means putting a physical barrier through the cross section of a pipe so that materials are stopped from flowing past that point. All connecting pipelines must be blanked off or disconnected and blinded. Blanks or blinds should be installed as close as possible to the confined space.



Blanking

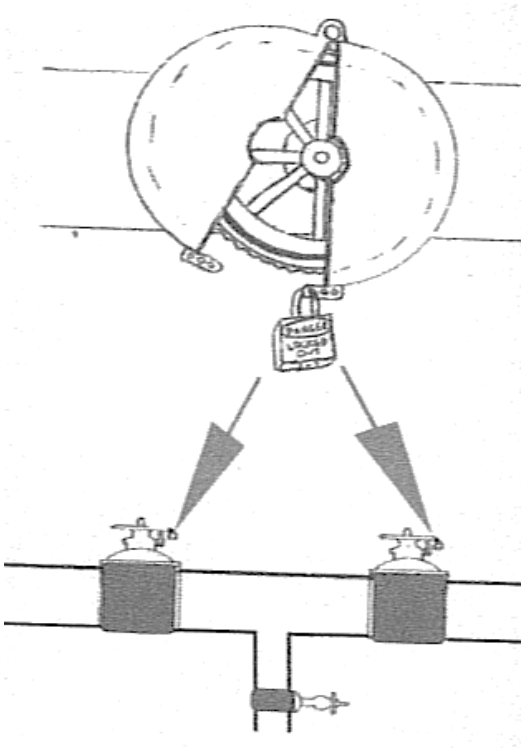
Source: *Confined space entry*. (2004). Nisku, AB: Leduc Safety Service Ltd. p.1-50

Separating and proper blocking

All connecting piping and pipelines must be disconnected and plugged or capped. Where threaded pipes are used, threaded plugs or caps must be of the same material.

Double Block and Bleed

Double block and bleeding is used with a three-valve system. A pipe has two closed valves secured with locks. This prevents material from flowing. Between the two closed valves is an open drain valve. This allows the material to be redirected in case of a valve leak. The isolation valves must be locked in the closed position. The bleed valve must be locked in the open position. It must be piped to a safe place of disposal.



Source: *Confined space entry*. (2004). Nisku, AB: Leduc Safety Service Ltd. p.1-50

If the fluid that would be released from the bleed of a double block and bleed is not toxic and does not create a hazard, then this method may be used to isolate lines to a vessel for entry.

Section 7 - Emergency Preparedness

To be prepared for an emergency the rescue equipment required in the plan must be written down. The list of rescue equipment should include the following:

- Adequate area, platforms or staging at access points.
- Lifting or lowering equipment to help remove a person from a confined space or vessel and lower that person to floor level.
- Personnel safety equipment such as body harness, safety lines and protective clothing.
- The actual equipment required on-site for a specific job. This shall be determined at the outset when a Confined Space Entry and Rescue Plan is being developed.

There must be a Man Watch at the confined space entrance. The Man Watch must:

- Be equipped with appropriate personal protective equipment.
- Be equipped with other emergency equipment.
- Be capable of effecting a rescue.
- Be able to communicate at all times with the worker(s) inside.
- Never leave their post unless they are properly relieved by a qualified person(s).

The “Confined Space Entry and Rescue Plan”, practices, and procedures must be reviewed at the pre-job toolbox talk. The site-specific emergency response plan must be documented and agreed to by all workers involved. All confined space personnel must sign the Confined Space Entry and Rescue Plan before confined space entry can proceed.

