1.0 Confined Space Entry

Confined spaces may be encountered in virtually any occupation or industry, with the ability to recognize them as the first step in preventing injuries, illnesses, or deaths. While confined space incidents are not the most common, they have been known to be the deadliest considering the hazards associated with a confined space tend to be misunderstood and, in most cases, underestimated. Many confined spaces fatalities involve more than one victim; the employee who initially entered the space, as well as the rescuer(s) who had attempted to save him from danger. Most recent data suggest that for every employee death associated with a confined space entry, there are two would-be rescuers who also lost their lives while attempting to rescue the entrant.

1.0 Confined Space Entry

The majority of the serious confined space safety incidents involve atmospheric contamination and engulfment in the space, of which most could have been prevented by the employer had the appropriate procedures been followed. The National Institute for Occupational Safety and Health (NIOSH) published research of actual fatality investigation reports from incidents of confined spaces revealing the obvious steps that an employer could have taken to have prevented this type of loss of life in a confined space.

With the hazards associated with confined spaces and an ever-increasing incident rate of injuries, illnesses and fatalities, the Occupational Safety and Health Administration (OSHA) published required practices and procedures in 1993 to protect employees in general industry from these hazards with the Permit-Required Confined Spaces standard (29 CFR 1910.146). The standard was created to assist in the prevention of injuries, illnesses, and fatalities with such spaces, as they often present conditions that are immediately dangerous to employees' safety and health if not properly identified, evaluated, tested and controlled. This course provides a comprehensive overview of the OSHA standard along with other guidelines for best practices. In addition, numerous resources are available for safety professionals including the American National Standards Institute (ANSI), Safety Requirements for Entering Confined Spaces (Z117.1-2016) and the National Fire Protection Association established guidelines in a publication entitled, Safe Confined Space Entry and Work.

Click Box

1.0 Confined Space Entry

Many safety professionals who begin to study these regulations and guidelines are not necessarily aware of many of the confined spaces in their workplaces and it is not until successful completion of a course such as this that they understand their liability regarding these potentially dangerous spaces. Confined spaces are not just pits and tanks; they may be a pipe chase, a vat, a piece of equipment or simply a room without adequate access and egress. Since the OSHA standard is often misunderstood, it is important for safety professionals to acquire a thorough knowledge of not only the regulations as set forth in the standard, but also to understand their obligation to consider even further steps beyond the minimum requirements in the support of the prevention of potentially dangerous injuries, illnesses, or fatalities in the workplace.

This course is not intended to qualify a safety professional as a confined space subject matter expert. The course objective is to assist in the identification of confined spaces and the subsequent application of regulations and guidelines in the workplace. Given the potential complexity of its application, some organizations create simple confined space programs by labeling all spaces that meet the criteria with a “DO NOT ENTER” sign so that the space may never be entered. While this approach is perfectly acceptable, it is not necessarily feasible. If numerous confined spaces exist and they need to be entered for cleaning, maintenance, or other reasons, it is highly probable that a written confined space entry program will be required, creating a challenge in its development and implementation without a thorough understanding of the intent of these important safety guidelines and regulations.

Click Box

1.1 Definition

A confined space which restricts the activities of the employee who must enter it, work within it, or attempt to exit from it, often poses significant risks to any employee associated with entry operations. These spaces are not necessarily configured for employees, as they typically are just large enough for an employee to enter and perform certain tasks during an abbreviated time frame. Confinement, limited access and restricted airflow can result in hazardous conditions that would not normally arise in an open-air workplace. In order for an employer to determine how the standard applies to their specific workplace, the complexities of a confined space need to be reviewed in order to fully comprehend the criteria for and types of confined spaces.

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. The OSHA definition of a confined space does not consider the hazards within the space (hazards are evaluated AFTER a space has been deemed as a “confined space”); but more as to the space’s configuration. The all-important first step in the process to decide whether an employer must apply the standard in their workplace is to determine whether a space is a confined space by definition. Next, if it is a confined space that meets the definition, an employer must then determine the type of confined space that it is, as described in the upcoming section “Types of Confined Spaces”.

Click Box

1.1 Definition

A confined space is defined by the standard as meeting ALL THREE of the following criteria, click each image to learn more about these elements:

1. ***Large enough that an employee's body is able to enter it fully and perform assigned tasks:*** If the area is large enough to bodily enter, then a safe assumption is that it is large enough to perform assigned work. However, bodily entry does not necessarily mean that the entire body can enter the space. OSHA offers no clear definition of exactly what "large enough" for "bodily entry" means. A space into which an employee inserts their upper body may be considered large enough to bodily enter. If so, it does not necessarily mean it is a confined space; it just means that it meets this one criterion of the definition. An important observation with this example is that the person's breathing space is inside the space in question, as opposed to an example whereby an employee is standing within a space, leaving their upper body exposed to fresh air. For purposes of meeting the standard, spaces such as pits and manholes in which an employee is requested to enter are considered a confined space if they are more than 4 feet deep.

CLICK THE THREE IMAGES TO LEARN MORE

1.1 Definition

A confined space is defined by the standard as meeting ALL THREE of the following criteria, click each image to learn more about these elements:

2. ***Have limited access and egress opportunities:*** The standard also does not provide a precise definition of limited access and egress. It is generally accepted practice to take a second look at this element of the definition to determine whether access and egress from the area are restricted in any way. If an employee enters the area via a ladder, this is typically considered limited access and egress. The same determination will be made if a space is entered via steep stairs. NASP suggests that if the entry and egress do not conform to NFPA 101, Life Safety Code, then the area may meet this one element of a confined space definition. Another consideration with this element is that "limited" may denote the need for the employee to assume an awkward bodily position to enable them to enter or exit the space, such as twisting or crawling into the confined space on their hands and knees or torso.

CLICK THE THREE IMAGES TO LEARN MORE

1.1 Definition

A confined space is defined by the standard as meeting ALL THREE of the following criteria, click each image to learn more about these elements:

3. ***Not designed for continuous worker occupancy:*** If these words are taken in the strictest sense, "not designed for continuous occupancy," then its interpretation would be clear. Even if a space contains ladders or catwalks, it does not necessarily mean that it is designed for continuous occupancy. If an architect designed the area to be continually occupied, then it becomes obvious as to its purpose. For example, if the area does not have proper lighting, heating, cooling, and ventilation, these are telltale signs that it was probably not designed for continuous occupancy. Taking this into consideration, it would be easy to see that many rooms in a workplace, including closets and storage areas, are not necessarily designed for continuous worker occupancy.

CLICK THE THREE IMAGES TO LEARN MORE

1.1 Definition

Should the space being assessed meet all three elements, then it is to be defined as a confined space. Once this determination is made, a confined space program must be developed according to the type of confined space it is. Although a space may not meet all three of the characteristics above, it does not necessarily mean that it is also safe for employees to enter; it simply means that this standard does not apply to the area in question. Examples of such spaces that meet all three elements may include tanks, silos, storage bins, and other similar areas.

Click Box

1.2 Types of Confined Spaces

Once the area has met the definition of a confined space, the next consideration is to determine the type of confined space the area is. The employer may then decide whether the *Permit-Required Confined Space* standard will apply.

Click Box

1.2.1 Permit-Required Confined Space

A permit-required confined space (or simply “permit space”) is a space to which all safety requirements in the standard apply. This type of confined space is different in its application than the definition of a confined space, since **ONLY ONE OR MORE** of the following characteristics is required to be met for it to be a permit-required confined space. It is noteworthy that the word “potential” used below somewhat clouds this definition. With this, NASP recommends that if an employer acknowledges even the smallest opportunity for a hazard to exist in a confined space, that the employer considers the space as having met one of the following:

- Contains, or has the *potential* to contain, a **hazardous atmosphere**
- Contains material (either solid or liquid) that has the *potential* to be an **engulfment hazard** for the entrant in the space
- Designed with an **internal configuration** with 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 serious safety or health hazards, such as unguarded machinery, exposed live wires or heat stress

1.2.1 Permit-Required Confined Space

Hazardous atmospheres may include, but are not limited to, oxygen deficiency, flammables, combustible dust, and a variety of toxins. *Any* confined space that contains a serious safety or health hazard is a permit-required confined space, utilizing the definition of a serious hazard as being any risk that could cause death or serious physical injury. Four inches of water in a confined space may not be a serious safety or health hazard in the minds of most; however, if an employee loses consciousness for some reason and drowns in the four inches of water, then the water was a serious safety or health hazard. The term "any" could very well include hazards such as electrical, steam, pneumatic, heat, cold, any energy source, or even vermin (e.g., rats, spiders, snakes). ***A confined space is rarely free of all hazards.***

Typically, after any accident causing death or serious injury has occurred, the safety or health hazard becomes clearly apparent with hindsight. Obviously, the timeliness of this conclusion did not allow for the prevention of the loss of life or serious injury. For these reasons, many employers designate all confined spaces as permit-required. To do otherwise is to say that an employee will likely *never* be killed or seriously injured in that space.

Click Box

1.2.1 Permit-Required Confined Space

NASP considers this last characteristic of a permit-required confined space quite similar to OSHA's General Duty Clause in that it is very broad and can be interpreted literally. For example, a serious recognized hazard could be the potential for vermin or snake in a manhole, the lack of illumination in a tunnel, or an electrical hazard such as a live wire. With this, an employer needs to consider striking a balance in his interpretation. A permitted space could very well be a closet if taken to the extreme (bearing in mind that it still must meet all three elements previously discussed), while on the other hand, an unidentified hazard that is not observable could create a very unsafe condition if the area is not permitted.

Click Box

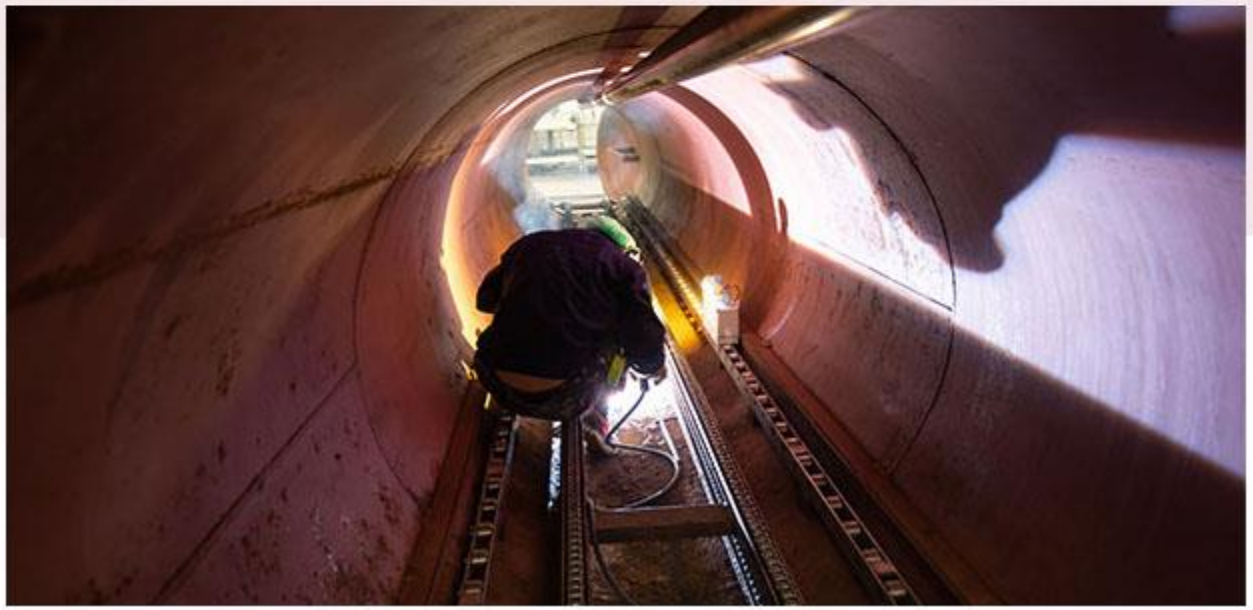
1.2.2 Alternate Permit Space

An employer may allow entry into a permit-required space using alternate entry procedures. Using these procedures, the employer is not required to have a confined space entry written program, a written permit, an attendant, or a rescue team, all of which may tempt an employer to consider this option. However, the space may only be deemed as an alternate permit space provided that:

- The only hazards in the permit space are atmospheric
- These atmospheric hazards can be controlled by the use of continuous forced-air ventilation
- The atmosphere is tested periodically during entry

1.2.2 Alternate Permit Space

With an alternate space, once the atmosphere has been tested and it is determined that the only hazard is an atmospheric hazard which may be controlled through the use of forced-air ventilation, the remaining requirement is that the atmosphere must be tested periodically during entry. If a hazardous atmosphere is detected at any time during the entry, the employee must leave the space immediately and the space must be re-evaluated to determine the cause of the hazardous atmosphere. Any subsequent entry calls for very specific testing requirements before entry is permitted. Once the atmosphere has been tested and it is determined that the only hazard is atmospheric in nature and may be controlled through the use of forced-air ventilation, the remaining requirement is that the atmosphere must be tested periodically during entry. If a hazardous atmosphere is detected *at any time* during the entry, the employee must leave the space immediately and the space must be re-evaluated to determine the cause of the hazard. Any subsequent entry calls for specific testing requirements before re-entry is permitted.



