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## **Module 8: Confined Spaces**

### **Module Description**

This module encapsulates the safety regulation of the workers working in spaces meeting the OSHA definitions of "confined space" and/or "permit-required confined space." It instructs about the hazards that may occur during the work in these spaces.

OSHA is striving to provide safety to the workers in all required disciplines by providing courses such as this one, which helps workers to learn about industry hazards, especially those critical to the lives of employees such as those found in confined spaces.

### **Module Learning Objectives**

At the conclusion of this module, you should be able to:

- Describe confined spaces as defined in the module.
- Identify the characteristics of confined spaces.
- Discuss atmospheric conditions found in confined spaces.
- Summarize a prevention program.
- Name the duties of employers and employees.
- Illustrate rescue and emergency services.
- Apply testing protocol.

# Lesson 1: Overview of Confined Spaces

## Lesson Focus

This lesson focuses on the following topics:

- Introduction
- Examples of Characteristics of Confined Spaces
- Atmospheric Conditions
- Prevention Program

## Introduction

### Confined Spaces

A "confined space" is a space which meets all of the following criteria:

- Is large enough and configured such that an employee can bodily enter;
- Has an entry and exit that is limited or restricted in some manner; and
- Is not designed for continuous occupancy by one or more employees.

### Permit Space

A "permit space" meets ALL of the requirements to be classified as a "confined space" AND meets ONE OR MORE of the following criteria:

- Contains, or has the potential to contain, a hazardous atmosphere;
- Contains a material that has the potential to engulf an employee who enters the space;
- The internal configuration is such that an employee entering the space could be trapped or asphyxiated by inwardly converging walls or by a floor with a downward slope tapering to a smaller cross section; or
- Contains any other recognized safety or health hazard of a serious nature.

Confined spaces can be found in many industrial settings, from steel mills to paper mills, from factories to farms, and from public utilities to the construction industry.

### Work Activities Covered by OSHA's Confined Spaces Standard

This standard applies to construction work performed in spaces meeting OSHA's definition of "confined spaces" except certain activities that are subject to the confined spaces provisions of other OSHA construction standards, including the following:

- Diving operations are regulated by 29 CFR 1926 subpart Y
- Excavation work is regulated by 29 CFR 1926 subpart P

- Underground Construction, Caissons, Cofferdams and Compressed Air operations are regulated by 29 CFR 1926, subpart S

It is important to note that employers engaged in exempted activities are required to comply with the Confined Spaces standard if their workers are exposed to confined space hazards that are not specifically covered by the standards noted above.

## Employer Responsibilities

All employers involved in construction activities are responsible for identifying all confined spaces that their employees may be working in and then determining whether any of these spaces meet the definition of permit-required confined spaces. The employer is then responsible to ensure that any workers in are properly protected from the identified hazards.

OSHA's Confined Spaces standard establishes duties for "entry employers," "host employers," and "controlling contractors."

If an employer has undertaken the necessary steps to identify permit spaces, and has identified these on the worksite, they are responsible to inform their workers of the location of any such danger(s) presented by the space. This is often accomplished by posting proper warning signs.

An **entry employer** is an employer whose employees actually enter a permit space. Multiple entry employers may be present on any given worksite if the employees of multiple employers enter the space. Every employer of workers entering a permit space is responsible for ensuring the safety of their employees and for complying with all applicable provisions of the Confined Spaces standard.

A **controlling contractor** is that employer with overall responsibility for construction at the worksite. This contractor is responsible for coordinating the entry operations when more than one employer will have employees in the permit space and when other activities on the site could result in a hazard in the space. Controlling contractors are also responsible for providing all information they have about any permit space hazards and the precautions previously used in the space.

A **host employer** is the employer that owns or manages the property where the construction work is taking place. This employer is responsible for sharing with the controlling contractor any information they might have regarding the hazards of any permit site.

