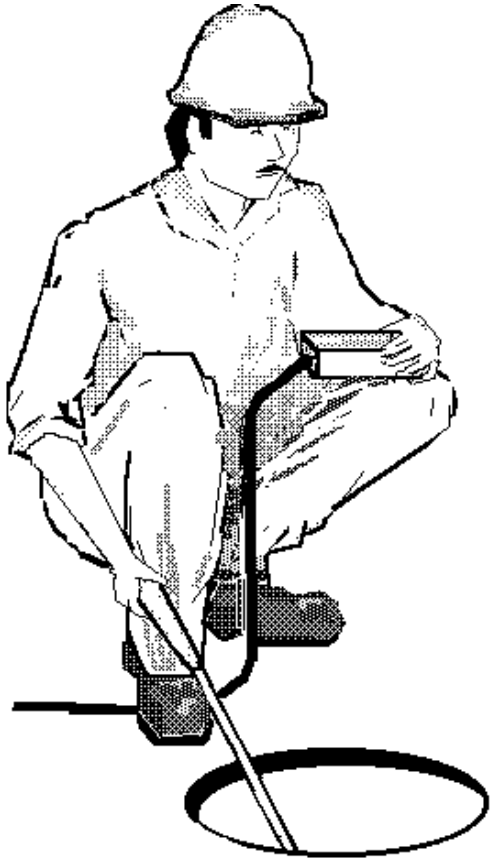
EMPLOYER GUIDE AND MODEL

PERMIT-REQUIRED CONFINED SPACE (PRCS)



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INSTRUCTIONS

This document is intended to serve as an employer's compliance and training guide to the Occupational Safety and Health Administration's (OSHA) Permit-Required Confined Space Standard 29 CFR 1910.146.
We want to thank the people from the New York On-site Consultation Program who made this manual possible. This document along with safety and health consultation services are provided at no cost to owners, proprietors and managers of small businesses by the Illinois Onsite Consultation Service, under a program funded largely by the Occupational Safety and Health Administration (OSHA), an agency of the U.S. Department of Labor. The service is provided without penalty or citations to any employer who requests consultation.

The document is designed to aid in the recognition, evaluation, and control of permit space hazards required by OSHA's standard. It is organized to assist employers who have little or no knowledge of confined spaces and for employers who have existing programs but who want to verify compliance with the standard. The document contains five sections for this purpose.

- Section I contains a summary and explanation of the standard.
- Sections II and III provide the means to recognize, evaluate and control related permit space hazards.
- Section IV is a non-mandatory fill-in-the-blank program provided to assist employers with addressing the mandatory general requirements of the standard, summarizing their specific program and designating responsibilities for specific tasks under the plan.
- Section V provides forms for use by the employer in developing the required written documents and to assist with training.

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INTRODUCTION

It is well recognized that working in permit-required confined spaces involves significant risks to employees. Fatalities and injuries have been caused by a variety of confined space related hazards, including:

- Atmospheric Hazards
- Entrapment Hazards
- Engulfment Hazards
- Mechanical and Electrical Hazards
- Untrained Personnel

The Permit-Required Confined Space (PRCS) Standard 29 CFR 1910.146 has been developed and implemented to alleviate or control these risks for the approximately 1.6 million workers who enter confined spaces annually. It is expected that this standard will prevent approximately 55-60 fatalities and more than 5,000 serious injuries each year.

The standard is based on a performance-oriented approach, which is designed to provide employers with the flexibility of achieving compliance through a proactive system specific to their particular worksite. The standard covers all general industry, including agricultural services, manufacturing, chemical plants, refineries, transportation, utilities, wholesale and retail trade and miscellaneous services. It does not cover the construction, maritime, agriculture or shipyard sectors of industry. In the construction industry, the American National Safety Institute (ANSI) document Z117.1 is used in conjunction with the OSHA General Duty Clause 5(a)(1).

Additionally, the following vertical standards take precedence over the Permit-Required Confined Entry Space standard for the specific hazards they address.

1910.120(b)(4)(ii)(l)	Hazardous Waste Site Specific Safety & Health plan must address confined space entry procedures.
1910.252(a)(4)(i)	Removal of arc welding electrodes during suspension of work in confined spaces.
1910.252 (b)(4)(i) to (vii)	Protection of personnel welding in confined spaces (ventilation, securing welding equipment, lifelines, electrode removal, gas cylinder shutoff, warnings).
1910.252(c)(4)	Health protection and ventilation during welding operations in confined spaces.
1910.252(c)(9)	Specifies ventilation and respiratory protection requirements for welding in confined spaces using cadmium-bearing filler metal.
1910.252(c)(10)	Specifies local exhaust ventilation or respiratory protection for welding in confined spaces using cadmium-bearing materials, including paint, in confined spaces.
1910.261(b)(5)	Specifies safe practices (lifeline, safety harness, attendant, atmospheric testing, availability of SCBA, and lock out) for entering a vessel in pulp, paper, and paperboard mills.
1910.268(o)	Addresses certain hazards involving manhole and unvented vault entry by telecommunication workers.

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1910.272(g)	Specifies entry procedures for bins, silos, and flat storage buildings and tanks with a diameter less than the height, and for all top entries of these structures in grain facilities.
1917.23	Addresses entry into hazardous atmospheres at marine terminals (testing, ventilation, standby observers).
1910.152(b)	Requires that work not be performed in confined spaces until it is determined, through atmospheric testing, that the space is not hazardous.
1917.152(f)(2)	Requires ventilation and respiratory protection, with standby person, when hot work is done in confined spaces.
1917.152(f)(3)	Specific requirements for welding, cutting or heating of toxic metals in confined spaces.
1918.93	Addresses entry into storage spaces or tanks where potential hazardous atmospheres exist.

Please note that the above vertical standards address specific hazards in specific operations, and therefore take precedence over 1910.146 for these situations. However, other hazardous conditions, not addressed by the vertical standards, are still covered under 1910.146.

Again, it is the responsibility of the employer to institute the appropriate protective measures required. Doing so will provide a safer and healthier work environment.

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Scope and Application - Paragraph (a)

Paragraph (a) states that 1910.146 contains requirements for practices and procedures to protect employees from the hazards of entry into permit-required confined spaces. This paragraph explicitly excludes agriculture, construction, and shipyard employment from the scope of the standard.

Under current OSHA practice, as outlined in 1910.5(c), confined spaces that are presently regulated in other sections of Part 1910 will continue to be regulated under those sections, to the extent that permit spaces are already regulated under those sections. For example, telecommunications work in manholes and underground vaults is normally covered under 1910.268(o). Such work will continue to be covered under the telecommunications standard, and the provisions of 1910.146 would not apply as long as the provisions of 1910.268(o) protect against the hazards within the manhole.[1] Confined spaces that are not covered by any other OSHA rule will fall under 1910.146.

OSHA is aware that confined space accidents occur in agriculture, construction, and maritime workplaces and that employees in those industries do face a significant risk of death and serious injuries from these accidents. However, the Agency believes that sufficient differences exist between these industries and general industry to warrant separate rulemaking activities. The Agency also believes that agriculture, construction, and shipyard work are likely to pose permit-space working conditions that are unique to these industries. Therefore, OSHA believes that confined space standards for agriculture, construction, and shipyard work should be addressed separately so that the Agency can focus on aspects of permit space safety that are specifically appropriate for these areas.

Definitions - Paragraph (b) - See Standard for definitions relating to 1910.146.

General Requirement - Paragraph (c)

Paragraph (c) of the standard provides information and general requirements for employers to identify any permit spaces at their workplaces and to take the appropriate measures for employee protection.

Paragraph (c)(i) requires employers who are covered by the standard to inspect their workplaces to determine if they have permit-required confined spaces (refer to Appendix A). Employers must identify any permit spaces by the time the final rule goes into effect (April 15, 1993) rather than waiting until a space will be entered. By doing so, the employer can take measures to prevent unauthorized entry, ensure that effective training is given, and have plans in place so the safety of workers is not compromised.

Note to the Employer: After proper evaluation of the workplace by an individual knowledgeable in the standard and where no space meeting the criteria of a permit-required confined space is found, no further action is required. However, if the space is altered or circumstances change in some manner to create a hazard, a reevaluation of the space is required.

[1] Taking the telecommunications examples further, the Agency can envision manholes that may be more appropriately covered by 1910.146. Although it is rare, manholes can become overwhelmingly contaminated with toxins or other hazardous chemicals. If the work area could not be made safe for entry, as required by 1910.268(0)(2)(i)(b), entry would have to be performed under the provisions of 1910.146.

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Paragraph (c)(2) requires the employer to inform exposed employees of the location and dangers posed by permit space(s) at their worksite. This may be accomplished by signs or any other effective means so long as they know the existence, location, and dangers of the permit spaces. If a sign is used, the sign must indicate the danger involved in the permit space, but does not need to list all the specific hazards that might be encountered.

A sign conspicuously posted by the permit space reading **"Danger -- Permit-Required Confined Space -- DO NOT ENTER"** is acceptable. Awareness training is another means available to employers to comply with paragraph (c)(2) by effectively informing employees of the existence, location, and dangers of those spaces.

Note to the Employer: In enforcing this provision, OSHA will check to ensure that methods, other than warning signs, are truly effective in imparting the required information to employees. General training on the OSHA Standard 1910.146, for example, cannot be expected to adequately inform employees of the specific location of permit spaces in the workplace. The standard places the burden of identifying the spaces and of controlling the resultant hazards on the employer, not on the employee.

Paragraph (c)(3) requires that if a permit space is present but the employer will **not** allow employees to enter the space, effective measures must be taken to prevent employee entry. These measures could include permanently closing the space by locking the entrance and/or controlling any specialized tools needed to open the space. These measures must be supplemented by employee awareness training and/or the posting of danger signs. Whatever method is ultimately chosen by the employer, it must be effective in preventing employee entry into the permit space.

Paragraph (c)(4) requires employers who decide to have employees enter a permit space establish and implement a **written** permit space program which complies with 1910.146. The written program must be available for employees and their authorized representatives to review.

A written Permit-Required Confined Space Program includes the following topics:

- Measures to prevent unauthorized entry
- Identifying hazards
- Development of the means, procedures, and practices for safe entry
- Providing, maintaining and using the appropriate equipment
- Testing atmospheric conditions
- Providing attendant
- Duties of permit space team members
- Rescue and emergency medical services
- Development and cancellation of entry permits
- Coordination of entries during multi-employer operations
- Review procedures of entry program

For additional information, see paragraph (d).

Paragraph (c)(5) states that OSHA has determined that it is not always necessary to require a full permit entry program [paragraphs (d) through (k)] when **only atmospheric hazards** are of concern and if the employer can demonstrate that the hazard can be controlled with continuous forced air ventilation alone.

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Historically some industries, such as telecommunications [regulated under 1910.268(o)], have successfully protected employees from atmospheric hazards in work spaces through testing and continuous ventilation without following all the requirements stated in 29 CFR 1910.146. OSHA believes that such experience indicates that ventilation and testing could protect employees throughout general industry from atmospheric hazards posed by similar types of permit spaces. Accordingly, OSHA has decided to allow employers, under certain conditions, to control atmospheric hazards within a permit space following specific procedures that are spelled out in paragraph (c)(5)(i) and (c)(5)(ii) in lieu of compliance with paragraphs (d) through (f) and (h) through (k). The only requirements from the full permit space program that would apply are the training requirements in paragraph (g). Note that the general requirements in paragraph 8 apply in all situations where the standard applies.

Paragraph (c)(5)(i) sets forth the conditions that must be met before a permit space may be entered under the alternative procedures, which are specified in paragraph (c)(5)(ii).

To qualify for these alternative procedures, the following provisions must be followed:

1) **Paragraph (c)(5)(i)(A)** requires ensuring that only atmospheric hazards are of concern and no physical hazards (entrapment, engulfment, mechanical hazards) exist or potentially exist. If the space poses other hazards, then the hazards must be eliminated using paragraph (c)(7) criteria. If paragraph (c)(7) criteria cannot be used, then a full permit space program [paragraph (d) through (k)] is required.

2) **Paragraph (c)(5)(i)(B)** requires the employer to demonstrate that continuous forced air ventilation alone is sufficient to maintain the permit space in a safe manner during the entry operation.

Note to the Employer: To be considered safe, the atmosphere within the space after ventilation must not be expected to approach a hazardous atmosphere. This is necessary so that, if the ventilation shuts down for any reason (such as loss of power), the employees will have enough time to recognize the hazard and either exit the space or quickly restore the ventilation. A general guideline of 50 percent of the permissible flammable or toxic substance level could be used by employers in making this determination.

Two examples may help to clarify this recommended guideline.

- **The LFL for methane is a concentration of 5 percent by volume. Ten percent of this value is 0.5%, a concentration which would be considered hazardous by definition. Under the general safety guideline mentioned above, the measured concentration of methane should not exceed 0.25% after ventilation in order to ensure a safe margin of protection.**

(Continued)

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- The 8-hour time weighted average PEL for chlorine, under table Z-1, is 0.5 parts per million. This conventration of chlorine would be considered hazardous by the definition of "hazardous atmosphere". Under the guideline, the measured conventration of chlorine shold not exceed 0.25 parts per million after ventilation in order to ensure a safe margin of protection.

Additionally, the work to be performed within the space must not introduce any new hazards. For example, work with hazardous quantities of flammable or toxic substances and hot work are not permitted. This additional work would introduce hazards beyond those accounted for by the initial determination and the permit space may not be maintained safe for entry. Paragraph (c)(5)(i)(B) clearly indicates that an employer who relies on continuous forced air ventilation to maintain the space safe for entry must be able to establish that other measures are not need to protect entrants. When other measures are needed such as when welding is performed, a full PRCS program is required.

3) Paragraph (c)(5)(i)(C) requires atmospheric monitoring and inspection data be gathered to support items (1) and (2). The data must show that the forced air ventilation will keep the air within the space at safe levels.

4) Paragraph (c)(5)(i)(D) states that if entry is necessary to conduct initial data gathering, the entry must be performed under a full entry permit program [paragraphs (d) through (k)].

5) Paragraph (c)(5)(i)(E) mandates providing written certification to verify that the space is safe for entry and that all measures listed here to qualify for these alternative procedures have been performed. Supporting documentation must also include: certification date, location of the space and signature of the person providing the determination.

Ensure that this information is available to each employee, authorized representative and OSHA representatives. Again, Appendix A has been included to assist employers with this task.

6) Paragraph (c)(5)(i)(F) stipulates that the entry must be performed in accordance with the specific procedures required by paragraph (c)(5)(ii).

Paragraph (c)(5)(ii) states that if qualified for the alternative procedures as outlined above, the entry can take place after the following specific procedures are performed:

1) Paragraph (c)(5)(ii)(A) requires that any conditions that will make it unsafe to remove an entrance cover be eliminated before the cover is removed. Some conditions within a permit space, such as high temperature and high pressure, may make it hazardous to remove the cover from the space. For example, if the atmospheric hazards within the space cause high pressure to be present within the space, the cover could be blown off in the process of removing it. To protect employees from such hazards, a determination must be made as to whether or not it is safe to remove the cover. Such determination would require the employer to examine the conditions that are likely to occur in the permit space. For example, the cover should be checked to see if it is hot; and, if it is fastened in place, it should be loosened gradually to release any residual pressure. An evaluation must also be made of whether

conditions at the site could cause a hazardous atmosphere to accumulate in the space which would make it unsafe for employees to remove the cover. The cover must not be removed until it is safe to do so.

2) Paragraph (c)(5)(ii)(B) requires that openings to permit spaces be guarded to protect employees from falling into the space, to protect employees in the permit space from being injured by objects entering the space and from the hazards of vehicle traffic. The guard could be in the form of a railing, a temporary cover or any other temporary barrier that provides the required protection. If the opening to the space is situated so that employees and objects cannot fall into the space, no additional guarding is necessary.

3) Paragraph (c)(5)(ii)(C) requires the internal atmosphere of the permit space to be tested with a calibrated, direct-reading instrument before any employee enters the space. The atmosphere must be tested, in sequence, for oxygen content, for flammable gases and vapors, and for potential toxic air contaminants.

4) Paragraph (c)(5)(ii)(D) prohibits employees from being in the space when a hazardous atmosphere is present. Any entry into a permit space containing a hazardous atmosphere must be conducted in accordance with the full permit space program requirements given in paragraphs (d) through (k).

5) Paragraph (c)(5)(ii)(E) sets out requirements for the use of continuous forced air ventilation. First, no employee may enter the space until the forced air ventilation has eliminated any hazardous atmosphere found within the space. Second, the ventilation must be directed to ventilate the immediate areas where an employee is or will be present. Third, the air supply for the ventilation must be from a clean source and must not increase the hazards in the space.

6) Paragraph (c)(5)(ii)(F) requires the permit space to be tested frequently or continuously to ensure the air is safe. The frequency for testing during entry will depend on the space and the results from the initial testing conducted. If, for example, the initial testing found no detectable levels of airborne contaminants and if the permit space is not normally expected to present atmospheric hazards, no further testing may be necessary. However, if the initial testing detected airborne contaminants, then frequent or continuous testing would be appropriate.

7) Paragraph (c)(5)(ii)(G) requires employees to exit the permit space immediately if a hazardous atmosphere is detected. Additionally, the employer is required to reevaluate the permit space to determine how the hazardous atmosphere developed and to implement measures to protect employees from the hazardous atmosphere before any subsequent entry is undertaken.

8) Paragraph (c)(5)(ii)(H) requires the employer to verify that the permit space is safe for entry and that the measures required by paragraph (c)(5)(ii) have been taken. This verification must be in the form of a certification that contains the date, the location of the space and the signature of the certifying individual. The certification must be made available to entrants. This certification, in combination with the documentation required under paragraph (c)(5)(i)(E), will maintain employer accountability for compliance with paragraph (c)(5)(ii). AppendixA has been included for this task.

Paragraph (c)(6) requires that if there are any changes in the use or configuration of a non-permit space that may increase hazards to entrants, the space must be reevaluated, and if necessary, reclassified as a permit required space. This does not mean that employers have to reevaluate spaces because of trivial changes. Only those changes that may increase the hazards to the workers need to be addressed.

Paragraph (c)(7) states that OSHA has determined that permit spaces that have all hazards eliminated can be temporarily reclassified as non-permit spaces for as long as the hazards remain eliminated.

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Note to the Employer: OSHA believes that employees are fully protected from the hazards of permit spaces once all hazards within the space have been eliminated. Clearly, if there are no hazards within the permit space, an entrant is in very little or no danger. By contrast, if the hazards are simply controlled rather than removed, the entrant could be injured upon failure of the control system. Therefore, the Agency has determined that it is appropriate to allow employers who eliminate hazards within permit spaces to reclassify those spaces as non-permit confined spaces.

Paragraph (c)(7)(i) allows employers to reclassify a permit space to a non-permit confined space if there are no potential atmospheric hazards and if all other hazards within the space are eliminated without entry into the space. The reclassification would be valid as long as the non-atmospheric hazards remain eliminated.

The reclassification of permit spaces allowed under paragraph (c)(7)(i) recognizes that spaces such as mixers and material bins can have their hazards removed before entry, so that entrants are fully protected without the need for permits, attendants, or other features required by the full permit space program requirements given in paragraphs (d) through (k). Mixers can be locked out before they are entered for servicing or maintenance, thereby removing the mechanical hazards. A material bin posing an engulfment hazard can be emptied before entry, thus removing that hazard. These are examples of the types of spaces that can be made safe for entry following paragraph (c)(7)(i). In these circumstances, after the hazards have been eliminated, it is believed that entry into the space is at least as safe as (if not safer) than entry in accordance with the full permit program.

Note to the Employer: If the equipment or machinery is not deenergized and locked out or tagged out in accordance with 29 CFR 1910.147, then it must be guarded as required in other general industry standards, such as Subpart O, for machine guarding, and 29 CFR 1910.303(g) and (h) for the guarding of electric equipment. As long as the equipment inside the permit space remains guarded, employees within the space are not considered to be exposed to any equipment-related hazards. For spaces posing only engulfment hazards, it may be possible to remove the hazard by removing the engulfing material from the space before entry.

In many permit spaces possessing the above noted conditions, employees can eliminate the hazard without having to enter into the space. However, if it is necessary to enter the space to verify elimination of the hazards, then this entry must be performed in accordance with a full permit-space program as stated in paragraph (d) through (k).

Paragraph (c)(7)(ii) allows permit spaces that contain or have the potential to contain hazardous atmospheres to also be reclassified as non-permit spaces by elimination of the hazards. These types of spaces must first be isolated, purged and ventilated. The elimination of a hazardous atmosphere must be verified by testing the atmosphere and inspecting the interior conditions of the space. The entry to determine that the source of the hazard has been eliminated must be conducted in accordance with the full permit space program requirements [paragraph 9d through (k) of the standard]. Types of permit spaces which may fall into this category include chemical tanks and boilers.

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Some chemical tanks can frequently be made safe by draining them of their contents, purging the residual chemicals with water, and ventilating the space after purging is complete. Boilers can be made safe for entry by shutting them down, opening the access ports to allow for temperature reduction and natural ventilation, and entering the space to remove any residual hazards, such as loose buildup that could fall onto entrants. In each case, an entry conducted in accordance with the full permit space program requirements must be completed to ensure that the hazards have been eliminated.

If the atmospheric hazard has been found to be the eliminated, the permit can be reclassified to a non-permit space.

Note to the Employer: The control of atmospheric hazards with forced air ventilation, as stated in paragraph (c)(5) of the standard, is different than elimination of the hazard as stated in paragraph (c)(7)(ii) of the standard. Forced air ventilation will control the hazard but does not constitute elimination of it. If the forced air ventilation is terminated, the hazardous atmosphere may return.

Paragraph (c)(7)(iii) requires employers who desire to reclassify a permit confined space to provide written certification which includes:

- documentation to substantiate that all hazards have been eliminated,
- the date of the certification,
- the location of the space and
- signature of the individual certifying the elimination of the hazards

Note to the Employer: Appendix C has been included for this task.

Paragraph (c)(7)(iv) requires that if conditions in the space were to change and a hazard were found to arise, the entrants must evacuate the space immediately. The employer is then required to reevaluate the space to determine the cause of the hazards and to determine if the space should revert back to a permit-required confined space.

Paragraph (c)(8) contains requirements pertaining to the responsibilities of host employers to employees of other employers (contractors) who are to perform permit-required confined space entry. If the "host employer" has employees of another employer (contractor) perform work that involves permit space entry, the host employer must perform the following duties:

1) Paragraph (c)(8)(i) requires informing the contractor that the work site contains permit required confined spaces. It is also necessary to inform the contractor that entry into these permit spaces must be in accordance with a permit space program [paragraphs (d) through (k)] that is program-specific to the space.

2) Paragraph (c)(8)(ii) requires informing the contractor of any known hazards and the host employer's experiences with the space. This provision of the standard does not require the host employer to make a detailed investigation of any permit spaces, but just to provide whatever information was used for identifying the space as a permit space.

3) Paragraph (c)(8)(iii) requires informing the contractor of any precautions that have been instituted by the host employer to protect employees in or near the permit space.

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4) Paragraph (c)(8)(iv) requires that the host employer develop and implement procedures to coordinate entry operations when both the host employer and the contractor have employees working in the space.

5) Paragraph (c)(8)(v) requires that at the conclusion of the entry operation, a debriefing session must be held with the contractor concerning the permit space program used and any hazards confronted or created while working in the space. Any information concerning hazards or potential hazards should be documented and steps taken to control or eliminate the situation.

Note to the Employer: The above information should be provided to the contractor in written form. By doing so, all required responsibilities are performed and available information is communicated. Appendix E has been included for this purpose.

Paragraph (c)(9) contains requirements pertaining to the responsibilities of contractors who are retained to perform permit space entry operations, including:

1) Paragraph (c)(9)(i) requires contractors to obtain any available information from the host employer regarding any hazards and entry operations in the permit space.

2) Paragraph (c)(9)(ii) requires contractors to coordinate entry operations with the host employer if both parties will have personnel working in the permit space.

3) Paragraph (c)(9)(iii) requires the contractors to inform the host employer of the contractors' permit space program that will be followed during the entry operation.

Coordination requirements between the host employer and contractor are included in paragraphs (c)(8)(iv), (c)(9)(ii), and(d)(11) of the standard. Paragraph (d)(11) requires employers to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit space, so that employees of one employer do not endanger the employees of any other employer. This provision applies generally to all multi-employer permit space entry operations. The potential hazards of multi-employer permit space entry operations exist whether or not one of the employers acts as a host employer. For example, a manhole that is shared by two utility companies (gas and water, for example) is one case in which neither employer may be considered the host employer. If employees of both employers are present, but neither employer acts as the host, paragraph (d)(11) would still require coordination of permit space entry operations. Therefore, OSHA has adopted paragraph (d)(11) to cover coordination among all employers whose employees are present during entry operations. Paragraphs (c)(8)(iv) and (c)(9)(ii) direct the host employer and contractor, respectively, to the basic requirement for coordination including a determination of what permit program is to be used by the contractor. The standard does not prohibit the host employer from requiring a contractor to use the host's permit program, nor does it require the contractor to use the host's program. However, the host employer may choose to condition its contract on the contractor's compliance with the host's program, as is often the case in the petrochemical industry.

Additionally, contractors are required to inform host employers of the permit program to be followed and of any hazards confronted or created in the permit space during entry operations. At the completion of the operation, a debriefing session must be held between the host employer and contractor to exchange any information and hazards found or created in the permit space.

Note to the Contractor: The above information should be provided to the host employer in written form. By doing so, all required responsibilities are performed and available information is communicated. Appendix F is included for this purpose.

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Permit Required Confined Space Program - Paragraph (d)

The general requirements which an employer must follow were discussed in the previous section. The requirements needed for the actual design and implementation of a written permit space program are included in this section entitled Permit-Required Confined Space Program. Though employers may defer the specific hazard evaluation of the permit space until the actual entry operation, employers are expected to begin developing their written program once they know employees will eventually perform an entry operation. These steps are needed prior to the entry operations to ensure that the permit space program is effective. Employers who wait until the last minute before an entry operation to begin to develop a program are likely to have problems which could significantly increase the risks to employees.

Note to the Employer: Remember, if alternative procedures [(c)(5)] or reclassify to a non-permit space procedures [(c)(7)] can be used, paragraphs (d) through (f) and (h) through (k) are not required.

Paragraph (d)(1) requires the employer to implement measures to prevent unauthorized entry into a permit space. It is the employer's responsibility to use whatever measures are necessary to prevent unauthorized entry; such as:

- locks
- fences
- guardrails
- signs in combination with training
- any other effective measure

Paragraph (d)(2) requires that the identification and evaluation of hazards in a confined space must be conducted in detail prior to entry so that the operation can be safely planned. Identifying the existence of permit spaces must be accomplished by the effective date of the final rule, April 15, 1993.

Note to the Employer: OSHA anticipates that employers will identify and evaluate permit space hazards as necessary for development of written permit space programs. For example, OSHA expects that employers who conduct frequent entries into permit spaces will be identifying and evaluating permit space hazards at the same time they are identifying permit spaces. On the other hand, OSHA understands that employers may not need to identify or evaluate the hazards of permit spaces that are entered at 5- or 10-year intervals until several years after the identification of those spaces. In the interim, since there are no authorized entries into those spaces, the program would only require that unauthorized entries be prevented. The hazards in the spaces need only be evaluated in detail some time before entry. The standard makes this clear - - the basic identification of permit spaces required by paragraph (c)(1) must be performed by the effective date of the final rule; the evaluation of the specific hazards posed by permit spaces identified under paragraph (d)(2) is required "before" entry.

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Paragraph (d)(3) requires the employer to develop and implement the means, procedures, and practices necessary for safe entry operations, including, but not limited to the following elements:

1) Paragraph (d)(3)(i) requires specifying the acceptable entry conditions. This control measure ensures that the employer has identified the hazards that could reasonably be expected to be found in the space and has limited entry conditions to those that are safe for entry. For example, if a space could contain a flammable gas, the employer would set a limit of 10 percent of the LFL of the gas as an entry condition. This would ensure that a flammable mixture is not present upon entry into the space.

2) Paragraph (d)(3)(ii) requires specifying the isolating procedures to be used. The permit space must be isolated from serious hazards. For example, if energized parts of electric equipment are exposed, the circuit parts must be deenergized and locked out in accordance with 29 CFR 1910.333(b). Mechanical equipment posing a hazard within the space must be locked out or tagged in accordance with 29 CFR 1910.147 or guarded in accordance with subpart O of the General Industry Standards. Chemical or gas lines that are open within the permit space must be isolated by such means as blanking or binding, misaligning or removing section of lines, pipes, or ducts, or double block and bleed system.

3) Paragraph (d)(3)(iii) requires specifying if purging, inerting, flushing or ventilating the space is needed to eliminate or control any atmospheric hazards.

