Introduction

Many workplaces contain spaces that are referred to as "confined" because their configurations hinder the activities of any employees who must enter, work in, and exit from them. These spaces may include, but are not limited to, underground vaults, tanks, storage bins, manholes, vessels, and silos. The Occupational Safety and Health Administration (OSHA) defines a confined space as "any space which, by design, has limited openings for entry and exit; unfavorable natural ventilation which could contain or produce dangerous air contaminants, and one which is not intended for continuous occupancy."

OSHA’s standard for confined spaces, 29 CFR 1910.146 (Title 29 Code of Federal Regulations, Standard Number 1910.146), contains the requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces (also referred to as permit spaces).

Occupational Safety and Health laws are strict about what must be done before entering a confined space; and well-trained workers know and follow the prescribed steps and testing protocols. Yet, tragedies have taken place when individuals disregarded these steps and failed to identify all possible hazards. In many cases, it’s the invisible hazards in confined spaces that have proven to be most deadly.
What are some of the Hazards associated with Confined Spaces?

- **Oxygen Deficiency** – Oxygen level should be within the range of 19.5% to 23.5%.

- **Exposure to toxic substances** – Most substances, such as liquids, gases, mists, solid materials and dusts, can present a hazard in a confined space. Toxic substances can come from a variety of materials including:
  - A product stored in the space.
  - The work being performed in the space, such as welding, cutting, brazing, painting, scraping, sanding, degreasing or use of solvents.
  - Toxic materials stored in areas adjacent to the confined space might include chemicals or fuel stored in leaking underground storage tanks, or section of the steam tunnels that may lie adjacent to a leaking sewer system.
  - Chemicals used in the space may cause various acute effects, including impaired judgement, unconsciousness, and death. A toxic atmosphere may occur due to the presence or influx of hazardous substances. A toxic atmosphere can restrict a worker's ability to escape from the space.

- **Presence of combustible or explosive gases or materials** – Flammable atmospheres are those in which oxygen is in the air and a flammable gas, vapor or dust is present in the proper proportion of the gas/vapor and oxygen to make it potentially explosive. Different gases have different flammable ranges. If a source of ignition, such as a sparking or electrical tool, is introduced into a space with a flammable atmosphere, an explosion may result.

- **Falling Objects** – Workers in confined spaces should be aware of the possibility of falling objects, especially in spaces which have topside openings and where work is being done above them.
• **Temperature Extremes** – Extremely hot or cold temperatures can present problems for workers. For example, if the space has been steamed, it should be allowed to cool before entry is made.

• **Noise** – Noise within a confined space can be amplified because of the design of the space. Excessive noise cannot only damage hearing but can also affect communication; such as causing a shouted warning to go unheard.

• **Slick / Wet Surfaces** – Slips and falls can occur on wet surfaces causing injury or death to workers. A wet surface will increase the likelihood and severity of electric shock in areas where electrical circuits, equipment, and tools are used.

**How can you make a Confined Space safer?**

The first step in making a confined space safer is to make sure that workers are properly trained. **Before initial work assignment begins, the employer must provide proper training for all workers who are required to work in permit spaces. Upon completing this training, employers must ensure that employees have acquired the understanding, knowledge, and skills necessary for the safe performance of their duties.**

A trained person must always test a confined space’s atmosphere before anyone enters. How do you know if you don’t test the atmosphere? If the oxygen, toxicity or flammable limits create a hazard, then the confined space is unsafe to enter. You can’t tell by looking or sniffing. *The atmosphere must be tested.* Many people have died because people have ignored atmosphere testing, or they weren’t prepared for the serious hazards involved. The same applies to rescue. When a person in a confined space is overcome by oxygen deficiency, toxic vapors or gases, what is the first reaction of the people standing by for rescue? The first reaction is to go get the downed person. If you are an attendant standing by, your duty is to observe and assist from above. If you have a tag line on the person inside and can pull them out without entering the confined space, that’s your job. If you have the proper equipment, ok, but at no time should you enter the confined space for any reason. Only properly trained and equipped rescue personnel may enter a confined space for rescue.

