Confined Space Entry
New Brunswick OH&S Compliant

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Saga Universal Training Corp. is dedicated to reducing deaths caused by illness and injury. It is expected that an employer will take the fundamentals of this training and apply them to their specific equipment and workplace.

Readers should not assume that reviewing this manual alone constitutes complete training.

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Saga Universal Training Corp. wishes to acknowledge the efforts of all the people who contributed to the writing, editing, and layout of this manual.

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Disclaimer

It is expected that an employer will take the fundamentals of this training and apply them to their specific workplace.

Job and / or familiarization of workers in specific workplace environments are in addition to this training.

Although every effort is made to ensure the accuracy, currency, and completeness of the information.

Saga does not guarantee, warrant, represent or undertake that the information provided is correct, accurate or current.

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Course Description

Program Overview

- This course is designed to introduce the learner to the basic concepts, hazards, hazard control processes and safe work procedures associated with confined spaces.

- The course includes all requirements of the New Brunswick occupational health and safety regulations.

- The course includes requirements of CSA Z1006-16 Management of work in confined spaces.

- Due to the different policies and procedures and equipment utilized on different work sites certain statements in this program may not apply.

- The course is intended to supplement a company's larger Health & Safety Management System.

Certification:

At the end of each chapter there will be a multiple choice, open-book exam of which, at least 80% correct must be achieved.

Certificates of training issued by Saga Universal Training Corp. must be recognized by the employer and are valid for 3 years from the date of completion.

Course Goals:

- The student should understand the relationship between Legislation, Regulations, Standards, Due Diligence, and Best Practices.

- The student should understand the roles and responsibilities of employers and employees and workplace programs as they relate to working in confined spaces.

- The student should be aware of hazards associated with a confined space.

- The student should understand how to evaluate and identify proper hazard controls associated with a confined space.

- The student should understand the safety procedures and equipment required for working in confined spaces.

- The student should understand the requirement for emergency response and the basic elements of an emergency response for confined space.

Exposure to Harm

- A confined space can be found at almost any work site.
- Crawl spaces, cramped mechanical rooms, mezzanine areas, plumbing or electrical vaults, cargo containers and attic spaces can all fit within the definition of a confined space, depending on the design, access and work activities taking place.
- Confined spaces have a history of being dangerous places to work as hazards within them are often magnified.
- Limited access may be combined with poor ventilation, hazardous surroundings or energized equipment.
- Workers unknowingly entering an oxygen deficient or toxic atmosphere, can be fatal.
- Working in a confined space is 150 times more dangerous than doing the same job outside the confined space.
- Some of the incidents resulted in the death or injury of several workers, including those trying to rescue the first worker in distress.
- The majority of deaths in confined spaces are caused by hazardous atmospheres such as toxic gases or lack of oxygen.
- The remaining deaths are the result of physical hazards, where workers may be crushed, struck by falling objects, or buried in materials.

Chapter 1 Oversight:

There are many layers of oversight of safety requirements in the workplace that are often in a hierarchical form of priority. For example, federal laws and regulations normally supersede provincial authority, but in some instances the federal government has given authority to the provinces.

Goal:
The student will have an awareness of the various legislation, regulations, and standards that pertain to workplace health and safety.

Objectives:

1. The student should understand the relationship between Legislation, Regulations, Standards, Due Diligence, and Best Practices.

2. The student should be aware of the regulations that pertain to working in confined spaces.

3. The student should be aware of the key elements of a health and safety program.

Students Notes

Legislation

Criminal Code of Canada Section 217.1

- One of the farthest-reaching mechanisms of oversight regarding health and safety is Section 217.1 of the Criminal Code of Canada;

“Everyone who undertakes, or has the authority, to direct how another person does work or performs a task is under a legal duty to take reasonable steps to prevent bodily harm to that person, or any other person, arising from that work or task.”

Canada Labour Code Part ll

- In Canada OH&S is a provincial jurisdiction and every province has its own OH&S legislation, code, and regulations.
- However, some industries are federally regulated, which can bring OH&S for those industries under the Canadian Labour Code and under federal jurisdiction.
- Federal health and safety legislation are found in Part ll of the Canada Labour Code and Regulations.
- The Canada Labour Code applies to employees of the Federal Government, the Post Office, airports, banks, canals, highway transport, pipelines, radio and television broadcasting, railways, shipping services, and many more.
- All Provinces and Territories must meet the minimum requirements of the Canada Labour Code and Regulations in their own legislation and are certainly encouraged to exceed them.
- Approximately 90% of the Canadian workforce falls under the OH&S legislation of the province or territory in which they work.

Employer and Employee Responsibilities

- This information is a high-level summary of the many responsibilities of workplace parties, it describes the intent of employer / employee responsibilities.

- You should be familiar with all regulations that pertain to you as an employer, employee, contractor, supplier, etc..

Employer Responsibilities

- The primary purpose of OH&S laws is to keep workers safe. Under OH&S laws, employers are ultimately responsible for all persons on their worksite.

- Employers must develop safety policies and procedures for its workers, ensure the workers are aware, understand, and follow all regulations and employer policies / procedures.

- As an employer, you play an important role in preventing workplace injuries and promoting a safe and healthy workplace.

Employee Responsibilities

- Employees must, while at work, make all reasonable efforts to ensure the safety of all persons at the worksite, including other workers, traffic and pedestrians and follow all regulations, employer policies / procedures.
- Employees have the right to refuse to work on a job or in any workplace, or to operate any equipment if they have reasonable grounds to believe that it would be unsafe or unhealthy to do so.
- As an employee you are responsible to ensure you are aware, understand, and follow all regulations that apply to you in the workplace.

Provincial Legislation and Regulations

- This information is for awareness purposes only. You must familiarize yourself with specific regulations that pertain to you and your worksite.

- The New Brunswick occupational health and safety regulations apply to every occupation, employment and business, with the exception of federally regulated businesses and industries.

Regulations

- Workplaces must meet the minimum requirements of OH&S Regulations but are also encouraged to exceed them.

- Whether the workplace simply meets or chooses to exceed the minimum of the Provincial regulations, the employer should document their regulations into the company's safe work policies and procedures manual.

Standards

- OH&S regulations often refer to standards where the regulation will require the worker to follow a specific standard or use equipment that has met the requirements of a specific standard.

- The standards organizations are not the government so they cannot implement regulations.

- However, the standards organizations are made up of experts in various disciplines. The standards organizations most frequently referenced in OH&S regulations are:

- CSA Group, formerly the Canadian Standards *Association* (CSA) (CAN/CSA)
- American National Standards Institute (ANSI)

Others Include:
- American Society of Safety Engineers (ASSE),
- European Committee for Standardization (CEN), or in French: (Comité Européen de Normalisation) Conformité Européenne (CE),
- National Fire Protection Association (NFPA),
- Underwriters Laboratories (UL),
- Underwriters Laboratories of Canada (ULC),
- Safety Equipment Institute (SEI).

For compliance purposes, any equipment required to meet specific standards must bear the mark or label of a nationally accredited testing organization such as CSA or ANSI, as evidence that the equipment has been approved to the requirements of the Standard.

Use caution when purchasing equipment required to meet the various standards. Manufacturers must meet stringent criteria to have their equipment tested to these standards. There have been cases of fraud where equipment has not been tested to the standards criteria and counterfeit marks are placed on the equipment. It is always best to purchase equipment from reputable and authorized dealers.

Due Diligence

- Applied to occupational health and safety, due diligence means that employers shall take all reasonable precautions, under the particular circumstances, to prevent injuries or accidents in the workplace.

  Note: The wording is very similar in the Criminal Code of Canada Section 217.1.

Best Practices

- A best practice is a method or technique that has been generally accepted as superior to any alternatives because it produces results that are superior to those achieved by other means, or because it has become a standard way of doing things.

- Best practices are used to maintain quality as an alternative to mandatory legislated standards and can be based on self-assessment or benchmarking.

- A procedure that has been shown by research and experience to produce optimal results and that is established or proposed as a standard suitable for widespread adoption.

- There are some standards that are not required to be followed by any regulations, but individuals and groups follow them because they produce results.

Best Practice vs. Due Diligence

- If due diligence in health and safety means to take all reasonable precautions, and best practices are used to maintain quality as an alternative to mandatory legislated standards; then wouldn't following best practices be considered an example of due diligence?

- A standard not required through a regulation but has been generally accepted as superior could be considered a best practice and therefore should be followed to meet due diligence.

  Note: Can you think of an example of best practices and due diligence being followed at your worksite?

Reasonably Practicable

- In OHS the term “reasonably practicable” is frequently used.
- Reasonably practicable is a recognized term that is assessed using the reasonable person test.
- That is, what would a dozen of your peers consider reasonable in similar circumstances.
- Your peers would likely review what you did and compare it to what they do in their own operations.
- Some might do more, others less.

Requirement to Comply

Notwithstanding the requirement for competency (training and experience), appropriate equipment, and the right to refuse unsafe work:

- If legislation, regulations, or an adopted code imposes a duty on an employer, the employer must ensure that duty is met in accordance with the legislation, regulations, or the adopted code.
- If legislation, regulations, or an adopted code imposes a duty on a worker, the worker must perform that duty, and the employer must ensure the worker performs that duty in accordance with the legislation, regulations, or the adopted code.

The Bottom Line

Employers and workers must ensure they understand under which authority they are working and be familiar with the legislation, regulations and standards they must follow.

Key Elements of a Health and Safety Management System

- An organized approach through a company Health and Safety Management System is necessary to ensure all roles, responsibilities, and program requirements are met or exceeded. Elements which should be included are:

- Training, Information and Auditing.
- Management, Supervision and Internal Responsibility.
- Job Planning and Hazard Assessments.
- Safe Operating Procedures.
- Prevention of Injuries.
- Equipment Maintenance and Modifications.
- Facility Design.
- Emergency Plan.
- Additional safety training such as First Aid, WHMIS, Transportation of Dangerous Goods, Spill Containment, Ground Disturbance, Fire Safety, etc.

Chapter 1 Summary:

What was covered in Chapter 1?

- The relationship between Legislation, Regulations, Standards, Due Diligence, and Best Practices.
- A brief overview of some of the regulations that pertain to working in confined spaces.
- The key elements of a health and safety program.

Chapter 2: Ensuring a Safe Worksite

Goal:
The student will understand the roles and responsibilities of employers and employees and workplace programs as they relate to working in a confined space.

Objectives:

1. The student should be aware of employers' and employees' responsibilities as they relate to working in confined spaces.

2. The student should be familiar with the definitions of confined spaces.

3. The student should be familiar with the process for identifying confined spaces

4. The student should be familiar with the regulations for confined spaces

5. The student should be familiar with the requirements of a confined space program and plan..

6. The student should be familiar with the 3 steps for preparing a confined space entry plan.

7. The student should be familiar with the minimum training requirements for workers involved in confined space work.

New Brunswick OH&S Regulations

The general conditions that determine whether a place should be considered a confined space in New Brunswick are that:

- An enclosed or partially enclosed space,
- Not designed or intended for continuous human occupancy,
- With restricted access or egress, and
- Which is or may become hazardous to a person entering it because of its design, construction, location, atmosphere or the materials or substances in it or other conditions*, but does not include a development heading in an underground mine*

Regulation Review

New Brunswick OH&S Act

Review applicable parts of: DUTIES OF EMPLOYERS, OWNERS, CONTRACTORS, SUB-CONTRACTORS, SUPERVISORS, EMPLOYEES AND SUPPLIERS

Review all other applicable parts.

New Brunswick OH&S Regulations

Review Part XVII Confined Space

Review all other applicable parts.

Guide to New Brunswick OH&S Legislation (Confined Space)

Use as a reference as required.

Confined Spaces Explained

- Confined spaces are not intended for continuous human occupancy. Even if entry is done frequently at the work site, they are not sites of ongoing or regular work activity.

- Though they come in many sizes and shapes, most confined spaces can be classified in one of two ways:

  - Spaces that are open-topped and have depth including pits, wells, vats, hoppers, bins, degreasers, and kettles.

  - Spaces with narrow openings including pipes, tunnels, silos, casings, and sewers.

Entry points may not be designed for easy walk in.

  - Other limitations include access by ladders or by stairwells that provide poor access because of steep slope, narrow width or extreme length.

  - Physical obstructions such as bulkheads, collapsed material, or machinery may impede exit.

  - Limited means of entry / exit would not only make escape and rescue difficult but could also restrict natural ventilation.

- A confined space without any hazards or possibility of becoming hazardous may not require a permit.

- Employers and workers must be mindful that new hazards may be introduced if conditions or work practices change.

A confined space may be, or may become hazardous to a worker entering it because of:

- An atmosphere that is or may be injurious by reason of oxygen deficiency or enrichment, flammability, explosivity, or toxicity.

- A condition or changing set of circumstances within or nearby the space that present a potential for injury or illness.

- The potential or inherent characteristics of an activity which can produce adverse or harmful consequences within the space.

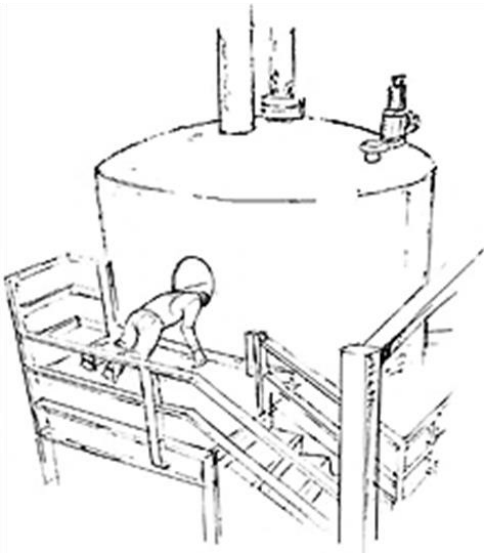
- Confined spaces may have poor natural ventilation and contain, or may contain, an unsafe atmosphere.