4) Paragraph (d)(3)(iv) requires the use of barriers. Barriers must be provided around the permit space opening for two reasons: (1) to prevent unauthorized entry into the space and (2) to protect employees inside the space from objects and persons outside the space. Paragraph (d)(3) requires barriers whenever they are necessary to protect employees within the permit space. If entrants face a substantial risk of injury due to unauthorized entry, objects falling into the space, or vehicular hazards during entry into and exit from the space, then barriers would be required.

5) Paragraph (d)(3)(v) requires testing and monitoring of the space. The employer must ensure that conditions in the permit space are acceptable for entry throughout the duration of entry operations. This is accomplished through the use of ventilation to maintain a safe atmosphere and the use of inspections to ensure that isolation procedures are being maintained for the space.

Paragraph (d)(4) requires the employer to provide the equipment needed for safe entry operations. This equipment must be available at no cost to employees and must be property maintained. The employer must ensure its proper use by employees. The equipment required may vary on the specific permit space to be entered. Equipment likely to be needed includes:

1) **Paragraph (d)(4)(i)** atmospheric testing and monitoring equipment.
2) **Paragraph (d)(4)(ii)** ventilation equipment.
3) **Paragraph(d)(4)(iii)** communication equipment.
4) **Paragraph (d)(4)(iv)** personal protective equipment.
5) **Paragraph (d)(4)(v)** lighting equipment
6) **Paragraph (d)(4)(vi)** barriers.
7) **Paragraph (d)(4)(vii)** access and egress equipment such as ladders.
8) **Paragraph (d)(4)(viii)** rescue and emergency equipment.
9) **Paragraph (d)(4)(ix)** any other equipment deemed necessary for safe entry into and rescue from the permit space.

Paragraph (d)(5) requires evaluation of the permit space for atmospheric hazards. The specific requirements for atmospheric monitoring to ensure that the hazard is controlled or eliminated are listed below:

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1) Paragraph (d)(5)(i) requires the employer to test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin. This testing is important to detect any hazardous atmospheres or other hazards that may be present in the permit space.

An exception to the above would be applied in the case where isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer system). In that case, the employer must perform pre-entry testing to the extent feasible before authorizing entry. If entry is authorized, then continuous monitoring of entry conditions in the areas where authorized entrants are working is required.

The type of testing that needs to be performed is dependent on the specific hazards that are present within the space. For permit spaces posing atmospheric hazards, atmospheric testing would be necessary. If the permit space poses thermal hazards, then the temperature within the space would need to be tested.

Because sewers and similar permit spaces are large continuous systems, conditions encountered at the point of entry may not be indicative of conditions at distances further from the point of entry. Also, since the space usually cannot be effectively isolated, conditions at any particular point in the space may deteriorate suddenly due to the introduction of a material from another point in the system that creates a hazardous environment for the entrants. Under these conditions, pre-entry testing often will not detect such hazards, and the need for continuous atmospheric monitoring becomes paramount. Atmospheric monitoring is necessitated virtually from the time pre-entry testing is done until the last entrant leaves the permit space. Because of these conditions, the procedure for authorizing entry into sewers has evolved so that authorization is usually granted immediately before entry.

2) Paragraph (d)(5)(ii) of the final rule requires permit spaces to be tested or monitored, as necessary, to determine if acceptable entry conditions are being maintained during the course of entry operations. This provision requires whatever period of monitoring (frequent or continuous) that would be necessary to protect employees.

3) Paragraph (d)(5)(iii) specifies the proper sequence to be used when permit spaces are tested for atmospheric hazards. This provision requires employers to test first for oxygen, secondly for combustible gases and vapors, and then for toxic gases and vapors.

A test for oxygen must be performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen-deficient atmosphere.

Paragraph (d)(6) requires providing at least one attendant outside the permit space for the entire duration of the entry operation.

Attendants may monitor no more permit space entry operations than they can safely handle. For example, if the attendant is communicating with authorized entrants by voice contact only, that attendant would not be able to monitor any other permit spaces that were not within voice contact. Also, if the number of spaces and the number of authorized entrants are too much for one attendant to keep track of, then additional attendants would be required.

In paragraph (d)(7) the standard also allows the use of electronic surveillance and other devices as aids or augmentations to the monitoring process. The use of such devices would allow an employer to increase the number of permit spaces a single attendant could effectively and simultaneously monitor (although OSHA is not permitting the use of such devices to replace an attendant entirely). Additionally, the attendant would normally be stationed near the entry point of the permit space, but the use of an electronic monitoring device makes it possible for an attendant to effectively perform his or her assigned duties from a remote location. Television monitors, public

address systems, and barricades can be used to assist the attendant in monitoring activities outside the space and in warning unauthorized personnel away from the space.

If the attendant is monitoring activities in multiple spaces, the specific procedures used to respond to an emergency situation affecting one or more spaces, must be documented in the written permit program.

Paragraph (d)(8) requires the employer to designate in writing the specific employees who will perform the various functions of the permit space entry, such as:

- authorized entrant,
- attendant,
- entry supervisor and
- person performing the atmospheric testing.

Additionally, identify the specific duties of each individual and ensure that they are properly trained for their assigned role.

Paragraph (d)(9) requires the employee to develop and implement written rescue procedures for summoning rescue and emergency medical services to:

- rescue entrants.
- provide necessary emergency medical services and
- prevent unauthorized personnel from attempting a rescue.

Paragraph (d)(10) requires the development and implementation of a system for the:

- preparation,
- issuance,
- use and
- cancellation of the entry permit as stated in paragraphs (e), (f) and (j) of the standard.

Paragraph (d)(11) requires employers to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants. Effective communication and coordination between employers will reduce the risk of employees of one employer endangering the welfare of employees of another employer.

Paragraph (d)(12) requires employers to establish the necessary procedures for concluding the entry once the entry operation has been completed. This is required so that the employer may carefully plan and control the entry operation from start to finish. Cancellation of the permit by established procedures alerts the employer to take the appropriate measures which include;

- the shut down of the space,
- the closing of the entry portal and
- the return of the space to normal operating conditions.

By implementing these control procedures, situations such as these can be avoided:

- accidentally locking an employee inside the space,
- employees accidentally entering the space,
- possible fire or explosion when the space is returned to its normal operating activity,

- leakage from misaligned pipes that have not been reconnected.

Paragraph (d)(13) requires that the employer must institute a review of entry operations if the employer has reason to believe that the control measures taken under the program are not adequately protecting employees. Correct any deficiencies found before subsequent entries are authorized. Circumstances that may prompt such review include:

- any unauthorized entry into the permit space,
- detection or discovery of a permit space hazard not covered by the entry permit,
- detection of a condition prohibited by the entry permit,
- a change in the use or configuration of the confined space and
- employee complaints about the effectiveness of the program.

Paragraph (d)(14) requires the employer to conduct a review of the permit space program using canceled permits within one year after each entry. The program may be reviewed sooner if needed, to ensure employees are protected from permit space hazards. Employers can perform a single annual review covering all entries performed during a 12-month period if they desire. If no entry is performed during a 12-month period, no review is necessary.

Note to the Employer: Appendix D PRCS Program Worksheet and Appendix D-1 contains an example of a completed written PRCS Program that is considered to comply with the standard. The program should be modified as necessary to meet the specific demands of the permit space to be entered.

Permit System - Paragraph (e)

It is well documented that many injuries and fatalities are the result of employers not taking the proper precautions necessary to ensure the safety of the employees working in permit spaces. Paragraph (e) Permit System requires employers to systematically implement measures to prevent these injuries and fatalities by instituting the following:

Paragraph (e)(1) requires the employer to document the completion of the measures needed for safe entry operations through the preparation of an entry permit as required in paragraph (d)(3).

Careful and thorough planning is required to ensure all measures are taken to ensure the safety of the authorized entrants. The specific elements that must be included on the permit are dependent on the particular space and the operation to be conducted in the space.

Appendix N provides an example of an entry permit that is considered to comply with the section. The elements in the entry permit can be modified to meet the specific hazards to be encountered.

Paragraph (e)(2) requires the entry supervisor to sign the entry permit to authorize entry.

Paragraph (e)(3) requires the employer to make the completed permit available to all entrants at the time of entry. It may consist of posting the permit at the entry portal or any other acceptable means so long as the authorized entrants can check to see if pre-entry preparations have been completed.

Paragraph (e)(4) requires that the duration of the permit not exceed the time required to complete the task or job identified on the permit. The entry permit is limited to the duration of whatever period of time is necessary for

completion of the assigned task or job. The employer can state the permit's duration in terms of a specific task to be performed; for example, the cleaning of interior surface of a tank, or the removal and installation of a relief valve. The duration of the permit is not of major concern to the safety of employees as long as acceptable entry conditions are maintained.

If conditions within the space change so that entrants are endangered, then the following steps are needed to fully protect these employees:

1) The entry supervisor, when they assume responsibility for a space and when they performs periodic checks, ensures the presence of acceptable entry conditions [paragraph (j)(6)].
2) If the hazard being introduced is atmospheric in nature, the testing and monitoring of the space will detect it [paragraph (d)(5)(ii)].
3) If other hazards are being introduced, the entry supervisor, the attendant, and authorized entrants are trained to detect their presence [paragraphs(g),(h)(1), and (j)(1)].
4) Entrants would vacate the permit space [paragraphs (h)(4) and (h)(5), (i)(6), and (j)(3)].

Paragraph (e)(5) requires the entry supervisor to terminate the entry and cancel the permit when:

- Entry operation has been completed, or

Note to the Employer: It is understood that there are situations where more than one entry supervisor may be needed over the course of an entry operation. For example, when multi-shift entry operations are conducted, more than one entry supervisor would be used for a permit space. Additionally, even for entry operations that do not extend across more than one shift, the original entry supervisor may be absent from the workplace for other reasons. Therefore, OSHA has adopted language to provide that the entry supervisor, not the person who authorized entry, will cancel the permit. As noted under the discussion of the term "entry supervisor", OSHA does not intend to restrict the position of entry supervisor to a single individual. Any individual who has been designated as the entry supervisor has the authority to terminate entry and cancel a permit.

- A prohibited condition arises in or near the permit space

Paragraph (e)(6) requires that all canceled permits be maintained for a minimum of one year to assist in the annual review process, i.e., paragraph (d)(14) of the standard. By making canceled permits available, any problems that arise can be evaluated and steps taken to avoid a reoccurrence.

Entry Permit - Paragraph (f)

Paragraph (f) requires that each permit space have an entry permit prepared as part of the employer's determination that conditions in the space are safe for employee entry. A specific, properly prepared entry permit will help assure that employees will be protected against any permit space hazards. The regulation requires all the information listed in paragraphs (f)(1) through (f)(15) of the standard be included and addressed on an entry permit.

Paragraph (f)(1) requires identification of the space to be entered

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Paragraph (f)(2) requires the purpose on entry to be listed on the permit

Paragraph (f)(3) requires the date and the authorized duration of the entry permit.

Note to the Employer: The duration of the entry permit need not be stated in terms of actual time, but may be stated in terms of the completion of the specific task [see (e)(4)] of the Permit System paragraph for additional information.]

Paragraph (f)(4) requires a listing of the authorized entrants. The employer may place the names on the entry permit, choose to use entry tags, badges, sign-out sheets, or any other effective means to track the authorized entrants. Whatever method is used, it must allow for quick and accurate accountability of the authorized entrants by the attendant. The method to be used must be stated on the entry permit.

Paragraph (f)(5) requires that the names of current attendants involved with the entry operation be placed on the permit.

Paragraph (f)(6) requires the names of the current entry supervisors, including a space for their signatures or initials for the entry supervisor who originally authorized entry.

Note to the Employer: New attendants or entry supervisors must have their names recorded when they assume the role at the permit space. This also provides these individuals with an opportunity to review the permit, as required by paragraph (j)(6) of the standard.

Paragraph (f)(7) requires the permit to contain a list of the hazards of the permit space to be entered.

Paragraph (f)(8) requires the permit to contain a list of the specific measures taken to isolate the permit space to either control or eliminate the hazards.

Note to the Employer: The permit need only refer to the procedures in sufficient detail to enable employees to know what measures should be taken and how to perform them (e.g., the use of blanking to isolate the permit space). The standard does not require the entry permit to contain an in-depth discussion of the procedures used. The detailed procedures are required under paragraph (d)(3) of the written PRCS Program and authorized personnel trained in their use under paragraph (g) of the standard.

Paragraph (f)(9) requires the permit to contain a list of the acceptable entry conditions.

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Note to the Employer: These conditions must be included on the permit so permit space personnel are aware of the acceptable entry conditions. For example, the acceptable conditions that may be listed on the permit might include:

- **oxygen, flammable gas and vapor, and toxic substance levels that must be met before entry,**
- **energy isolation controls, etc.**

Paragraph (f)(10) requires the recording of pre-entry and periodic atmospheric testing results on the permit along with:

- the name or initials of the individual performing the tests,
- the date and time of the testing and
- an indication where the testing was performed.

Having this information on the permit assists confined space team members in accessing the conditions during entry operations and also facilitates the review of canceled permits.

Paragraph (f)(11) requires the permit to list the rescue and emergency services (i.e., in-house, outside) that can be summoned and the means for contacting those services (e.g., phone, CB radio).

Paragraph (f)(12) requires the permit to list the communication procedures that will be used between the attendants and authorized entrants.

Paragraph (f)(13) requires that the permit contain a list of equipment that is required for the entry operation, such as:

- personal protective equipment,
- testing equipment,
- communications equipment,
- alarm systems,
- rescue equipment,
- barriers and fences and
- any other equipment deemed necessary for the safety of the workers.

Paragraph (f)(14) requires that the permit contain any other information that is needed for the protection of the employees during the entry operation.

Paragraph (f)(15) requires that any other additional permits (i.e., hot work permits) that have been issued to authorize work be identified on the permit or attached to it (see Appendix G for a copy of a typical hot work permit).

Training - Paragraph (g)

A major factor in permit space accidents is the lack of employee awareness of the dangers involved in these spaces. For example, many times, the lack of adequate training can result in death or serious physical harm to workers. Employees may enter a permit space unaware that the space contains an Immediately Dangerous to Life and Health

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(IDLH) atmosphere since in many situations there are no obvious symptoms associated with these life-threatening environments. Additionally, untrained rescuers of incapacitated individuals often become victims themselves because they are unaware of the hazards and of safe rescue procedures.

To prevent these types of situations from occurring, the regulation requires mandatory training of all members of the permit space team. The elements are listed in paragraph (h),(i),(j) and (k) for the authorized entrants, attendants, entry supervisors, and rescue personnel, respectively. Paragraph (g) requires employers to provide this training to these individuals so they obtain the background necessary for safe permit space entry. Training under paragraph (g) requires the following:

Paragraph (g)(1) requires employees to provide training to those employees whose work involves or may involve contact with permit spaces to acquire the understanding, knowledge, and skills necessary for the safe performance of their assigned duties.

Note to the Employer: This requires the employer to develop and implement the most effective confined space training program needed to meet the specific demands of the permit space at the worksite.

Paragraph (g)(2) sets out the general conditions under which training would have to be provided.

1) Paragraph (g)(2)(i) requires an employee to be trained when he or she is first assigned duties involving permit space entry.

Note to the Employer: Employees who are currently performing duties outlined in the standard and who have previously been trained need further instruction only insofar as they are unfamiliar with the hazards involved and must change their work practices so as to conform to 1910.146. The employer must still certify the training of these individuals. Additionally, OSHA will accept on-the-job training as long as the employee involved is under the direct supervision of a trained individual and has received sufficient instruction to enable the trainee to work safely at his or her level of training.

2) Paragraph (g)(2)(ii) requires training before there is a change in assigned duties. Such changes could be from introduction of new equipment, techniques, or reassignments.

3) Paragraph (g)(2)(iii) requires training before there is a change in the permit space operation that presents a hazard for which the employee has not previously received training.

4) Paragraph (g)(2)(iv) requires training whenever the employer believes that there are deviations by the employees from the prescribed permit space entry procedures, or lack of employee knowledge or use of these procedures.

Note to the Employer: Refresher or follow-up training is required in paragraphs (g)(2)(ii), (g)(2)(iii) and (g)(2)(iv), or whenever there is a demonstrated need for it (i.e., an accident with or without injury, employees not following procedures).

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Paragraph (g)(3) requires that the training must make the employees proficient in the tasks assigned to them.

Paragraph (g)(4) requires the employer to certify that employees have received training as required by (g)(1) through (g)(3) by maintaining a record of the following:

- Employees name
- Signature or initial of the trainers
- Date of training

Note to the Employer: Appendix O has been included for recording employee training. The employer is not required to generate individual certificates; a list or roster is sufficient. Also, make this training record available for inspection to the employees or authorized representatives.

Duties of Authorized Entrant - Paragraph (h)

An authorized entrant is an employee who is authorized by the employer to enter a permit space. Since this individual is at the greatest risk, it is imperative that this individual fully understand and practice safe permit space entry procedures. To accomplish this goal, the employer must provide training, communicate safe work practices and effectively implement the permit space program.

Paragraph (h)(1) requires entrants:

- to know the potential hazards associated within a specific permit space,
- to be able to recognize the signs or symptoms of exposure and
- to understand the consequences of exposure to the hazards.

Paragraph (h)(2) requires that the entrants properly use all the equipment necessary for a safe entry operation.

Paragraph (h)(3) requires that the entrant communicate with the attendant as necessary to enable the attendant to monitor the entrant's status and to enable the attendant to alert him/her of the need to evacuate the space.
Paragraph (h)(4) requires authorized entrants to alert attendant when the entrant recognizes any warning sign or

Note to Employer: Depending on the types of atmospheric contaminants that might be present within a permit space, subtle behavioral changes detected in the authorized entrant's speech or deviation from set communication procedures could alert the attendant that it is necessary for the authorized entrant to evacuate the space or be rescued. Additionally, the attendant needs to be able to communicate with authorized entrants to order them to evacuate the space in an emergency.

symptom of exposure to a dangerous condition or when the entrant detects a prohibited condition. The entrant ensures that other entrants are protected by informing the attendant of the presence of these conditions, which may make the space hazardous to other entrants as well.

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Paragraph (h)(5) through (h)(5)(iv) requires the entrant to exit from the permit space as quickly as possible whenever:

- the attendant or entry supervisor orders evacuation,
- the authorized entrant recognizes any warning sign or symptom of exposure to a hazardous substance,
- the entrant detects a prohibited condition,
- an evacuation alarm is activated.

Given the speed with which permit space hazards can incapacitate and kill entrants, it is essential that the entrants evacuate permit spaces as soon as any one of the four conditions set out in paragraphs (h)(5)(i) through (h)(5)(iv) is found to exist. OSHA believes that self-rescue will often provide the entrant=s best chance of escaping a permit space when a hazard is present.

Note to the Employer: Alerting other authorized entrants can also improve their chances of escape as well. However, there are several reasons why OSHA is not mandating this. First, the permit space may well be so large that the entrant who detects a hazard cannot quickly or efficiently communicate with other authorized entrants. Under paragraph (i)(5), the attendant is required to have the means of communicating with all authorized entrants in the space. The quickest and most effective means of ordering the evacuation of the space is therefore normally through the attendant. In fact, this is required under paragraph (i)(6). Furthermore, OSHA does not believe that it is appropriate to require one employee to risk injury or death to warn another. While in some cases it may be reasonable for entrants to inform each other of the presence of uncontrolled hazards and in other cases an employee may voluntarily risk injury or death to warn his/her fellow employees, OSHA has determined that the final rule should only require authorized entrants to inform attendants.

Duties of Attendants - Paragraph (i)

Paragraph (i) requires an attendant to be located outside the permit space to monitor the status of authorized entrants, watching for safety hazards that may arise in and around the space, keeping unauthorized employees away from the space and summoning rescue services in the event of an emergency. To accomplish this task, the employer must ensure that the attendant is familiar with the following information as outlined in paragraph (i)(1) - (i)(10):

Paragraph (i)(1) requires the attendant to know and recognize the hazards and potential hazards associated with the specific permit space.

Paragraph(i)(2) requires the attendant to be aware of possible behavioral effects of exposure to atmospheric hazards (e.g., carbon monoxide, hydrogen sulfide, etc.). Review material Safety Data Sheets (MSDS) for the chemical substances contained in the permit space.

Paragraph (i)(3) requires the attendant to maintain an accurate count of authorized entrants within the permit space. The system used should quickly enable the attendant to determine if authorized entrants are inside the permit space.

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Paragraph (i)(4) requires the attendant to remain outside the permit space until termination of the entry operation or being relieved by another authorized attendant. Additionally, the attendant may only enter a permit space to attempt a rescue if it is allowed under the specific permit program, if they are properly equipped and trained and if they are relieved by another attendant.

Paragraph (i)(5) requires the attendant to maintain communication with the authorized entrant to monitor their authorized status and to alert the entrant of any need to evacuate the space. Subtle behavioral changes detected in the authorized entrant's speech or deviation from a set communication procedure could be the first signs of trouble.

Paragraph (i)(6) requires the attendant to monitor activities inside and outside the space to determine if it is safe for entrants to remain in the space or order evacuation if the attendant:

a. detects a prohibited condition,
b. detects behavioral effects manifested from exposure to atmospheric hazards in the authorized entrant,
c. detects a condition outside the space (e.g., weather conditions, other work activity, etc.) that could endanger the authorized entrants, or
d. cannot effectively and safely perform all required duties of an attendant.

Paragraph (i)(7) requires the attendant to summon rescue and other emergency services as soon as it is determined that an emergency exists.

Note to the Employer: As long as the attendant is certain that self-rescue can be performed, no rescue summoning would be necessary. However, if the attendant has any doubts as to whether an authorized entrant can exit the space under his or her own power, then the attendant is required to summon rescue and emergency medical services.

Paragraph (i)(8) requires that the attendant take the following actions when unauthorized persons approach or enter a permit space while entry is underway:

1) warn the persons that they must stay out of the permit space,
2) advise the unauthorized persons that they must exit immediately if they have entered the permit space,
3) inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.

Paragraph (i)(9) requires the attendant to perform non-entry rescues as specified by the employers rescue procedure.

Note to the Employer: OSHA wishes to emphasize that attendants monitoring more than one space must not perform any duties that would distract them from their responsibilities for all the spaces being monitored. OSHA does expect such attendants to be permitted to perform any type of rescue, including non-entry rescue, as long as they are still acting as attendants. As noted earlier, the employer's permit space program must establish procedures to enable the attendant to respond to an emergency affecting one or more of the permit spaces being monitored without distraction from the attendant's responsibilities under paragraph (i).

Paragraph (i)(10) prohibits the attendant from performing other duties that may interfere with the attendant's primary duty to monitor and protect the authorized entrant. Passing tools to authorized entrant and monitoring the permit space atmosphere would be acceptable, so long as the attendant does not break the plane of the opening. Tasks that distract the attendant from his/her primary duty, such as repairing equipment outside the space, are prohibited.

Duties of Entry Supervisor - Paragraph (j)

Many of the permit space accidents are the result of the employer's lack of enforcement of appropriate permit space entry procedures. Employers must take responsibility for ensuring that acceptable entry conditions exist before allowing entry, and during entry operations. Employers must also enforce safe work practices and procedures necessary to protect employees.

In order to place the burden of employees= safety on employers, the standard requires each permit space entry to have an entry supervisor who has overall accountability for safe entry operations. The standard requires the entry supervisor to verify the existence of acceptable entry conditions and the presence of rescue and emergency medical services, to authorize the entry (which is evidenced by the signature on the permit), to remove unauthorized persons from the space, and to terminate the entry operation when necessary.

Paragraph (j) lists the duties of the entry supervisor.

Paragraph (j)(1) requires the entry supervisor to know the hazards which may be faced during entry.

Paragraph (j)(2) requires the entry supervisor verify, by checking that the appropriate entries have been made on the permit, that all tests specified on the permit have been conducted and that all procedures and equipment specified on the permit are in place, before endorsing the permit and allowing entry to begin.

Paragraph (j)(3) requires the entry supervisor to terminate the entry and cancel the permit as required by paragraph (e)(5).

Paragraph (j)(4) requires the entry supervisor to verify that rescue services are available and that the means for summoning them are operational.

Paragraph (j)(5) requires the entry supervisor to remove unauthorized individuals who enter or who attempt to enter the permit space during entry operations.

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Note to the Employer: OSHA recognizes that some persons near a permit space may have legitimate reasons for being there. These persons must be warned by the attendant [under paragraph (i)(8)(i)] to stay out of the permit space. They must know the danger involved and, under the observation of the attendant, can safely remain near the space.

Paragraph (j)(6) requires the entry supervisor to determine, whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

Note to the Employer: For entries lasting more than one work shift, the original entry supervisor will normally have to be relieved at the end of the shift. The responsibilities of the entry supervisor will then be passed onto someone else.
OSHA believes that it is important for the new entry supervisor to review the permit and to determine that acceptable entry conditions have been maintained. OSHA also believes that guidance beyond that of transfer of responsibility, must be given as to what appropriate intervals might be. In order to accomplish these goals, paragraph (j)(6) specifies that reevaluation of conditions within the space must occur whenever responsibility for permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space.

Rescue Services - Paragraph (k)

The requirements of the standard are in place to eliminate or control any hazards prior to and during the entry operation. However, in spite of all these precautions, hazards may arise which could incapacitate an entrant and prevent their self rescue. This may be the result of extraordinary circumstances suddenly appearing without warning or possibly due to some deficiency in the employer's program. Paragraph (k) of the standard has been devised to address the need for rescue and emergency services in such cases.

The regulation requires each employer who has employees who will enter a permit-required confined space to make arrangements for rescue and emergency services. Employers must determine if they are going to rely on-site or off-site rescue services. The regulation treats all rescue services identically, whether they are provided by employers or from an outside source, such as the local fire department.

It is very important for the employer to remember that an individual can only go without oxygen for approximately four (4) minutes before having permanent brain damage or being asphyxiated. The need for quick response is clearly evident. In light of this, non-entry rescue methods should be the primary means of rescue stressed.

A retrieval system which allows outside personnel to extricate an incapacitated individual without having to enter the space is the preferred method. Retrieval systems must be provided whenever an authorized entrant enters a permit space, unless the employer can demonstrate that the retrieval equipment would icrease the risk of entry or inhibit the rescue. If this is the situation, then an effective rescue alternative must be used.

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It is also well-documented that the majority of fatalities that occur are would-be rescuers who rush into a permit space without receiving proper training and/or without instituting the appropriate precautions. It cannot be stressed enough that entry rescues must only be performed by properly trained and equipped individuals. During an emergency situation, emotions must not be allowed to dictate actions. An appropriate rescue plan is required.

The following requirements under paragraph (k) apply to all employers who have employees enter a permit space to perform rescue services:

Paragraph (k)(1) sets the requirements for the rescue services.

1) Paragraph (k)(1)(i) requires the employer to ensure that personnel assigned as rescuers are equipped with and trained to use all personal protective equipment (PPE) and rescue equipment necessary to enable the rescuers to enter and perform rescue operations.

2) Paragraph (k)(1)(ii) requires the members of the rescue service to be trained to perform their assigned rescue duties. They are also required to receive the same training required for authorized entrants as stated in paragraph (g).

3) Paragraph (k)(1)(iii) requires rescuers to practice making permit space rescues at least once every 12 months, by simulating an actual rescue operation in which they remove dummies, mannequins, or actual persons from the actual permit space or representative permit space. The representative permit spaces must, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed.

Note to the Employer: Practice sessions can be in actual permit spaces or spaces that simulate the permit space expected to be entered. It is important that the practice openings resemble those of the actual spaces to be entered. By providing this type of practice, rescue service members will be familiar with the possible problems associated with restricted openings while wearing personal protective equipment (e.g., self-contained breathing apparatus), using rescue equipment and removing incapacitated entrants. This practice also provides feedback to the employer on the adequacy of the rescue equipment, the rescue procedures used and the training provided.

Actual rescues conducted during the 12-month period can substitute for a practice rescue. During the course of the actual rescue if the rescuers performed their assigned tasks in a satisfactory manner, they need not perform a practice rescue for that 12-month period, regardless of the outcome of the rescue attempt. OSHA notes that even if a rescue is performed in a satisfactory manner, the entrants could still not survive, through factors beyond the rescuers' control. It should also be noted, however, that the unsatisfactory performance of a rescue team indicates the need for further training.

4) Paragraph (k)(1)(iv) requires that each member of the rescue service shall be trained in basic first-aid and in cardiopulmonary resuscitation (CPR). At least one member of the rescue operation must hold current certification in first-aid and in CPR.

Note to the Employer: Because rescue service members= duties include the rendering of first-aid and CPR, they are covered by the OSHA Bloodborne Pathogen Standard 29 CFR 1910.1030.