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1.2.2 Alternate Permit Space

Once the employer satisfies the criteria for space using alternate entry procedures, proper certification must be completed before any employee enters the confined space. This certification consists of the date, location of the space, and signature of the person providing the certification.

With the use of an alternate permit space, the space automatically becomes *exempt* from many of the safety requirements of the standard. Most importantly, it also becomes a space in which forced air ventilation alone controls *all* hazards. While forced air ventilation may control atmospheric hazards, it does nothing to control *other* hazards in the space. Therefore, to designate a space as an alternate permit space with the use of forced air ventilation, the space now is assumed to be a space in which an employee will likely *never* be killed or seriously injured, since the employer deemed it free from all hazards with the use of forced air ventilation.

Click Box

1.2.3 Non-Permit Space

A space may be designated as non-permit spaces if certain and specific criteria are met. Once these criteria are met, a space will be exempt from many of the standard requirements. The criteria include the following:

- The space poses no actual or potentially hazardous atmospheres
- *All* hazards within the space can be eliminated without entry into the space, such as locking and tagging equipment to ensure that it is inoperable while employees are working in the space

1.2.3 Non-Permit Space

An employer must verify these conditions are met through certification, similar to the process for the alternative permit space procedure. The date, the location of the space, and the name of the person certifying the space must be on the certificate. The permit must also be made available to employees before entering the space. If hazards arise in a confined space that has been deemed to be a non-permit space, each employee must exit immediately. The employer must then determine if the space needs to be reclassified as a permit-required confined space. If the hazards are eliminated, the non-permit entry may continue.

With the definition of a non-permit space stating that it has no potential atmospheric hazard and the elimination of all hazards, an employer is once again certifying that an employee will likely never be killed or seriously injured in the space. While this space designation allows an employer to be exempt from the requirements of this standard, NASP discourages this approach in the prevention of serious injury, illness or death given the potential hazards that may exist that may not be either observable or understood. It is rare that once a space is defined as a confined space, that it would be designated as non-permit required.

Click Box

1.2.3 Non-Permit Space

The critical difference between an alternate permit space and a non-permit space is the use of forced-air ventilation in an attempt to control the atmospheric hazards. If forced-air ventilation is used during entry, it cannot be classified as a non-permit space. It is noteworthy to repeat that the use of forced-air ventilation to control atmospheric hazards does not constitute the elimination of all hazards. Utilizing either category imposes a burden on the employer to ensure that the conditions inside the space do not change. For example, the introduction of any type of hot work would immediately negate the possibility of a space being non-permit required. If an employer can neither reclassify a permit-required confined space to a non-permit space nor use alternate entry procedures, all requirements of permit-required confined spaces must be followed.

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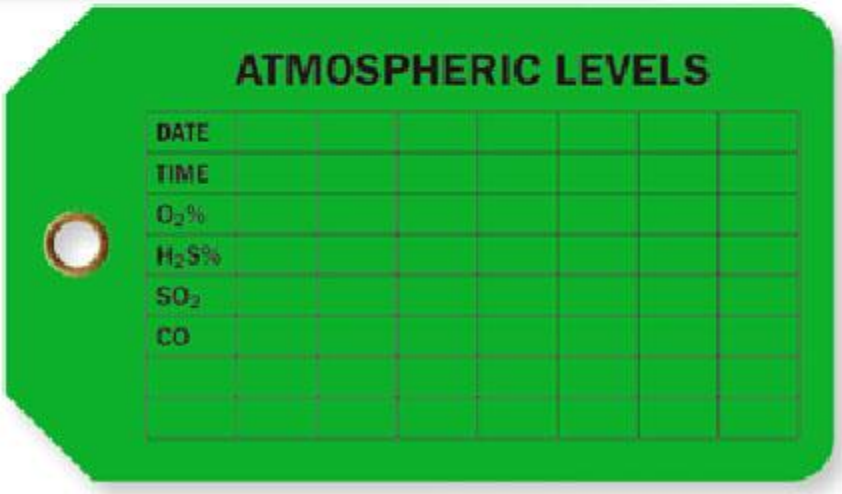
1.3 Reclassification

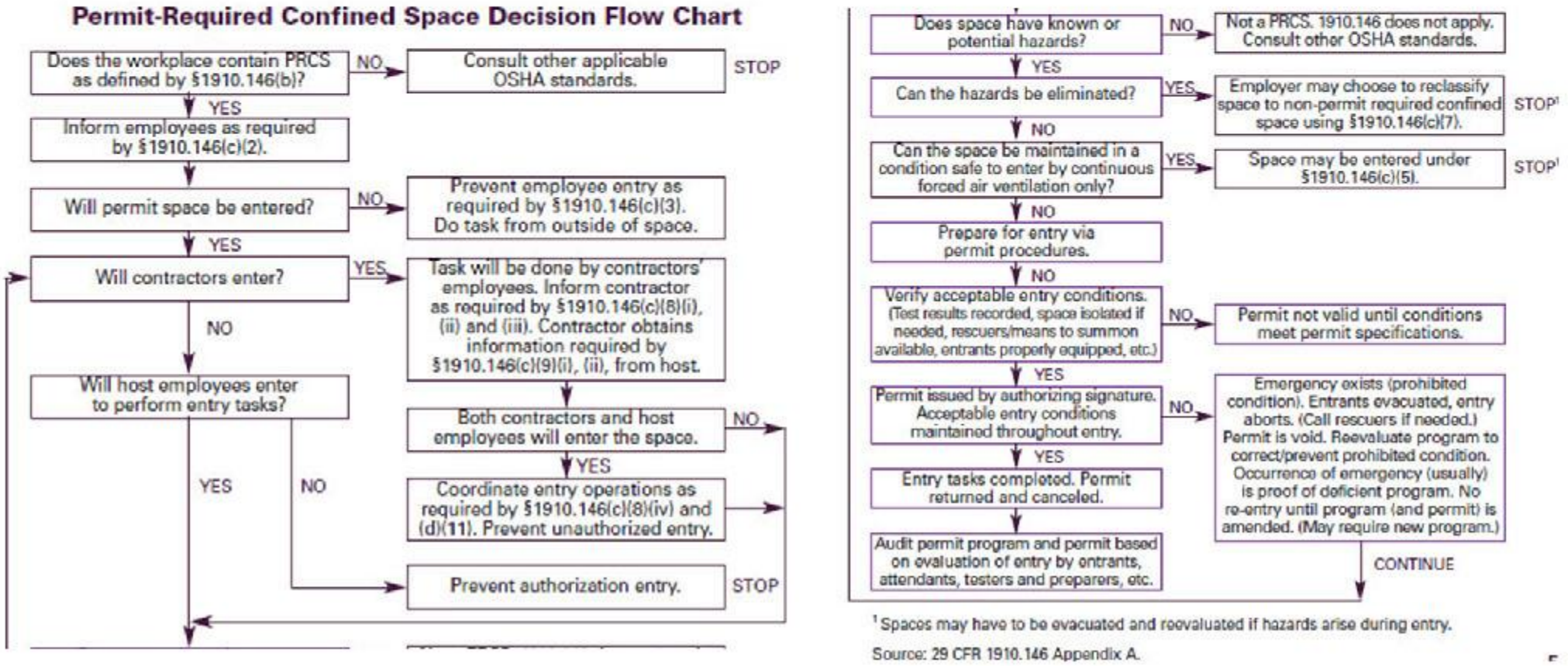


An alternative to designating a space as a non-permit space without having to treat it as a permit-required confined space is the option of "reclassification." Typically, the use of reclassification is designed for spaces without hazardous atmospheres and is normally used with simple spaces and routine entries. Should an employer wish to use this designation, there are still a number of requirements associated with it. A routine entry of a space may be reclassified as a non-permit space if, for example, the atmosphere is tested, and it has been determined that no other hazards are present. A reclassification provision allows for an opportunity for inspection and preventive measures to be taken at the time of entry. To implement this type of confined space, an employer must alleviate all hazards, limit the duration of the entry, and document all procedures in place. Note the word, "potential" again. Under the standard, OSHA states that one CANNOT use reclassification if there is a potential for atmospheric hazards. Typical spaces for reclassification may include air handling units, some cooling towers, and other spaces where the primary hazard is the removal of an energy source. Finally, this type of confined space is considered only as a temporary exemption and will revert to a permit required confined space prior to each time space is re-entered.

Click Box

1.4 Decision Flow Chart

As a tool in support of the determination of the type of confined space that an employer may face, NASP recommends following the "Permit-Required Confined Space Decision Flow Chart", which appears below. Once an employer evaluates the space and determines that it is a permit-required confined space (PRCS), other requirements as stipulated in the standard must be followed. These are depicted in the Decision Flow Chart and further described in subsequent sections of this course. To view the full Decision Flow Chart, click here.



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1.5 Confined Space Entry in Other Industries

While this course concentrates on the OSHA standard as it applies to General Industry, there are numerous standards in other industries regarding requirements that need to be met associated with industry-specific confined spaces.

Click Box

1.5.1 Construction Industry

Confined spaces that may be found on construction worksites include, but are not limited to, the following examples:

- Manholes (such as sewer, storm drain, electrical, communication, or other utility)
- Sewers
- Storm drains
- Tanks (such as fuel, chemical, water or other liquid, solid or gas)
- Pits (such as elevator, escalator pump, valve, or other equipment)
- Heating, ventilation, and air conditioning (HVAC) ducts
- Crawl spaces
- Pre-cast concrete and other pre-formed manhole units
- Mixers/reactors
- Attics and basements under construction

1.5.1 Construction Industry

In 2015, OSHA updated the Confined Spaces in Construction standard (1926 Subpart AA) with significant changes, since it previously only addressed employee training associated with confined spaces in the past. OSHA deemed this previous standard to be inadequate in addressing the ever-rising injury, illness, and fatality incident rates for this industry with regards to confined spaces.

An employer is now required to determine the type of spaces in which an employee is required to work, the hazards that exist or potentially could exist, the control measures that should be taken to make these spaces safe, the training required and the rescue provisions for those that may be placed in a hazardous condition.

Click Box

1.5.1 Construction Industry

There are 5 key differences from the construction rule, and several areas where OSHA has clarified existing requirements. Click the keys to read what the five new requirements include:

1. More detailed provisions requiring coordinated activities when there are multiple employers at the worksite to ensure hazards are not introduced into a confined space by workers performing tasks outside the space.