- Poor ventilation can be the result of unpredictable or limited air movement or air currents that draw contaminated air into the space.

- Unsafe atmospheres are most often associated with spaces that are fully enclosed such as tanks and vats, however, pits, trenches and vessels that are open topped can also contain an unsafe atmosphere.

Typical Reasons for Entering a Confined Space:

- Cleaning to remove sludge and other waste materials.
- Inspecting process equipment.
- Equipment repair and maintenance.
- Abrasive blasting and applying surface coatings.
- Tapping, coating, wrapping and testing underground sewage, hydrocarbon, steam and water piping systems.
- Installing, inspecting, repairing, and replacing, valves, piping, pumps, motors, etc. in below ground pits and vaults.
- Checking and reading meters, gauges, dials, charts and other measuring instruments.
- Rescue of workers who are injured or overcome while inside the confined space.



- Before entering a confined space, ask yourself if entering the confined space is necessary?

General Requirements for Workers Entering a Confined Space

- A hazard assessment must be performed prior to entry.
- Workers assigned duties related to the entry must be trained to recognize hazards and how to perform their duties in a safe and healthy manner.
- General safety requirements involving the use and availability of safety, personal protective, and emergency equipment, as well as a communication system.
- Prevention of unauthorized persons entering a confined space.
- Protection of workers from hazards created by traffic in the area of the confined space.
- Workers cannot enter or remain in a confined space unless an effective rescue can be carried out.
- A competent worker, designated by the employer, must be nearby and in communication with the worker(s) inside a confined space.
- A safe means of entry and exit must be available to all workers required to work in the confined space.

Confined Space Program

- A confined space program is a written document that includes:
    - a method for recognizing each confined space to which the program applies;
    - a method for assessing the hazards to which workers may be exposed;
    - a method for the development of confined space entry plans;
    - a method for training workers; and, an entry permit system.

A program sets out the methods by which an employer intends to comply with the regulation, such as how to recognize confined spaces, how assessments will be carried out, how plans will be developed, how training will be delivered and what the entry permit system will be.

Confined Space Entry Plan

A plan is a specific set of measures and procedures to control hazards identified by the assessment for that confined space to allow workers to enter and work in a specific confined space safely.

The plan should include;

- Recognition and identification of potential hazards associated with the confined spaces that will be entered.

- Evaluation and control procedures for the identified or potential hazards.

- All equipment such as ventilation equipment (blowers), harnesses and air quality monitors (e.g., Oxygen/combustible meters) that will be used while in the confined space.

- All personal protective equipment (e.g., respirators) that the worker will be using while in the confined space.

- All procedures for entering the confined space.

- Procedures to adequately secure each entrance to the confined space against unauthorized or accidental entry.

- Procedures to follow in the event of a situation developing that could present additional risk to the worker or an emergency.

- The specific work to be done while in the confined space.

- The help of safety professionals such as industrial or occupational hygienists or engineers may be necessary if the situation is particularly complex.

- A written confined space entry plan should identify who has responsibilities for confined space entry and a general description of how confined spaces are dealt with in your workplace.

- This specific information is necessary to ensure that all workers understand the requirements for entering a confined space.

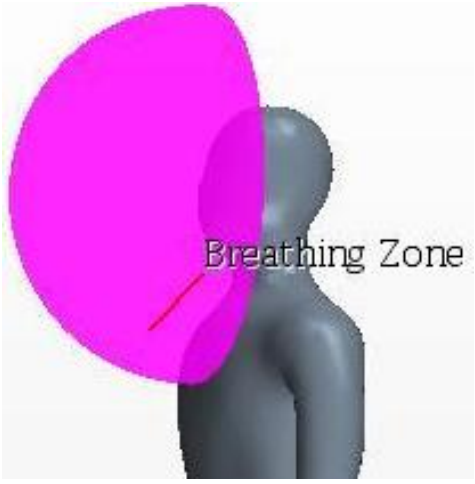
There are three basic steps in preparing a confined space entry plan:

- Develop the program
- Identify hazards in the confined spaces.
- Develop the entry plan.

- A worker is considered to have “entered” a confined space when any body part crosses the plane of the confined space access.

- The breathing zone is the area within 25cm (~10”) of a person’s mouth and nose and is where the air you breath is drawn from.

- You could potentially breathe in the air from the confined space without actually entering it.



Training Requirements

- Although it is the employers' responsibility for the provision of training, employees are responsible to use that knowledge and participate in any company procedures regarding safety.
- Remember, no one can make you safe, that is a choice that you make.
- All workers who work within confined spaces and all workers with related duties e.g. rescue workers and tending workers or "safety watch" personnel, must receive training specific to confined spaces.
- Every worker who works in a confined space must be able to recognize the hazards of working in the space and safely perform assigned duties.
- The rescue portion of this training may be part of a company or operation-wide emergency preparedness and response plan.
- Training on its own does not ensure that a worker is competent to safely perform work. In addition to training, a worker must be adequately qualified and experienced to work safely.
- In cases where a worker is new to the job and does not have sufficient experience, the worker must be teamed up with and work under the direct supervision of a competent worker.

- Requirements for worker training will vary depending on the tasks of different workers, but must at least include:
    - Safe work procedures for entry into the confined space.
    - Safe work procedures for working inside the confined space.
    - Hazard recognition.
    - Content of the entry permit.
    - How to properly use the control measures in place to protect workers, (engineering controls, administrative controls and personal protective equipment).
    - What to do in the event of an emergency.

Chapter 2 Summary:

What was covered in Chapter 2?

- The definition of confined space.
- The OH&S regulations requirements for confined spaces.
- The process for identifying confined spaces.
- The employers' and employees' responsibilities as they relate to working in confined spaces.
- The OH&S requirements with respect to a confined space program.
- The 3 steps for preparing a confined space entry plan.
- The minimum training requirements for workers to receive training for confined spaces.

Chapter 3: Hazards Associated with Confined Spaces

Goal:
The student should be aware of hazards associated with Confined Spaces.

Objectives:

1. The student should be familiar with the hazard assessment process.

2. The student should be aware of the hazards typically associated with confined Spaces.

The student should be familiar with five elements that should be included in the written procedures for atmospheric testing.

Hazard Assessment

- Before any worker enters a confined space, the employer shall ensure that an adequate assessment of the hazards related to the confined space has been carried out.

- The employer must have a list of all confined spaces in the workplace.

- The employer may have the qualified person review the list to ensure all the confined spaces have been properly identified.

- For each confined space or group of similar spaces, the qualified person will identify potential hazards and assess the likelihood of each occurring.

- Hazard assessments must be conducted to identify existing or potential hazards before work begins, at regular intervals and when anything changes that could affect the safety of the worksite.
- A report must be filled out listing the results of the hazard assessment.

- Hazards are required to be assessed for risk prior to any controls being put in place.

- The methods used to control or eliminate the identified hazards must be recorded.

- Once a hazard has been identified, a worker is required to follow safe work procedures to avoid causing damage or injury at the worksite.

- Workers should participate and contribute to discussions:
    - Ask questions of task assignment and how your job fits in with the overall job.
    - Discuss your role with supervisor/foreman and co-workers.
    - Develop a work plan that accounts for others' tasks and reduces or eliminates risks to others that could be created by your task's hazards.
    - Assess and discuss specific tasks and/or site hazards; introduce new information as needed.

- Be alert for changes that may impact your task or those of your co-workers.; if any significant changes are noted, inform your co-workers.

Assess weather conditions.

- If working outdoors, a detailed weather forecast should be assessed each morning.
- It is critical that weather is discussed during the planning sessions.
- Be prepared to adjust tasks, people and/or equipment if weather changes. If a weather change is expected, discuss the potential impact with the crew.

Confined Space Hazards

- A confined space could have any one or combination of chemical, physical, or biological hazards.
- Hazards in confined spaces generally fall within four categories:
    - Safety
    - Work-related
    - Human factors
    - Atmospheric

Safety Hazards

- Entry/exit points (e.g. very small openings, steep ladders, exits at height that could cause falls, exits into traffic or machinery hazard areas).
- Machinery (the worker may be trapped or crushed by drive belts augers, mixers, agitators, conveyor belts, etc.).
- Piping and distribution systems (e.g. steam lines, liquid distribution lines).
- Residual chemicals (e.g. material in a storage tank that is not completely emptied or purged, dry materials that may remain stuck to surfaces).
- Engulfment (workers can be trapped or buried by dry bulk materials such as grain, sand, flour, fertilizer and sawdust).
- Uncontrolled introduction of steam, water or other gas or liquid.
- Electricity (e.g. unguarded energized electrical equipment, motor control centres).
- Visibility (the space may be improperly or inadequately lit).
- Physical obstacles (e.g. cross bracing, baffle plates, piping).

- Walking or working surfaces (e.g. the surfaces may be hot or slippery).
- Traffic around the confined space.
- Temperature extremes (e.g. working in freezers or boilers, areas with steam or heat distribution pipes).
- Humidity.
- Noise (Noise levels can be up to 10 times greater than the same source placed outdoors).
- Vibration (e.g. equipment or tools may cause vibration, such as impact hammers, motors, etc.).
- Radiation (e.g. ultraviolet or infrared sources from welding, cutting or brazing, x-ray systems used for inspection and monitoring).

Work Related Hazards

- Manholes in contaminated ground e.g. near a leaking underground gasoline storage tank, into which poisonous or flammable gases can seep.
- Manholes, pits or trenches connected to sewers, in which there can be a build-up of flammable and/or poisonous gases and/or insufficient oxygen in the air.
- Tanks or pits containing sludge's and other residues which, if disturbed, may partially fill the confined space with dangerous gases.
- Confined spaces that contain rotting vegetation, rusting metal work, and similar natural oxidation processes that create an oxygen-deficient atmosphere.
- Some painting work and the application of certain adhesives, cleaners and liquids such as paint thinners, these can produce dangerous amounts of solvent vapour, which can cause dizziness and impair judgment.
- Solvents are often flammable so there is also a risk of fire.
- Welding activities may generate toxic gases or vapours and,
- The use of gasoline or diesel engines can lead to the build-up of poisonous carbon monoxide gas. There is also a risk of fire resulting from leaks.
- Introduction of hot work.

- The filling / emptying of an adjacent compartment / tank.
- Weather changes, such as thunderstorms a drop in barometric pressure, lightning, change in wind direction, etc.
- Heat of the day increasing vaporization and affecting personnel (heat exhaustion).
- Pipes entering the confined space may contain hazardous materials.

Human Factor Hazards

- Some workers may have phobias (e.g. claustrophobia, fear of heights) that could interfere with their ability to work in a confined space.
- The use of bulky personal protective equipment (especially respirators) can also cause heat stress and fatigue.
- The physical condition of workers may also be a factor in cases where there are temperature extremes, or the work is physically demanding.

- As a result, some workers may not be suited for work in confined spaces.
- The employer should consider the physical condition of the workers during the hazard assessment process.
- Fitness-to-work assessments should be done by a qualified professional to ensure it is safe for workers to perform work in a confined space.

Atmospheric Hazards

Confined spaces can become unsafe as a result of atmospheric hazards such as:

- Oxygen deficiency or enrichment.
- Flammable gases
- Toxic gases
- Other substances such as animal droppings, mould

- It is important to remember that all gases are chemicals and chemicals are extremely difficult or impossible to detect with human senses.

The atmospheric hazards of a confined space must be determined by a qualified person after considering:

- The design, construction, and use of the confined space.
- The work activities to be performed.
- Possible effects of all required engineering controls.

Atmospheric hazards are generally hazard-rated as high, moderate, or low risk. However, some employers use Level 1 (High), 2 (Moderate), or 3 (Low).

High Risk Atmosphere
A high risk atmosphere is one that may expose a worker to risk of death, injury, or acute illness, or otherwise impair a worker's ability to escape unaided from a confined space if the ventilation system or respirator fails.

Moderate Risk Atmosphere
A moderate risk atmosphere is one that is not clean, has breathable air but is not likely to impair a worker's ability to escape unaided from a confined space if the ventilation system or respirator fails.

Low Risk Atmosphere
A low risk atmosphere is one that is shown by pre-entry testing or is otherwise known to contain clean, breathable air immediately prior to entry into a confined space, and that is not likely to change during the work activity.

Oxygen Deficiency

- Lack of oxygen is a leading cause of death among workers in confined spaces.
- Normally air contains 20.9% oxygen.
- Where the percentage of oxygen in the confined space is less than 19.5% by volume, an employer shall ensure that an employee who enters the confined space uses appropriate respiratory protective equipment capable of providing at least five minutes reserve of unaided life support beyond the time the employee is expected to be in the confined space.
- Low oxygen levels cannot be detected by sight or smell, you must test the air for this hazardous condition.

Common causes of oxygen deficiency in a confined space:

- Oxygen is used up when metals rust.
- Oxygen is used up during combustion, for example, by propane space heaters, during cutting or welding, and by internal combustion engines.
- Micro-organisms use up oxygen, for example, in sewer lines and fermentation vessels.
- Oxygen can be displaced by other gases, for example:
    - Welding gases.
    - Toxic or flammable gases, (e.g. H2S or Methane)
    - Inert gases, for (e.g. argon or nitrogen).
- During purging, an inert gas such as nitrogen is deliberately pumped into a confined space to force out (purge) flammable or explosive vapours or gases.
- When possible, the inert gas is replaced with fresh air before the space is entered.
- Always test the atmosphere to confirm the oxygen concentration, concentration of flammable gases, the presence and concentration of any toxic chemicals.