Additionally, paragraph (d)(9) of the Permit-Required Confined Space Standard requires the employer to ensure the availability of necessary emergency medical services (such as paramedic services). Someone with this more advanced medical training is needed to treat the rescued individual after he/she is removed from the space. **Paragraph (k)(2)** sets requirements for the use of outside rescue services by host employers.

1) Paragraph (k)(2)(i) requires the host employer to inform the rescue service of the hazards that they may encounter when called on to perform rescue operations at the host employer's facility.

2) Paragraph (k)(2)(ii) requires the host employer to provide the rescue service with access to all permit spaces from which rescue services may be necessary so they can develop appropriate rescue plans and practice rescue operations.

Note to the Employer: An outside rescue service needs to know in advance the location, configuration and hazards of a permit space in order to develop and practice effective rescue procedures. To gather this information, the host employer must provide access to the space to the outside rescue service. This standard does not require the outside rescue service to actually use the permit space for practice. However, in the best interest of safety, the host employer is encouraged to provide the outside rescue service the opportunity for actual rescue practice with the permit space.

Note to the Employer: The following guidelines are provided to help determine when retrieval systems may increase the risk to the authorized entrant

1) **A permit space with obstructions or turns that prevent pulls on the retrieval line from being transmitted to the entrant does not require the use of a retrieval system.**

2) **A permit space from which an employee being rescued with the retrieval system would be injured because of forceful contact with projections in the spaces does not require the use of a retrieval system.**

3) **A permit space that was entered by an entrant using an air-supplied respirator does not require the use of a retrieval system if the retrieval line could not be controlled so as to prevent an entanglement hazard with the air line.**

Paragraph (k)(3) sets requirements for the use of non-entry retrieval systems that must be used by authorized entrants whenever they enter a permit space. Non-entry retrieval systems must be used unless this equipment would increase the overall risk of entry or would not contribute to the rescue of the individual.

1) Paragraph (k)(3)(i) requires that authorized entrants must wear:

- Chest or full-body harness with a retrieval line attached at the center of the entrant's back near shoulder level or above the entrant's head.

- Wristlets can be used in lieu of chest or full body harness if they can be demonstrated to be safer and more effective than the harnesses.

2) Paragraph (k)(3)(ii) requires that the retrieval line must be attached to a fixed point or a lifting device. A mechanical lifting device is required for vertical permit spaces more than five feet deep.

Note to the Employer: Any permit space whose opening is above the entrant is considered to be a vertical-type permit space. The mechanical device used should be appropriate for the rescue. The employer should not use any mechanical devices, such as a forklift that could injure the entrant during rescue.

Paragraph (k)(4) requires that if an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is already required to be kept at the worksite, the MSDS or other written information must be provided to the treating medical facility. Employers can comply with this provision by having that information accompany the employee to the medical facility or by providing it to the facility as soon as practicable after the employee's arrival there.

SECTION II - Recognition and Evaluation of Confined Space Hazards

CONFINED SPACE AND PERMIT REQUIRED CONFINED SPACE RECOGNITION

The inherent dangers associated with working in permit spaces is an ever present risk for a large portion of today's workforce. Many of the accidents that have been documented are a result of employers and employees failing to recognize the hazards or potential hazards involved with entering into permit spaces. This sections is designed to assist employers and employees with the task of identifying confined spaces and permit-required confined spaces in their workplaces.

Before an employer can properly evaluate their worksite, it is important that they understand the definitions of confined space and permit-required confined space.

Confined Space

A confined space is a space that has the following characteristics:

- Is large enough and so configured that an individual can bodily enter and perform assigned work; and
- Has limited or restricted means for entry or exit; and
- Is not designed for continuous employee occupancy.

Note to the Employer: All three criteria must be met for the location to be considered a confined space.

Confined spaces may include:

- Boilers
- Sewers
- Tunnels
- Vessels
- Wells
- Pits
- Silos
- Hoppers
- Digester
- Vaults
- Furnaces
- Septic Tanks
- Manholes
- Tank Cars
- Cistnerns
- Diked Areas
- Storage Bins
- Pumping Stations
- Process Vessels
- Plating Tanks

Permit-Required Confined Space

Once a confined space has been identified, the next step is to determine if it is a permit-required confined space. In order for a space to be considered a permit-required space, it must first meet the criteria of a confined space. Secondly, the space must contain one or a combination of the following conditions:

- Hazardous atmosphere,
- Liquid or solid materials that can engulf an entrant,
- A configuration that can trap and suffocate an entrant,
- Mechanical or electrical hazards, or
- Contains any other recognized serious safety and health hazards.

SECTION II - Recognition and Evaluation of Confined Space Hazards

Non-Permit Required Confined Space

Non-permit spaces are confined spaces which do not contain or, with respect to atmospheric hazards, have the potential to contain, any hazards capable of causing death or serious physical harm. Examples of non-permit confined spaces include vented vaults, motor control cabinets, and dropped ceilings. Although they are "confined spaces", these spaces have either natural or permanent mechanical ventilation available to prevent the accumulation of a hazardous atmosphere, and they do not present engulfment or other serious hazards.

Note to the Employer: Some additional clarification is provided here concerning confined spaces, permit-required confined spaces and entry into enclosed areas:

- **The standard is intended to cover only those spaces large enough for the entire body of an employee to enter. If employees cannot totally enter the space, they should not have any difficulty withdrawing from the space. A space that cannot be entered cannot be confined; therefore, it does not pose hazards related to the difficulty of exiting the space.**

- **The standard is not intended to address all locations that pose atmospheric hazards. For example, an open 55 gallon drum where an employee breaks the plane of the opening is not addressed by this standard. Provisions are already in place to protect the employee from atmospheric hazards by Subpart Z of the General Industry Standard.**

- **The employee must have difficulty exiting the space. Ladders (permanent or temporary), spiral or articulated stairs will usually be considered a limited or restricted means of egress. Fixed industrial stairs will be considered a limited or restricted means of egress when the conditions or physical characteristics of the space would interfere with the ability to exit or be rescued in a hazardous situation. As a rule of thumb, if someone can easily climb or descend the stairs without using the hands to aid in the climb or descent, then the stairs are not considered to be restricting or limiting.**

- **The presence of a door does not in and of itself mean that the space is not a confined space. The dimensions of a door and its location are factors in determining whether an entrant can easily escape. For example, a space such as a bag house or crawl space that has a door leading into it, but also has pipes, conducits, ducts or equipment/materials that an employee would be required to crawl over or under or squeeze around in order to escape, has limited or restricted means of exit.**

(Continued)

SECTION II - Recognition and Evaluation of Confined Space Hazards

- **Spaces which contain permanently installed mechanical ventilation which preludes a hazardous atmosphere from developing would not be considered a permit required confined space. This system should consist of an exhaust flue stack and low level air intakes which provide a cross draft in the space to prevent the formation of a hazardous atmosphere. If the ventilation system were to malfunction, the space would have to be reevaluated.**

- **The third characteristic of confined space is that it is not designed for humans to enter work for prolonged periods without any additional consideration for safety and health. Classification of a space would be based on its condition at the time employees would enter, not on the ultimate use of the space. Some products are considered permit spaces while they are being built and entries by workers are required as part of the manufacturing process. However, after they are completed and put to use, the hazards created by the manufacturing process are not present and they are then designed and intended for continuous occupancy.**

TYPES OF CONFINED SPACE HAZARDS

Hazardous Atmospheres
- Oxygen Deficiency or Oxygen Enrichment
- Combustible/Flammable/Explosive Gases and Vapors
- Toxic Gases and Vapors
- Combustible
- Engulfment Hazards

Entrapment or Configuration Hazards
Mechanical Hazards
Other Hazards
- Corrosive Chemicals (acids, cleaning solutions, etc.)
- Electrical
- Access with Ladders
- Lighting (poor visibility)
- Temperature Extremes
- Falling/Tripping/Insecure Footing
- Falling Objects
- Weather Conditions

HOW CONFINED SPACE HAZARDS OCCUR

Confined space hazards occur as a result of both natural and man-made sources.

SOURCES OF CONFINED SPACE HAZARDS

- Chemical Reactions from Products Stored in Vessels
- Oxidation/Reduction Reactions (i.e., rusting of metals)
- Decomposition of Organic Matter

SECTION II - Recognition and Evaluation of Confined Space Hazards

- Cleaning Agents (Solvents, Acids)
- Welding, Spray Painting, Grinding
- Inerting with Non-Flammable Gases
- Fire and Explosion Hazards from Organic Hydrocarbon Based Substances
- Ignition Sources from Static Electricity, Hot Work Operations, Electrical Equipment
- Lack of Proper Training
- Lack of Permit Entry Program
- Loose Materials Stored in Tank (Grain, Sawdust, etc.)
- Pyrophoric Chemicals
- Lack of Good Safety Policies and Practices

HAZARDOUS ATMOSPHERES

Hazardous atmospheres account for a majority of the fatalities that occur in permit spaces. The standard ensures the safety of the workers by requiring pre-entry testing and frequent or continuous monitoring during the entry operation. Various types of atmospheric hazards could be encountered depending on the specific type, use, and work performed in the space. It is important to know the hazards and potential hazards which might be present and to monitor accordingly. Once the employer has determined that atmospheric hazards could exist, the standard mandates that testing be conducted in the following sequence:

- Oxygen deficiency/oxygen enrichment
- Combustible gases and vapors
- Toxic gases and vapors
- Combustible dust

Oxygen Hazards

Air is a mixture of many gases, oxygen being just one of them. The normal oxygen concentration in air is approximately 20.9% by volume.

- Oxygen Deficiency
  An oxygen-deficient atmosphere is considered to exist when the oxygen level falls below 19.5% by volume. This condition could exist in a permit space from either consumption or displacement of oxygen by natural and man-made sources such as:

  - Oxygen consumption by individuals
  - Decomposition of organic matter
  - Displacement of oxygen by gases and vapors (e.g. inert gases such as nitrogen, carbon dioxide, helium, or steam used to purge tanks and vessels)
  - Oxidation of metals (e.g. rusting)
  - Combustion (e.g. fire, welding, etc.)

- Oxygen Enrichment

  Oxygen enrichment levels greater than 23.5% by volume present a serious fire hazard in permit spaces. This condition could result from leaking oxygen cylinders or lines brought into a space. Also, oxygen must never be used to ventilate a confined space.

Potential Effects of Oxygen-Deficient and Enriched Atmospheres

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Oxygen Content % by Volume	Effects and Symptoms (at atmospheric pressure)
23.5% and above	**Extreme fire hazard**
19.5%	**Minimum permissible oxygen level**
15-19%	**Decreased ability to work strenuously. May impair coordination and may induce early symptoms in persons with coronary, pulmonary or circulatory problems**
12-14%	**Respirations increase, pulse increases, impaired coordination, perception, judgment**
10-12%	**Respirations further increase in rate and depth, poor judgment, lips blue**
8-10%	**Mental failure, fainting, unconsciousness, ashen face, blueness of lips, nausea and vomiting**
6-8%	**8 minutes, 100% fatal; 6 minutes, 50% fatal; 4-5 minutes, recovery with treatment possible**
4-6%	**Coma in 40 seconds, convulsions, respirations cease, death**
These values are approximate and vary with the individual's state of health and his or her physical activities. **Exposures to atmospheres containing 12% or less oxygen can bring about unconsciousness without warning so quickly that the individuals cannot help or protect themselves.**	

Combustible/Flammable Gases and Vapors

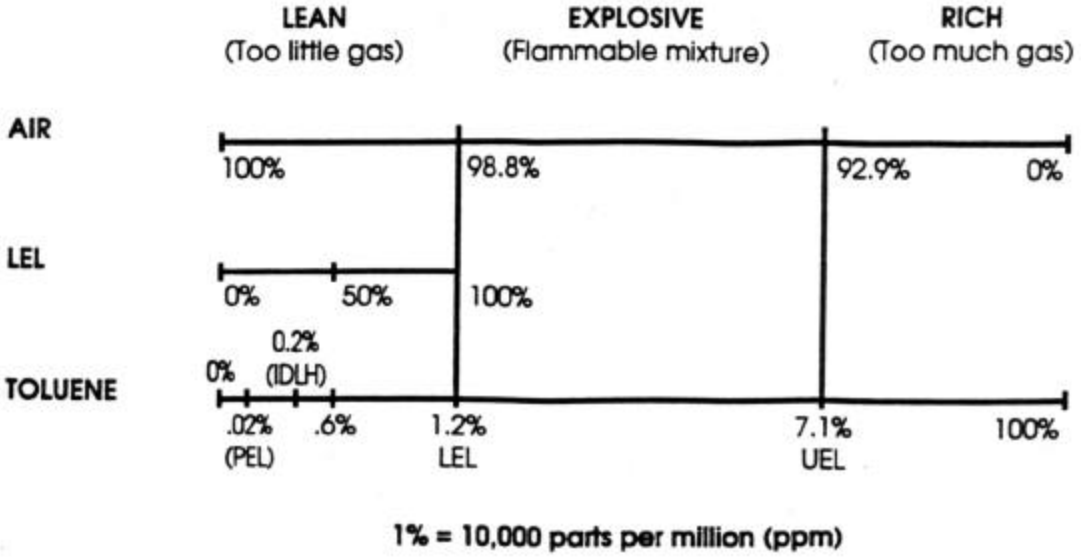
Combustible/flammable gases and vapors can pose a significant threat of fires and/or explosion in permit spaces.

The lowest concentration (air-fuel mixture) at which a gas or vapor can ignite is called its Lower Explosive Limit (LEL) or Lower Flammable Limit (LFL). Concentrations below this limit are too lean to burn. The highest concentration that can be ignited is its Upper Explosive Limit (UEL) or Upper Flammable Limit(UFL). Above this concentration, the mixture is too rich to burn.

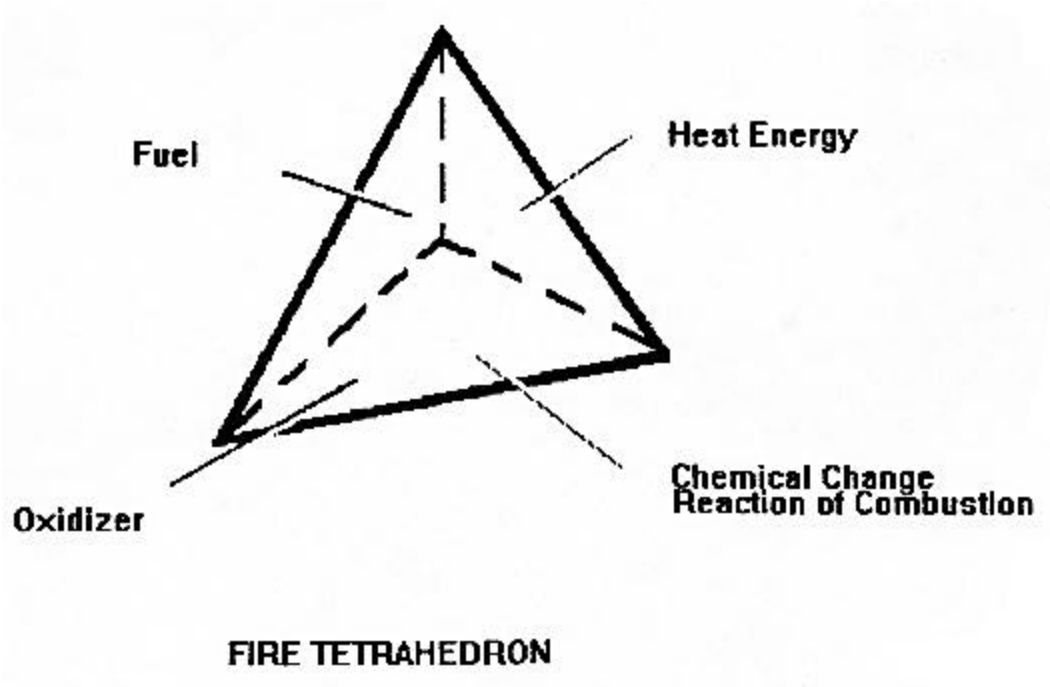
A gas or vapor is only explosive/combustible between its LEL and UEL, but any concentration of combustible gas or vapor should be of concern when in a confined space. Lean mixtures can collect in an area and reach a combustible level, or rich mixtures can be diluted with air to become combustible.

SECTION II - Recognition and Evaluation of Confined Space Hazards

Lower Explosive Limit (LEL) vs. Upper Explosive Limit (UEL) for Toluene



In order for an explosion or fire to occur, all components of the "fire tetrahedron" have to be present: fuel, oxygen, ignition source, and a chain reaction.



SECTION II - Recognition and Evaluation of Confined Space Hazards

Many provisions in the standard address prevention of fire and explosion hazards by removing components of the fire tetrahedron, including:

- Preventing an atmosphere from containing a flammable gas, vapor, or mist concentration in excess of 10% of the Lower Explosive Limit.
- Conducting atmospheric testing to determine the percentage of the LEL present.
- Elimination or control of sources of ignition.

Preventive measures are discussed in greater detail in the Control Section of this document.

Toxic Atmospheres

An additional concern is the presence of toxic or potentially toxic substances existing in the permit space. These substances may come in the form of gases, vapors, mists, dusts, fumes, or radiation. The standard references Subpart Z, Toxic and Hazardous Substances (i.e. chemical hazards), and Part 1910.94-100, Subpart G, Occupational Health and Environmental Controls (e.g., non-chemicals hazards such as ionizing radiation). A hazardous atmosphere is said to exist when atmospheric concentration exceeds a dose or a permissible exposure limit (PEL) for substances published in Subparts Z and G. Additionally, any other atmospheric condition that is immediately dangerous to life or health (IDLH) must be addressed as part of the permit space entry protocol.

Substances for which OSHA has not established a dose or PEL must be evaluated by the employer to determine their hazards. Sources of information include:

- Material Safety Data Sheets (MSDS)
- Published information on the substance
- Industry established exposure levels
- National Consensus Standards, including, American Conference of Governmental Industrial Hygienists (ACGIH), National Institute of Safety and Health (NIOSH)

Subpart Z contains a list of substances for which OSHA has established PELs. PELs may be expressed as 8-hour Time Weighted Averages (TWAs), 15-minute Short Term Exposure Limits (STELs), or ceiling limits. The ACGIH Threshold Limit Values (TLVs) and NIOSH Recommended Exposure Limits (RELs) are recommended exposure limits. In the absence of an OSHA PEL, OSHA can enforce TLVs and RELs.

Toxic substances will have acute (short-term) or chronic (long-term) health effects; some have both. It is important for the employer to know which, since accurate health hazards are of an immediate concern when determining the presence of a hazardous atmosphere. Three (3) of the most common toxic gases found in permit spaces include carbon monoxide, hydrogen sulfide, and methane.

- Carbon Monoxide

Carbon monoxide is a very toxic, colorless, odorless combustible gas that is a product of incomplete combustion. It is generated by many sources such as gasoline-powered internal combustion engines, arc welding where carbon dioxide is used as an inert gas, and fires, just to name a few. Carbon monoxide has a high affinity for the hemoglobin in blood and can quickly replace oxygen. In high concentrations, carbon monoxide can cause chemical asphyxiation.

SECTION II - Recognition and Evaluation of Confined Space Hazards

Effect of Various CO Levels

CO Level in PPM*	Resulting Condition/Effect on Humans
50	Permissible exposure level, 8 hours (OSHA)
200	Possible mild frontal headache in 2 to 3 hours
400	Frontal headache and nausea after 1 to 2 hours Occipital after 2-1/2 to 3-1/2 hours
800	Headache, dizziness and nausea in 45 minutes Collapse and possibly death in 2 hours
1500	IDLH
1600	Headache, dizziness and nausea in 20 minutes Collapse and possibly death in 2 hours
3200	Headache and dizziness in 5 to 10 minutes Unconsciousness and danger of death in 30 minutes
6400	Headache and dizziness in 1 to 2 minutes Unconsciousness and danger of death in 10 to 15 minutes
12,800	Immediate effect unconsciousness Danger of death in 1 to 3 minutes

*PPM = parts per million
10,000 PPM = 1% by volume
IDLH = Immediately Dangerous to Life and Health

All values are approximate with the exception of the OSHA PEL. The effects can vary depending on the individual's health and the type of physical activity being performed.

Source: American Industrial Hygiene Association

- Hydrogen Sulfide

Hydrogen sulfide is a flammable, colorless gas with characteristic rotten-egg odor and is soluble in water. It is commonly found in areas where petroleum products are processed, is a by-product of manufacturing operations such as tanneries, is released during the decay of sulphur-containing organic matter and is encountered in sewers and sewage treatment plants. Hydrogen sulfide has a strong odor noticeable at low concentrations, but overall, this substance has poor warning properties because of rapid olfactory fatiuge. Employees will quickly lose their ability to smell the gas, even though the gas is still present in the space.

Effect of Various H_2S Levels

SECTION II - Recognition and Evaluation of Confined Space Hazards

H_2S Level in PPM*	Resulting Condition/Effect on Humans
0.13	Minimal perceptible odor
4.60	Easily detectable, moderate odor
10.0	Beginning eye irritation Permissible exposure level, 8 hours (OSHA, ACGIH)
27.0	Strong, unpleasant odor, but not intolerable
100	Coughing, eye irritation, loss of sense of smell after 2 to 5 minutes
200	Marked conjunctivitis (eye inflammation) and respiratory tract irritation after one hour of exposure
300	IDLH
500-700	Loss of consciousness and possibly death in 30 minutes to one hour
700-1000	Rapid unconsciousness, cessation (stopping or pausing) of respirations and death
1000-2000	Unconsciousness at once, with early cessation of respirations and death in a few minutes. Death may occur even if individual is removed to fresh air at once.

*PPM = parts per million
10,000 PPM = 1% by volume
IDLH = Immediately Dangerous to Life and Health

All values are approximate. The effects can vary depending on the individual's health and the type of physical activity being performed.

Source: American National Standards Institute (ANSI Standard No. Z37.2-1972)

- Methane (Natural Gas)

Methane is a colorless, odorless, flammable gas. It is a simple asphyxiate and displaces air in a confined space. The natural decaying process of organic materials is the most common source.

- Other Atmospheric Hazards

In addition to the above-mentioned atmospheric hazards, there are other substances which may also pose a danger to permit space entrants. These substances can result from residues remaining in vessels, cleaning solvents, welding operations, by-products from chemical reactions with cleaning solvents, leaks from lines not blocked and bled off correctly, etc.

SECTION II - Recognition and Evaluation of Confined Space Hazards

It is very important for employers to know the particular substances that could be found in a particular permit space that will be entered. Material Safety Data Sheets (MSDS) as required by the OSHA Hazard Communication Standard (29 CFR 1910.1200) must be available for the contents of any vessels/tanks/containers and for any solvents or by-products generated. The MSDS will provide valuable information on the substance including:

1) Flammability
2) Density (heavier or lighter than air)

3) Any acute or chronic health hazards
4) Lower Explosive Limit (LEL)

5) Upper Explosive Limit (UEL)
6) OSHA Permissible Exposure Limits (PELs)

7) ACGIH Threshold Limit Values (TLVs)
8) Immediately Dangerous to Life and Health (IDLH) Levels

Note to the Employer: OSHA has determined that an atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability for self-rescue, injury, or acute illness due to its health effects is not covered by this provision of the standard. An atmosphere that contains a substance at a concentration exceeding its PEL which is intended solely to prevent long-term adverse health effects is not considered to be a PRCS hazardous atmosphere on that basis alone, according to the standard.

Keeping this in mind, it is important for employers to accurately determine the health hazards associated with the specific substance(s) in the space. The substance(s) must be evaluated to see if it has either long-term (chronic) effects, acute (short-term) effects or both. Consult the Material Safety Data Sheets (MSDS) for the specific health hazard data. Substances which have Short Term Exposure Limits (STELs) and/or ceiling limits can generally be considered to have acute effects and thereby be considered a potential hazardous atmosphere.

It is important for employers to know that a space may be tested and found to have acceptable oxygen and combustible gas/vapor levels, but still have a toxic gas hazard. For this reason, the specific toxic substance must be tested and the results compared to Subpart Z or other available sources. When testing for toxic gases and vapors, it is especially important to know what substance is expected because toxic gas detectors are very specific. If the PEL is only to protect employees from long-term health effects, the atmosphere may not be a hazardous atmosphere under the Permit-Required Confined Space Standard. But, control measures must be taken such as ventilation controls, respiratory protection, etc., to ensure compliance with the OSHA General Industry Standard, subpart Z, 29 CFR 1910.1048.

- Combustible/Explosive Dust

Combustible dust may also pose a significant hazard to employees should their airborne concentration reach the lower flammability limit for the specific dust. Some common types of combustible/explosive dust include:

Food Products
- Grain dusts
- Flour
- Starches

Spices
- Pepper
- Tea
- Cinnamon

Metal Powders
- Aluminum
- Magnewium
- Zinc

Other Dusts
- Hard rubber
- Plastic

Wood Products
- Wood dust
- Cellulose

Many other organic as well as inorganic materials, if ground finely enough, will burn and support a flame.

OSHA believes that there is currently no reliable dust-monitoring equipment available to provide on-site combustible dust concentration measurements, especially at high dust levels. Therefore, OSHA suggests employers and employees safely approximate the condition visually. If the dust concentration obscures vision at a distance of five feet or less (1.52 meters), the concentration is likely excessive and control measures are required.

Steps that must be taken to prevent the potential hazard include such methods as:

- controlling sources of ignition

- utilization of exh aust ventilation
- fire suppression systems
- housekeeping

Engulfment Hazard

Engulfment is the surrounding or capturing of an individual by a liquid or finely divided loose (flowable) solid substances (e.g., sand, grain, sawdust, etc.) These substances may be already in a confined space or inadvertently allowed to enter a space and engulf a worker. Death of the occupant can be caused by suffocation or drowning. Asphyxiation of the entrant is due to inhalation, or plugging of their respiratory system, or compression of their torso. Particular care must be taken in storage containment areas (e.g., silos) where these materials may have air pockets which can collapse under the weight of an individual.

To prevent engulfment hazards, the liquid or fine bulk material should be removed from the permit space to eliminate the hazard prior to authorized entry. In situations where the material cannot be removed from the space, have the entrant wear a full-body harness and retrieval line, and only allow entry if the individual can be rapidly pulled out. Also, the space must be isolated. Isolation procedures are means to keep out any potential hazardous substance whether it be solid, liquid, or gas.

Isolation procedures include such means as:

- Locking out and/or tagging out all electrical circuits and valves.
- Disconnecting all lines entering the space and at a location as close to the space as possible.
- Using double block and bleed techniques. Blanks and blinds inserted in a flange as close to the vessel as possible to completely block it off.
- Test for leaks with an atmospheric monitoring device if toxic substances are a concern.

Entrapment of Configuration Hazards

An entrapment hazard exists when a permit space has an internal configuration that could trap or asphyxiate an entrant. Configurations which promote these types of hazards have inwardly converging walls or a floor which slopes downward and tapers to a small cross-section. Entrants can become trapped in the space or caught in machinery and severely injured or succumb to exposure or suffocation before they can be extricated. Proper permit entry procedures must be instituted.

Mechanical Hazards

Confined spaces may also pose mechanical hazards created by moving equipment or parts, and energized systems. Mechanical systems such as compressing devices, drive shafts, gears, grinding equipment, conveyors, mixers, rotors, mulchers, cutters, or the actual rotating or tumbling of the space itself are common hazards in some industries. Most accidents associated with these types of hazards are the result of not properly isolating the space. Machinery may be accidentally activated and the entrant crushed or electrocuted. Therefore, it is important to first identify any mechanical hazards present and effectively deactivate the system in accordance with standard isolation procedures including:

- Lock out and/or tagging out all electrical circuits and valves.
- Completely deenergize all mechanical, pneumatic, hydraulic systems.
- Ensure all stored energy is removed from the equipment.
- Block any equipment that could have stored energy or gravity-activated parts.

- Guard machinery.

Other Hazards

- Corrosive Chemicals

  Corrosive chemicals may present a hazard to entrants by causing eye or skin irritation sufficient to impair their ability for self-rescue. The permit space should be drained and purged, whenever possible. Care must be taken to ensure that the purging agent (e.g. air, steam, water, surfactant, etc.) will not adversely react with the substance.

  Personal protective equipment (e.g. protective clothing, gloves, boots, splash-proof goggles, etc.) must be available and worn during the entry operation. Eye wash and shower facilities, whether portable or stationary, must be available outside the space and must provide a minimum of 15-minutes of flushing capacity.

