



INTRODUCTION

Are you required to construct or work in any of the following: Boiler, Cupola, Degreaser, Furnace, Pipeline, Pit, Pumping Station, Reaction or Process Vessel, Septic Tank, Sewage Digester, Sewer, Silo, Storage Tank, Ship's Hold, Utility Vault, Vat, or similar type enclosure? Then you are working in a confined space (see the illustrated examples).

Confined spaces have one or more of the following characteristics:

- Limited openings for entry and exit
- Unfavorable natural ventilation
- Not designed for continuous worker occupancy

Limited openings for entry and exit:

Confined space openings are limited primarily by size or location. Openings are usually small, sometimes just 18 inches in diameter, and are difficult to move through. Small openings can also make it very difficult to get needed equipment in or out of the spaces, especially protective equipment such as respirators used to enter spaces with hazardous atmospheres or life-saving equipment.

However, some openings are very large, especially open-topped spaces such as pits, degreasers, excavations, and ships' holds. Access to open-topped spaces may require the use of ladders, hoists or other devices. Escape from such areas may be very difficult in emergency situations.

Unfavorable natural ventilation:

When the design of a confined space does not allow air to pass freely through it, the atmosphere inside may become very different from the atmosphere outside. Deadly gases may be trapped inside, particularly if the space is used to store or process chemicals or organic substances that decompose. There may not be enough oxygen inside the confined space to support life, or the air could be so oxygen-rich that it increases the chance of fire or explosion if a source of ignition is present.

Not designed for continuous worker occupancy:

Most confined spaces are not designed for workers to routinely enter and work in. They are meant to store a product, enclose material and processes, or transport products or substances. Therefore, occasional worker entry for inspection, maintenance, repair, cleanup, or similar tasks is often difficult and dangerous due to chemical or physical hazards within the space.

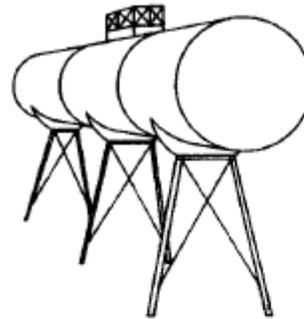
A workplace with a confined space that combines any of these three characteristics can complicate work efforts as well as rescue operations during emergencies. What are some of the hazards involved in entering and working in confined spaces?

HAZARDOUS ATMOSPHERES

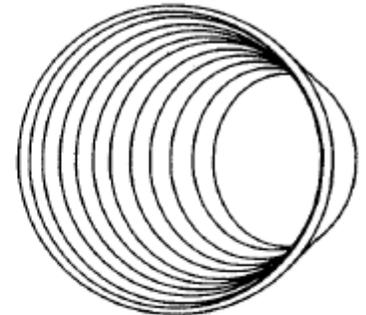
As mentioned, the atmosphere in a confined space may be extremely hazardous because of the lack of natural air movement. This can result in 1) oxygen-deficient atmospheres, 2) flammable atmospheres, and 3) toxic atmospheres.

1. Oxygen-Deficient Atmospheres

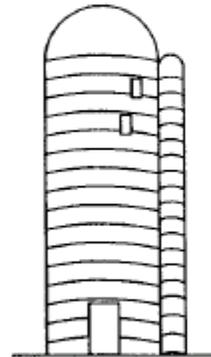
An oxygen-deficient atmosphere has less than 19.5% available oxygen. Any atmosphere with less than 19.5% oxygen should not be entered without an approved self-contained breathing apparatus (SCBA).



Storage Tank

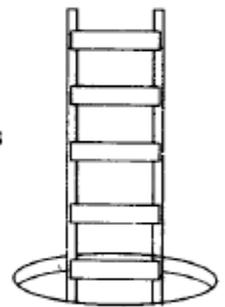


Pipeline

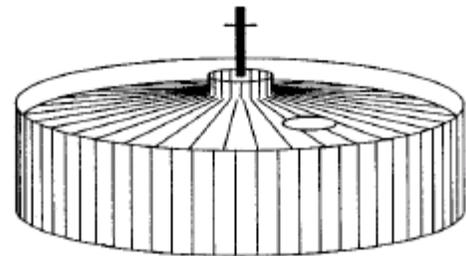


Silo

Examples of Confined Spaces



Manhole



The oxygen level in a confined space can decrease because of the type of work being done, such as welding, cutting or brazing; or, it can be decreased by certain chemical reactions (rusting) or through bacterial action (fermentation).