Chapter 3, Slide 29 - Video – The Effects of a Low Oxygen Atmosphere

Oxygen Enrichment.

- Air is considered oxygen-enriched at levels above 23%.

- Enrichment can be caused by improper isolation of oxygen lines, ventilation of the space with oxygen instead of air, leaks from welding equipment, improper use of oxygen for breathing air.

  The concern is that an oxygen enriched atmosphere could result in an unpredictable fire or explosion.

This is an oxy-acetylene torch flame BEFORE the oxygen is turned on.

- A fire or explosion in an oxygen enriched atmosphere will be spectacular.

This is an oxy-acetylene torch flame AFTER the oxygen is turned on.

To prevent oxygen enrichment, follow these precautions:

- Isolate the space from any oxygen lines.

- Never ventilate a confined space with oxygen.

- Keep cylinders of oxygen outside the confined space (except for medical emergencies).

- Remove oxyacetylene torches and hoses from the confined space when not in use, whenever practicable.

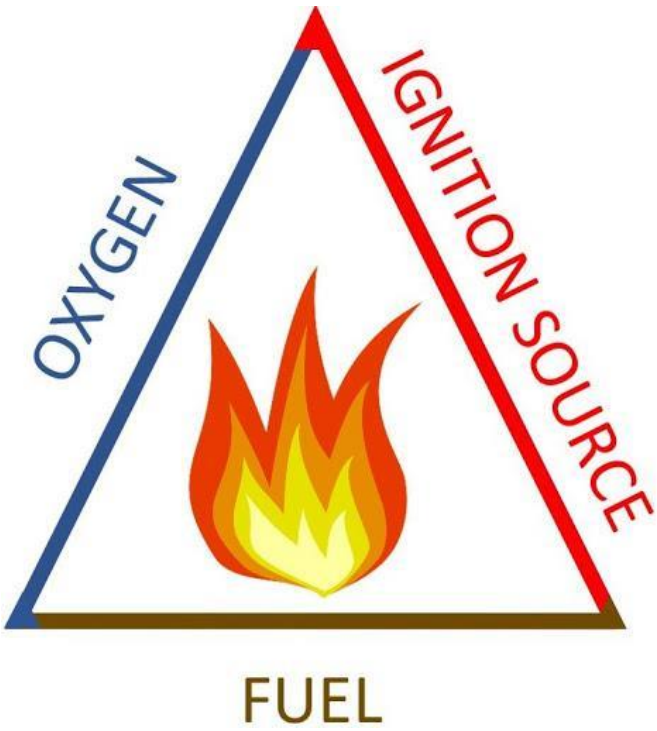
Entering oxygen enriched atmospheres

- Where the percentage of oxygen in a confined space is more than 23% by volume and an employee is to enter or work in the confined space, an employer shall ensure that the confined space does not contain any substance specified as flammable and combustible material or as dangerously reactive material in the *Hazardous Products Regulations* under the *Hazardous Products Act* (Canada).

Oxygen Concentrations	**Effects**
23% and greater	Increased combustibility of materials.
20.9%	Normal.
19.5%	Minimum for safe working condition.
16%	Rapid pulse, lack of coordination, impaired thinking.
12%	Extremely impaired judgment and coordination. Heart damage.
Less than 10%	Nausea, vomiting, unconsciousness, death.

- Note the difference between a normal oxygen level and an oxygen deficient atmosphere is only 1.4%.

Explosive Gases or Vapours
Three elements are necessary for a fire or explosion to occur:



Oxygen

- Combustion requires an oxidizing agent, the most common oxidizing agent is oxygen because of its abundance in the air.
- Air normally contains 20.9% oxygen, enough oxygen for a fire.
- A higher level of oxygen increases the likelihood of material burning.
- Keep in mind in some settings there may be other oxidizing agents present.

Fuel

- Fuel for a fire is any material that can burn.
- Fires and explosions in confined spaces are often caused by gases or vapours igniting.
- Flammable gases such as acetylene, butane, propane, hydrogen, and methane are often common in confined spaces.
- Combustible atmospheres are those in which a fuel is present in quantities sufficient to ignite.
- These concentrations define the “Combustible Range”, otherwise referred to as the “Flammable or Explosive Range”.
- These ranges vary from one material to another.

- The lower limit (LEL or LFL) is the lowest concentration of a gas or vapour that will support combustion and the upper limit (UEL or UFL) is the highest concentration of a gas or vapour that will support combustion.
- Concentrations of gas in the atmosphere less than the LEL (too lean) or greater than the UEL (too rich) will not ignite in a normal atmosphere (20.9% oxygen).

Maximum Concentrations of Explosive or Flammable Gas or Vapour

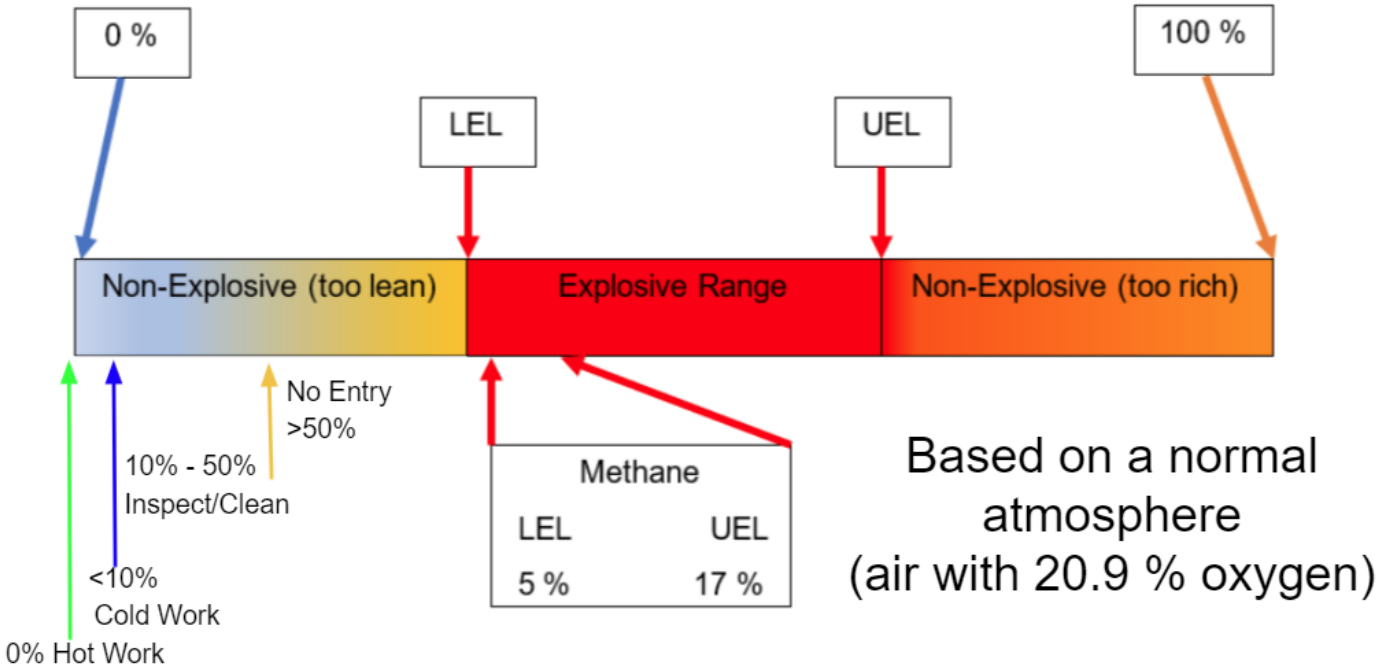
Work permitted in a confined space in relation with the lower explosive limit (LEL) detected is as follows:

0% of the Lower Explosive Limit
Hot work such as Oxy-acetylene cutting, grinding or welding in a confined space is only permitted when the LEL is 0%. Of course it will be necessary to monitor constantly for toxic gases and the LEL.

1 – 10% of the Lower Explosive Limit
Cold work is permitted in a confined space provided its LEL does not exceed 10%. Explosion-proof lighting and non-sparking equipment must be used.

11% - 50% of the Lower Explosive Limit
Cleaning or Inspection work is permitted in a confined space provided its LEL does not exceed 50%. Explosion-proof lighting must be used and the nature of the work will be such that it does not create any source of ignition.

>50% of the Lower Explosive Limit
Entering or remaining in a confined space <u>is not</u> permitted when it exceeds 50% of the LEL.



NOTE: Two or more chemicals may react with each other and become explosive.

- Containers of fuels such as gasoline and propane should not be taken into a confined space as fuel can easily burn or explode.

- Methane gas and hydrogen sulphide gas produced by rotting organic wastes in sewers or tanks.

- Hydrogen gas produced by contact between aluminum or galvanized metals and corrosive liquids.

- Solvents such as acetone, ethanol, toluene, turpentine, and xylene, which may have been introduced into the space through spills or by improper use or disposal.

- A fuel needs to be “primed” or at a minimum temperature before it can ignite.

- Flammable vapour mixtures occur at or above the flash point temperature of the liquid.

- Flammable gas mixtures can form at any temperature.

- Keep in mind as temperatures rise flammable liquids may start to give off vapours, the same applies to liquids being disturbed.

Ignition sources include:

- Open flames
- Sparks from metal impact
- Welding arcs
- Arcing of electrical motors
- Hot surfaces
- Lightning
- Chemical reaction
- Discharge of static electricity

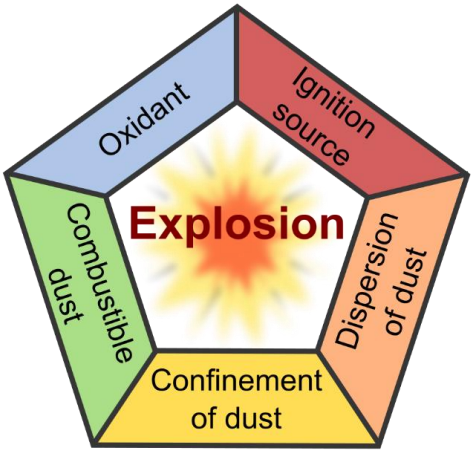
- Many processes can generate static charge, including steam cleaning, purging, and ventilation procedures.

- To reduce the risks from these ignition sources, use non-sparking tools and ensure all equipment is bonded or grounded properly.

Chapter 3, Slide 48 - Video – No Escape: Dangers of Confined Spaces

Combustible Dusts

- Grain, nitrated fertilizers, and ground chemicals can produce combustible dusts.
- Coal dust and grain dusts may explode under the right conditions.
- No worker may enter or be present in an enclosed area where there are combustible dusts posing a risk of fire or explosion unless the safety of the worker is ensured by the implementation of one of the following procedures:
    - By maintaining and controlling such dusts at a safe level;
    - By controlling existing ignition sources in the enclosed area associated with the training of the worker, by a qualified person, on the methods and techniques to be used for performing the work safely;



Corrosive Atmospheres

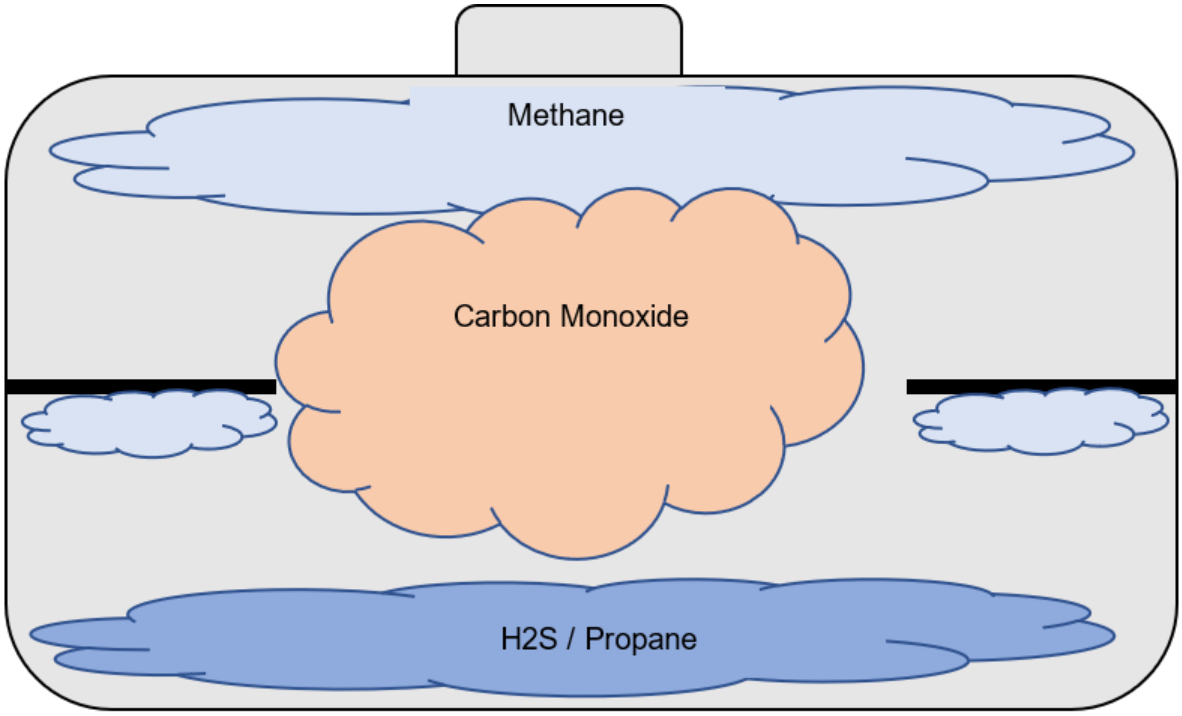
- Accumulates from some manufacturing processes, biological or chemical reactions.
- Corrosive substances destroy living tissue.
- Some cause immediate damage to skin and eyes; some have no immediate effect but cause cancer with prolonged exposure.