- Noise

  Excessive noise levels can be generated within permit spaces by grinding, welding, riveting, mechanical ventilation, etc. Due to sound reverberation within the space, noise levels are generally much higher than when the same task is performed outside the space. Noise levels could be high enough to interfere with communication between authorized entrant and attendant. In such circumstances, alternate or backup communication methods must be in place. The provisions outlined in the OSHA Noise Standard (1910.95) of Subpart G may also be required to protect the worker's hearing. In such cases monitoring to determine noise levels is required using a properly calibrated sound level meter. Hearing protection may also be required.

- Electrical Equipment

  Do not allow employees to take new hazards into the confined space. Routinely inspect all electrical equipment and tools, use ground fault circuit interrupters (GFCI) or low voltage transformers. If flammable/explosive atmospheres could possibly be of concern, use only explosion-proof equipment and spark-proof tools.

- Access with Ladders

  It is essential that authorized entrants be able to safely enter and quickly evacuate the permit space. Therefore, it is important to always maintain clear access to and from the space. Fixed or portable ladders are commonly used for access. In many situations ladders may be the only means of entry and egress. Therefore, ensure that proper ladder safety procedures are enforced.

- Lighting

  Adequate lighting must be provided to allow authorized entrants to safely enter and exit the confined space, and to perform their assigned tasks. If flammable or explosive atmospheres are possible, lighting must be approved for the location by being intrinsically safe. To avoid the potential of electrocution, which may be

of concern when water is present or the vessel is constructed of metal, lighting must be connected to ground fault circuit interrupters (GFCI).

- Thermal

Individuals engaged in strenuous activity in hot work environments are susceptible to heat stress exposure such as:

- heat stroke
- heat exhaustion
- heat cramps
- fainting

Individuals working in confined spaces are particularly at increased risk when wearing personal protective equipment.

- Falling/Tripping/Insecure Footing and Falling Object Hazards

These types of hazards are common in confined space entry operations. However, just because they are common does not mean that steps cannot be taken to reduce the risk associated with them. Policies should be established and workers given hazard awareness training to help in this goal. Procedures to keep in mind include:

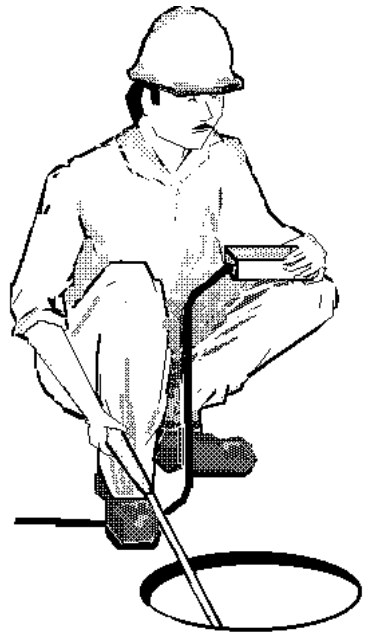
- Use good housekeeping practices (e.g., picking up tools around the confined space opening).
- Check ladders for slippery rungs. If there is any danger of falling from a ladder, have the worker wear a full-body harness attached to a fall-arresting and retrieval device.
- Tie off portable ladders.
- Wear the correct PPE (e.g., boots, helmets, etc.).
- Lower the equipment and tools safely by rope or baskets; never have the worker climb a ladder carrying tools.

SECTION II - Recognition and Evaluation of Confined Space Hazards

(Notes)

Atmospheric Monitoring Equipment & General Testing Protocol

Dangerous concentrations of gases and vapors may exist in a confined space and these hazards cannot be seen and may not be smelled. Therefore, air monitoring equipment is necessary to properly test the space prior to entry.



There are two (2) major types of direct reading atmospheric testing equipment used, electronic gas detectors and gas detector tubes. Direct reading instruments are portable units which can be carried in hand or worn on a belt. These devices may be subject to cross-sensitivity, which means that more than one chemical can give the same or similar response. Interfering chemicals may give a positive or negative deflection from the true atmospheric concentrations. Other factors, which are discussed later in this section, may have a direct influence on the proper use and reliability of this equipment. Therefore, it is very important that the individual performing the tests be properly trained on the actual use, maintenance, limitations, and proper selection of the appropriate instrument.

Electrical Gas Detection Monitors

Electrical gas detection instruments are battery-powered, direct-reading devices capable of providing continuous monitoring of a permit space. Oxygen monitors measure atmospheric concentrations generally over a range of 0 to 25 percent oxygen in air.

Combustible gas monitors display concentrations in percent of the LEL, some in percent by volume, and others display both. However, most combustible gas monitors display concentrations in percent of the LEL. Instruments that measure in the percent of the LEL are generally easier to use. For example, the LEL of methane is 5 percent by volume and the UEL is 15 percent by volume. When the concentration in a space reaches 2.5 percent by volume, it is 50 percent of the LEL. When the concentration reaches 5 percent by volume, it is 100 percent of the LEL.

Toxic gas monitors use specific electrochemical cells to measure substances such as carbon monoxide, hydrogen sulfide, chlorine, ammonia or other toxic gases of interest. The instruments are direct reading, available with either meters or digital read-outs and may also be equipped with alarms. Some instruments are equipped with a single sensor while others have multiple sensors to simultaneously measure a variety of gases. These devices are commonly referred to as 2-in-1, 3-in1, 4-in-1 monitors.

It is very important to select the instrument for the specific applications(s) to be encountered. Therefore, whenever specific contaminants have been identified, substance specific detectors should be used.

Special consideration must also be given to the use and interpretation of the results obtained from electrical gas meters under certain circumstances. The operator must be aware of situations which could interfere with the collection of accurate monitoring data. Instrument familiarization by the operator is needed for accurate atmospheric testing. A thorough understanding of the manufacturer's written operating instructions is a major component for the safe and effective use of the instrument. Therefore, employees who use this equipment must be trained on these

operating instructions and receive hands-on training as well. The operator should also be aware of the following facts concerning electrical gas monitors:

1. The instrument must be certified intrinsically safe for use in Class1, Division1, Groups A, B, C, and D hazardous locations.

2. Some combustible gas meter sensors are wheatstone bridge type sensors. This type of sensor can be easily poisoned by silicone vapors, leaded gasoline, sulfur compounds, and repeated exposure to halogenated hydrocarbons. This desensitization will cause erroneous low readings and appreciably reduce the life expectancy of the sensor.

3. The instrument selected must be specific to the substances likely to be found.

4. High relative humidity (90-100%) may cause a reduction in sensitivity and erratic behavior including an inability to properly calibrate the instrument.

5. Sensors have a limited life span, for example, oxygen sensors typically have a one year life span. Exposure to corrosive substances such as acid gases can significantly reduce sensors' life expectancy.

6. Erroneously low-readings can result from substances condensing in the sampling line or sensors. Substances such as chlorine, hydrogen sulfide, sulfur dioxide, and ammonia are some of the substances which can be absorbed into the sampling line. In drying ovens or unusually hot locations, solvent vapors with high boiling points may condense in the sampling lines.

7. Battery maintenance is very important. There are basically three different types of batteries currently used: nickel cadmium, alkaline, or sealed lead-acid. Each has advantages and disadvantages which should be researched with the manufacturer at the time of purchase.

8. Make sure the instrument has remote sampling capabilities.

9. Calibration of Electronic Gas Detectors

10. Gas detectors must be checked and calibrated each day prior to use. The inspection should include checking hoses, batteries, and any pumps the equipment might have. The unit must also be field tested using test gas cylinders containing known amounts of the substance to be encountered.

11. Oxygen meters should be calibrated in fresh air to 21%. They should also be tested to see if they respond to changes by holding one's breath and then breathing into the sensor. The sensor should drop to approximately 16%.

12. If the equipment does not calibrate properly, the unit must be removed from service. Replace the sensor or return the unit to the factory for repair and/or laboratory recalibration.

13. Operators should consult with the manufacturer's instructions or calibration curves when sampling for gases and vapors against which the instrument was not calibrated.

Detector Tubes/Pumps Method

SECTION III - Controls

Detector tube pumps are portable instruments which use a variety of detector tubes to measure the concentration of a wide variety of substances. The operating principle consists of drawing a known volume of air through a detector tube designed to measure the concentration of the substance of interest.

Detector tubes are easy to use and provide a relatively good idea of the concentration of a substance within a space. The length of stain or degree of color change corresponds to the relative concentration of the substance tested. The tubes are generally specific for the toxic substance of concern. However, the accuracy can be affected by cross-sensitivity. Therefore, the results must be interpreted in relation to the substances in the space.

Limitation for detector tubes include:

- Tubes can not be interchanged with different brands.
- Tubes may lack specificity; cross-sensitivity with other compounds is possible. Refer to the manufacturer's manual for effects of interfering substances.
- Detector tubes give only instantaneous results
- Tubes have a limited shelf-life (approximately 1-2 years). Refrigeration can extend their shelf life. However, tubes exceeding their expiration date should not be used.
- Accuracy ranges vary with each detector tube
- Tube accuracy is significantly affected by cold temperatures. In cold temperatures, try to keep the tubes in a pocket close to the body to keep them warm.

Calibrations and Maintenance:

Operators are reminded to consult the manufacturer's instructions for specific procedures for the calibration and maintenance of the instrument.

General recommendations when conducting atmospheric testing:

1) Use only monitoring instruments that have been properly calibrated and maintained and that are intrinsically safe.

2) Only trained operators who are skilled and knowledgeable with the use and limitations of the instrument should do the testing.

3) Check the area around the confined space opening for any hazardous gas or vapor concentrations.

4) Extreme care must be exercised when opening any confined space that may contain an explosive atmosphere. Some spaces may contain an atmosphere too rich to burn. But when opening the space, air entering will quickly change the atmosphere to an explosive one. Sparks from removing the hatch or cover could ignite the space. Therefore, insert the test probe into a vent hole when possible. If the manhole cover or hatch has no vent opening, open the cover just far enough to insert the probe into the space. Spark-proof tools must be used. If unacceptable levels are obtained, it will be necessary to purge and ventilate the space. All levels and remote areas of the space need to be tested. An extension device should be used for this purpose. If a hazardous atmosphere is detected, avoid having employees lean over the opening or breathe the air coming out of the space.

5) Oxygen content is always tested first. Make sure sufficient oxygen is available to support the use of the combustible gas monitor. A minimum of 16% oxygen is required for the combustible has monitor to function

properly. The sampling protocol requires that combustible gas levels in the confined space be checked next. Flammable gases or vapors must not exceed 10% of the lower flammability limit (LFL).

6) Toxic substances are measured next in parts per million (ppm). Again, the equipment used mu st be specific and sensitive to the substance likely to be found in the space. Never use a standard flammable gas monitor sensor to test for a toxic substance. The results could be deadly as the following example will show.

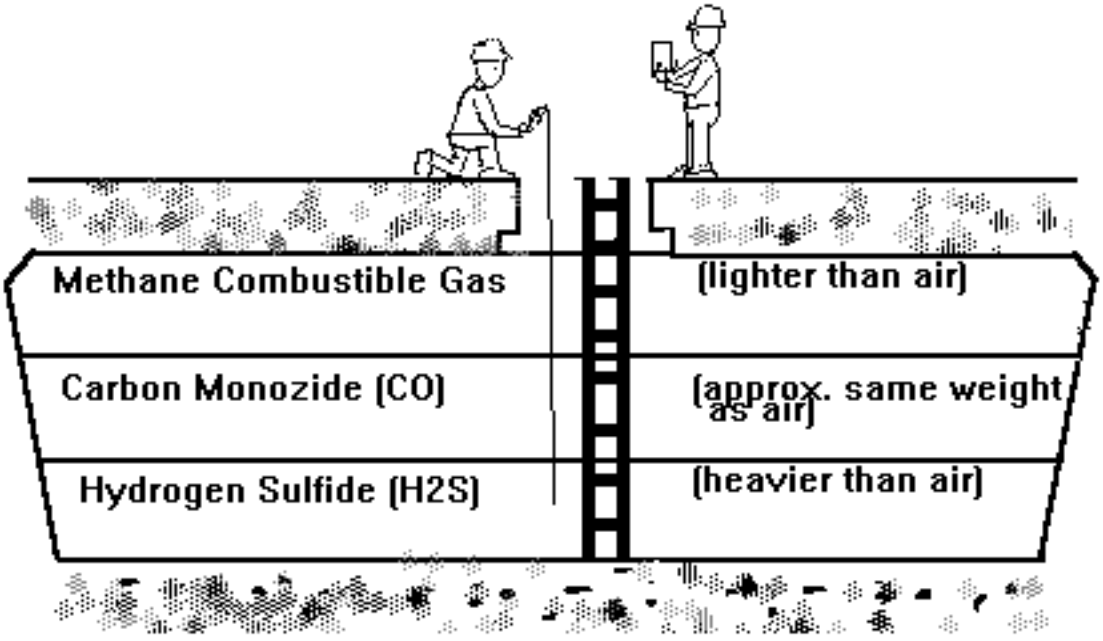
Hydrogen Sulfide

Percentage of LFL	PPM
100%	43,000
10%	4,300
5%	2,150
.7%	300 IDLH
.02%	10 PEL

Hydrogen sulfide is a common toxic gas encountered in many permit space locations. Hydrogen sulfide has an LFL of 4.3% or 43,000 ppm. The standard requires maintaining an environment of less than 10% of the LFL to avoid a potential explosion. Hydrogen sulfide also has Permissible Exposure Limit (PEL) of 10 ppm and an Immediate Dangerous to Life and Health (IDLH) concentration of 300 ppm. Say, for example, the LFL is found to be 5%, though the testing indicates no explosive hazard, it does indicate a level of approximately 2,150 ppm which exceeds the PEL and IDLH.

7) Some toxic substances may not respond very well to electrical gas sensors or detector tubes so more specialized test equipment or laboratory analysis may be necessary.

8) Depending on their density, some gases are heavier than air, others lighter, and some gases are nearly the same weight as air. As a result, gases and vapors will stratify within a given confined space. Therefore, the only safe way to test the atmosphere of a confined space is to sample all levels (top, middle, bottom) with properly calibrated equipment. When monitoring for entries involving a descent into atmospheres which may be stratified, the atmospheric envelope should be tested a distance of approximately four feet (1.22 meters) in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of progress should be slowed to accommodate the sampling speed and detector response.



Ventilation

Once a confined space has been determined to contain or potentially contain a hazardous atmosphere, steps must be taken to ventilate the space before personnel are allowed to enter. Ventilation can be accomplished by natural and mechanical means for the general purpose of:

- Controlling atmospheric contaminants
- Prevention of fire and explosion hazards
- Control of heat and humidity

Natural Ventilation

Natural ventilation is performed by removing roof and side covers and allowing natural air currents to remove gases and vapors. Natural ventilation employs wind and thermal convection to dilute any atmospheric hazard. However, the configuration of some confined spaces and the unpredictability of wind currents and thermal effects makes natural ventilation unreliable as a primary control method. When natural ventilation is insufficient to achieve and maintain acceptable atmospheric levels, mechanical ventilation is necessary.

Mechanical Ventilation

Mechanical ventilation typically refers to mechanical dilution ventilation and local exhaust capture ventilation. The applicability of each method is dependent on the type of atmospheric hazard present, whether the hazard is created by the contents in the space, or created by an operation conducted within the space. When alternative procedures are used, mechanical dilution ventilation is prerequisite.

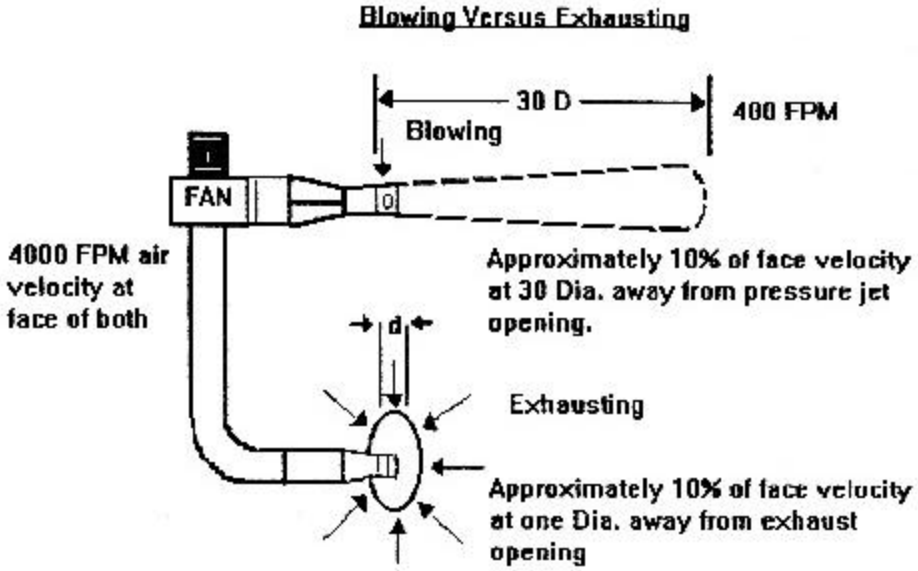
Mechanical Dilution Ventilation

SECTION III - Controls

This method uses mechanical means (fans, blowers, etc.) to provide uncontaminated air to a permit space. This control measure places the permit space in a positive pressure atmospheric condition. If the amount of fresh air being supplied to the space is sufficient, the concentrations of toxic and flammable contaminants can be maintained at acceptable levels. The acceptable dilution ventilation method commonly used is to supply clean air by explosion-proof blowers located far enough away from any source of contamination.

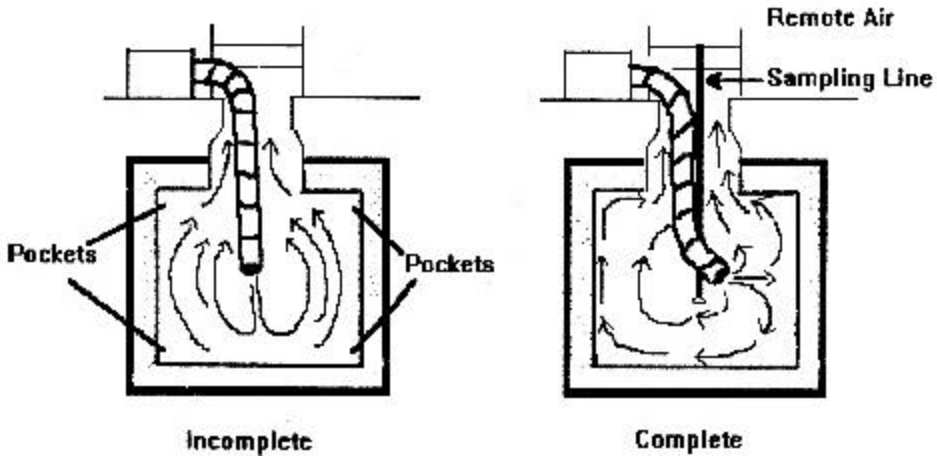
Portable Ventilating Unit with Flexible Ductwork

Air should be blown into a space, which contains a hazardous atmosphere. Remember that contaminants are likely heavier or lighter than air. Blowing air into a space will agitate and help evaporate the contaminants and disperse them throughout the space. A space under positive pressure will eventually expel the contaminant through any openings in the space. Theoretically, air blows a distance of 30 diameter times farther than it can be exhausted.



If an actual or potential hazardous atmosphere exists, then purging of the space is necessary. Keep in mind that forced air ventilation must be directed to ventilate the immediate area where an employee will be or is working. However, during the initial pre-entry ventilation procedure, the blowing duct outlet should be positioned for uniform dilution and elimination of any gas pockets as illustrated. Shown below are examples of complete and incomplete ventilation of manholes:

SECTION III - Controls



When purging a space, an effective initial purging duration must be determined. The following is a list of instructions for determining purging times using the nomographs (line charts) provided.

Instructions

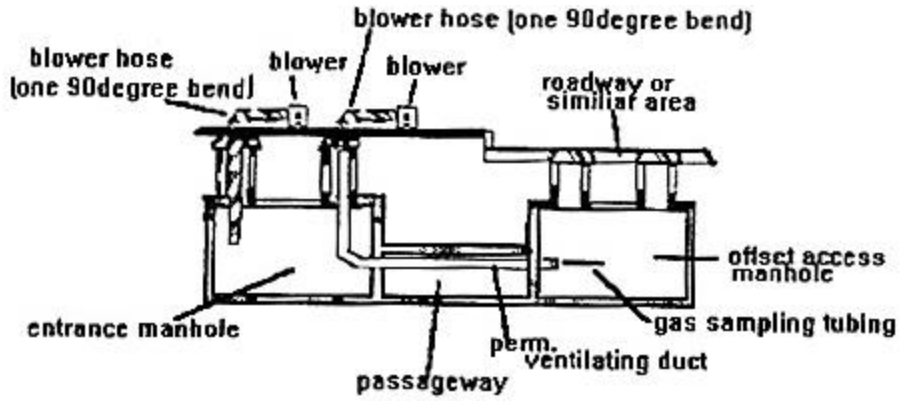
1) Test the confined space atmosphere to determine the initial atmospheric conditions.

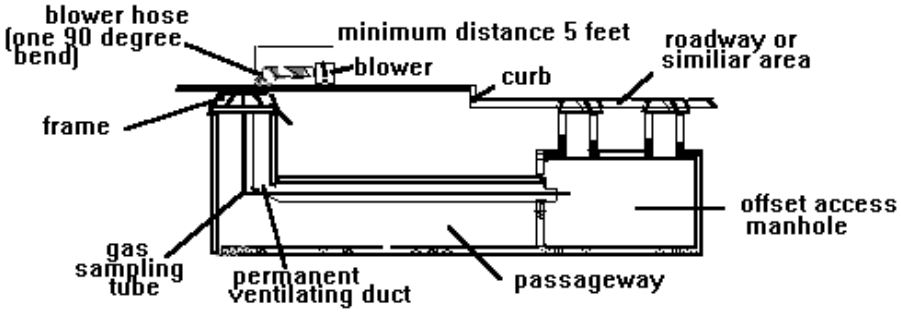
2) Use the alignment chart to determine the minimum purging time required by:
   a) placing the straight edge on the Confined Space Volume (left scale);
   b) placing the other end of the straight edge on the Blower Capacity (right scale);
   c) read the minimum required purging time from the diagonal scale in minutes
   d) if two blowers are used, add the two capacities and then proceed as outlined above.

3) Note, the effective blower capacity is affected by the number of bends and length of the hose. As the length of hose and the number of bends increases, the effective blower capacity will decrease. The effective blower capacities listed in the alignment charts are based on one to two 90 degree bends and standard 15-foot blower hose.

4) It is very important to remember that these values are theoretical approximations with safety margins included. The duration for purging a space is dictated by not only the size and blower capacity, but also by the configuration, number of openings and the airborne contaminant. The configuration of some confined spaces, for example multi-floor-level spaces or baffled spaces, restrict air flow and require additional purging time. In some situations, adequate purging and venting can only be achieved through permanently installed ventilation ducts that will introduce fresh air directly into the space. In light of this, employers are encouraged to install permanent ventilation ducts whenever possible. Examples are shown in the following illustrations.

SECTION III - Controls





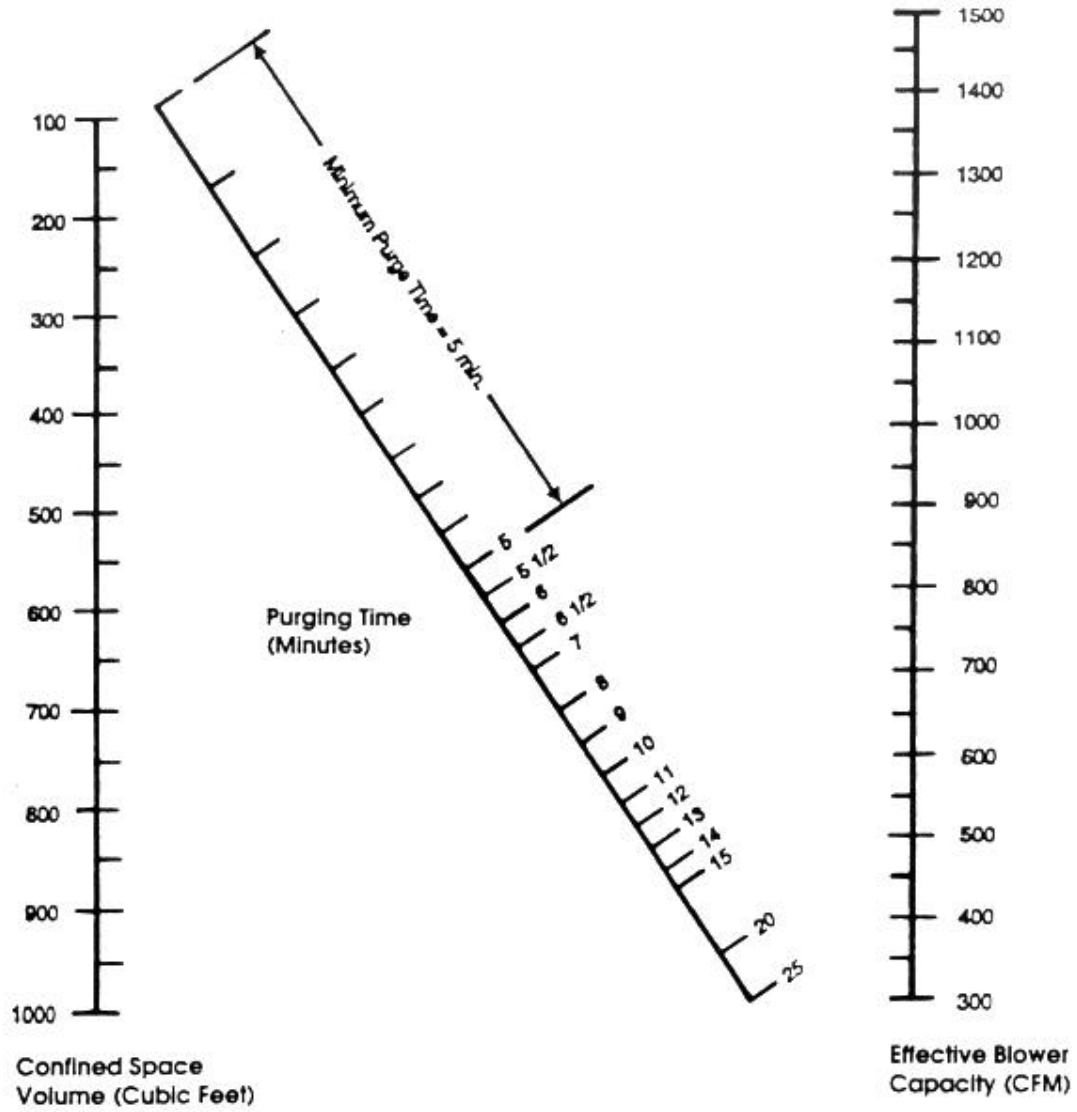
5) Employers are further reminded that under no circumstance should entry be allowed at the end of the purging time until the atmosphere is tested and shown to be within acceptable levels. If unacceptable levels are obtained, then it will be necessary to repeat the process.

6) If forced air ventilation is necessary to control any existing potential atmospheric hazards, then the blower must remain in constant operation for the duration of the permit space entry operation.

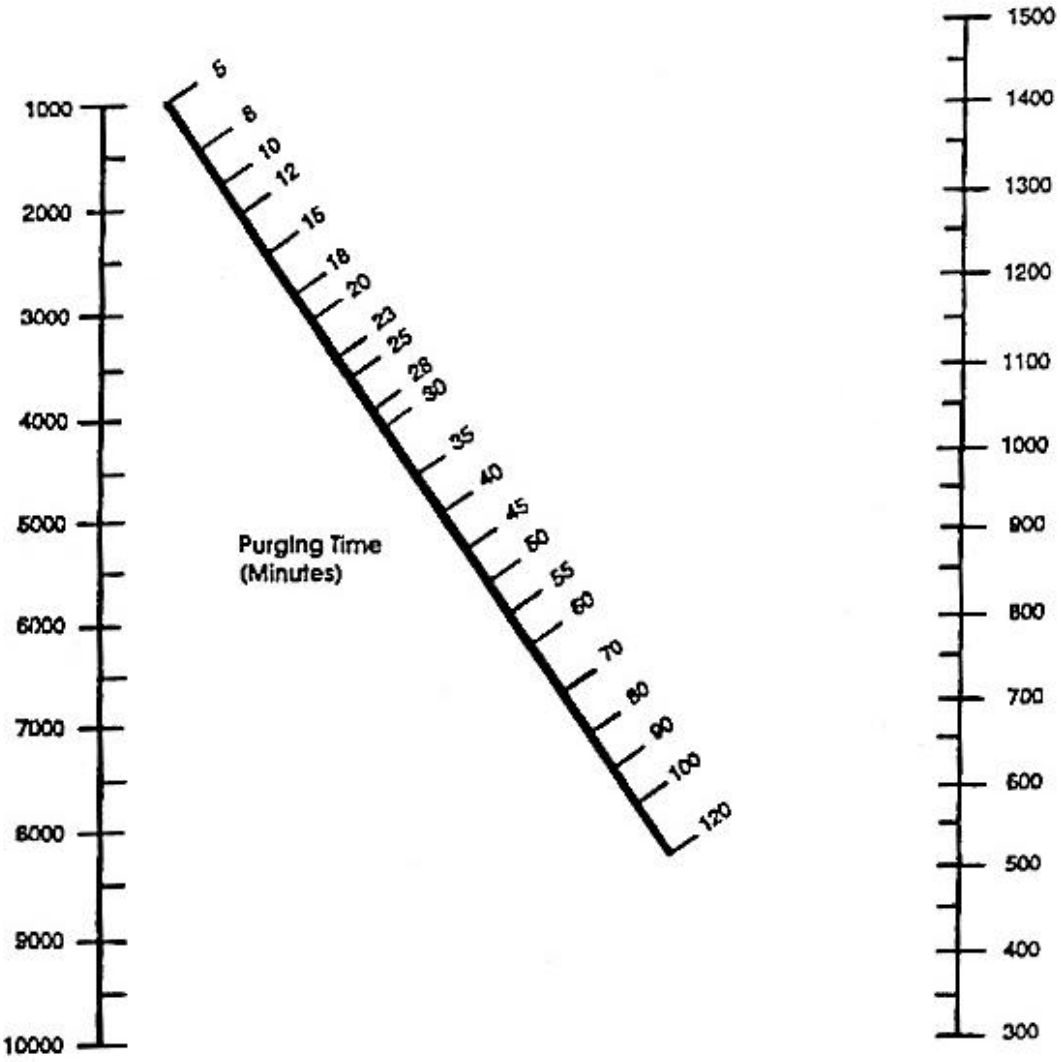
   The theoretical purging time can also be determined using the ventilation calculations provided.

SECTION III - Controls

Alignment Chart - Side 1



Alignment Chart, Side 2



Confined Space Volume (Cubic Feet)

Effective Blower Capacity (CFM)

VENTILATION CALCULATIONS

1) Determine the flow rate (Q) required to achieve 20 air changes per hour (ACH) in an underground lift station 20 ft. high, 40 ft. long, and 20 ft. wide.

EQUATION $N = \frac{Q \times 60}{VOL}$

$20\ ACH = \frac{Q \times 60\ min/hr}{}$

N = Nos. of ACH
Q = Ventilation Flow Rate (CFM)
60 = Constant (mins/hrs)
Vol = Space Volume (ft^3)

SECTION III - Controls

$$Q = \frac{20 \text{ AC/hr} \times 16{,}000 \text{ ft}^3}{60 \text{ mins/hrs}}$$

16,000 ft^3

N = 20
Q = ?
Vol = 20x40x20 = 16,000 ft^3

ANS = 5,333 ft3 /min

2) A permit-required confined space 20'x30'x10' in size is found to have an initial concentration of 250 parts per million (ppm) of carbon monoxide. How long will it take to lower the concentration to 50 ppm using a portable ventilation unit with a flow rate of 1000 cfm?

EQUATION $t = -2.303 (Vol/Q) \times \log (C_2/C_1)$

$t = 2.303 \times (6{,}000 \text{ ft}^3/1{,}000 \text{ ft}^3/\text{min}) \times \log (50\text{ppm}/250 \text{ ppm})$

ANS t = 9.6 mins.

t = time (minutes)
Vol = space volume (ft^3)
Q = ventilation flow rate (CFM)
C_1 = initial contaminant concentration (ppm)
C_2 = final contaminant concentration (ppm)
t = ?

Vol = 20'x30'x10' = 6,000 ft^3
C_1= 250 ppm
C_2 = 50 ppm
Q = 1,000 cfm
-2.303 = constant

3) What will be the concentration of hydrogen sulfide (H2S) after 20 minutes of purging a cylindrical tank (40' high with a 10' diameter)? The initial concentration is 200 ppm and the ventilation rate is 800 cfm.

EQUATION $C_2 = C_1 \times e^{(-Qt/Vol)}$

C_1 = initial contaminant concentration
C_2 = final contaminant concentration
e = inverse natural log
Q = ventilation flow rate (CFM)
t = time (minutes)
Vol = Space volume (ft^3)

C_1 = 200 ppm
C_2 = ?

Q = 800 fpm
t = 20 mins.
vol = space volume (ft^3) = 40' x [TT x D^2]/4]= 40' x [3.14 x 100]/4 = 40x 78.5 = 3140 ft^3

$C_2 = 200 \text{ ppm} \times e^{(-800 \text{ ft}^3/\text{min} \times 20 \text{ mins}/3{,}140 \text{ ft}^3)}$

$= 200 \text{ ppm} \times e^{-5.1}$

ANS C2 = 1.2 ppm

SECTION III - Controls

Localized Exhaust Ventilation

Dilution ventilation is seldom effective in controlling fume and dust-generating processes. However, localized exhaust ventilation is better suited to capture contaminants at or near their point of generation using hoods or enclosures with duct work connected to an exhaust fan. The contaminated air is discharged outside the confined space, thereby preventing its release into the employees' breathing zones. This type of capture control is especially effective for welding, cutting, burning and brazing operations. The ventilation system should maintain and exhaust airflow velocity of at least 100 linear feet per minute in the capture zone. Capture velocities decrease significantly as the distance between the exhaust hood inlet and welding source is increased. A good rule is to keep the exhaust inlet within six to eight inches of the source.

Some operations may require both mechanical dilution and localized exhaust ventilation to adequately control contaminants in permit spaces. Ventilation must be continuous during the entire length of the entry operation to ensure that the ventilation remains adequate and atmospheric hazards do not develop. Frequent or continuous testing must be performed for the entire length of the entry operation to ensure that the ventilation remains adequate and atmospheric hazards do not develop.

Choosing the most efficient ventilation system will depend on careful evaluation of the permit space. Some factors to consider in this evaluation process include:

- The fan or blower capacity.
- The configuration and size of the space.
- The number and size of the openings.
- The airborne contaminant, its properties, and its point of generation.
- Positioning the blower or exhaust fan so that there are no unnecessary bends in the hose. A 90 degree bend or two can reduce efficiency significantly.
- Increasing the length of hose will increase the friction and decrease the efficiency.
- Make sure the ventilation system does not block the exit if only one exit is available. Make sure the authorized entrants can quickly evacuate the space.

Cleaning and Purging of Permit Spaces

Residues of hazardous chemicals or materials capable of decomposing (e.g., food products) must be cleaned from the permit space to the extent feasible prior to allowing entry. Pre-entry cleaning and purging are necessary because even small amounts of some remaining materials can create hazardous atmospheres. Some basic steps to pre-entry cleaning include:

- First ensure that all material feed lines and equipment are completely and effectively isolated from the confined space.
- Drain or pump out contents and remove as much residue as feasible
- Test for hazardous atmosphere. If the test indicated harmful gases, vapors or mists, the space must be purged and ventilated.
- The particular purging agent used will depend on such things as: the product in the permit space and how it might react with the purging agent; the work to be performed in the space; and the suspected hazards.
- To remove flammable atmospheres, it may be necessary to purge the space with an inerting gas such as nitrogen, carbon dioxide, argon, etc. Other times, it may be possible to open the space to allow air to naturally ventilate the space.

SECTION III - Controls

- Flammable and toxic residues on the walls and floor should also be removed prior to entry. Water is commonly used. If the residue can not be washed away, steam may be used. However, be aware that steam may not be suitable for use in some situations where the substance has a low ignition temperature or flash point. This is because the steam condensate could build up a static electric charge and create a spark, thereby igniting the flammable atmosphere. In situations where steam is needed to clean or purge a vessel, make sure that the static electricity is eliminated by bonding and grounding the steam lines and vessel. Also, allow plenty of time for the space to cool down after steam is used.
- Occasionally, cleaning solvents may be needed. In these circumstances, make sure that the cleaning compound is compatible with the residue to be cleaned from the space.
- Never assume that the space is safe for entry after the purging and cleaning process is completed. The atmosphere in the space must be tested prior to entry. If a hazardous atmosphere still exists or potentially exists, purge and clean the space again.
- Continue to ventilate the space and conduct atmospheric testing frequently or continuously during the entire entry procedure.
- In the situations where the purpose of entry is to clean the confined space, the space must first be cleaned to the extent possible from the outside. Proper personal protective equipment must be used to protect individuals from any hazards which might remain after the pre-entry cleaning. If atmospheric hazards cannot be brought to acceptable levels by purging, cleaning and continuous ventilation, then special procedures must be put in place after properly evaluating the situation. If it is determined that an individual must enter the permit space, then these special precautions will include respiratory protection such as an airline respirator with escape bottle of Self-Contained Breathing Apparatus (SCBA). Note, most companies only allow such types of entries during emergency situations because of the immediate dangers and risks.

Isolation and Lockout/Tagout Procedures

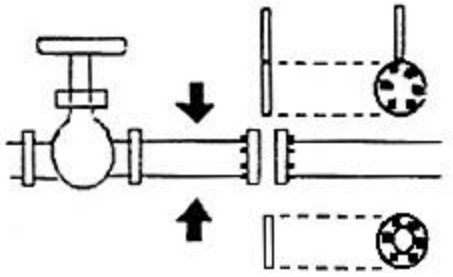
Prior to allowing personnel to enter into a permit space, the space must be evaluated to determine what energy sources or hazardous materials are present or potentially present. Steps must be taken to isolate the space to prevent injury to entrants by disconnecting, releasing or restraining all energy sources and/or hazardous chemical materials. Energy sources may include mechanical, electrical, pneumatic, hydraulic, thermal, radioactive and the effects of gravity; chemical hazards may include flammable, reactive, toxic, irritating, corrosive or oxygen displacing gases and vapors.

Isolation Procedures

Isolation procedures for chemical or gas lines must be instituted to eliminate potential hazards by such methods as:

- blanking and blinding,
- double-block and bleed,
- line breaking or misalignment and,
- lockout/tagout.

SECTION III - Controls



Blanking and Blinding is the absolute closure of a pipe, line or duct by the fastening of a solid plate, that completely covers the bore hole, in line with the system. This plate (such as a spectacle blind or a skillet blind) should be made of the same material as the line and must be able to withstand the maximum pressure exerted by the line. This method involves installing a blank between flanges with a leak-proof gasket at a point in the conducting line as close to the confined space area as possible. The blank or blind should be marked identifying its purpose.

Double Block and Bleed is a method that uses a three-point system to prevent leakage into the confined space, two closed valves and an open drain or vent valve located in between. Lockout or tagging the valves in their required positions provides additional protection.

Line Breaking is the intentional and physical disconnection of a pipe, line or duct. Added protection is obtained by misaligning or removing a section of the pipe, line or duct. Lines where potentially hazardous residues might remain downstream from the disconnecting point should be purged. Any disconnected line, blank or block valve should be checked with an atmospheric testing monitor to make sure it is not leaking.

Lockout/Tagout

The standard recognizes that energized parts of electrical equipment and mechanical equipment pose a significant hazard in many permit spaces. As such, circuit parts of electrical equipment must be deenergized and locked out/tagged out or both in accordance with 29 CFR 1910.333. Mechanical equipment must be locked out/tagged out or both in accordance with 29 CFR 1910.147 or guarded in accordance with Subpart O of the General Industry Standard.

General requirements for effective lockout/tagout programs include the following terms:

- Identify and implement specific procedures, in writing, for the control of hazardous energy including preparation for shutdown, equipment isolation, lockout/tagout application, release of stored energy and verification of isolation.
- Use locks where equipment can be locked out
- Ensure that new equipment or overhauled equipment can accommodate locks.
- Employ additional means to ensure safety when tags rather than locks are used.
- Institute procedures for release of lockout/tagout including machine inspection, notification and safe positioning of employees and removal of the lockout/tagout device.
- Obtain standardized locks and tags which indicate the identity of the employee using them and that are of sufficient quality, durability and quantity to ensure their effectiveness
- Require that each lockout/tagout device be removed by the employee who applied the device

SECTION III - Controls

- Train employees in the specific energy control procedures with training reminders as part of the annual inspection of the control procedures.
- Adopt procedures to ensure safety when equipment must be tested during servicing, when outside contractors are working at the site, when a multiple lockout is needed for a crew servicing equipment and when shifts or personnel change.

Control of Combustible/Explosive Dust

As discussed previously, combustible dust may also pose a hazard in permit spaces. In circumstances where explosive dust concentrations may possibly meet or exceed their lower flammability limit, measures are required to control or eliminate the hazard. The following measures are recommended to provide a safe environment for the employees:

- Housekeeping - dust explosions commonly occur in series. The initial explosion stirs up more dust and this additional dust propagates a secondary explosion. The interior surfaces should be kept as clean as possible and accumulations kept to a minimum.
- All sources of ignition must be removed from the permit space. All equipment must be in compliance with the National Fire Protection Association (NFPA) 70 - National Electrical Code for hazardous locations.
- Static electricity must be prevented from accumulating by proper bonding and grounding methods. The relative humidity should also be maintained to approximately 40-60%.
- Ventilation may also be necessary to control the airborne dust hazard where needed (see Ventilation Control Section).

PERSONAL PROTECTIVE EQUIPMENT

Permit spaces may pose many types of potential hazards for personnel required to enter or working nearby. Various types of equipment may be necessary to ensure the safety of these individuals. Proper planning and evaluation will determine what equipment is needed. Equipment which may generally be required include:

HEAD PROTECTION: Head injuries are caused by falling objects or by bumping the head against a fixed object. Head protection, in the form of protective hats, must do two things -- resist penetration and absorb the shock of a blow.

Selection - Each type of class of head protectors is intended to provide protection against specific hazardous conditions. An understanding of these conditions will help in selecting the right hat for the particular situation. For industrial purposes, three classes are recognized:

Class A - general service, limited voltage protection;
Class B - utility service, high-voltage helmets; and
Class C - special service, no voltage protection.

SECTION III - Controls

EYE AND FACE PROTECTION: Employers must provide eye and face protection suitable for the work to be performed and employees must use this equipment.

Suitable eye protectors must be provided where there is a potential for eye injury from machines, flying objects, glare, liquids, injurious radiation or a combination of these. Protectors must meet the following minimum requirements:

- Provide adequate protection against the particular hazards for which they are designed:
- Be reasonably comfortable when worn under the designated conditions:
- Fit snugly without interfering with the movements or vision of the wearer;
- Be capable of being disinfected;
- Be easily cleanable; and
- Be kept clean and in good repair.

Where employees are at risk of contact with corrosive chemicals, an eyewash with at least 15 minutes flushing capacity is required.

Design, construction, testing and use of eye and face protection must be in accordance with ANSI Z87.1-1989.

HEARING PROTECTION: Exposure to high noise levels can cause hearing loss. It may also create physical and psychological stresses such as increased blood pressure, abnormal secretion of hormones and tensing of muscles.

The extent of damage primarily depends on the intensity of the noise and the duration of exposure. Short-term exposure to noise can cause temporary hearing loss. Permanent damage is generally gradual and the result of prolonged exposure to high noise levels. There is no cure for permanent noise-induced hearing loss, so prevention is the key.

Control measures must be instituted to prevent hearing loss. When possible, noise should be reduced or controlled by engineering controls. In situations where engineering controls cannot be used, another effective method is the use of hearing protection. Hearing protection comes in many different types such as formable premolded plugs, semi-aural or canal caps and earmuffs. Each type has advantages and disadvantages, as well as different noise reduction ratings (NRR). The protection used should reduce the noise levels to at least 90 decibels (dB) , and 85 dB for those individuals who have experienced a significant hearing threshold shift. Under some conditions, such as when noise levels exceed 100 dB, it is necessary to use combinations of hearing protection to ensure adequate protection.

When employees are exposed to noise levels exceeding 85 decibels, OSHA requires that the exposed individual be included in a hearing conservation program. For more specific information on a hearing conservation program, refer to 29 CFR 1910.95 - Occupational Noise Exposure.

Employees must be properly trained in correct use, maintenance and the limitations of the hearing protection they use. Employees should be able to select from a variety of hearing protection to ensure that the equipment fits properly and is comfortable to wear.

In permit spaces, excessive noise can interfere with communication between the authorized entrant and attendant. In situations where excessive noise exists and the entrant must wear hearing protection, steps must be taken to ensure that communication is maintained. The communication method used must ensure that the entrant can immediately respond to an attendant's order to evacuate the space if a prohibited condition or situation arises. The method used must also enable the attendant to detect any behavioral changes in the authorized entrant. In some entry operations,

tugging on a rope may be adequate to ensure effective communication. In other circumstances, an intrinsically safe electronic communication system may be needed. Some electronic communication systems have headsets which also have a noise reduction rating assigned to them.

Intrinsically safe American National Standards Institute (ANSI) Type II Sound Level Meters (SLM) should be used to determine employee noise exposure levels. An SLM is a lightweight instrument for the measurement of sound pressure levels in decibels (dB). At a minimum, the device should measure on the A-weighted scale at the slow level response setting. The instrument should be calibrated in accordance with the manufacturer's instructions.

TORSO PROTECTION: Many potential chemical and physical hazards may threaten the torsos of permit space entrants such as contact with chemicals, temperature extremes, cuts and abrasions. Part of any pre-entry evaluation involves determining the proper protective clothing to use to protect workers from these hazards. Manufacturers provide a large selection of protective clothing for specific applications. General selection categories include single use and reusable clothing for particulate and chemical protection, full body chemical splash protection suits, insulated workwear and specially flame-resistant clothing.

ARM AND HAND PROTECTION: Potential hazards to the arms and hands of employees working in or around confined spaces can result in such injuries as absorption of chemicals, burns, cuts, and electrical shock. There is a wide assortment of gloves, hand pads, sleeves and wristlets for protection from various hazardous situations. The protective device should be selected to fit the job.

The following items should be considered when selecting chemical protective gloves and clothing:

- Choose gloves designed to protect against the specific chemical of concern.
- Keep in mind all chemicals will eventually permeate through protective clothing.
- Combinations of protection may be required since no single protective material can protect against all chemicals.
- Chemicals absorbed by protective clothing continue to permeate through the protective material.
- Consult with the chemical protective clothing manufacturer to determine the appropriate material for the specific chemical of concern. Employers may also want to test the material against the chemicals to be encountered to ensure its integrity.
- Certain occupations call for special protection. For example, electricians need special protection from shock and burns. Rubber is considered the best material for insulating gloves and sleeves. Rubber protective equipment for electrical workers must conform to the requirements established by ANSI.

FOOT AND LEG PROTECTION: For protection of feet and legs from falling or rolling objects, sharp objects, molten metal, hot surfaces and wet slippery surfaces, workers should use appropriate footguards, safety shoes, or boots and leggings. To be acceptable, safety footwear must meet ANSI requirements.

RESPIRATORY PROTECTION: OSHA standards require employers to establish and maintain a respiratory protection program whenever respirators are necessary to protect the health of employees. Before discussing the requirements of OSHA's respirator standard, it will be useful to review the various types of available respirators.

Respiratory protective devices fall into three classes: air-purifying; atmosphere or air supplying; and combination air-purifying and air-supplying devices. A brief discussion of each follows:

Class 1. Air-Purifying Devices

SECTION III - Controls

The air-purifying device cleanses the contaminated atmosphere. Chemicals can be used to remove specific gases and vapors and mechanical filters can remove particulate matter. This type of respirator is limited in its use to those environments where the air contaminant level is within the specified concentration limitation of the device. These devices do not protect against oxygen deficiency.

"Oxygen deficiency" means that the concentration of oxygen is below the percentage found in normal air and atmosphere-supplying respiratory protection must be provided. It exists in atmospheres where the percentage of oxygen by volume is less than 19.5 percent oxygen.

The various types of air-purifying devices include mechanical-filter cartridge; chemical-cartridge, combination mechanical-filter/chemical-cartridge, gas masks; and powered air-purifying respirators.

Mechanical-filter respirators offer respiratory protection against airborne particulate matter, including dusts, mists, metal fumes and smokes, but do not provide protection against gases or vapors.

Chemical-cartridge respirators afford protection against low concentrations of certain gases and vapors by using various chemical filters to purify the inhaled air. They differ from mechanical-filter respirators in that they use cartridges containing chemicals to remove harmful gases and vapors.

Combination mechanical-filter/chemical-cartridge respirators use dust, mist or fume filters with a chemical cartridge for dual or multiple chemical exposures.

Gas masks afford respiratory protection against certain gases, vapors, and particulate matter. Gas masks are designed solely to remove specific contaminants from the air; therefore, it is essential that their use be restricted to atmospheres which contain sufficient oxygen to support life. Gas masks may be used for escape only from atmospheres that are immediately dangerous to life or health (IDLH), but never for entry into such environments.

"IDLH" means an atmospheric concentration of any toxic, corrosive or asphyxiate substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

Canisters for gas masks are color-coded according to the contaminant against which they provide protection. This information is included in the standard.

Powered air-purifying respirators protect against particulate, gases and vapors. The air-purifying element may be a filter, chemical cartridge, combination filter and chemical cartridge, or canister. The powered air-purifying respirator uses a power source (usually a battery pack) to operate a blower that passes air across the air-powered air-purifying respirator. It usually supplies air at positive pressure (relative to atmospheric) so that any leakage is outward from the facepiece. However, it is possible at high work rates to create a negative pressure in the facepiece, thereby increasing facepiece leakage.

Class 2. Atmosphere- or Air-Supplying Devices

Atmosphere- or air-supplying devices are the class of respirators that provide a respirable atmosphere to the wearer, independent of the ambient air. Atmosphere-supplying respirators fall into three groups: supplied-air respirators, self-contained breathing apparatus (SCBA), and combination-SCBA and supplied-air respirators. A brief discussion of each follows:

SECTION III - Controls

Supplied-air respirators. These devices deliver breathing air through a supply hose connected to the wearer's facepiece or enclosure. The air delivered must be free of contaminants and must be from a source located in clean air. The OSHA requirements for compressed air used for breathing, including monitoring for carbon monoxide, are listed in 1910.134(d). Supplied-air respirators should only be used in non-IDLH atmospheres.

There are three types of supplied-air respirators: Type A, B and C. Type A supplied-air respirators are also known as hose masks with blower. Air is supplied by a motor-driven or hand-operated blower through a durable, large diameter hose. Type B supplied-air respirators are hose masks as described above without a blower. The wearer draws air through the hose by breathing. Type C supplied-air respirators are commonly referred to as air-line respirators. An air-line respirator must be supplied with respirable air conforming to Grade D Compressed Gas Association's Standard CGA G7.1-73, Commodity Specification for Air, 1973. This standard requires air to have the oxygen content normally present in the atmosphere, no more than 5 milligrams per cubic meter (mg/M3) of condensed hydrocarbon contamination, no more than 20 parts per million (ppm) carbon monoxide, no pronounced odor and a maximum of 1,000 ppm of carbon dioxide.

There are three basic classes of air-line respirators -- continuous-flow, demand-flow, and pressure-demand flow.

Continuous flow. A continuous-flow unit has a regulated amount of air fed to the facepiece and is normally used where there is an ample air supply such as that provided by an air compressor.

Demand flow. These air-line respirators deliver air flow only during inhalation. Such respirators are normally used when the air supply is restricted to high-pressure compressed air cylinders. A suitable pressure regulator is required to make sure that the air is reduced to the proper pressure for breathing.

Pressure-demand flow. For those conditions where the possible inward leakage (caused by the negative pressure during inhalation that is always present in demand systems) is unacceptable and where there cannot be the relatively high air consumption of the continuous-flow units, a pressure-demand air-line respirator may be the best choice. It provides a positive pressure during both inhalation and exhalation.

Types A, B, and C that are approved for abrasive blasting are designated AE, BE, and CE respectively. These respirators are equipped with additional devices designed to protect the wearer's head and neck against impact and abrasion from rebounding abrasive material and with shielding to protect the windows of facepieces, hoods and helmets.

Self-contained breathing apparatus (SCBA) provide complete protection against toxic gases and an oxygen deficiency. The wearer is independent of the surrounding atmosphere because he or she is breathing with a system that is portable and admits no outside air. The oxygen or air supply of the apparatus itself takes care of respiratory requirements.

Self-contained Breathing Apparatus

There are two basic types of self-contained breathing apparatus: closed-circuit and open-circuit. In the closed -circuit apparatus, the exhalation is rebreathed by the wearer after the carbon dioxide has been effectively removed and a suitable oxygen concentration restored from sources composed of: compressed oxygen; or chemical oxygen; or liquid-oxygen. In the open-circuit apparatus, exhalation is vented to the atmosphere and is not rebreathed. There are two types of open-circuit SCBAs: demand and pressure-demand.

Combination-SCBA and supplied-air respirators are air-line respirators with an auxiliary self-contained air supply. An auxiliary SCBA is an independent air supply that allows a person to evacuate an area or enter such an area for a

very short period of time where a connection to an outside air supply can be made. These devices are approved for use in IDLH atmospheres. The auxiliary air supply can be switched on in the event the primary air supply fails to operate. This allows the wearer to escape from the IDLH atmosphere. Combination air-line respirators with auxiliary SCBA are designed to operate in three modes: continuous-flow, demand-flow, and pressure-demand flow.

Class 3. Combination Air-purifying and Atmosphere-Supplying Devices

This type of device is a combination of an air-line respirator with an auxiliary air-purifying attachment, which provides protection in the event the air supply fails. These respirators are available in either continuous-flow or pressure-demand flow and are most often used with a high-efficiency filter as the air purifying element. Use in the filtering mode is allowed for *escape only*. Because of the positive-pressure and escape provisions, these respirators have been recommended for asbestos work.

A summary of the classification of respiratory protective devices follows:

1) **Air-Purifying Devices**
   - a. Mechanical-filter cartridge
   - b. Chemical-cartridge
   - c. Combination mechanical-filter/chemical cartridge
   - d. Gas masks
   - e. Powered air-purifying

2) **Atmosphere or Air Supplying Devices**
   - a. Supplied-air
     1. Type A and AE
     2. Type B and BE
     3. Type C and CE (Airline)
        - (a) Continuous-flow
        - (b) Demand-flow
        - (c) Pressure-demand flow
   - b. Self-contained breathing apparatus (SCBA)
     1. Closed-circuit
     2. Open-circuit
        - (a) Demand
        - (b) Pressure-demand
   - c. Combination-SCBA and supplied-air
     1. Continuous-flow
     2. Demand-flow
     3. Pressure-demand flow

3) **Combination Air-purifying and Atmosphere Supplying Devices**
   - a. Continuous-flow
   - b. Pressure-demand flow

OSHA requires employers to develop written standard operating procedures for employees who wear respiratory protection. This written program must address each element specified in 29 CFR 1910.134 (b) which are briefly outlined below.

MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

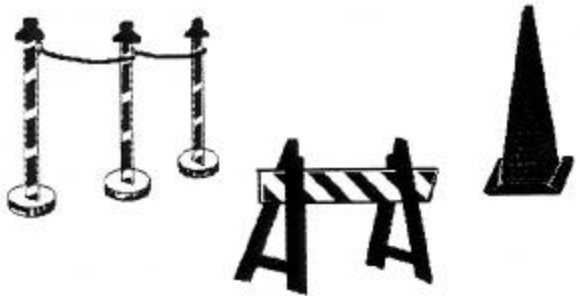
SECTION III - Controls

Requirement	Standard
Written Operating Procedures	.134(b)(1), (e)(1) and (e)(3)
Proper Selection	.134(b)(2), (c) and (e)(2)
Training and Fitting	.134(b)(3), (e)(5) and (e)(5)(i-iii)
Cleaning and Disinfecting	.134(b)(5) and (f)(3)
Storage	.134(b)(6) and (f)(5)(i-iii)
Inspection and Maintenance	.134(b)(7),(e)(4),(f)(2)(I-v) and (f)(4)
Work Area Surveillance	.134(b)(8)
Inspection/Evaluation of Program	.134(b)(9)
Medical Examinations	.134(b)(10)
Approved Respirators	.134(b)(11)

Note to the Employer: Refer to the sample respiratory protection program provided in Appendix I.

Precautionary Equipment

Once an entrance cover is removed, the opening must be promptly guarded by a railing, temporary cover, temporary fences or other temporary barriers. This is necessary to protect individuals from falling into the space, to protect entrants from having objects fall onto them or due to vehicular hazards. Barricades and/or pylons may also be used so long as they physically block access to the work area. Additionally, warning signs are recommended to warn unauthorized individuals not to enter the area. This may be accomplished with a warning sign reading **"Danger-Confined Space Entry in Progress -- No Unauthorized Entry".**



Communication and Communication Systems

A reliable method must be in place for attendants to monitor the activities of the authorized entrants and for the entrants to keep attendants informed of their status in the event the permit space must be evacuated. The standard allows any effective means to be used to accomplish this objective. Types of communication methods include;

1) Battery operated, voice activated communication systems.
2) Continuous electronic monitoring equipment such as televisions, cameras, etc.
3) Battery hand-operated communications devices (e.g., two way radios).
4) Body alarm devices may also be helpful where communication between the entrant and attendant is difficult. This type of device is designed to sound an alarm if the wearer does not move during a specified period of time.
5) Continuous and uninterrupted voice contact.