The oxygen level is also decreased if oxygen is displaced by another gas, such as carbon dioxide or nitrogen. Total or large displacement of oxygen by another gas, such as carbon dioxide, will result in unconsciousness, followed by death.

2. Flammable Atmospheres

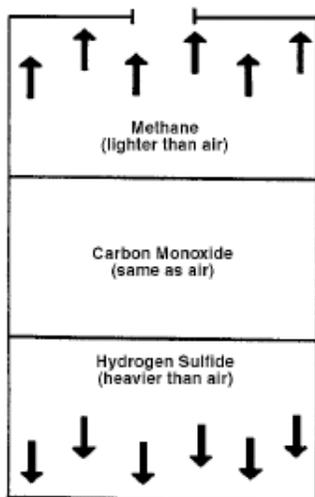
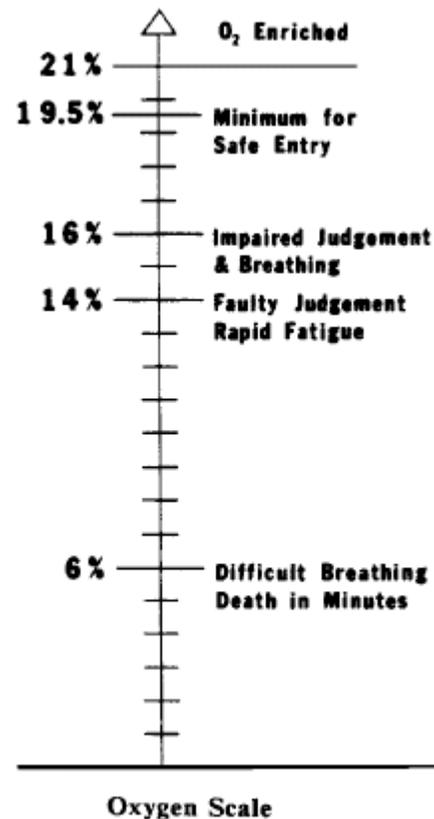
Two things make an atmosphere flammable: 1) the oxygen in the air and 2) a flammable gas, vapor or dust in the proper mixture. Different gases have different flammable ranges. If a source of ignition (e.g., a sparking or electrical tool) is introduced into a space containing a flammable atmosphere, an explosion will result.

An oxygen-enriched atmosphere (above 21%) will cause flammable materials, such as clothing and hair, to burn violently when ignited. Therefore, never use pure oxygen to ventilate a confined space. Ventilate with normal air.

3. Toxic Atmospheres

Most substances (liquids, vapors, gases, mists, solid materials and dusts) should be considered hazardous in a confined space. Toxic substances can emanate from the following:

- a. The product stored in the space. A product can be absorbed into the walls and release toxic gases when removed. Also, when cleaning out the residue of a stored product, toxic gases can be given off. For example, when sludge is removed from a tank, the decomposed material can emit deadly hydrogen sulfide gas.
- b. The work being performed in a confined space, such as welding, cutting, brazing, painting, scraping, sanding, degreasing, etc. Toxic atmospheres are generated in various processes. For example, cleaning solvents are used in many industries for cleaning/ degreasing. The vapors from these solvents are very toxic in a confined space.
- c. Areas adjacent to the confined space. Toxicants produced by work performed in the area of confined spaces can enter and accumulate in confined spaces.



From the Outside, Top to Bottom

TESTING THE ATMOSPHERE

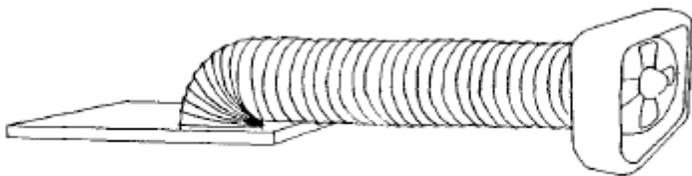
It is important to understand that some gases are heavier than air and will settle to the bottom of a confined space. Also, some gases are lighter than air and will be found around the top of the confined space. Therefore, it is necessary to test all areas (top, middle, bottom) of a confined space with properly calibrated testing instruments to determine what gases are present. If testing reveals oxygen-deficiency or the presence of toxic gases or vapors, the space must be ventilated and re-tested before workers enter. If ventilation is not possible and entry is necessary (e.g., for emergency rescue), workers must have appropriate respiratory protection.

NEVER TRUST YOUR SENSES TO DETERMINE IF THE AIR IN A CONFINED SPACE IS SAFE! YOU CANNOT SEE OR SMELL MANY TOXIC GASES AND VAPORS, NOR CAN YOU DETERMINE THE LEVEL OF OXYGEN PRESENT.