Toxic Gases or Vapours

- Contaminants in the air can result in an atmosphere that is toxic to workers and may result in injury or death.
- These gases/vapours can result from known materials in the work area that have not been adequately ventilated.
- Or they can result from gradual release from sludge or scale inside the confined space.
- Cleaning, painting or welding may produce dangerous vapours or fumes which can be health, fire and explosion hazards.
- Toxic gases like H2S may leak into the space from gas pockets underground.
- Carbon monoxide may be generated or collect in the space due to burning material or the use of an internal combustion engine.
- Liquids may produce hazardous atmospheres if they evaporate — for example, liquid fuel in a tank producing vapours.
- Dangerous conditions can develop when pockets of gas in waste materials are disturbed during cleaning.
- An organic material such as manure sludge can release hydrogen sulfide and methane when manure pits are cleaned out.
- Rotting pulp in tanks also creates hydrogen sulfide. If grains in silos ferment, they use up oxygen and produce deadly gases.
- The concentration of the substances inside the confined space must be determined with a recently calibrated air monitor set up with the correct sensors.
- Such an air monitor may sound an alarm that will alert the worker before the allowable exposure limit is reached.

Vapour Density

- Vapour density is the weight of a gas (vapour) compared to air.
- Air is used as the standard medium and has a vapour density equal of one (1).
- Heavier than air gases will collect in low lying areas:
  - Hydrogen Sulphide (H2S) vapour density is 1.19
  - Propane vapour density is 1.4
- Lighter than air gases will rise:
  - Methane vapour density is 0.6
- Other gases will mix evenly in the air:
  - Carbon monoxide vapour density is .98 at 20 C.
- Lighter than air gases may carry heavier gases up.
- Lighter than air gases may be trapped under baffles or other obstructions.



Key points to remember about gases in a confined space are:

- Identify the potential gases that may be present in the initial hazard assessment.
- Refer to the company Safety Data Sheet (SDS) for specific information about those gases.
- Test for the presence and concentration of the gases that were identified in the hazard assessment.
- Harmful substance must be eliminated wherever practicable.
- Take all necessary precautions to protect workers from exposure.
- In most cases, mechanical ventilation such as fans must be used to ventilate the space, bringing in clean outside air.
- Air testing and ventilation are the best ways to ensure that workers are not placed at risk from hazardous atmospheres.
- Remember, conditions may change as the result of work being done or temperature changes.

Immediately Dangerous to Life or Health (IDLH)

- Immediately dangerous to life or health means circumstances in which the atmosphere is deficient in oxygen or the concentration of a harmful substance in the atmosphere:
    - Is an immediate threat to life.
    - May affect health irreversibly.
    - May have future adverse effects on health.
    - May interfere with a worker's ability to escape from a dangerous atmosphere.
    - In most workplaces, IDLS conditions rarely occur. Confined spaces are the exception – IDLH conditions are much more common in sewers or tanks where welding is done or tanks which contained chemicals or fuel.
    - Most chemicals have a listed IDLH level https://www.cdc.gov/niosh/idlh/intridl4.html

Occupational Exposure Limits (OEL)

- Although many contaminants in the air may be toxic, exposure to the chemicals can be legal if they remain below identified levels of concentration for certain periods of time.

- These are known as Occupational Exposure Limits (OEL's).

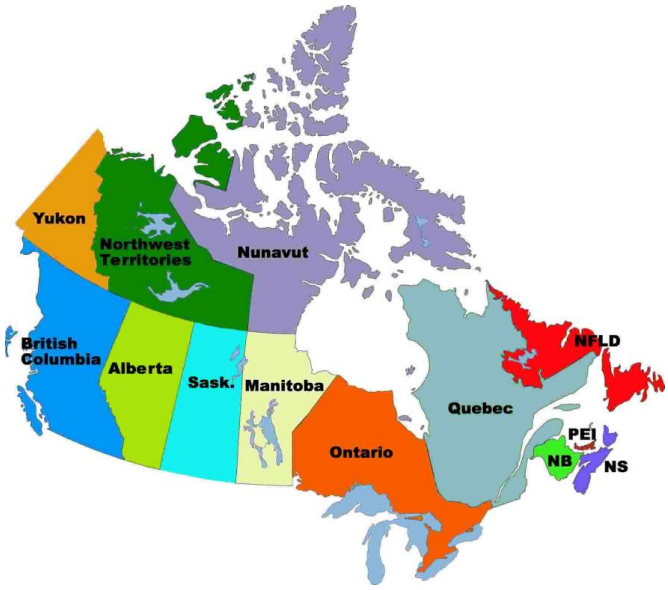
    - Also known as; Worker Exposure Limits (WEL) Threshold Limit Values (TLV's), or Permissible Exposure Limits (PEL).

- Time Weighted Average (TWA) is based on the average exposure to a contaminant or condition to which workers may be exposed without adverse effect over a period such as in an 8-hour day or 40-hour week without wearing respiratory protection.

- Short Term Exposure Limit (STEL) is the fifteen-minute (15) minute Time Weighted Average exposure which shall not be exceeded at any time during a workday.

- Ceiling Exposure Limit is the maximum allowable concentration of a controlled substance.

- Occupational Exposure Limits like many OH&S regulations can vary from jurisdiction to jurisdiction.



New Brunswick OH&S follows recommendations of the American Conference of Governmental Industrial Hygienists.

Testing the Atmosphere

- Remember all gases are chemicals and most are not detectable with human senses, you need the right tool to keep you safe.

- One of the most important requirements for keeping a confined space safe is having an accurate and reliable gas detection system and gas monitors and knowing the difference.

Gas Monitor

- A gas monitor is different from a gas detector.

- One of the most important differences is that a monitor can be portable, allowing workers to clip them onto their clothing when heading to work in an area that might have gas leaks.

- Many of the monitors are personal-use ones, and the addition of them to your commercial building can be a great benefit to your employees.

- There are some monitors that are especially designed to monitor one particular kind of gas, such as carbon monoxide, while others run the gamut of what they can detect.

- Typically, a personal gas monitor will have 4 sensors; oxygen, LEL, and 2 toxic gas sensors (H2S and Carbon monoxide) however more importantly is that the sensors that are required for the hazards that may be present have been installed.

- These devices are easy to use and light, allowing workers to carry them around as they work.

- They should be worn in the breathing zone

Gas Detector

- A gas detector is a device that will alert you if there is a gas present (provided you have the correct sensor).
- It is usually a device that is part of a greater alarm system which sends a warning in the form of an alarm to warn anyone in the area to leave.
- Gas detectors come in many different sizes and types, offering you a choice when you start looking for devices to purchase.
- There are different types for different gases (e.g., infrared, ultrasonic systems).
- These detectors can be used to detect toxic, flammable, and combustible gases as well as oxygen depletion levels.

Common Errors in Atmospheric Testing

- Have the right equipment for the job, do not use a monitor as a detector unless the manufacturer has indicated it has been designed for those specific purposes.
- If the sensors on the test equipment do not test for all the contaminants identified in the hazard assessment, then additional monitoring equipment appropriate for the contaminants and conditions must be used.
- When you turn your monitor on it will automatically zero, to ensure accurate and reliable readings before zeroing you must be certain that your environment is free from contaminants.
- Competent workers must conduct the testing with suitable test equipment that has been properly calibrated and is used in accordance with the manufacturer's specifications.
- You must be trained on the specific equipment that you will be using.
- You must follow the equipment manufacturer's instructions for proper use, but you must also have policies and procedures specific to your workplace.

- Sensors for detecting combustible gases need oxygen to provide an accurate reading, if the oxygen concentration in an environment is below 10 percent, the sensor will not function properly, and a dangerous condition may go undetected.

- It is particularly important for the individuals performing these tests to understand the limitations of the test equipment.

- The worker needs to ensure adequate levels of Personal Protective Equipment is used to protect them from what may be discovered.

- The employer must ensure that as often as necessary after the first time a worker enters the confined space, a competent worker performs the tests the atmosphere frequently enough to ensure the workers are not exposed to gases above legal limits.

Bump Test

- A bump test is a brief exposure of the monitor to gas in order to verify that the sensors respond and the instrument alarms function accordingly, the bump test does not check the accuracy of the instrument.

- Perform a “bump” (function) test before use.

Bump test using a docking station.

Manual Bump test

- A bump test is not a calibration it only let’s you know if the alarm will activate at the set point.

- A calibration check is performed by exposing the monitor to a certified concentration of gas for a particular time to verify that it provides an accurate reading.

- Monitoring equipment must be calibrated according to the frequency specified in the manufacturer’s instructions and must be bump tested or spanned as required prior to use.

- The plan must contain provisions for atmospheric testing.

- The testing must be done as often as necessary before and while a worker is in a confined space.

- The atmospheric hazards of concern include oxygen content outside the acceptable range of 19.5 to 23%, the potential accumulation of flammable, combustible, or explosive agents, or accumulation of atmospheric contaminants.

Minimum Requirements

- Testing should be done in accordance with the entry plan developed by the employer that should include:

    - What to test for.

    - Testing initial conditions.

    - Continuous monitoring.

    - Proper test procedures and equipment for when and where to test

What to Test For:

- Before entering a confined space that may contain a hazardous atmosphere e.g. oxygen deficient or containing toxic or explosive substances, pre-entry atmospheric testing must be done to ensure that levels of oxygen are adequate, and the concentration of any hazardous substance is identified.

Testing Initial Conditions:

- Test before opening access to the space, or if not possible, immediately after the space has been opened. (use appropriate PPE).

- If it is not possible to test before opening the space, do pre-entry testing before any ventilation is applied to the space.

- Testing must be conducted to verify that the required precautions have been effective at controlling the identified hazards and that the atmosphere is safe for a worker to enter a confined space.

Continuous Monitoring

- Situations may arise in which the atmosphere within a confined space, or the concentration of an airborne substance(s) within a confined space, can change unpredictably.

- If a wide enough margin of safety is applied to the alarm settings, the alarm can be used to indicate that workers must leave the space.

- The entry plan should ensure appropriate monitoring equipment is used for contaminants whose concentrations could exceed the protection provided by respirators.

Continuous monitoring is required:

- When performing hot work in a confined space.
- Where it cannot be confirmed that the concentration of toxic substances or safe levels of oxygen is able to be maintained .
- As set out in the confined space plan.

Proper test procedures and equipment for when and where to test.

- Where gases maybe trapped.
- At hazard points during line disconnect or other isolation procedures.
- Before workers re-enter a space after it has been vacated.
- Before and after procedures such as cleaning and purging.
- When there is a change in work.
- During work that causes contaminants to be generated in the workspace.
- If a change of atmosphere is suspected or it is possible that control measures cannot or do not ensure a safe atmosphere.
- If a hazardous substance is accidentally released into the confined space.
- If a worker indicates symptoms of exposure to air contaminants, for example a “light-headed” feeling, headache, a choking or coughing feeling, nausea, burning or fogging eyes.
- If ventilation fans have been shut down for any reason.

Five Essential Elements for Atmospheric Testing:

- Ensure the hazard assessment has been completed by competent persons, including;
    - A person who knows the history of the confined space and what possible hazards are.
    - A person who understands what work is being done and how work in the confined space will be conducted.
- Ensure the gas detector / monitor operator is competent.
- Ensure the proper sensors are in the gas detector / monitor.
- Ensure the gas detector / monitor is calibrated and properly bump tested.
- Ensure proper test procedures are followed.

Chapter 3, Slide 90 - Video – Sullivan Mine, Kimberly, BC

Chapter 3 Summary
What was covered in Chapter 3?

- The hazard assessment process.
- Hazards typically associated with Confined Spaces.
- Five elements that should be included in the written procedures for atmospheric testing.

Chapter 4: Controlling Confined Space Hazards

Goal:

- The student should understand how to evaluate and identify proper hazard controls associated with a Confined Space.

Objectives:

1. The student should be familiar with the hierarchy of controls and how it is applied.

2. The student should be familiar with controls used for hazards in confined spaces.

Hierarchy of Controls

- When a hazard has been identified and the risk assessment completed controls may be put in place beginning with the most effective control.
- For every confined space, the employer must evaluate each hazard that workers may be exposed to.