Section 8 - Entry

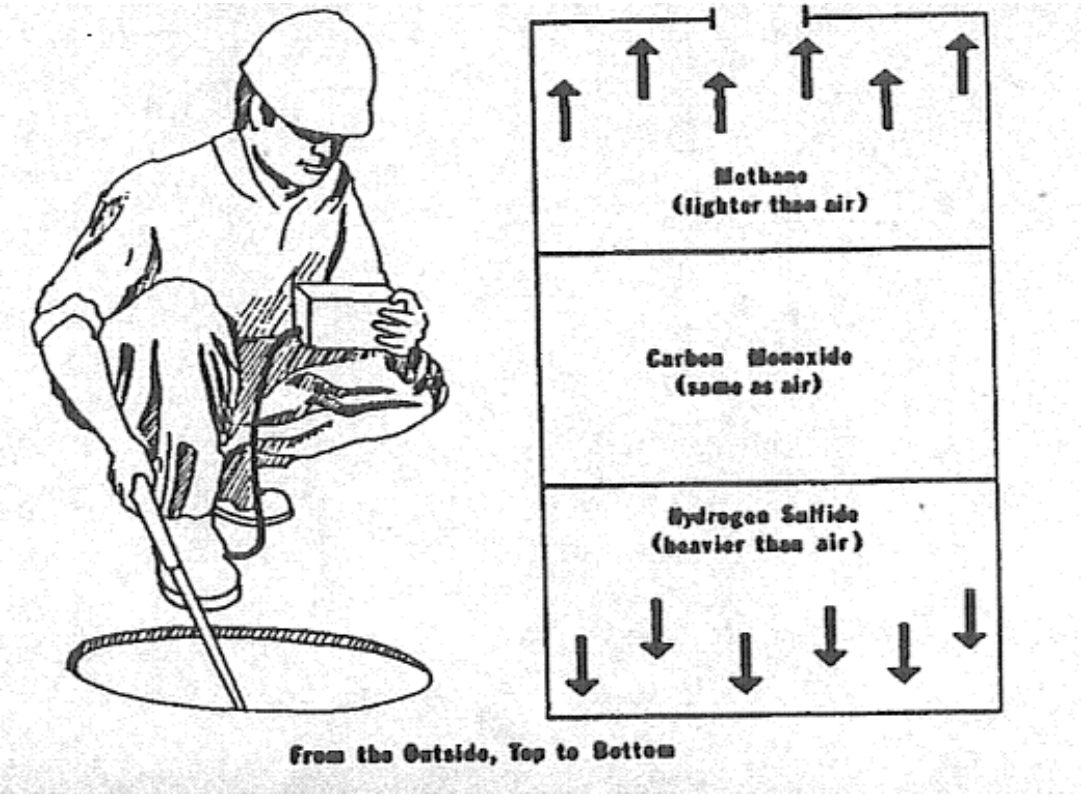
Before Entry

Before entering a confined space it is mandatory to test for:

- Oxygen levels.
- Explosive conditions.
- Levels of contaminants.

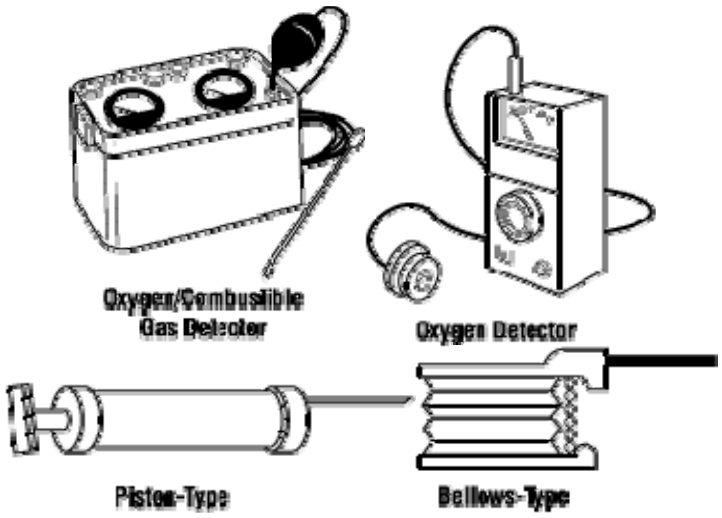
The test results must be recorded on the Safe Work Permit and the Confined Space Entry and Rescue Plan.

The air in the confined space should be tested from outside of the confined space before entry into the confined space. A trained worker using detection equipment which has remote probes and sampling lines should do the air quality testing.



Source: Pettit, T. and H. Linn. (1987). *A guide to safety in confined spaces.* Washington, D.C.: U.S. National Institute for Occupational Safety and Health. Retrieved November 14, 2006 from http://www.cdc.gov/niosh/pdfs/87-113.pdf

Air quality testing detector equipment is shown below.