There can never be more than one host employer. In those cases where the owner of the property has contracted with another employer to manage any relevant permit space information that it might have, that managing entity becomes the host employer. In the absence of any such contractual agreement and information exchange, the owner of the property is the host employer.

## **Summary of OSHA's New Confined Spaces Standard**

Every employer is responsible for taking the following steps to protect their employees against the hazards associated with confined spaces:

- Designate a competent person to identify all confined spaces in which employees may work. OSHA defines a competent person as "one who is capable of identify and existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authority to take prompt corrective measures to eliminate them." It is not required that the competent person be an employee of any particular employer, but they must have the required authority.
- In those cases where confined spaces are present, the employer is required to have a competent person determine if any of these spaces are "permit spaces."
- If one or more permit spaces are present, the entry employer must protect its employees from the hazards in that space.
- The entry employer is required to train every worker who must enter the permit space, as well as others impacted by the presence of the space and/or related operations.
- The entry employer is required to plan for the safe rescue of all entrants who are unable to exit the space under their own power.

This is only a summary of the requirements of OSHA's Confined Spaces standard for construction operations. This new standard requires significant action and attention by those employers completing work on sites with confined spaces, especially permit spaces.

### **Identifying Permit Spaces**

The thorough and proper identification of permit spaces is critical in order to determine whether or not precautions are required to protect employees entering these spaces—and if hazards exist, what controls are necessary. Failing to take these necessary steps can result in death or serious injury to the exposed workers. The competent person must answer four questions to determine if a confined space is a permit space. If the answer to any of these four questions is "yes," the space is a permit space, with all necessary controls required.

**1. Does the space contain or have the potential to contain a hazardous atmosphere?**

- This requires the identification of numerous potential hazards and testing, as necessary, to evaluate whether any of the following hazards are, or may be present, PRIOR to workers entering the space:
- Oxygen deficiency or excess concentrations of oxygen. Oxygen concentrations in the space must be between 19.5 and 23.5 percent;
- Concentration of any flammable gas, vapor, or mist in excess of 10% of its Lower Explosive Limit (LEL);
- Airborne combustible dust at a concentration equal to or in excess of its Lower Explosive Limit (LEL); and
- Atmospheric concentrations of any substance that can cause death, incapacitation, impairment of the ability to self-rescue, injury or acute illness.

**Note:** Proper procedures for all required testing must be established as part of the employer's confined spaces entry program.

**2. Does the space contain a material with the potential to engulf an entrant?**

Engulfment is the surrounding of a person by liquid or fine solid substance that can be aspirated or that exert sufficient force on the body to cause strangulation, constriction, or crushing. The competent person completing the analysis must consider whether any liquid or flow able solid could enter the space.

**3. Does the space have an internal configuration such that an employee entering the space could be trapped or asphyxiated by inwardly converging walls or by a floor with a downward slope tapering to a smaller cross section?**

A confined space with a small cross section can develop a hazardous atmosphere rapidly if inadequate ventilation is provided. This type of space can also prevent a worker from escaping the space or render rescue more difficult.

**4. Does the space contain any other recognized serious safety or health hazard that might pose an immediate danger to the worker's life or health or that might impair their ability to escape from the space if necessary?**

Consideration must be given to all potential hazards, including fire and explosion, mechanical, electrical, hydraulic, and pneumatic energy, temperature extremes, radiation, chemicals, biological hazards, and much more.

## Examples of Confined Spaces

Examples of confined spaces may include, but are not limited to, the following:

- Storage tanks
- Compartments of ships
- Process vessels
- Pits
- Silos
- Vats
- Wells
- Sewers
- Digesters
- Degreasers
- Reaction vessels
- Boilers
- Ventilation and exhaust ducts
- Tunnels
- Underground utility vaults
- Pipelines

## Examples of Characteristics of Confined Spaces

### Internal Configuration

**Open Space:** There are no obstacles, barriers, or obstructions within the space. An example of this might be some large, open water tanks with no internal walls, barriers, or baffles.

**Obstructed Space:** The permit space contains some type of obstruction that a rescuer would need to maneuver around. An example of this type of space would be a baffle or mixing blade.

### Elevation

**Elevated space:** A permit space where the entrance portal or opening is above grade by four feet or more. This type of space usually requires knowledge of high-angle rescue procedures.

**Non-elevated space:** A permit space with the entrance portal located less than four feet above grade. This type of space will allow the rescue team to transport an injured employee normally, without special procedures.

### **Portal Size**

**Restricted Portals:** A restricted portal is one of 24 inches or less in the least dimension. Portals of this size are too small to allow a rescuer to simply enter the space while using a Self-Contained Breathing Apparatus (SCBA).

**Unrestricted Portals:** An unrestricted portal is one of greater than 24 inches in the least dimension. These portals allow relatively free movement into and out of the permit space.

### **Space Access**

**Horizontal Portal:** This type of portal is located on the side of the permit space. Use of retrieval lines could be difficult when using this type of portal to access a confined space.

**Vertical Portal:** This type of portal is located either on the top of the permit space (rescuers must climb down to enter the space) or at the bottom of the permit space (rescuers must climb up to enter the space). Vertical portals may require knowledge of rope techniques.

## **Hazards**

The hazards associated with confined spaces that can cause serious injury and death to workers are numerous and potentially complex. Two of the major factors which lead to fatal injuries in confined spaces are:

- The failure to recognize and control the hazards associated with confined spaces.
- Inadequate or incorrect emergency response. If the emergency response is a spontaneous reaction to an emergency situation, as opposed to an appropriately planned and executed response, this can lead to multiple fatalities.

## **Atmospheric Conditions**

In those instances where there is reason to believe that unsafe atmospheric conditions might be encountered, it is critical to test the atmosphere of a confined space prior to entry being made, except in certain circumstances. Dependent upon the findings of the initial monitoring, activities taking place in the space, the history of the space, and other factors, it may be necessary to continue monitoring the atmosphere throughout entry operations.

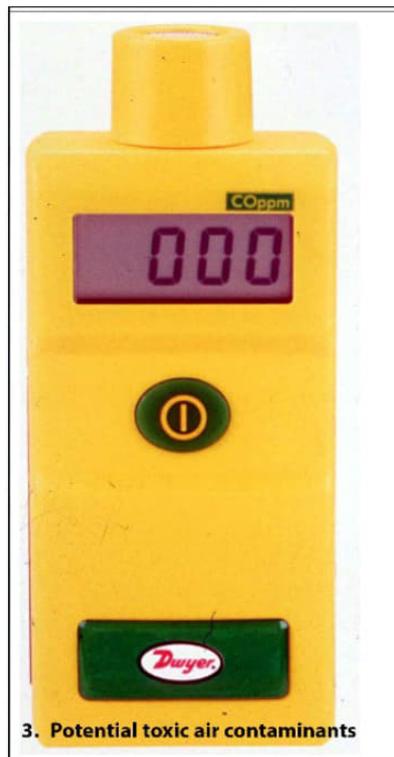
**1. Oxygen content**



**2. Flammable gases and vapors**



### 3. Potential toxic air contaminants



### Oxygen Deficiency

Oxygen deficiency occurs from chemical or biological reactions which displace or consume oxygen from within a confined space. Consumption of oxygen takes place during combustion of flammable substances, as occurs in welding, cutting, or brazing operations. Oxygen may also be displaced by other gases which may be inert, hazardous or flammable.

A more subtle form of consumption of oxygen occurs during bacterial action, as in the fermentation process.

Oxygen deficiency can result from bacterial action in excavations and manholes which are near garbage dumps, landfills, or swampy areas.

Oxygen may also be consumed during slow chemical reactions, as in the formation of rust on the exposed surface of metal tanks, vats, and ship holds.

### **Important Facts about Oxygen and Oxygen Deficiency:**

- Ambient air has an oxygen content of approximately 21 percent.
- When the oxygen level drops below 17 percent, one of the first signs of hypoxia is deterioration of night vision, which is usually not noticeable.
- Physiologic effects include increased breathing volume and an accelerated heartbeat.
- Between the oxygen concentrations of 14 percent and 16 percent, the physiologic effects consist of:
  - Increased breathing volume
  - An accelerated heartbeat
  - Poor muscular coordination
  - Impaired judgment
  - Impaired attention
  - Impaired coordination
  - Rapid fatigue
  - Intermittent respiration
- Between the oxygen levels of 6 percent and 10 percent, the physiological effects are:
  - Nausea
  - Vomiting
  - Inability to perform
  - Unconsciousness
- At concentrations of less than 6 percent, there is a rapid loss of consciousness and death in minutes.

### **Oxygen Displacement: Inert Gases and Simple Asphyxiants**

A simple asphyxiating atmosphere contains a gas, or gases, that are physiologically inert and which do not produce any ill effects on the body. However, in sufficient quantity, a simple asphyxiant will displace oxygen and may result in an atmosphere unable to support life.

The ambient, or normal, atmosphere is composed of approximately 21 percent oxygen, 78 percent nitrogen, and 1 percent argon, with small amounts of various other gases.

**Example:** Examples of simple asphyxiants that have claimed lives in confined spaces include carbon dioxide, argon, and helium.

For example, if 100 percent nitrogen—a non-toxic, colorless, odorless gas—is used to inert (displace oxygen in) a confined space, it will cause immediate collapse and death to the worker if the confined space is not adequately ventilated before worker entry.

## Safe Work Practices

- Consider each entry to a confined space to be potentially deadly. Proper testing and safe entry procedures must be followed for each entry.
- Identify and label confined spaces in the workplace.
- Provide written safe-work procedures for entering a confined space and ensure that workers are trained in these procedures.
- Isolate the confined space from adjacent piping by blanking, blinding, or disconnecting the piping.
- Assess the hazards before entering a confined space, including testing for oxygen levels if necessary.

## Flammable Atmospheres

A flammable atmosphere generally results from vaporization of flammable liquids, by-products of chemical reaction, enriched oxygen atmospheres, or concentrations of flammable gases or combustible dusts. Three components are necessary for an atmosphere to become flammable: fuel and oxygen, the proper mixture of fuel and oxygen, and a source of ignition.

The proper mixture of fuel and oxygen will vary from gas to gas within a fixed range. This range is between the lower flammability limit (LFL) and the upper flammability limit (UFL). These terms are synonymous with the lower explosive limit (LEL) and the upper explosive limit (UEL).

**Example:** For example, the explosive range for methane is between 5% and 15% in air. Concentrations below 5% methane are below the explosive range, and concentrations above 15% are too rich to support combustion. If a confined space contains 27% methane and forced ventilation is started, the introduction of air into the confined space may dilute the methane in air, taking it into the explosive range. Extreme care must be taken until the concentration is no greater than 10% of the LEL, at which time entry may be permitted if all other conditions are safe and stable.

## Toxic Gases

Toxic gases may be present in confined spaces because:

- The manufacturing process may use any of a wide variety of toxic gases. For example, in producing polyvinyl chloride, hydrogen chloride is used, as well as vinyl chloride monomer.
- There may be biological or chemical processes occurring within the product stored in the confined space. For example, decomposing organic material in a tank or sump can liberate hydrogen sulfide.
- The operation performed in the confined space can liberate a toxic gas. For example, welding can liberate oxides of nitrogen, ozone, and carbon monoxide.