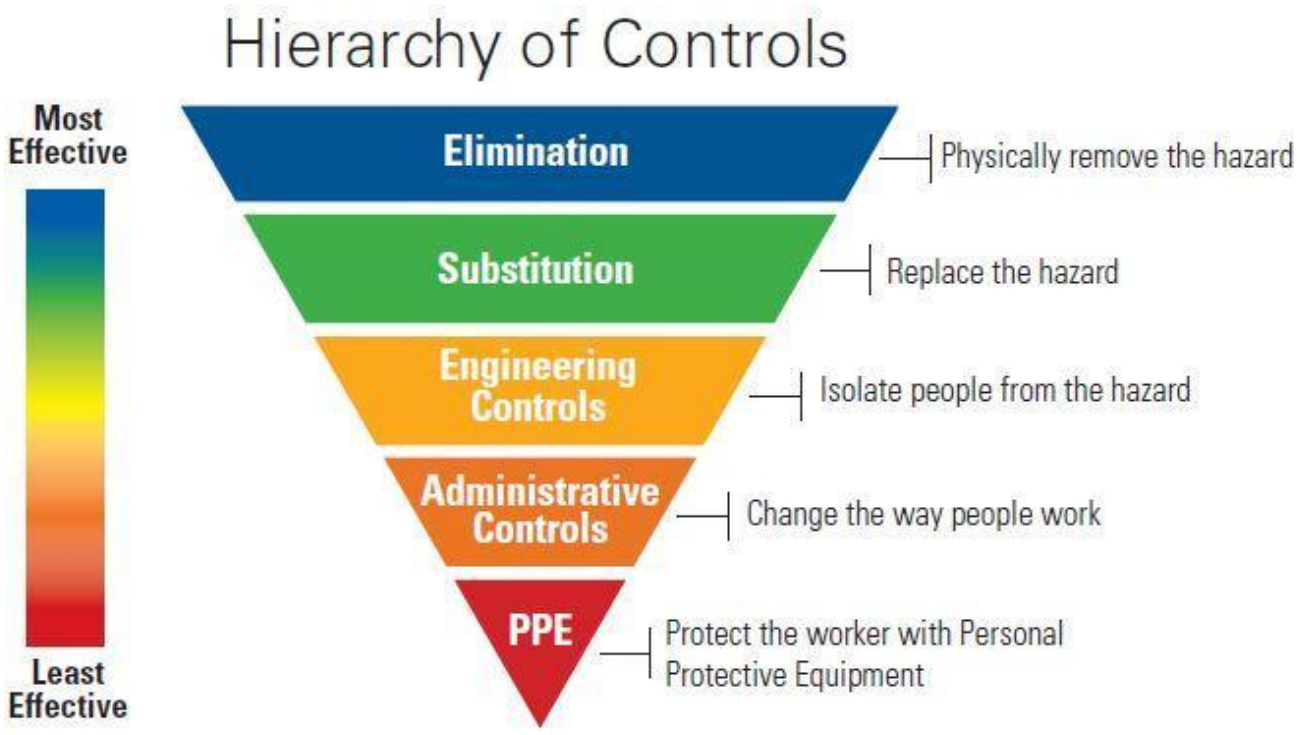
- For each hazard, the employer must identify the controls used to protect workers.

- Each control must be assessed for hazards (e.g. inerting displaces air, leaving an oxygen deficient atmosphere).

- Mechanical ventilation may be provided to improve the air quality in the space, or workers may be required to use particular tools or protective equipment.

- The employer must designate a trained and competent person to evaluate the hazards and recommend control options.

- A qualified person must prepare a hazard assessment for each confined space (or group of similar spaces) and for the work activities to be performed.



Source: NIOSH

- The qualified person must have training and experience in recognizing, assessing, and controlling the hazards of confined spaces.

- The qualified person will prepare a hazard assessment and develop written procedures to eliminate or minimize all the hazards likely to prevail.

- Once the assessment has been done for a specific activity within a particular space or group of similar spaces, it may provide the basis for procedures for every occasion when workers enter those spaces.

Controlling the Atmosphere

- If it is known or shown by pre-entry testing that a confined space does not contain clean breathable air, the hazard must be eliminated or controlled before workers enter the space.

- If the confined space has an oxygen-deficient or toxic atmosphere, the first control measure is to replace the atmosphere with air that is safe to breathe.

- The next step is to ensure the air remains safe while workers are inside.

- Even if the air tests as clean and breathable, further controls (such as ventilation) may be needed to ensure the atmosphere remains safe.

- If the atmospheric testing identifies that a hazardous atmosphere exists or is likely to exist in a confined space, an employer must ensure that the confined space is ventilated, purged or both, before a worker enters the confined space.

- If ventilating or purging a confined space is impractical or ineffective in eliminating a hazardous atmosphere, the employer must ensure that a worker who enters the confined space uses personal protective equipment appropriate for the conditions within the confined space.

- The entry plan must contain a description of when ventilation or purging are required and the specific procedures and materials to be used.
- The control measures depend on the hazard, for example:

    - If the atmosphere is oxygen-deficient, be sure the space is clean and replace the atmosphere with clean breathable air.
    - If there is, or there is a possibility of a toxic atmosphere from work inside the space, be sure the space is clean, and remove the contaminants and replace the atmosphere with clean breathable air.

    - If the atmosphere is explosive or flammable, be sure the space is clean and replace the atmosphere with clean breathable air.

- The atmosphere must be retested after any of the above procedures are used to clean the atmosphere.

- The goal is to ensure that the space contains clean breathable air before a worker enters.

Ventilation

Venting

- Venting is the opening up of a confined space to allow clean air to enter and circulate without the use of mechanical ventilation.

- Use of this method as a means of controlling contaminants can be authorized only by a trained and competent person and never for a space with a high or medium-hazard atmosphere.

Ventilating

- Ventilating means the active movement of air using mechanical devices, such as air movers, fans, and local exhaust systems to force fresh air into a confined space.

- It may bring clean air into a space or exhaust contaminated air out of the space.

- Confined spaces must be continuously ventilated to control hazardous atmospheres, except for certain low-hazard atmospheres and in emergency rescue.

- The specific procedure written into the entry plan will determine the amount of air required to make a confined space safe prior to entry and while workers are inside the space.

- If mechanical ventilation is required to maintain a safe work atmosphere within a confined space, the employer must ensure that the ventilation system incorporates a method of alerting workers if the system fails.

- Workers must be trained in the evacuation procedures to be used if the ventilation system fails.

Mechanical Ventilation

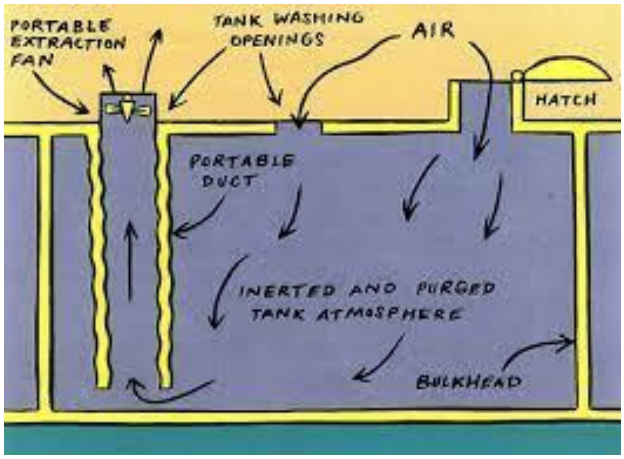
- The two main types of mechanical ventilation are Local exhaust ventilation and General ventilation.

Local exhaust ventilation

- Local exhaust ventilation uses exhaust fans or ducts to remove contaminated air at its source before it has a chance to spread throughout a confined space.

- Local exhaust ventilation is useful where air contaminants are generated from a point source, for example, at a waste sump during welding or during concrete grinding operations.

- Local exhaust ventilation is generally used to supplement general ventilation.



General ventilation

- General ventilation uses mechanical equipment such as fans, blowers, and ducting to deliver clean air into a space or to remove contaminated air from a space.

- General ventilation is sometimes referred to as “dilution” ventilation or positive-pressure ventilation.

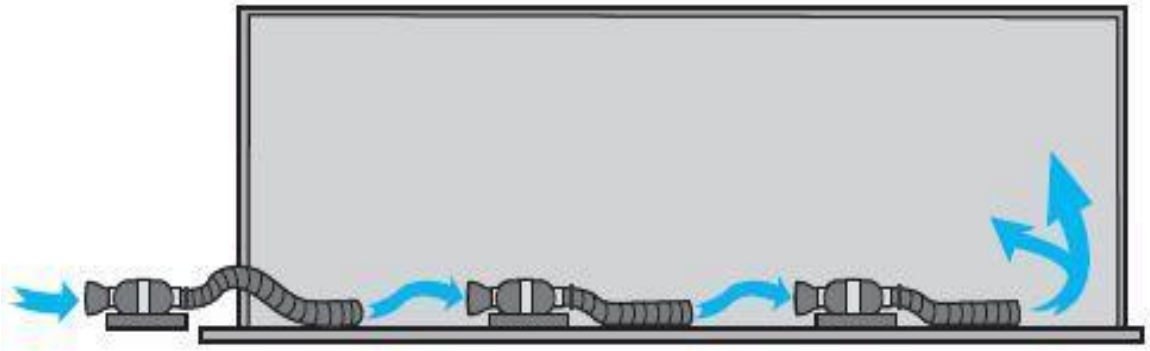
- When air is blown into a space, air currents are created and the outside air mixes with air in areas that might normally have stagnant air.

- The faster the air moves the more air mixing will occur, As the mixed air exits the space, contaminants are carried out.

- Ventilators that draw air out of a space minimize air currents and therefore reduce the possibility of generating dust.

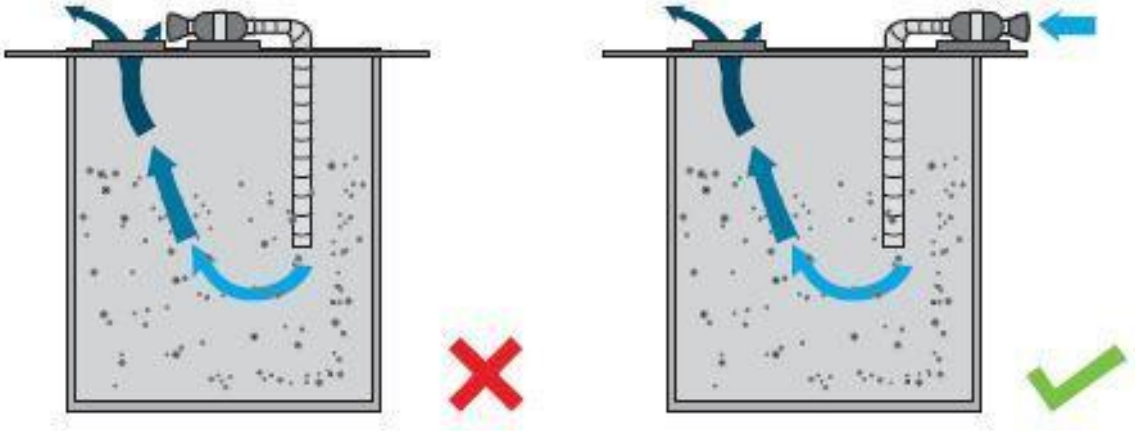
Ventilations systems must be effective and should be set up with the following considerations:

- To ventilate a long space, you may need a ventilator that draws air out at one end and another ventilator that pushes air in at the opposite end.

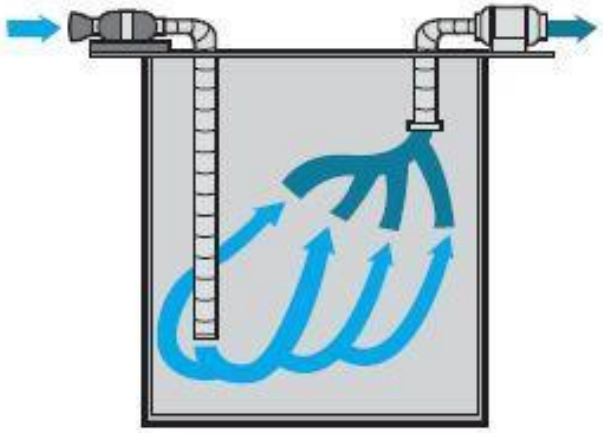


- For a deep confined space the fresh air is blown into the bottom, and the contaminated air is being exhausted near the top.

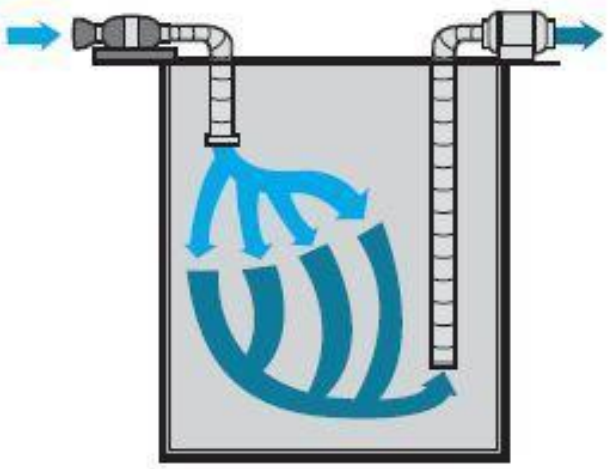
- Prevent the recirculation of exhaust air.



Removing lighter than air contaminants.



Removing heavier than air contaminants.



- There are two types of air-moving devices commonly used to purge or ventilate confined spaces, fans and Venturi eductors.

Fans

- Fans are usually electrically powered and can be divided into two main types: axial and centrifugal.
- Generally, axial fans are used for higher flow rates in systems with lower resistance.
- Centrifugal fans are used for lower flow rates in systems with higher resistance.

Eductors (also known as air horns, air blowers, and air ejectors)

- Eductors operate with compressed air on the principle of the venturi effect.
- Eductors have the advantage of fitting into small openings and have no moving parts.
- Usually, they are unable to move large volumes of air.
- A sufficient volume of compressed air and enough pressure are needed to achieve desired flow rates.

Natural ventilation

- Natural ventilation is ventilation of a space by natural air movement resulting from wind or convection currents.
- Using natural ventilation is <u>prohibited</u> in the following situations:
    - If a confined space has a high or medium risk atmosphere.
    - If natural ventilation could draw air other than clean breathable air into the confined space.
- In limited situations, natural ventilation is acceptable on its own.
- It is typically used to supplement mechanical ventilation.