VENTILATION

Ventilation by a blower or fan may be necessary to remove harmful gases and vapors from a confined space. There are several methods for ventilating a confined space. The method and equipment chosen are dependent upon the size of the confined space openings, the gases to be exhausted (e.g., are they flammable?), and the source of makeup air.

Under certain conditions where flammable gases or vapors have displaced the oxygen level, but are too rich to burn, forced air ventilation may dilute them until they are within the explosive range. Also, if inert gases (e.g., carbon dioxide, nitrogen, argon) are used in the confined space, the space should be well ventilated and re-tested before a worker may enter.



Ventilating with Fan and Trunk Hose

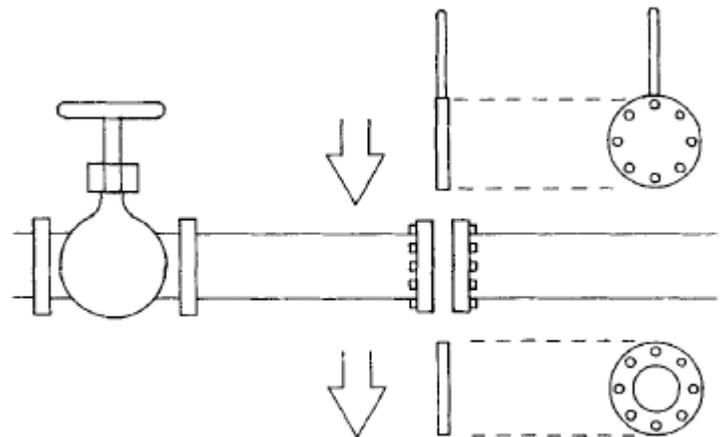
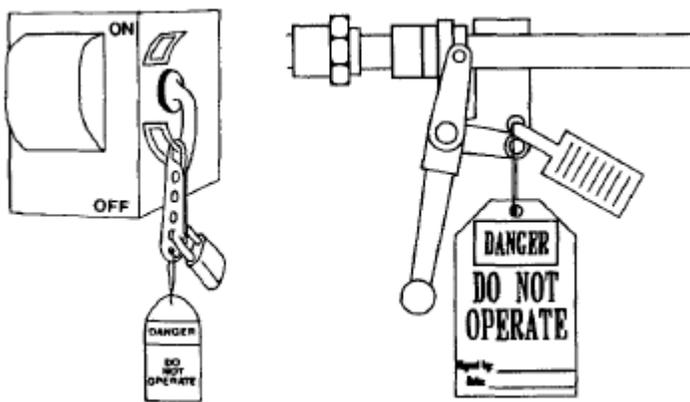
A common method of ventilation requires a large hose, one end attached to a fan and the other lowered into a manhole or opening. For example, a manhole would have the ventilating hose run to the bottom to blow out all harmful gases and vapors (see diagram). The air intake should be placed in an area that will draw in fresh air only. Ventilation should be continuous where possible, because in many confined spaces the hazardous atmosphere will form again when the flow of air is stopped.

ISOLATION

Isolation of a confined space is a process whereby the space is removed from service with the following measures: locking out electrical sources, preferably at disconnect switches remote from the equipment

- blanking and bleeding pneumatic and hydraulic lines
- disconnecting belt and chain drives, and mechanical linkages on shaft-driven equipment where possible
- securing mechanical moving parts within confined spaces with latches, chains, chocks, blocks or other devices

Examples of Lockout



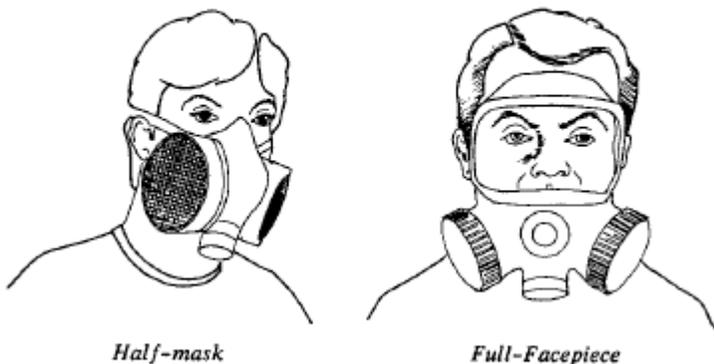
Method of Blanking Hydraulic/Pneumatic Lines

RESPIRATORS

Respirators are devices that can allow workers to safely breathe without inhaling toxic gases or particles. Two basic types include air-purifying respirators, which filter dangerous substances from the air, and air-supplying respirators, which deliver a supply of safe breathing air from a tank or an uncontaminated area nearby. Selecting the proper respirator for the job, hazard and person is very important, as is thorough training in the use and limitations of respirators.

Air-Purifying Respirators

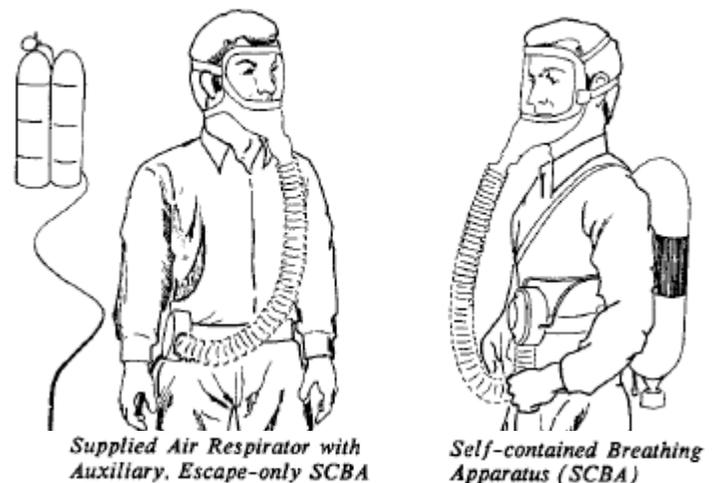
(Do Not Use in Oxygen-Deficient Atmosphere)



Half-mask

Full-Facepiece

Air-Supplying Respirators



Supplied Air Respirator with Auxillary, Escape-only SCBA

Self-contained Breathing Apparatus (SCBA)

STANDBY/RESCUE

A standby should be assigned to remain on the outside of the confined space and be in constant contact (visual or speech) with the workers inside. The standby, who should not have any other duties but to serve as a standby, must know who should be

notified in case of emergency. Standby personnel should not enter a confined space until help arrives, and then only with proper protective equipment, lifelines and respirators.

Over 50% of the workers who die in confined spaces are those attempting to rescue other workers. Rescuers must be trained in and follow established emergency procedures and use appropriate equipment and techniques (lifelines, respiratory protection, standby, etc.). Steps for safe rescue should be included in all confined space entry procedures. Rescue efforts should be well planned and drills should be frequently conducted on emergency procedures. An unplanned rescue, such as when someone instinctively rushes in to help a downed co-worker, can easily result in a double fatality, or even multiple fatalities when there are more than one would-be rescuers.

REMEMBER: AN UNPLANNED RESCUE WILL PROBABLY BE YOUR LAST.

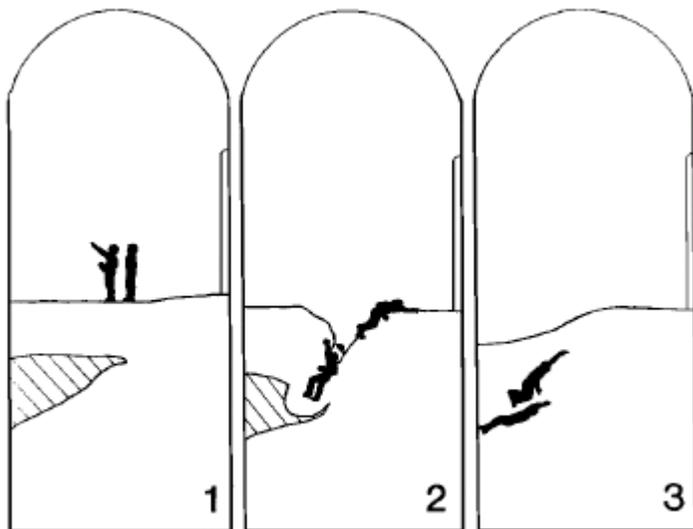
GENERAL PHYSICAL HAZARDS

1. Temperature Extremes

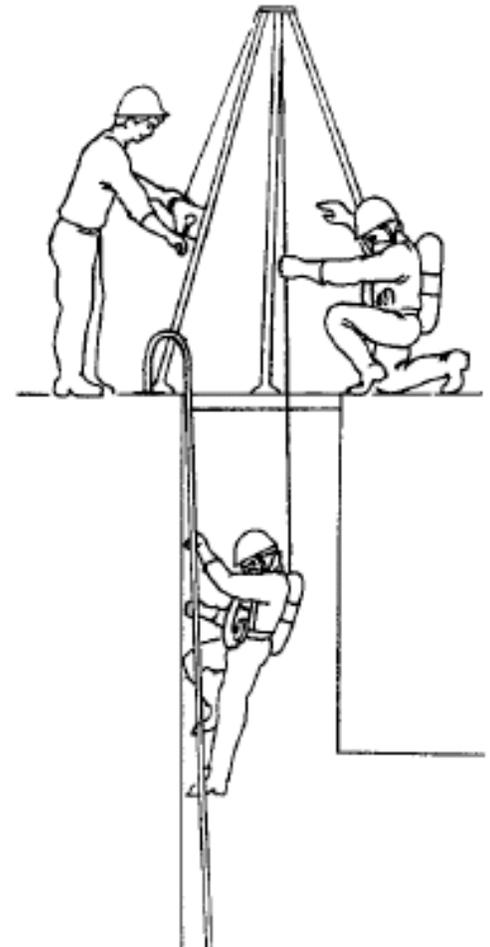
Extremely hot or cold temperatures can present problems for workers. For example, if the space has been steamed, it should be allowed to cool before any entry is made.

2. Engulfment Hazards

Loose, granular material stored in bins and hoppers, such as grain, sand, coal or similar material, can engulf and suffocate a worker. The loose material can crust or bridge over in a bin and break loose under the weight of a worker.



The Hazard of Engulfment in Unstable Material



Entry with Hoist and Standby Personnel

3. Noise

Noise within a confined space can be amplified because of the design and acoustic properties of the space. Excessive noise can not only damage hearing, but can also affect communication, such as causing a shouted warning to go unheard.

4. Slick-Wet Surfaces

Slips and falls can occur on a wet surface causing injury or death to workers. Also, a wet surface can increase the likelihood and effect of electric shock in areas where electrical circuits, equipment and tools are used.

5. Falling Objects

Workers in confined spaces should be mindful of the possibility of falling objects, particularly in spaces, which have topside openings for entry, and where work is being conducted above the worker.

RECOMMENDATIONS FOR SAFE ENTRY: A CHECKLIST

Use the following checklist to evaluate the confined space.

DO NOT ENTER A CONFINED SPACE UNTIL YOU HAVE CONSIDERED EVERY QUESTION, AND HAVE DETERMINED THE SPACE TO BE SAFE.

YES NO

Is entry necessary?

Testing

Are the instruments used in atmospheric testing properly calibrated?

Was the atmosphere in the confined space tested?

Was oxygen at least 19.5% - not more than 21% ?

- Hydrogen sulfide

- Carbon monoxide

- Methane

- Carbon dioxide

- Other (list) _____

Monitoring

Will the atmosphere in the space be monitored while work is going on?

Continuously?

Periodically? (If yes, give interval: _____)

REMEMBER – ATMOSPHERIC CHANGES OCCUR DUE TO THE WORK PROCEDURE OR THE PRODUCT STORED. THE ATMOSPHERE MAY BE SAFE WHEN YOU ENTER, BUT CAN CHANGE VERY QUICKLY.

Cleaning

Has the space been cleaned before entry is made?

Was the space steamed?

If so, was it allowed to cool?

YES NO

Ventilation

Has the space been ventilated before entry?

Will ventilation be continued during entry?

Is the air intake for the ventilation system located in an area that is free of combustible dusts and vapors and toxic substances?

If atmosphere was found unacceptable and then ventilated, was it retested before entry?

Isolation

Has the space been isolated from other systems?

Has electrical equipment been locked out?

Have disconnects been used where possible?

Has mechanical equipment been blocked, chocked and disengaged where necessary?

Clothing/Equipment

Is special clothing required (boots, chemical suits, glasses, etc.)?

(If so, specify: _____)

Is special equipment required (e.g. rescue equipment, communications equipment, etc.)?

(If so, specify: _____)

Are special tools required (e.g., sparkproof)?

(If so, specify: _____)

Respiratory Protection Are NIOSH approved respirators of the type required available at the worksite?

Is respiratory protection required (e.g., air purifying, supplied air, self-contained breathing apparatus, etc.)?

(If so, specify type: _____)

Can you get through the opening with a respirator on? If you don't know, find out before you try to enter.

YES NO

Training

- Have you been trained in proper use of a respirator?
- Have you received first aid/CPR training?
- Have you been trained in confined space entry and do you know what to look for?

Standby/Rescue

- Will there be a standby on the outside in constant visual or auditory communication with the person on the inside?
- Will the standby be able to see and/or hear the person inside at all times?
- Has the standby been trained in rescue procedures?
- Will safety lines and harness be required to remove a person?
- Are company rescue procedures available to be followed in the event of an emergency?
- Are you familiar with emergency rescue procedures?
- Do you know who to notify and how in the event of an emergency?

YES NO

Permit

(The permit is an authorization in writing that states: 1) the space has been tested by a qualified person; 2) the space is safe for entry; 3) what precautions, equipment, etc. are required; and 4) what work is to be done.)

- Has a confined space entry permit been issued?
- Does the permit include a list of emergency telephone numbers?

PERMIT-REQUIRED CONFINED SPACES

INTRODUCTION

Many workplaces contain spaces that are considered to be “confined” because their configurations hinder the activities of employees who must enter into, work in or exit from them. In many instances, employees who work in confined spaces also face increased risk of exposure to serious physical injury from hazards such as entrapment, engulfment and hazardous atmospheric conditions. Confinement itself may pose entrapment hazards and work in confined spaces may keep employees closer to hazards such as machinery components than they would be otherwise. For example, confinement, limited access and restricted airflow can result in hazardous conditions that would not normally arise in an open workplace.

The terms “permit-required confined space” and “permit space” refer to spaces that meet OSHA’s definition of a “confined space” and contain health or safety hazards. For this reason, OSHA requires workers to have a permit to enter these spaces. Throughout this publication, the term “permit space” will be used to describe a “permit-required confined space.”

DEFINITIONS

By definition, a **confined space**

- Is large enough for an employee to enter fully and perform assigned work;
- Is not designed for continuous occupancy by the employee; and
- Has a limited or restricted means of entry or exit.

These spaces may include underground vaults, tanks, storage bins, pits and diked areas, vessels, silos and other similar areas.

By definition, a **permit-required confined space** has one or more of these characteristics:

- Contains or has the potential to contain a hazardous atmosphere;
- Contains a material with the potential to engulf someone who enters the space;
- Has an internal configuration that might cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section; and/or
- Contains any other recognized serious safety or health hazards.

OSHA'S CONFINED SPACE STANDARD

OSHA's standard for confined spaces (29 CFR 1910.146) contains the requirements for practices and procedures to protect employees in general industry from the hazards of entering permit spaces.

Employers in general industry must evaluate their workplaces to determine if spaces are permit spaces. (See flow chart.) If a workplace contains permit 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.

Alternative to a full permit entry

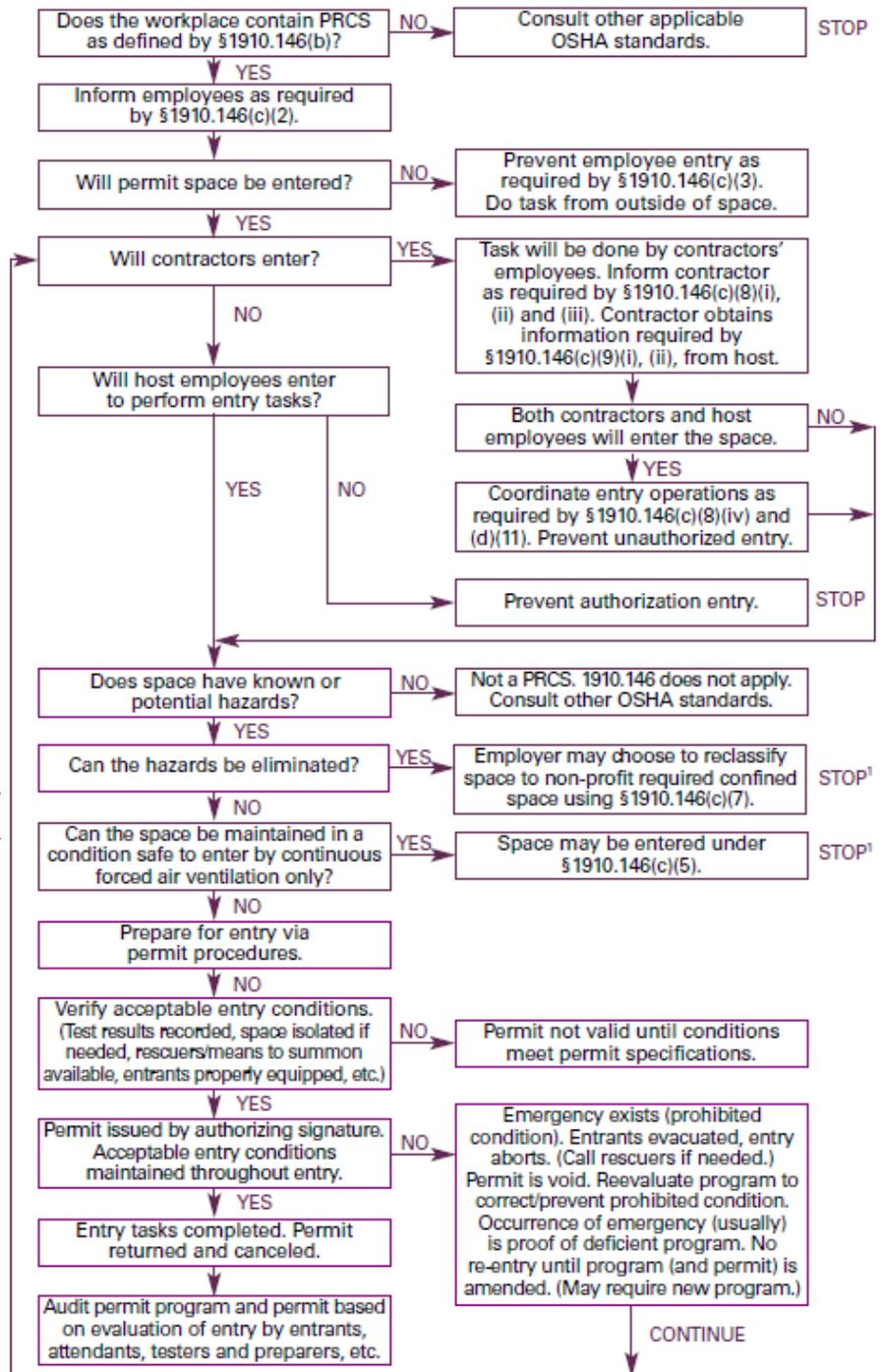
Under certain conditions described in the standard, the employer may use alternate procedures for worker entry into a permit space. For example, if an employer can demonstrate with monitoring and inspection data that the only hazard is an actual or potential hazardous atmosphere that can be made safe for entry using continuous forced air ventilation, the employer may be exempted from some requirements, such as permits and attendants. However, even in these circumstances, the employer must test the internal atmosphere of the space for oxygen content, flammable gases and vapors, and the potential for toxic air contaminants before any employee enters it. The employer must also provide continuous ventilation and verify that the required measurements are performed before entry.

Written Programs

Any employer who allows employee entry into a permit space must develop and implement a written program for the space. Among other things, the OSHA standard requires the employer's written program to:

- Implement necessary measures to prevent unauthorized entry;
- Identify and evaluate permit space hazards before allowing employee entry;
- Test atmospheric conditions in the permit space before entry operations and monitor the space during entry;
- Perform appropriate testing for the following atmospheric hazards in this sequence: oxygen, combustible gases or vapors, and toxic gases or vapors;
- Establish and implement the means, procedures

Permit-Required Confined Space Decision Flow Chart



¹ Spaces may have to be evacuated and re-evaluated if hazards arise during entry.

Source: 29 CFR 1910.146 Appendix A.

and practices to eliminate or control hazards necessary for safe permit space entry operations;

- Identify employee job duties;
- Provide and maintain, at no cost to the employee, personal protective equipment and any other equipment necessary for safe entry and require employees to use it;
- 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 in the permit space;
- Implement appropriate procedures for summoning rescue and emergency services, and preventing unauthorized 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; and
- Implement the procedures that any attendant who is required to monitor multiple spaces will follow during an emergency in one or more of those spaces.

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.

Detection of hazardous conditions

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.

A space with no potential to have atmospheric hazards may be classified as a non-permit confined space only when all hazards are eliminated in accordance with the standard. If entry is required to eliminate hazards and obtain data, the employer must follow specific procedures in the standard.

INFORMING CONTRACT EMPLOYEES

Employers must inform any contractors whom they hire to enter permit spaces about:

- The permit spaces and permit space entry requirements;
- Any identified hazards;
- The employer's experience with the space, such as knowledge of hazardous conditions; and
- Precautions or procedures to be followed when in or near permit spaces.

When employees of more than one employer are conducting entry operations, the affected employers must coordinate entry operations to ensure that affected employees are appropriately protected from permit space hazards. The employer also must give contractors any other pertinent information regarding hazards and operations in permit spaces and be debriefed at the conclusion of entry operations.

ENTRY PERMITS

A permit, signed by the entry supervisor, must be posted at all entrances or otherwise made available to entrants before they enter a permit space. The permit must verify that pre-entry preparations outlined in the standard have been completed. The duration of entry permits must not exceed the time required to complete an assignment.