**More Information:** Toxic gases may be evolved when acids are used for cleaning the interior of a confined space.

## Solvents

Hydrocarbon solvents are frequently used in industry as degreasing agents. These agents can cause unconsciousness by depressing the central nervous system. Some chlorinated hydrocarbon solvents, such as chloroform, have been used as anesthetic agents.

In addition, certain chlorinated or fluorinated hydrocarbon solvents are toxic to the heart and have been associated with sudden death in confined spaces. The solvent methylene chloride can be toxic both because of its solvent properties and also because it is metabolized in the body to form carbon monoxide.

## Physical Hazards

In addition to the atmospheric hazards in a confined space, physical hazards also must be addressed. Physical hazards cover the entire spectrum of hazardous energy and its control, the physical layout of the environment, and processes underway or previously underway. These hazards include those associated with:

- Mechanical, electrical, and hydraulic energy
- Engulfment
- Communication problems
- Noise
- The size of the openings into the confined space itself

## Engulfment

Engulfment in liquids or loose materials is one of the leading causes of death from physical hazards in confined spaces. Engulfment and suffocation are hazards associated with storage bins, silos, and hoppers where grain, sand, gravel, or other loose materials are stored, handled, or transferred, as well as vessels used for liquid storage. The behavior of such materials can be unpredictable, and entrapment and burial can occur in a matter of seconds.

In some cases, material being drawn from the bottom of storage bins can cause the surface to act like quicksand. When a storage bin is emptied from the bottom, the flow of material may form a funnel-shaped path over the outlet. The rate of material flow increases toward the center of the funnel. During an unloading operation, the flow rate can become so great that once a worker is drawn into the flow path, escape is virtually impossible.

## Other Physical Hazards

The nature of confined-space work may make it difficult to separate the worker from hazardous forms of energy (e.g., isolation) such as powered machinery, electrical energy, and hydraulic or pneumatic lines.

Examples of physical hazards often encountered in a confined space include the following:

1. Activation of electrical or mechanical equipment can cause injury to workers in a confined space. Therefore, it is essential to de-energize and lockout all electrical circuits and physically disconnect mechanical equipment prior to any work in confined spaces.
2. Release of material through lines which are an integral part of the confined space pose a life-threatening hazard. All lines should be physically disconnected, blanked off, or should use a double block and bleed system.
3. Falling objects can pose a hazard in confined spaces, particularly in spaces which have topside openings for entry, through which tools and other objects may fall and strike a worker.
4. Extremely hot or cold temperatures can make work inside a confined space hazardous. If a confined space has been steam cleaned, for example, it should be allowed to cool before any entry is made.
5. Wet or slick surfaces can cause falls in confined spaces. In addition, wet surfaces can provide a grounding path and increase the hazard of electrocution in areas where electrical equipment, circuits, and tools are used.

6. Noise within confined spaces can be amplified because of the design and acoustic properties of the space. Excessive noise is not only harmful to the worker's hearing, but can affect communication and cause shouted warnings to go unheard.

## Prevention Program

The worker who is required to enter and work in a confined space may be exposed to a number of hazards, ranging from an oxygen-deficient or toxic atmosphere to the release of hazardous energy (electrical/mechanical/hydraulic/chemical). Therefore, it is essential for employers to develop and implement a comprehensive, written confined-space entry program.

The following elements are recommended as a guide in developing a confined space program:

1. Identification of all confined spaces at the facility/operation
2. Posting a warning sign at the entrance of all confined spaces
3. Evaluation of hazards associated with each type of confined space
4. Performing a job safety analysis for each task to be performed in the confined space

## Confined Space Entry Procedures

Confined space entry procedures include the following:

- Initial plan for entry
- Assigned standby person(s) i.e., attendant(s)
- Communication between workers inside the confined space and standby attendants/persons about rescue procedures, conditions, monitoring information, and more
- Specified work procedures within the confined space

## Issuance of Confined Space Entry Permit

A confined-space entry permit is an authorized approval in writing that:

- Specifies the location and type of work to be done.
- Certifies that the space has been evaluated and tested by a qualified person, and that all necessary protective measures have been taken to ensure the safety of the worker.