- The Entry Plan should provide written work procedures that identify where and when natural ventilation can be used to maintain clean breathable air in a low-hazard atmosphere, under these circumstances, the air flow must be monitored.

- In addition to continuously measuring the amount of air that is flowing through the space, workers must continuously monitor the atmosphere using a gas monitor to make sure the space contains clean breathable air.

Purging and Inerting

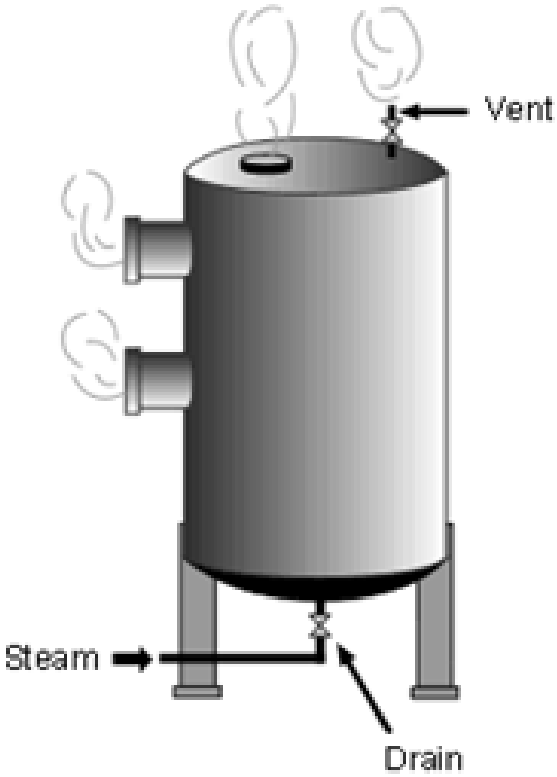
Purging

- Purging is removing (flushing) an unsafe atmosphere from a confined space and replacing it with clean breathable air prior to worker entry.

- This is commonly accomplished by blowing air into the confined space using portable mechanical ventilators.

- Purging can also be accomplished by introducing substances such as an inert gas, steam or water to displace or flush out contaminants.

- Purging is most effective if there are no contaminants being generated within the space. If there are contaminants, the space must first be cleaned and then purged.



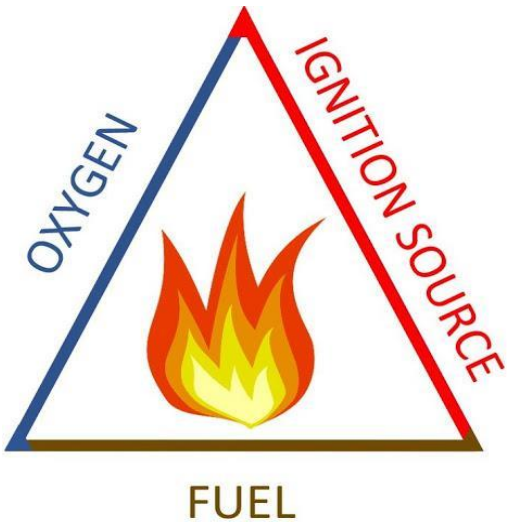
- Even though ventilators are used for ventilating and purging, ventilation starts at the point the atmosphere in the space is clean and the ventilator is maintaining fresh air.

Inerting

- Inerting means the introduction of an inert (nonreactive) gas such as nitrogen into a confined space to completely displace all oxygen.
- For a flammable mixture to burn or explode, a source of oxygen and a source of ignition are required.
- Inerting is a technique that is used to remove oxygen from the air.
- A confined space with an inert gas is deadly.
- The following requirements are essential:
    - All entry precautions for high-hazard atmospheres must be followed, except the requirement for continuous ventilation.
    - Every worker entering the confined space must be equipped with an SCBA or a supplied-air respirator equipped with an escape bottle.
    - Respirators must meet the requirements of the Occupational Health and Safety Regulation.
    - The atmosphere inside the confined space must remain inerted while workers are inside.
    - In the event the inert blanket is inadvertently lost, all ignition sources must be controlled.
    - Escaping inert gas must not cause a hazard outside the confined space.

Preventing Fires and Explosions

- Fire prevention requires control of one or more of the three elements needed for a fire or explosion: flammable substances, oxygen, and a source of ignition.



Controlling Flammable Substances

- When a space contains or may contain flammable substances, the qualified person will consider the following when developing the written work procedures:
- Minimizing quantities of flammable materials inside the space at all times.
- Isolating the confined space from flammable substances.
- Cleaning all flammable residues prior to entry.
- Using non-flammable cleaning solvents where possible.
- Controlling any flammable materials that must be used.
- Keeping cylinders of acetylene, propane, and other flammable gases outside the confined space.
- Wetting down spontaneously combustible residues before removal.
- Maintaining the atmospheric flammable and explosive gases and vapours as low as possible and within the permitted ranges stated in Section 19 (Explosive and flammable substances.
- Checking welding and cutting hoses.
- Removing oxyacetylene welding torches and hose assemblies from confined spaces when not in use, whenever practicable.
- Checking the other side of the surface for other workers or for combustible materials before using a torch or similar welding equipment on walls, bulkheads, etc.

Controlling Sources of Ignition

- If flammable substances are present, eliminate or control all sources of ignition.
- Use electrical equipment and lighting approved for hazardous locations.
- Use intrinsically safe air-testing and communications equipment, cameras, or any other equipment used in the space.
- Prohibit cigarettes, matches, and lighters.
- Do not use heaters in a confined space.
- Bond steam nozzles and ventilation systems to metal structures and ground the structures.
- Use non-sparking or low-sparking tools.
- Wear non-sparking footwear (no exposed shoe nails).
- Do not use internal combustion engines in the confined space unless they are approved in the written procedures (through the use of appropriate control measures).
- Where practicable, torches and hoses used for welding, brazing, or cutting must be removed.

Isolation of Physical Hazards

The purpose of isolating a confined space is to keep all hazards away from workers in a confined space. Isolation procedures should protect workers from:

- Entrapment. (Loose and unstable material)
- Moving parts of machinery.
- Substances entering through piping.
- Electrical shock.
- Stored energy.

- Isolation is a process used to stop the flow of energy or any other hazard.
- When a worker is in a confined space, uncontrolled energy sources and hazardous substances must be prevented from creating a hazard to workers.
- Consequences of not properly controlling hazards inside of a confined space are often more severe than the failure to control a hazard in a non-confined space situation, and for this reason a confined space generally requires isolation that is more effective than normal lockout.
- Examples of appropriate controls include blanking or blinding, double blocking and bleeding, misaligning or removing sections of lines, pipes or ducts, controlling all sources of hazardous energy, de-energizing equipment and immobilizing or disconnecting all mechanical linkages.

- In certain cases, alternate means of isolation and safe work procedures, certified by a professional engineer, may be used to protect workers.
- Physical hazards must be identified and controlled to make sure the space is safe for workers to enter.
- An employer must ensure that workers within a confined space are protected against the release of hazardous substances or energy that could harm them.
- The entry plan and hazard assessment will have identified all physical hazards and will have provided the required precautions and written procedures to control those hazards (including lockout and isolation).
- The supervisor of the entry must verify that all required precautions are in place before any worker enters a confined space.
- There are many types of physical hazards, including crushing hazards, heat and cold stress, radiation, vibration, and noise.
- Confined spaces with a hazard of entrapment or engulfment and any situations requiring lockout or isolation procedures should be considered a very serious hazard and in these cases an entry permit is required.

Entrapment

- A risk of engulfment or entrapment requires the highest level of standby emergency service.
- Whenever there is a danger of entrapment or engulfment, do not enter unless necessary.
- If entry is necessary, a competent person must provide a written procedure.

- The written procedure should consider the following:
  - Inspection prior to entry.
  - Use of kickers or probe bars to dislodge bridges and hung-up material prior to entry.
  - De-energization and lockout of all operating process equipment inside the confined space prior to entry.
  - Isolation and/or lockout prior to entry to prevent engulfment.
  - Requirement for lifeline and harness and provision for immediate rescue of a worker in distress.
  - Other protective equipment that may be needed, such as personal flotation devices or fall protection.

- Where workers could be exposed to danger from falling objects, follow these requirements:
    - Schedule work activity so that no worker is working above another.
    - Provide suitable protection from overhead hazards.
    - Provide workers with safety headgear.
    - It is the employer's responsibility to provide the required personal protective equipment and ensure that workers are trained to use it.

Hazardous Energy

- Hazardous energy is any electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other source of energy that could potentially injure a worker (e.g. machinery or equipment with moving parts has mechanical energy, and steam in a pipe has thermal energy).
- All hazardous energy at the location at which the work is to be carried out must be isolated by activation of an energy isolating device and the energy isolating device is secured in accordance with OH&S regulations as designated by the employer.

Lockouts

- Confined spaces having any moving parts and electrical power sources must be isolated by locking out and tagging the power source to prevent accidental reactivation.
- Lockout means the use of a lock or locks to render machinery or equipment inoperable or to isolate an energy source in accordance with a written procedure.
- Locks are generally used to prevent the inadvertent start-up or movement of machinery and equipment.
- Lockout is a two-step process.
    - The first step is isolation, usually by misaligning a line, setting a switch in the up or down position or closing a valve.
    - The second step is to affix a lock to the isolating device in order to prevent others from removing or changing the isolation.

- Affixing a personal lock is a very important step to ensure that the device controlling the energy or other hazard remains in its set state or position.

- To ensure that there is no inadvertent release of energy or energization, the energy isolating device(s) must be physically secured in the isolating position.

- A securing device is anything such as a personal lock that holds an energy-isolating device in its off or safe position.

- The device must be “positive”, meaning that once secured into position, it cannot fall off or allow the energy-isolating device to move from its off or safe position.

- A dowel rod placed in a valve handle, duct tape across a circuit breaker or a sign placed above a box containing fuses that have been removed from an electrical panel would not be “positive” securing devices.

- The securing device or mechanism must be strong enough to withstand inadvertent opening without the use of excessive force, unusual measures, or destructive techniques e.g. metal-cutting tools.

- The employer’s lockout program will outline the procedures required to make each confined space in the workplace safe to enter.

- The supervisor of the entry must ensure that all lockout precautions are in place before a worker enters a confined space.

- An entry permit is required for all spaces that require lockout.

- Occupational Health and Safety lists when lockout is required and the required lockout procedures.

- Once all energy-isolating devices have been activated to control hazardous energy an employer must ensure that a worker involved in work at each location requiring control of hazardous energy secures each energy-isolating device with a personal lock.

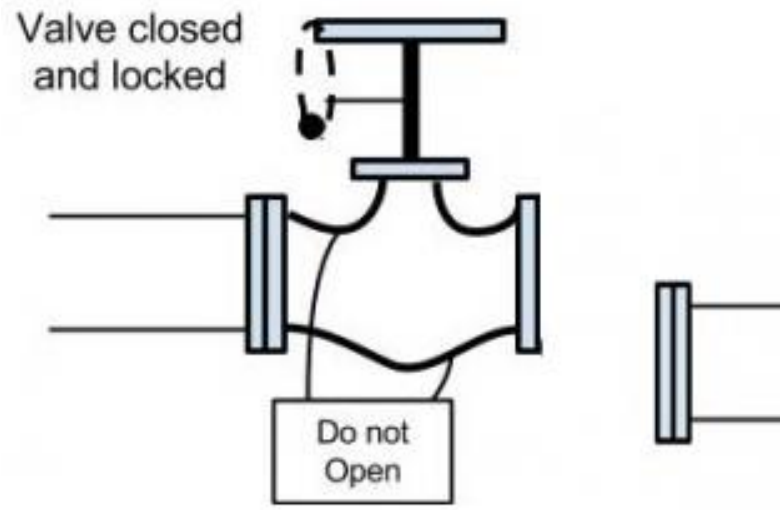
- Once each energy-isolating device is secured the worker must verify that the hazardous energy source has been effectively isolated.
- If more than one worker is working at each location requiring hazardous energy to be controlled each worker must attach a personal lock to each energy-isolating device.

- The first worker applying a lock must verify that the hazardous energy source has been effectively isolated.

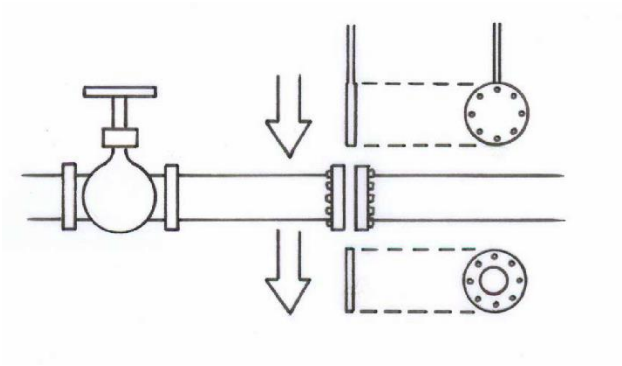
Disconnecting and misaligning a Pipe

- Isolating includes disconnecting a pipe, which can be done by removing the bolts that hold the pipe flanges together or by loosening unions that connect threaded pipe sections.

- If the piping will be left disconnected, the sections of the pipe that have been disconnected also must be misaligned to prevent overflow material from getting into the space.