**The Important Job of Testing Atmospheres**

• **Evaluation Testing** – Testing is required for evaluation of hazards and verification that acceptable entry conditions into the space exists. The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity to identify and
evaluate any hazardous atmospheres that may exist. Evaluation testing is usually done with certified and qualified professionals.

- **Verification Testing** – The atmosphere of a permit space which may contain a hazardous atmosphere should be tested for residues of all contaminants identified by evaluation testing to make sure the entry atmospheres meet safety standards derived in evaluation testing.

- **Testing Duration** – Each test equipment manufacturer has measurement values for each test or potential hazard for which you are testing. Be sure to follow the equipment manufacturer's requirements.

- **Testing of Stratified Atmospheres** – When monitoring for entries involving a descent into atmospheres that may be stratified, the atmosphere should be tested a distance of 4 feet in the direction of travel and to each side. A stratified atmosphere is one where there may be several layers of air inside the space. Some gases or vapors rise to certain levels, others may descend toward the ground. It's imperative that tests include all layers of the air or atmosphere in a confined space.

- **Order of Testing** – A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere. Combustible gases are tested next, because the threat of fire or explosion is both more immediate and more life threatening. Exposure to toxic gases and vapors may be required and these tests should be performed last.

**Permit-Required Confined Space**

A *permit-required confined space* (also referred to as a *permit space*) is one that meets the definition of a confined space and has one or more of these characteristics: (1) contains or has the potential to contain a hazardous atmosphere, (2) contains a material that has the potential for engulfing an entrant, (3) may contain walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant, (4) may contain other serious physical hazards such as unguarded machines or exposed live wires, (5) must be identified by the employer who must inform exposed employees of the existence and location of such spaces and their hazards.

A copy of the [OSHA Quick Card on Permit-Required Confined Spaces](http://www.osha.gov) (Publication 3214) is provided on page 5 of this RON update. *Employers must evaluate their workplaces to determine if spaces are permit-required confined spaces* (see the flow chart on page 6, per Appendix A of 29 CFR 1910.146).
Permit-Required Confined Spaces

A confined space has limited openings for entry or exit, is large enough for entering and working, and is not designed for continuous worker occupancy. Confined spaces include underground vaults, tanks, storage bins, manholes, pits, silos, underground utility vaults and pipelines. See 29 CFR 1910.146.

Permit-required confined spaces are confined spaces that:
- May contain a hazardous or potentially hazardous atmosphere.
- May contain a material which can engulf an entrant.
- May contain walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant.
- May contain other serious physical hazards such as unguarded machines or exposed live wires.
- Must be identified by the employer who must inform exposed employees of the existence and location of such spaces and their hazards.

What to Do
- Do not enter permit-required confined spaces without being trained and without having a permit to enter.
- Review, understand and follow employer’s procedures before entering permit-required confined spaces and know how and when to exit.
- Before entry, identify any physical hazards.
- Before and during entry, test and monitor for oxygen content, flammability, toxicity or explosive hazards as necessary.
- Use employer’s fall protection, rescue, air-monitoring, ventilation, lighting and communication equipment according to entry procedures.
- Maintain contact at all times with a trained attendant either visually, via phone, or by two-way radio. This monitoring system enables the attendant and entry supervisor to order you to evacuate and to alert appropriately trained rescue personnel to rescue entrants when needed.

You have a right to a safe workplace.
If you have questions about workplace safety and health, call OSHA. It’s confidential. We can help!

For more information:
www.osha.gov (800) 321-OSHA (6742)
Permit-Required Confined Space Decision Flow Chart

OSHA Standard 1910.146 – Appendix A
If a workplace contains permit-required confined spaces, the employer must inform exposed employees of their existence, location and the hazards they pose. This can be done by posting danger signs such as “DANGER—PERMIT-REQUIRED CONFINED SPACE—AUTHORIZED ENTRANTS ONLY” or using an equally effective means. If employees are not to enter and work in permit spaces, employers must take effective measures to prevent them from entering these spaces. If employees are expected to enter permit spaces, the employer must develop a written permit space program and make it available to employees or their representatives.