Entry permits must include:

- Name of permit space to be entered, authorized entrant(s), eligible attendants and individuals authorized to be entry supervisors;
- Test results;
- Tester's initials or signature;
- Name and signature of supervisor who authorizes entry;
- Purpose of entry and known space hazards;
- Measures to be taken to isolate permit spaces and to eliminate or control space hazards;
- Name and telephone numbers of rescue and emergency services and means to be used to contact them;
- Date and authorized duration of entry;
- Acceptable entry conditions;
- Communication procedures and equipment to maintain contact during entry;
- Additional permits, such as for hot work, that have been issued authorizing work in the permit space;
- Special equipment and procedures, including personal protective equipment and alarm systems; and
- Any other information needed to ensure employee safety.

Cancelled entry permits

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 and used in revising the permit space program. The standard requires that the employer keep all canceled entry permits for at least one year.

WORKER TRAINING

Before the initial work assignment begins, the employer must provide proper training for all workers who are required to work in permit spaces. After the training, 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 hazard; and
- An employee's job performance shows deficiencies.

In addition to this training, rescue team members also require training in CPR and first aid. Employers must certify that this training has been provided.

After completion of training, the employer must keep a record of employee training and make it available for inspection by employees and their authorized representatives. The record must include the employee's name, the trainer's signature or initials and dates of the training.

ASSIGNED DUTIES

Authorized entrant

Authorized entrants are required to:

- Know space hazards, including information on the means of exposure such as inhalation or dermal absorption, signs of symptoms and consequences of the exposure;
- Use appropriate personal protective equipment properly;
- Maintain communication with attendants as necessary to enable them to monitor the entrant's status and alert the entrant to evacuate when necessary;
- Exit from the 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; or
 - An automatic alarm is activated.
- Alert the attendant when a prohibited condition exists or when warning signs or symptoms of exposure exist.

Attendant

The attendant is required to:

- Remain outside the permit space during entry operations unless relieved by another authorized attendant;
- Perform non-entry rescues when specified by the employer's rescue procedure;
- Know existing and potential hazards, including information on the mode of exposure, signs or symptoms, consequences and physiological effects;
- Maintain communication with and keep an accurate account of those workers entering the permit space;
- Order evacuation of the permit space when:
 - o A prohibited condition exists;
 - o A worker shows signs of physiological effects of hazard exposure;
 - o An emergency outside the confined space exists; and
 - o 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 unauthorized person enters the permit space; and
- Perform no other duties that interfere with the attendant's primary duties.

Entry supervisor

Entry supervisors are required to:

- Know space hazards including information on the mode of exposure, signs or symptoms and consequences;
- Verify emergency plans and specified entry conditions such as permits, tests, procedures and equipment 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; and
- Ensure that entry operations remain consistent with the entry permit and that acceptable entry conditions are maintained.

EMERGENCIES**Rescue service personnel**

The standard requires employers to ensure that responders are capable of responding to an emergency in a timely manner. Employers must provide rescue service personnel with personal protective and rescue equipment, including respirators, and training in how to use it. Rescue service personnel also must receive the authorized entrants training and be trained to perform assigned rescue duties.

The standard also requires that all rescuers be trained in first aid and CPR. At a minimum, one rescue team member must be currently certified in first aid and CPR. Employers must ensure that practice rescue exercises are performed yearly and that rescue services are provided access to permit spaces so they can practice rescue operations. Rescuers also must be informed of the hazards of the permit space.

Harnesses and retrieval lines

Authorized entrants who enter a permit space must wear a chest or full body harness with a retrieval line attached to the center of their backs near shoulder level or above their heads. Wristlets may be used if the employer can demonstrate that the use of a chest or full body harness is not feasible or creates a greater hazard.

Also, the employer must ensure that the other end of the retrieval line is attached to a mechanical device or a fixed point outside the permit space. A mechanical device must be available to retrieve someone from vertical type permit spaces more than five feet (1.524 meters) deep.

MSDS

If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the worksite, that MSDS or other written information must be made available to the medical facility personnel treating the exposed entrant.

IMPORTANT NOTICE - The information and suggestions presented by Michigan Millers Mutual Insurance Company in this Safety Talks Toolkit Bulletin are for your consideration in your loss prevention efforts. They are not intended to be complete or definitive in identifying all hazards associated with your business, preventing workplace accidents, or complying with any safety related, or other, laws or regulations. You are encouraged to alter them to fit the specific hazards of your business and to have your legal counsel review all of your plans and company policies.