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CONFINED SPACES

Many workplaces contain spaces that are considered "confined" because their configuration hinders the activities of employees who must enter, work in, and exit them. The potential dangers and hazards associated with confined space entry are well know and well documented. Confined spaces pose a special and particular hazard to those employees that are required to work in them.

WHAT IS A CONFINED SPACE?

A confined space is designated as having one or more of the following characteristics:

- Large enough to enter and perform assigned work in.
- Limited or restricted means of entry and exit.
- Not intended for continuous employee occupancy.

They may include, but are not limited to underground vaults, tanks, storage bins, manholes, pits, silos, process vessels, and pipelines.

WHAT IS A PERMIT-REQUIRED CONFINED SPACE?

The term permit-required confined space is used to describe a confined space as having one or more of the following characteristics.

- Contains or has the potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Have walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant.
- Contains any other recognized safety or health hazard, such as unguarded machinery, exposed live wires, or heat stress.

Employers must evaluate their workplaces to determine if confined spaces are permit-required confined spaces. 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-required confined space program and make it available to employees.

FOR ENQUIRIES:

YOUR SAFETY DEPARTMENT, LLC

P + 1 888 859 5653
info@yoursafetydept.com
www.yoursafetydept.com

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If a workplace does contain permit-required spaces, employees should be informed of their existence, location and hazards posed. Posting danger/warning signs are an effective means.

Confined space entry regulations may vary from country to country. In addition to the requirements specified here, local and national regulations should also be adhered to.

WRITTEN PERMIT-REQUIRED CONFINED SPACE PROGRAM

A written program is required for any employer who allows employees entry into a permit space. The written program should include the following:

- Identify and evaluate permit space hazards before allowing employees entry.
- Test atmospheric conditions in the correct sequence in the permit space before entry operations and monitor the space during entry.
- Establish and implement the means, procedures and practices to eliminate or control hazards necessary for safe permit space entry operations.
- Identify employee job duties.
- Ensure that at least one attendant is stationed outside the permit space for the duration of entry operations.
- Coordinate entry operations when employees of more than one employer are working the permit space.
- Implement appropriate procedures for summoning rescue and emergency services, and preventing unathorized personnel from attempting rescue.
- Establish, in writing, and implement a system for the preparation, issue, use and cancellation of entry permits.
- Review established entry operations annually and revise the permit space entry program as necessary.

Confined spaces which are permit-required confined spaces require written permit authorization. This permit will state:

- Purpose of entry and what work is authorized.
- The space has been tested by a qualified person, including test results.
- The space is safe for entry, usually for a specified period of time.
- What precautions or equipment are required.

The entry supervisor must cancel entry permits when an assignment is completed or when new conditions exist. New conditions must be noted on the canceled permit used in revising the permit space program. All canceled entry permits should be retained for at least one year.

EVALUATION TESTING

The atmosphere within a confined space must be tested using direct reading instruments designed to detect the chemicals that may be present at levels that are well below the defined exposure limits. Evaluation testing is done to:

- Determine what chemical hazards are or may become present in the space's atmosphere.
- Identify what steps must be followed and what conditions must be met to ensure that atmospheric conditions are safe for a worker to enter the space.

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The testing results and the decisions about what steps must be followed before entry must be evaluated by, or reviewed by, a technically qualified professional, a certified industrial hygienist, a registered safety engineer, or a certified safety professional. The technically qualified professional must consider all of the serious hazards in his/her evaluation or review.

ATMOSPHERIC VERIFICATION TESTING PRIOR TO ENTRY

Before a permit space that may have a hazardous atmosphere can be entered, the atmosphere must be tested using the steps identified on the permit (developed during evaluation testing). Verification testing is done to make sure that the chemical hazards that may be present are below the levels necessary for safe entry, and that they meet the conditions identified on the permit. The atmosphere must be tested in the following order:

- For oxygen
- For combustible gases
- For toxic gases and vapors

The following are a few tips for safely conducting an atmospheric verification test:

- Do note enter a confined space for the purpose of testing it. Use an extension tube or other suitable remote device.
- Fully understand the operation and calibration of your equipment. Zero your instrument in known fresh air prior to sampling.
- Sample at all levels (top, middle and bottom). It is important to remember that some gases are heavier than air, some are lighter and some are the same. If possible also sample from more than one cross-sectional point.
- Never trust your senses (smell, taste, irritation, etc.) to determine the atmosphere in a confined space, but also do not ignore your senses either. Even if an instrument indicates something different, if the atmsophere does not seem right, get back to a fresh air base and check it and your instruments again.
- Retest and sample at regular intervals if your work calls you to remain in the confined space for an extended period of time. Atmospheric conditions should continue to be monitored. A once safe atmosphere can become hazardous again due to leaks, cleaning or repair processes etc.

DURATION OF TESTING

For each test required on the permit you must allow enough time for the air from the space to be drawn into the equipment and for the sensor (or other detection devices) to react to the chemical if it is present. This is considered the “minimum response time” and it will be noted by the manufacturer in the operator’s manual. Be aware that you will need to add time to this “minimum response time” if you have attached hosing or a probe extension to the inlet. The additional time is neeed to allow the air from different depths of the space to be pulled into the equipment inlet.

OXYGEN HAZARDS

Oxygen hazards occure when atmospheric concentrations are below 19.5% or above 23.5%. Oxygen concentration in normal air is 21%. An atmospheric oxygen concentration below 19.5% is considered oxygen deficient an may cause asphyxiations while concentrations above 23.5% is considered oxygen enriched and may create fire hazards.