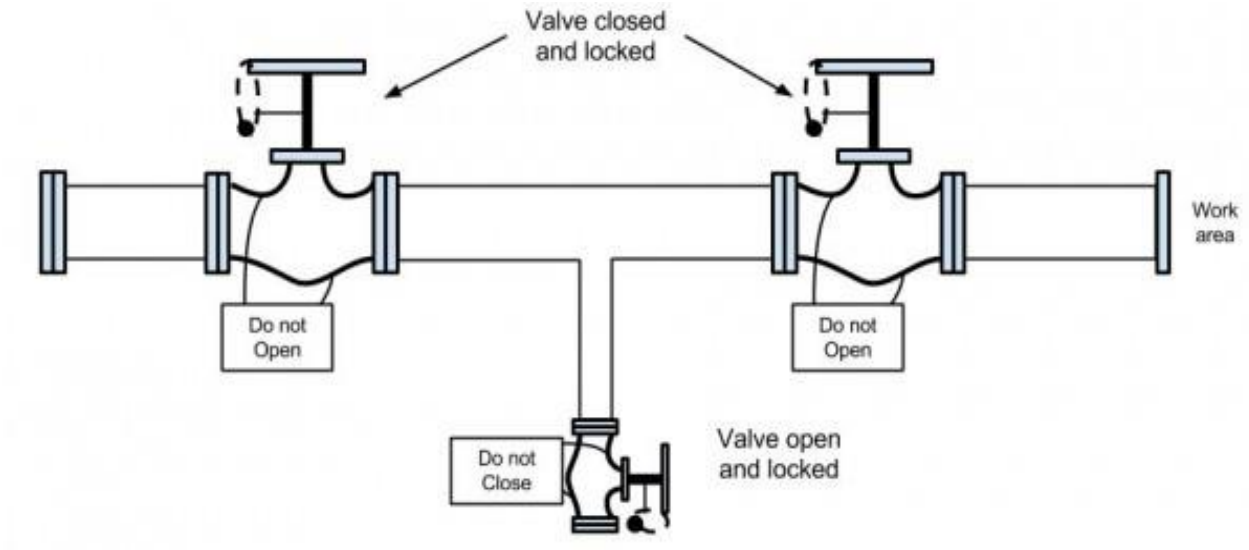
Blanking / Blinding



- Blanking involves inserting a physical barrier through the cross-section of a pipe so that materials are prevented from flowing past that point.
- Blinding involves disconnecting a pipe and attaching a physical barrier to its end so that materials are prevented from flowing out of the pipe.
- A blank or blind must be:
    - Designed with an allowance for corrosion if it will be used in conditions where it can corrode.
    - Stamped with its pressure rating or otherwise indicate its pressure rating.
- Generally, isolation is achieved by severing or blocking all product lines leading to and from the confined space.
- Typically, a “spectacle” is used as a visual indication that a blank has been installed.

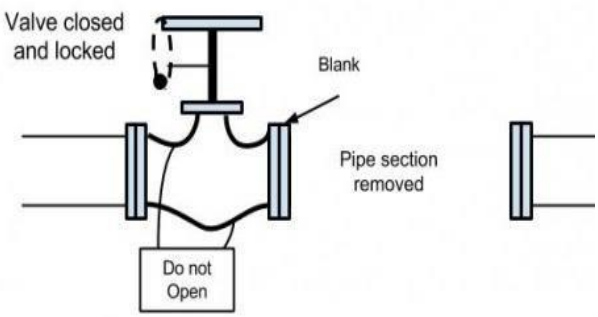
Double Block and Bleed

- Double blocking and bleeding involve use of a three-valve system where a pipe has two closed valves and an open drain valve positioned between them so that material is prevented from flowing and is re-directed in case of a valve leak.
- The valves of a double block and bleed system need to be locked.
- Block and lock the valves on either side of the drain valve.
- Lock the main valves closed and the drain valve open.
- A double block and bleed system is used if the harmful substance in the piping is NOT one of the following:
    - A gas.
    - A vapour.
    - A liquid volatile enough to produce a hazardous concentration of an air contaminant from the discharge from the piping.



Removal of a Valve or ‘Spool Piece’

- A Spool Piece is a short segment of pipe this is usually intended to be removed, either for service or as a stand-in for a valve or other fixture to be installed later.



Electrical Shock

- Electrical tools and equipment used in a confined space must be grounded or double-insulated and so marked.

- If wet or damp conditions exist inside the confined space, electrical tools and equipment must be protected by an approved ground fault circuit interrupter or other acceptable means of protection.

- It is always better to substitute equipment that will not be hazardous inside the confined space.

Pneumatic Tools

- In some cases, the potential for electrical hazards can be eliminated by substituting pneumatic equipment such as air-driven grinders and sanders.

- If these pneumatic tools present a risk of exposure to hazardous contaminants from the exhaust, the compressor system must be located in an area where the exhaust will not contaminate the air inside the space.

- If other utility lines are being used adjacent to the confined space (for example, lines containing gases such as nitrogen, acetylene, or oxygen), precautions must be taken to prevent the pneumatic tools from being attached to those lines.

Grounded Tools

- Properly grounded hand tools are equipped with a means of directing a ground fault back to the service entrance panel where it will blow a fuse or trip a circuit breaker.

- If properly grounded tools are not used, the resulting shock could be severe or even fatal.

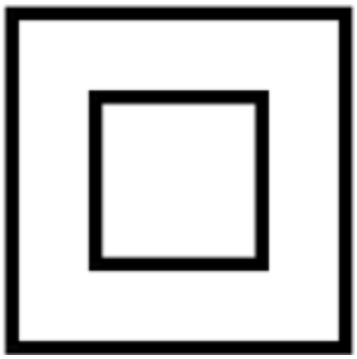
- A three-pronged plug or the wider spade terminal on the machinery/tool or the extension cord plug ensures that ungrounded devices (such as double insulated tools) are plugged in with the correct polarity.

- Never remove the ground pin (third prong) from the cord of a tool or three prong extension cord.

- This ground pin provides grounding protection and it also ensures that double insulated tools are plugged in with the correct polarity.

Double-Insulated Tools (Class II)

- Double-insulated tools are housed in a non-conductive plastic casing with a non-conductive on-off switch, which prevents the operator from coming in contact with any metal parts.



Symbol for double insulation.

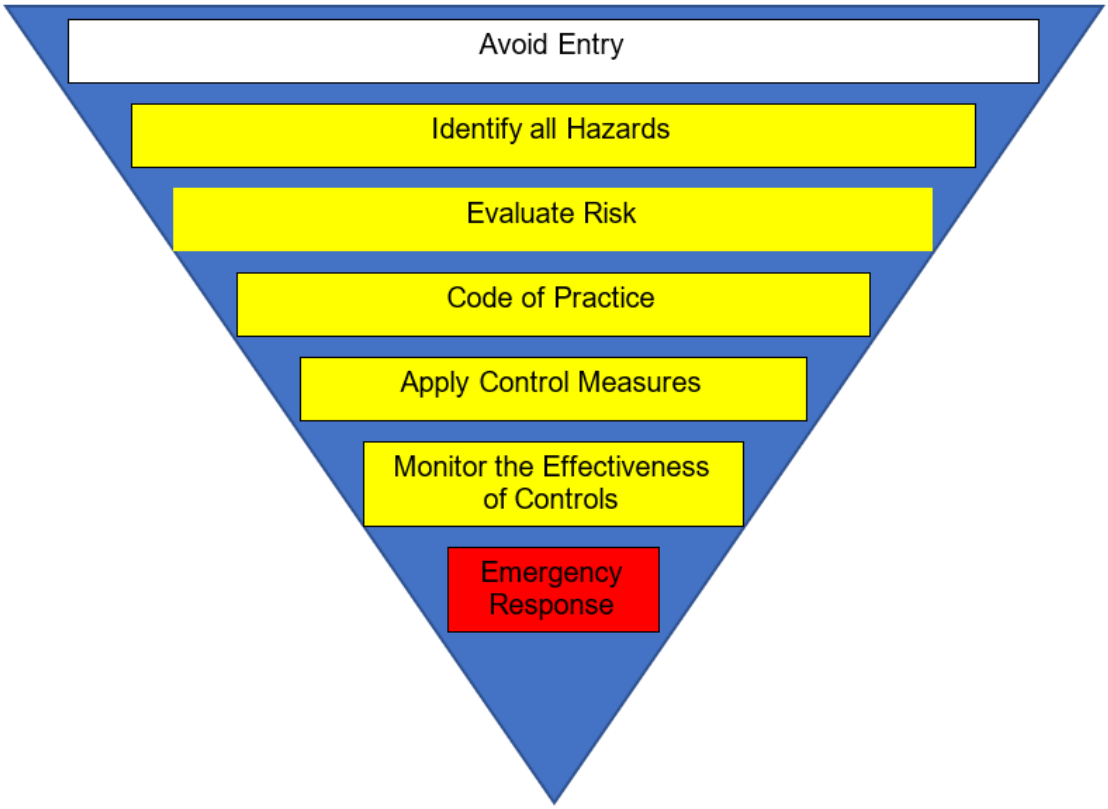
Ground Fault Circuit Interrupter (GFCI)

- A ground fault circuit interrupter is a type of circuit breaker that detects any difference (greater than 5 milliamps) between the current being supplied to a tool and the current that returns from the tool.

- If this difference is detected, the circuit breaker shuts off the flow of electricity. If the difference between the flow of electricity to and from the tool was because it was passing through a person, the person would be protected from any further current flowing through them by the ground fault circuit interrupter.
- Do not disconnect the tool from the GFCI because it keeps on tripping (sometimes called “nuisance trips”) the GFCI is operating properly. The reason for the GFCI “tripping” can usually be traced to electrical devices in need of repair, including the extension cords, or the tool or cord is being used in a wet or damp location.

- Electrical tools and equipment used in a confined space where flammable or explosive gases, vapours, or liquids are present must be CSA-approved for hazardous locations.

Hierarchy of Confined Space Entry Procedures



Chapter 4: Summary
What was covered in Chapter 4?

- The hierarchy of controls and how it is applied.
- Controls used for hazards in confined spaces.

Chapter 5: Safety and Protection

Goal:
The student should understand the safety procedures and equipment required for working in confined spaces.
Objectives:

1. The student should understand the confined space entry permit system.

2. The student should be familiar with the different PPE required for working in confined spaces.

3. The student should understand the circumstances under which respirators are to be used.

4. The student should understand the differences between the two common types of breathing apparatus.

5. The student should understand the role and responsibilities of the tending worker and back-up / rescue employee.

Chapter 5 – Slide 4 – Video - Case Study 1: Oxygen Deficiency in Barge Tank

Safe Entry Permit

- A safe entry permit is a document that sets out the work to be done and the precautions to be taken in the identified confined space.
- In some ways it functions as a safety checklist to make sure that nothing is overlooked.
- The purpose of an entry permit is to formalize entry into a confined space.
- A permit also informs workers of the hazards and entry procedures and keeps a record of workers who have entered.
- The permit does not have to be posted at the entrance to the confined space, but must be readily available to every person involved in the confined space activity and this would include knowledge of the permit's location.

- The entry permit should address the following:
    - The location of the confined space.
    - A description of the work to be performed there.
    - A description of the hazards and the corresponding control measures.
    - The time period for which the entry permit applies.
    - The name of the attendant described in section 15.
    - A record of each worker’s entries and exits.
    - A list of the equipment required for entry and rescue, and verification that the equipment is in good working order.
    - Results obtained in atmospheric testing under section 18.
    - If the work to be performed in the confined space includes hot work, adequate provisions for the hot work and corresponding control measures.
- Before each shift, a competent person shall verify that the entry permit complies with the relevant plan.
- The employer shall ensure that the entry permit, during the time period for which it applies, is readily available to every person who enters the confined space and to every person who performs related work with respect to the confined space.
- Once an entry permit has expired, a new permit must be issued before entry into the confined space is allowed.

Ineffective Work Permits

- Various drawbacks exist which can lead to an ineffective permit system, some examples are:

  - The format of the permit does not conform to the task to be completed.
  - The workers responsible for signing the permit have not inspected the job to ensure that the isolation, lockout or testing has been completed.
  - The workers are not following or do not understand the requirements of the permit.
  - The employer is not enforcing or monitoring the permit system.
  - Permits are prepared too far in advance, after the work has commenced, or by workers not trained in Confined Space Entry requirements.

Personal Protective Equipment

- The competent person who prepares the hazard assessment and written work procedures will specify the personal protective equipment (“PPE”) needed for each confined space (or group of similar spaces) and for the work activities that occur there.

- There may be different PPE requirements for workers inside the confined space, rescue workers, and tending workers.

- General requirements for personal protective equipment include the following:

    - All equipment must be used and maintained in accordance with the manufacturers’ instructions.

    - Equipment must be inspected regularly and kept in good working order.

    - Workers must be instructed and trained in the use, limitations, and assigned maintenance duties of personal protection equipment so that they can use the equipment correctly.

    - If the hazard assessment indicates that PPE is required, the employer must ensure that workers wear and use the required PPE properly.

- Employers to provide PPE in a limited number of situations where, for example, there is a breathing hazard or where noise exposure limits are exceeded.

    - This section does not require employers to provide PPE such as hard hats, safety boots, flame resistant clothing or eye protection.

    - Where such equipment is necessary the employer must make sure that workers use it.

- An employer must ensure that all equipment to safely confined space work, including personal protective equipment and rescue equipment, is available and inspected to ensure it is in good working order.

- All workers must follow entry for the confined space and use the equipment as necessary to protect their health and ensure their safety.

- If workers inside a confined space could become trapped or if a harmful atmosphere could prevent them from escaping without help it is recommended that the worker wear a full-body harness attached to a lifeline that is tended by a safety watch.

- Lifelines can present a danger if they get tangled around equipment or wrapped around a protrusion in a confined space.