CLICK THE FIVE KEYS TO LEARN MORE

1.5.1 Construction Industry

There are 5 key differences from the construction rule, and several areas where OSHA has clarified existing requirements. Click the keys to read what the five new requirements include:

2. Requiring a competent person to evaluate the worksite and identify confined spaces, including permit spaces.

CLICK THE FIVE KEYS TO LEARN MORE

1.5.1 Construction Industry

There are 5 key differences from the construction rule, and several areas where OSHA has clarified existing requirements. Click the keys to read what the five new requirements include:

3. Requiring continuous atmospheric monitoring whenever possible.

CLICK THE FIVE KEYS TO LEARN MORE

1.5.1 Construction Industry

There are 5 key differences from the construction rule, and several areas where OSHA has clarified existing requirements. Click the keys to read what the five new requirements include:

4. Requiring continuous monitoring of engulfment hazards.

CLICK THE FIVE KEYS TO LEARN MORE

1.5.1 Construction Industry

There are 5 key differences from the construction rule, and several areas where OSHA has clarified existing requirements. Click the keys to read what the five new requirements include:

5. Allowing for the suspension of a permit, instead of cancellation, in the event of changes from the entry conditions list on the permit or an unexpected event requiring evacuation of the space.

CLICK THE FIVE KEYS TO LEARN MORE

1.5.1 Construction Industry

In addition, OSHA has added provisions to the new rule that clarify existing requirements in the General Industry standard. These include:

- Requiring that employers who direct workers to enter a space without using a complete permit system prevent workers' exposure to physical hazards through elimination of the hazard or isolation methods such as lockout/tagout

- Requiring that employers who are relying on local emergency services for emergency services arrange for responders to give the employer advance notice if they will be unable to respond for a period of time

- Requiring employers to provide training in a language and vocabulary that the worker understands

1.5.1 Construction Industry

With these changes, an employer whose employees are engaged in both construction and general industry work in confined spaces will meet OSHA requirements if that employer also meets the requirements of the new Confined Spaces in Construction standard given its specificity and clarifications.

OSHA provides numerous resources for the Construction Industry to support their efforts in the management of confined spaces:

- OSHA Publication 3825: "Protecting Construction Workers in Confined Spaces"
- OSHA Publication 3849: "Is 911 Your Confined Space Rescue Plan?"
- OSHA eTool: "Construction Hazards in Confined Spaces"

Click Box

1.5.1 Construction Industry

An OSHA case study that highlights the significant need to conduct atmospheric testing, utilizing the minimal OSHA standard requirements, involved a construction worker required to enter a newly constructed manhole in order to access a sewer line under construction in Arkansas in 2004. The sewer line was constructed in a limestone environment, with a very acidic topsoil. The construction worker entered the manhole alone to gain access to the sewer line and was later found unconscious at the bottom of the confined space. Atmospheric testing results that were completed only after the fatality occurred depicted an oxygen-deficient environment of between 16-18.2% and carbon dioxide readings from 1.8 to 3.5% or 18,000 to 35,000 PPM.

The carbon dioxide apparently developed when the acid from the topsoil came in contact with the limestone, producing a hazardous environment. The research concluded that the carbon dioxide displaced the oxygen within the space, creating the oxygen-deficient environment and a dangerous level of a hazardous gas. With this common confined space configuration in the construction industry, the fatality could have been prevented had the employer had a confined space entry program in place and executed it in this instance by following the required atmospheric testing procedures. Not only did this employee lose his life, but his family was obviously severely impacted by the loss. This incident only underscores the importance of an effective confined permit space program managed with an intent to promote employee safety and health in order to reduce or eliminate the risks for injury, illness or death.

Click Box

1.5.2 Other Industries

Given the incidence rates for injury, illness and fatalities associated with confined spaces, other industries beyond construction have specific references to confined space entry requirements. They appear in the Code of Federal Regulations for the following work operations:

- Dipping and Coating Operations (1910.124)
- Welding, cutting, and brazing (1910.252)
- Pulp, paper, and paperboard mills (1910.261)
- Telecommunications (1910.268)
- Grain handling facilities (1910.272)

Click Box

1.5.2 Other Industries

Obviously, there are numerous confined space hazards associated with the above operations to include:

- Vats, rotators, and tanks
- Enclosed work areas
- Manholes and pits
- Silos and towers

Given the specificity of each of these standards, an industry with these types of operations should make certain that not only these specific standards are followed, but also that the general industry standard, Permit-Required Confined Spaces is taken into consideration as permit space programs are developed to ensure the safety and health of the industry employees.

2.0 Confined Space Entry Program

If an employer requires employees to enter designated permit-required confined spaces, a written program is to be developed incorporating standard procedures that address all hazards and potential hazards to ensure safe entry into each confined space. The written program is to include the following:

- Implementation of measures necessary to prevent unauthorized entry into the PRCS. This is completed by informing the employees who have not been trained in the requirements of the standard that they are to stay clear of the area during the entry activities. Signs and barricades deemed appropriate to prevent entry are considered sufficient notification.

- Hazards must be identified and evaluated in the permit space prior to entry by employees.

- Development of procedures and practices necessary to conduct safe permit space entries, including the following elements:

  - Specification of acceptable atmospheric levels prior to entry. This is to include atmospheric testing for:
    - an oxygen content minimally between 19.5% and 23.5%,
    - lower explosive limits (10% of the LEL means evacuation from the space is necessary), and
    - levels below established PELs, TWAs and/or TLVs of toxic substances that may be present.

Click Box

2.0 Confined Space Entry Program

- Isolation of the permit space, to include locking and tagging equipment to prohibit use while the entry is taking place.
- Control or elimination of atmospheric hazards through purging, inerting, flushing or ventilating the space.
- Protection of pedestrian or vehicular traffic from hazards by using barriers surrounding the area.
- Verification that the conditions in the permit space remain at safe levels throughout the entry.

- Provision and maintenance of equipment to ensure safe entry into a permit space, which involves:
  - Gas-detection equipment
  - Ventilating equipment
  - Communication equipment

Click Box

2.0 Confined Space Entry Program

- Personal protective equipment to be utilized when engineering and administrative controls are not feasible
- Lighting
- Barricades to prevent unauthorized entry
- Equipment, such as ladders, to provide for safe access to and egress from the permit space
- Rescue and emergency equipment, unless this service is provided by external personnel
- Any other equipment that would be used for safe permit space entry

- Evaluation of permit space conditions during entry operations by:
  - Testing conditions in the permit space before entry begins.
  - Monitoring the space to ensure the conditions are maintained.
  - Testing for the following atmospheric hazards in this sequence: oxygen, flammable/combustible gases and vapors, and toxic gases and vapors.

2.0 Confined Space Entry Program

- Provision of at least one attendant outside the permit space.
- Designation of employees who have active roles in entry operations, combined with a description of the job duties and identification of the training requirements for those employees.
- Development and implementation of procedures for summoning rescue and emergency services, to include a provision to prevent unauthorized personnel from attempting a rescue.
- Development of a permit system to include preparation, issuance, use, and cancellation of permits.
- Coordination of entry operations when more than one employer is involved.

Click Box

2.0 Confined Space Entry Program

- Establishment of a permit system, describing the preparation, issue, use, and cancellation of entry permits.
- An annual review of entry operations to correct problems that may have occurred during any entry incidents.
- Review of the written program annually, revising the program elements as needed to ensure that it has been updated with the most recent information available.

Click Box

2.1 Hazard Assessment and Control Measures

As a first step, an employer is to evaluate the workplace to determine if any spaces are permit-required confined spaces based upon the definitions and types.

The following are hazards typically found in confined spaces that should be considered in the process of completing the hazard assessment:

- Oxygen-deficient, combustible/flammable, or toxic hazardous atmospheres
- Extreme temperatures
- Engulfment risks, given the space configurations
- Noise levels
- Moisture, condensation, and humidity
- Mechanical, electrical, hydraulic, pneumatic

HAZARD RISK ASSESSMENT MATRIX

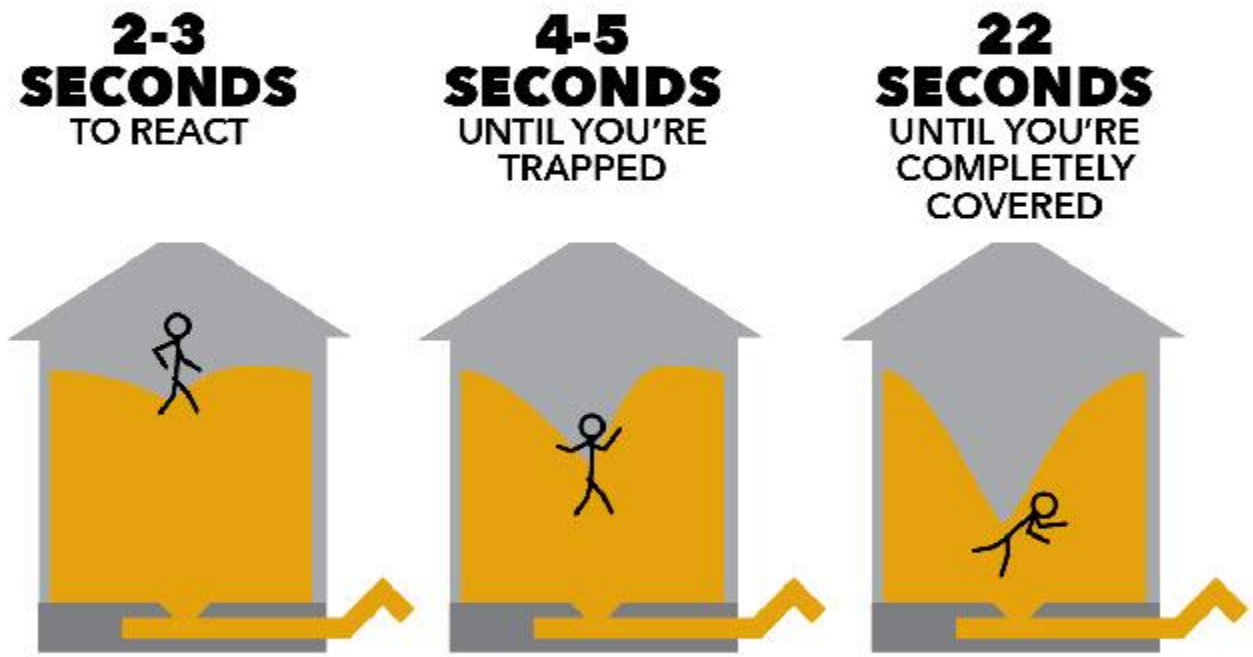
Frequency of Occurrence	Hazard Categories			
	1 Catastrophic	2 Critical	3 Serious	4 Minor
(A) Frequent	1A	2A	3A	4A
(B) Probable	1B	2B	3B	4B
(C) Occasional	1C	2C	3C	4C
(D) Remote	1D	2D	3D	4D
(E) Improbable	1E	2E	3E	4E

Unacceptable High Medium Low

Click Box

2.1 Hazard Assessment and Control Measures

- Concept of isolation of the entire space (LOTO, double block, bleed)
- Restricted air flow
- Vermin, reptiles, or spiders
- Proximity to other possible hazards (i.e. machinery components, electrical equipment, or running vehicles)
- Falling Objects



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2.1 Hazard Assessment and Control Measures

Hazard identification is a critical component of the written program, as it is the foundation from which all other procedures are developed. Typically, an emphasis is placed on hazardous atmospheres in confined spaces, simply due to the fact that they are the most commonly identified hazards and result in the most fatalities in a permit-required confined space. The concept of isolation is similar to a lockout tagout operation with equipment; however, the isolation covers the entire space.

Obviously, the ideal control measure that an employer may implement is one that eliminates the need altogether for any employees to enter a confined space. If the hazards need to be addressed, the use of engineering controls such as adequate ventilation of the space or reinforcement of the structure to ensure stability are recommended first. Implementing administrative controls with activities such as reducing exposure times through the use of more than one qualified entrant or utilizing outside contractors to perform the tasks in the confined space as alternates for the employees, are then to be considered. Finally, if an entrant has potential for exposure to hazardous conditions after all feasible engineering and administrative controls have been implemented, PPE requirements should be considered as the last resort to control the hazards. Additionally, if entry is required to eliminate hazards and obtain data, the employer must follow specific procedures in the standard.

Click Box

2.2 Permit System

ENTRY PERMIT

CONFINED SPACE _____ HAZARDOUS AREA _____ PERMIT NO. _____

• PERMIT VALID FOR EIGHT HOURS ONLY • ALL COPIES OF PERMIT WILL REMAIN AT JOB SITE UNTIL JOB IS COMPLETED

SITE LOCATION/DESCRIPTION _____

PURPOSE OF ENTRY _____

DATE _____ PERMIT EXPIRATION DATE/TIME _____

SUPERVISOR(S) IN CHARGE OF CREWS _____ TYPE OF CREW _____ PHONE NO. _____

REQUIREMENTS TO BE COMPLETED PRIOR TO ENTRY

ENTER N/A FOR ITEMS THAT DO NOT APPLY	(COMPLETED) DATE	TIME		(COMPLETED) DATE	TIME
Lock Out / De-Energize / Try-Out			Lifelines		
Line(s) Broken - Capped - Blanked			Resuscitator - Inhalator		
Purge - Flush and Vent			Standby Safety Personnel		
Ventilation			Full Body Harness (with "D" ring)		
Breathing Apparatus			Fire Extinguishers		
Emergency Escape Retrieval Equipment			Lighting (explosive proof)		
Communication Device(s)			Protective Clothing		
Atmosphere Monitoring Device(s)			Respirator(s) (air purifying)		
Secure Area (post and flag)			Burning and Welding Permit		

CONTINUOUS MONITORING (record results every 2 hours)

TESTS TO BE TAKEN	PERMISSIBLE ENTRY LEVEL	MONITORING RESULTS							
Percent of Oxygen	19.5%-23.5%								
Lower Flammable Limit	Under 10%								
Carbon Monoxide	+35 PPM								
Aromatic Hydrocarbon	+ 5 PPM: * 5 PPM								
Hydrogen Cyanide (Skin)	* 4 PPM								
Hydrogen Sulfide	+ 10 PPM * 15 PPM								
Sulfur Dioxide	+ 2 PPM * 5 PPM								
Ammonia	* 35 PPM								
Other									

* Short-term exposure Limit: Employee can work in the area up to 15 minutes

+ 8 hour time-weighted average: Employee can work in the area 8 hours (longer with appropriate respiratory protection)

REMARKS _____

GAS TESTER NAME & CHECK NO.	INSTRUMENT(S) USED	MODEL AND/OR TYPE	SERIAL AND/OR UNIT NO.

RESCUE PROCEDURE _____

ADDITIONAL INFORMATION _____

EMERGENCY PHONE NUMBERS

Ambulance _____ Safety _____

Fire _____ Rescue _____

Gas Coordinator _____

PERMIT AUTHORIZATION (pink copy to Safety)

I certify that all required precautions have been taken and necessary equipment is provided for safe entry and work in this space.

NAME (print) _____ DATE _____

SIGNATURE _____

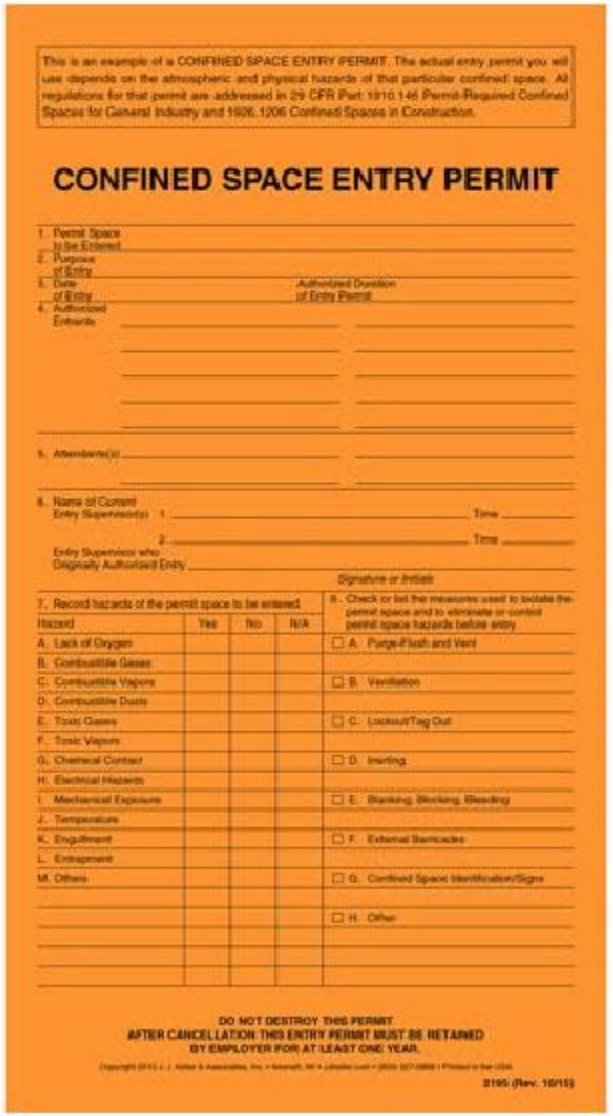
DEPARTMENT _____ PHONE NO. _____

REQUIRED SAFETY STANDBY PERSON(S)	CHECK NO.	AUTHORIZED ENTRANT(S)	CHECK NO.

As previously stated, OSHA requires employers to develop and implement a permit system should the confined space meet one or more of the criteria for a permit-required confined space. This permit system is designed to ensure that all required procedures are implemented to protect employees from hazards that may be in a confined space. The permit system not only informs affected employees of the protective measures that are to be taken, but it also creates a record of the entry, including atmospheric testing and monitoring, as well as the number of entrants that will be participating in the confined space entry.

Click Box

2.2 Permit System



This is an example of a CONFINED SPACE ENTRY PERMIT. The actual entry permit you will use depends on the atmospheric and physical hazards of that particular confined space. All regulations for that permit are addressed in 29 CFR (Part: 1910.146 (Permit-Required Confined Spaces for General Industry and 1926. 1206 Confined Spaces in Construction.

CONFINED SPACE ENTRY PERMIT

1. Permit Space to be Entered
2. Purpose of Entry
3. Date of Entry — Authorized Duration of Entry Permit
4. Authorized Entrants

5. Attendants(s)

6. Name of Current Entry Supervisor(s) 1 — Time
2 — Time
Entry Supervisor who Originally Authorized Entry
Signature or Initials

7. Record hazards of the permit space to be entered.

Hazard	Yes	No	N/A
A. Lack of Oxygen			
B. Combustible Gases			
C. Combustible Vapors			
D. Combustible Dusts			
E. Toxic Gases			
F. Toxic Vapors			
G. Chemical Contact			
H. Electrical Hazards			
I. Mechanical Exposure			
J. Temperature			
K. Engulfment			
L. Entrapment			
M. Others			

8. Check or list the measures used to isolate the permit space and to eliminate or control permit space hazards before entry

- ☐ A. Purge/Flush and Vent
- ☐ B. Ventilation
- ☐ C. Lockout/Tag Out
- ☐ D. Inerting
- ☐ E. Blanking, Blocking, Bleeding
- ☐ F. External Barricades
- ☐ G. Confined Space Identification/Signs
- ☐ H. Other

DO NOT DESTROY THIS PERMIT
AFTER CANCELLATION THIS ENTRY PERMIT MUST BE RETAINED BY EMPLOYER FOR AT LEAST ONE YEAR.

2195 (Rev. 10/13)

The following information is to be included in a required permit:

- Name of the 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 authorizing 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 the means to be used to contact them
- Date and authorized duration of entry
- Acceptable entry conditions

Click Box

2.2 Permit System

- Communication procedures and equipment to maintain communications during entry
- Special equipment and procedures, including personal protective equipment and alarm systems

To view a sample confined space entry permit, click here.

Preferably, if the permit developer has any other information that would help to ensure the safety of the employee(s) performing work in or around the space, it is recommended that it be included in the comments section of the permit.

The entry supervisors are required to sign the completed permit, authorizing the permit operations to begin. Authorized entrants must have the opportunity to review the permit before they enter the permit space, with a copy of the permit to be posted at the entry point of the space. The permit must verify that pre-entry preparations outlined in the standard have been completed. An estimated time for the entry operations is to be listed on the permit and once the time has expired, the permit is canceled, and the entry operations must cease. The entry supervisor must cancel the entry when the operation is complete or when a condition arises in the space that was not permitted under the original permit conditions. New conditions must be noted on the canceled permit and used in revising the permit space program. Unpermitted conditions must be noted on the entry permit such as surrounding hazards that may have an effect on the safety of the entrants. The permit must be retained for one year (NASP recommends at least 5 years) such that it can be reviewed at the time when the written program is reviewed.

Click Box

2.2 Permit System

Space-specific permits have many benefits, since they include additional details about the space that may save lives and avoid potentially dangerous incidents. On a space-specific permit, it is necessary that the hazardous conditions, such as potentially contaminated air, are listed in order for that condition to be properly evaluated. On the other hand, with a standard permit, the employees are required to determine for themselves what should be tested for, or at least check the confined space entry plan for further direction. On a space-specific permit, a list of the safety equipment required for that particular space is included, saving time and providing for the appropriate protection for those involved in the entry operations. Lastly, on a space-specific permit, the isolation steps are listed, similar to the established lockout/tagout procedures at the workplace.

Click Box

2.3 Required Equipment and Materials for Entry

In addition to personal protective equipment that may include protective apparel and appropriate respiratory protection, other required equipment and materials for those employees involved with entry operations into a permit space include:

- Testing and monitoring equipment
- Ventilation equipment
- Communications devices*
- Lighting equipment
- Barriers, guardrails, and shields
- Ladders
- Harnesses and other retrieval devices**
- Proper signage***
- Rescue and emergency equipment if not provided by an external service
- Safety Data Sheets, where applicable

Click Box

2.3 Required Equipment and Materials for Entry

*Communication by radio contact is the preferred communication method recommended by NASP. To supplement this method, providing extra signals, such as bells, offers additional options in case of any communication failure. Finally, a motion detector alarm to determine entrant movement or the lack of entrant movement is also a consideration to ensure the safety of any entrant.

**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. It is imperative that the retrieval line is never removed once it is connected. 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. 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 permit space more than five feet deep.

Click Box

2.3 Required Equipment and Materials for Entry

***With any permit-required confined space, exposed employees are to be informed of the existence and location of and the danger posed by these spaces. A sign reading "DANGER- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" or the use of similar language that may be considered equally effective would satisfy the requirement for appropriate signage.

Click Box

2.4 Employee Training

OSHA requires employers to provide training for those who may be involved in any permit-required confined space operations. Training is to be conducted before employees are first assigned duties relating to confined spaces or if there is a change in their assignments. Training is to be conducted when new hazards arise relating to permit-space operations if employees have not received prior training. Also, training must be provided to each affected employee whenever the employer believes there are deviations from the permit-space entry procedures. An employer is to train employees such that they are proficient in the duties of an authorized entrant, attendant, or entry supervisor. All training must be certified, indicating employees' names, trainers' signatures or initials, and dates of training.

2.4 Employee Training

Typical instructions to be included in the employee training for entry operations in a confined space include:

- Do not enter permit-required confined spaces without having completed the appropriate training, as well as without having a permit to enter.
- Review, understand, and follow the standard procedures as depicted in the permit space written program prior to entering permit-required confined spaces and be knowledgeable of self-rescue procedures and indicators.
- Identify any physical hazards prior to entry in a confined space.
- Test and monitor for oxygen content, flammability, or toxicity hazards before and during entry.
- Use an 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 two-way radio. This monitoring system enables the attendant and entry supervisor to notify an entrant to evacuate and to alert appropriately-trained rescue personnel to rescue entrants when needed.

2.4 Employee Training

Additional training is required when job duties change, a change occurs in the permit space program, new hazards appear in the space, or when an employee's job performance shows deficiencies in their ability to perform the required tasks safely. After the training, employers must ensure that the employees have acquired the knowledge, skills, and necessary abilities to perform their duties safely. In addition to this training, in-house rescue team members also require training in CPR and First Aid.

Click Box

2.5 Employee Participation

It is interesting to note that the standard specifically requires that an employer consult with affected employees regarding the development and implementation of all aspects of the permit space program. It also calls for an employer to make available to employees and their authorized representatives the information utilized to meet the requirements of the standard. NASP finds this requirement noteworthy, given the severity and frequency of injuries, illnesses, and fatalities associated with the standard. With any safety and health program, employee involvement with plan development and implementation allows for improved engagement in the process to ensure operational procedures are followed and the intent of providing a safe workplace is understood.

Click Box

3.0 Roles and Responsibilities

No worker should enter a confined space without the proper support team in place. There are 4 main members to a confined space team. Click on each member title to learn about their individual responsibilities.

Rescue Service Personnel
"Rescue service personnel" are those persons designated to rescue employees from permit spaces. Any employer who decides to have their employees enter a permit space must provide rescue and emergency services. There are three different types of emergency rescue that an employer can rely on:

- In-house rescue services
- Outside rescue services, such as local fire departments
- Non-entry rescues

CLICK THE FOUR TITLE BOXES TO LEARN MORE

3.0 Roles and Responsibilities

No worker should enter a confined space without the proper support team in place. There are 4 main members to a confined space team. Click on each member title to learn about their individual responsibilities.

Entry Supervisor
"Entry supervisor" is the employee (manager, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned. The supervisor also authorizes any entry into the confined space, oversees entry operations, and terminates entry as necessary. An entry supervisor may also serve as an attendant or as an authorized entrant, as long as that employee is trained and equipped for each role he assumes. Also, the duties of entry supervisor may be passed from one individual to another during the course of a single-entry operation.

Entry supervisors must know the hazards of confined spaces and the signs and symptoms of exposure to those hazards. They must verify that permits are thoroughly completed, the appropriate testing and procedures have been completed, and all required equipment is in place. It is the supervisor's responsibility to ensure that entry operations remain consistent with the entry permit and that acceptable entry conditions are maintained. The supervisor is the employee responsible for knowing when and under what conditions to cancel a permit and terminate the work performed. Supervisors are required to remove unauthorized employees from the area. Finally, they are responsible for ensuring that rescue services are available and the means for contacting them are operable.

CLICK THE FOUR TITLE BOXES TO LEARN MORE

3.0 Roles and Responsibilities

No worker should enter a confined space without the proper support team in place. There are 4 main members to a confined space team. Click on each member title to learn about their individual responsibilities.

Attendant
By definition, an "attendant" is an employee stationed outside the permit space who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program. Authorized attendants must be able to monitor situations inside and outside confined spaces, so they can order entrants to evacuate a space if a dangerous situation arises in either place. They must also maintain communication with and keep an accurate account of employees entering and exiting the space. Attendants must be well aware of the hazards of the confined space and also be aware of the physical and behavioral effects of hazard exposure so that they are able to notice the effects in any of the entrants. If an emergency situation arises in the confined space, the attendant is the person responsible for summoning emergency services and performing whatever rescue operation he or she has been trained and equipped to perform. The attendant is responsible for keeping all unauthorized personnel out of the confined space, including unauthorized rescuers. Under no circumstances is an attendant permitted to leave the space until replaced by another attendant or all entrants have been removed from the space. Lastly, they must ensure that unauthorized employees stay away from the permit space at all times of entry operations.

CLICK THE FOUR TITLE BOXES TO LEARN MORE

3.0 Roles and Responsibilities

No worker should enter a confined space without the proper support team in place. There are 4 main members to a confined space team. Click on each member title to learn about their individual responsibilities.

Authorized Entrant
"Entry" is the action by which a person passes through an opening into a permit-required confined space. Entry includes any ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space. Authorized entrants are employees who have been trained and approved to enter such a confined space. These employees must have had training regarding the potential hazards of the confined space, as well as the signs and symptoms of exposure to any of the hazards. They should be familiar with all equipment, know if the equipment is explosion-proof, and know how to tell when it is properly grounded. Authorized entrants must know how to communicate with the attendant, especially if a prohibited condition or a hazardous situation arises. Entrants must agree to immediately exit if an order is given to do so or an alarm goes off. Entrants must wear full-body harnesses with retrieval lines attached to the center of their backs or above their heads or wristlets if full-body harnesses are not feasible. The only exception to this is when the means of retrieval introduces a greater hazard through its use.

CLICK THE FOUR TITLE BOXES TO LEARN MORE

3.0 Roles and Responsibilities

The standard requires employers to ensure that responders are capable of responding to an emergency in a timely manner. If the employer elects to use in-house rescue services, they 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 (including information about the hazards in the permit space) and be trained to perform assigned rescue duties. The standard also requires that all rescuers be trained in First Aid and CPR, with minimally one rescue team member currently certified in First Aid and CPR. Employers must ensure that practice rescue exercises are performed yearly. As always, rescuers also must be informed of the hazards of the permit space.

Click Box

3.0 Roles and Responsibilities

The second option, summoning an outside rescue team to perform the rescue, is a more difficult option with which to comply. An employer must evaluate the prospective rescue team to determine how quickly it is capable of responding after members are notified of the need for rescue. OSHA requires the rescue team to respond in a timely manner, consistent with the specific hazard in the confined space. As an example, if there is an immediately dangerous to life and health (IDLH) atmosphere in the permit space and entrants are required to wear self-contained breathing apparatus (SCBA), the contractor must have a standby service that is capable of entering the space in a short period, and who has the appropriate personal protective equipment. The outside rescue services must have the capability to reach any victim within a time frame that is appropriate for the hazard in the permit space. The rescue team must be proficient in performing the needed rescue service. The employer must also inform the rescue team of all types of permit-required confined spaces that exist in the workplace at the time of identification by the employer and provide them with the opportunity to practice and develop rescue plans that may be site-specific given the conditions that exist.

Click Box

3.0 Roles and Responsibilities

The last option is to provide non-entry rescues. With this type of rescue, the entrant in the confined space must be required to wear a full-body harness with an attached retrieval line. A retrieval line must be attached to a mechanical device, such as a tripod, winch, or fixed point outside the permit space. This will allow the rescue team to pull an incapacitated victim out of the confined space without the need to enter the space themselves.

Click Box

3.1 Contract Worker Requirements

Oftentimes, an employer may need the assistance of outside contractors to enter confined spaces. An employer is to advise any outside contractors that are assigned to enter a permit-required confined space of the following information:

- The permit spaces and permit space entry requirements
- Any identified hazards
- The employer's experience with the space, such as knowledge of hazardous conditions
- 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 entrants and their support personnel are appropriately protected from permit space hazards. An employer is to also give contractors any other pertinent information regarding hazards and operations in permit spaces and be debriefed at the conclusion of any entry operations for which contractors have been assigned.

3.2 Personal Protective Equipment

Workers in underground tunnels, tanks, and crawl spaces contend with unique hazards, including explosions, asphyxiation, and contact with toxic materials. Regulations issued by OSHA address those hazards by referencing the personal protection equipment (PPE) used by workers in confined spaces.

PPE is for worker protection from toxic or harmful substances that may be present in the confined workspace. The identification of these materials is important so that the appropriate PPE may be selected, including:

- Disposable coveralls
- Chemical-resistant coveralls
- Water-resistant clothing (such as rain gear)
- Chemical-resistant gloves
- Chemical-resistant boots
- Eye and Face protection
- Hearing protection

3.2 Personal Protective Equipment

PPE should be immediately available at all times and should be selected with the potential hazards and contingencies associated with the confined space in mind. As necessary, PPE will be worn to protect entrants from the hazards associated with the confined space. If the confined space has a height of more than 5 feet with an entry point overhead, each entrant will be required to wear a body harness attached to a mechanical retrieval system, such as a tripod. If the confined space is less than 5 feet in height but has a potentially hazardous atmosphere, each entrant will wear a body harness attached to a lifeline that will be monitored by the attendant. This system will allow the attendant to perform a non-entry rescue, if necessary, by pulling the entrant out by the lifeline. If the confined space entry requires more than one entrant using an airline system, the attendant will be responsible for ensuring the air hoses and lifelines do not become entangled.

Box

3.2 Personal Protective Equipment

Under 1910.146, OSHA requires that a trained and equipped rescue team must be available whenever employees enter a confined space. It is vital that employees are familiar with the equipment used and procedures followed during confined space entry. Confined space rescue is safe only when rescue team members are outfitted with appropriate personal protective clothing and equipment. The choice of personal protection clothing and equipment is based on the hazards of the situation and must protect against the specific dangers encountered in confined space rescue. Rescuing a victim from a confined space involves several inherent hazards including:

- Contaminated air
- Oxygen deficient or enriched atmospheres
- Toxic atmospheres
- The potential for chemical flash or other types of fire
- Engulfment
- Physical hazards

Click Box

3.2 Personal Protective Equipment

Rescue team personnel must be adequately protected against the “worst case” scenario. Appropriate personal protective equipment will depend on the circumstances of the specific rescue operation. The selection of this personal protective equipment must be guided by a thorough understanding of the capabilities and limitations of individual clothing and equipment to avoid injury and safely complete the rescue. As previously discussed, the rescuer should not become another victim. Selection of personal protective equipment for confined space rescue requires special considerations:

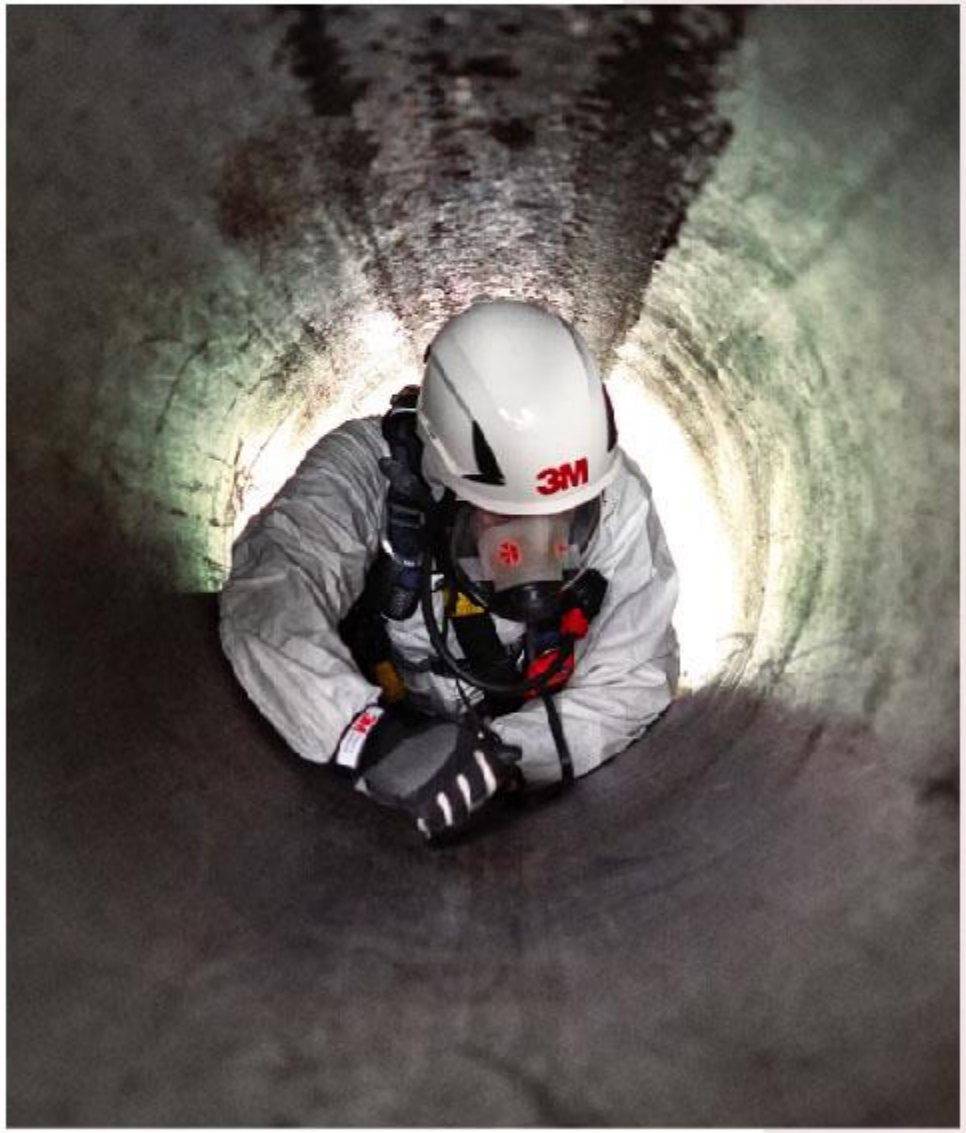
- Entry into a confined space may be restricted. As a consequence, bulky clothing and equipment may inhibit rescuer mobility and prevent certain motions. Personal protective equipment should be close-fitting, low profile, and offer little restriction to movement. It should also be especially free of loose areas or parts that can snag or get caught in doorways and machinery.

- A confined space allows chemical vapors to concentrate. Vapors trapped in a confined space will usually stay at the same concentration unless ventilated. However, in a study involving sewer manholes, changes in concentration for brief periods of time did occur, illustrating the need for continued atmospheric testing over time. The concentration of vapors can also be affected by temperature, with potentially higher concentrations at higher temperatures.

- Sparking inside a confined space must be avoided. Flammable or combustible vapors inside a confined space can be ignited if concentrations are within the chemical’s flammability range. Personal protective equipment should be free of materials or components that can generate static electricity.

Click Box

3.2 Personal Protective Equipment



A variety of personal protective clothing and equipment should be available to the rescue team. Even when no hazards are detected within the confined space, employees should still be required to wear basic PPE. While these items are often chosen separately, it is important that all protective clothing and respiratory protection equipment work together to provide the most effective “envelope” of protection around the wearer.

Click Box

3.3 Fall Protection

The first fall protection consideration when working near or preparing to enter a confined space relates to the access area itself. When a hatch or cover is removed to provide access to a confined space, as is the case with manhole covers, the opening immediately must be guarded with a railing, temporary cover, or some sort of barrier to prevent an accidental fall into the space. All workers, not just those entering the confined space, need to be outfitted with fall protection. An employee preparing to conduct atmospheric monitoring may inadvertently become overwhelmed by vapors when the cover is removed, which could result in loss of consciousness. Therefore, it is important for those working near the opening to wear either a restraint lanyard, preventing them from reaching the edge of the opening, or an arrest lanyard or lifeline, to stop a fall in progress, before the cover is even removed.

OSHA 1910.146 only indirectly addresses the need for fall protection equipment in the permit-required confined space standard when, in reference to non-entry rescues, it states in part (k)(3)(i):

"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 which the employer can establish presents a profile small enough for the successful removal of 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."

Click Box

3.3 Fall Protection

Although not elaborated upon directly, fall protection is covered in-depth throughout other portions of the 1910 and 1926 (construction industry-specific) standards and thus, is required in confined spaces.

If a vertical entrance into a confined space is required, equipment must be provided to ensure safe access. This usually is accomplished with a ladder or davit arm/tripod along with a winching mechanism. Additional fall protection is required by the regulations and all U.S. manufacturers require the use of fall protection equipment when using davit arms and tripods. If a worker is using a fixed ladder to descend into a confined space, the ladder becomes the primary means of fall protection, and a self-retracting lifeline along with a winching mechanism becomes the back-up or secondary means of fall protection.

The same full-body harness required in the event a non-entry rescue becomes necessary also can be used with a personal fall arrest system — it's as simple as attaching the harness to a self-retracting lifeline attached to the davit arm or tripod already in use to lower the entrant into the space.

If the concept of fall protection or the use of this equipment is new to an employee involved in the confined space program, or if no training documentation is on file for the employee, the employee must be trained in inspection and use of fall protection equipment as well as general fall protection issues.

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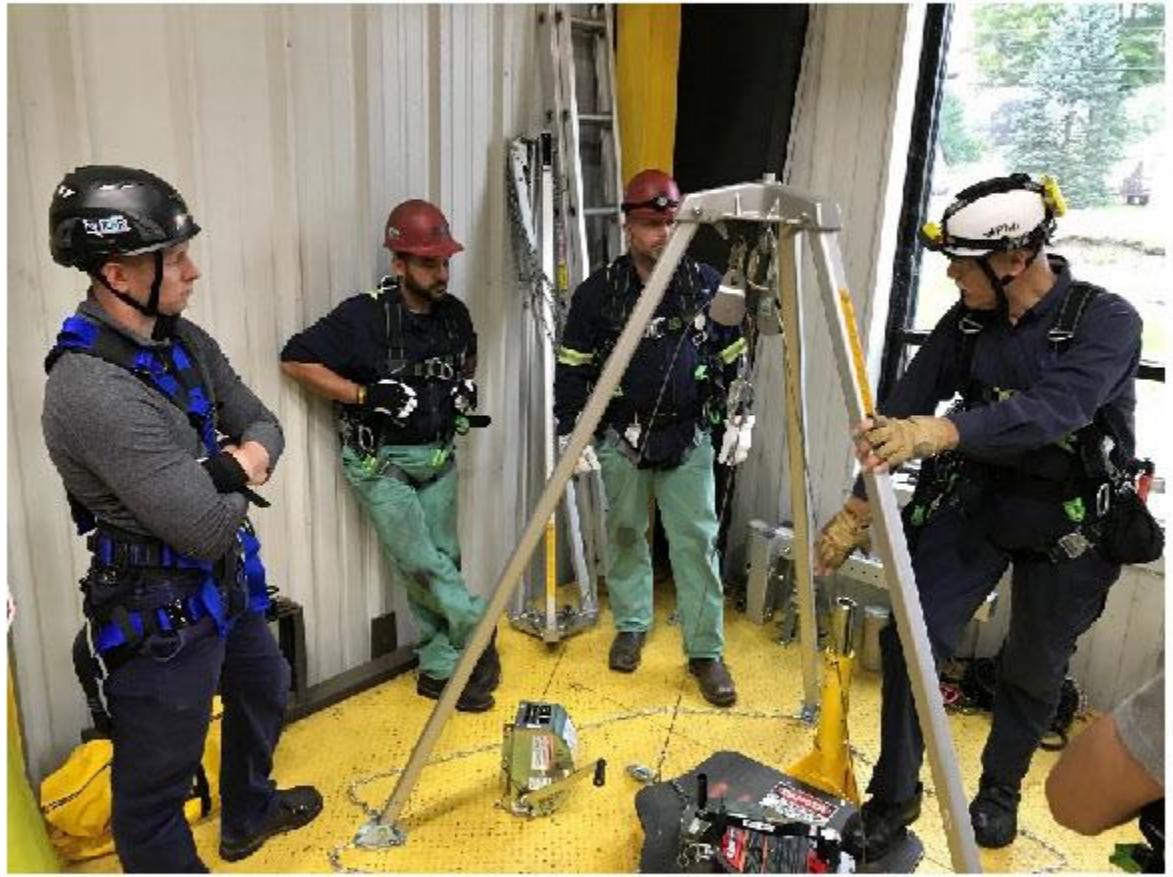
3.4 Protective Clothing



No one type of protective clothing will protect against all hazards. Therefore, personal protective equipment must be chosen with extreme care and with full knowledge of the threats facing the entry team. The clothing chosen must account for the type and severity of hazards present. When only physical hazards are present (in the absence of fire or chemical exposure threats), employees should be equipped with a hard hat, goggles or other eye protection, work gloves, and work boots. Hard hats and eye wear should meet ANSI Z87.1 requirements. Gloves should be leather work gloves with good fit, dexterity, and grip. Boots should be made of leather with steel toes, non-skid soles, protective insoles, and strong ankle support. Boots should meet the requirements of the new ASTM international standards F 2412, Test Methods for Foot Protection and F 2413, Specification for Performance Requirements for Protective Footwear which recently replaced ANSI Z41.

Click Box

3.4 Protective Clothing

Coveralls are often preferred in confined space rescues because they offer the lowest profile. Emergency medical protective clothing should always be on hand when rescues require extrication of victims who may be injured. At a minimum, latex medical gloves should be used. Splash-protective garments and face protection devices (such as face shields, goggles, and similar eye wear) should also be used when large amounts of blood exposure are expected.

Compliant clothing can be easily identified by inspecting the label on the clothing item. The label should state that the item meets the relevant standard and have the mark of the independent certifying organization. It is important to verify that employees are wearing clothing that fits correctly. Even the best protective clothing will fail to prevent injury if it is poorly sized. All front closures should be secured. The collar should be worn upward (even when a hood is worn). The visor on the helmet should be down. Any loose straps should be secured, and the clothing should be worn to provide the lowest possible profile.

Chemical protective clothing should be worn when chemical hazards are present in either liquid or vapor form. Many chemicals are toxic or corrosive through skin contact or absorption. Vapor-protective suits and liquid-splash protective suits should be available to the confined space team member based on the specific hazards present at each site.

3.5 Ventilation

Hazardous atmospheres cause most confined space deaths and injuries. All result from inadequate ventilation. One of the first objectives in confined space response is to ventilate the space. The purpose of ventilation in confined space entry and usage is to supply enough clean air or exhaust enough contaminated air to eliminate the atmospheric hazard. Portable air movers or high-powered fans are typically used to ventilate confined spaces. A fan used for this purpose should have the following features:

- Lightweight and portable
- Flexible hose connections
- Intrinsically safe (explosion proof)
- An audible alarm that sounds automatically if fan failure occurs

Click Box

4.0 Atmospheric Testing and Monitoring

It is impossible to detect a hazardous atmosphere without the appropriate test instruments designed for that purpose. An employer should never assume that a confined space is safe or that an employee will not be exposed should they linger unnecessarily in a confined space or perform dangerous work while in the space for a short period of time. An employee can be overcome in a hazardous atmosphere in a matter of moments. Even brief and simple work in an area not recognized as a confined space may result in injuries or death by asphyxiation or by explosion. Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to and during entry.