Testing and monitoring the air quality in the confined space to ensure that the oxygen level is between 19.5 and 23.5 percent by volume and the flammable range is less than

10 percent of the LFL (lower flammable limit) for any flammable materials is required for the permit to be issued.

### **Confined Space Preparation**

Confined space preparation activities may include:

- Isolation, lockout/tagout
- Purging and ventilation
- Cleaning processes
- Requirements for special equipment and tools

### **Safety Equipment and Protective Clothing**

Safety equipment and protective clothing including the following may be required for use in confined space entry operations:

- Head protection
- Hearing protection
- Hand protection
- Foot protection
- Body protection
- Respiratory protection
- Safety belts
- Lifelines, harness
- Mechanical-lift device-tripod

### **Training**

Workers and supervisors must be trained in the selection and use of the following:

- Safe entry procedures
- Respiratory protection
- Lifelines and retrieval systems
- Protective clothing

### **Safety Meetings**

Employers must conduct safety meetings to discuss confined space safety, including the following:

- The availability and use of proper ventilation equipment.
- Monitoring the air quality while workers are in the space.

## Lesson Summary

Material being drawn from the bottom of storage bins can cause the surface to act like a quicksand. When a storage bin is emptied from the bottom, the flow of material may form a funnel-shaped path over the outlet. The rate of material flow increases toward the center of the funnel. During an unloading operation, the flow rate can become so great that once a worker is drawn into the flow path, escape is virtually impossible.

Testing and monitoring the air quality in a confined space to ensure that the oxygen level is between 19.5 and 23.5 percent by volume and the flammable range is less than 10 percent of the LFL (lower flammable limit) of any flammable materials is required for a permit to be issued.

Oxygen deficiency occurs from many sources, including chemical or biological reactions that displace or consume oxygen from within a confined space. The consumption of oxygen takes place during combustion of flammable substances, as occurs in welding, cutting, or brazing operations. A more subtle form of consumption of oxygen occurs during bacterial action, such as in the fermentation process.

## **Lesson 2: Safety and Training Education**

### **Lesson Focus**

This lesson focuses on the following topics:

- Duties of Employers and Employees
- Rescue and Emergency Services
- Testing Protocol

### **Duties of Employers and Employees**

All employees required to enter into confined spaces must be instructed as to the nature of the actual and potential hazards involved, the necessary precautions to be taken, and in the use of protective and emergency equipment required.

### **Duties of Attendants**

An attendant:

- Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of potential exposures.
- Is aware of possible behavioral effects of chemical and environmental hazard exposure on authorized entrants.
- Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants is accurate and effective.
- Remains outside the permit space during entry operations until relieved by another attendant.
- Communicates with authorized entrants as necessary to monitor entrant status.
- Monitors activities inside and outside of the space.

An entrant has to exit the space:

- If the attendant detects a prohibited condition.
- If the attendant detects the behavioral effects of hazard exposure on an authorized entrant.
- If the attendant detects a situation outside of the space that could endanger the authorized entrants.

## **Providing Assistance**

An attendant must summon rescue and other emergency services as soon as she or he determines that authorized entrants may need assistance to escape from permit space hazards.

The attendant must:

- Warn unauthorized persons that they must stay away from the permit space.
- Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.
- Perform non-entry rescues as specified by the employer's rescue procedure.
- Perform no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

## **Rescue and Emergency Services**

The employer of the members of a designated rescue team are required to ensure that the team members have received all training required for authorized entrants and have also been trained to perform their assigned rescue duties. That employer is also responsible for providing all members of the rescue team with necessary personal protective and rescue equipment, including respirators, and must train them on how to use it.