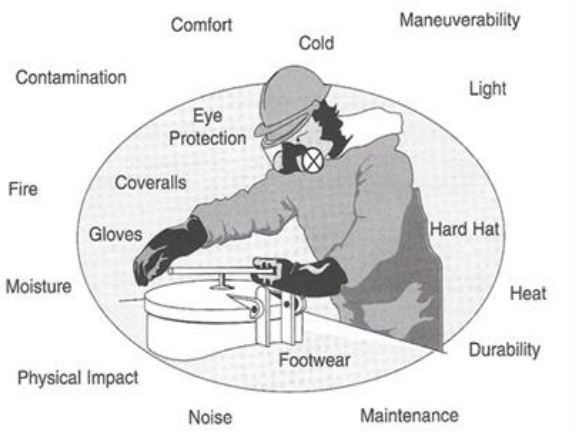
- Lifelines, if they are required, may only be used in a manner that does not endanger a worker by creating another hazard.

- Workers within a space must be able to effectively communicate amongst themselves and communicate with workers outside the confined space using a system that is appropriate to the hazards within the confined space (e.g. communication equipment that functions in the presence of hazardous gases).

- Protective equipment should offer the appropriate protection for the job at hand while being comfortable.

- Routine PPE:

    - Safety Boots.
    - Gloves.
    - Eye Protection.
    - Hard Hat.
    - Hearing Protection.
    - Fire Retardant Coveralls.



- Other considerations for wearing the appropriate equipment for the job include:

    - Extremes of heat or cold temperatures.
    - Potential chemical contact.
    - Potential ignition from welding, etc.
    - Extremes of dryness or wetness.

Respiratory Protection

- If clean breathable air in a confined space cannot be assured before workers enter, or if it cannot be maintained while workers are inside, the employer must provide the appropriate respirators for workers to safely enter and remain in the space.

- Respirators are to be used only if it is impracticable to provide clean breathable air or if the confined space has an inert atmosphere.

- In these situations, workers rely on respirators either to remove contaminants from the air they inhale or to provide a safe source of air.

- If a respirator is required, the written work procedures must specify the type needed.

- All workers entering the space must wear the appropriate respirator.

- A respirator with a filter removes particles from the air.

- Different classes of filters are available for different types of dusts and fibres.

- A respirator with a cartridge will remove gases and vapours to “clean” the air.

- There are different cartridges for different contaminants.

- The worker must have the right cartridge for the contaminant.

- Not all gases can be “cleaned” by a cartridge respirator.

Breathing Apparatus

An air-supplied respirator provides clean breathable air.

These must be used when the atmosphere is oxygen-deficient or when filters or cartridges are not able to remove the contaminant to a safe level.

There are two common types of breathing apparatus; Supplied Air Breathing Apparatus (SABA), and Self-Contained Breathing Apparatus (SCBA)

Supplied Air Breathing Apparatus (SABA)

Self-Contained Breathing Apparatus (SCBA)

Fit Test and Medical Evaluation

- If a worker required to use a self-contained breathing apparatus (SCBA) cannot get a good facial seal the worker must not use the apparatus (workers must report this situation to the employer so that it can be corrected).

- The CSA Standard requires that workers who use respirators be free from any physiological or psychological condition that may prevent them from using a respirator (the worker must not have a medical condition that, when combined with respirator use, could endanger his or her health and safety at the worksite).

- A formal fit test is required for all respirators.

- Evaluation of a worker's medical fitness to wear a respirator must be done before the worker is fit tested.

- The evaluation should be appropriate to the level of respirator use and take into consideration:

    - The type of respirator being used.

    - The type and concentration of contaminant the worker will be exposed to.

    - The amount of time that the respirator must be worn.

    - The activities the worker must do while wearing a respirator.

Communications

- With proper communication, work in a confined space is made easier, safer and in many cases, more productive.

- Care must be taken when selecting communication equipment for this unique work environment.

- Confined spaces are very different from any other work area and must be treated accordingly.

- Radio signals do not penetrate metal or concrete reinforced with re-bar, which describes a majority of confined space environments, creating dead spots or reducing signal strength.

- Messages can become garbled or are not received, this prevents continuous communication in certain types of spaces.

- Radio equipment is extremely effective when used by safety attendants outside spaces to maintain contact with their base or, in the event of a problem, to call for rescue assistance.

- The preferred choice for reliable communication in confined space is a hard-line full duplex system, which allows hands-free communication between a tending worker and workers inside the space.

- No matter which method of communication is chosen, the equipment selected should be suited to the particular work environment.

- It should be extremely rugged, resistant to chemicals, environmentally sealed and intrinsically safe if used in a potentially hazardous location.

Tending Worker

- At least three people are required at a site - The entrant, a person standing at the entrance (Tending Worker), and a back-up employee (Rescue Employee) within sight and shouting distance with no obstructions or barriers to overcome to reach the space (for example, not in another room or a parking lot). Each has to be properly trained to carry out their responsibilities.

- For every confined space entry, a worker must be assigned as a tending worker, who monitors the well-being of workers inside the space by visually observing them or using another method of checking.
- The tending worker also summons help in the event of an emergency.
- Workers inside the space must be able to contact the tending worker at any time, either through voice or visual contact.
- The tending worker must be stationed outside the confined space, never inside.
- A tending worker must:
    - Keep track at all times of the number of workers inside the confined space.
    - Be in constant communication with the workers inside the confined space.
    - Have a suitable system for summoning assistance.
    - Not leave the area until all workers have left the confined space, or another tending worker is in place.
    - Thoroughly understand the Safe Entry Permit and all related requirements.
    - Stay alert at all times.
    - Remain at the designated entrance.
    - Check with the workers at regular intervals.
    - Watch for potential hazards both inside and outside the confined space and alert worker inside as needed.

- A tending worker must be able to sound an evacuation alarm.

- Have a suitable system for summoning assistance in the event of an incident or emergency.

The Tending Worker must be knowledgeable in:

- The Emergency Response Plan.
- The Communications Procedures.
- The Safe Operating Procedures.
- The Scope of Work for the job at hand.

- The Tending Worker must keep track of all workers that move in and out of the confined space.

- If a Rescue is necessary, the Tending Worker must:
  - Initiate the Emergency Response Plan.
  - Stay outside the confined space until the backup arrives.
  - Give assistance to emergency responders and victims as required.

Back-Up / Rescue Employee

- An employee who is trained in the emergency procedures and who is fully informed of the hazards in the confined space is in the immediate vicinity of the confined space to assist in the event of an accident or other emergency.

Chapter 5 Summary:

What was covered in chapter 5?

- The confined space entry permit system.
- PPE required for working in confined spaces.
- The circumstances under which respirators are to be used.
- The differences between the two common types of breathing apparatus.
- The role and responsibilities of the tending worker and back-up / rescue employee..

Chapter 6: Emergency Response

Goal:
The student should understand the requirement for emergency response and the basic elements of an emergency response plan for confined space.

Objectives:

1. The student should be familiar with the requirement for an emergency response as it pertains to a confined space.

2. The student should be familiar with the various roles and responsibilities within an emergency response.

3. The student should be familiar with the elements of the initial response to a confined space emergency.

Employers' and Employees' Responsibilities in Emergencies

- Emergency procedures are required for any confined space that a person enters.

- The person who does the confined spaces hazard assessment (entry plan) must set out the emergency procedures, including immediate evacuation of the confined space when an alarm is activated or there's any significant change in the concentration, level or percentage of oxygen, chemical agents or airborne dusts as part of his/her written report.

- The hazard assessment report (entry plan) must specify the PPE and emergency equipment required for safe rescue and evacuation and the employer must ensure that such equipment is provided

- The employer shall ensure that no worker enters or remains in a confined space unless adequate written on-site rescue procedures that apply to the confined space have been developed and are ready for immediate implementation.

- Before a worker enters a confined space, the employer shall ensure that an adequate number of persons trained in the rescue procedures are available for immediate implementation of the on-site rescue procedures.

- The employer must ensure rescue procedures include every possible means of eliminating, controlling, or reducing the risk to emergency personnel, including the use of mechanical ventilation.

- All employers are responsible for the provision of first aid equipment, supplies, facilities, and services, as determined by an assessment that would meet the requirements of the OH&S Regulations.

- A worker must not enter or stay in a confined space unless an effective rescue can be carried out.

In the event of an emergency, workers must be able to carry out an effective rescue and workers must be able to immediately evacuate a confined space if conditions warrant.

Use of 911 for Confined Space Rescue

- In the case of rescues involving workers in confined spaces and workers suspended in the air after a fall, calling 911 alone and awaiting the arrival of rescue services personnel is considered to be an insufficient emergency response.

- In some situations, rescue services personnel may not have the equipment or skills to perform a rescue.

    - A worker in a confined space deep below ground level in a horizontal tunneling operation.

    - A worker who has fallen in a silo who is suspended in the air that cannot be reached from below.

- In such cases, the employer's on-site rescue capability must be such that the work site is virtually self-sufficient in returning a rescued worker to the surface or ground level.
- In an emergency, actions taken must be purposeful and well thought out.

- A well-documented plan must be developed, shared with anyone who it may impact (management, workers, responders, etc.).

- You must gain control of the incident at the earliest possible moment to prevent chaos and further injuries.

The Trained Rescue Team

- The person who directs the rescue or evacuation must be adequately trained in such procedures and must be in voice communication at all times between the person directing the rescue and the workers who are performing the rescue.

- A rescue team and rescue procedures should not be used as a substitute for making a confined space safe to enter.

- It is essential that the air is safe to breathe before entry so that a rescue team is not required, except for serious injuries or medical emergencies.

- Studies have shown that over 60% of confined space deaths occur among would-be rescuers.

- Rescue plans and proper training for rescuers must be in place before any confined space entry.

- Workers should be trained not to attempt a rescue, or be fully trained and equipped to perform the rescue safely.

- If the rescue persons are employees of another firm or an agency, there should be a written agreement detailing the services to be provided.

- A rescue plan includes practicing the plan, this helps to ensure that personnel, equipment, and procedures are in place to affect rescue.

- The written rescue plan provides a step-by-step means of ensuring all possibilities are considered.

- Practicing the plan provides information about where improvements must be made.

- The plan should be practiced frequently enough to maintain the competency of the rescuers, but no less than once each year.

- The more often the rescue plan is practiced, the less likely something will go wrong if a rescue is required.

- Every person assigned rescue duties must be properly equipped and adequately trained to carry out these duties.

- The supervisor of the entry, or the tending worker, must notify rescue personnel of work to be done before a worker enters a confined space.

If more than one confined space is to be entered at the same time, rescue personnel need to know this and be on alert status.

Confined Space Rescue Procedures

- Written procedures for rescue must be in place before every confined space entry and consider the following:
    - Additional workers located outside to assist.
    - Rescue from the outside (if possible).
    - Requirements for use of a safety harness and lifeline.
    - If IDLH conditions exist or could develop, rescuers must enter only with an SCBA or supplied-air respirator equipped with an escape bottle.
    - Small-diameter openings will require special consideration for rescue workers who are encumbered with SCBA.
    - A key objective is to correct atmospheric hazards prior to entry and supply adequate ventilation to ensure a safe atmospheric environment whenever practicable.
    - All hazards of the space as specified in the hazard assessment.
    - Possible hazards that may arise during rescue, the appropriate evaluation of these hazards, and control methods recommended by a qualified person.
    - Dimensions of the space, location of entry and exit points, and obstacles to removing an injured worker.
    - Rescue equipment required for each space.
    - Personal protective equipment for rescuers, including appropriate respirators for any contaminants or IDLH conditions.
    - Communication between workers, rescuers, the supervisor of the entry, and tending worker.

Rescue methods for a worker who is unconscious, unresponsive (on or off of a lifeline), or distressed.

Initial Response to a confined space emergency:

1. Warn others, ensure the safety of all workers.

2. Call for help, initiate the site emergency response plan (ERP) and Rescue Plan.

3. Assess the situation and resources available to respond.

- Maintain the safety of the emergency site where the incident has occurred by identifying and controlling any critical hazards.
- Have a worker meet emergency responders and show them a safe way in to access the emergency site.
- When safe to do so, assign a competent co-worker to maintain contact with the casualty to provide reassurance and remind the casualty what to do while waiting to be rescued.
- Do not allow co-workers who are not properly equipped or trained to perform the rescue.
- Do not experiment with equipment or procedures that have not been thoroughly thought out and with which training and drills have been carried out.

4. When safe to do so, proceed with the rescue.

- Workers involved in rescue must be competent and properly equipped.
- Once the rescue is complete, take the casualty to a safe location.

5. Persons qualified in first-aid should provide first-aid until arrival of emergency medical personnel.

6. Ensure all appropriate authorities have been notified as per the ERP.

- Document, document, document
- Cooperate fully with police, and/or OH&S Investigators.

Follow-Up

- Ensure co-workers are debriefed and receive any assistance they may require. Police services may be able to offer assistance through victim services.

- Before allowing work to begin after an incident, replenish all first-aid and rescue supplies and equipment.

- When appropriate, review the incident and ensuing response, and make any revisions to the ERP or Rescue Plan that may be necessary.

Chapter 6, Slide 23 View the “Precious Time” Video

Answer the following questions?

- Was this a confined space?
- What measures should have been taken to prevent the incident?
- If they had an entry plan and followed the requirements would it have prevented the incident?

Chapter 6: Summary
What was covered in chapter 6?

- The requirement for an emergency response as it pertains to a confined space.
- The various roles and responsibilities within an emergency response.
- The elements of the initial response to a confined space emergency: