

Confined Space Entry Program

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[Organization]

Confined Space Entry Program

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# REFERENCE

WorkSafeBC

* Occupational Health and Safety Regulation Part 9 Confined Spaces
* OHSR Guideline for Part 9 Confined Spaces

# PURPOSE

This program is designed to eliminate or minimize the risk to workers who enter or work in confined spaces, through the identification and assessment of hazards for the confined space and work activities within that space, development of safe entry procedures, implementation of required controls, all supplemented by worker education and training.

# POLICY

The[Organization]will develop and maintain a Confined Space Entry Program to ensure the well-being of workers required to enter or work in confined spaces.

# SCOPE

This program applies to all workers who may have to enter a confined space or be involved in a confined space entry.

# DEFINITIONS

|  |  |  |
| --- | --- | --- |
| **Adjacent Piping** | | A device such as a pipe, line, duct or conduit which is connected to a confined space or is so located as to allow a substance from within the device to enter the confined space. |
| **Blank** | | A solid plate installed through the cross-section of a pipe, usually at a flanged connection. |
| **Blanking or Blinding** | | The absolute closure of adjacent piping, by fastening across its bore a solid plate or cap that completely covers the bore and that is capable of withstanding the maximum pressure of the adjacent piping. |
| **Blind** | | A solid plate installed at the end of a pipe which has at that point been physically disconnected from a piping system. |
| **Clean Respirable Air** | | When used to describe the atmosphere inside a confined space, means an atmosphere which is equivalent to clean, outdoor air and which contains:   1. about 20.9% oxygen by volume, 2. no measurable flammable gas or vapour as determined using a combustible gas measuring instrument, and 3. no air contaminant in concentrations exceeding either 10% of its applicable exposure limit in Part 5 of the Regulation (Chemical Agents and Biological Agents) or an acceptable ambient air quality standard established by an authority having jurisdiction over environmental air standards, whichever is greater. |
| **Confined Space** | Except as otherwise determined by the Board, means an area, other than an underground working, that:   1. is enclosed or partially enclosed, 2. is not designed or intended for continuous human occupancy, 3. has limited or restricted means for entry or exit that may complicate the provision of first aid, evacuation, rescue or other emergency response service, and 4. is large enough and so configured that a worker could enter to perform assigned work. | |
| **Disconnecting** | Means physically disconnecting adjacent piping from a confined space to prevent its contents from entering the space in the event of discharge. | |
| **Double Block and Bleed** | The closure of adjacent piping by locking out a drain or vent in the open position in the line between 2 locked out valves in the closed position. | |
| **Engulfment** | Being buried by free flowing loose granular materials such as sawdust or earth or being drowned in liquids. | |
| **Harmful Substance** | A WHMIS hazardous product, a substance referred to under OHSR [Section 5.48](http://www2.worksafebc.com/publications/OHSRegulation/Part5.asp#SectionNumber:5.48), or a substance which may have a harmful effect on a worker in a confined space. | |
| **Isolation** | Separating piping from a confined space so that there is no chance that the materials in the pipe can enter the confined space. Methods include disconnecting, blanking, blinding, double block and bleed, engineered systems, and alternate procedures acceptable to WorkSafeBC. | |
| **Hazard Identification** | A review of the hazards created by the design, location, or use of the confined space. | |
| **Hazardous Atmosphere** | *Defined into one of 3 classifications – Low, Moderate, High* | |
|  | ***Low Hazard Atmosphere:*** An atmosphere which is shown by pre-entry testing or otherwise known to contain clean respirable air immediately prior to entry to a confined space and which is not likely to change during the work activity, as determined by a qualified person after consideration of the design, construction and use of the confined space, the work activities to be performed, and all engineering controls required by this Regulation. | |
|  | ***Moderate Hazard Atmosphere:*** An atmosphere that is not clean respirable air but is not likely to impair the ability of the worker to escape unaided from a confined space, in the event of a failure of the ventilation system or respirator. | |
|  | ***High Hazard Atmosphere:*** An atmosphere that may expose a worker to risk of death, incapacitation, injury, acute illness or otherwise impair the ability of the worker to escape unaided from a confined space, in the event of a failure of the ventilation system or respirator. | |
| **Prior Representative Sampling** | Documented atmospheric testing of a confined space or a number of similar confined spaces in circumstances that will ensure that the results are statistically significant. | |
| **Program Administrator** | The person who has been assigned the overall responsibility for administration of the Confined Space Entry Program. | |
| **Risk Assessment** | An analysis of the risk of injury to workers who are performing work in a confined space. | |

# RESPONSIBILITIES

[Organization] will:

* Identify every confined space, or group of similar confined spaces, in the workplace.
* Implement a Confined Space Entry Program.
* Assign an administrator for the program.
* Ensure hazard identifications and risk assessments are completed for each of the confined spaces, or group of similar confined spaces.
* Provide training for workers.
* Ensure that there are written procedures for entry into all of the confined spaces.

[Insert name or job description here] will administer the Confined Space Entry Program. The Administrator’s responsibilities include:

* Maintaining the inventory of confined spaces or group of similar confined spaces.
* Maintaining a record of hazard identifications and risk assessments.
* Ensuring that completed entry permits will be kept for a period of one year after the expiry of the permit.
* Maintaining the written procedures for entry into confined spaces.
* Ensuring that qualified persons perform the hazard identifications and risk assessments.
* Ensure that written procedures are developed to eliminate or minimize the hazards or risks to workers.

**Supervisors** will:

* Ensure that pre-entry testing is performed where it is required.
* Ensure that workers follow proper procedures and have all the required personal protective equipment.
* Complete and sign Confined Space Entry Permits where they are required.
* Ensure that testing equipment is calibrated, and ventilation equipment has the proper capacity.
* Ensure that workers are trained in the confined space entry procedures and take all required precautions.

**Workers conducting air monitoring and testing** must understand:

* The limitations and reliability of the test equipment.
* How to calibrate the equipment.
* How to use sampling techniques that are safe.
* How to document test results.
* How to interpret data relative to the history of the confined spaces.

**Workers** will:

* Follow the confined space entry procedures.
* Not enter a confined space unless they have been trained and have all of the proper equipment.
* Where a space requires an entry permit, not enter the space until their names are on the permit, and the supervisor signs the permit. (Confined Space Entry Permit is located in Appendix C).
* Ensure that atmospheric testing is conducted less than 20 minutes prior to entry, where atmospheric testing is required.

**Contractors** will:

* Ensure they have copies of the confined space inventory and hazard identification for the space(s) they are working on.
* Complete a risk assessment for the work they perform in confined spaces.
* Develop safe work procedures based on the hazard identification and risk assessments.
* Comply with all applicable WorkSafeBC OHS Regulations.

# CONFINED SPACE IDENTIFICATION

Each confined space that requires special precautions is identified on an inventory. This inventory is maintained by [insert name or job positions here] and is located [insert location here]. (An example of a Confined Space Inventory Form is provided in Appendix B).

Each confined space that does not require entry has a warning sign posted at the entry stating that it is a confined space and that entry is not allowed. A confined space identification chart is provided in Appendix A**.**

# HAZARD IDENTIFICATION AND ASSESSMENT

A hazard identification and assessment must be conducted and documented for each confined space or group of similar confined spaces. This must be carried out by a “qualified person” as defined in OHSR Section 9.11.

Each space will be assessed for the identification for both space hazards and those for the work activities required within the confined space.

## Space Hazard Assessment

The space hazard assessment is normally done during the initial identification (Appendix A), and compilation/preparation of a confined space inventory (sample presented in Appendix B). Use a Confined Space Hazard Identification and Assessment Form (example of information presented in Appendix C for this purpose). A written hazard assessment for the space must be completed by a Qualified Person and must be completed for all confined spaces or groups of similar spaces in [Organization].

The completed forms will be reviewed and the Hazard Identification and Assessment confirmed by the Confined Space Administrator and/or by the Manager responsible for the space, and in consultation with the joint committee or the worker health and safety representative.

The hazard identification must include the following information:

* Location of the space.
* Layout of the space, which may include a floor plan/schematic drawing.
* The conditions that may exist prior to entry due to the confined space’s design, location or use, and those which may develop during work activity inside the space.
* Atmospheric hazards including the potential for oxygen enrichment and deficiency, flammable gas, vapour or mist, combustible dust, and other hazardous atmospheres.
* Concentrations of toxic substances.
* Physical hazards such as noise, electric shock, deteriorating structural components, slick, wet surfaces, etc.
* The potential for engulfment and entrapment.
* Lockout and isolation requirements.

Hazard identification will be redone whenever any change in the space is likely to result from any of the following:

* installation or modification of a space.
* a change in equipment operating conditions.
* a change in the atmosphere or working environment.
* a change in working arrangements or procedures.

## Work Activity Hazard Assessment

When the hazards of the confined space have been identified, a hazard assessment must be completed for the duties to be performed in the confined space.

Various work location (i.e., space) and work activity (i.e., task) related hazards will be taken into consideration when completing the identification. This can include, but is not limited to:

|  |  |
| --- | --- |
| **Work Location (Space)** | **Work Activity (Task)** |
| * Atmospheric hazards * Chemical hazards * Physical hazards * Biological hazards * Mechanical hazards * Electrical hazards | * Cutting, grinding or welding * Spraying of materials * The use of epoxies or other chemicals * Sand blasting and * Any other activity which may cause sparks or release harmful substances into the air or expose workers to any other potential hazard |

## Atmospheric Assessment

Atmospheric hazards can be present from either the space itself or generated during work activities within the confined space. This must take into account the goal of every confined space to have a “clean respirable air” atmosphere (whenever practicable) and determination of a **LOW**, **MODERATE**, or **HIGH** hazard atmosphere (*refer to Appendix C*).

### Atmospheric Hazards

#### Oxygen Hazards

Hazards due to oxygen can occur as a result of oxygen enrichment or oxygen deficiency. Oxygen naturally occurs in the atmosphere at approximately 20.9 percent of the total volume of air.

Oxygen enrichment can occur as a result of chemical processes or as a result of leakage from a tanked source such as welding equipment. When the percentage of oxygen in the air is greater than 23 percent, it significantly increases the rate of chemical reactions and can cause an explosive atmosphere.

Oxygen deficiency can occur as a result of:

* rusting of metal consumes oxygen.
* bacterial action such as found in sewage systems consumes oxygen.
* chemical processes in the space.
* displacement by other gases such as Carbon Dioxide and some fire extinguishing agents.
* operation of open flame heaters or internal combustion engines, as well as any other burning activities that use oxygen.

Oxygen can also be displaced by acetylene, methane, propane and natural gas.

When the percentage of oxygen in the air is less than 19.5 percent, it can result in disorientation and unconsciousness. At oxygen levels less than 6 percent, unconsciousness occurs in a matter of minutes, followed by death.

#### Flammable Hazards

Flammable gases and vapours can result in explosions. Decaying organic matter can produce methane gas. Natural gas can be present due to leaks in the building or home heating gas distribution system. Gasoline can be found in storm drains as a result of inadvertent or intentional disposal. Acetylene can leak from tank or piping systems for welding. Flammable gases and vapours can become explosive when they are mixed with air in concentrations over a certain range. In some circumstances airborne dust can create an explosive atmosphere, e.g. fine wood dust, coal dust.

Where workers must enter a confined space, the concentration of flammable gases and vapours in the space must be maintained below 20 percent of the lower explosive limit (*all considerations will include an evaluation of the flammable gas used at calibration and application of correction factors for display reading*). If any flammable or explosive gas, vapours or liquids are present, all sources of ignition will be eliminated prior to entry, including cutting, grinding and burning activities. Under most situations NO flammable conditions (i.e., 0% LEL) should be expected to be present in order to allow entry (e.g., “clean respirable air”).

Non-sparking tools will be used and equipment will be grounded to prevent static electricity.

Only intrinsically safe electrical equipment will be used in confined spaces where there is a possibility of a flammable atmosphere.

#### Carbon Monoxide Hazards

Carbon monoxide is a colorless, odorless, tasteless gas that results from the incomplete combustion of hydrocarbon fuels, e.g. gasoline, diesel. It is commonly produced by internal combustion engines and may be produced by the decomposition of organic matter. It can cause workers to become disoriented and can cause death. Carbon monoxide is approximately the same weight as air and therefore can be found in the breathing zone. It has an 8-hour exposure limit of 25 ppm and a 15 minute ceiling exposure limit of 100 ppm.

#### Hydrogen Sulfide (H2S) Hazards

Hydrogen sulfide is a gas that is produced by the decomposition of organic matter. It can be found in sewage systems, but also in stagnant areas in storm drains. It smells like rotten eggs, but even low levels of hydrogen sulfide can paralyze the sense of smell. Hydrogen sulfide can be fatal at very low levels. This gas is heavier than air and will collect in low areas, but it can be moved by strong air currents and so may be at the top of the space as well. Hydrogen sulfide has a ceiling permissible concentration of 10 ppm.

#### Additional Work Generated Atmospheric Hazards

When a work activity that has not been identified on an existing hazard assessment is to be carried out within a confined space, the existing hazard assessment document must be reviewed and revised when the hazards are not similar to those currently identified on the existing document.

# ENTRY PROCEDURE

A written procedure for entry into a space or group of similar spaces, prepared from the hazard identification and assessment, is required and includes details on entry requirements and controls as described in the following sections.

# ENTRY REQUIREMENTS

## Pre-Entry Preparation

The Entry Supervisor, when planning the work and/or prior to entering the space, must review any prior prepared hazard assessment document to confirm that the initial hazard assessment reflects the confined space conditions (no changes in the space since the hazard assessment’s initial preparation) and the work to be carried out is included and has been assessed to identify the applicable hazard.

The entry procedure for that entry must also be reviewed by the Entry Supervisor to ensure no changes have occurred since its initial preparation.

## Entry Assessment

The Entry Supervisor must evaluate the entry conditions found at the confined space to verify/confirm that no additional or unrecognized/anticipated hazard are present for which the existing hazard assessment requires amending or updating (by a Qualified Person).

This assessment is done to identify any changes that may have taken place in the confined space since the initial assessment of the space and/or since the last entry (changes in the surrounding area the confined space is present or changes to connecting systems.

## Entry Permits

There are certain situations, as outlined below, in which a confined space entry permit is required.

#### An entry permit is required:

* If the hazard assessment shows that the confined space has the potential for a high hazard atmosphere. A high hazard atmosphere means an atmosphere that may expose a worker to risk of death, incapacitation, injury, acute illness or otherwise impair the ability of the worker to escape unaided from a confined space, in the event of a failure of the ventilation system or respirator.
* If there is a potential for entrapment. Entrapment can be caused by structural failure, such as rusting of the floor of a culvert, or hazardous adjacent activities such as a location next to a chlorine plant that might require evacuation. It can also be caused by the design of the space.
* If there is a potential for engulfment. This refers to being buried by loose materials or being drowned by fluids. This risk occurs whenever free flowing solid or liquid materials are present in enclosures.
* If isolation is required, for example:
* If piping into the space must be disconnected
* If blanks, or blinds must be installed, or
* If a double block and bleed system is used
* If lockout is required either prior to entering the space or while work is being done in the space.

If a permit is required no worker is allowed to enter the space until the permit has been filled out and signed by the Entry Supervisor.

Using the Confined Space Entry Permit *(sample presented in Appendix D*) the Entry Supervisor will identify the required precautions from the Entry Procedure. It takes into account the type of work to be done and any equipment or materials that will be used in the space during the entry.

**The confined space entry permit:**

* Describes the type of the work being done in the space.
* Describes the ventilation system being used.
* Records the results of the atmospheric testing.
* Lists the precautions that must be taken to minimize the risk to workers entering and working in the space.
* Names each worker that is in the space.
* Outlines the provision for rescue.
* Identifies the expiry time of the permit.
* Must be re-authorized and signed by the supervisor if there is a change in the work crew or supervisor.

Completed permits are kept [insert location here] by [insert name or job description here] for a minimum period of one year.

## Space Preparation, Cleaning and Purging

Whenever possible, [Organization]will ensure that a confined space contains clean respirable air. If the confined space does not contain clean respirable air, cleaning, purging or venting will be used to control the hazardous atmosphere.

Purging residual gases in the space may precede cleaning of residual materials within the space. Purging is the removal of a dangerous atmosphere in a confined space by a fluid such as water or non-flammable gas such as nitrogen or carbon dioxide. Prior to entry, the purge gas will be displaced with ventilation, and the atmosphere will be tested to ensure that clean respirable air exists.

## Isolation and Control of Harmful Substances

If there is piping entering and/or exiting the space that contains or has contained a harmful substance as described in WorkSafeBC Regulation 9.18(1), it must be controlled by either disconnecting the adjacent piping or isolating it using blanks or blinds that are either certified by a professional engineer or have been manufactured in accordance with ANSI standards (see WorkSafeBC Regulation Part 9.20).

If the harmful substance in the piping is not a gas or vapour or a volatile liquid, then in addition to either disconnecting the adjacent piping or isolating it using blanks or blinds, a double block and bleed system may be used as per WorkSafeBC Regulation 9.21. (Double block and bleed involves closing two valves in the line, and opening a drain valve between them.)

Opening piping to install blanks and blinds is dangerous if the piping contains harmful materials. Workers must follow written safe work procedures when installing blanks and blinds. The written procedures include the procedure to depressurize the line and drain the system. Proper personal protective equipment including respirators, if required, must be part of the written procedures, as well as lockout procedures and monitoring for air contaminants.

In any case, every isolation point must be visually checked or otherwise verified to ensure that the confined space is effectively isolated before a worker enters the space.

### Municipal Water Systems

If a substance in the piping is harmful only because of the temperature, pressure or quantity of the substance, e.g. a municipal water system, then the harmful substance must be controlled by either:

* disconnecting the adjacent piping, or
* isolating it using blanks or blinds as per Regulation 9.20, or
* using a double block and bleed system as per Regulation 9.21, or
* by isolating the adjacent piping in a manner that a professional engineer has certified will make the confined space safe for a worker to carry out the intended work, or
* if there is no head pressure in the adjacent piping, by de-energizing and locking out each pressure source for the adjacent piping and depressurizing the adjacent piping.

Depending on the material to be isolated, if isolation cannot be carried out in keeping with the requirements of the OHS Regulation Alternative Measures may be required 9and to be accepted by WorkSafeBC prior to entering the space(s), e.g., controlling the flow of non-hazardous fluid by closing a valve or using inflatable rubber bladders). *See WorkSafeBC Guideline regarding Regulation 9(18)(3)(b) for more information*.

### Municipal Sanitary Sewers

Where the gases from a gravity-flow municipal or domestic sanitary sewer system or storm sewer system may enter the space, a worker may enter if:

* The space is protected from the ingress of gases by use of a p-trap.
* The atmosphere in the space has been tested immediately before entry and the testing confirms clean, respirable air.
* The integrity of the p-trap has been confirmed immediately prior to entry.
* The atmosphere is continuously monitored while the worker is in the space and confirms the space contains clean, respirable air.

### Alternative Measures

Where normal isolation practices are not practicable in a municipal sewage system (including storm drains systems) an evaluation will be conducted by a Qualified Person to determine the alternate measures required in order to safely enter the space without isolating the liquid flow.

Alternative measures may include simply closing a valve instead of blanking, blinding or double block and bleed. The alternative measures, including occupational hygiene and safety precautions other than or in addition to isolation, will be submitted to the regional WorkSafeBC office to determine acceptability prior to entering the space.

Alternative measures for fluid control may include inserting inflatable rubber bladders into pipes, or simply closing valves or gates. If it is possible to lockout the device then a lockout system must be implemented, e.g. for closing valves.

### Engineering Certification

In some situations (e.g., potable water systems) the isolation may be able to be reviewed and certified by a Professional Engineer. *See WorkSafeBC Guideline regarding Regulation 9(18)(3)(b) for more information*.

## Lockout

Lockout is used to eliminate or minimize hazardous energy in confined spaces. Lockout procedures have been established for all work being performed in confined spaces. [Organization] uses locks to render machinery or equipment inoperable and to isolate energy sources in accordance with the organization’s written lockout program and procedures. The lockout procedures and all lockout points are identified and documented as part of the hazard identification and risk assessment process.

## Atmospheric Testing and Monitoring

All confined spaces must be continuously monitored for the presence of contaminants and safe oxygen levels prior to and during entry. This must be done by a trained worker using calibrated equipment and in accordance with written procedures. A record of the tests must be kept using the Confined Space Entry Permit / Form.

Atmospheric testing will be carried out to verify that “clean respirable air” is present:

1. the confined space contains a safe oxygen level – 20.9%VOL (e.g., 20.7 to 21.1%).
2. there is no measurable flammable contaminant in the atmosphere, and
3. the atmospheric contaminants in the confined space are reduced to not exceeding 10% of an applicable exposure limit (e.g., carbon monoxide ≤ 2.5 ppm; hydrogen sulfide ≤ 1 ppm).

In addition to regular atmospheric testing for contaminants such as hydrogen sulfide and carbon monoxide, testing for other contaminants should be done based on the information recorded in the confined space risk assessment for the specific confined space that is to be entered.

Some possible contaminants include, but are not limited to:

|  |  |
| --- | --- |
| **Gas or Contaminant** | **Possible Locations** |
| Hydrogen sulfide (H2S) | Sewers |
| Carbon monoxide (CO) | Sewers |
| Ammonia (NH3) | Arenas |
| Chlorine (Cl2)  *(excluding sodium hypochlorite or liquid chlorine)* | Pools, wastewater treatment |
| Methane (CH4) (flammables) | Sewers, wastewater treatment |
| Ozone (O3) | Pools, water treatment |
| Petroleum hydrocarbons | Various |
|  |  |

The worker doing the testing must always assume that the space has a dangerous atmosphere until it is proven otherwise. Testing must be done in the following order:

1. **At the opening of the space** – Where possible, test above a manhole cover (pick-hole) or access hatch prior to opening.
2. **Before ventilating –** After removing the cover to the space test at various levels of the space, i.e. at least every 5 feet, and record.
3. **After ventilating** - Testing after ventilation can give false security to the workers because they will not know if a hazard existed prior to the ventilation and therefore may not look for the source of the contaminants.
4. **Monitor continuously** – while workers are in the space (recommended).

Record the results of the monitoring at least every 30 to 60 minutes, more often if contaminants are noted or oxygen or other contaminant levels are changing.

Pre-entry atmospheric testing is not required in a confined space with a low hazard atmosphere if:

1. the location and control of the space ensures a more hazardous atmosphere could not inadvertently develop,
2. such testing is not required to verify the effectiveness of an isolation or other pre-entry control,
3. prior documented representative sampling shows the space contains clean respirable air, and
4. the written procedures do not require such testing.

Atmospheric testing will be completed within 20 minutes before workers enter the space and prior to each re-entry if all workers leave the space for more than 20 minutes.

## Ventilation

All confined spaces will be continuously ventilated while workers are inside the space except in:

* an atmosphere intentionally inerted, or
* a low hazard atmosphere where the following conditions are met:
  + the atmosphere is continuously monitored and shown to contain clean respirable air, and
  + the space has an internal volume greater than 1.8m3 (64 cu ft) per occupant, is occupied for less than 15 minutes, and the work inside the space generates no contaminants other than exhaled air.

The ventilation blower is to be situated up wind of the entry point so as to draw clean air, free of dust, exhaust fumes, etc. The Standby Person must be aware of changes in wind direction, etc., and adjust the air intake as required. The discharge end of the hose is to be located such that incoming air movement is obtained at the waist level of the worker at the lowest level in the confined space. In the event of a failure of the ventilation system, the space must be vacated immediately.

The ventilation system will adequately ventilate every occupied area within the space.

Be aware of:

* Obstructions within the space that could result in pockets of dead air or affect airflow.
* Short-circuiting of the airflow that can occur when air intakes are too close to air outlets on the ventilation system.

The ventilation system will normally push air into the space rather than pull it out, except for the use of local exhaust systems (or other locations where makeup air sources are known to be clean respirable air). The ventilation system will be able to maintain any contaminants below their exposure limits.

Contaminants produced by the work will be controlled at the source by a local exhaust ventilation system if practicable. This includes internal combustion engines as well as activities such as welding. The exhaust will be positioned well away from the intake for the ventilation air. Typical airflow for welding is 100 to 200 cubic feet per minute with the hood less than six inches away from the arc. Air arc gouging will require up to 2000 cubic feet per minute.

When spray painting, the ventilation rate must be high enough to ensure that the permissible concentration of the chemicals listed in the Material Safety Data Sheet, is not exceeded. Also, the ventilation rate must be high enough to ensure that flammability limits are not exceeded if there is a flammable component to the paint or chemical.

Other processes, which may require local exhaust may include but are not limited to:

* Painting
* Applying epoxy
* Grinding, or burning galvanized metal

### Natural Ventilation

If natural ventilation is used, the rate of air flow through the space must be monitored and must be sufficient to maintain the concentration of any contaminants below their exposure levels. Natural ventilation will not be used if there is a high hazard atmosphere, or if the natural ventilation could draw other contaminants into the space. Natural ventilation typically would be used in low hazard atmospheres such as air plenum intakes, attic crawl spaces, etc.

## Standby Person

One of the most important components of any Confined Space Entry Program is communication. Workers can be placed at significant risk if:

* A confined space is improperly identified due to poor communication,
* The procedures are improperly followed, or
* Help is delayed.

Each confined space has different requirements for communication between the Standby Person and the worker(s) in the space based on the atmospheric hazard determination:

1. **Low Hazard Atmosphere Communication:**

In a confined space with a low hazard atmosphere, there must be continuous means of summoning the Standby Person. Also, the Standby Person must:

* Check on the well-being of workers inside the space at least every 20 minutes, and
* Have a means to immediately summon rescue personnel

1. **Moderate Hazard Atmosphere Communication:**

In a confined space with a moderate hazard atmosphere, there must be a continuous means of summoning the Standby Person. Also, the Standby Person must:

* be **stationed at or near the entrance to the space,**
* visually observe or otherwise check the well-being of the workers inside the space at least every 20 minutes or more often if required, and
* have a means to immediately summon rescue personnel.

1. **High Hazard Atmosphere Communication:**

In a confined space with a high hazard atmosphere, or potential for engulfment or entrapment, there must be a continuous means of summoning the Standby Person. Also, the Standby Person must:

* be **stationed at the entrance to the space,**
* do no other work activities,
* continuously monitor the well-being of the workers in the space, and
* be equipped and capable of immediately commencing the rescue of the workers in the space.

## Equipment

### Air Monitoring (Gas Detectors)

The portable gas detector is one of the most important tools used by personnel required to enter confined spaces or areas where contaminated atmospheres may exist or may develop.

All gas detectors must be certified, calibrated according to the manufacturer’s instructions, and function tested (bump-tested) prior to use.

Everyone involved in confined space entry, i.e. the entry worker, the Standby Person and the supervisor must know how to operate the gas detector used in any confined space entry in which they are involved. It is imperative that the worker using the portable gas detector be trained, familiar with, and practiced in the use, functions and operating procedures of the gas detector he/she may use.

#### Testing

Before a gas detector is used on the day the entry is to occur, it must be function tested or bump tested to ensure that all sensors are responding to known concentrations of gases. This must be done by a worker who has been trained in the procedure.

Most gas detectors are equipped to self-diagnose automatically when the power is turned on. The user should observe this diagnosis with particular attention paid to the battery condition. The battery voltage must be within certain limits for the instrument to function properly. Self-diagnoses is not the same as function testing.

### Ventilation Equipment

Ventilation equipment includes blowers, hoses and saddle vents where applicable. Blowers are required to be used unless the natural ventilation in the space has been measured and found to be adequate as described above. Each blower must be identified as to its capacity (cubic feet per minutes – cfm) and must be able to provide at least 50 cfm for each worker in the space. More important, the ventilation equipment must be able to supply clean respirable air to the space during the entry.

### Emergency Response and Retrieval Equipment

When entering any confined space workers must wear a full body harness. In spaces with moderate or high hazard atmospheres, or those where there is a risk of entrapment, engulfment or any other recognized serious health or safety hazard, the harness must be connected to a lifeline that is connected to a retrieval device. The Standby Person must be trained in how to use the emergency response/rescue equipment to remove a person from the space in an emergency.

Lifelines must have an ultimate strength of 27 kN (6,000 pounds) and be kept free of knots or splices except at the ends. Only stainless steel lines will be used where hot work is being done.

### Personal Protective Equipment

The conditions in the confined space will dictate the requirements for personal protective equipment. PPE may include: safety headgear, safety goggles, face shields, gloves, safety footwear, disposable suits, and earplugs or muffs. Intrinsically safe flashlights and tools must also be required if a flammable atmosphere is, or could be, present.

### Electrical Tools and Equipment

Electrical tools and equipment used in the confined space will be grounded or double insulated. Generators located outside the confined space must be equipped with ground fault circuit interrupters (GFCI).

### Other Tools and Equipment

Torches and hoses used for welding, brazing or cutting will be removed from the confined space when not in use. No welding, brazing or cutting will be allowed if flammable or explosive gases, vapours or liquids are present.

### Communications Equipment

It is essential to have an appropriate means of communication between the person working inside a confined space (the entry worker) and the person stationed outside (the Standby Person).

It should be noted that radio frequency and wireless devices do not work effectively in confined spaces such as tanks or sewers where there is metal or concrete shielding between the interior of the space and the outside. When visual monitoring of the worker is not possible because of the design of the confined space or location of the entry hatch, a voice or alarm-activated explosion proof type of communication system may be necessary, particularly for rescue operations.

Another consideration is that, in some instances, electrical communication may introduce an ignition source in a flammable atmosphere.

Basic equipment includes a mobile or portable radio and/or a cell phone in order to provide:

* a system of communication between the Standby Person and entry personnel.
* a system of communication between the Standby Person and an outside source such as Yard Dispatch and/or 911.

**All communications equipment must be tested prior to entry to ensure proper operation and that a contact person is available.**

# EMERGENCY RESPONSE

Emergency response plans will be in place before workers enter a confined space. The rescue plan will consider:

* The specific hazards of the confined space
* Any obstacles to rescue
* The type of rescue equipment that must be in place before the confined space entry
* Communication, and
* First aid

For spaces with a high hazard atmosphere rescue personnel will be stationed at the entrance to the confined space whenever a worker is in the space. For all other situations the Standby Person will have the means to summon emergency rescue personnel and/or conduct an outside rescue using the lifeline and lifting device that is in place. A sample Confined Space Emergency Response Guideline is provided in Appendix E.

The following paragraphs are provided as examples of possible rescue situations. The organization utilizing this document must determine which of the following paragraphs best suits their circumstances and remove the rest of the paragraphs as appropriate.

[Organization] will ensure that rescue services are available when a worker enters a confined space. Prior to entering the space, rescue personnel will be notified that work is taking place in a confined space. Rescue personnel will monitor the incoming line to ensure that they receive the signal if rescue is required.

[Organization] will rely on its internal rescue team and the use of lifting devices and harnesses to ensure that workers can be rescued from the confined space without it being necessary for any other worker to enter the confined space. The Standby Person will call [insert phone number or radio call sign here] to activate the rescue.

[Organization] will rely on its internal rescue team who has been trained in the use of self-contained breathing apparatus and rescue procedures. The Standby Person will call [insert phone number here] to activate the rescue team.

[Organization] has entered into a written agreement with [insert name of agency here] to provide rescue services from confined spaces on a 24-hour a day basis. In the event that there is a requirement for rescue, the Standby Person will call [insert phone number here] to activate the rescue service.

A sample of a Confined Space Entry and Emergency Response Checklist is provided in Appendix F.

# TRAINING REQUIREMENTS

## Goal

To educate and train workers in the hazards of confined spaces and inform them of procedures to eliminate or minimize the risks associated with confined space entries.

## Objectives

Workers involved in confined space entry will:

* be familiar with the WorkSafeBC Regulations regarding confined spaces
* understand the criteria for a confined space
* be able to identify confined spaces
* understand how to perform hazard identification and risk assessments
* know how to conduct pre-entry testing based on written procedures
* understand the typical air contaminants found in municipal confined spaces
* understand the hazards associated with the space
* know how to complete the confined space entry form / permit
* understand ventilation requirements and be able to properly set up the ventilation system
* understand and be able to follow the safety precautions required by the written procedures

## Summary of Training

* Confined space policy
* WorkSafeBC’s Occupational Health and Safety Regulations and definitions
* Hazard identification and assessment
* Pre-entry atmospheric testing
* Communication required for confined space entry
* Use of the confined space entry forms / permits
* Equipment required for confined space
* Rescue procedures for confined space

# 

# DOCUMENTATION

Documentation for the confined space entry program includes:

* Completed inventory of confined spaces
* Completed hazard identification and assessments for each space or group of similar confined spaces (including those hazards for work activities required within the space)
* Records of pre-entry testing
* Completed entry permits – must be kept for at least one year
* Emergency response procedures

[Organization]will ensure that the inventory of confined spaces is kept current and that hazard identification and assessment information provided to contractors is correct and current.

All hazard identifications and assessments, and corresponding entry (work) procedures (where entry activities are identified) are maintained as part of the inventory.

Maintenance of the inventory is the responsibility of [insert name or job description here].

# PROGRAM EVALUATION AND REVIEW

This program will be reviewed periodically to ensure that it remains effective at addressing and controlling identified confined space hazards.

The Confined Space Entry Program Coordinator will coordinate the periodic review of the Confined Space Entry Program with input from any personnel involved in confined space entry activities.

This entire program must be formally reviewed annually, or more frequently as required, to ensure that it remains effective at addressing and controlling identified confined space hazards. The review will include, but not be limited to:

* Verifying the accuracy of the confined space inventory and site labelling
* Reviewing regulatory changes that may impact site practices and requirements
* Reviewing existing written hazard assessments and entry procedures for application period expiry (e.g., less than 5 years) where identified on entry documentation
* Reviewing work activities included on hazard assessments and entry procedures
* Reviewing education and training requirements, programs and providers
* Reviewing availability and suitability of confined space related equipment (including emergency response equipment)

The Program Coordinator will coordinate the annual review of the Confined Space Entry Program with input from the [Organization] Occupational Health and Safety Committee and any personnel involved in confined space entry activities.

**REVISION HISTORY:**

|  |  |  |
| --- | --- | --- |
| **REVISION DATE** | **CHANGE MADE** | **ACKNOWLEDGEMENTS / AUTHOR** |
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**APPENDICES**

**Appendix A: Confined Space Identification**



**NOTES:**

1. **Continuous Human Occupancy (OHSR Guideline G9.1-2 Definitions)**

If a space is designed or intended for continuous human occupancy, it will generally:

* Incorporate a permanent Heating, Ventilation and Air Conditioning (HVAC) or similar system
* Rely in its design on relevant codes as applicable, including the BC Building Code, National Fire Code, BC Electrical Code, BC Plumbing Code, Mechanical Refrigeration Code, and municipal by-law requirements
* Include installed utility services that anticipate human occupancy e.g., hard-wired lighting rather than portable lamps, plumbed water lines rather than hoses etc.
* Not be designed as a container or conveyance of a product or substance
* Be entered for purposes other than periodic inspection, maintenance, repair or construction
* Include designed access and egress means such as doorways and staircases
* Incorporate features intended solely to accommodate continuous occupancy e.g., have amenities associated with continuous occupancy such as furniture, flooring material, wall coverings
* Be designed to allow worker self-rescue if there is a failure of the above features

1. **Restricted means for entry or exit (OHSR Guideline G9.1-2 Definitions)**

Entry or exit refers to crossing the portal between the confined space and the outside work area, but also includes consideration of the routes inside the confined space for gaining access to the work area in the space or returning to the portal from it.

The OHSR Guideline refers specifically to four types of emergency responses:

1. First aid, which refers to treatment for the purpose of preserving life and minimizing the consequences of injury until medical treatment is obtained, and treatment of minor injuries.
2. Rescue, which involves removing a worker or workers from danger, in circumstances where they have become incapable of removing themselves.
3. Evacuation, which refers to the exit of the entire workforce from the work area in an emergency situation.
4. Other emergency response, which includes scenarios such as firefighting, and hazardous materials spill response.

The following are some examples of situations where the means of entry or exit will typically be considered to have complicated the provision of first aid or rescue:

* A space for which the means of exit prevents the use of a first aid transport device, and requires a worker to be removed from the space by other means such as a harness, lifeline, and possibly a lifting device.
* A space in which circumstances impede the ability to transport an injured worker. For example:
  + The exit port of the space is narrower than the width of the transport device.
  + The exit port is so constructed that a person carrying the device has no alternative but to put it down in order to get through the port or pass it to another person through the port.
  + The transport device needs to be lifted at any time to shoulder height or higher when exiting the space with the injured worker in it. (Such lifting might be needed, for example to get a stretcher over top of a piece of machinery on the way to the exit port, or if the exit port was well above floor level and access on a stairway or ramp was not possible.)
  + The transport device needs to be inclined at any time to an angle of 45 degrees or more above horizontal. (This might occur, for example, when easing the device up to the exit port and out of the space.)
  + Specialized equipment such as a block and tackle or other equipment is necessary during the exit scenario to lift or direct the transport device.
* A space with a potentially dangerous atmosphere and a means of entry or exit that is so constructed that first aid or rescue workers wearing self-contained breathing apparatus (SCBA) must remove tanks from their backs at any point when entering or exiting.

**Appendix B: Sample Confined Space Inventory Form**

|  |  |  |  |
| --- | --- | --- | --- |
| **Description** | **Location** | **Hazard Assessment Completed** | **Work Activities Identified** |
| **Wastewater Treatment** | | | |
| Grit tank | Wastewater Plant | Yes | Agitator mechanical maintenance |
| Primary clarifier | Tank farm | Yes | Repairs to rake |
| Grit tank | Tank farm | Yes | Repairs to aeration piping |
| Gallery sump | Tank farm | Yes | Repair pump / piping |
| Valve chamber | Lagoon | Yes | Valve operation  Valve maintenance / replacement |
| Hypochlorite (liquid chlorine) tank | Lagoon | Yes  [space only] | *None identified* |
| **Sanitary Collection System** | | | |
| Sanitary pump station | Cook Road | Yes | Manual cleaning  Repair pumps / check valves |
| Sanitary air valve chamber | Cook Road | Yes | Service and repair |
| **Parks and Recreation** | | | |
| Elevator pit | Community centre | Yes | LOW HAZARD - “Excluded space” |
| Snow pit | Arena | Yes | Manual cleaning |
| **Water Distribution** | | | |
| Meter chamber | Low road | Yes | Meter maintenance  Meter replacement |
| Valve chamber | Low road | Yes | Valve operation  Valve maintenance |
| Pressure reducing valve chambers | 1. High Rd. 2. Middle Rd. 3. Low Rd. 4. Cook Rd. |  | Weekly checks  Strainer cleaning  Valve maintenance |
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**Appendix C: Hazard Identification and Assessment**