All rescuers must be trained in first aid and CPR. At a minimum, one rescue team member must be certified in first aid and CPR. Employers must ensure that the team practices or performs rescue exercises at least annually and that rescue services are provided access to permit spaces in order to allow for the practicing of rescue operations.

All members of the rescue team must be informed of the hazards of each permit space before entering a space. All rescue services must agree to notify the employer in the event the service becomes unavailable. The employer must provide the service with access to the permit space so the service can develop an appropriate rescue plan and practice rescue as necessary.

If the entry employer designates an off-site rescue service, including a local fire department, it must determine that the service has the ability and equipment to carry out a rescue in the particular permit space or type of permit space in which the entrant is working.

Whether using their own on-site rescue team (consisting of its own or another contractor's employees) or an off-site team, such as a local fire department or other rescue service,

the employer must make certain that the rescue team is able to respond in time to enable the injured worker to receive needed medical attention in light of the hazards present in the permit space. This must be done by contacting the rescue team prior to entry and informing them of the nature of the space and the hazards involved. In some cases, this may require a standby rescue team, such as when the entrant is working in an atmosphere that is immediately dangerous to life or health (IDLH) and is wearing an airline respirator or a self-contained breathing apparatus.

### **Employees Designated to Rescue**

An employer whose employees have been designated to provide permit space rescue and emergency services shall take the following measures:

- Provide affected employees with the personal protective equipment (PPE) needed to conduct permit space rescues safely, and train affected employees so they are proficient in the use of that PPE, at no cost to those employees.
- Train affected employees to perform assigned rescue duties. The employer must ensure that such employees successfully complete the training required to establish proficiency as an authorized entrant.
- Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR). The employer shall ensure that at least one member of the rescue team or service holding a current certification in first aid and CPR is available.
- Ensure that affected employees practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, mannequins, or actual persons from the actual permit spaces or from representative permit spaces.

### **Duties of Authorized Entrants**

The duties include:

- Knowing the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.
- Properly using equipment as required.
- Communicating with the attendant 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.

An authorized entrant must alert the attendant whenever:

- The entrant recognizes any warning sign or symptom of exposure to a dangerous situation.
- The entrant detects a prohibited condition.

## **Duties of Entry Supervisors**

Duties include:

- Knowing the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.
- Verifying, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit.
- Verifying that rescue services are available and that the means for summoning them are operable.
- Removing unauthorized individuals who enter, or who attempt to enter, the permit space during entry operations.
- Determining whenever responsibility for a permit space entry operation is transferred and doing so at intervals dictated by the hazards and operations performed within the space.

## **Rescue and Emergency Services**

Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back, near shoulder level, above the entrant's head, or at another point from which the employer can establish the ability to successfully remove the entrant.

Wristlets may be used in lieu of the chest or full body harness if the employer can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

The other end of the retrieval line shall be attached to a mechanical device or a fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical-type permit spaces more than five feet deep.

## **Safety Data Sheet**

If an injured entrant is exposed to a substance for which a Safety Data Sheet (SDS) or other similar written information is required to be kept at the worksite, that SDS or written information shall be made available to any emergency responders and medical facility treating the exposed entrant.

## Testing Protocol

Before an employee enters the space, and when necessary and appropriate, the internal atmosphere must be tested, with a calibrated direct-reading instrument, for the following conditions, in the order given:

1. Oxygen content
2. Flammable gases and vapors
3. Potential toxic air contaminants

## Lesson Summary

A rescue retrieval line should be attached at one end to a mechanical device or a fixed point outside of the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that it is necessary and a full body harness is worn by the entrant on the other end. A mechanical device shall be available to retrieve personnel from vertical-type permit spaces more than five feet deep.

An authorized entrant must alert the attendant if he or she recognizes any warning sign or symptom of exposure to a dangerous situation or if the entrant detects a prohibited condition. An entrant must also exit the space if the attendant detects a prohibited condition, the behavioral effects of hazard exposure, or any situation outside of the space that could endanger the entrant.