6) Visual observation from outside the space by the attendant.

A clearly understandable back-up system (line-jerk signals) is suggested should the primary system fail. Failure of the primary system is sufficient cause for immediate evacuation of the permit space. Therefore, special attention must be given to ensure that the communication system is working properly, and that a device is used that has sufficient transmission range. Also, ensure outside lines of communication have been established to summon rescue services.

The exact type and extent of communication required will depend on the operation being performed and the hazards within the space. For example, work that can only be performed in an IDLH atmosphere (because engineering controls are infeasible) would necessitate the use of continuous contact monitoring equipment. In contrast, authorized entrants working in a permit space that pose only mechanical hazards would need a communication system that provides only periodic monitoring. The desired system is one that alerts the entrant of any situation where evacuation is needed and the entrant can perform self-rescue. If no means of communication is available, then the entry should be prohibited.

Retrieval Equipment

The standard requires employers to provide, maintain and ensure the use of protective equipment. This includes equipment necessary to facilitate both entry into and exit from a permit space. Whenever possible, rescues should be performed outside the confined space so rescuers are not exposed to hazardous conditions. Proper retrieval equipment generally needed for permit space entries include:

1) chest or full-body harness
2) heavy-duty life line
3) mechanical winches
4) tripods
5) wristlets

Winches should be self-braking to prevent free falls and to hold personnel in place when raising and lowering has stopped. Additionally, tripods should have two winches; one for lowering, arresting and retrieving an entrant and a second for tools. By having two winches, the entrant would not be tempted to disconnected himself/herself from the lifeline.

A wide variety of harnesses are available. Some coveralls have been specially designed with a built-in full-body harness for easy donning.

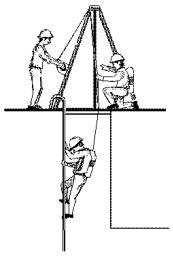
In deciding what type of retrieval equipment is needed for a specific entry operation, an evaluation of the permit space must be conducted with the following conditions in mind: size and configuration of the confined space; size and location of the opening; any obstacles within the space; whether or not a rescue of the entrant would be vertical or horizontal; and potential hazards within the space.

Retrieval lines are very effective in assisting in the safe removal of unconscious personnel from many permit spaces. Therefore, each authorized entrant must use a chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, or above the entrant's head.

Wristlets may be used in lieu of chest or full body harness if the employer can demonstrate the use of a harness is not feasible or creates a greater hazard. Wrist harnesses are used where the entrant may need to be withdrawn through a small opening.

SECTION III - Controls

In some situations, however, retrieval lines have been known to pose an additional risk by creating entanglement hazard. In these particular situations, the use of retrieval lines may be inappropriate. In such cases, the following guidelines are provided to determine if retrieval lines are appropriate:



1) A permit space with obstructions or turns that prevent pull on the retrieval line from being transmitted to the entrant does not require the use of a retrieval system.

2) A permit space from which an employee being rescued with the retrieval system would be injured because of forceful contact with projections in the space does not require the use of a retrieval system.

3) A permit space that was entered by an entrant using an air supplied respirator does not require the use of a retrieval system if the retrieval line could not be controlled so as to prevent entanglement hazards with the air line.

In circumstances where retrieval lines or harnesses cannot be worn, an alternative method must be in place should an entrant need assistance. If an acceptable alternative method is not available, then entry is prohibited. In all circumstance, inspect retrieval equipment prior to use.

Portable Power Tools

Portable power tools are generally grouped according to their power source such as electrical, pneumatic, hydraulic, gasoline and power-actuated.

In confined spaces, air-operated pneumatic power tools are normally recommended to avoid the hazards associated with using these other types of portable tools. Compressors servicing any pneumatic tools must be located outside the confined space and not pose a hazard. Ensure that all safety devices are in place such as air line safety check valves, safety retainers, etc., before using air powered tools. If portable electrical tools must be used, the electrical equipment must meet the requirements of Article 500 of the National Electric Code (NEC) for the specific hazardous location. An effective grounding system must be instituted, or ground fault circuit interrupter used to protect individuals from electrical shock. Use double insulated tools whenever possible. Low voltage lights operated at a maximum 12 volts should be used. Lights should be shielded to prevent breakage of the bulb. Gasoline power tools should not be used in confined space situations. Power-activated tools may also be prohibited in many confined space operations.

Eye and face personal protective equipment is required when using portable power tools. Hearing and respiratory protection may also be needed depending on the circumstances.

Ladder Safety and Other Forms of Entry and Egress

Ladders are often the only means of entry and egress from permit spaces. It is therefore important that they be used and maintained in accordance with safe operating procedures. Workers should observe and practice the following items when using a ladder in a permit space.

- Choose a ladder that will not react with the substance in the space.
- Make sure the ladder is equipped with a non-slip base and that is tied at the top.
- Place the ladder so that the horizontal distance from the base to the vertical plane is approximately 1/4 the ladder length (for example, place a 12' ladder so that the base is 3' from the wall).

SECTION III - Controls

- The preferred pitch for a fixed ladder is 75-90 degrees.
- Extend the ladder at least 3' above the top of the landing.
- When ascending or descending a ladder make sure workers hold on with both hands. Raise or lower tools or equipment with a rope or in a basket or winch.
- The ladder must be maintained in good condition and should be inspected prior to each use. A fixed ladder in a confined space should be checked visually for slippery or corroded rungs prior to using it.
- If a worker is at risk of falling from a ladder, have the employee wear a full body harness attached to a fall-arresting and retrieval device.
- Fixed ladders exceeding 20' must be equipped with a ladder safety device if a cage is not present.

Boatswain's chairs are also used for entry and egress. The seat should not be less than 2' long and 1' wide. Swinging (two-point suspension) scaffolds are occasionally used in certain situations in confined space operations. When this equipment is used, it should be suspended by wire or synthetic fiber rope capable of supporting at least six times the maximum intended load. Workers should wear a full body harness attached to a fall-arresting and retrieval device.

Heat Stress

Operations conducted in a confined space may present potential heat stress problems. Factors which might contribute to heat stress disorders include: high temperatures, radiant heat sources, high humidity, direct physical contact with hot objects and strenuous physical activity.

Personal characteristics predispose an individual to heat stress problems; these factors include: age, weight, degree of acclimatization, use of alcohol and drugs and various existing medical conditions such as hypertension.

Heat Disorders

1) **Heat Stroke,** the most serious health problem for workers in hot environments, is caused by the failure of the body's internal mechanism to regulate its core temperature. Sweating stops and the body can no longer rid itself of excess heat. Signs include mental confusion, delirium, loss of consciousness, convulsions or coma; body temperature of 106 degrees F or higher; hot dry skin which may be red, mottled, or bluish. Victims of heat stroke will die unless treated promptly. While awaiting medical help, the victim must be removed to a cool area and their clothing soaked with cool water. They should be fanned vigorously to increase cooling. Prompt first aid can prevent permanent injury to the brain and other vital organs.

2) **Heat exhaustion**, results from loss of fluid through sweating when a worker has failed to drink enough fluids or take in enough salt or both. The worker with heat exhaustion still sweats but experiences extreme weakness or fatigue, giddiness, nausea, or headache. The skin is clammy and moist, the complexion pale or flushed, and the body temperature normal or lightly higher. Treatment is usually simple; the victim should rest in a cool place and drink an electrolyte solution (a beverage use by athletes to quickly restore potassium, calcium, and magnesium salts). Severe cases involving victims who vomit or lose consciousness may require longer treatment under medical supervision.

3) **Heat Cramps**, painful spasms of the muscles, are caused when workers drink large quantities of water but fail to replace their bodies = salt loss. Tired muscles - - those used for performing the work - - are usually the ones most susceptible to cramps. Cramps may occur during or after working hours and may be relieved by taking liquids by mouth or saline solutions intravenously for quicker relief, if medically determined to be required.

4)**Fainting,** (heat syncope) may be a problem for the worker unclimatized to a hot environment who simply stands still in the heat. Victims usually recover quickly after a brief period of lying down. Moving around, rather than standing still, will usually reduce the possibility of fainting.

5)**Heat rash**, also known as prickly heat, may occur in hot and humid environments where sweat is not easily removed from the surface of the skin by evaporation. When extensive or complicated by infection, heat rash can be so uncomfortable that it inhibits sleep and impedes a worker's performance or even results in temporary total disability. It can be prevented by resting in a cool place and allowing the skin to dry.

6)**Heat Fatigue**, is largely caused by a lack of acclimatization. Symptoms include impaired performance of skilled vigilance tasks. No specific recommendations for treatment are needed unless accompanied by other heat illness. The use of a program of acclimatization and training for work in hot environments is advisable.

Sampling methods for determination of Potential Heat Stress and Environmental Heat Stress Areas

1)Body Temperature Measurements. Instruments such as an ear canal temperature probe or chest surface measurement are available to determine individual body temperature non-invasively

2)Environmental Measurements. Environment heat measurements should be made at or as close as possible to the specific work area where the worker is exposed.

When a worker is not continuously exposed in a single hot area but moves between two or more areas having different levels of environmental heat which varies substantially, then measurements should be taken in these areas as well.

3)Testing Methods

- Wet Bulb Globe Temperature Index (WBGTs). Portable heat stress monitor or meter is commercially available. The instrument can determine how long an individual can safely work or remain in a hot environment.
- Effective Temperature Index (ET). The ET index combines the temperature, the humidity of the air and air velocity to determine comfort ventilation. This method has been used effectively where humidity is high and radiant heat is low, as can be found in many confined spaces.
- Heat Stress Index (HSI). The HSI method considers how all the environmental factors and the work relate; however, it is complicated to use and is not always effective in determining the heat stress level on individual workers.

Preventing Heat Stress

Most heat-related health problems can be prevented or the risk of developing them reduced. The following are basic precautions which can lesson heat stress problems.

1)**Acclimatization** to the heat through short exposure followed by longer periods of work in the hot environment can reduce heat stress. New employees and workers returning from an absence of two weeks or more should have a 5-day period of acclimatization. This period should begin with 50 percent of the normal workload and limited time exposure the first day and gradually building up to 100 percent on the fifth day.

2)A variety of **engineering controls** including general ventilation and spot cooling by local exhaust ventilation at points of high heat production may be helpful. Shielding is required as protection from radiant heat

sources. Evaporative cooling and mechanical refrigeration are other ways to reduce heat. Cooling fans can also reduce heat in hot conditions. Eliminating steam leaks will also help. Equipment modifications, the use of power tools to reduce manual labor and using personal cooling devices or protective clothing are other ways to reduce the hazards of heat exposure for workers.

3) **Work practices** such as providing a period of acclimatization for new workers and those returning from two week absences and making plenty of drinking water - - as much as a quart per worker per hour - - available at the workplace can help reduce the risk of heat disorders. Training first aid workers to recognize and treat heat stress disorder and making the names of trained staff known to all workers is essential. Employers should also consider an individual worker's physical condition when determining his or her fitness for working in hot environments. Older workers, obese workers and personnel on some types of medication are at greater risk.

4) Alternating **work and rest** periods with longer rest periods in a cool area can help workers avoid heat stress. If possible, heavy work should be scheduled during the cooler parts of the day and appropriate protective clothing provided. Supervisors should be trained to detect early signs of heat stress and should permit workers to interrupt their work if they are extremely uncomfortable.

5) **Employee education** is vital so that workers are aware of the need to replace fluids and salt lost through sweat and can recognize dehydration, exhaustion, fainting, heat cramps, salt deficiency, heat exhaustion and heat stroke as heat disorders. Workers should also be informed of the importance of daily weighing before and after work to avoid dehydration.

More Information. A 15-page booklet, *Working in Hot Environments*, is available free from National Institute of Occupational Safety and Health Publications, 4676 Columbia Parkway, Cincinnati, Ohio 45226; telephone 513/533-8287.

Hot Work Operation

The definition of hot work includes operations which provide a source of ignition including:

- welding
- spark or arc producing tools
- static discharges
- non-explosion proof lighting
- grinding (friction)
- cutting
- burning
- riveting

These types of hot work are a normal part of routine maintenance operations, and they are often performed in confined spaces. These operations pose unique hazards within confined spaces, such as:

- fire and explosion hazards in the presence of flammables,
- the generation of toxic atmospheres,
- the generation of physical hazards, such as noise, vibration, heat stress, non-ionizing radiation, etc.

A combination of engineering controls, work practice controls and personal protective equipment are required to reduce or eliminate the hazards associated with hot work. These control measures must be coordinated by using a hot work program which includes:

- a written hot work permit for every hot work operation,

SECTION III - Controls

- evaluation of the existing hazards within a permit space and
- evaluation of potential hazards created from hot work operations.

Hot work operations must be properly evaluated by the employer and precautions instituted specific to the tasks to be performed. General precautions to keep in mind include:

- use of localized exhaust ventilation,
- selecting appropriate tools,
- use necessary personal protective equipment,
- surface coatings and residues in confined spaces must be evaluated to avoid creating hazardous by-products, i.e., arc welding produces high levels of ultraviolet radiation and in contact with chlorinated solvents can quickly generate toxic gases such as phosgene, chlorine and hydrogen chloride,
- pipes, tubes, coils must be purged, flushed, or cleaned of hazardous residues and
- be aware that conducting hot work operations in a non-permit space will change the status to a permit-space

The following specific procedures in conjunction with a full PRCS program are required when welding is performed in a confined space:

- Welding electrodes must be removed from their holders during suspension of work (e.g., during lunch or overnight). The welding machine must be disconnected from its power source.
- Mechanical ventilation is mandatory.
- Compressed ventilation is mandatory.
- Compressed gas cylinders and welding machines must be left outside the confined space.
- Portable equipment on wheels must be secured to prevent accidental movement.
- Gas welding and cutting equipment, such as hoses, connections, torches, etc., must be inspected and testing to ensure their integrity.
- Means must be available for the quick removal of a welder in the event of an emergency. Full body harness or safety belts attached to a lifeline must be used whenever their use will facilitate rescue.
- An attendant with a pre-planned rescue procedure must be stationed outside the space.
- Torch valves must be closed and the fuel, gas and oxygen supply positively shut off at some point outside the confined space when the torch is not to be used for a substantial period of time (e.g., during lunch hour or overnight). Additionally, the torch and hose must also be removed from the confined space where practicable.
- Warning signs or other means of warning workers of hot metal after welding is completed.
- Welders and helpers must use appropriate respiratory protection when ventilation controls are insufficient.
- Never use oxygen to ventilate a confined space.

A copy of Hot Work Permit can be found in Appendix G.

SECTION IV - Program Administration, Written Plan

1.0 POLICY

(Company Name) _____ is committed to providing a safe and healthful work environment for our entire staff. Therefore, the following written program is in place to identify any Permit-Required Confined Spaces (PRCS) and to eliminate or control hazards associated with PRCS operations. This program is in accordance with the Occupational Safety and Health Administration's (OSHA) Permit-Required Confined Spaces Standard, Title 29, Code of Federal Regulations 1910.146.

2.0 RESPONSIBILITIES

2.1. Overall Program Responsibility. (Company Representative's Name) _____ is responsible for the overall implementation and maintenance of any written program or any certification concerning the requirements of the Permit-Required Confined Space Standard at our facility.

2.2. Permit-Required Confined Space Evaluation. (company representative's name) _____ is responsible for evaluating the workplace to determine if any permit spaces are present.

Note to the Employer: If you determine that no permit-required confined spaces exist at the facility, no further action is needed (refer to subsection 3.0 for additional clarification).

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SECTION IV - Program Administration, Written Plan

(company representative's name) _____ will be responsible for determining if a PRCS program is required, or if the permit space can be reclassified as a non-permit space, or if alternative procedures can be used.

2.3. Training. (company representative's name) _____ is responsible for ensuring that all affected personnel are properly trained and that refresher training is given. Personnel who may be included are any authorized entrants, attendants, entry supervisors, on-site rescue team members and employees who may potentially enter the space.

2.4. Initial Contacting For Rescue Services. (company representative's name) will ensure that rescue and emergency services have been informed of any permit-required confined spaces at our facility and have been given access to the spaces for drills, training, etc.

Note to the Employer: The completion of 2.4 is not a required entry if the permit space is reclassified as a non-permit space or if alternate procedures are used. However, if an entry is required to verify the elimination of the hazard, then a full PRCS program is needed and 2.4 must be completed.

2.5. Equipment. (company representative's name) _____ will ensure that all equipment needed for safe entry into any permit spaces and non-permit spaces is available and in proper working order.

3.0 PERMIT SPACE IDENTIFICATION

3.1. (company representative's name) _____ has evaluated the workplace and determined (check box)

- ❑ No Permit-Required Confined Space(s) Exist at the Worksite.
- ❑ Permit-Required Confined Space(s) Have Been Determined to Exist.

Note to the Employer: Refer to Appendix A for information to assist in the determination process. As a reminder, a confined space is a space which:

- **Is large enough and so configured that an employee can bodily enter and perform assigned work; and**
- **Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.) and;**
- **Is not designed for continuous employee occupancy.**

A permit space is a confined space which has one or mare of the following characteristics:

- **Contains or has a potential to contain a hazardous atmosphere**
- **Contains a material that has the potential for engulfing an entrant**
- **Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or**
- **Contains any other recognized serious safety or health hazard.**

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Note to the Employer: Develop a list of all permit-required confined spaces including their locations and identified hazard(s) which qualify it as a permit space. Though not mandated by the standard, it would be wise to develop a second list of all non-permit confined spaces in the event that these spaces are reclassified in the future.

3.2. The location(s) and hazard(s) posed by these permit spaces are listed below:

Location	Hazards
_____	_____
	_____
_____	_____
	_____

4.0 PREVENTION OF UNAUTHORIZED ENTRY

4.1. For permit spaces that are identified at our worksite, all potentially exposed employees will be informed of their existence and hazards. The method(s) that will be used will be: (check box for specific policy)

- ❑ Posting of danger signs at each permit space reading "Danger, Permit-Required Confined Space, DO NOT ENTER".
- ❑ Other (specify)_____
  _____

Note to the Employer: The standard allows any other equally effective means of informing employees of the presence of any permit spaces. For whatever method is chosen, OSHA will check to ensure that the method is effective.

4.2. It has been determined that the permit spaces identified at our worksite:

- ❑ Will not be entered by our employees. The following measures have been taken to prevent employees from entering the space(s):
- ❑ Will be entered by employees of our workplace._____

Note to the Employer: The measures used to prevent entry could include permanently closing the spaces; use of barriers; specialized tools, under management=s control, to open the space(s); and supplementing these measures with training signs. The steps taken by the employer must be effective in preventing employee entry into the permit space(s).

Employers who determine that their employees will enter a permit space must set up procedures to ensure safe entry. Because of the different types of permit spaces found in the work environment, the regulations allow options for employers to use to obtain this goal. Some permit spaces may be reclassified as non-permit spaces. Others may qualify for alternative procedures. Still others may require a full permit-required confined space program. It is the responsibility of the employer to determine which procedure is acceptable for the particular space of concern.

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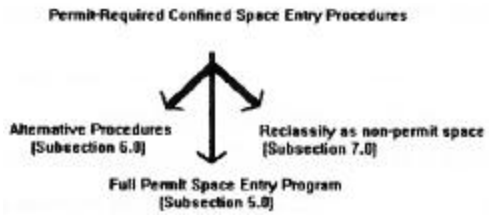

5.0 PERMIT-REQUIRED CONFINED SPACE (PRCS)

Note to the Employer: A written PRCS program is not required for:

1. **Situations where alternative procedures are used for entry. The procedures outlined in paragraph (c)(5)(ii) are mandated and written verification is required by (c)(5)(iii)(H). Appendix B can be used to document that the alternative procedures ensure safe entry.**
2. **Situations where a permit space is reclassified as a non-permit space and entry is not required to verify elimination of all the hazards. Paragraph (c)(7)(iii) requires employers to document that the hazards have been eliminated. Appendix C can be used for documenting that the reclassification allows for safe entry.**

If procedure 1 or 2 cannot be used and if the employer determines that their employees will enter a permit space, then a written PRCS program (see Appendix D) is needed for each permit space and Section 5 must be completed. Keep in mind that a written PRCS program is a guidance document for employers and employees so they can develop and utilize the procedures required for safe entry into a permit space. An entry permit is basically a checklist to ensure all the steps for the safe entry have been taken prior to entry.

The program elements to be considered for a full PRCS are outlined in paragraph (d) of the standard. This program must specify the potential hazards of the space and the procedures needed to correct them. These step by step procedures must include acceptable entry conditions, isolation methods needed, methods for eliminating or controlling hazardous atmospheres (i.e., purging, cleaning, ventilation), equipment needed, testing protocol and duties of permit space team members.

Safe entry procedures have been developed for each permit space at our facility. These procedures specify the proper methods and equipment necessary to conduct the entry operation in a safe manner. A Permit Space Entry Procedure Worksheet has been completed for each permit space and is located at _____.

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Note to the Employer: Appendix D contains a Permit-Required Confined Space (PRCS) Program Worksheet that can assist in the development of such a program. Appendix D-1 contains an example of a completed written program.

A written PRCS Program addresses the following elements for each permit space entered:

- The methods used to prevent unauthorized entry.
- Identify and evaluate the specific hazards before entry.
- Establish measures for the safe control of identified hazards such as isolation, purging, inerting, ventilation, barricades, lockout/tagout, etc.
- Providing and maintaining equipment necessary for safe entry, including testing and monitoring, ventilation, communications, personal protection, lighting, barriers, entry and egress, and rescue equipment.
- Procedure to test the permit space and document results.
- Procedure to maintain acceptable conditions in the permit space.
- Identify duties of each employee required and provided training.
- Provide at least one attendant outside the permit space for the duration of the entry operations.
- Implement proper procedures for rescue.
- Establish a written system for preparation, issuance, use and cancellation of permits.
- Coordinate entry operations during multiple employer entries.
- Review entire entry program at least annually, unless previously reviewed at conclusion of a specific entry.

6.0 ALTERNATIVE PROCEDURES

The OSHA regulations allow permit spaces which have, as their *only hazard*, an actual or potential hazardous atmosphere to use alternative procedures for entry. These alternative procedures as discussed in Section 1 do not require the implementation of a full PRCS program. The following is a list of permit spaces at our workplace which currently qualify for alternative procedures:

_____
_____
_____
_____
_____

Note to the Employer: Refer to Appendix B for a Worksheet that can be used to certify that alternative procedures can be used and that the space is safe for entry. For those employers who can demonstrate that continuous forced air ventilation alone is sufficient to maintain the permit space safe for entry, only the General Requirements - paragraph (c)(5) and Training - paragraph (g) are required. Remember, continuous forced air ventilation controls the hazard - - it does not eliminate it.

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7.0 RECLASSIFYING PERMIT SPACE TO NON-PERMIT SPACE

The OSHA regulations also allow permit spaces to be reclassified as non-permit spaces by the total elimination of all the hazards. A permit space can be reclassified as a non-permit space if there are no actual or potential atmospheric hazards and if all the other hazards within the space are eliminated without entry into the space. The following is a list of permit spaces at our workplace that can be reclassified as non-permit spaces by the elimination of the hazards:

_____
_____
_____
_____
_____

Note to the Employer: Information on reclassifying permit spaces to non-permit spaces is discussed in Section I. Refer to Appendix C for a worksheet that can be used to certify that the hazards have been eliminated and the space is safe for entry. If an entry is needed to eliminate or verify the elimination of a hazard, then a full PRCS program is required. Once it has been determined that all the hazards have been eliminated, then the space can be reclassified.

_____

8.0 PERSONNEL, DUTIES AND TRAINING FOR FULL PERMIT-REQUIRED CONFINED SPACE ENTRY OPERATIONS

Note to the Employer: Subsection 8.0 does not apply if a full PRCS is not used. Note that subsection 12.0 contains the training needed when reclassifying or alternative procedures are used.

8.1. Entry into any PRCS where a full PRCS program is mandated will require a specially trained and equipped team. Each team will consist of an authorized entrant; attendant; entry supervisor and rescue personnel.

8.2. Each member of the team will receive initial and annual refresher training. The training will be specific for the duties of each team member and include the procedures and practices necessary to protect them from the dangers of the permit space.

Note to the Employer: Provide a training program for employees using the information contained in this document and any other applicable resources. Make your training program specific to the particular permit space(s) to be entered. This training must give team members the understanding, knowledge and skills necessary for them to safely perform their assigned duties.

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8.3. The training program will include the duties of each team member as listed below:

Authorized Entrants

- Know the hazards associated with the permit space and their effects.
- Properly use the equipment required for entry.
- Maintain a continuous means of communication with the attendant.
- Alert the attendant in the event of an emergency.
- Evacuate the space if an emergency occurs.

Attendants

- Know the hazards associated with the permit space and their effects.
- Maintain an accurate account of the authorized entrants.
- Remain at their assigned station until relieved by another attendant or until the permit space is complete.
- Monitor conditions in and around the permit space.
- Summon rescue and applicable medical services in the event of an emergency.
- Perform non-entry rescue procedures.
- Perform appropriate measures to prevent unauthorized personnel from entering the permit space.

Entry Supervisors

- Know the hazards associated with the permit space and their effects.
- Verify that the safeguards required by the permit have been implemented.
- Verify that rescue services are available and that means for summoning them are operable.
- Cancel the written permit and terminate the permit space entry when required.
- Remove personnel who are not authorized to enter the permit space during entry operations.
    - Periodically, determine that the entry operation is being performed in a manner consistent with the requirements of the permit space entry procedures and that acceptable entry conditions are maintained.

Rescue Personnel

- See Appendix L for information on rescue personnel.

8.4. **Permit-Required Confined Space (PRCS) Program Training** - If a full permit-required confined space program is required, training is needed on the following topics:

- Types of confined space hazards
- Components of the written PRCS program
- Components of the entry permit system
- Components of the hot work permit
- The need for prompt guarding of the entrance opening
- Atmospheric testing equipment including its use, calibration and maintenance
- Atmospheric testing protocol:
    - oxygen, combustibles, toxics
    - pre-entry, frequent or continuous testing
    - check all levels of the space

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- Methods for the control or elimination of any atmospheric hazards:
    - inerting
    - draining and rinsing
    - purging and cleaning
    - continuous forced air ventilation
- Procedures the emp loyees must follow if they detect a hazard
- The evaluation process to be used for reentry if hazards are detected
- Train employees on the use of entry equipment (e.g., ladders, communication devices, etc.)
- Personal protective equipment required:
    - full body harness
    - respiratory protection
    - chemical protective clothing
    - eye and face protection
- Personnel and their responsibilities:
    - authorized entrant
    - attendant
    - entry supervisor
    - rescue team
- On-site or Off-site rescue:
    - rescue plan
    - practice rescues
    - basic first-aid and cardiopulmonary resuscitation certification
    - full body harness with retrieval line attached to mechanical retrieval device
- Procedures for annual review of canceled permits
- Any other information necessary to ensure employee safety during a permit space entry operation
- Documentation of the training

Note to the Employer: Again, the training required is dependent on the specific space to be entered and the procedures which are needed to protect entrants. The information provided in this training subsection is a generalization of the topics which must be covered during employee training. Additionally, document employees' training and refresher training. This certification simply requires the employees' names, the signatures or initials of the trainers and the dates of training. Appendix O has been added if additional space is needed to record employee training.

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8.4.1 The following is a list of employees who have been equipped and trained to serve as authorized entrants at our facility:

Authorized Entrants	Trainer	Date of Training

8.4.2 The following is a list of employees who have been equipped and trained to serve as attendants:

Attendant	Trainer	Date of Training

8.4.3 The following is a list of employees who have been trained to serve as entry supervisors:

Entry Supervisor	Trainer	Date of Training

Note to the employer: remember, training must be provided:

- **Before employees are assigned duties involving permit space entry.**
- **Whenever their assigned duties change.**
- **Whenever there is a change in a permit space that creates hazards for which they have not been notified.**

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9.0 HOST EMPLOYER'S RESPONSIBILITIES WITH CONTRACTORS

When contractors are involved in permit space entry work at our workplace, (company representative's name) _____ will inform them of the following information and coordinate any entry operations:

- The location of the permit spaces at our facility and that entry into these spaces is only allowed through a permit space program or alternative procedures or space reclassification.
- Our rationale for listing the space as a permit space such as any identified hazards and our experiences with the particular space
- Precautions that we have implemented to protect employees working in or near the space.
- (company representative's name) _____ will debrief the contractor at the completion of the entry operation, or during if a need arises and if any hazards were confronted or created during their work.