Source: *Confined space: introduction*. (2002). Canadian Centre for Occupational Health and Safety. Retrieved August 8, 2006, from http://www.ccohs.ca/oshanswers/hsprograms/confinedspace_intro.html

Before entry is permitted air quality samples must show that:

- The oxygen content is within safe limits – not too little and not too much.
- A hazardous atmosphere (toxic gases, flammable atmosphere) is not present.
- Ventilation equipment is working properly.

Logging in and logging out

A white board or similar log system must be set up beside the vessel or confined space. All workers entering the confined space must sign in and out. They must record the time of their entry and exit. It is mandatory to record and document every single entry.

Job completion

At the end of a confined space entry job make sure:

- That no tools, equipment or workers have been left behind.
- That all personnel have been signed off the board and are accounted for before leaving the confined space.
- Lockouts, mechanical blocks, or other hazard-control devices have been removed, and a record system is signed off.

Section 9 – Glossary of Terms

air contaminants	Substances in the air that may be harmful to health. Five major types are: dusts, mists, fumes, gases and vapours.
A.P.R **air purifying respirator**	see **respirator**
bio-hazardous materials	Infectious agents that present a risk, directly through inhalation, ingestion, or skin absorption, or indirectly through disruption of the environment, i.e. waste water treatment.
blank	A solid circular metal plate installed at the end of a pipe, which has been physically disconnected from a piping system, i.e. blend flange.
blind	A solid circular metal plate installed through the cross-section of a pipe, usually at a flanged connection, and typically inside the flange bolt pattern, i.e. spade blind.
bonding	Electrically connecting elements of an installation to each other so that differences in electrical potential between the elements are minimized.
breakthrough	The point where a respirator filter element is no longer able to provide the protection it was designed for. Some indications of reduced effectiveness are breathing difficulty or odour penetration. Breakthrough time varies due to concentrations and chemical type.
burns	Thermal burns are caused by steam, compressed gas streams, hot fluids or surfaces, and chemical burns from acids or caustics.

CSA
Canadian Standards Association

Canadian Standards Association is a voluntary association chartered under the Standards Council of Canada that sets design and procedures standards.

combustible Capable of burning.

competent/qualified A competent worker is qualified, trained and has sufficient experience to safely perform work in a confined space with little supervision. Proof of competency is the responsibility of the supervisor.

confined space A space which, because of its construction, location, contents or work activity:

- Provides limited means of entry or exit.
- Has poor natural ventilation.
- Is not designated or intended for human occupancy.
- Contains or may develop a hazardous atmosphere.
- May require the use of protective equipment including the capability for immediate rescue of a worker who enters.

double block and bleed A method used to isolate a Confined Space from a line, duct or pipe. It provides a primary blocking seal and a second back-up seal with an operable bleed off between the two seals. If valves are used for isolation, the employer shall ensure that the bleed off valve is locked in the "OPEN position and the flow valves must be locked in the "CLOSED" position. Bleed must have the capacity to handle potential flow.

egress Means or route of escape.

entry into a confined space The point where the worker's breathing zone crosses the entrance of the confined space.

flammable Any substance that is easily ignited, burns intensely or has a rapid rate of flame spread.

hot work Work such as welding, torch cutting, heating and grinding. This work can raise the temperature inside the confined space, or use up the oxygen, or create

a source for ignition of flammable or combustible substances.

IDLH
Immediately Dangerous to Life and Health Atmospheres

Conditions that pose an immediate threat to life or health. Conditions that pose an immediate threat of severe exposure to contaminants such as radioactive materials that are likely to have adverse effects on health.

isolation — The separation of a confined space from sources of danger.

LEL
Lower Explosive Limit — All gases have an explosive range with a Lower Explosive Limit (LEL) and an Upper Explosive Limit (UEL). When the fuel and air mixture is below the LEL, or above the UEL, ignition will not take place. A gas is combustible only between LEL an UEL.

lockout — A specific set of procedures for making sure that a machine shut down for maintenance or repair or other reasons is secured against accidental start-up or movement of any part for the time of the shut down.

man watch — A worker assigned to remain outside a confined space and in communication with persons inside. This person must be able to effect emergency procedures.

mechanical ventilation — Ventilation of a space with mechanical air movers such as fans and blowers. The air may be directed by ductwork.

natural ventilation — Ventilation of a space by natural air movement from wind or convection currents.

NIOSH
National Institute for Occupational Safety and Health

An agency of the United States Department of Health and Human Services which is responsible for the evaluation and approval of respirators and other safety equipment.

OEL
Occupational Exposure Limit

A limit set by Legislation that refers to the concentration of a substance to which workers may be repeatedly exposed, eight hours per day, forty hours per week, without known adverse health effects. There are different levels of OEL which refer to the time of exposure.

OEL-TWA
Occupational Exposure Limit - Time Weighted Average

Unless otherwise stated, is assumed to be an eight hour work day. The exposure limit is the average concentration, in air, that workers can be safely exposed to for 8 hours, day in and day out. For example. 10 parts per million is the maximum exposure level for H_2S(hydrogen sulphide) in an eight hour day.

OEL-STEL
Occupational Exposure Limit - Short Term Exposure Limit

This is the maximum concentration, in air, that workers may be exposed to for a short period of time only (usually 15 minutes). For example, for H_2S, 15 parts per million is acceptable for no more than 4 exposures, no longer than 15 minutes in duration, in an eight hour day.

OEL-Ceiling
Occupational Exposure Limit - Ceiling

The concentration, in air, that must NEVER be exceeded, even momentarily. For example, for H_2S, workers should not be exposed to 20 parts per million at ANY time.

OEL- Skin
Occupational Exposure Limit - Skin

Substances which can add to the overall exposure by being absorbed through the skin, including mucous membranes in the nose and throat and the eyes. Because of the wide variations in people,

	some workers may feel discomfort from concentrations below the Occupational Exposure Limit, or may suffer worsening of a pre-existing condition from previous exposures.
oxygen deficiency	An atmosphere with less than 19.5% oxygen is oxygen deficient. Normal air contains about 21 % oxygen. If a person is exposed to levels between 14% -17%, it is likely to impair judgment, create euphoria and fatigue. Unconsciousness and death will occur in minutes at levels below 6%. If you notice changes in how you feel, GET OUT of the confined space as soon as possible. Because many deaths in Confined Spaces are due to lack of oxygen, make sure the levels are carefully tested with special instruments before you enter the Confined Space and continue to test the levels while you are working in the space.
oxygen enrichment	An oxygen with more than 23% oxygen is enriched. When the atmosphere is oxygen enriched, it increases the flammability of materials. Oxygen enrichment will cause flammable materials such as clothing and hair to burn violently when ignited.
PPM **Parts per million**	Parts per million is a measurement of the concentration of a contaminant in a medium. To put perspective to the term parts per million, think about one inch in 16 miles or one ounce in thirty-one tons.
respirator	A device designed to protect the human respiratory system from contaminated air. There are many types of respirators. Each provides different protection factors for the worker. Examples are air purifying, supplied air, and self-contained breathing apparatus.

routes of access

Contaminants can enter the body in a variety of ways:

- Inhalation (breathing).
- Ingestion (swallowing).
- Skin absorption (including eyes, ears, etc.).
- Injections i.e. high pressure washers.
- Open wounds.

In confined spaces, the two most likely routes of access are inhalation and skin absorption.

standby worker

see **man watch**

tending worker

see **man watch**

toxic substances

Toxic air contaminants can cause bad health effects if inhaled by workers. Safe limits of exposure are provided for many substances by regulations.

Toxic substances can be produced from such sources as:

- The process that normally occurs in the confined space.
- Work activity in the confined space.
- Waste materials in the confined space.
- Sources outside the confined space.

Some toxic substances are:

- paint thinner
- silica sand
- solvents
- polishing agents

UEL
Upper Explosive Limit

All gases have an explosive range with a Lower Explosive Limit (LEL) and an Upper Explosive Limit (UEL). When the fuel and air mixture is below the LEL, or above the UEL, ignition will not take place. A gas is combustible only between LEL an UEL.

WHMIS
Workplace Hazardous Materials Information System

A federal and provincially administered system. The system is designed to provide workers with information on how controlled substances may affect their health and safety or impact the environment.