Potential effects of oxygen enriched and deficient atmospheres are displayed in the following table:

OXYGEN CONTENT (% by VOL.)	EFFECTS AND SYMPTOMS (At Atmospheric Pressure)
➢ 23.5%	Oxygen enriched, extreme fire hazard

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20.9%	Oxygen concentration in normal air
19.5%	Minimum permissible oxygen level
15% to 19%	Decreased ability to work strenously; may impair coordination; early cardiac problems
10% to 12%	Respiration further increases in rate and depth; poor judgement; blue lips
8% to 10%	Metal failure; fainting; unconciousness; nausea; vomiting
6% to 8%	Recovery still possible after 4-5 minutes; fatal after 8 minutes
4% to 6%	Coma in 40 seconds; convulsions; respiratoin ceases; death

COMBUSTIBLE GASES OR VAPORS HAZARDS

Combustible gas or vapor hazards exist when a flammable gas or vapor is in excess of 10% of its lower explosive limit (LEL) yet still remaining below the upper explosive limit (UEL).

In order to understand the subject, it is necessary to understand the concept of the explosive or flammable range of a gas or vapor. The ratio of the vapor in the air to that of the air itself is known as concentration, and is usually expressed as a percentage. For any gas or vapor there is a range of concentrations which are explosive. This is known as the explosive range. The limits of the explosive range are known as the UEL and the LEL.

- The UEL is the highest concentration at which gas can be ignited. Above that concentration, the mixture is to rich to burn.
- The LEL is the lowest concentration at which a mixture can ignite. Concentrations below this limit are to lean to burn.

TOXIC GASES OR VAPOR HAZARDS

Toxic gas or vapor hazards occur when atmospheric concentrations of any toxic compound are above the permissible exposure limit established. Examples of common toxic gases found in confined spaces include:

- Ammonia
- Carbon monoxide
- Hydrogen cyanide
- Hydrogen sulfide
- Nitric oxide
- Sulfur dioxide

WORKER TRAINING

Before the initial work assignment begins, workers should be provided proper training if they are required to work in permit spaces. Employers must ensure that the employees have acquired the understanding, knowledge and skills necessary to safely perform their duties. Additional training is required when:

- The job duties change
- A change occurs in the permit space program or the permit space operation presents any new hazards
- An employee's job performance shows deficiencies

Records of employee training should be retained. The record must include the employee's name, the trainer's signature or initials and dates of the training.

ASSIGNED DUTIES

Authorized entrants, attendants, entry supervisors and rescue personnel are required to know space hazards, including

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information on the means of exposure, signs of symptoms and consequences of the exposure.

AUTHORIZED ENTRANTS are required to:

- Use appropriate PPE properly
- Maintain communicatoin with attendants as necessary to enable them to monitor the entrant's status and alert the entrant to evacuate when necessary
- Alert the attendant and exit from permit space as soon as possible when:
    - Ordered by the authorized person
    - He or she recognizes the warning signs or symptoms of exposure
    - A prohibited condition exists
    - An automatic alarm is activated

The ATTENDANT is required to:

- Remain outside the pemit space during entry operations unless relieved by another authorized attendant
- Maintain communication with and keep an accurate account of those workers entering the permit space
- Order evacuation of the permit space when:
    - A prohibited condition exists
    - A worker shows signs of physiological effects of hazard exposure
    - An emergency outside the confined space exists
    - The attendant cannot effectively and safely perform required duties.
- Summon rescue and other services during an emergency
- Ensure that unauthorized people stay away from permit spaces or exit immediately if they have entered the permit space (inform authorized entrants and the entry supervisor if any unathorized person enters the permit space)
- Perform no other duties that interfere with the attendant's primary duties

ENTRY SUPERVISORS are required to:

- Verify emergency plans and specified entry condition's before allowing entry
- Terminate entry and cancel permits when entry operations are completed or if a new condition exists
- Verify that rescue services are available and that the means for summoning them are operable
- Take appropriate measures to remove unauthorized entrants
- Ensure that entry operations remain consistent with the entry permit and that acceptable entry condtions are maintained

EMERGENCY AND RESCUE

Employees should ensure responders are capable of responding to an emergency in a timely manner.

- Rescuers must receive the authorized entrants training and be trained to perform assigned rescue duties. Rescuers must be informed of the hazards of the permit space. They should also be trained and supplied with personal protective and rescue equipment, including respirators.

  All rescuers are required to be trained in first aid and CPR. At a minimum, one rescue team member must be currently certified in first aid and CPR. Practice rescue exercises should be performed yearly so that rescue services can practice rescue operations.

- Harnesses and retrievel lines are necessary to facilitate non-entry rescue. Authorized entrants who enter a permit space must wear a chest or full body harness with a retrieval line attached to the center of

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their backs near shoulder level or above their heads. Ensure the other end of the retrival line is attached to a mechanical device which must be available to retrieve someone from a vertical type permit space more than 5 feet or 1.5 meters depth.

- If an injured entrant is exposed to a substance, the Safety Data Sheet (SDS) must be made available to the medical facility personnel treating the exposed entrant.

CONCLUSION

Despite all of the efforts that are put into making people aware of the dangers of confined spaces, it still remains one of the leading causes of industrial work related fatalities. This is a subject that must never be taken lightly. It is very serious business. Confined spaces are unforgiving of human error and rarely give second chances.

THOUGHT OF THE DAY

Use proper equipment for confined spaces or you may find yourself in the final confined space – a coffin

MINUTES OF MEETING

Date:_____**Person Conducting Meeting:**_____

Topic:_____

Branch: _____**Division:**_____

Attendees:

NAME	INITIAL	DATE

NAME	INITIAL	DATE

Additional Items Discussed:

_____

_____

Problem Areas or Concerns:

_____

_____

Comments:

_____

_____

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YOUR SAFETY DEPARTMENT, LLC

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