*The following are examples of information to document on a written hazard assessment prepared by a Qualified Person. A written confined space hazard assessment may take on varying formats depending on the organization.*

*It is recognized that when a hazard assessment is completed that the potential or actual atmospheric hazard classification is evaluated taking into account the varying entry activities that may or may not influence the space atmosphere (e.g., LOW, MODERATE, or HIGH hazard atmosphere).*

*If the Qualified Person uses a risk assessment rating scheme this should not be confused with the OHSR defined atmospheric hazard ratings since work / entry procedure requirements identified in the OHSR can determine what procedural activities are or are not permitted.*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SPACE / WORK LOCATION DETAILS** | | | | | | | | |
| **WORK LOCATION,SPACE OR VESSEL TYPE** | | | | | | | | |
|  | | | | | | | | |
| **IDENTIFICATION AND LOCATION DETAILS:** | | | | | | | | |
| **Identification/Code** | | **Name** | | | | | **Address** | |
|  | |  | | | | |  | |
| **DESCRIPTION OF CONTENTS** | | | | | | | | |
|  | | | | | | | | |
| **PROCESS / FUNCTION DESCRIPTION** | | | | | | | | |
|  | | | | | | | | |
| **ADJACENT VESSELS AND PIPING** | | | | | | | | |
| **Upstream:** |  | | | | | | | |
| **Downstream:** |  | | | | | | | |
| **PHYSICAL CONFIGURATION** | | | | | | | | |
| **Description:** |  | | | | | | | |
| **Equipment/Space** | | | | **Approx. Dimensions (m)** | | **Approx. Volume (m3)** | | **Space Material** |
|  | | | |  | |  | |  |
| **SPACE ACCESS CHARACTERISTICS** | | | | | | | | |  |
| **Description:** |  | | | | | | | |
| **Equipment/Space** | | | **Orientation** | | **Location(s)** | **Approx. Dimensions** | | **Securing Mechanism** |
|  | | |  | |  |  | |  |
|  | | |  | |  |  | |  |
| **DRAWING / PHOTOGRAPHS OF CONFINED SPACE** | | | | | | | | |
|  | | | | | | | | |

| **HAZARD IDENTIFICATION AND ASSESSMENT** | | | | | |
| --- | --- | --- | --- | --- | --- |
| Potential Hazards | | **Specific Hazards for This Space** | **Hazard Control as Part of Entry Procedures** | | **PPE**  **Required** |
|  | **Oxygen Deficiency** – e.g. rusting construction components, new concrete, excessive organic growth. |  |  |  | |
|  | **Toxic Gases** - Gases in the space may be toxic, irritating, asphyxiating, or flammable. |  |  |  | |
|  | **Toxic Materials** - Ensure MSDS available on site; Ventilation and/or respiratory eqpt to be used |  |  |  | |
|  | **Outside Contaminant Sources** - Nearby sources may affect workers in the space |  |  |  | |
|  | Limited or restricted entry/egress  * small access point, |  |  |  | |
| * equipment placement |  |  |  | |
| * Material placement |  |  |  | |
|  | **Ventilation** - Limited or no ventilation |  |  |  | |
|  | Isolation & Lockout  * Piping coming into the space may have to be isolated, block and bleed… * Equipment, e.g. electrical must be isolated & locked out |  |  |  | |
|  | **Internal configuration hazards** - Specific rescue procedures may be required |  |  |  | |
|  | Below grade heavier than air contaminants may settle |  |  |  | |
|  | **Fall Hazard** – Excessive height or depth |  |  |  | |
|  | Slipping Hazards  * wet floor- risk of slip * sloping floor – risk of slip |  |  |  | |
|  | **Electrical Hazards** – e.g. Near power lines |  |  |  | |
|  | **Deteriorating construction components**:   * Concrete - spalling or cracking * Wood - rotting |  |  |  | |
|  | Entrapment/Engulfment  * Rotting materials, e.g. wood. |  |  |  | |
| * Upstream fluids - risk of drowning |  |  |  | |
| * Internal baffles - may also restrict ventilation |  |  |  | |
|  | **Internal pinch points** - risk of crushing |  |  |  | |
|  | **Dust** - may be flammable or irritating, or restrict vision |  |  |  | |
|  | **Temperature** - may be too hot or too cold |  |  |  | |
|  | **Noise** – Hearing protection may be required |  |  |  | |
|  | Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |  | |
| **Emergency Response Considerations** | | | | | |
| Horizontal 🞏 Entrapment 🞏 Piping 🞏 Multi-level 🞏 Other 🞏   |  |  | | --- | --- | | Comments: |  | |  | | |  | | |  | | | | | | | |

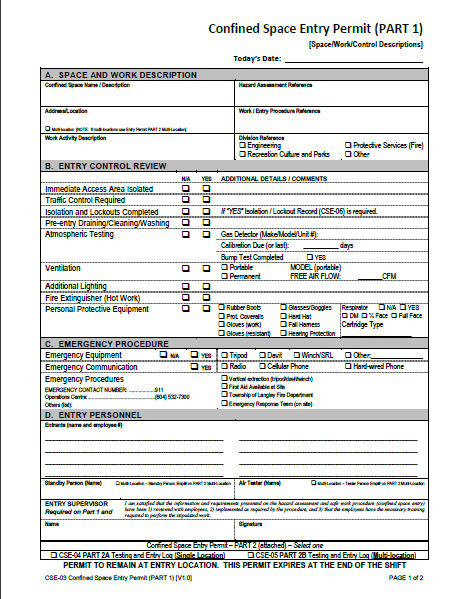
**Atmospheric Hazard Classification**

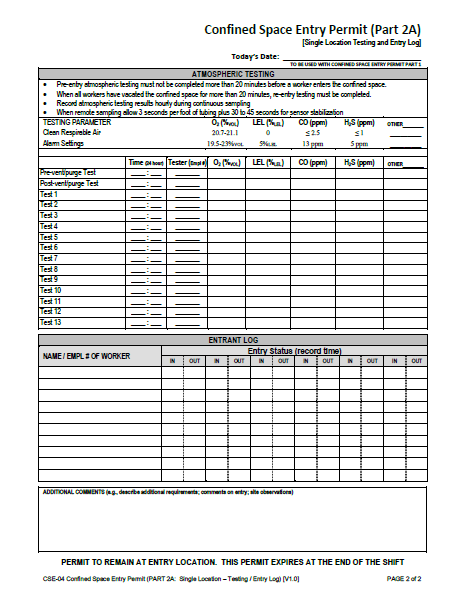


**Appendix D: Confined Space Entry Permit**

*There is no “perfect” confined space permit. Any entry permit must contain:*

1. *confined space and the work activities to which it applies,*
2. *workers who are inside the space,*
3. *required precautions for the space, and*
4. *time of expiration of the permit.*