Controlling Hazards

The employer’s written program should establish the means, procedures and practices to eliminate or control hazards necessary for safe permit space entry operations. These may include:

- Specifying acceptable entry conditions;
- Isolating the permit space;
- Providing barriers;
- Verifying acceptable entry conditions; and
- Purging, making inert, flushing or ventilating the permit space.

Equipment for Safe Entry

In addition to personal protective equipment, other equipment that employees may require for safe entry into a permit space includes:

- Testing, monitoring, ventilating, communications and lighting equipment;
- Barriers and shields;
- Ladders; and
- Retrieval devices.

Ventilation hoses provide air and exhaust toxic vapors during confined space entry. A guardrail would also be necessary to protect workers from potential falls.
If hazardous conditions are detected during entry, employees must immediately leave the space. The employer must evaluate the space to determine the cause of the hazardous atmosphere and modify the program as necessary.

When entry to permit spaces is prohibited, the employer must take effective measures to prevent unauthorized entry. Non-permit confined spaces must be evaluated when changes occur in their use or configuration and, where appropriate, must be reclassified as permit spaces.

**Attendant Training**

An **Attendant** is an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program. Attendants need to receive training in the following areas:

- **Hazard recognition and the use of atmospheric testing devices**, including information on the mode, signs or symptoms, and consequences of exposure. Training should include the use of personal protective equipment, including rescue harnesses, respiratory protection, and similar required equipment. Certainly, training in proper entry procedures and precautions should include maintaining communications with the entrant, as necessary, to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space.

- **Training in evacuation** is necessary so when both the entrant and attendant receive an evacuation order, or the entrant recognizes any warning sign or symptom of exposure to a dangerous situation, they know what to do. There must be training in the emergency and non-entry rescue methods and procedures for calling rescue services. Additionally, training is required in the behavioral effects of hazard exposure in authorized entrants.

- Additional training and responsibilities of attendants should include a **constant maintenance of an accurate count of authorized entrants in the permit space** and ensure that the means used to identify authorized entrants accurately identifies who is in the permit space. The attendant should remain outside the permit space during entry operations until relieved by another attendant.

- The **attendant should communicate with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space**. The attendant monitors the activities inside and outside the space to determine if it's safe for entrants to remain in the space. The **attendant may also order the authorized entrants to evacuate the permit space immediately under the following conditions**: 
  - [List of conditions]
o If the attendant detects a prohibited condition.
   o If the attendant detects behavioral effects of hazard exposure in the authorized entrants.
   o If the attendant detects a situation outside the space that could endanger the authorized entrant or;
   o If the attendant cannot effectively and safely perform the requirements of this job.

The attendant may summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards. Also, the attendant warns unauthorized persons to stay away from the permit space and generally controls the space. The attendant has specific work assignments established for this job but does not perform any duties that might interfere with the primary duty; which is to monitor and protect the authorized entrants or other duties established by company policies and procedures. One of the most important lessons to be learned by attendants is they do not enter the confined space at any time, for any reason. Attendants are there for monitoring, observing and protecting the entrants. They cannot be distracted from this responsibility and generally are not trained or equipped for rescue services. Too many people have died trying to rescue people from confined spaces. Attendants do not attempt rescue, under any circumstances. Call for help and let the professionals make the rescue.

**Conclusion**

Confined spaces need not be dangerous places to work if the applicable OSHA standards and precautions are routinely followed to prevent tragedies from occurring. Remember that it is a
rare circumstance that a single fatality occurs in a confined space; usually there are multiple fatalities.

For additional information, please visit the OSHA Confined Spaces webpage, and refer also to OSHA Standard 1910.146 – Permit-Required Confined Spaces.

Resources and References:

- CIRMA Tail Gate Topics II (Connecticut Conference of Municipalities) – http://cirma.com-ct.org/Resources.ashx?id=9be4d177-1635-4f64-85c4-3b5dc52ade8b.
- Confined Space Entry Program, Ohio Department of Transportation, Office of Employee Health & Safety.

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