Click Box

4.1 Atmospheric Testing

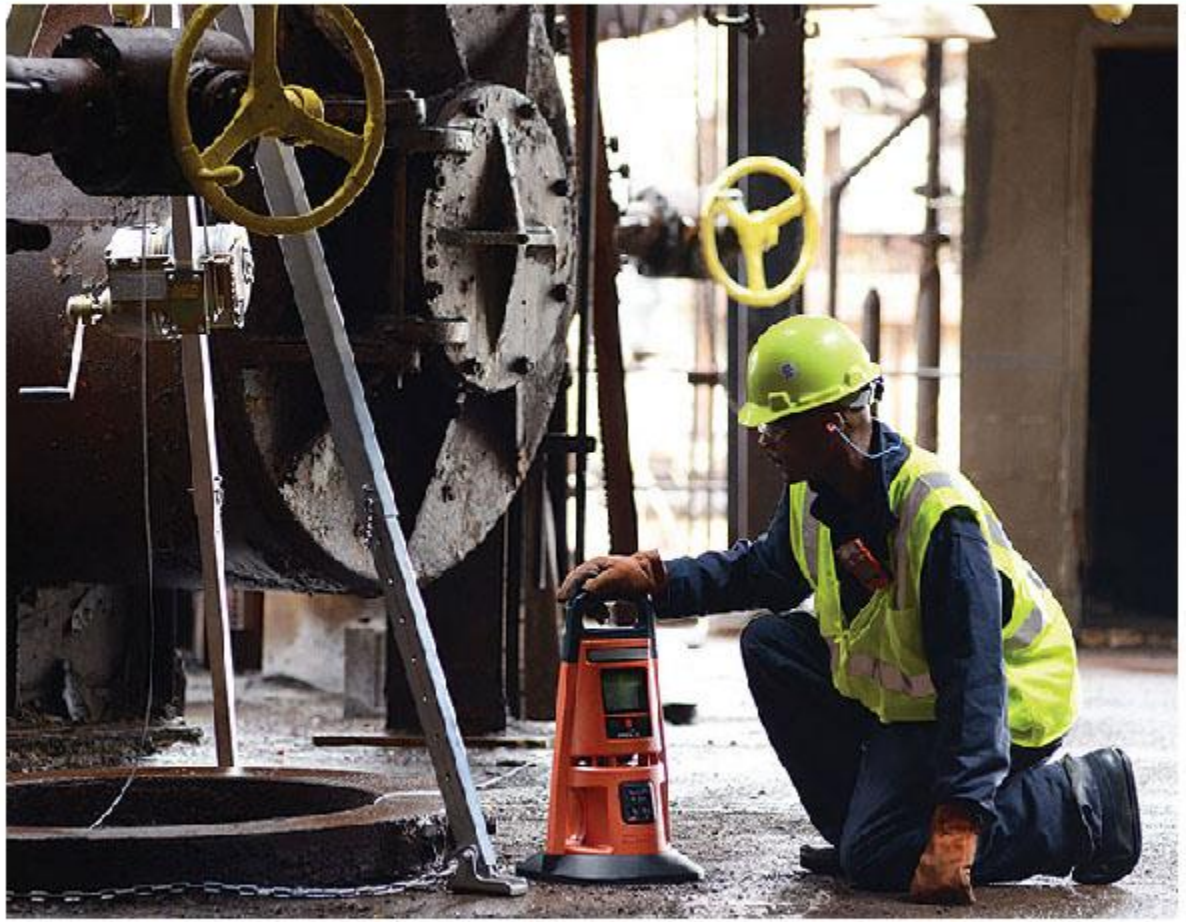
Atmospheric testing and monitoring are the processes by which gases and vapors that may create hazardous conditions for employees participating in the entry operations are detected. The term atmospheric testing generally refers to testing conducted *prior* to entry into the atmosphere in question. Atmospheric monitoring generally refers to *ongoing* testing of the atmosphere while the entry operations are taking place. Monitoring can be conducted either continuously or periodically.

Gases or vapors that are detected utilizing an atmospheric testing process can pose serious hazards to those that work in entry operations, as they may burn or explode, may damage an employee's body, or may exclude oxygen to the extent that an employee does not have sufficient oxygen to breathe. These contaminants may not be of the same concentration everywhere in the tested atmosphere. There may be multiple gases in multiple layers within the same atmosphere, especially if the spaces are deep or have areas that lead away from the point of entry. This is considered a "stratified" atmosphere, posing a risk to the entrant at different elevations and areas. Imagine four different gases with four different vapor densities with the lightest settling at the top layer and the heaviest at the bottom layer. Testing and monitoring at varying heights must be completed to ensure that the entire atmosphere has been assessed. Since there may be times when a gas gathers in one spot within a larger area, multiple tests must be completed throughout the entire space.

Click Box

4.1 Atmospheric Testing

Ideally, pre-entry testing is performed remotely from outside the atmosphere in question if at all possible, providing the most protection to those conducting the test, since the employee exposure is limited. If the space must be entered in order to perform the test, then the maximum PPE must be worn and the test must be performed carefully as it is completed, with employee(s) required to exit at any sign of trouble. While testing stratified atmospheres, it is important that the testing be conducted at a distance of approximately four (4) feet in the direction of travel and to each side, with a proper rate of progress to ensure a detector response and adequate exit time. If a meter is placed on the entrant, the preferred placement is to be as close to the breathing source as possible, such as the shoulder, rather than the belt or lower harness straps, in order to collect the most accurate and timely data possible.



Click Box

4.1 Atmospheric Testing

Continuous monitoring instrumentation is typically equipped with an alarm that will notify those within the atmosphere in the event of a dangerous change in the atmospheric conditions. Instrumentation for periodic testing typically requires activation by the operator for each pre-determined time frame to be tested for the operator to follow the procedures in a timely manner. Whether using continuous or periodic monitoring, it is recommended to regularly document and log the findings, allowing the supervisor to see any change in the atmosphere's contents and determine any patterns that indicate an imminent problem. While OSHA, in this General Industry standard, has not stipulated that continuous monitoring is required, NASP strongly recommends that continuous monitoring be considered as a part of the standard operating procedures for entry operations to ensure the safety of those that enter the space. It is interesting to note that while OSHA does require periodic monitoring, the regulatory agency has not stipulated any time periods for which to assess the atmosphere. If continuous monitoring is not feasible, NASP recommends periodic testing at a minimum of 15 minute intervals of time.

In Appendix B of the standard, OSHA provides specific requirements for the order or sequence in which the atmosphere is to be tested. First, a test is conducted to determine the oxygen content of the air, after which a test for flammability is conducted. The third test is a test for toxics that have the potential for being present in the confined space, such as H_2S and carbon monoxide.

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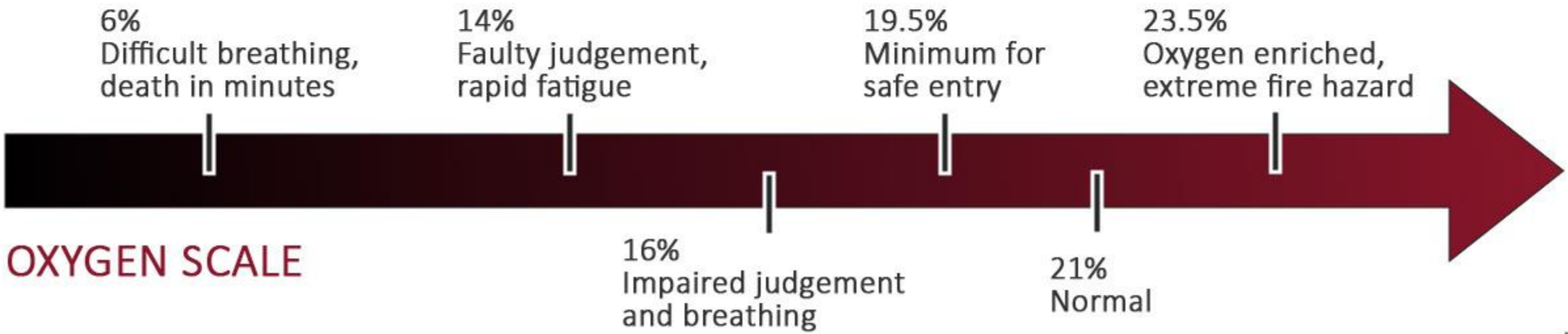
4.1.1 Oxygen Testing

Testing for the level of oxygen can provide significant information for those involved in the entry operations. First, it provides a measurement to determine whether the atmosphere contains too little oxygen, considered as “oxygen deficient”. A 19.5% minimum oxygen level by volume was established by OSHA, which requires that entry into the space be forbidden should the testing result be at or below this level. However, any time the oxygen content is below that of the normal atmosphere (20.8% at sea level), a potential serious problem is indicated, as there must be a reason for this condition to have occurred. The oxygen level may be continuing to deplete, in which case it is not safe to enter that atmosphere. Also, if less than the normal oxygen content is present in the space, then some other vapor or gas must be replacing it. This could very well be a toxic gas that has not yet been discovered. It is not safe to enter such an atmosphere until the tester determines the other gas or vapor that displaced some of the oxygen, that the gas is not toxic, and that the atmosphere is not continuing to degrade. On the other hand, an atmosphere containing too much oxygen (more than 23.5% oxygen by volume, per OSHA) is considered “oxygen enriched”, which presents an increased risk of explosion. Oxygen monitors are set to alarm if the atmosphere contains either too little or too much oxygen.

4.1.1 Oxygen Testing

While the OSHA permissible levels for oxygen in a confined space are 19.5% to 23.5%, the safety of the entrant may be in question if these minimum requirements are utilized. If the oxygen content is anything less than approximately 20.8%, there is a legitimate reason for this deficiency and it must be determined before the life of an employee is put at risk in that atmosphere. If there is an ongoing leak of some other gas that is displacing oxygen, the time to find it is before someone enters the space. If all attempts to answer the "why" question are exhausted without a determination, the next step is to ensure that the oxygen level is stable. If the oxygen level is tested over a long period of time and it is found that it does not change and it is above 19.5%, then an entrant may be at minimal risk to proceed per OSHA. On the other hand, if the oxygen content is above the norm (20.8%), there is likely some leak of oxygen into the atmosphere. It is then incumbent upon the tester to find and stop the leak, followed by properly ventilating the area such that the oxygen level can return to normal prior to any entry in the space.



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4.1.2 Flammability Testing

Gases or vapors that may burn are categorized as flammable or combustible and present a fire hazard and/or an explosion hazard, with an explosion merely being a rapid burning in a confined place. Both hazards are more immediate and life-threatening than might be a toxic, so the testing sequence as defined by OSHA must be followed. Testing for these hazards involves measuring the amount of the hazardous gases or vapors in the atmosphere. If the amount present is enough to ignite the atmosphere, then a fire or explosion hazard exists.

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4.1.2 Flammability Testing

Combustible gas monitors are designed to alarm the tester before there is a sufficient amount of the hazardous gas present to ignite, normally activated at 10% of the lower explosive limit (LEL is the concentration of gas mixed with air that forms an ignitable mixture) for that specific gas or vapor. At this level, it provides a safety factor of 90%, since the atmosphere would have to increase from 10% of the LEL to 100% of the LEL before a fire or explosion would possibly occur. The reason for this high of a safety factor is that atmospheres can change quickly in confined spaces and so the entrant must exit at 10% of the LEL.

If a flammable gas is present in the space, it is important to determine what it is and the reason that it is present. With this knowledge, the tester is better equipped to know if the atmosphere is likely to remain stable or if it will degrade. Knowing the nature of the gas will also assist the tester to understand whether the atmosphere can be purged of the flammable gas. However, this is not always possible. Keep in mind, that the typical combustible gas detector does NOT read the specific gas that may be found in a confined space. Further, most meters are not calibrated with the specific gas for which an attendant may be testing. In fact, most meters are not calibrated with the specific gas for which they may be testing. This is another reason why there is a safety factor of 90%. If, in the end, an entry is made at less than 10% of the LEL, it must be done with caution, as it could reach the 10% cutoff level very quickly. Testing often and exiting the space at any increase in the presence of the flammable will then be critical. Additionally, it is important to understand that combustible gas meters are oxygen-dependent and must be calibrated outside of the confined space prior to entry. Otherwise, flammable readings (as well as oxygen and toxic readings) may be erroneous.