Section 10 - Hazard Identification and Controls Checklist

HAZARD	YES	NO	CONTROLS	YES	NO
Crushing Injury			Lockout/ Blocking		
Entanglement			Lockout		
Accidental Start up			Lockout		
Flammable Explosive Gas			Monitoring		
Flammable Liquids			Monitoring		
Engulfment			Lockout/ Blocking		
Process Residue			Clean / Purge		
Electrical			GFI / Lockout		
Radiation (X-Ray)			Isolation		
Falling Objects			Fall Protection		
Trenching			Back Sloped / Shored		
Environmental			Monitoring / Ventilation		
Oils			Clean		
Dust			Monitor / Ventilation / APR		
Water			Blinded		
Steam			PPE/Blinded		
Temperature			Ventilation / Monitoring		
Chemicals			APR / Protective Clothing		
Toxic Vapors			APR/Ventilation		
Hydraulic			Positive Isolation		
Other					

Date:

Location:

Client Signature:

Prime Contractor Signature:

Section 11 - Emergency Response Checklist

Communications Requirements

The Man Watch must be able to communicate with the workmen inside the confined space at all times.

Check (X) the means of communication to be used.

Radio ___ Visual ___ Voice ___ Other (specify) _____

Should the Man Watch be unable to establish communications after several immediate attempts, activate the Rescue Plan

Personal Protective and Emergency/ Rescue Equipment required on site

PPE Equipment	Yes	No	Rescue Equipment	Yes	No
Winch			Confined Space Kit		
APR			Horizontal		
Trigas Monitor			Vertical		
Ropes (Life lines)					
Full Body Harnesses			Nearest Stretcher Located		
Head, Hearing, Hand Foot, and Body Protection Provided			First Aid Kit		
			Fire Extinguishers Available		

PPE equipment	Yes	No	Rescue equipment	Yes	No

Confined Space Entry Kit contents:

Confined Space Entry Kit contents:

- Trigas monitor.
- Thermometer.
- Whiteboard and pens.
- Ventilation unit.
- Rescue ropes and carabiner.
- Winch.
- Lockouts.

Section 12 - Confined Spaces Rescue Plan

1. Man Watch sounds alarm and briefly describes what is known about the incident.
2. Man Watch waits outside the confined space until client confirms that help is on the way.
3. Man Watch may then enter the confined space only after the atmosphere has been assessed. He will assess the situation and provide necessary information to stabilize situation.

List in the ADDITIONAL RESCUE PLAN INFORMATION section, the personnel and the action to be performed by them to effect rescue. For example: the placement of personnel at specific locations and the action they must perform to assist in the rescue).

Rescue Plan Information

_____

_____

_____

_____

_____

_____

_____

Date:

Location:

Signature:

ADDITIONAL RESCUE PLAN INFORMATION

NAME OR JOB TITLE	ASSIGNED ACTION RESCUE RESPONSE

References

Alberta Vocational College. (1998). *TDG Handbook: Study Supplement*. Edmonton: Alberta Vocational College.

Confined Space Entry. (2004). Nisku, AB: Leduc Safety Service Ltd.

Confined Space: Introduction. (2002). Canadian Centre for Occupational Health and Safety. Retrieved August 8, 2006, from http://www.ccohs.ca/oshanswers/hsprograms/confinedspace_intro.html

Doss, H.J. and C. Tilma. (2002). *Confined Space Hazards a Threat to Farmers*. Retrieved November 14, 2006, from http://www.cdc.gov/nasd/docs/d000801-d000900/d0000836/d000836.html

Enform Canada. (2005). *GELS: General Entry Level Safety*. (3rd ed.). Calgary: Enform Canada.

Hazards of Confined Spaces. (2006). WorkSafeBC. (2006 ed.) Retrieved November 14, 2006, from http://www.worksafebc.com/publications/health_and_safety/by_topic/assets/pdf/confined_space_bk80.pdf

Lethbridge Community College. (date?) *Confined Space Entry Program.* Lethbridge, AB.: Lethbridge Community College. Industrial and Technical Training Department.

Manure Pit. www.midwestadvocates.org

Pettit, T. and H. Linn. (1987). *A Guide to Safety in Confined Spaces.* Washington, D.C.: U.S. National Institute for Occupational Safety and Health. Retrieved November 14, 2006 from http://www.cdc.gov/niosh/pdfs/87-113.pdf

WHMIS Labels. (2006). WorkSafeBC. Retrieved November 11, 2006, from http://www.worksafebc.com/publications/health_and_safety/whmis/assets/pdf/whmis_basics.pdf