Note to the Employer: Appendix E has been included to assist with the requirements of this subsection.

10.0 CONTRACTOR'S RESPONSIBILITIES WITH HOST EMPLOYERS

When a contractor is hired to perform work in a PRCS, we will obtain the following information from the host employer and ensure the following tasks are performed:

- Obtain any information on the hazards of the permit space and information from previous entry operations from the host employer.
- Determine if the host employer's workers will be working in or near the space.
- If the host employer will have employees working in or near the space during our entry operation, (company representative's name) _____ will coordinate entry operations with the host employer's representative.
- Will inform the host employer of the permit space program that will be utilized.
- Hold a debriefing conference at the completion of the entry operation or during the entry operation (if needed) to inform the host employer of any hazards confronted or created.

Note to the Employer: For clarification, refurnishing of the existing equipment and space is considered maintenance; reconfiguration of the space or installation of new equipment (as for a process change) is usually considered construction. Additionally, Appendix F can be used to assist the contractor with the standards requirements.

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11.0 RESCUE AND EMERGENCY SERVICES

Note to the Employer: This subsection is not required if the permit space has been reclassified as a non-permit space or if alternative procedures are used.

11.1. The precautions and procedures outlined in our written PRCS program are designed to ensure that our employees are safe while working in permit spaces. Under no circumstances do we expect our employees to enter a permit space where hazards have not been eliminated or effectively controlled.

Additionally, we recognize that unexpected situations might arise that prevent entrants from self-rescue. In response, the following rescue and emergency action plan has been developed and will be strictly enforced.

We have decided to utilize: (check all that apply)

- ❑ on-site rescue services which include:
- ❑ non-entry rescue procedures
- ❑ entry rescue procedures
- ❑ off-site entry rescue services

Note to the Employer: Employers who choose to use off-site rescue services need not complete subsections 11.2, 11.3 and 11.4, but must complete 11.5. Additionally, a non-mandatory letter (Appendix K) has been included to notify off-site rescuers (e.g., local fire department) of the potential hazards associated with the space. This form should be sent well in advance of any entry operation. This advanced information provides outside rescue services with the time to develop appropriate rescue strategies and practice rescue techniques.

Note to the Employer: Each permit space must be individually evaluated to determine whether entry or non-entry rescue procedures can be used to remove incapacitated entrants. Non-entry rescue is the desired method because it is not necessary to place the rescuer at risk to remove the injured employees. Non-entry retrieval systems, such as full body harness with retrieval line, must be used whenever an authorized entrant enters into a permit space, except in situations where the retrieval system would increase the risk of entry or would not contribute to the rescue.

12. 11.2. (company representative's name) _____ will ensure:
    - that each member of the firm=s rescue service is appropriately trained. Refer to Appendix L for rescue plan and training requirements.

- that the member of the rescue service will receive basic first aid and cardiopulmonary resuscitation (CPR). At least one of these members must hold current certification in first aid and CPR.
- that rescue team members will practice rescue techniques at least annually from the actual or similarly configured space(s).

Note to the Employer: Simulated rescue operations must include dummies, mannequins, or actual persons from the actual or from representative permit spaces. Actual rescues during the 12-month period may also substitute for a practice rescue, even if the rescue was not successful.

13. 11.3. (company representative's name)_____ has made arrangements with, (Name of Off-site Rescue Service) for off-site rescue and emergency services and they have consented to provide this service. This service has been informed of the hazards they may encounter if they are summoned. The rescue service has been provided access to the PRCS so they can evaluate the spaces to develop appropriate rescue plans and practice rescue operations. If rescue and emergency services are needed, the following procedures will go into effect:

Note to the Employer: Describe the procedures that will be used for summoning the rescue and emergency services. Include the name, location and telephone numbers of the rescue services in this program and also on the entry permit. Train employees on the specific procedures for summoning the rescue and emergency services.

Name of Rescue Service _____
Telephone Number _____
Location _____
Approx. Response Time _____

Name of Emergency Medical Service _____
Telephone _____
Location _____
Approx. Response Time _____

The specific procedures for summoning rescue and emergency services for our workplace is outlined as follows:

_____
_____
_____
_____
_____
_____

12.0 TRAINING

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11.1. Training must be given to each employee who has access or potential access to a permit space. The amount of training needed will depend on the individual's duty assignment. For example, some employees may only be required to know the existence, location, and danger posed by a permit space. Others would need considerably more training if they are members of a PRCS team. Still others would need training as it pertains to the type of entry procedures used (i.e., alternative procedures or reclassifying to non-permit space procedures). The overall intent of this training is to give employees the understanding, knowledge, and skills necessary for the safe performance of their assigned duties in relation to the permit spaces of concern.

12.2. Four basic categories have been set up to train employees based on duties and potential exposure.

12.2.1. **Awareness Training**. Awareness training for employees potentially exposed to permit spaces can be satisfied by providing them with the specific information contained in subsection 3 and 4.

12.2.2 **Training Required for Using Alternative Procedures.** If the space qualifies for alternative procedures, training on the following topics is warranted:

- A major point concerning the use of alternative procedures is that these procedures can only be used when a hazardous atmosphere is the only hazard of concern.
- The harm associated with the atmospheric hazards of concern including their acceptable entry levels and symptoms of overexposure.
- Awareness training to recognize other potential hazards in or around the space.
- Any conditions which may make it unsafe to remove the entrance cover.
- The need for prompt guarding of the entrance opening.
- Atmospheric testing equipment including its use, method of calibration and maintenance
- Atmospheric testing protocol for oxygen, combustibles, toxics.
- Pre-entry, frequent or continuous testing of the permit space.
- Check all levels of the space for atmospheric hazards.
- Atmospheric Controls
    - inerting
    - draining and rinsing purging and
    - continuous forced air ventilation including type, proper use and placement and its limitations.

- Procedures the employee must follow if a hazardous atmosphere is detected.
- The evaluation process to be used for reentry if a hazardous atmosphere is detected or the individual vacates the space and returns some time later.
- Train employees on the use of entry equipment used including ladders and intrinsically safe lighting.
- Personal protective equipment (e.g., gloves, hard hat, boots, etc.), its use, limitations and required maintenance.
- A review of the completed written certification form (Appendix B) with the employee prior to entering the space.
- Any process which may introduce a hazard (e.g., welding, cleaning with solvents) which would prohibit use of alternative procedures.
- The requirements of paragraph (c)(5) must be reviewed with the employee.
- Any other information needed to ensure the safety of the employee
- The documentation of the training.

12.2.3 **Training Required for Using the Reclassifying Permit Space Procedures**. If the permit space can be reclassified as a non-permit space, the following items must be discussed:

- Documentation of the elimination of the hazards. If the elimination of the hazards or verification of elimination requires employees to enter the space, then a full PRCS program is needed.

- Train employee on the hazards associated with the space (i.e., mechanical, chemical, atmospheric) and the methods needed to eliminate the hazards such as:
  - Isolation techniques
  - Lockout/tagout
  - Disconnection and misalignment of pipes
  - Double block and bleed
  - Blanking and blinding
  - Removal of engulfment hazards
  - Elimination of hazardous atmosphere by draining, inerting, purging, cleaning, venting
- Train employees on the use of entry equipment used including ladders, ground fault circuit interrupters for electrical equipment, etc.
- Personal protective equipment, (i.e. gloves, hard hat, boots, etc.) including its use, limitations, and required maintenance.
- A review of the completed written certification form (Appendix D) with the employee entering the space.
- The requirements of paragraph (c)(7) must be reviewed with the employee(s).
- Inform employees that any procedures such as welding, cleaning with a chemical, etc. would negate the reclassification and convert the space back to a permit space.
- Any conditions which may make it unsafe to remove entrance cover.
- The need for prompt guarding of the entrance opening.
- Atmospheric testing equipment including its use, method of calibration, and maintenance.
- Atmospheric testing protocol
- oxygen, combustibles, toxics
- pre-entry, frequent or continuous testing

Note to the Employer: This subsection is not required if the permit space has been reclassified as a non-permit space or if alternative procedures are used.

- check all levels of the space.
- Procedures the employee will follow if a hazard is detected.
- The evaluation process to be used for reentry if a hazard is detected or the individual vacates the

Note to the Employer: The training required depends on the specific permit space to be entered and the procedures which are needed to protect entrants. The information provided in this training subsection is a generalization of the topics which must be covered during employee training.

space and returns some time later.
- Awareness training to recognize other potential hazards in or around the space.
- The documentation of the training.

12.2.4 **Training Required for using full Permit-Required Confined Space Procedures (see 8.4).**

13.0 PERMIT-REQUIRED CONFINED SPACE PROGRAM REVIEW

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Within one year of any entry operation, (company representative's name) will conduct a review of the program using the canceled entry permits to identify any deficiencies in our program. A review will be conducted sooner if there is reason to believe that the program does not adequately protect employees. Any corrective measures will be documented by a revision of the program. Employees will be trained on any changes. Additionally, employees who note any inadequacies with the program can contact (company representative's name) .

Note to the Employer: If no permit space entry operations are conducted during the year, no review is needed.

SECTION IV - Program Administration, Written Plan

(Notes)

SECTION V - Appendices

APPENDIX A - CONFINED SPACE AND PERMIT-REQUIRED CONFINED SPACE RECOGNITION FORM

Part I		**Yes**	**No**
1	Is the space large enough so an employee can bodily enter and perform work?		
2	Does the space have limited or restricted means for entry and exit?		
3	Is the space designed for occupancy?		

Note to the Employer: Refer to Section II for additional clarification and assistance. If the answers to items 1 and 2 are yes and item 3 is no, then the space is not considered a confined space and no further action is needed. If the answers to items 1,2 and 3 are yes, then you have identified the space as a confined space. Continue to Part II if a confined space has been identified to determine if it is a permit-required confined space.

Part II		**Yes**	**No**
1	Does the space contain or potentially contain a hazardous atmosphere?		
2	Does the space contain any chemicals or chemical residues?		
3	Does the space contain any flammable/combustible substances?		
4	Does the space contain or potentially contain any decomposing organic matter?		
5	Does the space have any pipes which bring chemicals into it?		
6	Does the space have any materials that can trap or potentially trap, engulf or drown an entrant?		
7	Is vision obscured by dust at 5 feet or less?		
8	Does the space contain any mechanical equipment?		
9	Does the space have converging walls, sloped floors or tapered floor to smaller cross-sections which could trap or asphyxiate an entrant?		
10	Does the tank or vessel contain a rusted interior?		
11	Does the space contain thermal hazards (e.g., extreme hot or cold)?		
12	Does the space contain excessive noise levels which could interfere with communication with an attendant?		
13	Does the space present any slip, trip or fall hazards?		
14	Are there any hazards from falling objects?		

SECTION V - Appendices

APPENDIX A - CONFINED SPACE AND PERMIT-REQUIRED CONFINED SPACE RECOGNITION FORM

Part II		**Yes**	**No**
15	Are there any operations conducted near the space opening which could present a hazard to entrants?		
16	Are there lines under pressure servicing the space?		
17	Are cleaning solvents or paints going to be used in the space?		
18	Is welding, cutting, brazing, riveting, scraping or sanding going to be performed in the space?		
19	Is electrical equipment located in or required to be used in the space?		
20	Does the space have poor natural ventilation which would allow an atmospheric hazard to develop?		
21	Are there any conditions which could prevent any entrant=s self rescue from the space?		
22	Are there any corrosives which could irritate the eyes in the space?		
23	Are there any substances used in the space which have acute hazards?		
24	Is mechanical ventilation needed to maintain a safe environment?		
25	Is air monitoring necessary to ensure the space is safe for entry due to a potential hazardous atmosphere?		
26	Will entry be made into a diked area where the dike is 5 feet or more in height?		
27	Are residues going to be scraped off the interior surfaces of the vessel?		
28	Are non-sparking tools required to remove residues?		
29	Does the space restrict mobility to the extent that it could trap an entrant?		
30	Is respiratory protection required because of a hazardous atmosphere?		
31	Does the space present a hazard other than those noted above which would make it a permit space?		

Note to the Employer: If any of the questions in Part II have been checked Ayes@, the confined space is a permit-required confined space. As such, entry into these spaces must be performed under the protection of a full permit-required confined space program. Note that in some situations, alternative procedures or reclassifying to a non-permit space may be possible in lieu of a full permit-required confined space program.

SECTION V - Appendices

APPENDIX B - ALTERNATIVE PROCEDURE WORK SHEET

Note to the Employer: This worksheet is intended to provide written certification that the permit space qualifies for alternative procedures and verifies that the space is safe for entry. This checklist should be augmented with any relevant information for this certification process.

1. a) Permit Space Location_____
   b) What is the size (volume) and configuration of the space?_____
   _____

2. a) Have employees received permit space training? Yes___No___
   b) Has the certifier received permit space training? Yes___No___

3. a) What tasks are to be performed during the entry operation?_____
   _____
   b) Is a hazardous atmosphere the only hazard of concern? Yes___No___
   If no, alternative procedures cannot be used.

4. Does the atmospheric hazard in the space have the potential to create high temperatures or high pressures? Yes___No___
   If yes, take appropriate action before removing cover.

5. Are conditions safe to remove cover? Yes___No___
   If no, cover removal is prohibited.

6. After cover removal, is opening properly guarded? Yes___No___
   List guarding methods: _____

7. a) Continuous forced air ventilation provided? Yes___No___
   If no, explain why _____
   If yes, explain capacity (CFM) air exchange rate._____
   _____
   b) Minimum ventilation duration prior to allowing entry_____

Note: Refer to Section III for information on ventilation systems and appropriate calculations. Conduct pre-entry atmospheric testing and continue to ventilate the space during the entire entry operation.

8. Is atmospheric testing equipment calibrated? Yes___No___
   Date of calibration_____

SECTION V - Appendices

APPENDIX B - ALTERNATIVE PROCEDURE WORKSHEET

9. Atmospheric Testing Record:

Substance	Acceptable Level	Readings
Oxygen	19.5% - 23.5%	
Explosive (Gas/Vapor)	<10% LFL	
Explosive Dust	<LFL (5 ft. Visibility)	
Carbon Monoxide	50 PPM	
Hydrogen Sulfide	10 PPM	

10. Does inspection of interior have to be conducted to see if other hazards exist? Yes___No___
If yes, full entry program is required.

11. a) Is frequent or periodic testing performed? Yes___No___
If no, explain why_____
b) Who is to perform frequent or periodic monitoring?_____

12. a) If a hazardous atmosphere is detected during entry, have employees been instructed to evacuate immediately? Yes___No___
b) Is there a procedure to reevaluate the space if a hazardous atmosphere does develop? Yes___No___
Describe Procedure: _____
_____

c) Have steps been taken to prevent employees from re-entering the space until it is proven to be safe? Yes___No___
List steps_____
_____

13. Have employees had the opportunity to review the data to support use of alternative procedures? Yes___No___

_____ _____
Signature of Certifying Head Date

SECTION V - Appendices

APPENDIX C - RECLASSIFYING PERMIT SPACE WORK SHEET

1. Permit Space Location_____

2. Have employees received permit space training? Yes___No___

3. A. Are any hazardous atmospheres present or potentially present? Yes___No___

   B. Is continuous forced air ventilation needed to maintain acceptable levels? Yes___No___

   C. Is air monitoring required? Yes___No___
   If yes, record test results.

ATMOSPHERIC TESTING RECORD

Substance	Acceptable Level	Readings
Oxygen	19.5% - 23.5%	
Explosive (Gas/Vapor)	<10% LFL	
Explosive Dust	<LFL (5 ft. Visibility)	
Carbon Monoxide	50 PPM	
Hydrogen Sulfide	10 PPM	

D. Is atmospheric testing equipment calibrated? Yes___No___
Date of calibration_____

Note to the Employer #1: If hazardous atmospheres are present or ventilation is needed to control levels, then reclassifying the space is not possible. It is necessary to eliminate the atmospheric hazard to reclassify (see Note to the Employer #2).

4. Is an engulfment hazard present? Yes___No___
   If yes, what control measure is used to eliminate the engulfment hazard?
   _____

5. Is there an entrapment hazard? Yes___No___
   If yes, then list the steps to be taken to eliminate
   the hazard._____
   _____

SECTION V - Appendices

APPENDIX C - RECLASSIFYING PERMIT SPACE WORK SHEET

6. Have all hazardous energy sources (including chemical and physical hazards) been eliminated? Yes___No___
   Check isolating methods used to eliminate the hazard(s).
   __ deenergize equipment
   __ locking out electrical circuits and related training provided
   __ tagging out electrical circuits and related training provided
   __ physically block machinery so it can not move
   __ blank or blinds
   __ double block and bleed
   __ locking and/or tagging valves
   __ disconnecting lines
   __ other procedures, be specific _____

Note to the Employer: The above listed isolation techniques are generally used in combination to ensure elimination of the hazard(s).

Is it necessary to enter the permit space to determine if the hazard has been eliminated? Yes___No___

If yes, then the entry must be performed in accordance with a full PRCS program, paragraphs (d) through (k).

Note to the Employer #2: Permit spaces that contain or have the potential to contain hazardous atmospheres may also be reclassified as non-permit spaces if the source of the hazardous atmosphere can be eliminated during the entire entry operation. After the space is isolated, purged and ventilated from outside, it must be entered to test the atmosphere and inspect conditions within the space in order to ensure that the hazards have been eliminated. This entry must be conducted in accordance with the full permit space program requirements given in paragraphs (d) through (k). Once again, control of a hazardous atmosphere is not the same as its elimination. This reclassification would also be valid only as long as the hazards remain eliminated.

7. Have all employees who will enter the declassified space been instructed to immediately evacuate the space if a hazard is detected? Yes __ No __
   If no, instruct employees of this safety precaution measure.

8. Has a procedure been instituted to re-evaluate the space and reclassify it back to a permit space if the need arises? Yes___No____
   If no, then institute steps to properly re-evaluate the space, prohibit entry and if necessary reclassify it back to a permit space.

SECTION V - Appendices

APPENDIX C - RECLASSIFYING PERMIT SPACE WORK SHEET

If yes, describe procedure: _____
_____

9. Have all employees participating in the entry operation had an opportunity to review this safe entry certification form? Yes___No___

_____ _____
Signature of Certifying Head Date

SECTION V - Appendices

APPENDIX D - PERMIT-REQUIRED CONFINED SPACE (PRCS) PROGRAM WORK SHEET

Permit Space Location:_____

Hazards	Acceptable Entry Conditions
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Equipment	Required Yes/No	Type
Air testing monitor		
Forced air ventilation		
Communication	**Yes**	
Personal Protective Equipment		
Lighting		
Barriers		
Entry/Egress		
Rescue Equipment		
Respirator		
Other Equipment		

Methods to prevent Unauthorized Entry: _____
_____

Specific Space Entry Procedures: _____
_____

SECTION V - Appendices

APPENDIX D - PERMIT-REQUIRED CONFINED SPACE (PRCS) PROGRAM WORK SHEET

Designated Required Personnel:

Authorized Entrant's Name(s): _____
_____
_____

Duties:
_____
_____
_____

Attendant's Name(s): _____
_____

Duties:
_____
_____
_____

Is one attendant monitoring multi-spaces at the same time? Yes___No___
If yes, 1) list method(s) to monitor multi-spaces:
_____
_____
_____

2) Provide procedure(s) to respond to an emergency and still be able to ensure the safety of the other spaces:
_____
_____
_____

Entry Supervisor's Name: _____
_____

Duties:
_____
_____
_____

Air Monitor's Name: _____

Duties:
_____
_____
_____

SECTION V - Appendices

APPENDIX D - PERMIT-REQUIRED CONFINED SPACE (PRCS) PROGRAM WORK SHEET

Entry Permit: (company representative's name) _____will provide entry permits for PRCS operations. All entry permits will be completed by the entry supervisor authorizing entry. Upon cancellation of the entry permit by the entry supervisor, the entry permit will be returned.

Procedures for Summoning Rescue and Emergency Services:

_____
___

Multi-Employer Permit Space Operation? Yes___No___

If yes, develop procedures to coordinate entry operations.

_____
_____

List measures taken to close entry portal and return the space to normal operating conditions.

_____
_____
_____
_____

(Company Representative's Name)_____will review entry operations if measures taken did not fully protect employees [see 1910.146 (d)(13)].

(Company Representative's Name)_____will conduct a review of the permit program at least annually utilizing canceled entry permits. Any inadequacies will be corrected.

SECTION V - Appendices

APPENDIX D-1 - SAMPLE COPY OF A PERMIT-REQUIRED SPACE PROGRAM WORK SHEET

Permit Space Location: Reactor Vessel #1, Production Department, Main Building

Hazards:	**Acceptable Entry Conditions:**	
Oxygen Deficiency		19.5-23.5%
Flammable Substances	-Toluene	Toluene (LEL 1.3%)<10%
	-Acetone	Cleaning Solvent (Acetone) (LEL 2.6%)<10%
Toxic Substances	-Toluene	<150 ppm-15 min. STEL <100 ppm-8 hour PEL
	-Acetone	<1000 ppm-15 min. STEL <750 ppm-8 hour PEL
Mechanical/Engulfment-Mixer	-Isolate Space	Lockout/Tagout/Block
Raw Product Line	-Isolate Space	Disconnect Lines
Toluene	-Isolate Space	Purge, Clean, Ventilate

Required Equipment:

Equipment	**Required Yes/No**	**Type**
Air testing monitor	**Yes**	**O_2 and combustible gas meter; detector tubes for toluene and acetone**
Forced air ventilation	**Yes**	**Explosion-proof fan; adequate length of hose for ventilation**
Communication	**Yes**	**Radios**
Personal Protective Equipment	**Yes**	**Splash-proof goggles, Viton gloves, chemical-resistant clothing**
Lighting		
Barriers		
Entry/Egress		
Rescue Equipment	**Yes**	**Retrieval system (full body harness, tripod, winch) Self-contained breathing apparatus**
Respirator	**Yes**	**Air-purifying respirator with organic vapor cartridges**
Other Equipment	**Yes**	**High-pressure steam cleaner**
	Yes	**Isolation equipment (locks, tags)**

SECTION V - Appendices

APPENDIX D-1 - SAMPLE COPY OF A PERMIT-REQUIRED SPACE PROGRAM WORK SHEET

Specific Space Entry Procedures:

1. Have entry supervisor obtain and complete entry permit items as necessary. Refer to this written entry program for procedures to follow. Have entry supervisor contact on-site rescue service to notify them of confined space entry operation in progress.

2. Isolation Procedures -
    a. Raw Product Line - Have employees wear chemical protective clothing, gloves, splash-proof goggles, air-purifying respirators with organic vapor cartridges. Close, lock and tag upstream/downstream valves to the vessel. Bleed raw product residue from between valve. Misalign or remove section of pipe and cap. Use calibrated air-monitoring equipment to test valve or cap for any leaks.

    b. Mixer - Lockout/Tagout mixer's electrical source at the control box number one, switch number two. Verify that all stored energy has been dissipated from the mixer and it is disengaged by attempting to activate mixer.

    c. Drain residual material from vessel.

3. Rinse space with acetone-containing solvent applied from grounded and bonded low-pressure steam cleaner then allow material to drain from the vessel. Make sure affluent line is open.

4. Allow vessel to cool, then rinse vessel with grounded and bonded high-pressure steam cleaner using soap and water solution. Allow material to drain from the vessel and allow it to cool.

5. Make sure it is safe to remove entrance cover, and use only spark-proof tools.

6. Have attendant conduct air monitoring using calibrated equipment. Test vessel after opening for:
    a. Oxygen
    b. LFL
    c. Toluene
    d. Acetone

7. Purge vessel with forced air ventilation for 30 minutes.

8. Retest atmospheric conditions. If hazardous atmosphere exists, repeat cleaning and purging procedures.

9. Perform continuous forced air ventilation for duration of entry operation

10. Check and set up equipment. Have authorized entrant wear personal protective equipment and full-body harness with retrieval line attached.

11. Have entry supervisor inspect operation and provide authorization for entry. Post completed and signed entry permit near entrance for employees to review.

12. Conduct additional pre-entry test and have attendant conduct continuous monitoring for duration of entry operation.

SECTION V - Appendices

APPENDIX D-1 - SAMPLE COPY OF A PERMIT-REQUIRED SPACE PROGRAM WORK SHEET

13. Complete work inside the vessel and ensure all authorized entrants have exited from the space.

14. Notify entry supervisor for cancellation of the entry permit.

15. Return space to normal operation.

16. Return canceled permit to Safety Manager.

Designated Required Personnel:

- Authorized Entrant's Name(s):_____

Duties: Know hazards, use equipment properly, communicate with attendant, and alert attendant of any hazards, exit quickly if ordered to do so.

- Attendant's Name(s)_____

Duties: Know hazards of space, behavioral effects of hazards, keep track of number of entrants, remain outside of space during entry, communicate with entrants, monitor activities outside space, summon rescue and emergency medical services, take actions to keep unauthorized entrants away from space, perform non-entry rescues, and do no other duties while monitoring entrants.

- Entry Supervisor's Name:_____

Duties: Know hazards of the space, verify that acceptable entry conditions exist, terminate entry operations, verify that rescue service is available, remove unauthorized persons from area and ensure acceptable entry conditions are maintained at appropriate intervals.

- Air Monitor's Name:_____

Duties: Know hazards of the space, know acceptable entry conditions, know how to properly calibrate, use, maintain and understand limitations of the air sampling device, know how to properly interpret the results obtained from the device.

Entry Permit: (company representatives name) _____will provide entry permits for PRCS operations. All entry permits will be completed by the entry supervisor authorizing entry. Upon cancellation of the entry permit by the entry supervisor, the entry permit will be returned.

Procedures for Summoning Rescue and Emergency Services:
Rescue services will be onsite for the duration of the entry operation. Attendant will use walkie-talkie radio to contact security officer, who will contact onsite emergency services at _____.

Multi-Employer Permit Space Operation? No

SECTION V - Appendices

APPENDIX D-1 - SAMPLE COPY OF A PERMIT-REQUIRED SPACE PROGRAM WORK SHEET

List measures taken to close entry portal and return the space to normal operating conditions.

Attendant will ensure all entrants have vacated the space by checking their names off the entry permit. The entry supervisor will verify that the entry operation is complete and terminate the entry permit. The entry supervisor will also check to ensure that the entry portal is replaced properly and that the vessel is returned to normal operating conditions. The entry supervisor will notify the onsite rescue services that the confined space entry operation has been completed

The safety manager will review entry operations if measures taken did not fully protect employees. The safety manager will conduct a review of the permit space at least annually utilizing canceled entry permits. Any inadequacies will be corrected.

Note to the Employer: This sample copy of a completed PRCS worksheet is intended to give employers an idea of what types of information is helpful in completing this form. The procedures outlined are merely examples and should not be expected to be the correct protocol for each permit space entry operation. The employer is reminded that the information provided in their program should be as specific as possible to be beneficial to entry team members. For example, more specific list of duties for PRCS team members is likely needed to be appropriate.

SECTION V - Appendices

APPENDIX E - HOST EMPLOYER'S RESPONSIBILITIES WITH CONTRACTOR WORK SHEET

In accordance with the requirements of the OSHA Permit-Required Confined Space Standard 1910.146, this information is being made available to (Name of Contracting Company) _____ so they can take appropriate precautions to protect their employees during a PRCS operation. The following is a list of permit space locations, their identified hazards and any precautions taken by our firm.

Location	Hazard	Precautions Taken

Other applicable information concerning the permit space which may be of assistance:

Note to the Employer: A PRCS program is required for these spaces, unless alternative procedures or reclassification procedures can be utilized and certified to allow safe entry.

During the contractor's PRCS operation, our employees (will) (will not) be involved in entry or work near the permit space.

If our employees will be involved with entry into or near the permit space, then (Host Employer Representative's Name)_____will coordinate the entry operations with the contractor.

List whose permit space program will be used for entry into the space: (Host Employer's) OR (Contractor's)

SECTION V - Appendices

APPENDIX E - HOST EMPLOYER'S RESPONSIBILITIES WITH CONTRACTOR WORK SHEET

Note to the Employer: This coordination should include a determination of whose permit program is to be used. The standard does not prohibit the host employer from requiring a contractor to use the host employer's permit program, nor does it require the contractor to use the host=s program. The employer may choose to condition its contract on the contractor=s compliance with the host=s program.