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4.1.3 Toxics Testing

Toxic gases or vapors damage or irritate the human body. Toxic gas monitors are designed to alert employees before the gas level reaches a harmful concentration, normally measured in parts per million. These monitors do not necessarily alarm at the mere presence of the gas, but rather at a pre-determined level, such as OSHA's permissible exposure limit (PEL), that indicates a safe exposure limit for the particular gas that is being evaluated. Some toxic gas monitors calculate the average exposure over time, providing short-term exposure limit (STEL) and time-weighted average (TWA) readings. Testing for toxics differs from testing for flammability or oxygen deficiency, which either exist or don't exist based on a single test. Rather, there is no meter that tests for the presence of all toxics. Toxics must be tested individually, with the exception of a few that can be tested as a family of chemicals. The resulting problem is that if a specific toxic is not tested, it may be present in the space. It is possible to ensure that there is no flammable atmosphere and there is no oxygen deficiency, but it's never possible to be sure there is no toxic present since it is unreasonable to test for every toxic chemical. The fact remains that, "the absence of evidence is not evidence of absence". Simply because no evidence that a toxic is present does not mean there is no toxic present. The two most common toxic materials tested for in a confined space (found on a typical four-gas meter, that includes oxygen and LEL) are carbon monoxide (CO) and hydrogen sulfide (H2S).

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4.1.3 Toxics Testing

Similar to testing for flammability, if the testing meter was not calibrated in an atmosphere with 20.8% oxygen, then it may give a false positive or negative on toxic readings inside the space. An added concern relative to toxic gases is the question of what level of a toxic is deemed to be too much that would endanger the health and safety of entrants in the space. Even though the permissible exposure level (PEL) is regulation developed by OSHA, many PELs are outdated and considered high. It is important that an employer chooses acceptable levels of toxics after considering TLVs, STELS, and TLV-TWAs developed with sound scientific research. NASP recommends that when more than one TLV, STEL, or TLV-TWA for the same gas are considered, that an employer choose the most restrictive one, as it is always better to err on the side of safety when it comes to the lives of employees involved in entry operations.

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4.1.4 Continuous v. Periodic Monitoring

An instrument that continuously monitors the atmosphere is equipped with an alarm that will notify those within the atmosphere in the event of a dangerous change. With instruments that require activation by the operator for each test, a time frame for periodic testing is pre-determined and then followed. Once the entrant has entered the confined space, monitoring is suggested to ensure that conditions have not been altered and that the entrant can remain safely in the space. Whether utilizing continuous or periodic monitoring, logging all meter readings is critical to ascertain any dangerous trends that may occur. Below is an example of such a log, followed by an interpretation of the readings.

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4.1.4 Continuous v. Periodic Monitoring

Material Tested	Time 1	Time 2	Time 3	Time 4
Oxygen	20.8%	20.4%	19.9%	19.7%
Flammability	0%	2%	4%	7%
Carbon Monoxide	0%	0%	0%	0%
Hydrogen Sulfide	0%	0%	0%	0%

In the example above, a continual trend downward of oxygen and upward of a flammable is obvious. It appears some flammable gas is entering and displacing the oxygen in the atmosphere. Regardless of OSHA's allowable limits (which are not yet met in the chart), it is imperative that an employee in this situation is immediately removed. For every 1% drop in the oxygen level, there is a displacement of 10,000 ppm of oxygen with another air contaminant. It may be that the atmosphere has a toxic contaminant, and it may be above the TLV-TWA for that material. With these readings, the entrant must exit the space which will need to be revaluated prior to a second entry.

It is important to note that actual work operations that may take place within the space and any hazardous substances that may be created as a result, such as fumes from welding or vapors from solvents or other chemicals, must also be considered while assessing the hazards and implementing feasible control measurements. Also, noteworthy for consideration is the proximity of the space to traffic, as well as any automotive vehicles on site, as they may generate carbon monoxide.

4.2 Emergency Rescues

"Emergency" is any incident or occurrence (including any failure of hazard control or monitoring equipment) internal or external to the permit space, that has the potential for endangering the entrant(s) in a confined space. It is again noteworthy to state that more than two thirds of all fatalities attributed to confined spaces are rescuer deaths. In an attempt to reduce the number of rescuer deaths, OSHA developed and follows two primary objectives in the confined space standard for which an employer is to adopt: self-rescue and non-entry rescue.

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4.2.1 Self-Rescue

Self-rescue is defined as providing the means and education necessary for an entrant to know when to come out of the confined space before they are injured or killed. Naturally, when self-rescue is effective, there is no need for rescuers, thereby eliminating the risk for even greater numbers of potential fatalities.

One self-rescue method commonly used is the provision of detectors for oxygen content, flammability, and toxics to any entrant. As previously reviewed, these detectors normally have alarms that sound when flammability exceeds 10% of the LEL, oxygen content drops below 19.5%, or the PEL/TWA/TLV of the toxins that are being measured is met. The entrants are also trained to pay attention to these detectors and remove themselves from the space if any unacceptable changes occur.

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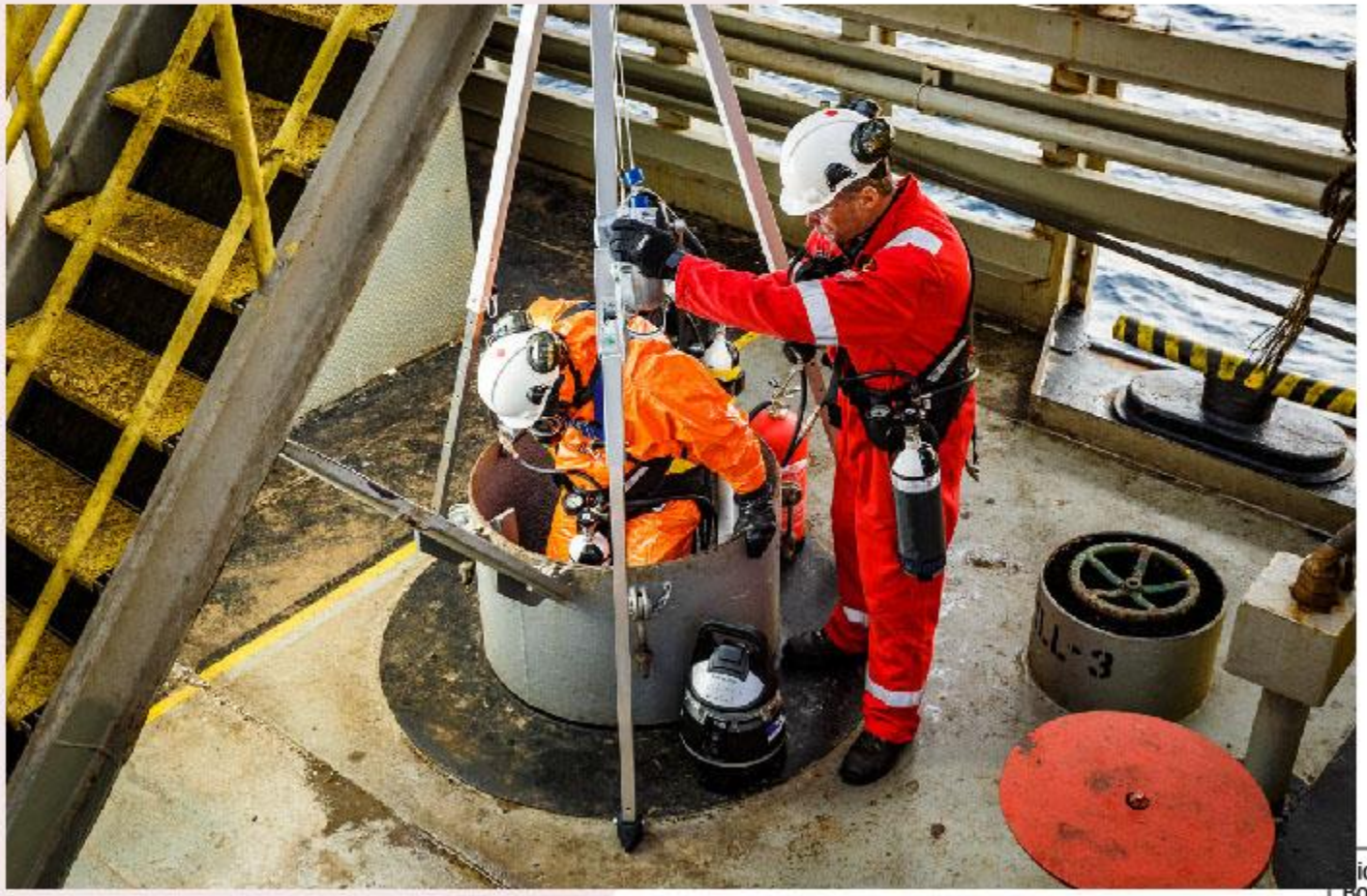
4.2.1 Self-Rescue

Another means of providing for self-rescue is to train the entrants on the acute effects of any hazardous atmospheres that they may encounter. With a thorough knowledge of these potentially acute effects, the entrant may recognize that he or she is being affected by a hazardous atmosphere in time enough to remove themselves from the confined space. The training should include such physical signs such as headaches, disorientation, and lethargy, as well as environmental indicators such as specific odors or temperature changes.



4.2.2 Non-Entry Rescue

Non-entry rescue is the ability to rescue entrants without actually entering the space, allowing for a minimal risk for injury or death to the rescuers. This type of rescue is accomplished through the use of a rescue retrieval system that allows the attendant and/or rescuers to pull the entrant out of the space without entering themselves via the use of lifelines.

Another method to accomplish non-entry rescue is by training the attendant in the behavioral effects of all of the potential hazardous atmospheres that the entrant might encounter. For example, one effect of carbon monoxide or oxygen deficiency is confusion. If the attendant recognizes confusion in the speech or actions of an entrant, then the attendant can instruct the entrant to remove themselves from the confined space.

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4.2.3 Entry Rescue Services

Entry rescue is required when self-rescue and non-entry rescue either have failed or are not feasible. Whether or not an employer provides their own entry rescue had been widely debated in the past. However, the requirements of the OSHA First Aid standard (1910.151 (b) – letter of interpretation) clarify that medical assistance is available in close proximity if someone is injured, including in support of those incidents that occur in a permit-required confined space. In the standard, OSHA regulated that medical assistance must be available within *three to four minutes* from the time of the injury if it is considered life-threatening. Injuries typically associated with confined spaces certainly may fall into this category (e.g., suffocation, severe bleeding, blunt force trauma to the head).

4.2.3 Entry Rescue Services

Typically, it is not possible for any fire department or rescue squad to meet that need for an employer with an emergency that may occur in a confined space. Consider the time allotment s required of the following:

- The attendant summons rescue assistance
- The call is made to the emergency dispatcher
- The dispatcher alerts the proper responders
- Responders don protective equipment and board the emergency vehicle
- Responders drive from their station to the workplace location
- Responders locate the confined space involved
- Responders assess the situation

With these time allotments, it may be unreasonable to think that all of these steps can be accomplished in three to four minutes.

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4.2.3 Entry Rescue Services

It is even unlikely that the employer's own entry rescue team at the workplace could reach the injured party in this amount of time. But the employer's in-house rescue team could certainly initiate the rescue within a much faster time frame than the fire department or rescue squad. For this reason, it is common for employers to have their own entry rescue teams that are backed up by public fire department or rescue squad. With in-house rescue teams, it is recommended that they work collaboratively with the local firefighting services, utilizing practical training exercises and on-site visits to acquire the necessary knowledge and skills.

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4.2.3 Entry Rescue Services

If the services of outside rescue personnel are anticipated, it is also recommended that advance notice is provided to them of the confined spaces that exist at the workplace. It also follows best practice to grant them the opportunity to visit and practice rescue operations onsite ahead of any incident or event. Compliance may require the employer to be in close communication with the off-site rescue service immediately prior to each permit space entry. The employer must ensure close communication with the rescue service during entry operations so that if the rescue service becomes unavailable while entry is underway, the employer can instruct the attendant to abort the entry immediately. Entry operations cannot resume until the entry supervisor verifies that rescue services are able to respond in a timely manner.