**Appendix E: Sample Confined Space Emergency Response Guidelines**

The emergency response team supervisor shall ensure that an initial risk assessment is completed. This includes:

* Identifying external hazards (traffic etc.)
* Evaluating status of persons inside space
* Identifying potential contaminants
* Testing atmospheric conditions
* Ensuring that ventilation equipment supplies clean respirable air to the space during rescue
* Identifying life safety threats to rescuers
* Ensuring communication system is in place
* Ensuring PPE and other equipment is being used as required

The confined Space Entry Emergency Response Planning Checklist shall be completed for this purpose.

The emergency response team supervisor shall then formulate the emergency response, allocate tasks and assess further manpower requirements. He/she shall also ensure that all applicable parts of the general entry and/or the emergency response procedures are met.

**ACTIONS:**

* On attending the scene, an assessment must be completed immediately. The Emergency Response Planning Checklist can be used for this purpose.
* If a single responder enters the space, a Standby Person who is trained to perform emergency response, will be situated immediately outside the space. The Standby Person shall be in constant voice communication with the responder(s) inside the space at all times. In addition, another person must be immediately available to be the Standby Person in case the Standby Person must enter the space to aid in emergency response operations.
* Testing and ventilation of the space: Prior to entry, the space must be tested for contaminants. Entry, without breathing apparatus, requires the atmospheric conditions to be within the following parameters (*NOTE: Emergency Response Supervisor to make risk assessment of conditions which will include an atmospheric assessment provided as an example below*):
* Oxygen concentration not less than 19.5% and not greater than 23%
* Lower flammable limit less than 5% LEL

(considering that the flammable used for calibration may be methane)

* Carbon monoxide less than 25 ppm
* Hydrogen sulfide less than 5 ppm
* Other toxins less than identified exposure limits
* If atmospheric parameters are not acceptable and/or cannot be met through mechanical ventilation of the space, all entry personnel shall use SCBA or a supplied air system with escape bottles (*excluding flammable atmosphere for which supplied air respiratory protection does not eliminate a flammable hazard*).
* If atmospheric conditions are unknown or cannot be confirmed, all entry personnel shall use SCBA or a supplied air system with escape bottles (*excluding flammable atmosphere for which supplied air respiratory protection does not eliminate a flammable hazard*).
* If ventilation is employed, positive pressure must be maintained inside the space. Ventilation supply air must be circulated throughout the entire space.
* Where atmospheric LEL cannot be maintained below 5% by ventilation of the space or other means, appropriate measures will be taken to control ignition hazards or no entry will be made.
* In addition to appropriate personal protective equipment, persons entering a confined space will wear a rescue harness. A lifeline shall be used where a high hazard atmosphere is present. Lifelines are not required if obstructions or other conditions make their use impractical or unsafe. Provision shall be made to prevent the entanglement of lines and equipment.
* At least two additional rescuers shall be equipped with and dressed into any equipment required to enter the space and assist the initial entry personnel.
* Where a mechanical lifting device is required for retrieval of persons inside the space, rescue equipment will consist of the following minimum equipment:
* A suitable fixed anchor or tripod system for attachment of the lifting device
* A manual winch or similar lifting device
* A rescue diaper (and lifeline if required) to enable hauling the incapacitated worker(s) to the surface or exit hatch
* A spine board or similar device as required for spinal immobilization.
* Motorized winches, cranes or other equipment of this nature shall not be used for rescue or retrieval of personnel.

**Appendix F: Confined Space Emergency Response Checklist**

|  |  |
| --- | --- |
| **MANPOWER DEPLOYMENT** | **PERSON ASSIGNED** |
| **Emergency Response Supervisor** |  |
| **Risk Assessment** |  |
| **Gas Testing/Ventilation** |  |
| **Entry Rescue** |  |
| **Medical** |  |
| **Equipment** |  |

|  |  |  |
| --- | --- | --- |
| **Approach Hazards:** | **Assessed** | **Controlled** |
|  |  |  |
|  |  |  |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| **Other Entry Hazards:** | **Assessed** | **Controlled** |
| Lockouts/blanking required |  |  |
| Electrical |  |  |
| Fire/explosion |  |  |
| Entrapment/engulfment |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Victim’s Status:** | **Walking Wounded** | **Incapacitated** | **Life Threatening** | **Deceased** |
|  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Atmospheric Testing Results** | | | | |
|  | **TEST 1** | **TEST 2** | **TEST 3** | **TEST 4** |
| **O2** |  |  |  |  |
| LEL |  |  |  |  |
| **CO** |  |  |  |  |
| **H2S** |  |  |  |  |
| **Other/specify:** |  |  |  |  |
|  |  |  |  |  |
| **Other/specify:** |  |  |  |  |
|  |  |  |  |  |

|  |  |
| --- | --- |
| **For entry without use of breathing apparatus:**  ***(breathing apparatus does not eliminate a flammable condition hazard)*** | * Oxygen >19.5% and <23% * LEL <5% * Carbon monoxide <25 PPM * Other Toxins <10% of OEL |
| **If atmospheric parameters are not acceptable and/or cannot be met:** | All entry personnel must use breathing apparatus |
| **Atmospheric conditions unknown:** |

Confined Space Entry and Emergency Response Checklist – page 2 of 2

|  |  |
| --- | --- |
| **Gas testing** | * Gas detector * Extension tube and pump * Extra batteries |
| **Ventilation** | * Supply air ventilator CFM \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ * Vent tube * Exhaust ventilator CFM \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **PPE** | * Harness * Lifeline * SCBA * Extra bottles * Air-line breathing apparatus * Compressor/cascade system * Air-lines * Escape bottle * Portable radios/hardwire telephone/cellular phone |
| **High-Angle** | * Pulleys * Gibbs cams * Figure-8 * Carabiners * Webbing |
| **Access** | * Portable ladder * Lowering system – figure 8/lifeline |
| **Retrieval** | * Tripod or anchor * Manual winch system * Rescue diaper |
| **Fire guard** | * Portable extinguishers * Non-sparking tools * Explosion-proof ventilators |
| **Heavy rescue-extrication** | * Air bags * Shoring * Hurst jaws * Power saw * Pry bars * Turfer/come-alone |