Debriefing conference will be held with, (Host Employers representative)
_____ and (Contractors Representative)
_____ at the completion of the entry operation. At a minimum, the following items must be covered:

Was the PRCS program adequate? Yes___ No___

If no, what deficiencies were noted?
_____
_____
_____

Were there any hazards confronted or created by the entry operation (e.g.; hazardous atmosphere, ventilation or testing equipment failure, unauthorized entry, etc.)? Yes___ No___

If yes, list circumstances and actions to be taken to prevent reoccurrence.
_____
_____
_____
_____

SECTION V - Appendices

APPENDIX F- CONTRACTOR'S RESPONSIBILITIES WITH HOST EMPLOYERS - WORK SHEET

In accordance with the OSHA PRCS Standard (1910.146), (Name of Contracting Company) _____ is requesting that the host employer (Name of Host Employer) _____ provide any available PRCS hazard information for the space to be entered. Additionally, please notify (Name of Contractor's Representative) _____ if you plan to have your employees work in or near the PRCS during our entry operation.

(Name of Contractor's Representative) _____ will inform you, the host employer, of the PRCS program our employees will follow during the PRCS operation. Additionally, (Name of Contractor's Representative) _____ will notify you of any hazards confronted or created during our PRCS operation.

The following is a list of hazard(s) confronted by the PRCS operation and the action(s) taken to correct the condition.

Condition	Corrective Action Taken
_____	_____
_____	_____
_____	_____

Note to the Contractor: List any hazards confronted by your employees during the PRCS operation. Conditions to be considered include a hazardous atmosphere, ventilation or testing equipment failure, unauthorized entry, etc.

SECTION V - Appendices

APPENDIX G - HOT WORK PERMIT

Permit No._____Permit Space No._____

Permit Valid For (date)_____ (time)_____AM/PM , (date)_____ (time)_____AM/PM

Location of Space_____

1. Hot Work to be performed:
   - ____ grinding
   - ____ electrical spark-producing equipment
   - ____ cutting
   - ____ heating
   - ____ welding
     Type of welding _____ (locate cylinders outside the permit space)
   - ____ brazing or soldering
   - ____ space heater (Note: space heaters must not be taken into spaces. Fresh warm air should be blown in when needed)
   - ____ other sources of ignition

2. Specify nature of work to be performed:
   _____

3. Pre-entry atmospheric testing: yes___ no___

Note: Frequent or continuous monitoring is required. Use entry permit to record results.

4. Flammable/combustible gas or liquid present? yes___ no___
   Flammable/ combustible residue present? yes___ no___

Note: If any item in Number 4 is marked Ayes, then appropriate steps must be taken to ensure no flammable or explosive hazards exist. Refer to the entry permit to record the control methods needed.

   Combustible dust present? yes___ no___
5. Is ventilation provided? yes___ no___
   __ General Mechanical
   __ Localized Exhaust
   Is the ventilation equipment intrinsically safe? yes___ no___

Note: Refer to entry permit for specific entry procedures required to be in place.

6. Has the space been isolated? yes___ no___
7. Is fire-fighting equipment available?
   Type of Equipment_____ yes___ no___
   __ Located Inside Space __ Located Outside Space

SECTION V - Appendices

APPENDIX G - HOT WORK PERMIT

Have employees received training on how to use equipment? yes___ no___

Have authorized entrants, attendants and entry supervisors been given training on the potential hazards associated with performing these "hot work" duties? yes___ no___

8. If welding in a confined space, ensure the following:
   a. Have welding electrodes been removed from holders during suspension of welding? yes___ no___
   b. Have welders been instructed to never allow gas cylinders or welding machines into the space and are they complying? yes___ no___
   c. Portable equipment secured? yes___ no___
   d. Emergency procedures in place (e.g., lifelines, rescue procedures, etc.) yes___ no___
   e. Torch removed from space during suspension of welding? yes___ no___

An evaluation of the permit space operation has been conducted with respect to performing "hot work" activities. Conditions are acceptable for the "hot work" to be conducted.

_____

(signature of certifying individual) (date) (time)

SECTION V - Appendices

APPENDIX H - Common Combustible Substances

Material	LEL (%/Vol)	UEL (%/Vol)	PEL (ppm)	IDLH (ppm)	Density (Air=1)
Acetone	2.6	12.8	1,000	20,000	2.0
Acetylene	2.5	100.0	-A-	-A-	.9
Ammonia	16.0	25.0	50	500	0.6
Benzene	1.3	7.1	1.0	-C-	2.6
N-Butyl Acetate	1.7	7.6	150	10,000	4.0
Cyclohexene	1.0	5.0	300	10,000	2.7
Ethane	3.0	12.5	-A-	-A-	1.0
Ethanol	3.3	19.0	1,000	-U-	1.6
Ethyl Acetate	2.0	11.5	400	10,000	2.6
Ethyl Ether	1.9	36.0	400	19,000	2.6
Ethylene Oxide	3.6	100.0	1	-C-	1.5
Gasoline (100 octane)	1.4	7.4	300*	-U-	3-4.0
Heptane	1.6	6.7	500	5,000	3.5
Hexane	1.1	7.5	500	5,000	3.0
Hydrogen	4.0	75.0	-A-	-A-	0.1
Isoproply Alcohol	2.0	12.0	400	12,000	2.1
Methane	5.0	15.0	-A-	-A-	0.6
Methanol	6.7	36.0	200	25,000	1.1
Methyl Ethyl Ketone (MEK)	1.8	10.0	200	3,000	2.5
Pentane	1.5	7.8	1000	15,000	2.5
Propane	2.2	9.5	1000	20,000	1.6
Styrene	1.1	6.1	100	5,000	3.6

SECTION V - Appendices

APPENDIX H - Common Combustible Substances

Material	LEL (%/Vol)	UEL (%/Vol)	PEL (ppm)	IDLH (ppm)	Density (Air=1)
Toluene	1.2	7.1	200	2,000	3.1
Turpentine	0.8	100.0	100	1,900	4.7
Vinyl Chloride	3.6	33.0	5	-C-	2.2
Xylene	1.1	7.0	100	1,000	3.7

LEL = Lower Explosive Limit
UEL = Upper Explosive Limit
PPM = Parts Per Million
PEL = Permissible Exposure Limit (OSHA)
IDLH = Immediately Dangerous to Life & Health

Data from NIOSH *Pocket Guide to Chemical Hazards (1990)*

Density <1.0 = lighter than air; >1,0 = heavier than air
-A- = Asphyxiant
-C- = Carcinogen
-U- = Data not Available
***ACGIH TLV**

SECTION V - Appendices

APPENDIX I - RESPIRATORY PROTECTION PROGRAM

Purpose

The elements described in this program are designed to ensure the safe and effective usage of respiratory protection at (company name)_____.

Program Administration

(Company Representative's Name)_____ is responsible for the overall implementation and maintenance of the respiratory protection program. (Company Representative's Name) _____ duties include:

- Determining which tasks require respiratory protection.
- Selecting the proper respirator for the specific application.
- Conducting employee training and conducting fit testing.
- Ensuring employees clean, maintain and properly store respirators.
- Overseeing the medical screening program for respirator users.
- Conducting periodic evaluation of the respiratory program to ensure that it is achieving its desired goal.

Supervisors are responsible for:

- Ensuring that the appropriate respirators are available for use.
- Ensuring that employees wear the required respirators.
- Conducting periodic inspections to ensure employees are adequately maintaining their respirators.

Employees are responsible for:

- Using the respiratory protection in accordance with the training received.
- Inspecting, cleaning, sanitizing and proper storage of their respirator.

Respiratory Selection

Our respiratory protection coordinator is responsible for selecting the appropriate respiratory protection. Selection will be made according to "Practices for Respiratory Protection" American National Standards Institute (ANSI) Z88.2-1980

The respiratory protection coordinator will select the appropriate respirators based upon the following elements:

- The type of airborne contaminant(s).
- The characteristics and location of the hazardous area.
- The worker=s activities in the hazardous area.
- The capabilities and limitations of the respirators.
- Duration of respirator use.
- Only respirators having NIOSH/MSHA approval will be used.

Additional information for the proper selection of respiratory protection can be found in Section II - Respiratory Protection

SECTION V - Appendices

APPENDIX I - RESPIRATORY PROTECTION PROGRAM

Respirators currently approved for use are:

Respirator Manufacturer	Model	Work Task

Determination for respiratory protection

The permit-required confined space program and the entry permit will be used to determine if respiratory protection is required for the permit-space entry operation. If engineering controls cannot control the hazard or if the airborne contaminant cannot be eliminated and entry must be conducted, respiratory protection is required.

Maintenance, Cleaning, Inspection and Storage

The entry supervisor will ensure that employees properly clean and maintain their respiratory protection.

- Cleaning and sanitizing.
- Disassemble components from the respirator and inspect for any defects.
- Immerse the respirator and components into warm water (120-130 degrees F). Note, air-purifying filters and cartridges must never be washed. The respirator facepiece and components should be gently scrubbed to remove all dirt. Care must be taken not to damage any of the components.
- Rinse the respirator and components.
- Sanitize the respirators and components by immersing them into a chlorine bleach solution (approximately one ounce to one quart of water).
- Rinse components and allow to dry.
- Inspect, test, and repair if necessary.

Inspection should be performed before and after each use for the following:

- Deterioration of any rubber or silicone parts.
- Conditions of components.
- Tightness of all connections.
- Check any end of service life indicators.
- SCBA alarms, regulators, gauges, etc.
- SCBA cylinder pressure.

SECTION V - Appendices

APPENDIX I - RESPIRATORY PROTECTION PROGRAM

Respirator Inspection Record

Respirator type_____model #_____

Components	Acceptable	Not Acceptable
Facepiece		
Inhalation Valve		
Exhalation Valve Assembly		
Headbands		
Cartridge Holder		
Filter		
Harness Assembly		
Hose Assembly		
Speaking Diaphragm		
Gaskets		
Connections		
Comments:		

Note to the Employer: If any components are found not acceptable, the respirator should not be used and a replacement part or replacement respirator should be obtained.

Storage

All respirators must be properly stored to protect them from damage due to environmental factors and chemicals. When respirators are not in use, they must be placed in a plastic bag and stored in a clean area. Respirators should be stored with the facepiece and exhalation valve in a normal position to prevent it from taking a permanent distorted shape. Respirators should not be stored in work benches, tool boxes, or lockers unless they are protected against airborne contaminants, distortions and any damage.

SECTION V - Appendices

APPENDIX I - RESPIRATORY PROTECTION PROGRAM

Note to the Employer: Ensure that management personnel periodically check to see if respirator wearers are inspecting, cleaning, maintaining and storing their equipment properly.

Training

All employees who are required to use respiratory protection will be instructed on the proper selection, use and limitations of this equipment. This training will be provided prior to any assignment requiring the use of such equipment. The training, conducted by (name)_____, will also include information on:

- Nature of the respiratory hazard and what may happen if the respirator is not used properly.
- Engineering and administrative controls being used and the need for the respirator as added protection.
- Reason for selection of a particular type of respirator.
- Limitations of the selected respirator.
- Methods of donning the respirator and checking its fit (negative and positive checks) and operation.
- Proper wear of the respirator.
- Respirator maintenance and storage.
- Proper method for handling emergency situations.
- A record of employee names and dates and type of initial training and subsequent refresher training will be recorded.

Training Record

Name	Type of Respirator	Date

Fit Testing

No one respirator will fit every individual. Therefore, to provide the appropriate respirator, fit testing will be performed to ensure a tight seal between the facepiece and wearer.

SECTION V - Appendices

APPENDIX I - RESPIRATORY PROTECTION PROGRAM

Respiratory Fit Test Record

a. Employee_____Date_____ Employee job title_____

b. Respirator Selected_____
Manufacturer_____
NIOSH Approval #:_____
Model_____

c. Conditions Which Could Affect Respirator Fit: (check all that apply)

__Clean Shaven __Facial Scar __Beard Growth
__Dentures Absent __Moustache __Glasses __None

Comments:_____

d. Fit Testing (check all methods used)

Qualitative Fit Testing
- Isoamyl Acetate Pass____ Fail____
- Irritant Smoke Pass____ Fail____
- Saccharin Test Pass____ Fail____

Quantitative Fit Testing Pass____ Fail____

Comments:_____
___

Test Conducted By:_____ Date:_____

Medical Examination

Individuals assigned to tasks that require the use of respiratory protection will have a medical examination to determine if they are able to perform the work while wearing a respirator. The medical examinations will be performed by (name of clinic, or physician)_____. The examination will be given prior to an employee being allowed to wear a respirator. Periodic examinations will be conducted_____.

Note to the Employer: Generally medical examinations are given annually. However, the frequency of the examinations will depend upon the age, health condition and hazards associated with the work operations. The local physician would be the best source to determine the examination frequency for a particular individual. The physician should also be informed of the nature of the hazards to be confronted by the respirator wearer. For example, the physician should be aware that the individual may use an SCBA in a confined space.

SECTION V - Appendices

APPENDIX J - SAMPLE LETTER FROM RESCUE AND EMERGENCY SERVICE PROVIDER TO HOST EMPLOYER - - Non-Mandatory

Dear _____:

This is to confirm that (rescue organization)_____ can provide the following rescue and emergency services in the event it is needed during confined space entries at your facility. Our organization can provide the following services:

_____
_____
_____

In order for us to properly develop a rescue plan, we must be informed of the hazards associated with the space and we must have access to these spaces. Please provide for us a list of your permit-required confined spaces, their locations and the hazards. I have enclosed a form you may use. In addition, we must conduct annual practice rescue entries in your confined space(s) or in some other similarly configured space(s). We would like to know if and when this could be arranged in your workplace.

Please contact (rescue organization representative)_____at (phone number):_____so that we can discuss this in more detail and make arrangements to visit your workplace before any confined space entry operations are scheduled. Thank you for your cooperation.

Sincerely,

_____
(rescue organization=s representative)

SECTION V - Appendices

APPENDIX J - SAMPLE LETTER FROM RESCUE AND EMERGENCY SERVICE PROVIDER TO HOST EMPLOYER - - Non-Mandatory

CONFINED SPACE LOCATIONS

_____

_____
(name & location of facility)

The following is a list of permit-required confined spaces located at our facility:

Space	Location	Hazards

Prepared By:

Date:

Phone Number:

SECTION V - Appendices

APPENDIX K - SAMPLE LETTER FROM EMPLOYER TO OUTSIDE RESCUE SERVICE - - Non-Mandatory

Dear _____:

We are currently developing a permit-required confined space program as required under the Federal OSHA regulation, 29 CFR 1910.146, that will allow our employees to safely enter and work in permit-required confined spaces in our workplace. Although our existing program is intended to prevent employee exposure to health hazards in the space, extra ordinary circumstances could appear without warning that would cause an emergency situation where the employee(s) in the space may need rescue and/or emergency medical assistance. Therefore, a very important element of our program is to develop and implement procedures for summoning rescue and emergency services. We are requesting that you be available to provide rescue and emergency services, in the event of an emergency.

Enclosed is a listing of the permit-required confined spaces in my workplace, as well as a description of the hazard(s) associated with the space(s). I am providing this information to you so that you can adequately develop a rescue plan appropriate for the space(s). You may also have access to this space as a part of your planning.

We will be contacting you shortly to confirm your willingness to participate in our permit-required confined space program and to discuss adequate notification procedures (e.g., communication contact methods at the time of scheduling the entry operation) for a timely response. At that time, we can also discuss the rescue plan provisions in more detail and offer you our assistance in working together to safeguard both your employees as well as ours.

Sincerely,

_____
(rescue organization=s representative)

SECTION V - Appendices

APPENDIX K - SAMPLE LETTER FROM EMPLOYER TO OUTSIDE RESCUE SERVICE - -Non-Mandatory

CONFINED SPACE LOCATIONS

_____

_____
(name & location of facility)

The following is a list of permit-required confined spaces located at our facility:

Space	Location	Hazards

Prepared By:

Date:

Phone Number:

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APPENDIX L - RESCUE AND EMERGENCY SERVICES

Confined space rescues are extremely dangerous operations which must only be performed by properly trained and equipped individuals. It has been well documented that the majority of fatalities that occur in confined spaces are would-be rescuers who have not been properly trained or equipped. For rescue operations to be conducted safely, there must be a systematic approach by the rescue service. In response, the OSHA permit-required confined space standard (1910.146) mandates requirements that must be addressed for all on-site and off-site rescue personnel who will enter PRCS to perform rescue or retrieval operations.

As previously mentioned, fire departments and other rescue service organizations are not required to have a full PRCS program in place for performing rescue operations. However, the performance-oriented elements stated in paragraph (g) and (k) of the standard are required so rescuers can prepare themselves for emergency PRCS operations. Paragraph (k) also requires rescue service organizations to develop a rescue plan for each PRCS they must enter.

This appendix is provided as a guide that uses a systematic approach covering the general topics and procedures rescuers may need to know or need to consider when developing rescue plans.

The standard states that when a host employer arranges to have another employer perform rescue services, the host employer must perform, the following:

- Inform the rescue service of the hazard of the PRCS.
- Provide access to the space so the rescue organization can develop a rescue plan and practice rescue operations.

For rescue service organizations who choose to use this appendix, a Rescue Plan Checklist (RPC) has been provided to assist them in developing a rescue plan for the PRCS they may have to enter. The RPC is designed so a rescue service organization can develop specific entry procedures with the participation of the host employer.

It is also realistic to assume that some rescue organizations, particularly fire departments, may not be given an opportunity for advance preparation with a host employer. This RPC is also designed to assist rescue organizations during these situations as well. Rescue personnel who are properly trained on PRCS operations can utilize the RPC to help identify any hazards and addresses control procedures and equipment needed.

Before proceeding to use the RPC, it is necessary that rescue personnel receive appropriate training. To assist with this task, the following general Standard Operating Procedures and training are suggested. Rescue organizations should modify their training and rescue plans accordingly to meet their specific situations. The elements of this program are arranged in the following manner: preplanning; training and standard operating procedures (SOPs).

Preplanning

- Determine the various types of permit spaces which are likely to be encountered by rescue team members.

Note to the Rescue Service: Appendix J provides a sample of a non-mandatory letter which can be sent to employers by the rescue service to determine the presence of any permit spaces and their particular hazards.

- Designate on-site command and control structure.
- Designate rescue team members duties.

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APPENDIX L - RESCUE AND EMERGENCY SERVICES

- Develop SOP for the permit spaces likely to be entered
- Determine availability of appropriate rescue equipment, for example:
  - Combination oxygen and combustible gas monitors
  - Full-body harnesses
  - Mechanical winch
  - Reeves (collapsible) stretcher
  - Stokes stretcher
  - Communication equipment
  - SCBAs/SAR
  - Ladders
  - Personal Protection Equipment
  - Explosion-Proof Lighting

Training

- All members of the rescue team must receive training covering the following elements:
  - Permit space recognition
  - Permit space hazards
  - Control of permit space hazards
  - Atmospheric monitoring equipment and testing protocol
  - Use and maintenance of personal protective equipment
  - Rescue equipment
  - Simulate permit space rescues and required rescue techniques
  - Basic first aid and cardiopulmonary resuscitation (CPR)
  - Requirements stated in paragraph (k) and (g) of 1910.146
  - Train personnel on how to use rescue plan checklist (RPC)

Standard Operating Procedures (SOPs)

- These SOPs are merely examples. Rescue organizations may use this information to develop their own SOPs.
  - Initiate on-site command system
  - Utilize rescue plan checklist
  - If available, review entry permit
  - Determine number and condition of occupants in the permit space
  - If possible, attempt rescue without rescuers entering the permit space
  - If entry is necessary, institute entry procedures
  - Utilize rescue entry checklist, institute appropriate procedures and use required equipment
  - Secure area outside space and remove or control any potential hazards
  - Retrieving victims
    - Victim packaging-type required is indicated by the victim=s injuries and size of the opening
    - Determine victim=s immediate needs, if possible remove victim promptly
    - Rescuer must never remove their respirator face piece to administer fresh air to the victim
    - If victim is trapped and can not be move promptly:
      - Provide air to the victim with SCBA or SAR
      - Oxygen cylinder must not be taken into a permit space if the oxygen could react with any substances in the space and create an additional hazard.
    - Provide necessary first aid/CPR and transport. Obtain material safety data sheets, if available, for the chemical to which the victim was exposed and provide this information to the hospital treating the individual(s).

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APPENDIX L - RESCUE AND EMERGENCY SERVICES

Name	Rescue Duties	Rescue Equipment & PPE Authorized for Use	Trained in First Aid or CPR		Certified Yes/ No	Rescue Practice Date & Session Description	Name of Trainer & Date of Training

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APPENDIX M - RESCUE PLAN CHECKLIST

Rescue Plan Checklist

General Information

Location of Rescue ____________
Entry Permit available Yes ____ No ____
No. of occupants in space ____________
Condition of occupants ____________
Approx. time incapacitated ____________
No. of rescuers in space ____________
Rescue on-site commander ____________

NOTE: The control procedures and equipment needed will depend on the specific confined space rescue situation. It is the responsibility of the rescue personnel to determine the appropriate action needed. Listed are the items which may need to be considered.

Control Procedures and Equipment

Permit Space Hazards	Test Atmosphere	Determine Cause	Ventilate Space	SCBA/SAR	Standby person with SCBA	Control/Eliminate Ignition Sources	Use non-sparking tools	Full Body harness, Lifeline, Mechanical Winch, Tripod, Fall Arresting Device	Fire Suppression Equipment	Lockout energy sources and controls, dissipate stored energy	Rescue ropes, appropriate stretcher for victim	Lockout valve/break line / misalignment of pipe/ etc.	Chemical Protective Clothing	Constant Communication	Explosion-proof lighting	Appropriate PPE
☐ Oxygen less than 19.5%	●	●	●	●	●			●			●			●		●
☐ Oxygen more than 23.5%	●	●	●	○	●	●	●	●	●	●	●			●	●	●
☐ Explosive gases/vapors	●	●	●	○	●	●	●	●	●	●	●	●	●	●	●	●
☐ Explosive dust	●	●	●	○	●	●	●	●	●	●	●	●	●	●	●	●
☐ Toxic gases/vapors	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
☐ Engulfment		●		●	●			●		●	●	●	●	●	●	●
☐ Entrapment		●			●			●			●			●		●
☐ Mechanical		●			●			●		●	●			●		●
☐ Electrical		●			●			●	●	●	●			●		●
☐ Chemicals	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●
☐ Heat Stress		●	●		●			●			●			●		●
☐ Noise		●			●			●			●			●		●
☐ Falls/Slippery Surfaces		●			●			●			●			●		●

Specific Entry Procedures Note: Rescue services may use the following space to list the specific entry procedures for safe entry based on advanced preparation with the employer.

Atmospheric Testing Record

Substance	Acceptable Level	Readings
Oxygen	19.5% - 23.5%	
Explosive (Gas/Vapor)	<10% LFL	
Explosive Dust	< LFL (5 ft. Visibility)	
Carbon Monoxide	50 PPM	
Hydrogen Sulfide	10 PPM	
____________	____________	
____________	____________	

Testing Equipment calibrated yes ____ no ____ name or initials of tester ____________

○=Note, entry must not be made until explosive atmosphere is removed.
●=Control Procedure and Equipment Suggested

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APPENDIX N - ENTRY PERMIT FORM

ENTRY PERMIT (page 1 of 2)

GENERAL INFORMATION

Permit Space Location:_____

Purpose of Entry: _____

Entry Permit Valid For: Date: _____ to Date: _____
Time: _____to Time: _____

PERMIT SPACE HAZARDS

	Yes	No
ATMOSPHERIC		
Oxygen Deficiency	☐	☐
Oxygen Enrichment	☐	☐
Explosive (Gas/Vapor)	☐	☐
Explosive Dust	☐	☐
Carbon Monoxide	☐	☐
Hydrogen Sulfide	☐	☐
Other Toxic gases/vapors	☐	☐
ENGULFMENT	☐	☐
CONFIGURATION (ENTRAPMENT)	☐	☐
MECHANICAL	☐	☐
ELECTRICAL	☐	☐
SUBSTANCE HAZARDOUS TO SKIN OR EYES	☐	☐
HEAT STRESS	☐	☐
OTHER POTENTIAL HAZARDS (e.g., radiation, noise, etc.)	☐	☐

_____
_____

PERSONNEL

Entrant(s)	Time In	Time Out
_____	_____	_____
_____	_____	_____
_____	_____	_____

Attendant(s) _____
_____

Entry Supervisor(s) _____
_____

COMMUNICATION PROCEDURES USED BY ENTRANT(S) and ATTENDANT(S) Check all that apply

☐ Visual ☐ Rope
☐ Voice ☐ Radio
☐ Other (specify) _____

CONTROLS/EQUIPMENT Check all that apply

☐ ISOLATION ☐ LOCKOUT/TAGOUT
☐ BLANKING/BLINDING
☐ DOUBLE BLOCK AND BLEED
☐ LINE BREAKING/MISALIGNMENT
☐ OTHER _____

☐ INERTING

☐ PURGE/CLEAN
☐ METHOD FOR SAFE COVER REMOVAL & SECURING AREA

☐ ATMOSPHERIC TESTING
☐ Periodic (give interval) _____
☐ Continuous

☐ VENTILATION
☐ Natural
☐ Continuous forced air
☐ Local Exhaust

☐ ENTRY EQUIPMENT
☐ Ladders
☐ Other _____

☐ PERSONAL PROTECTIVE EQUIPMENT
☐ Respiratory - SCBA, SAR, Air Purifying
☐ Clothing (specify) _____
☐ Eye and face protection
☐ Hearing protection

☐ RESCUE AND RETRIEVAL EQUIPMENT
☐ Full body harness
☐ Lifeline
☐ Tripod w/mechanical winch
☐ Explosion proof lighting

☐ NON-SPARKING TOOLS
☐ INTRINSICALLY SAFE ELECTRICAL EQUIP MENT & GFCI

☐ COMMUNICATION EQUIPMENT
☐ Radio
☐ Phone
☐ Other _____

☐ HOT WORK PERMIT
☐ FIRE EXTINGUISHERS

RESCUE AND EMERGENCY SERVICES	RESCUE PROCEDURES
Names _____ Phone _____ _____ Summoning Procedure _____ _____	_____ _____ _____ _____ _____

SECTION V - Appendices

APPENDIX N - ENTRY PERMIT FORM

ENTRY PERMIT (page 2 of 2)

ATMOSPHERIC TESTING RECORD

CONDITION	ACCEPTABLE LEVEL	PRE-ENTRY READINGS				ENTRY READINGS			
		(Reading)	(Time)	(Reading)	(Time)	(Reading)	(Time)	(Reading)	(Time)
OXYGEN	19.5% - 23.5%								
EXPLOSIVE (GAS/VAPOR)	<10% LFL								
EXPLOSIVE DUST	<LFL (5 ft. Visibility)								
CARBON MONODIXE	50 ppm								
HYDROGEN SULFIDE	10 ppm								
_____	_____								
OTHER HAZARDS (e..g., heat stress)	_____								
NAME(S) OF TESTER									
TESTING EQUIPMENT USED	TYPE _____	SERIAL NO. _____		TYPE _____		SERIAL NO. _____			

ENTRY AUTHORIZATION

ENTRY AUTHORIZED BY:

NAME _____ TIME _____

SIGNATURE _____ DATE _____

POST ENTRY PERMIT AT ENTRANCE TO PERMIT SPACE

ENTRY CANCELLATION

ENTRY CANCELLED BY:

NAME _____ TIME _____

SIGNATURE _____ DATE _____

REASON FOR CANCELLATION:

Entry Operations Completed

Prohibited Condition Arose (specify) _____

_____

_____

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APPENDIX O - TRAINING LOG

Employee Name	Assigned Duty(s)

_____ _____

Date of Training Signature of Trainer(s)

REFERENCES AND PERTINENT STANDARDS

American National Standards Institute, ANSI Z88.2-1980, Practices for Respirator Protection[2]

ANSI Z88.2-1992, Respiratory Protection

ANSI Z117.7-1989, Safety Requirements for Confined Spaces

Occupational Safety and Health Administration (OSHA), US Department of Labor, Code of Federal Regulations, Title 29, Part 1910, General Industry Safety and Health Standards [3]

OSHA, Permit-Required Confined Space Training Material, March 1993, Office of Training and Education, Des Plains, Il 60018

OSHA, Pamphlet 3079 - Respiratory Protection

OSHA, Pamphlet 3080 - Hand and Power Tools

OSHA, Pamphlet 3120 - Control of Hazardous Energy (lockout/tagout)

National Institute for Occupational Safety and Health (NIOSH) - A guide to Safety in Confined Spaces, Publication No.l 87-113[4]

NIOSH Abstract - Request for Assistance in Preventing Occupational Fatalities in Confined Spaces, January 1986

NIOSH - Pocket Guide to Chemical Hazards, Publication No. 90-117

NIOSH - Safety and Health in Confined Workspaces for the Construction Industry - 1985

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2 Available from American National Standards Institute, 11 West 42nd Street, New York, NY 10036

3 Available from OSHA Publications Office, 200 Constitution Avenue, N.W., Room N-3101, Washington, D.C. 20210

4 Available from Publication Dissemination, DSDTT, National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, 4676 Columbia Parkway, Cincinnati OH 45226